JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING

CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR

Assessment of the Kaizen principle of building construction: The case of Jimma Town

A Thesis submitted to the School of Graduate Studies, Jimma University, Jimma Institute of Technology, Faculty of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree of Master of Science in Construction Engineering and Management

By: BADASA OLJIRA WAKJIRA

January,2020

Jimma, Ethiopia

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I declare that this research entitled **Assessment of the Kaizen Principle of Building Construction: the case of Jimma Town**

This research paper is my original work and has not been presented for a degree in any other university.

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ABSTRACT

Kaizen originated in Japan to be applied in the improvement of productivity, cost, delivery, morale, safety and health, quality, efficiency, and overriding good management and problem solving tools. It is one of the principles that support the Toyota Production System (TPS) as a philosophy. But in recent time it expands to the other manufacturing areas such as: construction industries, manufacturers, hospitals, banks, software developers and other business sectors. Kaizen in construction is an approach to construction management that aims to eliminate operational inefficiencies through a focus on optimizing production at the construction work face. Common goals of kaizen in the building construction practices on projects are to improve productivity, time on task, flow of work, and the value added to the final product with each work task.

But the contribution of kaizen principles in building construction techniques in sustainable construction cannot be over emphasized, in the building construction industry in Ethiopia particularly Jimma town.

The purpose of this thesis focused on assessment of the critical success factors for the adoption and issuing implementation of the kaizen principles in the building construction industries from design to final completions of projects to avoid or minimize the wastage(muda): the case of Jimma town. The study design is descriptive research. Both qualitative and quantitative data were used. To achieve objectives of the research design primary and secondary data are used. The selected sample was probability sampling method. In order to achieve the objectives of the research the design study methodology was utilized. The questionnaire was applied to 46 ongoing sample building construction, and 15 formal interviews for the populations of project sites. The data collected were analyzed using Microsoft office Excel 2016 and descriptive statistics such as frequency, mean, standard deviation and percentage. Based on literature review and collected data's analyzed, this study proposed and developed a conceptual framework for improving kaizen implementation practice and enhancing sustainability of the implementation.

Even if the kaizen benefits was producing high quality of products and service in the project site, the kaizen implementation program has been not yet in pervious time. The reasons for not used in the previous time of kaizen management are, lack of problem solving culture in the project, lack of follow up and support by top managements, failure to provide good mobility to the well-being of others, lack of training for rehabilitation and new staff, the existence of key success factors that are considered as essential for the successful adaptation did not meet the requirement. So it's important to adopt the kaizen principles in building construction to minimize/ totally avoid the problems occurred in the case of building construction industry.

KEYWORDS: *Continuous improvements; Construction industry; Kaizen; Toyota production system; wastage.*

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ACRONYMS

μ	Mean
5S Five	Set in Order, Shine, Sort, Standardize, and Sustain
AEC	Asian Economic Community
BPR	Business Process Re-engineering
CI	Construction Industry
CT	Cycle Time
GDP	Growth Domestic Product
JICA	Japanese International and Cooperation Agency
JIT	Just In Time
LT	Lead Time
LEI	Lean Enterprise Institute
LOB	Line of Balance
MUDA	Japanese word meaning waste
PDCA	Plan, Do, Check, Act
PGRPD	Post Graduates Research and Publication Director
QA	Quality Assurance
QC	Quality Control
QCC	Quality Control Circle
R&R	Reward and Recognition
SD	Standard Deviation
STM	Scientific Thinking Mechanism
SWPS	Step Wise Problem-Solving
TQM	Total Quality Management
TPS	Toyota Production System
WW II	Second World War
VSM	Value Stream Mapping

CHAPTER 1

INTRODUCTION

1.1 Back Ground of the Study

Construction industry is a significant sector which plays basic role in both developed and developing countries by creating employment, establishing social infrastructures such as Road, bridge, water work construction, canal, building construction, hospitals, schools etc., to contributing gross domestic product (GDP) of the countries (Awad & Ibrahim , 2016). Among the construction industries the building construction industry is the one which is an important for both the developing and developed economies. It contributes 10% towards Gross Domestic Product (GDP) for developed economies and more than 4% for the developing countries (Murithi & Silas , 2017). Building construction sectors are now resource and management service gain growth, since it raises productivities through increasing return and generating high levels of output.

According to (Awad & Ibrahim , 2016) inefficiencies of the building construction industry are well known and include: low productivity rates, poor quality of work, cost overruns, delays, constant changes, rework, poor management, and claims among stakeholders at international and national level.

This thesis was carried out in the building construction industry: the case of Jimma town, which is characterized by organizations that develop their work based on projects, which by nature are temporary, have limited resources and defined scope of work, and are carried out by different, often adversarial and includes of different stakeholders.

Currently the building construction activities has been increasing rapidly as a result of urban transformation process in Ethiopia, Jimma town in particular. As soon as the building construction increases there is also the wastages (muda) has been increasing from time to time during: design, construction, operation, demolition phases of building life cycle.

Improvements are being made in construction projects as new or improved technical solutions are introduced, and new working methods are applied with the intention to eliminate wastes and increase efficiency of products.

Sustained improvements are often obstructed as innovative solutions to problems that arise at the construction site are not systematically transferred to the next project (Meiling & John , 2010).

In building construction projects, the workers have to move around the project, from place to place in a path usually dictated by the previous crew. Each product can be considered one of a kind is building, and frequently each one of a kind project is complex and involves several iterations among many participants (André, n.d.) . The building construction industries has implemented different techniques, strategies, initiatives, management and improvement of productivities to increase the competitiveness of the sector as national and international level movement.

The main objective of these movements is to improve productivity and quality as well as minimizing wastage and costs by adopting kaizen in Building construction sector.

Hence, the kaizen principle issues should be taking into account starting from design to the completions of building construction process to achieve quality productive and service with least cost of the building site.

