

BINDURA UNIVERSITY OF SCIENCE EDUCATION;

Faculty of Commerce

Department of Economics



**AN INVESTIGATION INTO THE EFFECTS OF MATERIALS HANDLING AS
A COST DRIVER IN THE SUPPLY CHAIN, A CASE STUDY OF CROSS
COUNTRY CONTAINERS**

By

Blessing Murandu

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS OF THE BACHELOR OF SCIENCE (HONOURS)
DEGREE IN PURCHASING AND SUPPLY OF BINDURA UNIVERSITY OF
SCIENCE EDUCATION. FACULTY OF COMMERCE**

RELEASE FORM

STUDENT REG NUMBER: B1542486

PROJECT TITLE: **EFFECTS OF MATERIAL HANDLING AS A COST
DRIVER IN THE SUPPLY CHAIN**

DEGREE PROGRAM: BACHELOR OF SCIENCE (HONOURS) DEGREE IN
PURCHASING AND SUPPLY

YEAR GRANTED: 2019

Permission is hereby granted to the Bindura University Library to produce single copies for scholarly and academic research purpose only. The author does not reserve other publication rights and the project nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

SIGNED.....

PERMANENT ADDRESS: 22778 BUDIRIRO 4 HARARE

PHONE NUMBER: 0778 907 563

APPROVAL FORM

The undersigned certify that they have supervised, read and commended to the Bindura University of Science Education for acceptance of the dissertation research entitled: *The effects of material handling as a cost driver in the supply chain. Case of Cross Country Containers*. Submitted by B1542486 in partial fulfilment of the requirements for the Bachelor of Commerce (Honours) Degree in Purchasing and Supply.

..... /...../...../
(Signature of Supervisor) **Date**

..... /...../...../
(Signature of the Departmental Chairperson) **Date**

..... /...../...../
(Signature of Student) **Date**

DECLARATION

I B1542486 declare that this research project herein is my original work and has not been copied or extracted from previous source without acknowledgement of the source.

...../...../...../.....

Signature

date

Dedication

This dissertation is dedicated to my parents for their tender love and support in my life, my siblings and my friends for their continued inspiration and encouragement.

Abstract

The study aimed at investigating the effects of material handling as a cost driver in the supply chain. The costs of material handling are increasing due to types of material handling system used at the organization. These material handling systems leads to some costs of maintaining the equipment especially in mechanical handling system where forklifts are used and they need fuel and being serviced. In manual material handling compensation costs increase due to accidents that happen at work. The trend of costs has shown that manual material handling system is causing these costs to increase. Hence the study seeks to find out whether material handling system causes costs to increase or there are other factors. The study made use of primary data and this was obtained from Cross Country Containers. In order to meet the set objectives, the research made use of linear regression method. The dependent variables were distance, experience, training, manual handling system, mechanical handling system and automated handling system. From the regression results it shows that there is a positive relationship between material handling systems and material handling costs. As such the conclusion drawn is that the company under study should focus much on manual handling systems to reduce manual handling costs. Recommendations are that policy makers should ensure that standard load, normal working hours, enforce shift break for employees, employ competent people and minimize distance travelled whilst carrying materials manually. The results also show that there is a negative relationship between employee competency and material handling costs. The conclusion is that organizations should focus on training employees and employing staff with experience in material handling. Safety and health department should ensure that safety signs are put in place so as to reduce accidents at work. As such the Occupational health and safety ought to carry on implementing policy like reducing working hours, recruit young labor force, employ competent personnel, regulate individual load weight and impose shift breaks.

Acknowledgements

I would like to thank God the Almighty for His amazing grace that continued to follow me in my entire life. I thank Him for His mercy that supervened and allowed me to do this study because it was not by my knowledge but by His divine will and mercy. Without God it was impossible to pursue my degree program and flourish in my studies at Bindura University.

I would also like to acknowledge my supervisor for his patience, guidance and skills that he assisted me with during this project. His knowledge and effort made it possible for this study to be a success.

Furthermore, I would like to extend my profound gratitude to my family for they have been a pillar of strength and stood by me financially, spiritually, emotionally and physically. I would also like to thank my friends who motivated me, offered me support and courage to undertake this study, they supported me through thick and thin and encouraged me to study hard and trust in God

I would also like to thank the management of Cross Country Containers that allowed me to collect data at their organization and responded honestly to my questionnaires. I would like to thank everyone else who participated for this project to be a success and may the good Lord richly bless them

Table of Contents

RELEASE FORM	ii
APPROVAL FORM	iii
DECLARATION	iv
Abstract	vi
Acknowledgements	vii
List of tables	xi
List of figures	xii
CHAPTER 1	1
INTRODUCTION	1
1.0 Introduction	1
1.1 Background of the Study	1
1.2 Problem statement	4
1.3 Research objectives	5
1.4 Research questions	5
1.5 Significance of the study	5
1.5.1 To Bindura University of Science Education	6
1.5.2 Transport Industry	6
1.5.3 Public at large	6
1.5.4 To the Government	6
1.6 Delimitations (scope of the study)	7
1.7 Assumptions	7
1.8 Limitation of the study	7
1.8.1 Limited financial and other resources	7
1.8.2 Time frame	8
1.9 Definitions of key terms	8
1.9.1 Material handling	8
1.9.2 Supply Chain Management	8
1.9.3 Cost driver	8

1.10 Organization of the study.....	8
CHAPTER 2.....	10
LITERATURE REVIEW	10
2.0 Introduction	10
2.1 Conceptual Framework.....	10
2.2 Theoretical literature.....	12
2.2.1 Automating Material Handling System.....	12
2.2.2 The Ergonomic Theory	14
2.2.3 Queuing theory	15
2.3 Empirical Literature Review	15
2.3.1 The effects of different material handling systems on material handling costs	16
2.3.2 Relationship between employee competency and material handling costs	17
2.3.3 Relationship between distance travelled by materials and material handling costs.....	20
2.4 Gap Analysis	20
2.5 Conclusion.....	21
CHAPTER 3.....	22
RESEARCH METHODOLOGY	22
3.0 Introduction	22
3.1 Research design.....	22
3.2 Regression analysis	22
3.8 Sample size determination (Yamane, 1967)	23
3.3 Justification of variables	23
3.4 Model specification	25
3.5 Research techniques	25
3.6 Justification for quantitative research design	25
3.7 Population and sample.....	25
3.9 Sampling procedure	26
3.9.1 Judgmental sampling	26
3.9.2 Random sampling	27
3.10 Research instruments	27
3.10.1 Primary data instrument.....	27

3.10.2 Questionnaire	27
3.10.3 Closed ended questions	28
3.10.4 Open ended questions	28
3.10.5 Secondary Data collection	29
3.10.6 Documentary analysis	29
3.11 Data collection procedures	29
3.12 Data analysis and presentation procedures	30
3.13 Reliability and validity of data	31
3.14 Ethical considerations	32
3.15 Chapter summary	32
CHAPTER 4	33
4.0 Introduction	33
Table 2: Multiple regression results	33
4.1 Research findings	34
4.2 Effects of different material handling systems on material handling costs	34
4.3 The relationship between employee competency and material handling costs	35
4.4 Relationship between distance travelled by materials and material handling cost .	36
4.5 Chapter summary	36
CHAPTER 5	37
Summary, recommendations and conclusions	37
5.0 Introduction	37
5.1 Summary of the research	37
5.2 Conclusions	38
5.4 Areas for further study	39
References	40

List of tables

Table 1 Target Population.....	26
Table 2 Multiple regression results	33

List of figures

Figure 1Material handling costs in a warehouse.....	Error! Bookmark not defined.
Figure 2 Conceptual framework	11
Figure 3Scatter plot : Regression Standardized Predicted Value.....	Error! Bookmark not defined.

CHAPTER 1

INTRODUCTION

1 Introduction

The research project is going to unearth the hidden costs associated with handling materials at Cross Country Containers and how these costs contribute to operational cost build up at the organization. The research shall give an insight to management on possible areas of cost reduction. To achieve this, the researcher shall review extensive literature on the subject matter and conduct thorough investigations on how materials are being handled and how this has driven material handling costs at the organization under study. The supply chain consists of suppliers, manufacturing assemblies, distribution and logistics facilities that perform the functions of procurement of materials and also the distribution of these products to customers. Thus the study will look into all these areas to find out how material handling is seen as a cost driver. This chapter will provide information on background of the study, problem statement, research objectives and research questions and the importance of the study to different institutions and individuals.

