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FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING

CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR

ASSESSMENT OF CONSTRUCTION MATERIAL MANAGEMENT SYSTEM ON PUBLIC BUILDING PROJECTS IN THE CASE OF HAWASSA TOWN

A Thesis Submitted to the School of Graduate Studies of Jimma University Institute of Technology, Faculty of Civil and Environmental Engineering in partial fulfillment of the requirement for the degree of Master of Science in Construction Engineering and Management.

By:

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March, 202

DECLARATION

I declare that this research entitled **"Assessment of Construction Material Management System on Public Building Construction Projects in the Case of Hawassa town"** is my original work and has not been submitted as requirement for the award of any degree in Jimma University or elsewhere.

Meaza Messele Taye _____ _____

Candidate Signature Date

As research Adviser, I hereby certify that I have read and evaluated this thesis paper prepared under my guidance, by Meaza Messele Taye entitled **"Assessment of Construction Material Management System on Public Building construction Projects in the Case of Hawassa town"** and recommend and would be accepted as a fulfilling requirement for the Degree Master of Science in Construction Engineering and Management.

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ABSTRACT

Material management can be defined as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material.

In construction project operation, often there is a project cost variance in terms of the material, equipment, manpower, subcontractor and overhead cost.

The aim of this research was to assess the construction material management system in public building projects in the Hawassa town.

This Research has employed descriptive research method and the data for the study were collected using structured questionnaires, interview and observation. The data was analyzed by RII using descriptive statistics in the form of Percent, averages, pie chart, histogram and tabular form.

The researcher concludes that the construction material management system of the contractor personnel have lack of technical professionals, lack of waste control management systems and lack of training system for laborers in construction site.

Even though the construction material management process were practiced, there were ineffective communication, designer's unfamiliarity with products, unclear specification, purchasing non waste efficient materials, improper construction material delivery, damage of materials, improper stocking and insufficient storage of materials, lack of security, poor training system related to wastage and negligence practice of workers.

And the improper implementation of the construction material management process affects the overall budget, accomplishment time, quality and productivity of the construction project.

The researcher recommends that for effective construction material management the contractor personnel should provide specific material department and establish a system to provide appropriate training for workers under the contractor on how to handle the construction materials and the mechanisms for minimization of wastage of materials.

Keywords - Material management, process of material management and waste minimization method

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ABBREVIATIONS

MRP Material Requirement Planning

JIT Just In Time

RII Relative Importance Index

BC Building contractor

GC General Contractor

HCB Hollow Concrete Block

SC Specialized Contractor

No. Number

Ave. Average

CHAPTER ONE

INTRODUCTION

1.1 Background

Material management is the process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material. (Ayegba.C, 2013)

Materials management is an important function for improving productivity in construction projects. The management of materials should be considered at all the phases of the construction process and throughout the construction and production periods. This is because poor materials management can often affect the overall construction time, quality and budget. (N.B, 2008)

Building materials account for 60 to 70 percent of direct cost of a project or a facility, the remaining 30 to 40 percent being the labor cost (Patel K.V, 2011)

According to (Abdu, 2015) In Ethiopia, in building projects the construction materials constitute 57 percent of the total budget allocated for construction work. Since material cost of the project covers large portion of the project cost

Construction materials are important to consider effective materials management in the construction project management process. So in order to achieve successful building projects which fulfill all the parameters (cost, quality and time) it needs to have the appropriate and effective material management system. (Eshetie A. E., 2019)

Materials management involves the logistics of the materials components of a supply chain which involves the process of planning, implementing and controlling of the movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of consumption. The management of materials should be considered from the phases of the construction process and throughout the construction period. Generally, construction materials are bulky, expensive and are supplied in large amounts to construction sites (N.B, 2008).

Materials management is an important element in project management. Materials represent a major expense in construction, poor materials management can result in increased costs during construction. Effective management of materials can result in substantial savings in project costs and it is one of the major factors for any construction project to become successful. (Eshetie A. E., 2019).

1.2 Problem statement

The management of materials should be considered at all the phases of the construction process and throughout the construction and production periods (Kasim N.B, 2005). The result of improper handling and managing materials on site during construction process will influence the total project cost, time and quality. There is a need for efficient materials management in construction projects. (Stephen C. W. K, 2004)

According to (Madhayi. T P, 2013). In construction project operation, often there is a project cost variance in terms of the material, equipment, manpower, subcontractor, overhead cost, and general condition.

In Ethiopia Poor construction material management is one of the debatable issues between the parties which involved in the construction industry (Abdu, 2015). Because of poor construction material management in the construction project has different problems occurred such as cost overrun, delay, and material wastage, dispute between stakeholders, storing and handling material problems etc.

Therefore, the researcher was interested on this research area to assess the practices of material management system and its processes, the causes for poor construction of material management, wastage minimization mechanisms and the impact of construction material management system on the public projects.

1.3 Research questions

1. What are the practices of construction material management processes in Hawassa town?
2. What are the practices of the construction material wastage minimization method?
3. What are the effects of the construction material management system on building projects?

1.4 Objectives of research

1.4.1 General objective

- The main objective of this study is to assess the construction material management system in Hawassa town.

1.4.2 Specific objective

- To identify the practices of construction material management processes in public building projects.
- To determine the construction material wastage minimization method during the construction material process.
- To determine the effect of construction material management system in public building projects.

1.5 Scope of the Research

The research scope was assessing the construction materials management system in public building projects in Hawassa town from side of contractor. The study was only focused on site management system of construction materials, the current practice of management process and the material management impacts on the project from point of contractors view.

1.6 Significance of study

The study is significant for different contractors to be considering carefully the material management system and to use effectively their construction materials by creating awareness and to give direction to sort out the current practice and the gap of the construction material management and its impact on the project.

Additionally, it is significant for different researchers who are working related with construction material management system.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Construction projects are complex, with many organizations involved such as clients or owners, architects, engineers, contractors, suppliers and vendors. This includes the heterogeneous and often complex process of producing unique, large and immovable products with a supply of the many resources which are money, equipment, material, and labor.

Construction projects can be accomplished utilizing management processes. These processes include planning, organizing, executing, monitoring, and controlling. During any construction project the three inter-related factors of time, money, and quality need to be controlled and managed. Successful completion of projects requires all resources to be effectively managed.

The management of materials in construction projects is an important function that significantly contributes to the success of a project. As projects grow in scale and complexity, materials management becomes more difficult, often requiring the use of appropriate tools and techniques to ensure, amongst other things, that materials are delivered on time, stock levels are well managed, the construction schedule is not compromised, and that wastage is minimized. Materials management is especially problematic for large and complex projects, where sophisticated tools and techniques are necessary (Kasim N.B, 2005).

2.2 Construction material management

Material management is a tool to optimize performance in meeting customer service requirements at the same time adding to profitability by minimizing costs and making the best use of available resources. The basic objective of Materials Management as explained by is to ensure that the right item is bought and made available to the manufacturing operations at the right time, at the right place and at the lowest possible cost (Banjoko, 2014).

Material management can be defined as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material. Building materials account for 60 to 70 percent of direct cost of a project or a facility, the remaining 30 to 40 percent being the labour cost (Patel K.V, 2011). Construction material management is clearly important to manage all material processes from the design stage to the construction stage.

Material management is a management system that integrates purchasing, shipping and material control from suppliers. Based on those definitions, generally materials management can be defined as a process of planning, executing, and controlling the right source of materials with the exact quality, at the right time and place suitable for minimum cost of construction process.

Selection of personnel for marketing, purchasing, inventory control, stores management and materials handling and their training and placement is also to be seen by the materials management department. The material management department is very essential to have a materials management department in any organization to support the management in the production activities. (Nayak .R, 2016)

(Kasim N.B, 2005)To improve the effective material management the contractor should make provisions for training and retraining of management and site personnel in order to improve their efficiency for effective material management (Ayegba.C, 2013).

2.3 Objectives of material managements

According to (Pali. S . S, 2016). The objectives of Material Management are to efficient material planning, buying or purchasing, procuring and receiving, storing and inventory control, stock and waste control, supply and distribution of material, quality assurance, good supplier and customer relationship, improved departmental efficiency, reduce the cost of project, time saving and achieve economy in project.

To fulfill all these objectives, it is necessary to establish harmony and good co-ordination between all the employees of material management department and this department should have good co-ordination with the other departments of the organization to serve all production centers. Researchers (Pali. S . S, 2016) Identifies the responsibility of Material management department for the flow of material from the time the material is ordered, received, and stored until they are used is the basic responsibility of material management.

2.4 Construction material management goals

The goal is to ensure that the right quality and quantity of materials and equipment are procured in an effective manner, obtained at a reasonable cost, and available when needed. The implementation of a comprehensive materials management program contributes to more-predictable project outcomes, reduced costs, improved productivity and quality, and a safer working environment.

Also, to ensure that the materials are available at their point of use when needed hence, efficient procurement of material represents a key role in the successful completion of the work. It is important for the contractor to consider that there may be significant difference in the date that the material was requested or date when the purchase order was made, and the time at which the material will be delivered, thus material management is a key of project management.

2.5 Functions of materials management

In order to fulfill the objectives of materials management as stated above to meet the basic objectives and goals, the functions of the materials management are also categorized as primary and secondary functions. (Patel K.V, 2011) States that the functions of materials management are discussed below:

2.5.1 Primary Functions

To meet the primary objectives, the primary functions of the materials management are given as follows:

- Materials Requirements Planning (MRP)
- Purchasing
- Inventory Planning and Control
- Ascertaining and Maintaining the Flow and Supply of materials
- Quality Control of Materials
- Departmental Efficiency

2.5.2 Secondary Functions

- Standardization and Simplification
- Make and Buy Decisions
- Coding and Classification of Materials
- Forecasting and Planning

2.6 Material management processes

According to Patil & Pataskar, 2013. Material management process begins from need generated from site followed by this information conveyed to store department and material is ordered in the store, indent is generated. Usually, vender selection is to be carried out for the least value and best items. Materials are received at store departments and inspection is carried out. Below figure shows the flow chart of material management.

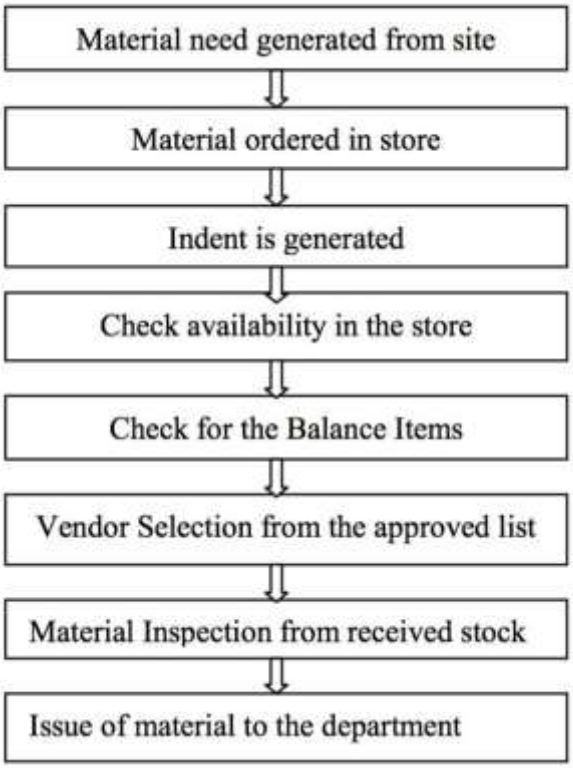

Figure 2 1 Construction Material Management process

Material management process involves planning, procurement, handling, stock and waste control, and logistics surrounding materials on construction projects. A good materials management environment enables proper materials handling on construction sites. In order to better understand materials management are the following processes are discussed: planning, procurement, logistics, handling, stock and waste control (N.B, 2008).

2.6.1 Planning

The materials planning process covers setting up and maintaining the records of each part used in each plant to determine target inventory levels, and delivery frequency. As a result, an excellent management of the materials record will help the flow of materials at the site in order to avoid several problems such as materials out of stock and materials that have not been delivered. Material planning would provide guides to all the subsequent activities and that this could have a great impact on the project plan. The materials planning process covers the set up and maintenance of records and determines the target inventory levels, and delivery frequency (Payne, *et al.,* 1996).

Planning of access and routing of materials within a construction site has an important implication for the development of an effective materials management strategy particularly in terms of increasing productivity and profit, and facilitating the timely completion of construction projects. The requirement for efficient materials planning is, to increase productivity and profit of the company, and facilitate the completion of construction projects. Thus, better planning of raw materials on site can help to eliminate project delays and reduces activity times, resulting in better service (Wong. E. T. T, 1997).

2.6.2 Procurement

Procurement of materials begins with defining the requirements of the project, followed by the selection of suppliers or subcontractors, and ends with the delivery of materials at the destination (Patel K.V, 2011).

(Kasim N.B, 2005) Purchasing materials from the best source, at the right price and with timely delivery are challenges of many construction companies. Therefore, a control strategy is needed during materials procurement to achieve the targeted objectives. All requests for quotations and purchases must be initiated through a properly authorized requisitioning procedure normally controlled by the Project Manager. The Project Manager must ensure that the purchasing of materials follows the standard requirement, time and quality. Waste efficient procurement requires accurate material takeoff and ordering of materials based on accurately prepared design documents (Ajayi, *et al*., 2018)

The objective of procurement in materials management is to provide quality materials at the right time and place, and at an agreed budget. Procurement is about organizing the purchasing of materials and issuing delivery schedules to suppliers and following-up, to make sure that suppliers deliver on time. A failure in the purchasing process or in overseeing and organizing the buying functions as listed by could result in:

- Over-ordering of materials (wastage problems)
- Over-payments for materials (inadequate administration procedures)
- Loss of benefits (lack of skilled negotiating procedures) and
- Lack of knowledge (when and where the best service/source might be available at any particular time).