Kaizen originated in Japan to be applied in the improvement of productivity, quality, efficiency, and it is also the overriding concepts behind good management and problem solving tool, and it comes from two Japan words “Kai” and “Zen” which has a meaning “change” and “better” respectively.

(Singh & Kumar , 2017) explains that in the Japanese language, kaizen means continuous improvement and that in practice it seeks to involve all the participants of the process that is being analyzed at a relatively low cost for the company.

Continuous improvement implies an incremental, ongoing effort to improve products, processes and services (Meiling & John , 2010)

Kaizen is one of the principles that support the Toyota Production System (TPS) as a philosophy. But in recent time it expands to the other manufacturing areas such as: construction industries, manufacturers, hospitals, banks, software developers and other business sectors are making a difference by adopting kaizen philosophies. To make this, kaizen which is said to be continuous improvement is now a key concern of most business organizations including construction industry sector. Building construction is also one among construction industries.

Improving construction production is desired in order to reduce costs, shorten schedules, improve quality, increase competitiveness, beneficial for worker safety and ultimately improve a firm's economic standing in construction. As a production management approach for project delivery, kaizen in construction is implemented to maximize performance at the jobsite level by looking at construction as both conversions and flow, where only conversions add value to the final product (John Gambatese, 2014) .

Different researchers are reported the benefit of kaizen implementation along both social and technical dimensions of organization and include cost reduction, productivity improvement, reduction in defects, and improvement in employee's morale and motivation (Pestana & Ana Catarina , 2011).

The adoptions of kaizen in building construction industries includes the use of both analytical techniques such as Value Stream Mapping (VSM) and Line of Balance (LOB), in addition to the systematization of the relationship of the problems identifying with the workflow activities and with those relating to processes and operations in a building construction industry. The adoption of kaizen concepts and tools must be made considering the whole, to understand the behavior and the consequences of the changes implemented in the building sites. This involves professionals, quality, time, costs, equipment, techniques and technologies in building construction. Thus, for the proposition of changes it is necessary to identify and understand the problem, find its causes and propose improvements for viability analysis in a systematic way to finally implement them.

Therefore, to adopt the kaizen principles in building construction sector is everyone's job in the company; it requires sophisticated problem-solving expertise as well as professional and engineering knowledge and involves people from different departments working together in teams to solve problems.

1.2 Statement of the Problem

In the construction industry, as in other industries, a great amount of waste remains hidden in processes which are not adequately understood, and consequently not properly managed resulting in inefficiencies throughout a projects supply chain at international levels (Alarco´n & Javier Freir, 2002). These inefficiencies are practices in production processes, at construction sites, during supply plants, in office and during management system.

There is too much waste in the building construction project areas at international and national levels (John Gambatese, 2014).

Today there are different problems in building construction in the case of Jimma town. Among which; delays, overproduction, defects, high consultancy fees, inadequate allocation of resources, wastage of materials, over run cost, quality production problem.

As a result, the number of building projects increasing with not much success on waste reduction in the case of Jimma town.

The research interest in this area has driving by insights into the practical challenges faced in the principles of kaizen initiatives in the building construction and the inability of the project to firmly establish a measurement criterion for its success.

So, kaizen principle in building construction activity is use to shift the projects to streamline work and reduce the amount of wastes occurring in construction industry area. To avoid or minimize such likes wastes in the projects have come under many banners. Such as: creating strategic planning, giving education and training, commitment, involvement, consisting of financial, human resource and materials management functions in the building construction.

1.3 Research Questions

In view of the rationales and points discussed above and the views expressed in relevant literature, the research addresses the following questions:

1. How to identify the performance methods of kaizen implementation in building construction?

2. What are the key challenges faced during building construction in the implementation of kaizen?

3. What are the major contributing factors to the effective implementation of kaizen?

1.4 Objectives

1.4.1 General Objectives

- The main objective of this research is to assess the kaizen principle of the building Construction Industry (CI): The case of Jimma town.

1.4.2 Specific Objectives

- To identify the performance methods of kaizen implementations in building construction.
- To assess the key challenge facing during building construction in the implementation of kaizen
- To identify the major contributing factors for the effective implementation of kaizen.

1.5 Scope of the Study

The research primarily considering the conceptual limits of assessing the kaizen implementation in the building construction the cases of Jimma town. For this purpose, a composition of certain theories in assessing the kaizen principle is considering for its applicability and adopting it in building construction process to eliminate or avoid wastage in the building construction.

1.6 Significance of the Study

The result of this research can be applied to the building construction industry under study to realize its achievements from design to final completion to adopt and ensure the implementation and sustain with the help of kaizen principles. Also organization came across the impact of implementation was change to sustainability and other organizations and individuals can apply the outcome of this research to become adopted the process by management and employee attitude with their commitment regards of construction industries use to shift the projects to streamline work and reduce wastes.

1.7 Limitations of the Study

In the study, only management of building construction building were assessed, and not all respondents in each building construction project were directly participated (by questionnaire, interview, and open their site for observation) because of limiting factors like budget and time. So, only actively participating respondents from each building construction project sites like site engineers, contractors, Forman and storekeeper were included.

CHAPTER 2

LITERATURE REVIEW

2.1 Historical Overview and Definitions of Kaizen

Every researcher believes that kaizen was started in Japan during the country's recover after Second World War (WW II) for improvement of quality and production. Kaizen means it is a continuous improvement concept that underpin the Toyota Production System (TPS) (André, n.d.). And it's an improvement, continuous improvement involving everyone from top management to lower workers. In Japan, the concept of kaizen is so deeply engrained in the minds of both managers and workers that they often do not even realize they are thinking kaizen as a customer-driven strategy for improvement.

The researcher found in all related literatures as kaizen is originated from Japan two words "Kai" and "Zen" it means "change" and "better" respectively. Therefore, kaizen directly translated to "change for better" (André, n.d.). It is internationally known recently as a continuous process of quality and productivity improvement in industrial development in particular. Kaizen by now is a widely discussed and applied manufacturing philosophy, in a variety of industries across the globe.