1.1 Background of the Study

Transport and Logistics is day by day gaining more attention in the business world and in the fields of interest of policy makers. As the transport and logistics industry grows demand to lower costs and improve product quality to provide reliable delivery dates through coordination of production and supply chain management also increases. According to Dongre and Mohite, (2015) these conflicting goals can be achieved through changing business practices and employ information systems. Materials handling has always been an area of analysis for organizations. This has become a central crucial point for many organizations in the transport and logistics industry and

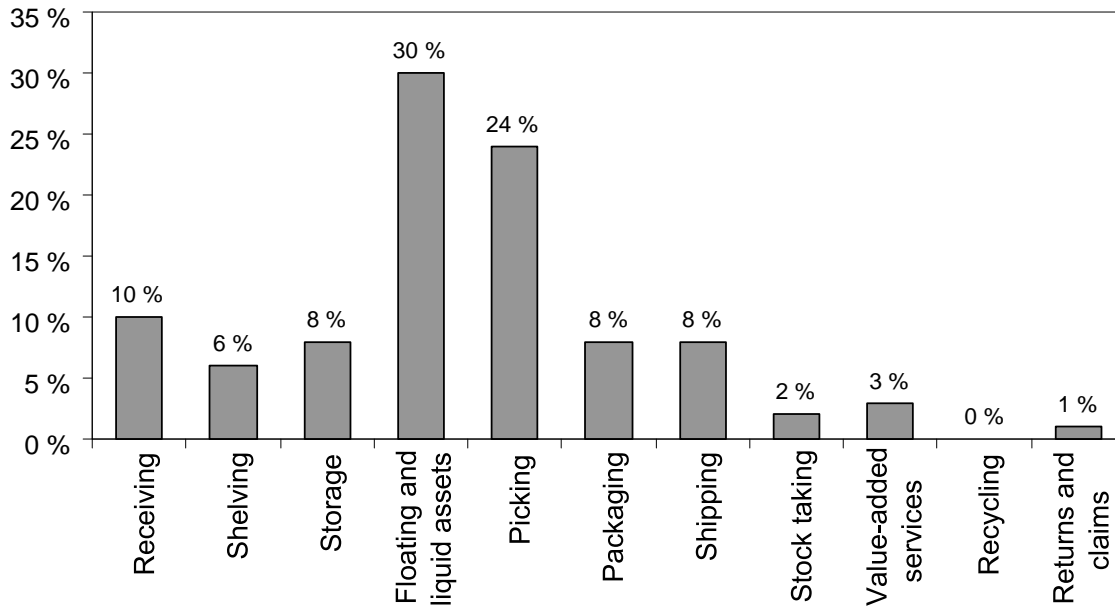
developments from the supply chain field have indicated that substantial operating capital can be freed with leaner and proficient handling of inventory.

In the effort of trying to scrutinize the state of the inventory, companies are regularly incorporating visibility across markets and warehouses. Companies are checking if stock levels are incoherent and if demand is certain and contact between stores locations or warehouses may be minimal or non-existent. Among other things, the lack of an integrated and effective interface between marginal systems and materials managers lead to unnecessary purchasing and overstocking which cascades to ballooning costs. In a recent research carried out on this issue by Dongre and Mohite (2015), 20% of the 500 Indian manufacturing firms interviewed still consider logistics as nothing more than freight transportation (9%) or transportation and some other services (13%). There however exists, a strong but often discreet relationship between materials handling system and the cost build up for a company. In transport industries companies that use automated materials handling and mechanical material handling systems experience less costs than those that make use of manual handling system only (Nasution *et al.*, 2017). However, Material handling as such is not a production process and hence does not add to the value of the product but it costs 30-75% of the total product cost (Dongre and Mohite, 2015).

The notion of “supply chain management”, “materials management” as well as "physical distribution management," are the principal materials organizational tools. These tools have been successfully used since time immemorial. Several evidences point to the suggestion that such tools will be used increasingly in the future to realize an intimate coordination and control of diverse materials activities of a company. Material handling and management is mainly concerned with inbound logistics which involves bringing materials into the organization to the place they are stored and outbound logistics from their location to the workstation and out of the organization to the final consumer. The fast developing and technologically changing environment has placed before the materials administrator a tremendously challenging task and responsibility of managing costs. Coordination and control are required to move materials that act as inputs to the process and remove materials as outputs from the process flow. According to Nasution *et al.*, (2017) companies usually take an overlook on material handling in the general scheme of production. Nasution *et al.*, (2017) is also of the idea that material handling has a greater effect on material handling costs and averages around 20-25% of total manufacturing labor and operational costs.

Consequently, the importance of materials handling lies in the fact that any significant contribution made by the materials manager in reducing materials cost will go a long way in improving the profitability and rate of return on investment. Such increase in profitability, no doubt, can be affected by increasing sales. An efficiently designed material handling system ensures the reduction in operation cost, manufacturing cycle time, material handling cost, delay and damage to equipment and merchandise. Such a system promotes productivity, flexibility, better utilization of manpower, increases material flow and automation in handling. This research study envisages to investigate how material handling systems in use at Cross Country drives costs to get the best solution for implementing the design of material handling system in the existing facilities. The constraints and challenges in ensuring an efficient material handling system as well as subsequent solutions are also identified and discussed.

According to Frazelle, (2002), the basic activities concerned with material handling are receiving, which consists of unloading materials checking quality and quantity. It also includes put away which defines placing materials at their appropriate location to wait for use. Order picking which is the retrieving of materials from their location and transporting them to the work station. It also includes shipping, which is inspecting packing, palletizing and loading items into a carrier for further delivery. These processes can be divided into two sections which are inbound and outbound logistics. Receiving and put away are inbound logistics and order picking and shipping are mostly outbound logistics



Source: secondary source

Figure 1.1: Material handling cost in a warehouse (Apple, J.M 2008)

According to Apple ,(2008) the processes above of receiving, shelving, storage , picking , packaging ,shipping , stock taking, returns and claims add costs of material handling in the supply chain. According to Meyers, (1993), to reduce material handling costs, receiving and shipping functions should be normally located near the input and output points. Due to human error picking can cause a lot of material damage which includes much into material handling costs. Meyers also said that some materials require certain kind of handling procedures. Some items for example may be fragile which requires being in a very safe environment that does not require maximum shifting. According to Sujuno et al., (2007) packaging itself does not cause harm to the product but the systems used. Manual packaging have the positive effect on material damage it is recorded as a material handling costs.

1.2 Problem statement

Organizations are experiencing more costs than value addition from material handling. Despite of efforts being made by the purchasing department to procure goods and services at a lower price and that are of high quality to reduce costs, much is spend on operating costs of material handling

vehicles during their life cycle. The costs include labor costs to train employees on how to use material handling equipment. In addition, materials are damaged due to poor handling. Cost per unit tends to increase when overhead costs increase due to breakage of the inventory. The use of manual handling system to handle materials have also caused accidents at work that has led to employee injuries. Therefore, the research seeks to investigate the effect of materials handling as a cost driver in the supply chain.

1.3 Research objectives

The research project shall aim to fulfill the following objectives:

- 1** To analyze the effects of different material handling systems on material handling costs.
- 2** To examine the relationship between employee competency and material handling costs.
- 3** To find out whether there is a relationship between distance travelled by materials and material handling cost

1.4 Research questions

- 1** What are the effects of different material handling systems on material handling costs?
- 2** What is the effects of employee's competency when handling materials on material handling costs?
- 3** What is the relationship between distance travelled by materials and material handling costs?

1.5 Significance of the study

Cross Country Containers have been doing a lot in trying to reduce the costs of its operations but not much has been done in reducing the cost associated with materials handling. This research is going to impart an in-depth knowledge on the effect of materials handling as a cost driver in the supply chain. This research is going to benefit the different organs as follows

1.5.1 To Bindura University of Science Education

The study will benefit the academia as it contributes to the ongoing debate on material handling effect as a cost driver in the supply chain. The study will also assist scholars interested in conducting research in materials handling and related areas as a source of reference.

1.5.2 Transport Industry

The study is expected to be of significance to the transport industry in Zimbabwe since it will contribute towards an insight of how too much materials handling can contribute to costs build up in the supply chain and pin point areas where materials handling can be minimized and reduce by costs concentrating much on materials handling.

1.5.3 Public at large

The research will benefit the public because suppliers will know that if they do not take much attention on how they handle their materials it will increase in cost build up. They will also know that time management is crucial in material handling because it can increase costs in the supply chain. It will also benefit workers on how manual handling can contribute to cost buildup. In addition, workers should also know the dangers that may arise when handling materials manually and how this can contribute to cost build up in the supply chain.

1.5.4 To the Government

It will also be beneficial to the Government as it will provide information on strategic decisions regarding materials handling along the supply chain. It will also benefit the government in knowing how manual material handling a threat to human health can be. Also, the obtained findings will provide guidelines on material handling can be a cost driver in the supply chain.