2.6.3 Logistics

Logistics is a concept that emphasizes movement and it encompasses planning, implementing, and controlling the flow and storage of all goods from raw materials to the finished product to meet customer requirements (Stukhart, 1995). Raw materials for construction are usually varied, bulky and heavy and required proper handling in the supplying process. Consequently, the construction industry requires active movement of materials from the suppliers to the production area in both the factory and the worksite (Pheng L.S, 2001). The primary focus of the logistics concept in construction projects is to improve coordination and communication between project participations during the design and construction phases, particularly in the materials flow control process. They also mentioned that problems arise in the materials flow control process which includes delays of materials supply, due to some materials purchased just before they are required and waste of materials during storage, handling and transporting when procured in large quantities without complying with the production needs on site. The previous research suggested that, the routing of materials is one of the main causes which affect cost and time during construction projects (Varghese and O'Connor, 1995). Hence, the factors that should be taken into consideration during the logistics process for effective materials management include:

- Optimum forecasting of materials movement and
- Planning of access and routing of material within a construction site

2.6.4 Handling

According to (Tompkins, 1984.) The effective material handling as using the right method in providing the right amount of the right material, at the right place, time, sequence, position, condition, and cost. This involves handling, storing, and controlling of the construction materials. Therefore, materials handling provides movement to ensure that materials are located and that a systematic approach is required in designing the system. Handling of materials is the flow component that provides for their movement and placement. The importance of appropriate handling of materials is highlighted by the fact that they are expensive and engage critical decisions. Due to the frequency of handling materials, there are quality considerations when designing a material handling system. The selection of the material handling equipment is an important function as it can enhance the production process, provide effective utilization of manpower, increase production and improve system flexibility (Chan. Z . L, 2002).

Handling with safety during movement of materials at site, which reduce the percentage of materials wastage and finally foster significant improvement can often the total system productivity (N.B, 2008)

2.6.5 Stock and Waste Control

Stock control can categorize as a technique planned to be the cover and to ensure all materials or equipment are available when needed. Stock control include raw materials, processed materials, assembly components, consumable stores, general stores, maintenance materials and spares, work in progress and finished products. It is very important as the construction materials were delivery as requested and with the progression by the proper management of stock control. At the same time, construction activities will generate big amount of the waste and it will cause difficulty to the construction industry. However, with the planning of the material management which is effective will help to reduce the waste of material and increase the profit of the companies. (Ekanayake, *et al.,* 2000) findings showed that inadequate stacking and insufficient storage on-site leads the material to wastage. The researcher (P.V, 2015) confirms that the improper material schedule for materials deterioration during storage or get stolen and delays and extra expenses may be incurred.

According to Shen (2002) defined building material wastages as the difference between the value of materials delivered and accepted on site. Moreover, material waste has been recognized as a major problem in the construction industry and it can also implicate inefficiency in project delivery. Adopting a proper stock control will help to increase the productivity and also can be one of the ways to improve waste control in the construction site. By introducing minimizing strategies to reuse materials in both design and construction phase can be a mean to reduce waste (Brooke, 2004).

2.7 Factors related with construction material management

According to (M. Zakeri., 1996) suggested that factors such as waste, transport difficulties, improper handling on site, misuse of the specifications, lack of proper work plan, inappropriate material delivery and excessive paperwork all adversely effect on material management.

Phu and Cho, (2014) suggest the Factors related with material management in construction projects as follows.

1. Planning and Scheduling
2. Monitoring and Controlling
3. Organization and Personnel
4. Procurement
5. Delivery
6. Storage and Storage facilities
7. Usage
8. Surplus and Waste control

A. Planning and Scheduling

Planning is a fundamental, important process for every project. Material planning, which is a key function of material management, is closely linked with project planning and control set-up. Scheduling the entire material program is essential to meeting the project timetable. Indeed, planning and scheduling are significant in terms of increasing productivity, profit and facilitating the timely completion of construction projects.

B. Monitoring and Controlling

Monitoring and Controlling of all construction activities in material management are conducted to ensure the right source of materials with the exact quality, at the right time and place suitable for minimum cost construction process. It is a process in which facilities, personnel, resources and capital are monitored and controlled to a significant impact on the operations of construction projects.

C. Organization and Personnel

Material management structure is organized in such a way that it allows for integral planning and coordination of the flow of materials, in order to use the resources in an optimal way and to minimize costs. The organization must be structured to provide for the timely performance of the work, with material personnel located at appropriate level of project management and influence the decision-making process.

D. Procurement

Preliminary investigations for developing sources for procurement of materials are made by floating enquiry indents. It is processed by the material procurement responsible personnel for inviting quotations with samples of materials where applicable.

E. Delivery

Delivery in terms of organizing the movement of vehicles, people and materials ensures the efficient use of workforce and production or process in construction projects. The routing of materials is one of the main causes which affect cost and time during construction.

F. Storage and Storage facilities

Material storage can be defined as the provision of adequate space, protection and control of building materials and components held on site during the construction process. A good and systematic storage of materials provides better management of materials in construction.

G. Usage

Usage of materials is the flow component that provides for their movement and placement. Material usage can be defined as the provision of proper handling techniques either manually or mechanically for the components held on site during construction process.

H. Surplus and Waste Control

All projects can expect a certain amount of surplus and waste of materials after construction. Surplus and waste materials arise at any stage of construction process from inception, right through design, construction and operation of the building facility. Hence, control of surplus and waste materials is important to successful material management.

2.8 Material management problems

Different researchers have conducted studies to find out the problems of material management in constructions projects. Among the studies the some of them are followings.

(M. Zakeri., 1996) suggested that transport difficulties, waste, improper handling on site, misuse of specification, lack of proper work plan, inappropriate materials delivery and excessive paperwork all have an immense effect on materials management.

According to (N.B, 2008)The major problems that were discovered are material management activities related to constraints site storage, site logistics with regards to material handling and distribution and also ordering and delivery of materials to the construction site. The identified problems for material management system are; Late delivery, Site storage problems, logistics problems, incorrect delivery, inadequate loading area, site access problem, regulation consideration, congestion time, incomplete delivery, constraints storage compound, material damages, lack of materials, improper handling, tower crane distribution problem, supply chain challenge, project size challenge, and project location challenge.

According to Sohrab Donyavi, (2009) the common problems in material management are as follows:

- Failure to order on time which may cause delay in the projects;
- Delivery at the wrong time which may interrupt the work schedule;
- Over ordering;
- Wrong materials or wrong in direction of materials requiring re-work;
- Theft of materials from delivery into production;
- Double handling of materials because of inadequate material

Researcher Dey, (2001) states that the common problems of material management are as follows:

- Receiving materials before they are required which may increase inventory cost and may increase the chance of deterioration in quality;
- Not receiving materials during the time of requirement causing to decrease motivation as well as productivity
- Incorrect materials take-off from design and drawing documents;
- Constant design changes
- Theft or loss of item
- Choice of type of contract for specific material procurement
- Vendor evaluation criteria
- Piling up of inventory and controlling of the same
- Management of surplus material.

2.9 Advantage of construction material management

There are so many advantages for a company of an effective construction material management with in the projects.

According to Maharashtra, *et al., (2017)* the advantage of construction material managements are stated as follows.

- Systematic operations
- Reduction in cost of material handling
- Reduction in overall cost of the project
- Increase in productivity of the labors
- Time management

- Quality control
- Better relations with suppliers
- Better relations with customers
- Reduces seasonal problems arising with materials

2.10 Material storage and storage facilities

Material storage can be defined as the provision of adequate space, protection and control of building materials and components held on site during the construction process.

(Patel K.V, 2011) States the types of physical storage system on site vary according to the space availability and company practices. Industrial guidelines are also taken into consideration for the storage of particular materials. Materials are most often classified as per the comfort level of working of the workers. Basic categories followed are civil, electrical, plumbing, finishes, construction chemicals, miscellaneous. The materials are also often stacked as per the specification of the vendor or manufacturer.

According to Liwan S.R., (2015) there are four categories workflow of material storage management namely planning and arrangement, implementation and handling, control and monitoring and supervision. Planning matters involving the determination of material requirements for carrying out production and other related work processes such as determining the types of materials to be used in construction works, quantities, and specifications to carry out construction work.

Material managers should play a role in determining storage locations, layouts and all necessary equipment including coding and cataloging, material acceptance, material inspection, building materials storage safety, material production, cost data preparation, stock records and disposing of bad building materials or cannot be used (Brutus. I, 2015).

According to (J.E, 1981)improper storage and handling of materials on building projects, which could result to waste can be caused by inadequate supervision and careless attitudes, together with misplaced incentives.

2.11 Construction Material Waste management

Construction material wastes refer to materials from construction sites that are unusable for the purpose of construction and have to be discarded for whatever reason. Construction material waste is defined as any material apart from earth materials, which needs to be transported

elsewhere from the construction site or used on the site itself other than the intended specific purpose of the project due to damage, excess or non-use or which cannot be used due to non-compliance with the specifications, or which is a by-product of the construction process (K. Aygerum, 2012)

According to Shen (2002)the wastages of building materials can be divided into two types. One is direct waste and the other is an indirect waste. Direct waste is the loss of those materials, which were damaged and could not be repaired and subsequently used, or which were lost during the building process; indirect waste was distinguished from direct waste because it normally represented only a financial loss and the materials were not lost physically. Such losses are principally from the substitution of materials, from the use of materials in excess of quantities allowable under the contract and form errors. The failure to recognize and record waste from these causes makes accounting for materials meaningless. Therefore, a simple measure of waste on-site would be the difference between that used as specified and the quantity of material delivered to the site as a percentage of such deliveries.

Material wastage has become a serious problem, which needs urgent attention in the construction industry and it has affects the delivery of many projects reduces the productivity, efficiency, worth, and profitability of construction activities (O. T. Adewuyi, 2014). Additionally, Construction waste can have a significant impact on cost, time, quality and sustainability, and also on the success of projects (Nagapan, Abdul-Rahaman, & A., 2012)

2.11.1 Causes of construction material wastage

According to (Ekanayake. L. L, 2000). The causes of construction material wastages are categorized into four such as at design, procurement, handing of materials and operational stage of construction materials.

Most causes of materials wastage occur during construction phase of building projects. Project executing or construction stage is the critical phase which comprises lots of activities and it needs high level materials management. However, in all phases the wastage of construction materials should be considered. (Eshetie A. E., 2019)

i. During planning stage

Ekanayake, et.al. (2009) found the main causes that related to design are Lack of attention paid to dimensional coordination of products, Changes made to the design while construction is in progress, Lack of attention paid to detail in the drawings, Lack of information in the drawings, Errors in contract documents, incomplete contract documents at commencement of the project, Selection of low-quality products.

ii. During procurement stage

Materials wastage can also occur during procurement phase of a project. Lack of trade's skill with, ordering errors (e.g., ordering significantly more or less, and lack of possibilities to order small quantities are the major causes of construction materials wastage during procurement.

Unfriendly attitudes of project team and labourers, inappropriate storage leading to damage or deterioration, and damage of materials due to deficient stockpiling and handling of materials, are the major causes of construction materials wastage during materials handling. (Eshetie A. E., 2019).

iii. During storage stage

Storage is sometimes not properly prepared and dangerous it causes waste of material.(Lu, et.al., 2011) suggested that Poor Materials Storage Material that exposes to wet conditions and unsuitable places can lead to injury material deteriorate. This may raise the proportion of loss between the actual material and waste as a result of the injury material. Other waste preventive measures identified in the literature include the Just-in-Time (JIT) mode of materials delivery, reduction in materials packaging (Dainty, et.al., 2004)

iv. During handling stage

According to Ayegba.C, (2013) the causes of material wastage on building construction sites are damage by mishandling and re-work due to poor workmanship, inadequate storage facilities on site, delay in material supply, inadequate supervision, poor site security, weather and other natural occurrence, alteration of de signs, over ordering of construction materials, theft and vandalism. The building industry uses a considerable amount of resources most of which are wasted because of poor material control on building sites. (Formoso, 2002)

The major causes of construction material wastage during construction are workers' mistakes, lack of onsite material control, and poor coordination among project participants. The major causes of wastage frequently occur more during construction phase of a project. (Eshetie A. E., 2019)

v. During operational stage

According to H. Lingard, et.al. (2000) the dominant causes of waste generation in the Construction industry is late information, incomplete design, inadequate information, Poor control of materials on site. Other cause that leads to material wastages described by (Dania, et.al., 2007) in there study Unnecessary movement of people, Untrained labor, Incomplete work, Poor technology of equipment, Changes to design, Damages during transport is the most leading factors. (Ekanayake, et.al., 2000) the other causes of construction waste in the construction industry sites are Errors by trades persons or laborers, ineffective control of the project progress, Accidents due to negligence, Damage to work done caused by subsequent trades, Use of incorrect material, thus requiring replacement, Required quantity unclear due to improper planning, cutting of uneconomical shape, Delays in the passing of information to the contractor on types and sizes of products to be used, Use of whatever material which are close to working place, Unfriendly attitudes of the project team and laborers, Theft, Lack of possibilities to order small quantities (Tam, 2008).

2.12 Construction materials wastage minimization strategies

Construction material waste can be reduced by using waste management practice on construction project. The construction project activities are to be planned at every stage by every construction personnel, who are involved, in minimizing and mitigating the overall waste generation at project. (P. K. G., 2014).