Kaizen is continuous improvement in performances of cost and quality which strives to empower the workers, increase worker satisfaction, facilitates a sense of accomplishment, thereby creating a pride of work (Imai, 1986).

According to Imai the kaizen philosophy is what distinguishes the Japanese management from the Western concepts and focuses on the process way of thinking as opposed to the western focus on innovation and result orientation. Kaizen activities have developed and spread among other Japanese manufacturers as they gained fame in the international market for high quality products and later to the rest of the world (Development & Forum , 2009). Kaizen is now an international word appearing in the Oxford English dictionary, which defines it as a Japanese business philosophy of continuous improvement of working practices, personal efficiency (Keijiro Otsuka & , n.d.).

According to (Imai, 1986), Kaizen is an umbrella concept covering most of those uniquely Japanese practices like customer orientation, total quality control (TQC), robotics, Quality

Control Circles(QCC), suggestion system, automation, discipline in the workplace, total productive maintenance (TPM), Kamban, quality improvement, zero defects, small-group activities, cooperative labor management relations, productivity improvement and new-product development these principles and tools significantly helped Japanese companies to develop process oriented way of thinking that assures continues improvement involving people at all levels. Imai reduced the principle and tools to one word under the umbrella: Kaizen. Authors like (André, n.d.) consider that kaizen represents an action that promotes beneficial changes in a structure of continuous learning and improvement in the context of the CI, it can be considered that the kaizen concept is essentially for CI.

There are some deficiencies in the design process, during construction, cause frequent and unexpected failures in construction, wastage of materials. In a way, this promotes rushed decisions, which in most cases are based on the practical experience of managers and workers regarding to assessing kaizen principles.

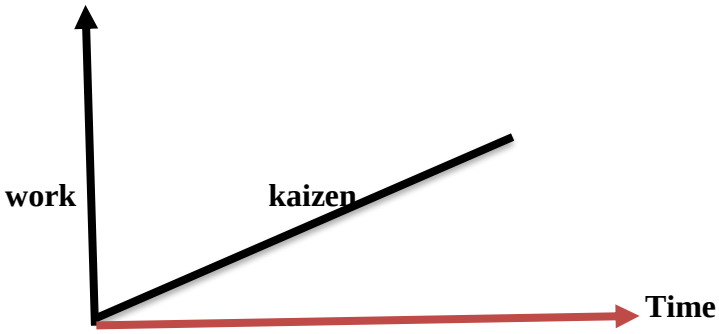


Figure 2. 1:Ideal pattern for Kaizen

2.2 Implementation of Kaizen in Manufacturing Industries

Nowadays the world economy is moving towards more global. Due to this many manufacturing sectors are a victim of the effect of globalization. As the world is becoming more connected to one another, especially with the advance in information technology, it has created a new level of competition among the industry players. Globalization has caused business decision or action at one part of the world to have significant impacts in other parts of the world. In this case the global market place competition will rise. In order to stay in the market, place a number of manufactures are forced to rethink their manufacturing and management approach to lower costs of production, minimize waste,

improve productivity, boost quality, and achieve sustainability. Improving customer service, making operation faster, more operation and reduction in costs are challenges faced by manufacturers today.

As (Mahmud & Mohd Ghazali , 2016) review some of the challenges in implementing kaizen are resistance to change, failure to motivate employees, lack of understanding on companies' strategic path and difficulties in managing continuous improvement

From the above review, resistance to change (culture), motivation, training, company's strategies and globalization are the most important factors for continuous improvement.

As discussed by (Shingo, 2010), a process kaizen utilizes various tools and methods to make the problem visible, and uses formal root tool cause analysis and other means to identify and correct the problem. In order to implement the kaizen, the company should follow the methodology and standards of kaizen. These standard and methodology of kaizen can be implemented in various fields. Today, Deming's cycle, PDCA cycle (Waston.M, 1986) is used to improve various kinds of processes that are involved in manufacturing, management and other supporting processes in the business. Improvement of production quality can be performed on several ways and on any element of production like production processes, production equipment, management structure, employees and organizational culture.

Kaizen implemented by new principles include just-in-time, lean thinking, six sigma, total quality management, and process improvement (Singh & Kumar , 2017). According to the literatures review the main target for using these new techniques is better meet customer needs by eliminating practices that do not add product value for reduce high production costs and to improve low levels of productivity, insufficient quality and poor safety.

On the other hand, manufacturing factories wastage during production process is rapidly growing day by day. This will lead to increase in production costs. Due to these challenge the global competition of the market is very high and stiff for manufacturing companies. Therefore, a lot of studies suggest that manufacturers need to do something to ensure that they remain competitive in the market.

As previously discussed kaizen is a system of continual improvement which is undertaking by an organization to improve its business activities and processes with the goal to always improve quality of products and services resulting to meet customer satisfaction. Kaizen

can be built in and run with an integrated and companywide approach through the collaboration of all the levels of the organization that are top management, middle managers and frontline employees.

As discussed earlier, the philosophy of kaizen is one of the instruments to increases productivity of the company and helps to produce high quality products with minimum efforts. If the philosophy is implemented properly using effective tools, methods, culture, principles, and application techniques, the existing problems and challenges in the company can be solved. There is large evidence that kaizen implementation have positive impact on the performance of the industries (Williams.M, 2001), which results in better space utilization, improved productivity, quality, faster delivery time, better safety to the employees, increased employee's motivation and greater customer satisfaction.