1.6 Delimitations (scope of the study)

The focus of the research was on investigating the effect of material handling as a cost driver in the supply chain. The research was confined only to Cross Country Containers and its four major suppliers specifically the stores staff and departments which also interface with the stores department were also included in the study because it was thought that each department would contribute in some way the investigation of the problem. Time was the delimitation as the research only covered the period from 2017 to 2019.

1.7 Assumptions

The study is premised on the following crucial assumptions

1. The study respondents were co-operative and provided unbiased information.
2. The data from the respondents was acceptable to gather findings and conclusions.
3. All provided information was treated with critical confidentiality.
4. Conclusions were drawn from evaluations of results and recommendations derived from these conclusions.

1.8 Limitation of the study

The limitations are the constraints on the utility of findings that are the result of the ways in which you chose to design the study and the method to establish internal and external validity. Naturally, as in most such studies, certain limitation and problems would arise:

1.8.1 Limited financial and other resources

Being a full-time student who is therefore unemployed and the research being public, or donor funded financial constraints. However, finance was sourced from the relatives and friends. High transport cost limited the researcher from travelling since the researcher was still financially dependent. To overcome this constrains, the researcher had to make use of a representative sample and soliciting for donations in order to meet transportation and stationary costs.

1.8.2 Time frame

The researcher; as a full time, student had insignificant time to grasp the concepts being educated while at the same time trying to emanate up with a well-researched project. To overcome this, the researcher had to make use weekends and the vacation prior to undertaking 4.2 semester. In addition, the researcher had to use of voluntary research assistants to distribute questionnaires and carry out some interviews to collect data; this would help the researcher to meet the deadlines.

1.9 Definitions of key terms

1.9.1 Material handling

According to Kulweic,(1993) ,material handling is the movement, storage, control and protection of materials, goods and products through the process of manufacturing, distribution consumption and disposal.

1.9.2 Supply Chain Management

Supply chain management is a customer focus to create unique and individualized sources of customer value, leading to customer satisfaction. (Lysons and Farrington, 2012)

1.9.3 Cost driver

a cost driver is a factor that can cause a change in the cost of an activity.
(www.businessdictionary.com)

1.10 Organization of the study

This section describes the organization and layout of the research

Chapter one- In this chapter the researcher will give a general idea of the background of the study, the purpose of the study, the motive behind embarking on the study and the manner in which the research process was carried out.

Chapter two - reviews together thematic and theoretical researches that have been done regarding the factors affecting effective implementation of e-procurement practices in the public health sector.

Chapter three- develops the research through appropriate methodology:

Chapter four – this section deals with data presentation, analysis, discussion and interpretation of findings.

Chapter five-present summary, conclusions and recommendations of the study

1.11 Chapter summary

The chapter aimed at giving an insight of what the research is all about, that is the factors affecting effective implementation of e-procurement practices in the public health sector. The researcher stressed objectives and research questions that gave direction of the research. The next chapter, which now follows will review the relative literature used for this study.

CHAPTER 2

LITERATURE REVIEW

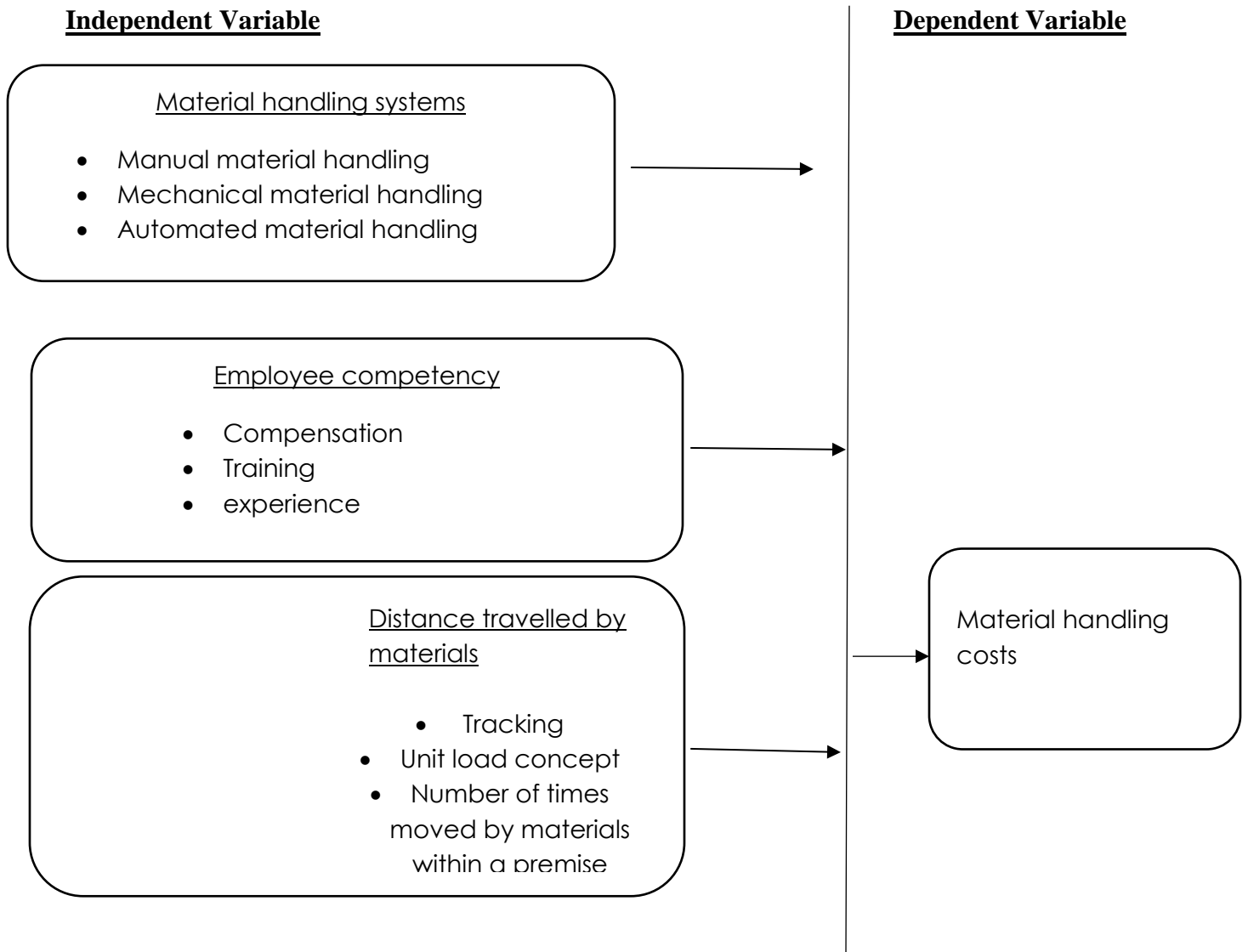
2.0 Introduction

Literature review addresses the research problem by use of literature which was written by other scholars. The major aim of literature review is to bring about the extent to which the available theories goes hand in hand with the subject under study as well as showing conflicting areas amongst various writers. Reviewing of related literature was done to show the theoretical framework for this research and together with empirical evidence. This enables the identification of research gaps, thus further justifying the research.

2.1 Conceptual Framework

Haynes,(2006),defines materials handling as the basic operations in connection with the movement of bulk, packaged and individual products in a semi-solid state by the means of gravity manually or power actuated equipment and within the limits of individual producing .processing or service establishment. This concept mainly comprises of the movement of materials, manually or mechanically in batches or a single item at a time within a plant or facility. The movement may be parallel, upright or combination of both. It is the moving, storing, controlling and protecting of materials, goods and products throughout the process of engineering, distribution, consumption and disposal. The attention is on the systems, mechanical equipment, and associated controls used to accomplish these functions. Materials handling focuses on motion, time, quantity and space. Material Handling focuses much on moving goods in the most efficient manner. Material handling is time conscious. Material handling must guarantee that no production process or consumer need will be hindered by moving materials arranged of location too late or too early. Material handling is also responsible of making sure that each location continually receives the correct quantity of parts. Finally material handling is space. Both active and dormant storage space, is a major consideration in any building as space costs money. The above concepts can be shown on the diagram below.

Figure 1 Conceptual framework



Source: Secondary source

Figure 2: Factors affecting material handling costs Kulwiec, R., (1993)

2.2 Theoretical literature

According to Gabriel, (2008), theories were formulated to explain, predict and understand phenomena and to challenge the existing knowledge within the limits of critical bounding assumptions. The theoretical framework introduces and describes the theory that explains why the research problem under study exists. The purpose of this chapter is to investigate whether materials handling effects as a cost driver in the supply chain basing on the available theories on materials handling.