Reduction and minimization of waste can be done by practicing attitude towards Zero wastage, proper decisions at design stage, procurement, construction site management, and proper standardization of construction materials and Codification of the same. (Harikumar, *et,al.,2014.)*

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study area

This research was conducted in Hawassa town which is located in southern part of Ethiopia at distance of about 278 km from the capital town of Ethiopia.

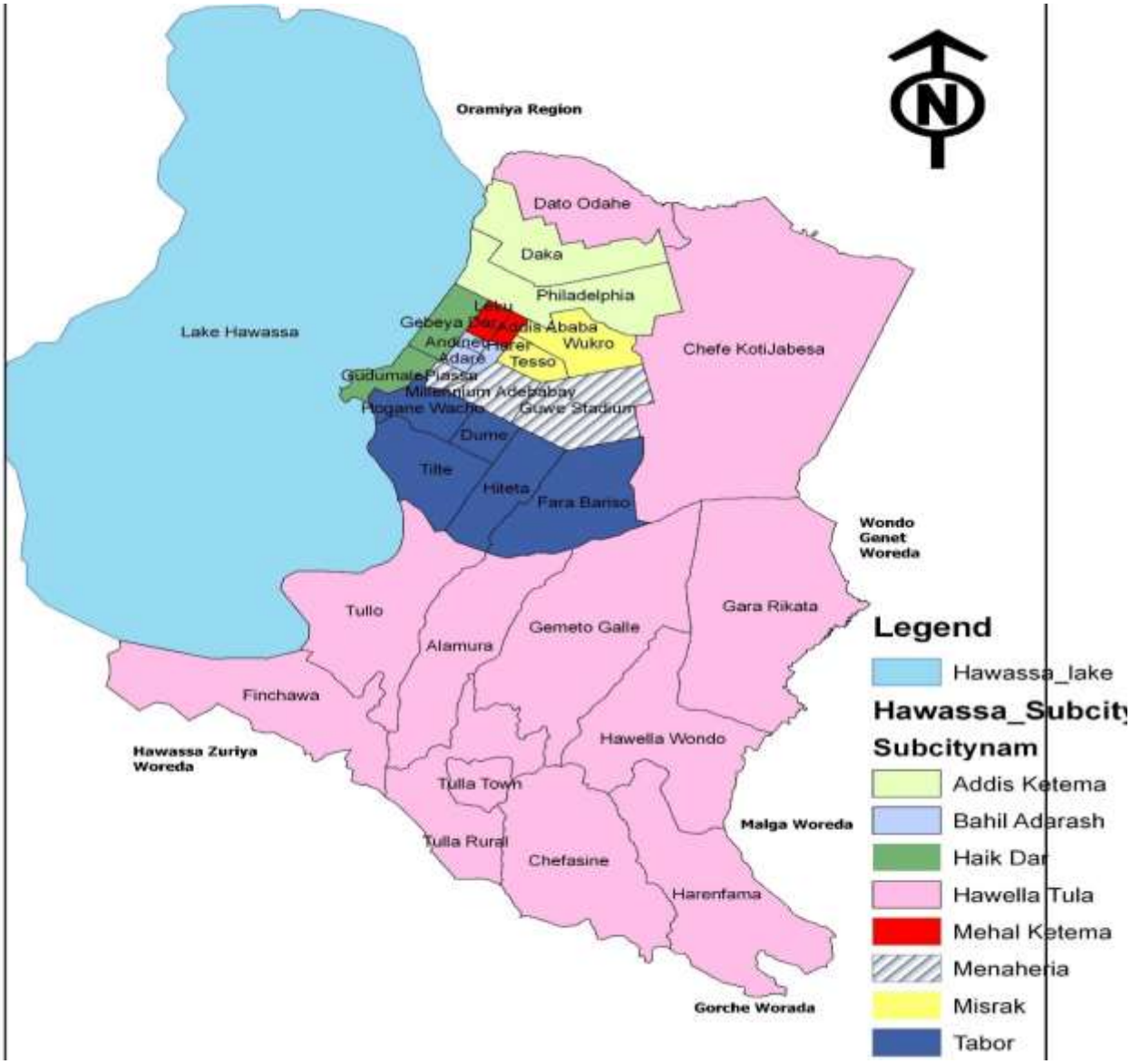

Figure 3 1 Map of Hawassa town

3.2 Research design

For this study the descriptive survey method was adopted. The descriptive research design method is useful in non-experimental study that to seek to describe reality and significant in gathering information from target population of study. The data collected qualitatively often possibly analysed quantitatively using percentages, averages, or other statistical analyses to determine relationships of phenomenon with this type of research design

3.3 Research structures

The research titled with "*Assessment of construction material management system on public building construction projects".* The research has problem statement which states the magnitude of the problem and research questions. The literature review describes and explains different secondary evidences on construction material management system. Research data was collected from primary and secondary sources through structured questionnaires. Moreover, research has employed descriptive research method which is flexible in nature and to describe reality and significant in gathering information from targeted population of study. And then based on collected data analysis and discussion was made by using relative importance index, frequency, percentage and rank. Finally, conclusion and recommendation have made for actions to taken by concerned bodies. The following *figure 3.2.* Shows the schematic representation of the research structure.

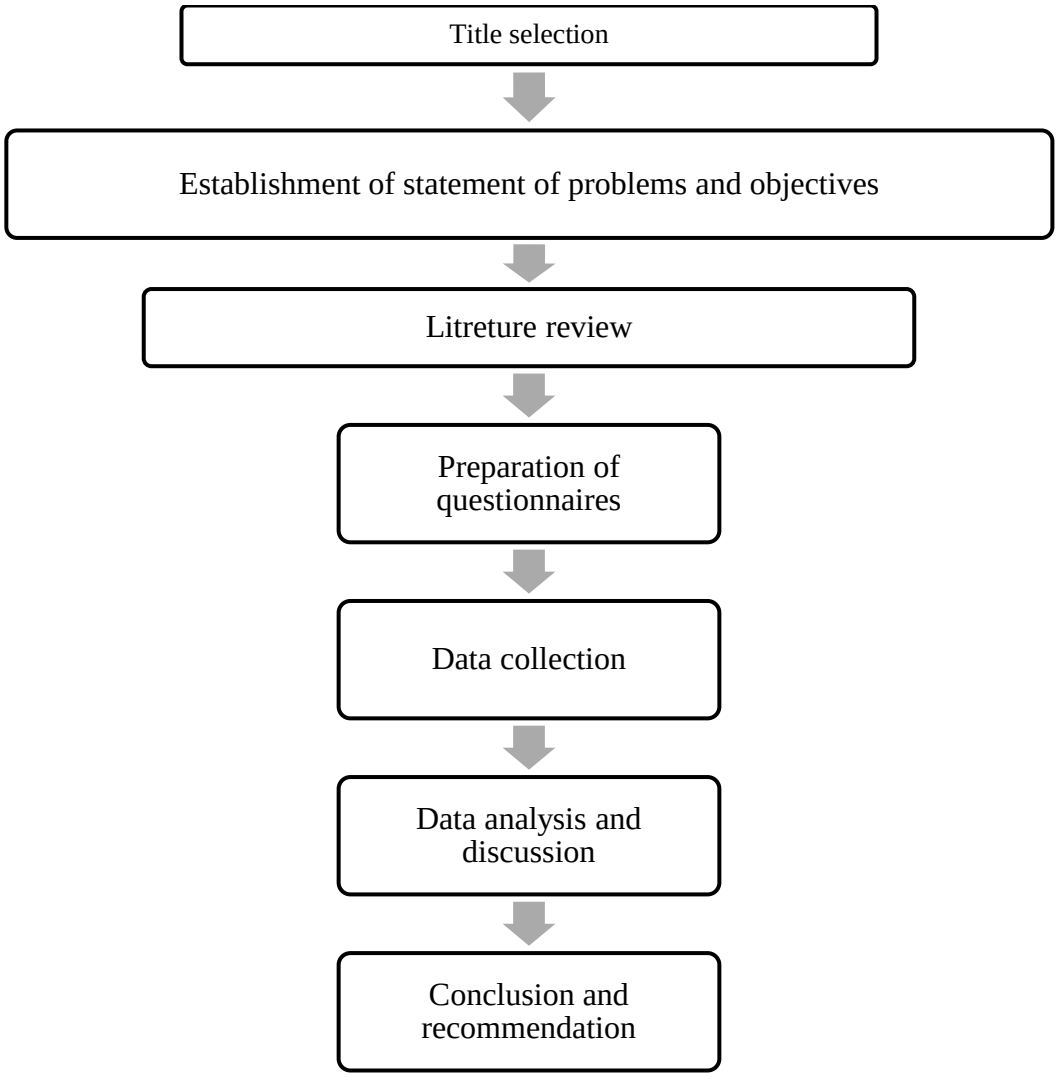

Figure 3 2 Schematic representation of the research structure

3.4 Study variable

- **Dependent variable**
  - ✓ Construction Material management system
- **Independent variable**
  - ✓ Process of construction materials
  - ✓ Waste minimization
  - ✓ Effects of material management

3.5 Target population of the study

The population of the study was contractors involved in public building projects in Hawassa town. According to Hawassa construction bureau data, there are 17 public projects under construction. However, 14 out of 17 public projects are active when a researcher has been collecting data for the purpose of this study. Therefore 14 contractors were participated in this study.

3.6 Sample size and sampling techniques

The samples of this study were selected by using non probability sampling technique which is the purposive sampling method. The samples are general and building contractors involved in public building construction projects. For each contractor averagely 5 questionnaires were distributed for site worker, Project Manager, Site Engineer and Office Engineer. Totally 70 questionnaires were distributed for 14 construction sites. The following figure has shown the sample size of the research.

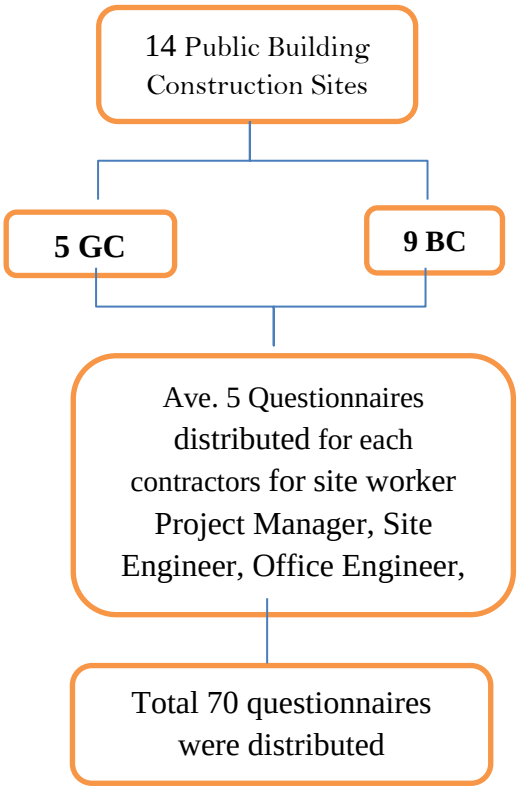

Figure 3 3 Sample size of the study

3.7 Sources of data

This research were used both primary and secondary data. The primary sources of data are more credible as evidence and provide raw information. The primary sources of data were conducted through the structured questionnaires, observation of the site and interview. The primary sources of this study were project manager, site engineer, office engineer, store keeper and Forman.

The secondary data sources were used in this research are: academic journals, related books, articles of different authors and information from different web site which are related and relevant to the study.

3.8 Data collection procedure

The questionnaire was prepared to have open-ended and close-ended questions. The questions were prepared based on the research questions. Then the questionnaire was distributed for respondents and then collected. The interviews were conducted by asking the respondents. A field observation through site visits was used to collect all the relevant data used to answer the research questions.

i. The structure of questionnaire

The questionnaires consisted both open and closed ended questions providing both qualitative and quantitative data. The questionnaires have four parts. The first part of the questionnaires involves the general information of studied companies and respondents. The second part of the questionnaires involves the general questions about the construction material management system of the companies. The third part of questionnaires involves the current practices of the construction material management the company, the practice of construction material management processes and waste management system of construction materials. The fourth and the last part of questionnaires involves construction material management effects on the building projects.

As per the data collection methods, structured questionnaires were prepared based on the research questions and objectives then it was distributed to the sampled population by researcher for the selected companies.

ii. Site observation

The site observation is also another way of data collection too which is this used in these studies. On-site observation is the process of recognizing and noting people, objects and gets the information. The main objective of site observation is to visualize the real work system.

iii. Interview

The interview is conduced to clarify the ambiguities if any when respondents filed questionnaires and to investigate the issue in depth and to discover individuals thinking and feeling and also interviews were conducted with one of each respondent on the studied construction sites.

3.9 Validity and reliability

Validity of the research instrument has been checked to measure the extent to which research instrument should represent the variables they are intended to measure. To construct validity, literature review were conducted and thoroughly examined to make sure that the content of measuring instrument is relevant to study variables.

Questionnaires were reviewed by advisors. Advisors were requested to identify the internal validity and to what extent it is suitable to be used as an instrument to realize the research objective. They ensure that the items covered all relevant issues under investigation. A pilot study was conducted with a few respondents at two separate times to check reliability of the instrument. Then the questionnaire is finalized and distributed to the respondents.