2.3 Continuous Improvement

The overall aim of continuous improvement is to develop learning capabilities among all employees (Meiling & John , 2010). The learning procedure within continuous improvement is formalized in problem-solving settings and executed through various applications of the PDCA (Plan, Do, Check, Act), learning cycle (Deming, 1993). The PDCA-learning cycle implies the application of experience feedback in order to grasp problems, find root causes, suggest solutions, make implementation and evaluate results (Deming, 1993). Execution of PDCA cycles involves stepwise problem-solving (SWPS), targeting the improvement of products and processes (Meiling & John , 2010). TQM is defined by (Steve & Odek, 2013.) as an overall management system consisting of values, techniques and tools intended to increase external and internal customer's satisfaction using reduced amounts of resources. The kaizen production strategy stresses the importance of human and cultural aspects, together with quality tools and methodologies, focusing on even production flows, targeting value adding activities from customer pull, while continuously eliminating waste. Both TQM and kaizen production share focus on improving production processes through CI. From a TQM perspective, (Gunaydin & David , n.d.) argue that continuous improvement can be used as a vehicle to lead construction companies into learning from their mistakes and becoming learning organizations.

Continuous improvement is a vital means of reaching new levels of efficiency and effectiveness in the construction sector.

2.4 The Objectives of Kaizen

The benefits of kaizen include increasing number of private enterprises and implement quality and productivity improvement. The success of the kaizen implementation also established to disseminate kaizen to private enterprise in sustainable manner. Kaizen aims for improvements in productivity, effectiveness, safety and waste reduction. Those who follow the approach often find a whole lot more in return: less waste inventory is used more efficiently as are employee skills; people are more satisfied they have a direct impact on the way things are done; improved commitment team members have more of a stake (a share or interest in business) in their job and are more inclined to commit to doing a good job; improved retention satisfied and engaged people are more likely to stay; improved competitiveness increases in efficiency tend to contribute to lower costs and higher quality products; improved consumer satisfaction coming from higher quality products with fewer faults; improved problem solving looking at processes from a solutions perspective allows employees to solve problems continuously; improved teams working together to solve problems.

2.5 Kaizen and Management

Kaizen management has two functions: Maintenance and Improvement. Maintenance activities are directed towards maintaining existing technological, managerial, and operating standards while improvement refers to improving existing standards (Imai, 1986).

2.5.1 Role of Top Management

Top management is responsible for establishing kaizen as the overriding corporate strategy and communicating this commitment to all levels through policy deployment of the organization and allocating the resources necessary for kaizen to work and build systems procedures, and structure conducive to kaizen.

2.5.2 Role of Middle Management

Responsible for implementing the kaizen policies established by top management; establishing, maintaining and improving work standards; ensuring employees receive the

training necessary to understand and implement kaizen and employees learn how to use problem solving and improvement.

2.5.3 Role of Supervisors

Responsible for applying the kaizen approach in their functional roles; engage in kaizen through the suggestion system and small group activities, practice discipline in the workshop, engage in continues self-development to become better problem solvers, improving communication at the work place; maintaining morale and providing coaching for teamwork

2.5.4 Role of Employees

Responsible for participating in kaizen through teamwork activities, making kaizen suggestions, engaging in continuous self-improvement activities, continually enhancing job skills through education and training and continually broadening job skills through cross-functional training

2.6 Just-In-Time (JIT)

Just-in-time is a concept for good-flow control. It stimulates reduction of stocks of material by providing goods when and in the amounts needed (Rooy & Ignatius , 2010).

Stock of materials is seen as muda. The implementation of JIT needs reliable production or zero defects and good relations with suppliers.

JIT can also be referred as a management philosophy. JIT is as a set of principles, tools and techniques that allows a company to produce and deliver products in small quantities with short lead times to meet specific customer needs. The underlying concept of Just-in-Time (JIT) philosophy is to smooth the manufacturing process through the efficient handling of materials, such as providing the right materials in the correct quantity and quality, just in time for production (Shang & Low Sui Pheng , 2011) to eliminate or reduce waste, thus producing the maximum value for the customer. The “Kanban” (pull) system can be introduced for ordering materials. At the construction site, access time needs to be monitored and ensured so that resources can be utilized at the right time, in the right place and with the correct quantities and qualities.

2.7 Suggestion System

A Suggestion System is the method by which the ideas and suggestions of employees are communicated upwards through the management hierarchy to achieve cost savings or improve product quality, workplace efficiency, customer service, or working conditions. Through suggestions, employee participate in continuous improvements activities in the workplace and play a vital role in upgrading standards (Imai M. 1986). Suggestions or proposals start from a problem perception and recognizing the need to solve it.

Kaizen focuses on making improvements in any area where there is a scope for improvement. The management of the company encourages suggestion or kaizen from employees regarding possible improvements in their respective work area.

2.8 Quality Control Circle (QCC)

QCC is a small group of workers who collectively find a problem, discuss alternative remedies, and propose a solution. QCCs voluntarily perform improvement activities within the workplace, with self-disciplined and humanity focused approaches, utilizing scientific techniques. QCC need to be supported by the top management and the middle managers who treat QCC activities as an important part of employee development and workplace utilization, and provide guidance and support for genuine participation while respecting the humanity of all employees. From the definition of kaizen provided by (Imai, 1986) QCC is the vehicle, which could call intention and participation from all levels of employees from top managements, managers, supervisors, to shop floor workers. The kaizen concept utilizes the cooperative features of the QCC to collect suggestions on the work process.

2.9 Quality Assurance/ Quality Control

According to the manual of professional practice for quality in the constructed project, Quality Assurance (QA) is a program covering activities necessary to provide quality in the work to meet the project requirements (Gunaydin & David , n.d.). QA involves establishing project related policies, procedures, standards, training, guidelines, and system necessary to produce quality. The design professional and constructors are responsible for developing an appropriate program for each project. QA provides protection against quality problems through early warnings of trouble ahead. Such early warnings play an important

role in the prevention of both internal and external problems. On the other hand, Quality Control (QC) is the specific implementation of the QA program and related activities. Effective QC reduces the possibility of changes, mistakes and omissions, which in turn result in fewer conflicts and disputes. Through the first half of this century, engineers and architects were in total control during the design phase. During the construction phase they carried out a role described as 'supervision', insuring that the owner received his money's worth in terms of quality.