2.2.1 Automating Material Handling System

Automated materials handling (AMH) refers to any automation that reduces or eliminates the need for humans to check-in, check-out, sort material, or to move totes and bins containing library material. Manzini et al (2005) explains that there is an increasing new trend towards automation of logistical activities. Automated systems were put in place to simplify the material handling activities. Automation has substituted capital equipment for labor. Automated systems requires less direct labor and has also the potential to operate faster and more precisely with less or no product damage than its mechanical material handling system. The level of automation differs depending on the handling requirements. Completely automated handling systems guarantee that the materials are delivered to the production line when required without any manual intervention.

Manzini et al (2005) is of the view that there is an increasing new trend towards automation of logistical activities. Ondiek (2009) evaluates materials management in the Kenyan manufacturing firms with an objective of determining whether long term accomplishment and survival of any organization depended much on how well organization are managing their material(cost). The study was a survey of medium and large manufacturing firms in Nairobi. The result shows that Kenyan companies were not practicing expertise in material management.

Grant et al., (2006), suggests that automated systems have some benefits. These includes eliminating labor that needs to be paid wages and salaries and compensation in case of any accidents. It also reduces any non-value adding processes. However, these advantages can be

held against the disadvantages as well. According to Grant et al., (2006), there is a list of some advantages such as reducing cost in labor, improvement in output, reliability and time of service will be improved, the amount of materials handling will be reduced. Disadvantages of automating the systems include initial capital cost, risk of downtime and unreliability of equipment, software related problems, lack of flexibility to respond to changing environments, user interface and training .All these disadvantages contribute more to material handling as a cost driver in the supply chain. With regard to the attributes to be considered in a material handling system, according to Roger et al., (1995), effective use of labor, providing system flexibility, increasing productivity, decreasing lead times and costs are some of the most important factors influencing selection of automated material handling systems.

Cohen, (2014) propounded that three significant costs that buyers incur over the useful life of pallet trucks and forklifts are operator training, maintenance and fueling. Operator training is generally the least costly of these expenses. The Occupational Safety and Health Administration (OSHA) requires operator training for all employees that operate a pallet truck or forklift. As such, this cost is directly related to the number of operators that require training at the buyer's company. Maintenance costs are more substantial. Given the nature of the tasks performed in the manufacturing and construction sectors, pallet trucks and forklifts are frequently exposed to hazardous conditions that accelerate wear and tear.

Rushton et al., (2006) further added that pallet trucks and forklifts are subject to heavy loading applications, which can lead to damage. To repair damage to pallet trucks and forklifts, buyers can procure maintenance services from the supplier they purchased the vehicle from. It is important to note that maintenance services can be quite costly. Frazelle (2002) concurred that the actual amount that a buyer pays for maintenance services depends on a variety of factors, such as the age of the vehicle, the condition of the vehicle, the setting it is used in and the number of operating hours it accrues on an annual basis.

Although the above expenses significantly add to the total cost of owning a forklift or pallet truck, there are ways that buyers can reduce these costs beyond purchasing electric equipment. Maintenance costs are largely related to the total use that the equipment has endured and its general condition. As such, new equipment has lower maintenance costs than used equipment, and buyers should weigh the purchase price difference against expected maintenance costs when choosing

new or used equipment. Another way that buyers can reduce their total costs is through renting or leasing the equipment. If a buyer only plans on using the equipment for a limited amount of time or is just using it for a small project, renting or leasing the equipment will work in the buyer's favor, (Cohen, 2014).

2.2.2 The Ergonomic Theory

Across Canada, many workplaces are experiencing an increase in the number of musculoskeletal injury (MSIs). New Brunswick statistics for 2007 reveal that MSIs account for 38% of all long term claim costs. Approximately 70% of all MSIs are injuries to the back and shoulders Mital,A.,AS (1997) According to Kroemer,Karl et al., (1994),manual material handling is defined as any task which require a person to lift, lower , push, pull hold, or carry any object or material.

Ergonomics focuses much on the work design activity that suits the person in that it takes account of their capabilities, limitations and behavior. Matching the requirements of a job with the capabilities of the worker is the approach to be adopted in order to reduce the risks of musculoskeletal injuries resulting from handling materials manually (Gould, 1996). Ergonomic approach aims at analyzing the environment in which the work is carried out. This takes into account the load, distance, individual, safety devises and task. These factors contribute much on how materials handling can be a cost driver in the supply chain. Therefore the study aims to point out how materials handling can add supply chain's costs and if possible these can be minimized.

Proactive Ergonomics emphasizes the prevention of work related musculoskeletal disorders through recognizing, anticipating and reducing risk factors in the planning stages of new systems of work or workplaces. The elements already discussed offer a plan for identifying manual handling tasks, risk factors and control measures to avoid or reduce risk of injury.

Proactive Ergonomics emphasize efforts at the design stage of work systems to recognize the need for avoiding risk factors that can lead to musculoskeletal problems. In effect, to design operations that ensure proper selection and use of tools, job methods, workstation layouts and materials handling that impose no undue stress and strain on the worker. Additional costs are incurred in redesigning or modifying work processes therefore it is more cost effective to reduce risk factors at the design stage.

As such the ergonomics perspective should be taken into account when using manual and mechanical materials handling system. Labar, (1995) propagates that in the event of a heavy load, shop floor workers may prefer to let go of materials they are handling before they hurt themselves. In another case a conveyor can operate at a higher speed than the capacity of an individual. As such all materials may not be collected from the conveyor as it will be moving thus compromising safety of materials. Some materials may end up being damaged and broken as they reach the end of the conveyor before they are collected thus increasing costs in the supply chain.

So much time maybe will be lost if shop flow workers that are engaged in manual handling are injured. The time lost to recover mean a lot much to the wellbeing of the organization. Sometimes the organization may have to take part in paying hospital bills in case of intense injuries. This means that these costs incurred are costing the organization and they may be transferred to the final consumer.

2.2.3 Queuing theory

This theory will guide the study in investigating the relationship between material handling equipment and company costs. Queuing theory is a mathematical study of waiting lines or queues (Shingo, 2005). The theory enables mathematical analysis of several related processes, including arriving at the back of the queue, waiting in queue (a storage process) and being served in front of the queue. The theory permits the derivation and calculation of several performance measures including the average waiting time in the queue or the system, the expected number waiting or receiving service, and the probability of encountering the system in certain states such as empty, full having an available server or having to wait a certain time to be served (Frazell, 2002).

2.3 Empirical Literature Review

The empirical review of literature is a field of research that deals with experiments done by others and also observations carried out by certain people in a certain field. (Schmidt, Siegfried, 1998). The results from that experiment or observation will act as evidence rather than theory. (Free

dictionary, 2013). Lisiak et al (2010), is of the view that empirical study of literature attracts scholarship in most cases in the areas of reception and audience studies and in cognitive psychology when it is concerned with questions of reading. Empirical literature review makes an irreplaceable contribution to the development of a more rational, scientific and socially relevant study of literature (Gorp et al, 1991).

2.3.1 The effects of different material handling systems on material handling costs

A research which was done by Milan and Pandolfo (2011) attributes that material handling management is among many factors that contribute to improve a company's performance. They defined material handling according to Material Handling Industry in America (MHIA) as the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. The focus of material handling according to their study is on methods, mechanical equipment systems and related controls used to achieve these functions. (mhia.org/learning/glossary)

The company examined production system as a whole and identified that it was necessary to improve materials handling systems in the manufacturing process. This was as a result of the delay of forklifts service and their high maintenance costs. These forklifts were used for both parts handling and transportation and to assist in tooling changes which many times resulted in excessive setup time leading to production delays. Changes were made in the materials handling process to address these concerns.

In their study they noted that a key factor in materials handling system design process is the selection and configuration of equipment for materials transportation. They noted that equipment should be selected basing on some preliminary considerations. The results of the study has shown that there was a cash flow savings of \$85 000 from improved materials handling.

According to Karitas (1965) who studied on the breakage and damage of groceries in warehouse and food retail stores. His objective was to determine the breakage and damage of materials in the grocery warehouses and retail food stores. His results has shown that employees have contributed to material damage by 36.7 percent due to dropping cases or accidents when using manual handling system. The above figure of 36.7 percent shows that manual material handling can contribute more

to the material handling costs. According to this study Karitus shows that about 19.3 percent of material damage is as a result of forklifts crushing materials. The recommendations from Karitus are that there should be enough space when handling materials. Alkinalah (2013) shares the same view with Karitus and he recommends that in order to minimize breakages there should be storage racks in warehouse for glass packed and other items which can be easily damaged.