To test the internal consistency of the questionnaire result, "Cronbach's alpha" was used

Cronbach's alpha calculation

$$\boldsymbol{\alpha = \left(\frac{k}{k-1}\right) \times \left(1 - \left(\frac{\sum si^2}{st^2}\right)\right)} \text{.....Equation 3.3}$$

Where: - α = alpha

k = number of items (questions/statement)

si = variance of i^{th} item

st = variance of sum of score

From the Cronbach's alpha calculation, the average result for each part of questionnaires was 0.99. According to George & Mallery (2003) Cronbach's alpha value which is greater than 0.7. Therefore, based on the test, the result was excellent. .

Table 3. 1 Cronbach's alpha test

A	Range	A	Consistency
0.9	$0.9 \leq C\alpha \leq 1$	1	Excellent
0.8	$0.8 \leq C\alpha \leq 0.9$	0.9	Good
0.7	$0.7 \leq C\ \alpha \leq\ 0.8$	0.8	Acceptable
0.6	$0.6 \leq C\alpha \leq 0.7$	0.7	Questionable
0.5	$0.5 \leq C\alpha \leq 0.6$	0.6	Poor
0.4	$0.4 \leq C\alpha \leq 0.5$	0.5	Un Acceptable

3.10 Data presentation and analysis

The data collected through pre-tested structured questionnaire were categorized and analyzed. The data were tabulated, analyzed and interpreted using Excel sheet. The five-point scale was converted to a Relative Importance Index (RII) for each individual factor using the following formula (Ibrahim and Nabil, 2013).

The data received in the second questionnaire were analyzed by Relative Importance Index (RII) method.

Relative importance index (RII) = ΣW ÷ (H * N)

Where W is the total weight given to each factor by the respondents, which ranges from 1 to 5 and is calculated by an addition of the various weightings given to a factor by the entire respondent, H is the highest ranking available (i.e., 5 in this case) and N is the total number of respondents that have answered the question.

The computation of the Relative Index using this formula were yield the value of RI ranging from 0.2 to 1.0. The values 0.2 represent the lowest strength and the value 1.0 representing the maximum strength

3.11 Ethical considerations

The data collection processes were conducted after getting the approval and permission letter from Jimma University. All respondents were treated polite and respect and avoiding misunderstanding of respondents and they were informed of the purpose of the study. Each

respondent was politely requested to fill the questionnaires and assured of confidentiality with regard to any information they gave. The data, results, methods and procedures were truthfully reported in this study.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Response rate

The designed questionnaire was distributed for selected contractors who are involved in public building construction project in Hawassa town. For 14 companies 70 questionnaires were distributed. Out of 70 questionnaires distributed, 54 were returned. All the returned questionnaires were used for the study. 54 or 77.1% represent a reliable response rate and adequate for the analysis. The other 16 or 22.9% of questionnaires were not returned. The following figure shows the response rate.

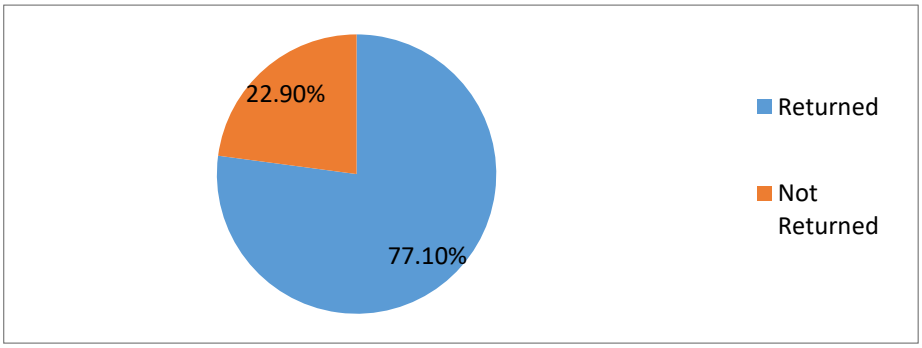

Figure 4. 1 Response rate by Percentage

4.2 General information about company and respondents

This section discusses the category of the respondent's, establishment year of the respondents and the work experience of the company.

4.2.1 Company description

In this study, grade one general and building construction contracting companies were involved by filling the questionnaire, ready for interview and providing their site for observation. The percentage of respondents with in a company level is 35.71% from general contractors and 64.29% of building contractors. The following chart shows the analysis result of the rate of respondent.

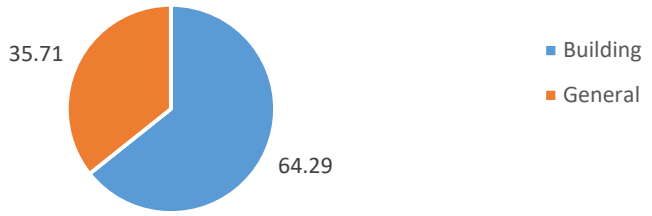

Figure 4. 2 Company description by Percentage

4.2.2 Establishment of the company and Work experience

Companies with wide-ranging categories of work experience and year of establishment ranging from 1-15 and ≤ 5 - 20 respectively. Work experience of a companies varied due to that some companies have both public and none public project experience. In this paper a researcher included companies experience solely focused on public projects. The *table 4.1* shows the summarized establishment and work experiences of the company.

Table 4. 1 Work experience and establishment of the company

Year	Work experience of the company		Establishment of the company	
	No. of respondents	Percentage	No. of respondents	Percentage
<5 years	6	42.86	1	7.14%
6-10 years	5	35.71	2	14.29%
11-15 years	1	7.14	3	21.43%
16-20 years	2	14.29	5	35.71%
>20 years			3	21.43%
Total	14	100.00%	14	100.00%

4.2.3 Work experience of the respondents

Respondents with wide-ranging categories of work experience were ranging from 1-10 years. Work experience of a respondents varied due to that some respondents have both public and none public project experience. The *table 4.1* shows the summarized work experiences of the respondents.

Table 4. 2 Work experience of respondents

Work Experience	No. of respondents	Percentage
<5 years	29	53.70%
5-10 years	14	25.93%
>1o years	11	20.37%
Total	**54**	100.00%

4.3 Construction material management

I. The current performance of the construction material management in public projects

According to the collected data the current practices of construction material management in public projects is fair which shows 35.19%.

Table 4. 3 Current performance of construction material management

Tools	No. of respondents	Percentage
Excellent	8	14.81%
Very good	9	16.67%
Good	12	22.22%
Fair	19	35.19%
Poor	6	11.11%

II. Specific department for construction material management

According to the survey data 53.7 % of the companies were involved in this study have their own specific department for construction material management and 46.3% of the companies have not specific department for construction material management. Forman, site engineer, office engineer, and store keeper are responsible for construction material management for those 46.3% of the companies.

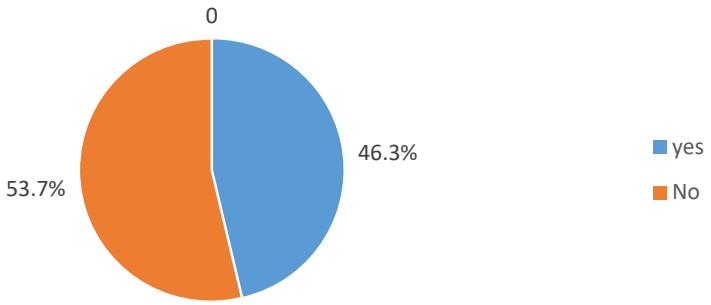

Figure 4. 3 Specific departments by percentage

iii. Storage of construction materials

All the construction companies involved in this study have an appropriate storage for the construction materials.

Table 4. 4 Availability of storage of materials

	No. of respondents	**Percentage**
Yes	54	100%
No	0	0%

iv. Problems of delivery of material

The survey data result indicated in *table 4.4* shows 44.44% of the respondents have problems for delivery of materials and 55.56%of respondents have not problems for delivering of materials. The problems for delivering of materials are 23.33% have unplanned delivery date of the construction materials, 36.67% have improper construction material delivery and 40 % have damage of construction materials as shown in *figure 4.4.*

Table 4. 5 Problems of delivery of materials

Tools	No. of respondents	Percentage
Yes	24	44.44%
No	30	55.56%

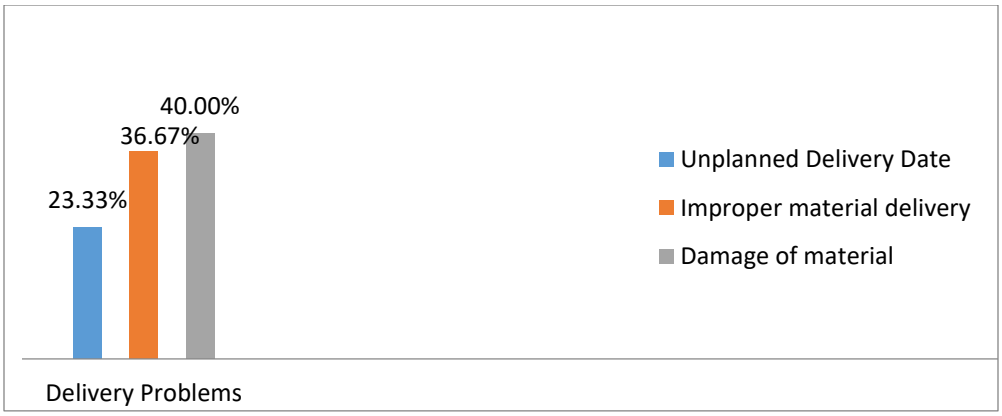

Figure 4. 4 Problems of delivery of materials

4.4 System of construction material management

The *table 4.5* gives the response to the list of the system of construction material management. According to the data the effective control of the progress of the construction material is very good practiced, follow professional practice of material management, effective planning and scheduling of the construction material and proper distribution of labors are good in practice and they are ranked 1st, 2nd and 3rd respectively.

According figure 4.5, availability of technical professionals within the contractor has 0.41 RII. This implies that there is very high shortage of technical professionals within the contractor. As a result of this, a researcher identified that shortages of professionals within the contractors have strongly affects the effective material management system. According to the above result the provision of the technical professionals inside the contractors is the main problems and the proper waste control management systems and adequate training system for laborers are problems for the construction of material management.

Proper waste control management system has a value of 0.51 RII. This implies that there is an ineffective waste control system in the project which also affects the effective material management system.

According to the finding, training system in place for laborers have a value of 0.54 RII, which implies that there is an insufficient training system for laborers to improve efficient and effective utilization of construction materials. Therefore, insufficient training provided for laborers and limited training system in place have strongly affects the effective construction material management system, particularly public projects in a Hawassa town.

Table 4. 6 System of construction material management

No	Construction material management system	RII	Rank
1	Effective control of the progress of construction materials	0.73	1
2	Follow professionals' practice of material management	0.66	2
3	Effective planning and scheduling of the construction material	0.64	3
4	Proper distribution of labours	0.63	4
5	Proper provision of information to project participants	0.61	5
6	Availability of clear policies related to material management	0.61	5
7	Adequate of training system for labourer	0.54	7
8	Proper waste control management system	0.51	8
9	Provision of technical professionals inside the contractor	0.41	9

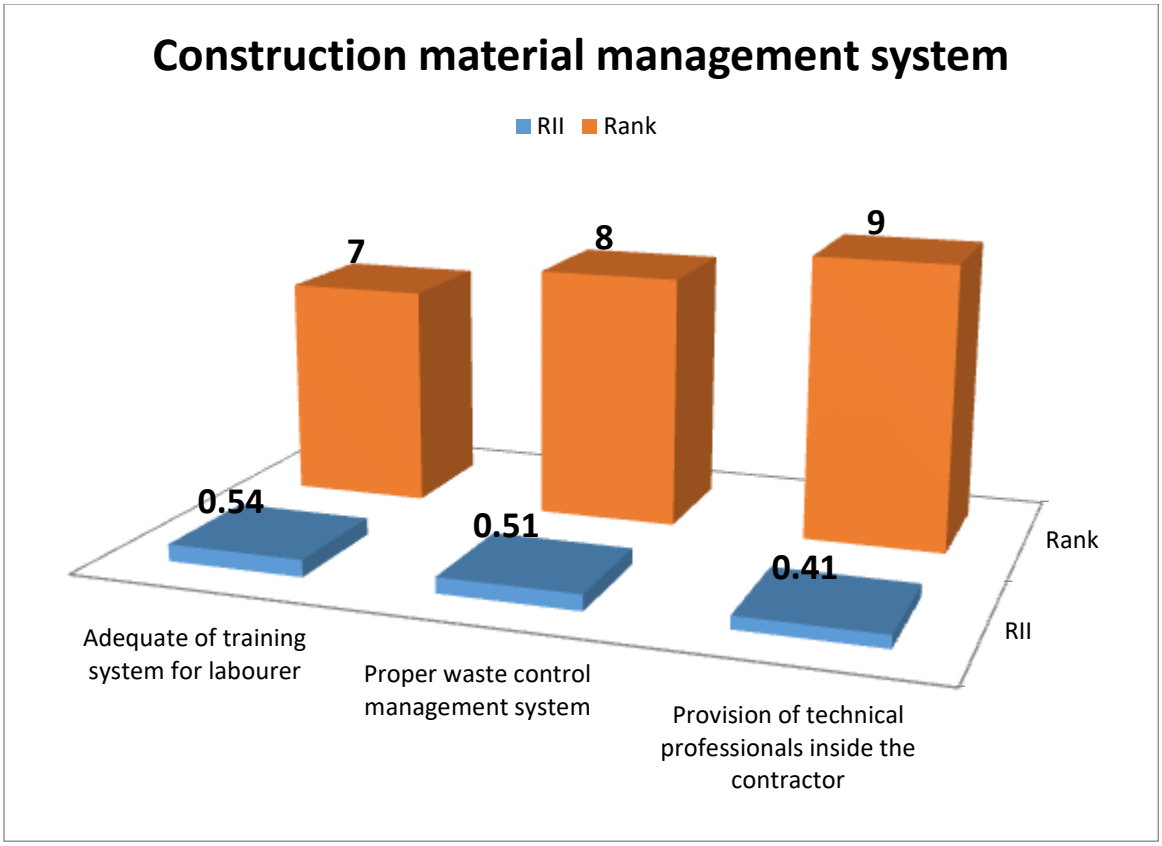

Figure 4 5 Construction material management system

4.5 The practices of material management processes or functions

4.5.1 Planning

The *figure 4.6* gives the response to the list of the practices of planning of construction material. From the result the relative importance index for all the list practices of planning of construction material management were greater than 0.5 which indicates that all respondents are in good manner in the practice of planning of construction material.