The terms quality assurance (QA) and Quality Control (QC) are frequently used interchangeably (Gunaydin & David , n.d.). Since quality control is a part of quality assurance, maintaining a clear distinction between then is difficult but important. Quality assurance is all planned and systematic actions necessary to provide adequate confidence that a structure, system or component will perform satisfactorily and conform with project requirements. On the other hand, quality control is a set of specific procedures involved in the quality assurance process. These procedures include planning, coordinating, developing, checking, reviewing, and scheduling the work. The quality control function is closest to the product in that various techniques and activities are used to monitor the process and to pursue the elimination of sources that lead to unsatisfactory quality performance. Most design-related quality assurance and quality control activities are covered by a design organization's standard office procedures.

Developing and monitoring the activities within the quality assurance program in the construction phase are the responsibility of either the designer or the construction management firm depending on the project delivery system in use.

2.10 Kaizen Rewards and Recognitions

Corporate culture has several essential components corporate values, leadership, and the reward and recognition structure of the organization. The reward system reflects the corporate philosophy, democratic and innovative or autocratic and bureaucratic. Promotion and rewards reinforces employee commitment to corporate values and to the corporate culture.

Reward and recognition (R&R) have various functions and can be valuable tool at organizations on their road for TQM as for example:

- They improve the reinforcement of quality-related behavior and achievements.
- They show organizational values, and they show how the organization appreciates efforts.
- They indicate achievement, and R&R activities provide feedback which is an element of continuous improvement.
- Recognition is also a form of feedback about the result of individual or team efforts. It shows the individuals or the teams that they are on the right track toward continuous improvement. Recognition as feedback can come from supervisors, other teams, internal customers in the organization, or external customers in the marketplace.
- Kaizen philosophy and TQM processes demand empowered employees, team players and cross-functional activities.
- R&R can motivate these individuals and groups to continue their active participation in the organization to create positive environment.
- The R&R system will increase the awareness among 'workers that management is prepared to reward them if they are serious in applying critical TQM values, such as quality, customer satisfaction, and continuous improvement.
- Some forms of recognition, such as awards and plaques, show publicly that the individual or team has achieved some degree of success within TQM frame.

2.11 Principles of Kaizen

Kaizen principles are a comprehensive way of approaching the continual improvement of manufacturing processes such as: construction industries, manufacturers, hospitals, banks, software developers and other business sectors are making a difference by adopting kaizen philosophies. Each principle has a significant impact upon improvement of quality and productivity at each sector (Rooy & Ignatius , 2010).

Kaizen uses five main principles:

- **Processes must evolve by gradual improvement rather than radical changes**

In practice, kaizen can be implemented by improving every aspect of a process in a step by step approach, while gradually developing employee skills through training education and increased involvement resulting in quality improvement. With quality improvement, employees meet together to discuss the current operations of the company. They decide

what things can be changed that will improve the quality of the company and of the products.

- **Human resources are the most important company asset**

Kaizen must be practiced in tandem with respect for people not resulting in outcomes such as layoffs. Kaizen has become successful with many manufacturing companies because the employees are involved. They feel that their opinion is important and this boosts the employee morale. Keeping the employees happy will cause them to be more productive and satisfied with their jobs.

- **Teamwork**

One of the biggest principles of the kaizen approach is the ability to work in teams. Each department is considered a team and they will be responsible for making small changes that impact the organization. All employees from top manager to front line workers should share common values, business objectives, and information. And, should fulfill their respective role properly, enhancing their capabilities through exercising autonomy and creativity. The teams will then report to their manager. The manager takes this information to management and the entire process of kaizen is evaluated.

- **Discipline**

In order for kaizen to be effective, discipline is necessary. Management as well as workers needs to believe in the kaizen idea and strive toward obtaining the small goals in order to reach overall success. A strong commitment to discipline and to the kaizen method will prove success for a company.

- **Continuous improvement**

Improvement must be based on statistical or quantitative evaluation of process performance. The small improvements will lead to bigger improvements throughout the entire company. This is why kaizen is called a continuous process improvement system or a continual improvement method. Even with the changes, there are still small things employees can do to change the way they work (Pheng & Lo, 2014).

Uses of continuous improvement:

- Increase output value through systematic consideration of customer requirements
- Reduce variability
- Reduce cycle times

- Simplify by minimizing the number of steps, parts, and linkages
- Increase output flexibility
- Increase process transparency
- Build continuous improvement into the process
- Benchmark

2.12 The Scientific Thinking Mechanism (STM)

In the context of integrated continuous improvement, as foundation of the TPS (Singh & Kumar , 2017) proposes a scientific approach to identify problems, propose and develop improvements, and implement them in a systematic flow-oriented organization.

(Singh & Kumar , 2017)shows the STM in a preliminary phase and four main phases, which will be identified and briefly analyzed in the following sections.

a) Preliminary Stage: In essence, (Singh & Kumar , 2017)structures the systematization of the STM starting with the Preliminary Stage, in which the author assumes that the process must be analyzed considering its division into groups of elements.

b) Identification of the problem: (Singh & Kumar , 2017)believes that an improvement or the development of a kaizen should take place only after those involved have gained an in-depth understanding of the identified problem. Thus, according to the STM, the resolution of a problem involves three essential steps, namely: identify the problem, clarify the problem, and discover its cause.

c) Basic approaches for improvement: (André, n.d.) emphasizes that the professionals should: understand the facts with great level of detail, quantitatively instead of qualitatively; think in terms of categorical principles to understand the phenomenon for improvement.

d) Making plans for improvement: In this stage, the plans for improvements should be understood and developed from scientific and creative criteria developed by brainstorming methods. Planning processes define and refine objectives and select the best of the alternative courses of action to attain the objectives that the project was undertaken to address.

e) **Translating plans into reality:** The last stage of the STM promotes the use of proposals for improvements. (Shingo, 2010) draws attention to possible objections that can appear even during the implementation of the proposals. It is used to executing processes that

involve coordination of people and other resources (which can be seen to as project leadership and resource allocation functions), such as equipment and material, to carry out the plan in order to perform the project.