Kathurima, (2016) carried out a research on the effects of material handling systems on performance of cement manufacturing firms in Machakos. His aim was to determine the effects of material handling systems on performance of the organisation. The targeted population was 60 and data was collected through the use of questionnaires. The research states that mechanical handling system should be used to reduce the effects manual handling. Labor and handling equipment is used in mechanical systems to enable receiving, processing and shipping. Grant et al (2006) is of the view that the level of mechanized material handling system in manufacturing companies has increased over the past years. Organisations are choosing to mechanized equipment such as conveyor belts and cranes.

Research done by Baudin (2004) shows that the use of traditional methods in workshops such as using forklifts to dispatch materials is opposing with lean manufacturing principle since they are expensive to operate and they may lead to safety hazards and need to be operated by trained personnel. The results of the previous forklift study done by Larsson and Rechnitzer states that many forklift related hazards starts from not treating forklift trucks as any other vehicle that needs systematic traffic management.

2.3.2 Relationship between employee competency and material handling costs

A research by John Peter Cooney has shown that most research done into occupational health and safety has shown that the high rates of injury are primarily due to inadequate, or non-existent, OHS systems. Therefore, the application of an effective management can lead to safer systems of construction and reduce incidence of injuries and work related diseases (Davis and Tomasin 1999).

According to Jeselskis, (1996) research has shown that an effective way of measuring the employee safety of a company is by using quantitative safety measurements. The quantitative measures that have led to cost build up in the supply chain are the time lost when an employee is

injured, severity rates, safety trainings, protective clothing and maximum temperatures such as a measure used to calculate accident of companies.

Wilson, (2000) conducted a study and found out that safety trainings varied by the size of the company. His results has shown that there is a negative relationship between safety trainings and injuries meaning that number of safety conferences, workshops and seminars, leads to a reduction of injuries. This leads to an increase in costs of an organization as it needs to fund those trainings.

Some doubt whether smaller companies can benefit from higher standards of OHS practice, due to the implementation costs involved. Other research by Lingered and Rowlinson, (1994) showed that firms having more resources and experience tend to deal with health and safety issues more effectively. Therefore in a relative sense, larger companies tend to be more committed to safety. It is also possible that OHS regulations which require formal documentation procedures do not fit the traditions, competence and needs of very small companies (Hale and Baram, 1998).

Mayhew (1987) has suggested that there is more manual handling system in light industries therefore there is higher incidence of serious injuries. In his analysis of United States census data, he found that self-employed workers were more than twice as likely to be killed at work. Light industries are generally much smaller companies than heavy industries, hence prone to more injuries due to lack of adequate equipment and effective management.

Karitas (1965) undertook a study on the breakage and damage in grocery warehouse and retail food stores of three firms P & C Food Markets, Red Owl Stores and Super Valu Stores in South Africa. His objective was to determine the breakage and damage of materials in the grocery warehouses and retail food stores. Data collection was done in the way of collecting forms already filled in with information from the stores in questionnaire form. After inspection of each facility and consulting with the major and store personnel, a list of over 50 causes of damage was compiled. Karitas found out that some damages in the warehouse and retail stores that occur are peculiar and unique to individual firms.

The Fourth European Working Conditions Survey was carried out in the EU – 27 in 2000 and the objective was to determine the handling systems used. Observation for data collection was used for the survey and it revealed that 35% of all workers are exposed to the risk of moving heavy

loads for at least a quarter of their working time. Literature from The Health and Safety Executive Manual handling at work: (A brief 2011-12) also shows that workers are exposed to carrying heavy loads because they take instructions which come from their supervisors. Young workers are reportedly to be the most exposed of all age groups. A sectorial background of rates of exposure to manual handling shows that workers in agriculture, construction, hotels and restaurants are most likely to be exposed to heavy loads (68%, 64% and 48% respectively), followed by workers in the sectors of manufacturing and mining, wholesale and retail trade (close to 42%), and transport and communication (35%). The survey recommended that young and energetic workers should be dominant in handling systems especially in manual handling systems because they do not lead to damages compared to the elderly.

The European Agency for Safety and Health at work conducted a study in 2000 in Europe and took a sample of five companies. The main objective of the study was on materials handling systems. The agency used a qualitative technique where data was collected using questionnaires and interviews. Their conclusion was that manual handling can result in fatigue and lead to injuries of the back, neck, shoulders, arms and other body parts. In addition manual handling also leads to breakages of the load because the injury result in dropped loads in most cases. The study was carried out in developed countries as such automated handling systems were most dominant in the study. The recommendations of the study are that manual handling system should be circumvented when possible and if not possible, then employees should be trained on how to handle materials in a safe manner which eliminates damages to materials.

The Health and Safety Executive (2004) carried out a study of problems encountered in materials handling systems in various sectors. They are of the view that the problem of manual handling is not confined to a narrow range of industries nor is the problem confined to 'industrial work' for example manual handling account for more than 50% of damages in wholesale and retail trade. They also found out that an ergonomic approach is favorable as it suggests that factors such as nature of task, load, working environment and individual capability contribute to materials damage. It also encourages weight limits for manual and mechanical handling purposes. Decisions on mechanization are said to create risks of their own. Nyabwanya (2012) is also of the view that layout of the system or process should be laid out such that it minimizes distance, load and also capacity which inventory is supposed to move. Such improvements often add benefits in terms of

greater efficiency and productivity and reduce damages to loads. They also observed that the distance through which a load is lifted or leveraged can also be improved. The health and safety recommend that task should involve rest periods, job rotation where possible whether mandatory or fixed breaks. It also states that when undertaking team handling, the load should have enough handholds, space movement is adequate, and the ground is not slippery for machinery and human beings to operate among other factors.

2.3.3 Relationship between distance travelled by materials and material handling costs.

Symk (2018) conducted a research on how to minimize order picking distance through storage allocation policy. His research has shown that there are many studies that prove that picking can be a way to reduce order fulfilment costs. He stated that storage allocation regulates where to keep the stock in order to reduce material handling costs. His research has shown that reduced picking distance has resulted in 38% reduction in material handling costs as stated by (McGinnis et al. 2007). After this has been observed Vantaa warehouse has been searching for ways to improve picking process to advanced levels and it has admitted that reduced distance traveled by materials will result in reduced material handling costs. Researchers like De Koster et al and Peterson have described travelling of the order picker as the most time consuming activity. The estimates were about at 50%. The main objective which researchers have focused on when dealing with improvement of order picking efficiency was mostly minimizing material handling costs, reducing distance travelled by materials and also reducing travelling time. The research has stated that distant order picking needs more labor, it is time consuming and is a very costly activity. The results of the study has shown that strategic picking and reduced distance results in cost reduction by mostly 60% (Tompkins et al 2010)

2.4 Gap Analysis

Researches done before were mainly focusing on how to reduce costs of materials handling while this research is focusing on how materials handling drives costs in the supply chain. Some of these researches were done in the private sector in automotive industries which is almost the same with this study though it focuses much on the transport and logistics company. In addition some of the previous researches were done in developed countries where companies there can afford different materials handling equipment. Differences in economic conditions technological economic,

political and social environments between developed and developing countries gives a reason for the research to be carried out in our own country. The previous researchers were able to show where materials handling can be a cost driver in the supply chain and they were able to give solutions to that problem.

2.5 Conclusion

This chapter has scrutinized the literature review that included theoretical literature found in text books and empirical evidence theory that is found in previous research results from other researchers on the similar topic of materials handling as a cost driver in the supply chain. There is a little difference in researches done by others and the current research. The next chapter therefore will focus on the research methodology that is how the researcher collected information related to the problem at hand.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

This study seeks to determine the effect of materials handling as a cost driver in the supply chain specifically at Cross Country Containers. The previous chapter examined literature review which includes theories and empirical evidence on material handling systems as a cost driver in the supply chain. This chapter shows the methodology that was used to carry out the research. The chapter will start by showing the research design used, the sources of data used are to be explained and justification of variables.

3.1 Research design

The study used a cross-sectional descriptive survey in which information was captured based on data gathered for a specific point in time. This design was chosen because of its economic benefits to the researcher in terms of time and financial resources.

3.2 Regression analysis

The study followed a regression analysis of the nature:

$$\gamma = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e_i$$

Where γ = Material handling costs

β_0 = Constant or intercept which is the value of dependent variable when all the independent variables are zero

$\beta_1 - \beta_6$ = Regression coefficient for independent variables.

X_1 = Manual handling system

X_2 = Mechanical handling system

X_3 = Automated handling system

X_4 = Training

X_5 = Compensation

X_6 = tracking

X_7 = experience

e_i = error term

3.8 Sample size determination (Yamane, 1967)

$$n = \frac{N}{1 + N(e)^2}$$

Where,

n refers to sample size

N refers to population size

e refers to level of significance

3.3 Justification of variables

Manual handling system

Manual handling system was used as a dependent variable since it contributes as a cost driver in the supply chain. According to Nyabwanga & Ojera, (2012) manual handling system has a positive effect on the cost addition of material handling. Some of the factors that makes manual handling be a material handling cost driver is too much labor involved during the process and the cost of material damage caused by human error.

