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Effect of Material Handling on Performance of Supply Chain; A Case Study of MAGERWA Ltd

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Abstract

This study examined the effect of Material handling on performance supply chain. A case study of Magerwa Ltd. The target population was the Magerwa Ltd employees, the population target was 150 employees of Magerwa Ltd while undertaking sample size was 109 of respondents. Study employed descriptive statistics and inferential statistics, both qualitative and quantitative were used to analyse the data with assistance of SPSS software program version 25.0 descriptive statistics and inferential statistics were used to present frequencies tables, percentages, and mean and inferential analysis was employed in order to use Pearson correlation and multiple regression model to test the relationship between the independent variables and the dependent variable. Qualitative and quantitative analysis were used descriptive statistics were employed in order produce frequency tables, percentages and mean. Inferential statistics were used in order to use person correlation and multiple regression model to test and draw relationship between variables both for independent band dependent. The the effect of nature of materials for Material handling on performance of supply chain was analyzed. The overall means of results was 3.74, the effect of facility layout for Material handling on performance of supply chain.was analyzed, The overall means of results was 3.72 the effects of equipment reliability on performance of supply chain was analyzed. The overall means of results was 3.72, the effect of operation system for Material handling on performance of supply was analyzed. The overall means of results was 3.59. The data of performance Supply chain was analyzed, the overall means of results was 3.73 depending on the results, it presents that the performance supply chain was on good grades. The indicated that the relationship material handling and performance supply chain between nature, facility layout, equipment reliability and operation system and performance supply chain was 0.780, 0.864 ,0.847 and 0.843 respectively, and the results presented than the variables were statistically significant with p value=0.000. The results presented the variables of material handling; the Nature was not statistically significant with p value=0.316[b], the Facility layout was statistically significant with p value=0.000[b], and the Equipment reliability was statistically significant with p value=0.000[b]. It concluded that there was a significant relationship between material handling and performance supply chain. The study recommended that MINICOM and MINIFRA should sensitize the citizens to be engaged in material handling as part of logistics in order to develop themselves be good citizens in the country.

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1. Introduction

Material handling understood to be the procedure used in moving, controlling and protecting to ensure storage material (Ondiek, 2009). It plays an essential role in efficiency and effective when handling materials equipment.it is with regard logistics companies are suffering from usage of inefficiency of material handling system in terms of investigation of equipment, processing in relation to the problems that are in material handling system (Steven, 2013). The most challenges experienced in the material handling are found in loading, unloading confusion, inefficient flow, equipment damage and inadequate storage equipment issues related to the high costs, safety and services that are reliable. With this regard, the consulted report acknowledged that the material handling confirmative system undertake s damage elimination, and reduction of unnecessary movement and space utilisation effectiveness (MHS Report, 2014) According to the construction materials utilised in construction industry are importantly in terms of cost effectiveness , according to author (Abhilin & Vishak, 2017).

As it was pointed out that the studies undertook on the material handling estimated to be accounting for 60% of total project cost (Kumar & Nayak, 2018) in this perspective direct cost was employed to be of the costs of material handling in turn becomes typical high in terms of cost, and being non-valued added operating activities which estimated and counting in range between the percentages of 30% to 70% of allocated cost in all material manufacturing (Hornáková *et al*., 2019), therefore, the most production companies under manufacturing functions experience the practices ranging between 25% involving workforce and 55% involves the rest of all in factory spaces with 87% for production time (Hornáková *et al*., 2019). In this regard, the ineffectiveness material handling equipment management are ones that undermined and later alone becomes the major cause of construction project delays (Kumar & Nayak, 2018). From the perspective view, the construction companies still looked remaining on increase with good momentum in relation to tracking and allocating items to the distinguished construction sites regardless all difficulties in industry especially in tracking and locating materials needed, due to the inappropriate handling and storage of resources in construction sites (Abhilin & Vishak, 2017).