2.13 Quality of Kaizen in Building Construction

What does quality mean in the context of building construction Industry? Many definitions of quality in building construction industry exist, testifying to the complexity and multifaceted nature of the concept. The terms efficiency, effectiveness, equity and quality have often been used synonymously (Tehrani & Maryam , 2010) .

Considerable consensus exists around the basic dimensions of quality building construction industry today, however quality building construction industry includes, when the construction progress activities are being carried out according to the given design, specification, the interest of each stakeholders' involvement, health and safety of the building, such as material, equipment and labor are well-nourished is said to be quality.

Quality can be defined as meeting the legal, aesthetic and functional requirements of a project. Requirements may be simple or complex, or they may be stated in terms of the end result required or as a detailed description of what is to be done. But, however expressed, quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirements.

Law defines quality in terms of professional liability, a legal concept that requires all professionals to know their trade and practice it responsibility. Every architect and engineer who offers his or her expertise to owners is subject to professional liability laws.

Some design professionals believe that quality is measured by the aesthetics of the facilities they design. According to (Gunaydin & David , n.d.), this traditional definition of quality is based on such issues as how well a building blends into its surroundings, a building's psychological impacts on its inhabitants, the ability of a landscaping design to match the theme of adjacent structures, and the use of bold new design concepts that capture people's imaginations.

2.14 Impact of Kaizen in Building Construction

The impact of kaizen in building construction can be profound. Substantial improvement in a variety of processes has been achieved compared to the condition prior to improvement

of the construction process. Additional significant gains are achievable if improvement is continuous rather than sporadic. The benefits include the kaizen leaded to increase the continuous improvement productivity satisfaction and quality through minimizing wastage. Kaizen principle in building construction indicate that the construction is being success the interest of stakeholders in construction activities will likely perceive their organization to be substantially different or possess unique characteristics compared to other service organizations or businesses using kaizen management. While its origins are being successfully applied to any organization whose involved in the building constructions.

2.15 Application of Kaizen

The kaizen application management is dedicated to the improvement of productivity, efficiency, quality and avoid wastage in general of different business sectors not only in construction industry (Boca, 2011). The kaizen method acknowledged as method of improvements applied to key processes will generate the major of company's profit, while constituting a secure way to obtain the clients loyalty and fidelity.

The kaizen application represents a solid strategic instrument, with a view to reach and surpass the company's objectives.

The 5S's represents a fundamental technique which allows the enhancement of efficiency and productivity, while ensuring a pleasant building construction situations. The paper presents in a concrete way a study regarding the application of these concepts in a real kaizen principles in building construction which builds its business success in construction process. The term "Five S" is derived from the first letters of Japanese words referred to five practices leading to a clean and manageable work area: seiri (organization), seiton (tidiness), seiso (purity), seiketsu (cleanliness), and shitsuke (discipline). The English words equivalent of the 5S's are sort, straighten, sweep, sanitize, and sustain.

Five S evaluation contributes to how employees feel about product, company, and their selves and today it has become essential for any company, engaged in manufacturing, to practice the 5S's in order to be recognized as a manufacturer of world-class status.

Table 2.1: 5S Activities

Seiri /Sort	Identify what is not needed, then give everyone a chance to indicate if the items really are needed.
Seiton/ Straighten	what must be kept. Make things visible. Put tools on pegboard and outline the tool so its location can be readily identified.
Seiso/ Scrub	Means cleaning the working environment, including machines, tools, floors, walls and other areas of work place.
Seiketsu /Systematize	Extend the concept of cleanliness to oneself and continuously practice the above three steps. Keeping one's person clean, by such means as wearing proper clothes, safety glasses, gloves, shoes, and as well as maintaining a clean , healthy working environment.
Shitsuke/standardize and self-discipline	Established a cleaning schedule. Use downtime to clean and straighten area.

Construction is a dynamic production; lay down area change dramatically as production is moving forward, hence, the material layout plan should be a continuous effort that includes all trades involvement. Throughout the project, Sort, Straighten, and Standardize are the winners in this category mainly due to management eagerly making efforts. Conversely, the traditional working behavior became an obstacle for the enforcement of shine (clean up) and sustain.

General Contractor realized that behavior change, commitment, and discipline are the keys to the success of housekeeping. The material layout is commonly used for acceleration of 5S implementation on the construction site. (Salem, 2005) indicates that 5S is an area-based system of control and improvement. The benefits from implementation of 5S include improved safety, productivity, quality, and set-up-times improvement, creation of space, reduced lead times, cycle times, increased machine uptime, improved morale, teamwork, and continuous improvement (kaizen activities).

2.16 Value Stream Mapping (VSM)

Value stream mapping is one of the most important continuous improvement strategies because it can be used within almost all others. This process looks at the design and flow of processes within a company to see where value is being added. A value stream map can also be a great brainstorming tool for areas that could be improved.

A good value stream map will be very detailed and formatted like a flow chart. It is utilized to help isolate each of the steps in a process to see where value is being added and where it is not. This makes it easier to eliminate or modify the areas where value is either missing or could be increased in the process. The idea of value stream mapping was originally developed for manufacturing processes, but it can be adapted to other industries as well.

This is a planning and communicating tool that enables to manage the material and information involved in the process. (Blumenthal & Adrian , 2003) presented standardized icons that make it easier to understand and apply this tool. It is composed of the following steps: identify a product, draw the current VSM, proposals for improvement, create the future VSM and implement and monitor the changes.

This tool is very practice oriented and it is basic for the evaluation of where and how in the production process other lean tools and techniques can be applied.