Mechanical handling system

According to Saleheen et al., (1987) mechanical handling system is a better way to handle materials which is more superior to manual handling system. It is there to reduce material damage through the use of forklifts and reducing the number of people needed to handle materials.

Automated handling system

This system was put in place to reduce all the disadvantages caused by two other material handling systems. According to Saleheen et al., (1987) this system involves use of conveyor belts which requires little or no human effort. This material handling system has a little effect on material handling cost.

Compensation

When handling materials, workers are likely to get injured and the organization has to compensate the employees with some money which drains its financial resources. According to European Safety and Health at Work, (2000) employee compensation has a positive effect on material handling costs since it drains the finances of the organization

Training

Training is an act of equipping an employee with some skills to carry out a tasks. Byso doing if employees are trained it means there is a lower risk of getting injured and this leads to reduced costs of material handling, (Holmes, 1999)

Tracking

Material tracking is an act of increasing the visibility of materials in transit. This includes technology to enable tracking and technology is expensive in its nature, (Thomas et al., 1989). This means that tracking of materials has a positive effect on material handling costs.

Experience

More experienced workers tend to have less mistakes than learners which means experience has much effect on the increase of material handling costs.

3.4 Model specification

To determine the relationship between material handling systems and materials handling costs, regression analysis was used to describe and evaluate the relationship between two or more variables mostly one being dependent. According to Pszonicki, (1997), can be used to find the interface between two or more variables. In this regression model a dependent variable is materials handling costs which is affected by materials handling system, employee competence and distance travelled by materials.

3.5 Research techniques

The researcher made use of quantitative research technique. .It provides insight into the problem. According to Shingo, (1998), quantitative research is a technique that provides statistical figures and the relationship between variables.

3.6 Justification for quantitative research design

The researcher used quantitative research since the study is quantitative in nature. According to Shingo, (1998) the research seeks to identify the relationship between independent variable and dependent variable under each objective therefore quantitative research can be used. The research seeks to find statistical figures that will show how much material handling is a cost driver in the supply chain. Quantitative research design has an advantage since the results are measurable and can be shown through objective data.

3.7 Population and sample

According to Rick Yount (2006) population consists of all the subjects you want to study. The population of this research was 75 from 4 departments. The sample size was 40 and these also responded to the questionnaires.

Table 1 Target Population

Department	Population	Sample	Respondents
STORES	36	18	18
WORKSHOPS	28	16	16
PROCUREMENT	4	4	4
OPERATIONS	7	2	2
TOTAL	75	40	40

Table 1: target population

Source: Cross Country Population size 2017

According to Mugenda & Mugenda (2003) target population refers to an entire group of individuals having common observable characteristics. The target population consisted of the procurement staff, stores staff, operations staff and workshop staff who are engaged in day to day handling of materials in their working areas. Procurement staff was targeted because they are involved in the receiving of materials and are responsible for every procurement decision. The other departments are also targets because they are involved in the use of materials which need to be moved on a daily basis. According to Mugenda & Mugenda (2003), judgmental sampling is a type random sampling based on the opinion of an expert. It was used to select these four departments since they are directly involved in the handling of materials unlike those left Human resource department and Accounting department. From these departments the sample was chosen on the basis of random sampling in order to reduce bias.

3.9 Sampling procedure

In order to collect quality data, the sample should be a representative of the whole population. All population units must stand a chance to be selected.

3.9.1 Judgmental sampling

To select the departments, judgmental sampling was used which is an expert sample that is selected based on the opinion of an expert. The researchers selected only four departments from six because these four are directly linked to the day to day handling of materials. This sampling method saves time since it does not include other respondents who lacks information on the subject matter.

3.9.2 Random sampling

The researcher carried out a random sampling in the above four mentioned departments. This type of sampling has an advantage of that there are better chances that the sample represents the whole population. It also reduces costs of taking care of the whole population.

3.10 Research instruments

This refers to the research tools that were used by the researcher to collect data. The researcher used questionnaire as a tool to collect primary data. For researcher made use of organizational material handling records as secondary data to collect quantitative information.

3.10.1 Primary data instrument

Primary data was used because it is the first hand information and was collected especially for this research and that contributed to the strength of the study results. According to Kotler, (1994), primary data is the data collected from the field especially for the study. The following research instrument was used to collect primary data.

3.10.2 Questionnaire

A questionnaire is a list of questions which are used to collect data from respondents according to Baxter (2012).The questionnaires included both open ended and closed questions. The questions in the questionnaire were formulated from research questions and research objectives in order to find answers which were needed by the study. Respondents had adequate time to complete the questionnaire. Questionnaires that were used as a research instrument to gather information were more beneficial to the researcher because there were limited resources. Privacy of participants was taken into consideration. There was also uniformity in questions asked and answered. The

disadvantages of the questionnaire were that there was no clarity and there were large amounts of presented difficulties in data analysis.

3.10.3 Closed ended questions

Closed ended questions helped participants to show their views from a collection of given alternatives. Each question had possible answers so that respondents will select whichever answer which was in line with their opinion. These closed ended questions made it easier for respondents to complete questions and it gave an advantage to the researcher in data tabulation process. On the other hand closed ended questions had some limitations to the study because there was no chance to show one's opinion but to stick to the provided answers (Makewa et al., 2014). If there was such room all the information beneficial to the study would have been yielded. The questionnaire included open ended questions so as to address limitations of closed ended questions.

3.10.4 Open ended questions

Open ended questions gave freedom to respondents to express their opinion in an exhaustive manner. These questions did not limit respondents to provided answers but they allowed them to express their views, attitudes feelings opinions and concerns freely and it promoted in obtaining enough information so as to get the effect of material handling as a cost driver in the supply chain. However open ended questions had some difficulties in data analysis and data tabulation. This problem was addressed through code designing to classify responses that were gotten from different respondents trying to analyze data collected to make it meaningful and presentable. The questions made use of funnel approach starting with general and conclude with specific questions and this gave respondents a motive to supply enough and detailed information.

Questionnaire drafting was guided by the important guidelines which included keeping, questions simple, clear and concise. Questions were asked one at a time and leading questions were avoided. Ambiguous questions were also avoided and double negative questions as well. In addition the questionnaire was very short and had short questions. This helped to reduce monotony to the respondents because long questions tend to very low overall response rate.

3.10.5 Secondary Data collection

Berkowiz and Rudelius (1997) defined secondary data as facts and figures that have been already recorded. Secondary sources of data in this study includes internet, safety and health reports, company manuals and also purchasing forklift hire and maintenance report of the company. Much information was obtained from purchasing reports and safety and health reports of the company. Secondary research was much cheaper than primary data collection. Availability of data made research much easier and less time consuming. Information from secondary sources was already simplified and it made the researcher understand it better. Apart from all the advantages provided by secondary data, some limitations also prevail like comprehensiveness of data hence it took time to take required data only.

3.10.6 Documentary analysis

This is collecting data from other documents to support the study. These documents can range from company documents and also purchasing procedures. These were used because they do not require participants and they can also be checked for reliability. However documentary analysis failed to provide much information to be used in the study.

3.11 Data collection procedures

Arrangement for appointment was made by the researcher with the respondents in advance prior to distribution of questionnaires in order to allow respondents to get ready for the exercise. Distribution of questionnaire was a duty of the researcher. There was no delegation of duties. This was due to the small sample size which was manageable. Questions needed a follow up so that respondents would get clarity and asking of questions outside those provided on the questionnaire.

Participation of the researcher during data collection process was an advantage since there was room for verbal communication and also analysis on non-verbal communication through observing facial expressions. This helped in determining false and honest responses.

Pilot survey was conducted by the researcher and noted some irregularities in the wording of some questions. Also noting the questions that did not give required data and response rate. Some of the questions were altered during the pilot survey. Some were also rephrased in an effort to allow the research instrument collect actual data which was required by the study. Therefore pilot survey worked successfully to make research instrument effective.

However there were some drawbacks in trying to distribute questionnaire which includes respondents who were not at their work stations all day. The researcher made efforts of calling to meet respondents so that they can fill in the required answers.

3.12 Data analysis and presentation procedures

Collected data was entered into Microsoft excel. To analyze data the researcher made use of Statistical Package for Social Sciences (SPSS) version 20. The SPSS package was used for regression to meet the objectives of the research.

Linear regression analysis was used to determine the relationships between the independent and dependent variables in all of the three objectives.