MAGERWA Ltd has a wide range of handling equipment from (3tons forklifts to 60 Tons cranes) this makes it the leading company among the other players. Magerwa Ltd encounters many problems such as heavy volume and traffic of cargoes due to slowed and inefficient in material handling equipment and clearances aspect, the company is owning the open space for truck parking that accommodates the capacity in terms of truck slot on one go, in-land container terminal (120 000 TEUS throughput per annum) cargo clearing and division forwarding and owned truck. For this perspective highlighted capacity owned by Magerwa Ltd, it is proven that what reduces the handling and supply chain performance leading to the inefficient and ineffectiveness in handling equipment that leads to increasing time for waiting and dwelling in the parking unwillingly at Magerwa Ltd due to the handling of more and more cargos, thus financial unsteadiness due to lose time in waiting. In connection to this, handling are undertaken through sequential components to be drove in the production and distribution variation effects on logistics company performance (Biles, 2006) as it was cited by (Ombul & Iravo, 2016), the problem also revealed is long transit time plus time used by handling equipment then leads into in competitiveness of material handling equipment on performance of supply chain.

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Thus, handling in Rwanda still appears to have gaps in this sector which include; incompetence inadequate automated handling systems, inadequate manual handling, ineffective Material flow and low skills in material orientation system ineffective handling procedures, unsatisfactory handling equipment, lack of skilled and trained staff are challenges that hinder supply chain performance. Therefore, a Researcher picked the interest to address the foreseen gaps and conduct research on effect of Material handling on performance supply chain. A case study of Magerwa Ltd.

1.2 Objectives of the Study

The general objective of the study was to find out the effect of Material handling on performance of supply chain in MAGERWA Ltd

Specific Objectives:

i. To assess the effect of nature of materials for Material handling on performance of supply chain
ii. To determine the effect of facility layout for Material handling on performance of supply chain.
iii. To examine the effects of equipment reliability on performance of supply chain
iv. To evaluate the effect of operation system for Material handling on performance of supply chain

1.3 Research Hypothesis

H01= There is no significant effect of nature of materials for Material handling on performance of supply chain

H02= There is no significant effect of facility layout for Material handling on performance of supply chain

H03= There is no significant effect of equipment reliability on performance of supply chain

H04= There is no significant effect of operation system for Material handling on performance of supply chain

2. Literature review

2.1 Conceptual Review

This part assesses the relationship between both variables (Independent variables and dependent variables) in connection to theoretical groundwork in turn to the relate the background of the concepts delivered from the effect Material handling on performance supply chain

Effect of Material Handling

Simply means the process that is done to move, control, protect and even store materials which is important to ensure handled material are kept way from any damage in order to remain safety and in quality conditions (Ondiek, 2009). With this regard mechanical devices are needed for many material handling operations as well as the mechanical alternatives related to manual, handling are used with tendency of minimizing lifting and bending necessities (Sahari *et al*., 2012). As a need of combined labor handling equipment in order to apply mechanical handling systems in terms of receiving, processing and shipping (Pong & Mitchell, 2012).

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Nature

Nature is determined through its state of nature, that is, it may be solid, gas or liquid regardless of its size, shape and weight. Acknowledgement of the nature of equipment undergoes review as its tip, preliminary from the assortment of equipeement.it is important to know variety of equipment so that, it can be handled, cared differently. Suppose the equipment are flammable, toxic corrosive, there would a need to a special handling and storage (MHI., 2015). from perspective view, the automation and semi -automated handling system characteristics by material nature must be primarily considered and inspected in a special way otherwise failure may lead to poor operation as result of material breakup or theft, in the regard high attribute consideration must paid to enable effective unitization of material handling to result into efficiency productivity and cost reduction (Kulak, 2005).

Facility Layout

The facility layout for material handling is the prominent icon due to the fact that, all activities concerning with material handling require handling space which is in simple term called Facility layout, therefore, another restricting factor is the availability of space for handling, it is a factor that may limit efficiency of material handling system when a proper and convenience handling space for movement of materials are not considered. It encompassing using cranes or hoists while placing the goods in the designated spaces and again example; any arise that may occur on supportive pillars in difficult places can limit the dimension of the material handling equipment. Effective and efficient use must be made of all available space (MHI, 2015). These are main activities undergo the facility layout; Eliminate cluttered and unorganized spaces and blocked aisles in work areas, in storage areas, balance the objective of maximizing storage density against accessibility in case the facility is multistoried, cascades or ramps for industrial trucks may be utilized (MHI., 2015).

Material Reliability

Supplier status depends on reliability and then after-sale service shows significant part in choosing material handling equipment (MHI., 2015). Equipment reliability is the probability through truth worthy in which the equipment, system or handling process can work without failure for a specified time during handling functions. Therefore, the more equipment reliability the effective handling system in organization. It also Identifies Efficient routing

Operation system

The first place to reduce manufacturing costs and increase production efficiency. Therefore, minimizing handling costs is the core aim of most MHS design project (Chittratanawat *et al*., 2010).explicated that allocation through respective operation system rely on skilled operators that are necessary. Equipment Choice also depends is chosen carding to the respective nature such as order mentioning, information technology, automatic identification, storage equipment, lifting equipment, conveyors equipment (MHI., 2015).