According to the result listed below similarity of material plans and specification, determining what and when materials are needed and selection of quality products having higher relative importance index 0.75 and they ranked 1st. this implies that similarity of material plans and specification, determining what and when materials are needed and selection of quality products are extremely practiced at planning phase.

Designer's familiarity with alternative products is ranked last which have 0.53 RII. This indicates that the designers were not familiar with alternative products in the market and it also results in a poor construction material management.

The effective communication ranked 8th having 0.54 RII. This indicates that there is a weak communication at the planning stage. The effective communication is needed throughout the project life cycle for the effective accomplishment of the project and construction materials management.

Clear specification has the value of 0.55 RII, which implies that there is an unclear specification within the public projects. This also results in an ineffective construction material management. At the planning phase, each and every material should be clearly specified to avoid ambiguity. Unless it results in an extra time to correct the specification of materials and improper material delivery. Therefore, unclear specification is the cause for poor construction material management and negatively affects the project as a whole.

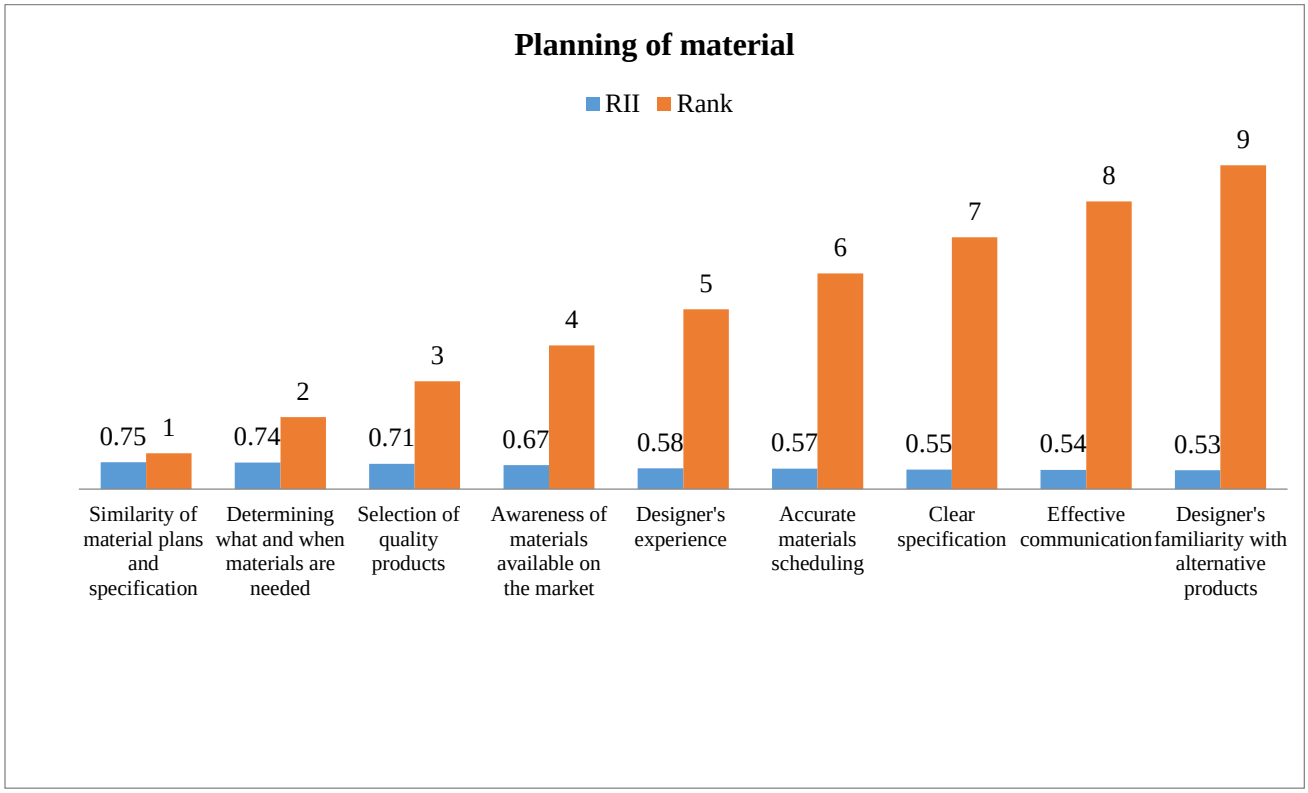

Figure 4. 6 Planning of material

4.5.2 Procurement

The following table 4.7 gives the response to the list about the procurement of construction material.

Purchasing quality and suitable materials having 0.67 result is higher relative importance index and which is ranked 1st. This implies that purchasing quality and suitable materials and they purchase materials with the specification.

Purchasing of waste efficient materials has 0.48 RII. This implies that there is lack of purchasing of waste efficient materials which can result the material wastage. For proper management of construction materials by considering procurement of waste efficient materials this means by preventing over ordering of materials and ordering the materials based on the accurate specification unless lack of purchasing waste efficient materials leads to construction material wastage.

Proper schedule to procurement of the materials have 0.56. This implies there is improper schedule to the procurement of materials within the company which means early or late procurement of materials this causes for the materials wastage and it's also the result of poor material management.

Table 4. 7 Procurement of materials

	Related with procurement	**RII**	**Rank**
1	Purchasing quality and suitable materials	0.67	1
2	Correct material purchase as per the plan	0.57	2
3	Proper schedule to procurement of the materials	0.56	3
4	Purchase reusable and durable materials	0.56	3
5	Purchasing of waste efficient materials	0.48	5

4.5.3 Delivery system of materials

According table 4.5 the proper site access for delivery vehicle having higher relative importance index 0.73 and which is ranked 1st. This implies the proper site access for delivery vehicle properly adequate for the delivery of construction materials to the site.

Proper planning for good delivery system onsite, follow JIT (Just-In-Time) delivery system and adequate and efficient delivery schedule having 0.69 RII and which having ranked 2nd. This implies proper planning for good delivery system onsite, follow JIT (Just-In-Time) delivery system and adequate and efficient delivery schedule are much practiced.

Proper construction material deliveries have 0.42 RII. This implies that improper construction material delivery is the main problem in construction site. The construction materials are damaged when they are improperly delivering to the site and the construction materials should delivered at the right time and right quantity. Unless it leads the project to delay and affects the effective material management

Lacks of knowledge (when and where the best service/source might be available at any particular time) have 0.49 RII. This is also related to the technical professionals, as I have mentioned above the respondents were lack of technical professionals with in the company. Therefore, this is the causes for lack of knowledge when and where the services available.

Damage of construction material has 0.53 RII. This implies that there is wastage of materials on the company due to damage of construction material on the site. It affects the overall cost of project. The site observation is strongly agreed with damage of construction materials on the site materials

Over-ordering of materials has 0.54 RII. This implies that there is over-ordering of materials applied in the construction projects. This is also cause for wastage of materials and it affects the cost of projects.

Table 4. 8 Delivery of materials

No.	**Delivery system of materials**	**RII**	**Rank**
1	Proper site access for delivery vehicle	0.73	1
2	Proper planning for good delivery system onsite	0.69	2
3	Follow JIT(Just-In-Time) delivery system	0.67	3
4	Adequate and efficient delivery schedule	0.66	4
5	Sufficient protection of materials during loading/unloading	0.64	5
6	Over-ordering of materials	0.55	6
7	Planned delivery date	0.54	7
8	Damage construction material	0.53	8
9	Lack of knowledge (when and where the best service/source might be available at any particular time).	0.49	9
10	Proper construction material delivery	0.42	10

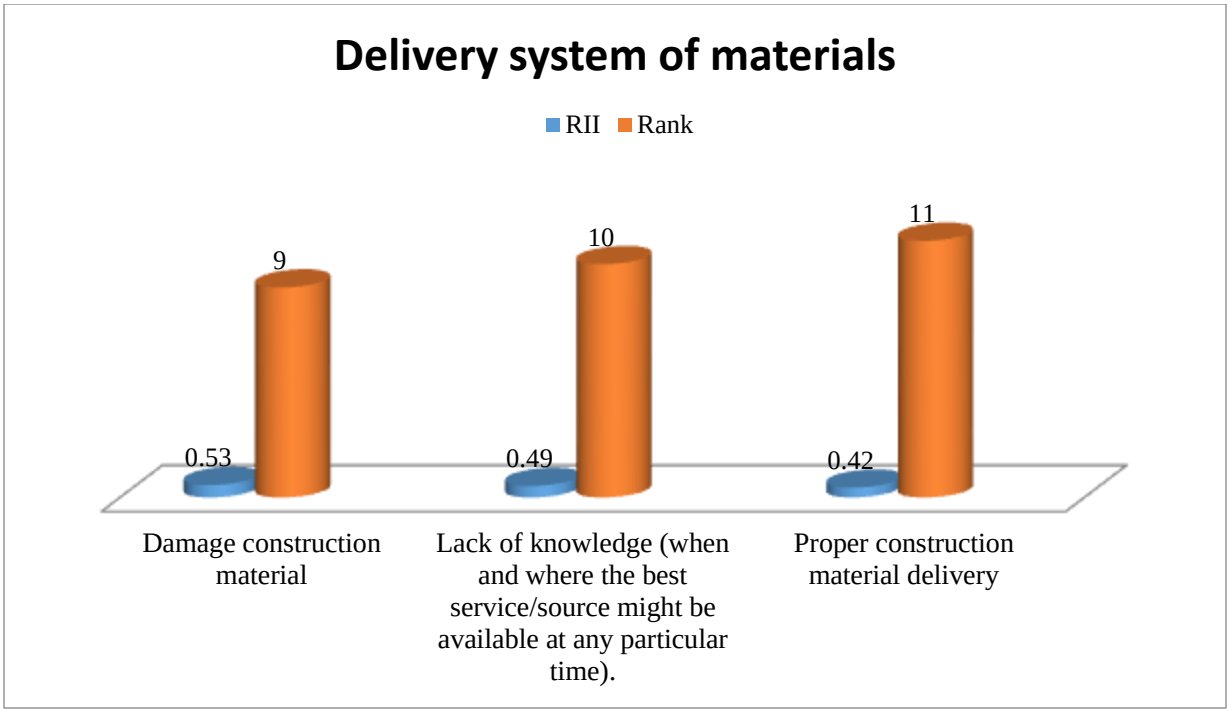

Figure 4 7 Delivery system of materials

4.5.4 Storage and storage facility

A good and systematic storage of materials provides better management of materials in construction. Improper storage and handling of materials on building projects could result to waste can be caused by inadequate supervision and careless attitudes, together with misplaced incentives.

The figure 4.8 gives the response to the list about the storage of construction material. From the result the relative importance index for all the list practices of storage of construction material are greater than 0.5 which indicates that all respondents are in a good manner having an appropriate storage of construction material.

Sufficient storage and stacking are ranked as 1st having with 0.69 relative importance index value. This implies that they give sufficient instruction to the store keeper how to store and stack the construction materials in the storage. Availability of storage of materials near to construction site and appropriate store of materials having 0.67 RII and which are ranked 2nd. This implies the respondents have storage for materials and the storage is near to the site which eliminates the materials from damage due to loading and unloading of materials.

Damages due to placement of material have 0.52 RII. This implies that there were damages of materials due to improper placement of materials which leads the construction materials to wastage. The construction materials should place in properly constructed sheds which must be stored in cool dry and well ventilated and confines, ensuring its storage without deterioration, contact to ground and structural members, without exposure to moisture and heat, and away from direct sun.

Adequate proper material storage and stacking on site having 0.51 RII. This implies that there is inadequate stacking and insufficient material storage with in the construction site. Construction materials should be properly stored at site based up on their individual characteristics and type, they shall be atmospheric action to avoid deterioration. But in this case the materials were placed inappropriate place this leads materials to deteriorate, damage and wastage of materials. The site observation result was strongly related to this result. As my observation there were insufficient or very narrow spaces for material storage.