The effects of different material handling systems on material handling costs

$$\gamma = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e_i$$

Where,

γ = material handling costs

X_1 = manual handling system

X_2 = mechanical handling system

X_3 = automated handling system

e_i = residual error term

Effects of employee's competency when handling materials on material handling costs

$$\gamma = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e_i$$

Where,

γ = material handling costs

X_1 = training

X_2 = compensation

X_3 = experience

e_i = residual error term

The relationship between distance travelled by materials and material handling costs

$$\gamma = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e_i$$

Where,

γ = material handling costs

X_1 = tracking

X_2 = unit load concept

X_3 = number of times moved by materials

e_i = residual error term

3.13 Reliability and validity of data

Data validity and reliability can be difficult especially where questionnaires are used as a research tool. The researcher had to take some measures so that validity and reliability can be improved. Research instruments were pre-tested in a way that improved the validity and reliability of data. The questionnaire was changed until the researcher got satisfied that the contents would yield the results the researcher intended to get. The questionnaire was also stated clearly in a way that respondents would have the same meaning of what is being asked by the researcher.

Management staff of the institution was asked to answer to the questionnaire. This is because it is the perception of the researcher that the questions asked were familiar to them and they have qualifications in supply chain.

The researcher used simplified questions that did not give confusion to respondents. This was done in order to avoid invalid and unreliable responses from respondents.

3.14 Ethical considerations

Ethics are moral principles that govern the behavior of an individual when carrying out a certain activity. Considering this study, the researcher observed some ethics by respondents to volunteer in participating in the study. The researcher asked for permission to get responses from respondents and no one was forced.

In addition the researcher did not ask for names of respondents by clearly showing on the questionnaire not to write any name. The information provided was only meant for academic purposes and the researcher assured that the information will be confidential. The researcher

3.15 Chapter summary

The study satisfied that the methodology used was enough to address and achieve the objectives of the study despite of all the highlighted limitations above.

CHAPTER 4

4.0 Introduction

This study intended to investigate how the independent variables such as training, experience, distance, compensation manual handling system, automated handling system and mechanical handling system are affecting material handling costs. The significance is set at 5%.

Table 3: Multiple regression results

Coefficients					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	192.814	33.351		5.781	.000
Experience	-12.814	7.440	-.172	-1.722	.095
Compensation	1.372	5.361	.012	.256	.800
Distance	33.065	13.514	.288	2.447	.020*
Training	-22.420	8.739	-.235	-2.565	.015*
Manual handling system	32.968	8.949	.353	3.684	.001*
Automated handling system	-1.878	5.311	-.016	-.354	.726
Mechanical handling system	.782	5.131	.008	.152	.880

Dependent variable: Material handling costs.*Significant at 5%

4.1 Research findings

The table 4.1 above presents the econometric results of multiple linear regression model for the factors affecting material handling costs. As shown by the table, the level of significance is set at 5 % (0.05) the results of linear regression analysis indicated that manual material handling system, training and distance were statistically significant and on the other hand experience, mechanical handling system, automated handling system and compensation were not statistically significant on increasing or reducing material handling costs.

4.2 Effects of different material handling systems on material handling costs

There are three type of material handling systems which are manual, mechanical and automated handling systems. The results of multiple linear regression shows that two of material handling systems have a positive effect on material handling costs. Manual handling systems contribute more to material handling costs. Table 3 of multiple regression results shows coefficient of 32.968 shows that there is a positive relationship between manual material handling system and material handling costs. The results show manual handling system is 0.001 % significant. The health and safety authority, (2007) has indicated that approximately one third of all work related incidents are caused by manual handling system which will be a cost to the organisation through compensation of workers hurt at the workplace. Citing Labar, (1995), he indicated that in the event of a heavy load, shop floor workers may prefer to let go of materials they are handling before they hurt themselves. When materials are damaged it then means that material handling costs thereby showing a positive effects of manual handling to material handling costs.

Mechanical handling system has a positive effect on material handling costs. The coefficient 0.782 shows that there the system is contributing positively to material handling costs. Mechanical handling is not statistically significant is increasing material handling costs as shown by the table 4.1 that it is 0.880% insignificant. As shown by research done by Baudin (2004) shows that the use mechanical handling systems in workshops such as using forklifts to dispatch materials is opposing with lean manufacturing principle since they are expensive to operate and they may lead to safety hazards and need to be operated by trained personnel. Also the results of the previous

forklift study done by Larsson and Rechnitzer states that many forklift related hazards starts from not treating forklift trucks as any other vehicle that needs systematic traffic management. Therefore the results shows that mechanical handling systems have a positive effect on material handling costs but the effect is less than that of manual handling system.

The results have also indicated that automated handling system have a negative effect on material handling costs as shown by the coefficient -1.878. This means that as automated handling is increase there will be reduction in material handling costs of the organization. The results has shown that automated handling system is insignificant at 0.726% in reducing material handling costs, it may be supported by the huge amounts of money that is needed to setup the automation system. According to. Manzini et al (2005) , automated handling system is known for its benefits of recuing human labor and has also the potential to operate faster and more precisely with less or no product damage than its mechanical material handling system. The level of automation differs depending on the handling requirements. Completely automated handling systems guarantee that the materials are delivered to the production line when required without any manual intervention.

4.3 The relationship between employee competency and material handling costs.

The negative coefficients of experience -12.814 and training -22.420 shows that there is negative relationship between employee competency and material handling costs. Training is significant at 0.15%. The more the employee is trained and equipped with skills to the work, the less they add to material handling costs. It is known that when employees and trained they get the technics of doing the work well, reduce costs and increase productivity. According to Wilson, (2000), he conducted a study and found out that safety trainings varied by the size of the company. His results has shown that there is a negative relationship between safety trainings and injuries meaning that number of safety conferences, workshops and seminars, leads to a reduction of injuries. It shows that any increase in training and the number of years a person has been employed, there will be a reduction in material handling costs. These were also the findings of Moyo, (2015) where she also conducted the study on the relationship between employee competency and material damage and found out that there was a negative relationship between employee competency and material damage.

4.4 Relationship between distance travelled by materials and material handling cost

The results also shows that there is a positive relationship between distance travelled by materials and material handling costs. The coefficient of 33.065 on distance means that any increase in distance will lead to an increase in material handling costs. The results have also shown that distance is significant at 0.02% at increasing material handling costs. The research done by McGinnis et al., (2007) has shown that that reduced picking distance has resulted in 38% reduction in material handling costs which means as distance travelled by materials is reduced the material handling costs also decrease. But as shown by this current study distance travelled is increasing and therefore the material handling costs are also increasing. According to the study carried out by Moyo, (2015), her results have shown that when distance travelled by employees carrying materials increase, employees are bound to experience fatigue and tiredness. Therefore effectiveness of people and machinery is affected because distance leads to dropped cases and breakdowns during travelling to another destination within the facility.

4.5 Chapter summary

The results have shown that there is a positive relationship between manual material handling system, mechanical handling system and material handling costs. Automated handling system has a negative effect on material handling costs because of its known advantages and effectiveness. It was also shown that as distance moved by materials increase, the material handling costs also increases. It was also shown that there is a negative relationship between employee competency and material handling costs. This means that as employees get trained and experienced, they gain more skills and they contribute less to material damage thus reducing material handling costs.

CHAPTER 5

Summary, recommendations and conclusions

5.0 Introduction

The research seeks to investigate the effects of material handling as a cost driver in the supply chain. This chapter consists of summary findings from the study, the policy implications and also the recommendations suggestions to several stakeholders in the transport and logistics sector. Future researchers are also provided with suggestions in this chapter.

5.1 Summary of the research

The research was driven by the increase of material handling costs at the organization under study. Material handling costs are increasing rapidly at a high rate and manual handling system in use is being blamed which depends on ergonomic capacity and also mechanical material handling system where there is continuous repair of forklifts and maintenance costs. Linear regression method was used to find the relationship between the dependent and independent variables of objectives under study. The results found managed to address the objectives of the study

5.2 Effects of different material handling systems on material handling costs

It was shown that manual and mechanical material handling systems have a positive effect of material handling costs. Any increase in manual handling system will increase costs with a greater percentage as compared to other systems of material handling. Mechanical handling systems have

a positive effect on material handling cost but not as much as manual handling system. Automated handling reduce systems material handling costs because of its effectiveness and use of less human labor that is prone to fatigue and so many mistakes.

5.3 The relationship between employee competency and material handling costs

The study has also shown that there is a negative relationship between employee competency and material handling costs. The more training employees get, the more they are capable of carrying out tasks with little or no material damage. It is wise to consider experienced workers when employing a team for material handling so as to minimize material handling costs.

5.4 Relationship between distance travelled by materials and material handling cost

The study has also shown that there is a positive relationship between distance travelled by materials and material handling costs. As employees move around the premise carrying materials, their efficiency tends to decrease due to tiredness and fatigue. This is where materials can be dropped and be broken causing an organization to incur material handling costs.