Supply chain performance

The fortitude of material handling is to move materials such as equipment and trucks to a required place in a right time and at the optimal operational costs. In this view, performance supply chain of material handling system depends on effective use of space, equipment and time to handle products at the optimal costs (Lu Xiaohong, 2008). The proper performance is determined when system is away from loading or unloading confusion, efficient flow, low equipment damage and suitable equitable storage equipment. The supply chain performance of material handling run into; costs, safety and time services.

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2.2 Theoretical Review

These reviews are up on those all machines manufactured by various industries and be transferred as materials or in terms of goods that are in controlled for the aim of so-called manufacturing, warehouse and storage, manufactured stuffs are to be moving raw, finished semi-finished and finished goods ones for right orientation and respective operations of diverse functionalities.

The Queuing Theory

This Queuing theory is applied to relevancy study in relation to the handling systems and it is associated with storage, warehousing, inventory, and material handling systems. According to (Shingo, 2005) cited by Kathurima *et al.* (2016) described this theory based mathematical study of time management in waiting, This theory permits numerous material handling process mathematical analyzed ,including cargo reached at the back of queue. Queue movement waited as cargo storage and cargo operated in queue. This theory also allows calculation of numerous material handling systems to encounter the average by time in queue. This implies Material handling distinctly include AGVs human operators, forklift trucks exercising movement from a point to another point (Kathurima *et al.*, 2016). In manner of routines and layouts confirmation. There is a gap that the researcher employed to resolve in the research on the effect material handling on per performance of supply chain. A case study of Magerwa Ltd

Constraints theory

This Constraints theory is management paradigm and manageable system with the focus of achieving its goals by redactable number of constraints. In other words, the theory explicates the way of problem solving or challenges in logistics company facing which categorically lying in resource constraints, policy constraints and dummy constraints. It is impossible to work without constraints, the constraints must occur all in all, only the procedural concentration objecting at limiting for complying alteration situations. Restraints can be interior or exterior to the handling system. An interior constraint is when customer demands their cargo more rapid while the handling system lack capacity to handle to deliver to the customers (Ombul & Iravo, 2016) theory is all about managing effects of material handling shortcomings that leads to poor operations in respective Company. There is a gap that the researcher employed to resolve in the research on the effect material handling on per performance of supply chain. A case study of Magerwa Ltd

2.3. Empirical Review

Ombul and Iravo (2016) did a study on the effects of materials handling systems on performance of cement manufacturing firms in Machakos County. The aim of this research was to establish the effects of materials handling systems in order to achieve better performance and generate available efficiency and cost reduction benefits. A descriptive correlational research design was incorporated in the study where a respondent was drawn from selected departments. The target population was 60 employees. The study found out that there was a positive and significant effect of automating material handling systems on performance in that 32.8 percent of the performance of cement manufacturing firms in Machakos County was explained by automating material handling systems (R squared = 0.328). The study has relied on smaller sample size hence, similar study can be conducted using larger sample size.

Kisioya and Moronge (2019) examined the influence of material handling practices on performance of large-scale processing firms in Nairobi County, Kenya the study adopted descriptive survey design and the target population was 355 large -scale-manufacturing firms