Figure 4.8 indicates that there is poor security within the company due to theft having 0.44 RII value. This leads the project for additional cost of construction material, affects the construction material management and impact on the construction projects

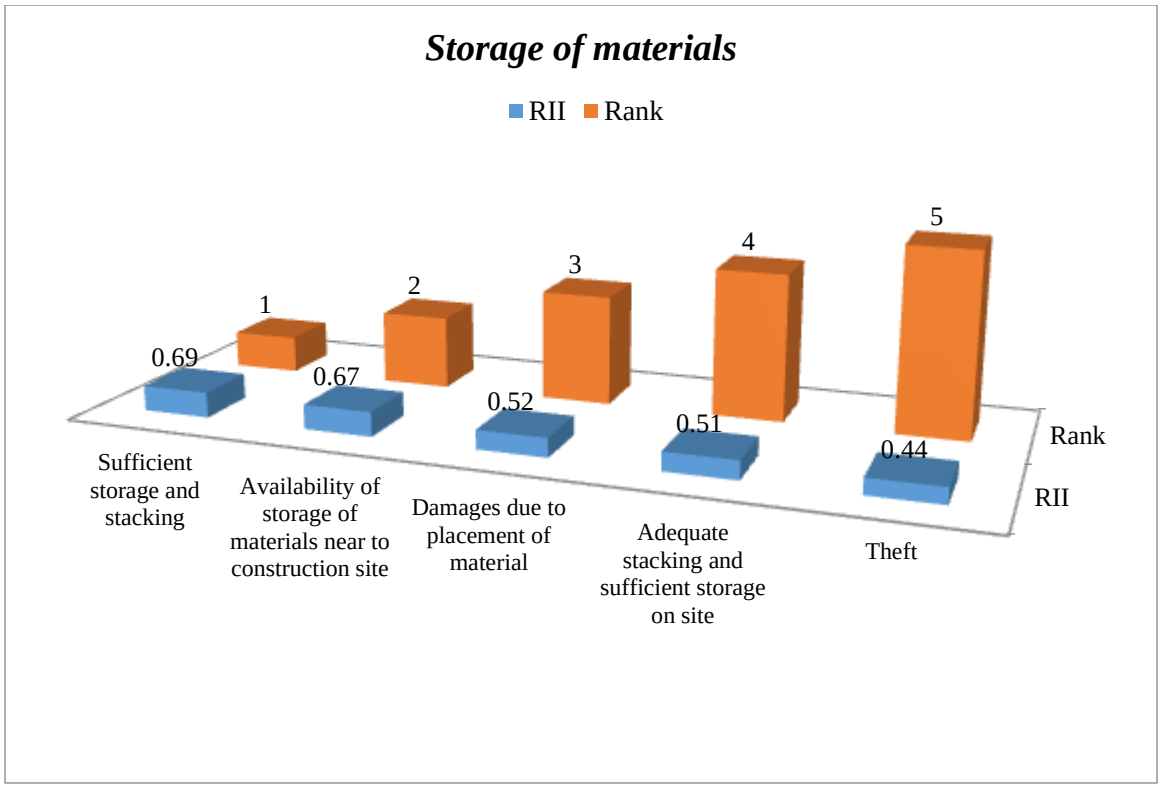

Figure 4. 8 Storage of materials

4.5.5 Handling

Poor handling of material management affects the overall performance of construction projects in terms of time, budget (cost), quality and productivity. The wastage of material should also be minimized during construction in order to avoid loss of profit for construction companies.

The table 4.9 gives the response to the list about the handling of construction material. From the result the relative importance index for all the list practices of handling of construction material were greater than 0.5 which indicates that all respondents are in a good manner an having a proper handling of construction materials.

Proper material handling techniques having higher relative importance index 0.70 and which is ranked 1st. This implies proper handling techniques of material is highly applied in the construction site. There is properly practiced handling techniques including loading/unloading time and other stages of material usages

The Proper handling of construction materials having 0.67 result of relative importance index which ranked 2nd. This implies that they practiced a good proper handling of material provide

sufficient instructions about how to handle materials properly and materials are supplied in movable form to the construction site.

Materials supplied in loose form have 0.51 RII which is ranked the last. This implies that there is supplying materials in wet form to the site this may lead the materials to easily breakage and out of use. Therefore, this is the result of poor material management and it causes for material wastage.

Table 4. 9 Handling of materials

	During Material Handling stages	**Weight**	**RII**	**Rank**
1	Proper material handling techniques	188	0.70	1
2	Proper handling of materials	182	0.67	2
3	Sufficient instructions about handling	151	0.56	3
4	Materials supplied in loose form	138	0.51	4

4.6 The practice of wastage minimization method of construction material management on public building projects

The table 4.10 shows the list of the wastage minimization of materials. From the result the relative importance index of the practices of wastage minimization of materials are greater than 0.5 and less than 0.5. However, less than 0.5 indicates that the respondents are not in a good manner to minimizing of material wastage.

During working hours, laborers follow a professional practice to minimize wastages of material has higher relative importance with a value of 0.71 and ranked 1st. This implies that the companies follow a professional way to minimize wastage of materials on the construction site.

Implementation of waste control practice and reduction of material wastage at each stage of the project ranked 2nd having 0.69 relative importance index. This implies that the majority of companies are practiced reduction of material wastage and waste control method at the each stage of construction materials management.

According to the result, insufficient training system to raise awareness to their workers about wastage minimization of construction materials and negligence practices of the workers are the main problems of the material wastage.

Training system related to material wastages for the worker is 0.40 RII which implies there are gaps on training system in place to train workers. In the company majority of the workers are unskilled and it needs capacity building training to improve the skill on how to minimize wastage and handle the construction material at the working time. Thereby insufficient training system in place for workers is the main causes for the wastage of construction materials in a public project. Most of the workers are unskilled so they need training to enhance their skills

Workers mistake having a value of 0.48 RII which implies that it is the main problem and cause for the construction material wastage. Workers are made mistake to their work due to insufficient training system within the company, lack of knowledge and lack of regular supervision. Therefore, this is also another main cause for wastage of materials which affects the public building project.

Table 4. 10 Wastage minimization of materials

	Related to wastage	**RII**	**Rank**
1	During working time follow professional practice to minimize wastages of material	0.71	1
2	Implement waste control practice	0.69	2
3	Reduction of material wastages at each stage of the project	0.60	3
4	Clear policies related to material wastages	0.59	4
5	Workers mistake	0.48	5
6	Training system related to material wastages for the worker	0.40	6

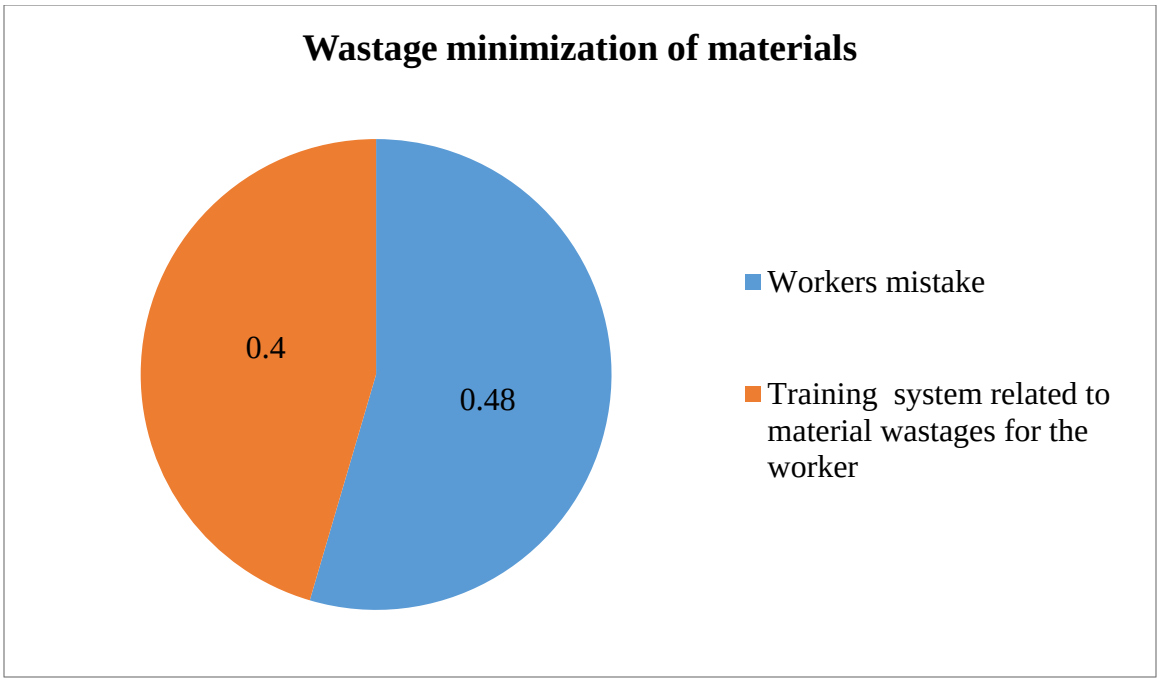

Figure 4 9 Wastage minimization of materials

4.7 The effect of the construction material managements on public building project

According to the respondents proper planning of construction materials have positive effect on the building projects such as control wastage of materials, on time accomplishment of the projects, control improper material delivery, helps to know when and where the materials are needed, to purchase on the budget and to proceed the project as per the schedule. The improper planning of the construction materials managements were effects on the projects by increasing the cost of materials and the delay of the project

According to the respondents, the proper delivery of construction materials have positive effect on the projects such as prevent materials from damage, accelerate project progresses, increase productivity and minimize wastage. And the negative effects of improper delivery of materials are increasing the damage of materials, increase the cost of materials, idleness of the projects and wastage of the materials.

According to the finding the properly providing of the storage and storage facility for construction materials have positive effects on the project such as protect materials from theft and weather, increase productivity, reduce time, prevent damage of materials and minimize

wastage of the materials. And the negative effects on the projects are deterioration of materials, reduction of quality, accident, wastage of materials and expose the project for additional cost.

Table 4. 11 Material management effects on public building project

	Material management process effects on the construction projects	
	Positive effects	**Negative effects**
Planning	Control wastage	Increase cost of materials
	On time accomplishment of projects	Delay of projects
	Control improper delivery of materials	
	Helps to know when and where materials are needed	
	To purchase on the planned cost	
	To proceed as per the schedule	
Delivery	Prevent damage of materials	Increase overhead and labor cost
	To accelerate project progresses	Idleness of activities
	Increase productivity	Damage of materials
	Minimize wastage	Wastage
Storage and handling	Protect from theft and weather	Deterioration of materials
	Increase productivity	Wastage
	Reduce time reduce wastage	Damage of materials
	Reduce damage	Accident
		Exposes for additional costs of materials

4.8 Site observation

Site observation is another way of collecting data for this research. The researcher observed the implementation of construction material management systems in the construction site and the effect on the construction projects.

The figure 4.5 inappropriate storing of aggregate which causes to limit the strength of concrete work on the building project, affect the durability and structural performance of the building, segregation of aggregate, contamination of materials by deleterious substances, undesirable moisture content.

Figure 4.5 Picture of storage of aggregates

The figure 4.6 has shown us the wastage of hollow concrete blocks due to transportation, poor handling and improper cutting of blocks which are the main causes to the damage and wastage for materials. If proper transportation, handling and cutting of blocks as per the design and by paying great attention they will minimize the wastage of materials. To avoid wastage of blocks on construction site, it's advisable to take consideration into its appropriate storage and handling.

Figure 4.6 Picture of wastage of HCB

The figure 4.7 wastage of reinforcement bar due to poor handling and inappropriate storage which are causes to wastage and affects the strength of concrete.

Figure 4.7 Storing and wastage of reinforcement bar

According to the collected data and site observation all respondents have storage of construction materials but there were inappropriate storage and improper handling of material, improper cutting of materials, damage of materials and wastage of materials and negligence practices of workers using construction materials.

A researcher observed that majority of companies have improper handling and material wastage management in the construction sites which have been negatively impacting the project by increasing the overall cost, it will limit the strength of materials, creating crowded place, uncomfortable working area and unsafe condition for workers.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSION

A researcher has assessed the construction material management system on public building projects in Hawassa town. The findings and summary of the study are concluded as follows.

The construction material management system of the contractor personnel has lack of technical professionals, lack of waste control management systems and training system to train laborers in a construction site.

Even though the construction material management process were practiced, there were ineffective communication, designer's unfamiliarity with products, unclear specification, purchasing non waste efficient materials, improper construction material delivery, damage of materials, improper stacking and insufficient storage of materials, lack of security, poor training system related to wastage and negligence practice of workers.

The construction material management processes were not properly implemented, which affects the overall budget, time and quality of the project and also affects successfully accomplishment of the projects.

The practice of wastage minimization process has lack of training system related to material wastages for the worker and workers' mistake. In the construction industry majority of the workers are unskilled and it needs capacity building training to improve the skill on how to work, handle and minimize wastage the construction material at the working time. Thereby insufficient training system in place for workers is the main causes for the wastage of construction materials in a public project.

Ineffective communication, lack of training system, lack of security and insufficient instructions about handling were mainly affects the productivity of the workers. Therefore, the workers were not productive they will affect the productivity of the projects.

Lacks of professional and skilled laborer within the company were the major problems that affect the cost, completion time and the productivity of the project.

5.2 RECOMMENDATIONS

- For effective construction material management, a contractor personnel should establish a system to train workers under the contractor to improve the handling of construction material and to minimize of wastage of materials.
- Contractors should provide a construction material department with in the project for effective management of materials from the planning to the handling stage of construction materials and to the wastage minimization of materials. And also, to control all the types of materials for its quality, quantity and cost.
- Contractor should assign qualified staff, proper storage facility for materials, provide storage near to the site and assign security personnel to protect from theft in the construction site.
- Contractors should improve working procedures and prepare good handling and storing of materials on the construction site, provide waste reduction training to the workers to maintain the effective material management and to reduce the wastage of materials in a construction project.
- Contractors should improve the impact of poor construction material management on the entire projects through hiring professionals, providing clear specification and developing standard of materials, clear specification on quality, quantity, delivery time, method and packaging, applying material optimization to avoid over-ordering, under ordering and excess waste allowance, purchasing waste efficient materials, minimizing wastage and preparing waste management plan.