2.16.1 Value Adding Activities

An example of the amount of value adding activities that are attained in various sectors is provided by the Cardiff Business School of Lean Profit Potential, which shows comparatively higher amounts of waste within construction,

In a Construction Environment

- 40% value adding activity or support activity
- 60% waste

In an Information Environment

- 51% value adding activity or support activity
- 49% waste

2.17 Effective of Kaizen Principle

According to (Beyene, 2017) one of the best approaches that can help companies to effectively implement kaizen is through benchmarking. This is because through

benchmarking firms can learn and adopt certain business process that they might consider as beneficial to be implemented at their place. Therefore, many of the kaizen activities, also known as Toyota Production System (TPS), were benchmarked based on the initiatives done at Toyota Motor Company. The work of kaizen which involves incremental changes rather than radical changes has enabled people involved in the kaizen activities to be easily adaptable to those changes, thus formalized those changes into their daily routine activities.

Analysis by principal components was applied for finding the critical success factors for kaizen; such as: giving education and training in operators, communication process between stakeholders, documentation and evaluation of projects results, human resources integration, management commitment, checking the quality of materials and equipment and customer focus during construction process on progress makes the kaizen effective.

2.18 Concept of Gemba Kaizen

In Japanese gemba means real place, where the products or services are formed. Gemba provides the product or services that satisfy the customer and management by setting strategy and deploying policy to achieve that goal in gemba. Gemba improvement uses bottom up and top down approach and it becomes the source for achieving commonsense, low cost improvements (Singh & Kumar , 2017).

(Imai, 1997) also introduced the concept of the house of gemba where major activities are taking place on a daily basis for resource management-namely maintenance (maintaining the standard and the status quo) and kaizen (relates to improving standards). The house of gemba shows, a bird's eye view of activities taking place in gemba.

Imai also asserted that, daily management of resources requires standards, and the standards are the basis for daily gemba kaizen improvement. According to him, standardization in gemba means the translation of technological and engineering requirements specified by engineers in to worker's day to day operational standards "translating process does not require technology or sophistication".

Kaizen application can improve quality, reduce cost and meet customer's delivery requirements without any significant investment or introduction of new technology. The three major kaizen activities such as muda (waste) elimination, 5S activities and standardization are crucial in building efficient organization. He also recommended these three kaizen activities are the three pillars of kaizen and they are the basic activities for

kaizen implementation in construction or other service industries. They are easy to understand and implement and do not require sophisticated knowledge or technology. Anybody, any manager, supervisor, or any employee can readily introduce these commonsense.

(Aditya, 2017) also argues, one of the competitive "weapons" for Japanese companies is the involvement of their human potential in the maintenance of implemented changes in gemba kaizen.

2.19 Important of Kaizen Concepts and Terms

This section presents a list of definitions of kaizen (lean) concepts and terms, commonly used by lean thinkers, which have their roots in the industrial Engineering field and quality movement. The list is mostly based on the work developed by the Lean Enterprise Institute (LEI). the basic definitions of the most commonly used terms are:

• **Batch-and-Queue**: a mass production approach to operations in which large lots (batches) of items are processed and moved to the next step - regardless of whether they wait in a line.

• **Cycle Time (CT)**: how often a part or a product actually is completed by a process, as timed by observation.

• **Five Whys**: consists in asking why five times every time a problem happens so that the root cause of the problem can be properly identified and its recurrence can be prevented.

• **Inventories**: materials and information present along a value stream between processing steps. Inventories can be broadly categorized as raw materials, work in process and finished products.

• **Plan, Do, Check, Act (PDCA)**: an improvement cycle based on the scientific method of proposing a change in a process, implementing the change, measuring the results, and taking appropriate action.

• **Production Lead Time (LT)**: the time it takes one piece to move all the way through a process or value stream, from start to finish.

• **Value** - the inherent worth of a product as judged by the customer from the project.

2.20 Characteristics of Kaizen

As one of the most important aspects of Japanese quality, kaizen is well-known for its characteristics. One of the main characteristic of kaizen is on finding the root cause of mistakes made and correcting them. Kaizen practitioners are prepared to find even their own errors. Each error is seen as an opportunity in the path of improvement. Kaizen is more process-focused than results-focused. Kaizen also seeks to improve the systems rather than the human resources. In a kaizen environment, when an employee error in his job, it is not seen as an occasion to blame, but is seen as a chance to find out what went wrong with the process. Kaizen practitioners spend a lot of their time to measure customer satisfaction and error rates. They also make use of meetings and such opportunities to discuss avenues for improvement. Thus, kaizen focuses on incremental improvements rather than exact solutions to problems. The focus of small improvements in kaizen makes it easier to implement. Also, if the changes made in the business process are small, the people find it easier to adjust. Since most of the improvement proposals come from the employees, the resistance to change is much less. In fact, people tend to enjoy such a change. This is the way in which kaizen principle helps to beat the competition. The kaizen philosophy of work is to stress employee participation in decision making process. Every employee is considered as a link in the process of continuous improvement. Kaizen is not something which people do on an hourly basis. Instead, it is part of their lifestyle. Kaizen principles are often used to improve building construction products activities aiming to minimize waste and increase value to the client.

However, it is worth discussing some characteristics of building construction activities and the demand facing resources supplied for construction.

Kaizen revolves around teamwork activities to:

- Intact work groups
- Problem-solving
- Cross-functional
- Proactive or implementation teams.
- Productivity improvement
- New product development
- Just in time
- Zero defects
- Small group activities
- Quality improvement

2.21 Total Quality Management(TQM)

(Meiling & John , 2010) state that quality management through TQM is a widespread concept for improved competitiveness, efficiency and profitability. As (Meiling & John , 2010) identify TQM as a means to achieve a state of continuous improvement in construction, which is considered to lead companies into learning from mistakes and become learning organizations. TQM is defined as both a philosophy and a set of guiding principles (Dale, 1997).