5.5 Conclusions

The study has investigated the effects of material handling as a cost driver in Transport and Logistics Company. The major results reviews that all material handling systems, training and distance are significant and can influence positively in material handling costs. It has also shown that tracking and experience influence negatively to the material handling system and these are insignificant.

5.6 Recommendations to transport and logistics companies

Basing on the results and findings of this study, transport companies should consider to reduce manual handling through reduction of loads per each employee, reduce working hours and also increase employees with qualifications.

From the conclusions above, material handling systems have a positive relationship with material handling costs. It means that organizations should try to shift from manual handling systems to mechanical because they cause less damage to human being and also materials. Mechanical handling equipment usually does not involve lifting, pulling and pushing heavy loads, carrying out tasks in an awkward postures, moves that cause fatigue. It encourages the use of forklifts, cranes and dollies. This means that the ergonomic problem can be solved by using mechanical handling systems to carry loads within the facility of the firm.

The research also shows that there is a negative relationship between employee competency and material handling costs. This implies that an increase in training and experience of an individual will reduce material handling costs. I recommend that firms train employees on how to handle materials to reduce accidents and also encouraging the safety and health department to put safety signs in place. Supervisors who impose heavy loads per day for employees should be penalized for the materials damage that would have occurred.

The research has shown that material handling costs increase as distance travelled by materials increases. I would recommend that materials should be stored closer to the workstation or rather close to workshops where materials are less prone to damage. A travel path for people and machinery should exist which is shorter and convenient for personnel carrying or moving materials

5.7 Areas for further study

Researches on effects of material handling systems, employee competency and distance should also be conducted in other firms besides Cross Country Containers. It should also be carried out in other developing countries like Zambia, Mozambique and Kenya so as to determine the effects of material handling as a cost driver in the supply chain so as to take corrective action.

There are other sectors which use materials handling system such as manufacturing, mining and agriculture in Zimbabwe. A study which pursues to find the effect of materials handling as a cost driver in the supply chain should be conducted so as to benefit from the knowledge. The study can also be conducted looking at other factors that drive costs in the supply chain.

References

- Apple J, M. 2008. *Plant and material handling*, (3rd Edition) .New York Wiley
- Baxter .S: Reflecting on the child oriented research experience. *International Journal of Market Research*. 2012
- Chen, Y. (2016). *Spatial Autocorrelation Approaches to Testing Residuals from Least Squares Regression*. Peking University, Beijing, China.
- Cohen, J. (2014). Reducing Ownership Costs for Material Handling Equipment. IBIS World
- European Agency for Safety and Health at Work.,2000.Hazards and risks associated with manual handling in the workplace. Retrieved from <http://osha.europa.edu> on 03/12/15.
- Frazelle Edward, H. (2002) *Supply Chain Strategy*, Tata McGraw Hill, New Dehli
- Garson,G.D. (2012). *Testing for statistical assumptions*.North Carolina: Statistical Publishing Associates
- Gould, S.J.(1996). *Musculoskeletal Examination and Recording guide*, 3rd edition.UK. McGraw-Hill
- Grant, D.B., Lambert, D.M. ., J.R and Ellram, L.M., 2006.Fundamentals of logistics management. European Edition.UK: McGraw-Hill Education.GR
- Gujarati, D. (2004). *Essentials of Econometrics*. (4th edition). New York, United States of America.:McGraw-Hill
- Gunderson, 2000. Economics, 5TH Edition, Saunders college publishing.
- Holmes, 1999. Employer-provided training: results from a new survey. *Mon Labor Rev* 1995; 118: 3-17.
- Kroemer , D (1994). Effects of training in modifying work methods and behaviours during common material handling activities.
- Kulwiec,R., 1993. Material handling equipment guide: Plant Engineering: Volume 47 (8):
- Labar, G., 1995. Ergonomic help for material handling. Occupational Hazards: Volume 57 (1): 137-138.
- Lysons, K and Ferrington, B. (2012) *Purchasing and Supply Chain Management*. Pearson Education Limited. England

- Makewa L , Kujoba J, and Yango M. Intergration in Higher Education.University of Arusha, Tanzania
- Meyers , F.E (1993) .Plant layout and material handling. Englewood Cliffs,NJ:Prentice Hall
- Moyo. K, (2015): Effects of different material handling systems on material damage. A case study of retail firm in Harare
- Mugenda, O . M & A.G Mugenda (2003) Research methods. Quabtitative and Qualitative approaches : Nairobi African Centre for Technology Studies.
- Nasution O, Lee YM. Kim E, Kim W (2016) Contribution of overexpression to different types of stress.
- Nyabwanga,R.N., and Ojera,P., (2012).Inventory management practices and business performance for small-scale enterprices in Kenya: Journal of business management, Volume 4 (4): 75-81.
- Oino, T.(2013).*Multiple linear regression approach to modeling determinants of profitability of life insurance companies in Kenya*.University of Nairobi.
- Ondiek, G .O. (2009). Assessment of Materials Management in the Kenyan Manufacturing Firms- Explanatory Survey of Manufacturing Firms based in Nairobi. Journal of Social Sciences
- Paul, R. K. (2014). Multicollinearity: Causes , effects and remedies, (May)
- Pszonicki , L.E (1997) The Specifity Characteristics of Analytical Method. Non Specifity Coefficients.
- Roger, D.E., Jager, E and Kula, E., 1997.Analysis and optimization of the Material Handling System. Sweden, Central Lager.
- Rosopa, P.J., & Schroeder, A.N.(2018). *Managing heteroscedasticity in General Linear Models*,(March) <https://doi.org/10.1037/a0032553>
- Rushton, A., Croucher, P., Baker, P (2006). Handbook of Logistics and Distribution Management, 4th edition. The Chattered Institute of Logistics and Transport. Kogan
- Shingo S., 1988.Non Stock Production. The Shingo system for continuous improvement. Cambridge. Productivity Press.
- Shingo, S., 2005. A study of the Toyota production system. Boca Raton, London and New York: CRC Press.
- Sujono, S., and R. S. Lashkari., 2007. A multiobjective model of operation allocation and system selection in a flexible manufacturing system: A sequential modeling approach.

Thomas, H.R.,Sanvido .V.E and Sanders.S.R (1989) impact of material management on productivity: A case study.Journal of Construction Engeneering and Management,115(3). Pp370 -384

APPENDIX 1: QUESTIONNAIRE

Instructions to the participant

You are not required to write your name on the questionnaire.

You are sincerely required to answer all the questions truthfully.

Show our answer by a tick where appropriate

SECTION A: BIOGRAPHIC INFORMATION

Show your answer by a tick where appropriate.

1. Gender

Male [] Female []

2. Level of education

O level []

A level []

Diploma []

Undergraduate []

Post graduate []

Others []

3 Age of the respondent .Indicate by a tick

18 – 35	36 - 45	46 - 50	51 - 54	55 – 60

4. Work experience

0-3 years	4 – 10 years	11 -15 years	15+

5. Department: indicate by a tick

Stores	
Procurement	
Workshops	
Operations	

SECTION B: THE EFFECTS OF DIFFERENT MATERIAL HANDLING SYSTEMS ON MATERIAL HANDLING COSTS

INSTRUCTION: Show how much you agree that the following material handling systems have effect on material handling costs.

6. How much do you agree that the following material handling systems have an effect on material handling costs?

	Strongly Agree	Agree	Disagree	Strongly disagree
Manual				
Mechanical				
Automated				

Please tick where appropriate

7. Which system is used by the organization in material handling?

- (a) Manual material handling
- (b) Mechanical material handling
- (c) Both a and b
- (d)None of the above

8. Are there any material handling equipment used at the organization?

Yes No

If yes, kindly state the material handling equipment

- 1.....
- 2.....
- 3.....
- 4.....

SECTION C: THE RELATIONSHIP BETWEEN EMPLOYEE COMPETENCY AND MATERIAL HANDLING COSTS

Instruction: Respond with a tick on one correct answer

	Strongly Agree	Agree	Disagree	Strongly disagree
9) Does training of employees reduces material handling costs?				
10) Do you think experience plays a greater role in reducing material handling costs?				
11) Do employees get compensated when they get injured during handling materials?				

SECTION D: THE RELATIONSHIP BETWEEN DISTANCE TRAVELLED BY MATERIALS AND MATERIAL HANDLING COSTS

	Strongly Agree	Agree	Disagree	Strongly disagree
12) Is there a follow up when material handling works or services is delayed?				
13) Is the unit load concept applied by the organization?				
14) Do you think number of times moved by materials within a premise affect material handling costs?				

15) What can be done to reduce the number of times material is moved within the premise?

.....

.....

.....

.....

THANK YOU