5.2.1 Recommendations for Further Research

- Further research can consider the construction material management on building construction from view of other stakeholders in detail to sort out the gap for ineffective implementation and poor construction material management.

REFERENCES

A. A.Dania, O. K. (2017). A Study of Construction Material Waste Management Practices by Construction firms in Nigeria. *Proceeding of the 3rd Scottish Conference for Postgraduate Reserachers of the Built and Natural Environment* , (pp. 121-129). Glasgow.

Abdu, D. (2015). *Assessment of Performance Measures for Material Management Process on Building Projects in Addis Ababa.* Addis Ababa.

Ayegba.C. (2013). An assessement on Material Management on Building construction sites. *Civil and Environmental Research, 3*(5), 18-23.

Banjoko, S. (2014). Production and Operation Management. *European Journal of Material sciences, 1*(1), 1-10.

Banjoko.S.A. (March 2014). Production and Operation Management. *European Journal of Material Sciences, 1*(1), 1-10.

Bell.C, S. (1986). Attributes of management System. *Journal of Construction Engineerng and Management, 112*(1), 14-22.

Brooke, A. J. (2004). Towards improved Constructive Waste minimization. *A need for Improved supply chain Integration, 22*(1), 20-29.

Brutus. I, C. (2015). assessement of Material Managemet and profiatability of an organization. *j.Policy development study, 9*, 153-165.

C.Ayegba. (2013). An assessement of Material Management ON Building construction sites. *Civil and Environmental Research, 3*(5), 18-23.

Chan. Z . L, W. (2002). An application of Bar-Code System for Reducing Consruction Wastes. *Autoomation in Construction, 11*(5), 521-533.

Ekanayake. L .L, O. (2004). Building Waste Assessement Score:Design-Based tool. *Building and Environment, 39*(7), 851-861.

Ekanayake. L. L, G. O. (2000). Construction Material Waste Source Evaluation: Proc. of the 2nd Southern African Conference on Sustainable Development in the Built Environment: Strategies for a Sustainable Built Environment. Pretoria.

El Sawalhil N. I, K. M. (2012). A construction Materials Managment System for Gaza Building Contractors. Gaza: IUG,Palestine.

Eshetie, A. E. (2019). Cuases of material Wastega in Building Construction projects. *International Journal of Scinetfic and Engineering Research, 10*(10), 1614-1618.

Formoso, C. S. (2002). Material Waste in Building Industry:Main Causes and Prevention. *Journal of Construction Engineering and Management, 128*(4), 316-325.

J.E, J. (1981). *Site Control of Material Storage and Protection* (1st edition ed.). London: Butterworth.

K. Aygerum. (2012). *Minimizing Materials Wastage at the Construction Stage of a Project through the Implementation of lean Construction.* A Thesis Submitted to the Department of Buiding Technology, Kwame Nkurumah University of Science and Technology.

Kasim N.B, A. C. (2005). Improving Material Management Practices on Fast Track Moving Construction Projects:Annual ARCOM Conference. Istambul: ARCOM.

Kulkarni V, S. R. (2017). Factors Affecting Material Management on Construction Site. *International Research Journal of Engineering and Technology, 04*(01), 471-478.

Lingard H., G. P. (2000). Employee Perceptions of the Solid Waste mangement System Opertaing in a Large Austrialian Contracting Organiztaion. *Construction Management na dEconomisc*, 383-393.

M. Zakeri., P. O. (1996). A Survey of Constraints on Iranian Construction Operatives Productivity. *Construction Management and Economics, 14*(5), 417-426.

Madhayi. T P, M. S. (2013). Material Management in Construction a Case Study. *International Journal of Research in Engineering and Technology, 7*(10), 400-403.

N.B, K. (2008). Improving Materials Management on Construction Projects. A Doctoral Thesis. Submitted in partial fulfillment of the requirements for the award of Doctor of Philosophy of Loughborough University. Loughborough : Loughborough University.

Nagapan, S., Abdul-Rahaman, A. A., & A., H. (2012). Identifying the Causes of construction Waste-Case of Central. *Iternational Journal of Integrated Engineering, 4*(2), 22-28.

Nayak .R, P. M. (2016). Management of Construction Materials on Project Site. . *International Research Journal of Engineering and Technology, 03*(12), 487-491.

O. T. Adewuyi, I. G. (2014). Empirical Evaluation of Construction Material Waste Generated on sites in Nigeria. *Civil Engineering Dimension, 16*(2), 96-103.

P., J. L. (2004). A framework for a decision Support Model for Supply Chain Management in the Construction Industry. Pictoria : Institute and state University.

P., K. G. (2014). Material Management in Construction Industry. *Indian Journal of Applied Research, 4*(4), 1-3.

P.V, G. A. (2015). Management for Construction Materials and Control of Construction Waste in Construction Industry: . *A Review. Int. Journal of Engineering Research and Applications, 5*(4), 59-64.

Pali. S . S, A. H. (2016). Study of material management techniques on construction project. . *Journal of Mechanical and Civil Engineering, 13*(4), 12-17.

Patel K.V, V. C. (2011). Construction materials management on project sites. National Conference on Recent Trends in Engineering & Technology. Dubia: Engineering and Technology Insitute.

Pheng L.S, C. C. (2001). Just-in-time Management in Precast Concrete Construction: A Survey of the Readiness of Main Contractors in Singapore. Integrated Manufacturing Systems. *Journal of Singapore Construction Management system, 12*(6), 416-429.

R, L. S. (2018). The Framework of Improving on-Site Materials Tracking for Inventory Management Process in Construction Projects. *Technology Management in Construction, 4*(1), 180.

S. C, B. (1982). Attributes of Managment System. *Journal of Construction Engineering and Management, 112*(1), 14-22.

Sachim Pali, H. A. (2016). study of material management techiniques on construction project. *Journal of mechanical and civil engineering , 13*(4), 12-17.

Stephen C. W. K, H. L. (2004). Enabling in information sharing between E-commerce systems for construction material procurement. Automation in Construction. Tokyo: Journal of Automation construction E-commerce.

Tompkins, J. A. (1984.). *Facilities Planning* (2nd Edition ed.). New York.: John Wiley and Sons,.

W Lu., H. Y. (2011). An empirircal Investigation of Construction Demolotion Waste Generation rates in Shenzhen city, south chian. *waste Management, 31*(4), 680-687.

Wong. E. T. T, N. G. (1997). Economic Evaluation of Materials Planning Systems for Construction. *Construction Management and Economics. , 15*(1), 39-47.

APPENDIXES

JIMMA UNIVERSITY

School of Graduate Studies

Jimma Institute of Technology

Faculty of Civil and Environmental Engineering

Construction Engineering and Management Chair

Questionnaire Survey on:

- **Assessment of Construction Material Management System on Public Building Projects in Hawassa town**.

Dear Sir/Madam

I kindly request you to involve your company by providing relevant information for my project. The information that you will provide will kept confidential and it is intended only to serve for academic purpose.

I would like to thank you in advance for your kindly cooperation and returning them back on time.

By Meaza Messele

Mobile. +251926305110

Advised by: -

Dr. Getachew Kebede

Eng. Abebe Eshetu (MSc.)

Appendix A: Questionnaires for Contractors

Company Description

1.1.Name of the Company:

_____

1.2.Category

a) General Contractor ☐ c) Building Contractor ☐

b) Specialized Contractor ☐

1.3.Years since establishment:

☐ <5 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years

☐ >21years

1.4.Your work experience in construction projects and construction project related works:

☐ <5 years ☐ 5-10 years ☐ >10 years

Contact address:

Name (Optional)**:**_____

E-mail**:**_____

Tel (mob.): _____

PART ONE

I. General questions

1. How do you describe the current performance of the construction material management in in projects?

☐ Excellent ☐ Very Good ☐ Good ☐ Bad ☐ Very Bad

If your answer is bad or very bad, what challenges may you have contributed in your opinion for the poor performance? (Please check all that apply in your point of view)

- ☐ Related with planning
- ☐ Problems with delivery system
- ☐ Storage of materials
- ☐ Related to wastage

If Other (Please specify)

_____

2. Do you have a specific department, procurement division or others for managing materials on your projects?

☐ Yes ☐ No

If your answer is no who is responsible for coordinating the construction materials in your project?

_____

3. Has problems happened in the process of delivery of material?

☐ YES ☐ NO

If your answer is yes what are the problems?

- ☐ Unplanned delivery date
- ☐ Improper material delivery
- ☐ Damage material

☐ Vague

4. Do you have an appropriate storage of construction materials?

☐ YES ☐ NO

PART TWO

II. Current practice of construction material management

Please indicate the significance of each factor by ticking the appropriate boxes.

1. Very low 2. Low 3. Acceptable 4. Good 5. Very good

IT NO.	Related to construction material management	1	2	3	4	5
1	Adequate of training system for laborer					
2	Proper provision of information to project participants					
3	Effective control of the progress construction of materials					
4	Provision of technical professionals inside the contractor					
5	Effective planning and scheduling of the construction material					
6	Proper waste control management system					
7	Proper distribution of labors					
8	Availability of clear policies related to material management					
9	Follow professionals' practice of material management					

III. PART THREE

Please tick in the box that best indicates your level of agreement with each of the Statements below, where:

1. **Extremely practical** 2. **Much practical** 3. **Practical** 4. **Somewhat practical 5. Not practical**

No	**Planning phase**	1	2	3	4	5
1.	Designer's experience					
2.	Similarity of material plans and specification					
3.	Determining what and when materials are needed					
4.	Awareness of materials available on the market					
5.	Accurate materials scheduling					
6.	Designer's familiarity with alternative products					
7.	Selection of quality products					
8.	Clear specification					
9.	Effective communication					
	Due to delivery system of materials					
1.	Proper planning for good delivery system onsite					
2.	Over-ordering of materials					
3.	Damage during transportation					
4.	Follow JIT(Just-In-Time) delivery system					
5.	Proper site access for delivery vehicle					

6.	Sufficient protection of materials during loading/unloading					
7.	Adequate and efficient delivery schedule					
8.	Availability of storage of materials near to construction site					
9.	Planned delivery date					
10.	Proper material delivery					
11.	Damage material					
12.	Lack of knowledge (when and where the best service/source might be available at any particular time).					
	Due to storage					
1.	Appropriate store of materials					
2.	Availability of storage of materials near to construction site					
3.	Sufficient instructions about storage and stacking					
4.	Accident					
5.	Adequate stacking and sufficient storage on site					
6	Damages due to placement of material					
7	Theft					
8	Appropriate store of materials					
	During Material Handling stages					
1.	Proper handling of materials					
2.	Sufficient instructions about handling					
3.	Materials supplied in loose form					

4.	Proper material handling techniques					
	Related with procurement					
1.	Proper schedule to procurement of the materials					
2.	Purchase of quality and suitable materials					
3.	Purchased materials with the standard					
4.	Purchase reusable and durable materials					
5.	Correct material purchase					
6	Purchasing of waste efficient materials					
	Related to wastage					
1.	Implement waste control practice					
2.	Clear policies related to material wastages					
3.	Reduction of material wastages at each stage of the project					
4.	During working time Does your company follow professional practice related to material wastages					
5.	Training system related to material wastages for the worker					

PART FOUR: Effect on the building projects

1. Does the material planning have effects on the building project?

If the effects are positive please specify on the provided space

_____

_____

_____

If the effects are negative please specify on the provided space

_____

_____

_____

2. Does the material delivery system have effects on the building project?

If the effects are positive please specify on the provided space

_____

_____

_____

If the effects are negative please specify on the provided space

_____

_____

3. Does the storage of materials have effects on the building project?

If the effects are positive please specify on the provided space

_____

_____

_____

If the effects are negative please specify on the provided space

_____

_____

_____

Thank you!!!

Appendix B: - Observation check list

	YES	NO
Availability of Storage		
Storage near to site		
Proper handling		
Damage of materials		
Attention of workers		
Wastage management		

Appendix C: Interview Guide line

1. How you are practicing construction material management system in your project?
2. What are the effective means of construction material management?
3. What are the effective ways of minimizing construction materials wastage?