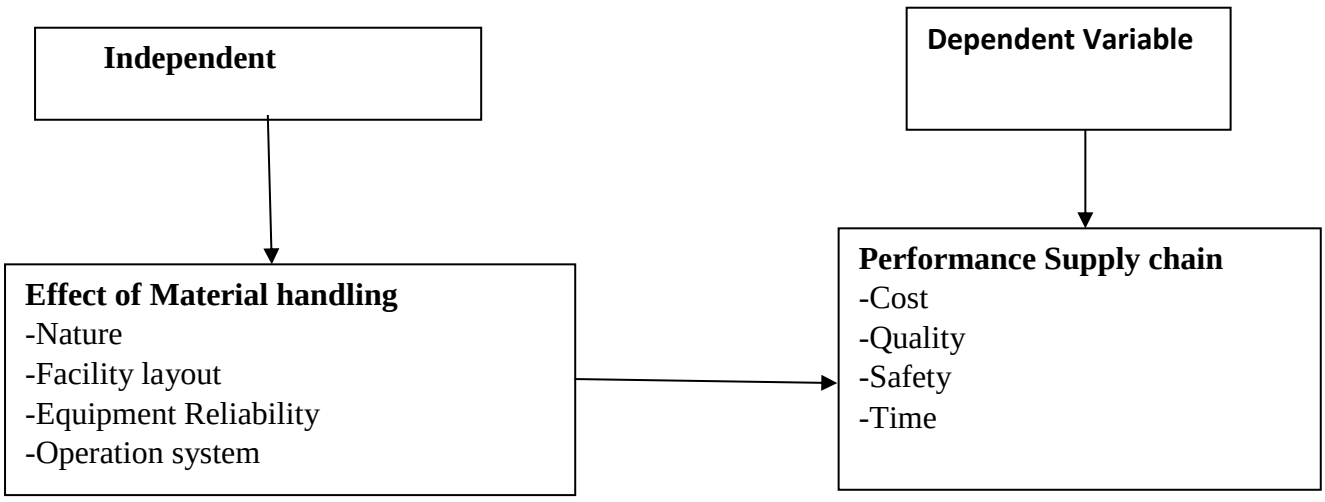
in Nairobi County Kenya. Stratified random sampling was adopted to select a sample size of 188 large-scale manufacturing firms in Nairobi County, Kenya. Primary data was collected using structured questionnaires inform of Likert scale. The analysed data was presented inform of tables. It was established that most of the material handling practices indicators have positive impact on performance of the firm. The study found that material packaging elements have an impact in overall performance of the manufacturing firms calling for the need to research on more variables of material handling.

Milan and Vieira (2011) investigated the materials handling management: A case study in Indian Manufacturing sector. The study adopted the descriptive design. The population under consideration which was the unit of analysis comprises of Mumias Sugar Company. The respondents for this study were drawn from the employee listings which were obtained from Mumias Sugar Company. Stratified random sampling was used to select 79 respondents in the Company. The sample of 79 was equivalent to 10% of the target population which is regarded as statistically significant. The Statistical package for social sciences (SPSS) was used to generate the required frequencies and percentages to answer the research questions. The study concluded that materials procurement and inventory control positively influenced the performance of sugar manufacturing industries in Kenya. The study relied on one Sugar Company;

Mwebia and Mutua (2016) established the analysis of storage and material handling on the profitability of mastermind Tobacco Company in Migori County, Kenya. This research study contributes to new knowledge to the staffs of Mastermind Tobacco Company on how to store and handle materials effectively. It entailed system theory and inventory control theory in literature review. A sample size of 21 respondents was used. The data was collected using both primary and secondary methods. Collected data was analysed using simple statistical methods such as percentage and frequencies. The study also found that as concerns transparency in the procurement process, 96% of respondents agreed that tenders are openly advertised. The study only targeted staffs that are directly linked to stores of the company and did not provide the participation of the community being served.

2.4 Conceptual Framework

Figure 1: Conceptual framework of the study



Source: Researcher, 2023

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3. Research methodology

Research Design

Descriptive research was chosen to explain effect of Material handling on performance supply chain (Calkins, 2009). The use of correlational research design is seen as to find out the relationship between dependent variables and dependent variables, from this perspective view, the important goal of any correlation research under determination of whether there is a relationship between relationship between variables and to what extent is the relationship (Bhattacharyya., 2006) on the study Effect of material handling on Performance of Supply chain, A case Study of Magerwa Ltd.

Study population

A case study of MEGERWA Ltd, the target population target is 150 workers according to their departments respectively as they include; Administration staff, Finance department staff, Engineering department staff, Operation department staff and Supplier in charge staff and Temporary staff .

Sample size

The sample size of the research study is used to determine the number of respondents from MAGERWA Ltd that employed in this study, therefore study adopted the in determining the sample size from (Slovin, 1980), the formula used to calculate the sample size include of (95% confidence level and α= 0.05), a confidence interval of 95 percent, the sample size used (Slovin, 1980), that was quoted and used by (Omar, 2017)

$$n = \frac{N}{1 + N * (e^2)} = \frac{150}{1 + 150 * (0.05^2)} \approx 109$$

Data collection procedures and instruments

Primary and secondary data were collected during the period of data collection in the specified instruments for collection: They were collected by the data field collector, here it was a matter of visiting the field of study area with the questionnaire addressed to the respondents. Primary data were collected from administration staff, Finance department, Engineering department, Operation department and supplier staff and Temporary staff. Employing a structured questionnaire, data collector collected primary data, while collecting secondary data the researcher used documentaries from the Magerwa Ltd as the company of study area.