Appendix D:- RII calculation

No	Related to construction material management	Very low	low	Acceptable	Good	Very good	Weight	RII	Rank
1	Effective control of the progress construction of materials	5	4	13	11	21	197	0.73	1
2	Follow professionals' practice of material management	3	6	23	15	7	177	0.66	2
3	Effective planning and scheduling of the construction material		13	25	8	8	174	0.64	3
4	Proper distribution of labours	3	12	19	11	9	171	0.63	4
5	Proper provision of information to project participants	5	4	29	11	5	165	0.61	5
6	Availability of clear policies related to material management	1	11	28	12	2	165	0.61	5
7	Adequate of training system for labourer	4	18	24	4	4	145	0.54	7
8	Proper waste control management system	13	9	16	13	4	139	0.51	8
9	Provision of technical professionals inside the contractor	14	21	10	6	3	112	0.41	9

No	Planning phase	Extremely practical	Much practical	Practical	Somewhat practical	Not practical	Weight	RII	Rank
1	Similarity of material plans and specification	11	20	21	2		202	0.75	1
2	Determining what and when materials are needed	12	27	3	12		201	0.74	2
3	Selection of quality products	13	13	20	7	1	192	0.71	3
4	Awareness of materials available on the market	5	23	16	6	4	181	0.67	4
5	Designer's experience	7	10	14	17	6	157	0.58	5
6	Accurate materials scheduling	4	15	12	14	9	153	0.57	6
7	Clear specification	4	14	11	15	10	149	0.55	7
8	Effective communication	3	14	7	25	5	147	0.54	8
9	Designer's familiarity with alternative products		7	26	15	6	142	0.53	9
No.	**Due to delivery system of materials**	**Extremely practical**	**Much practical**	**Practical**	**Somewhat practical**	**Not practical**	**Weight**	**RII**	**Rank**
1	Proper site access for delivery vehicle	10	30		14		198	0.73	1
2	Proper planning for good delivery system onsite	12	18	6	17	1	185	0.69	2

3	Follow JIT(Just-In-Time) delivery system	7	28	1	13	5	181	0.67	3
4	Adequate and efficient delivery schedule	9	10	25	8	2	178	0.66	4
5	Sufficient protection of materials during loading/unloading	5	22	10	13	4	173	0.64	5
6	Damage during transportation	4	10	24	11	5	159	0.59	6
7	Over-ordering of materials	6	6	17	19	6	149	0.55	7
8	planned delivery date	4	9	19	10	12	145	0.54	8
9	Damage construction material	3	10	17	14	10	144	0.53	9
10	Lack of knowledge (when and where the best service/source might be available at any particular time).	2	7	14	21	10	132	0.49	10
11	Proper construction material delivery		4	10	27	13	113	0.42	11
	Due to storage	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Weight**	**RII**	**Rank**
1	Sufficient instructions about storage and stacking	12	13	18	9	2	186	0.69	1
2	Appropriate store of materials	9	15	18	10	2	181	0.67	2
4	Availability of storage of materials near to construction site	10	16	13	10	5	178	0.66	3
5	Accident	2	8	20	17	7	143	0.53	4

6	Damages due to placement of material	5	6	15	19	9	141	0.52	5
	Adequate stacking and sufficient storage on site	4	9	10	20	11	137	0.51	6
8	Theft	2	3	12	25	12	120	0.44	7
	During Material Handling stages	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Weight**	**RII**	**Rank**
1	Proper material handling techniques	10	18	16	8	2	188	0.70	1
2	Proper handling of materials	14	13	9	15	3	182	0.67	2
3	Sufficient instructions about handling	5	6	20	19	4	151	0.56	3
4	Materials supplied in loose form		13	10	25	6	138	0.51	4
	Related with procurement	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Weight**	**RII**	**Rank**
1	Purchase of quality and suitable materials	12	12	17	10	3	182	0.67	1
2	Purchased materials with the standard	10	10	15	13	6	167	0.62	2
3	Correct material purchase	6	8	20	13	7	155	0.57	3

4	Proper schedule to procurement of the materials	4	5		23	19	3	150	0.56	4	
5	Purchase reusable and durable materials	2	14		15	16	7	150	0.56	4	
6	Purchasing of waste efficient materials		10		15	16	13	130	0.48	6	
	Related to wastage	**Strongly agree**	**Agree**		**Neutral**	**Disagree**	**Strongly Disagree**	**Weight**	**RII**	**Rank**	
1	During working time follow professional practice to minimize wastages of material	13	17		13	8	3	191	0.71	1	
2	Implement waste control practice	6	21		20	6	1	187	0.69	2	
3	Reduction of material wastages at each stage of the project	7	15		10	14	8	161	0.60	3	
4	Clear policies related to material wastages	7	11		14	16	6	159	0.59	4	
5	negligence practices of workers		4		19	26	5	130	0.48	5	
6	Training system related to material wastages for the worker		1		13	25	15	108	0.40		

Appendix E:- Cronbachs result

Part one

No.	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8	Question 9	Total
1	5	5	5	5	5	5	5	5	5	45
2	5	5	5	5	5	5	5	5	5	45
3	5	5	5	5	5	5	5	5	5	45
4	5	5	5	5	5	5	5	5	4	44
5	5	5	5	5	5	5	5	4	4	43
6	5	5	5	5	5	5	5	4	4	43
7	5	4	5	5	5	4	5	4	4	41
8	5	4	4	5	5	4	4	4	3	38
9	5	4	4	4	4	4	4	4	3	36
10	5	4	4	4	4	4	4	3	3	35
11	5	4	4	4	4	4	4	3	3	35
12	5	4	4	4	4	4	4	3	3	35
13	5	4	4	4	4	4	4	3	3	35
14	5	4	4	4	4	4	4	3	3	35
15	5	4	4	4	4	4	4	3	3	35
16	5	4	3	4	4	4	3	3	3	33
17	5	4	3	4	4	4	3	3	2	32
18	5	4	3	4	4	4	3	3	2	32
19	5	4	3	4	4	4	3	3	2	32
20	5	4	3	4	3	4	3	3	2	31
21	5	4	3	3	3	4	3	3	2	30
22	4	3	3	3	3	3	3	3	2	27
23	4	3	3	3	3	3	3	2	2	26
24	4	3	3	3	3	3	3	2	2	26
25	4	3	3	3	3	3	3	2	2	26
26	4	3	3	3	3	3	3	2	2	26
27	4	3	3	3	3	3	3	2	2	26
28	4	3	3	3	3	3	3	2	2	26
29	4	3	3	3	3	3	3	2	2	26
30	4	3	3	3	3	3	3	2	2	26
31	4	3	3	3	3	3	3	2	2	26
32	4	3	3	3	3	3	3	2	2	26
33	3	3	3	3	3	3	3	2	2	25

34	3	3	3	3	3	3	3	2	2	25
35	3	3	3	3	3	3	3	2	2	25
36	3	3	3	3	3	3	3	2	2	25
37	3	3	3	3	3	3	3	2	2	25
38	3	3	3	3	2	3	3	2	2	24
39	3	3	2	3	2	3	2	2	2	22
40	3	3	2	3	2	3	2	2	2	22
41	3	3	2	2	2	3	2	1	2	20
42	3	3	2	2	2	3	2	1	1	19
43	3	3	2	2	2	3	2	1	1	19
44	3	3	2	2	2	3	2	1	1	19
45	3	3	2	2	2	3	2	1	1	19
46	3	2	2	2	2	2	2	1	1	17
47	2	2	2	2	2	2	2	1	1	16
48	2	2	2	2	2	2	2	1	1	16
49	2	2	2	2	2	2	2	1	1	16
50	2	2	2	2	2	2	2	1	1	16
51	1	2	2	2	2	2	2	1	1	15
52	1	1	2	1	1	1	2	1	1	11
53	1	1	2	1	1	1	2	1	1	11
54	1	1	2	1	1	1	2	1	1	11
									Total	86.18
Variance	1.58	1.00	0.97	1.22	1.28	1.00	0.97	1.41	1.17	10.60

Alpha

0.99

Part two

No.	**Question 1**	**Question 2**	**Question 3**	**Question 4**	**Question 5**	**Question 6**	**Question 7**	**Question 9**	**Question 9**	**Total**
1	5	5	5	5	5	5	5	5	5	45
2	5	5	5	5	5	5	5	5	5	45
3	5	5	5	5	5	5	5	5	5	45
4	5	5	5	5	5	5	5	5	4	44
5	5	5	5	5	5	5	5	4	4	43
6	5	4	5	5	4	5	5	4	4	41
7	5	4	5	5	4	4	5	4	4	40
8	5	4	4	5	4	4	4	4	3	37
9	5	4	4	5	4	4	4	4	3	37

10	5	4	4	5	4	4	4	3	3	36
11	5	4	4	5	4	4	4	3	3	36
12	4	4	4	5	4	4	4	3	3	35
13	4	4	4	5	4	4	4	3	3	35
14	4	4	4	4	4	4	4	3	3	34
15	4	4	4	4	4	4	4	3	3	34
16	4	4	3	4	4	4	3	3	3	32
17	4	4	3	4	4	4	3	3	2	31
18	4	4	3	4	4	4	3	3	2	31
19	4	4	3	4	4	4	3	3	2	31
20	4	4	3	4	4	4	3	3	2	31
21	4	4	3	4	4	4	3	3	2	31
22	4	4	3	4	4	3	3	3	2	30
23	4	4	3	4	4	3	3	2	2	29
24	4	4	3	4	4	3	3	2	2	29
25	4	4	3	4	4	3	3	2	2	29
26	4	4	3	4	4	3	3	2	2	29
27	4	4	3	4	4	3	3	2	2	29
28	4	4	3	3	3	3	3	2	2	27
29	4	4	3	3	3	3	3	2	2	27
30	4	4	3	3	3	3	3	2	2	27
31	4	4	3	3	3	3	3	2	2	27
32	4	4	3	3	3	3	3	2	2	27
33	3	4	3	3	3	3	3	2	2	26
34	3	4	3	3	3	3	3	2	2	26
35	3	4	3	3	3	3	3	2	2	26
36	3	4	3	3	3	3	3	2	2	26
37	3	4	3	3	3	3	3	2	2	26
38	3	3	3	3	3	3	3	2	2	25
39	3	3	2	3	3	3	2	2	2	23
40	3	3	2	3	3	3	2	2	2	23
41	3	2	2	3	3	3	2	1	2	21
42	3	2	2	3	3	3	2	1	1	20
43	3	2	2	3	3	3	2	1	1	20
44	3	2	2	3	3	3	2	1	1	20
45	3	2	2	3	2	3	2	1	1	19
46	3	2	2	3	2	2	2	1	1	18
47	3	2	2	3	2	2	2	1	1	18
48	3	2	2	3	2	2	2	1	1	18

49	3	2	2	2	2	2	2	1	1	17
50	3	2	2	2	2	2	2	1	1	17
51	3	2	2	2	1	2	2	1	1	16
52	3	2	2	2	1	1	2	1	1	15
53	2	2	2	2	1	1	2	1	1	14
54	2	2	2	1	1	1	2	1	1	13
									Total	72.95
Variance	0.68	0.97	0.97	1.03	1.09	1.00	0.97	1.41	1.17	9.29

Alpha

0.98

Part Three

No.	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total
1	5	5	5	5	5	5	5	5	5	5	4	54
2	5	5	5	5	5	5	5	5	5	5	4	54
3	5	5	5	5	5	5	5	5	5	4	4	53
4	5	5	5	5	5	5	5	5	4	4	4	52
5	5	5	5	5	5	5	5	4	4	4	3	50
6	5	4	5	5	4	5	5	4	4	4	3	48
7	5	4	5	5	4	4	5	4	4	4	3	47
8	5	4	4	5	4	4	4	4	3	3	3	43
9	5	4	4	5	4	4	4	4	3	3	3	43
10	5	4	4	5	4	4	4	3	3	3	3	42
11	5	4	4	5	4	4	4	3	3	3	3	42
12	4	4	4	5	4	4	4	3	3	3	3	41
13	4	4	4	5	4	4	4	3	3	3	3	41
14	4	4	4	4	4	4	4	3	3	3	3	40
15	4	4	4	4	4	4	4	3	3	3	3	40
16	4	4	3	4	4	4	3	3	3	3	2	37
17	4	4	3	4	4	4	3	3	2	3	2	36
18	4	4	3	4	4	4	3	3	2	3	2	36
19	4	4	3	4	4	4	3	3	2	3	2	36
20	4	4	3	4	4	4	3	3	2	3	2	36
21	4	4	3	4	4	4	3	3	2	3	2	36
22	4	4	3	4	4	3	3	3	2	3	2	35
23	4	4	3	4	4	3	3	2	2	3	2	34
24	4	4	3	4	4	3	3	2	2	2	2	33
25	4	4	3	4	4	3	3	2	2	2	2	33

26	4	4	3	4	4	3	3	2	2	2	2	33
27	4	4	3	4	4	3	3	2	2	2	2	33
28	4	4	3	3	3	3	3	2	2	2	2	31
29	4	4	3	3	3	3	3	2	2	2	2	31
30	4	4	3	3	3	3	3	2	2	2	2	31
31	4	4	3	3	3	3	3	2	2	2	2	31
32	4	4	3	3	3	3	3	2	2	2	2	31
33	3	4	3	3	3	3	3	2	2	2	2	30
34	3	4	3	3	3	3	3	2	2	2	2	30
35	3	4	3	3	3	3	3	2	2	2	2	30
36	3	4	3	3	3	3	3	2	2	2	2	30
37	3	4	3	3	3	3	3	2	2	2	2	30
38	3	3	3	3	3	3	3	2	2	2	2	29
39	3	3	2	3	3	3	2	2	2	2	2	27
40	3	3	2	3	3	3	2	2	2	2	2	27
41	3	2	2	3	3	3	2	1	2	2	2	25
42	3	2	2	3	3	3	2	1	1	2	2	24
43	3	2	2	3	3	3	2	1	1	2	2	24
44	3	2	2	3	3	3	2	1	1	1	1	22
45	3	2	2	3	2	3	2	1	1	1	1	21
46	3	2	2	3	2	2	2	1	1	1	1	20
47	3	2	2	3	2	2	2	1	1	1	1	20
48	3	2	2	3	2	2	2	1	1	1	1	20
49	3	2	2	2	2	2	2	1	1	1	1	19
50	3	2	2	2	2	2	2	1	1	1	1	19
51	3	2	2	2	1	2	2	1	1	1	1	18
52	3	2	2	2	1	1	2	1	1	1	1	17
53	2	2	2	2	1	1	2	1	1	1	1	16
54	2	2	2	1	1	1	2	1	1	1	1	15
											Total	106.48
Variance	0.68	0.97	0.97	1.03	1.09	1.00	0.97	1.41	1.17	1.07	0.69	11.06

Alpha

1.01

$$\alpha = \left(\frac{k}{k-1}\right) \times \left(1 - \left(\frac{\sum si^2}{st^2}\right)\right)$$

The average of Cronbach's alpha value for three parts = **0.99**