Data analysis

The statistical methods was applied for this descriptive research, the primary data were employed and captured from field for analysis. Substantially in as far as the research study, inferential statistics were showed for the purpose of reviewing the relationship correlation between instruments on the material handling and supply chain performance concepts and variables. Multiple correlation and regression applied to analyze the data SPSS 25.0 as computer software utilized to process the whole analyses the results from field as findings.

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4. Research findings

This part presents the findings from the inferential statistical test that encompassed correlation coefficient and multiple linear regression analysis between the variables that was independent variables and dependent variables for this study

Table 1: Correlation Coefficient

		Nature	Facility layout	Equipment reliability	Operation system	Performance supply chain
Nature	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	107				
Facility layout	Pearson Correlation	.777**	1			
	Sig. (2-tailed)	0.000				
	N	107	107			
Equipment reliability	Pearson Correlation	.704**	.751**	1		
	Sig. (2-tailed)	0.000	0.000			
	N	107	107	107		
Operation system	Pearson Correlation	.710**	.708**	.745**	1	
	Sig. (2-tailed)	0.000	0.000	0.000		
	N	107	107	107	107	
Performance supply chain	Pearson Correlation	.780**	.864**	.847**	.843**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	107	107	107	107	107

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Primary data, 2023

The results present the relationship between the effects of material handling on performance supply chain. It is in this regard that the factor pushing on effect of material handling and performance supply chain were as; Nature, Facility layout, Equipment Reliability and Operation system. The statistical package for social science (SPSS) software version 25.0 was used to determine the Pearson coefficients. The Pearson coefficient correlation is between -1 and 1 where -1 to 0 presents negative correlation (-1 to -0.5 indicates high negative correlation and -0.5 to 0 indicates low negative correlation) and 0 to 1 presents positive correlation (0 to 0.5 presents low positive correlation while 0.5 to 1 presents high positive correlation). According to the results, the correlation between Nature, Facility Layout, Equipment Reliability and Operation system were 0.780, 0.864, 0.847 and 0.843 respectively, it presents that there was a significant relationship between effect of material handling and performance supply chain.

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Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.940[a]	0.884	0.879	7.51212

a. Predictors: (Constant), Operation system, Facility layout, Nature, Equipment reliability

Source: Primary data, 2023

The researcher wanted to know the effect of Material handling on performance supply chain. A case of Magerwa Ltd, from this perspective view , a researcher used regression analysis in order to measure on the effect of nature of materials for Material handling on performance of supply chain, the impact of facility layout for Material handling on performance of supply chain, the effects of equipment reliability on performance of supply chain and the impacts of operation system for Material handling on performance of supply chain , Correlation coefficient (R=0.940[a]) verified the relationship between Material handling and performance Supply chain, therefore ,the results present the Model Summary, the results present that the R Square=0.884. It was statistically significant clear that 88.4% of all variables of performance can be explained by one's of all variables of the material handling in relation to performance supply chain.

Table 3: ANOVAa of Material handling and performance supply chain

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43861.094	4	10965.273	194.309	.000[b]
	Residual	5756.065	102	56.432		
	Total	49617.159	106			

a. Dependent Variable: Performance supply chain
B. Predictors: (constant), Operation system, Facility layout, Nature, Equipment reliability
Source: Primary data, 2023

The results indicate ANOVA[a], the results presented than the variables were statistically significant with F=194.309 and p value=0.000[b], it means that there was a significant relationship between the Material handling and performance supply chain in this research study

Table 4: Coefficient[a] of Material handling and Performance supply chain

Model		Unstandardized Coefficients		Standardized Coefficients	t	
		B	Std. Error	Beta		Sig.
1	(Constant)	9.653	2.735		3.530	0.001
	nature	0.223	0.221	0.058	1.007	0.316
	facility layout	1.406	0.226	0.380	6.219	0.000
	equipment reliability	1.049	0.219	0.278	4.788	0.000
	operation system	0.890	0.152	0.326	5.843	0.000

a. Dependent Variable: Performance supply chain

Source: Primary data, 2023

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The results presented the constant of independent variables of Material handling. It is statistically significant since p value is less than 0.05. The results present the variables of Nature was not statistically significant with p value=0.316[b], the Facility Layout was statistically significant with p value=0.000[b], Equipment reliability was statistically significant with p value=0.000[b] and the operation system was statistically significant with p value=0.000[b]

It is in this regard, based on the SPSS generation of table 4 regarded to the equation $Y= \beta 0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$, where by Y= Performance supply chain, then the Equation served as;

Y=9.653+0.223X1 +1.406X2+1.049X3+0.890X4+7.51212

Therefore, the regression equation mentioned above is response for holding all constants (Nature, Facility Layout, Equipment Reliability and Operation system) in relation to performance supply chain was at 9.653, This implies that ensure performance of supply chain was steadily attained, Indicators of material handling affect the performance of supply chain excluding the factor "Nature ", the rest of indicators of which are; facility layout, equipment reliability and operation system lead to the performance of supply chain and again the only the nature of material lead into insignificance however , the facility layout in material handling leads to significance, and the equipment reliability led to significance and operation system provided significance.

The SPSS Calculated the t-statistic as t-test showed increase on 3.530 and t-test showed low increase on 1.0078 and t-test increased on 6.219 and t -test increased on 4.788 and. The results present the variables of Material handling, the Nature was not statistically significant with p value=0.316, the Facility layout was statistically significant with p value=0.000[b], and the Equipment Reliability was statistically significant with p value=0.000[b] and then Operation system was statistically significant with p value=0.000[b].

Hypothesis testing

In order to test the study's four formulated hypothesis, the t statistic that tests whether a B value is significantly different from zero (HO: β=0). The study computed simple regression analysis to test the study hypothesis. For p-value<0.05, H0 was rejected; and H1 accepted

H_{01}= There is no significant effect of nature of materials for Material handling on performance of supply chain. As evident in Table 4.10, the Unstandardized beta value of nature of materials for Material handling on performance of supply chain was significantly greater than zero ($\beta_{1=}$ 0.223 p-value=0.316<0.05, t= 1.007). Subsequently the null hypothesis was accepted because p-value=0.316 is greater than 5% level of significant, hence nature of materials for Material handling had a statistically insignificant relationship on performance of supply chain

H_{02}= There is no significant effect of facility layout for Material handling on performance of supply chain. As evident in Table 4.10, the Unstandardized beta value of facility layout for Material handling on performance of supply chain was significantly greater than zero ($\beta_{2=}$-1.406, p-value=0.000<0.05, t= 6.219). Subsequently the null hypothesis was rejected because p-value=0.010 is less than 5% level of significant, hence of facility layout for Material handling had a statistically significant effect on performance of supply chain.

H_{03}= There is no significant effect of equipment reliability on performance of supply chain. As evident in Table 4.10, the Unstandardized beta value of equipment reliability on performance of supply chain was significantly greater than zero ($\beta_{3=}$1.049 p-

value=0.000<0.05, t=4.788). Subsequently the null hypothesis was rejected because p-value=0.000 is less than 5% level of significant, hence equipment reliability o had a statistically significant effect on performance of supply chain.

H_{04}= There is no significant effect of operation system for Material handling on performance of supply chain. As evident in Table 4.10, the Unstandardized beta value of operation system for Material handling on performance of supply chain was significantly greater than zero (β_4=0.890 p-value=0.000<0.05, t= 5.843). Subsequently the null hypothesis was rejected because p-value=0.010 is less than 5% level of significant, hence operation system had a statistically significant effect on performance of supply chain.

5. Conclusion

Material handling is highly valuable in as far as the performance supply chain activities is concerned. It provides an important mechanism of how any material handling works with respective activities to ensure the measured activities and how help to the achievement of material handling and supply chain performance project objectives (Akincilar, S., 2013). It is in this regard that a researcher concluded that by relying on the obtained results. Based on the results, the relationship attained between Nature, Facility layout, Equipment reliability and Operation system was 0.780 ,0.864, 0.847 and 0.843 respectively, and the results presented than the variables were statistically significant with p value=0.000b, it concluded that there was a significant relationship between Material handling and performance supply chain.

6. Recommendations

The investors should consider the information taken in material handling in relation to the performance supply Chain.

The governments should know that the outcomes of material handling in logistics perspective and sensitize the citizens to be engaged in the material handling because it boosts the economic development in.

The MINICOM, MINIFRA should provide regular the professional guidelines to citizens and incoming investors in logistics especially in the component of material handling to follow and participate in material handling.

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