The values of TQM are summarized in six cornerstones or core values:

- Focus on the customer,
- Base decisions on facts,
- Focus on processes,
- Improve continuously,
- Let everyone be committed, and
- Top management commitment

The cornerstones are supported by a set of techniques and tools (Dale, 1997), many of which are also used within the kaizen production system.

TQM is a continuously evolving management system consisting of core values, methodologies and tools, the aim of which is to increase external and internal customer satisfaction. This could be compared with the definition of total quality control stated by (Gunaydin & David , n.d.), one of the inventors of TQM.

Total quality control is to provide genuine effectiveness and control by identification of customer quality requirements and ends only when the product has reached the customer and he is satisfied.

An important difference is that (Dale, 1997) emphasis that TQM is continuously evolving, indicating the long term commitment. According to (Dale, 1997) the TQM system should be executed in three steps, the first of which is to establish the core values. Secondly, techniques should be identified that are suitable for the organization to use and support its values. The third step is to find tools that can be used in an efficient way to support the chosen techniques.

TQM is a journey, a movement centered on the improvement of managerial performance at all levels. Total Quality control (TQC) means that the quality is determined at all stages of the whole product lifetime, and all the functions are included in the quality control. The quality activities start with the product design, incoming quality approval, and continue through production control, product reliability, inventory, delivery, and customer service (Mulatu, 2018). It deals with:

- Quality Assurance
- Safety and health
- Employee involvement
- Continuous improvement, and
- Cost reduction
- Productivity improvement.

Moreover, TQM journey deals with management concerns such as organizational development, planning, cross-functional management, material management, health and safety welfare and quality deployment. In other words, management has been using TQM as a concept and a tool for improving overall performance of building construction.

2.22 Kaizen Training

Training of skills to eliminate waste, standardize operations and other technical principles, as well as cultivating the right attitudes among employees, is critical. Over time, promising employees should receive formal professional education and obtain qualifications to work in construction projects as multi-skilled workers as advocated by the Toyota Production System. Multi-disciplinary training will allow the workforce to be exploited to its fullest potential. This provides greater flexibility in deploying workers to improve productivity. For construction managers, the training should include their commitment to JIT implementation (Kumar & Douglas, n.d.). Furthermore, training also needs to be provided for the suppliers and subcontractors so that they can better understand the JIT principles.

2.23 Employee Involvement

Establish a flat model, remove hierarchies and give more responsibility to individual project teams. As (Shang & Low Sui Pheng , 2011) highlighted, JIT requires flexibility and worker's participation in the decision making process. Moreover, encouraging the labor force to stop work once any problems are identified has worked on the Toyota shop floor (Liker,2004). In China, most of the construction workers do not possess a high level of education. Nevertheless, the need to take responsibility and to build effective teamwork skills needs to be emphasized among the Chinese workers.

2.24 Ethiopian Experience of Kaizen

The Government of Ethiopia implemented organizational performance and effectiveness before implementing kaizen called Business Process Re-engineering (BPR), shortly after the introduction of a nationwide BPR. According to (Mekonnen, 2017), the government of Ethiopia has embarked on reforming its civil service organizations with the objective of improving the public sector service delivery system. It was applied in government bureaus, an idea introduced to bring radical changes among state institutions but, in the process, virtually stalled them for months and now widely deemed to be a failure. The Ethiopian government started advocating the idea of kaizen a Japanese management philosophy among private and state owned companies; the idea was first brought to the attention of Ethiopia's late prime minister Meles Zenawi.

In this instant the government of Ethiopia inspired by the practicality of the kaizen policy and strategy adopt the exemplary approach. In 2008, the Government of Ethiopia as a result requested the Japanese government to help Ethiopia established the Japanese management technique, known as kaizen. Before implementing and fully institutionalizing the kaizen unit on a large scale, then Ethiopian Ministry of Industry and Trade (MOIT) reviewed about 63 companies in 2009 that were located within 100-kms of Addis Ababa to ascertain their quality and productivity status from October 2009 to June 2011. After a preliminary diagnosis of the 63 companies only 30 companies (i.e., 10 from Metal; 6 from Agro processing;6 from Chemicals; 4 from Leather and; 4 from Textiles) were chosen to serve as pilot projects. Pilot companies from this, ten, five and three companies have been awarded good, best and excellent status respectively by Ethiopian kaizen unit (EKI, 2017).

2.25 Implementation of Kaizen

As articulated by (Beyene, 2017), the success of kaizen overseas transferability and implementation of the kaizen practices in Ethiopia depend on the degree of compatibility between the Japanese company's kaizen culture and the host country's national culture. Given this conceptual framework, the introduction of kaizen as a management tool and success in the transfer of technology to improve and enhance productivity and managerial capability in higher institution needs to be seen in the establishment of several building blocks in addition to conceptual issues related to:

- The fit between kaizen culture and the organizational culture of the practices;

- Changes in the mindset of colleges workers so they will adhere to the kaizen work ethics;
- Workers' training and discipline so that workers follow standard operating procedures;
- The existence of a hungry mentality so colleges workers will do work which is

above and beyond their responsibility; and the empowerment and involvement of workers in decision-making to cooperatively identify problems, generate solutions, implement them and then follow up to evaluate quality and productivity.

Thus, implementation of kaizen in manufacturing companies needs to be fully committed to boosting the morale of their workers to develop members' capabilities, to achieve self-actualization, and to work cooperatively. These commitments are vital to the process for improving the quality of the training output.

2.25.1 The Role of Employees in the Process of Kaizen Implementation

The importance of owners'/employees productivity issue has been recognized as the initial until completing construction project. The activities that contribution the implementation of delivering a project process can be step in from initial to completion (Thirapatsakun, et al., 2016).

Everybody in the building project has its own role and responsibility (Thirapatsakun, et al., 2016). There are two ways to approach kaizen. Ultimately improvement is being designed and implemented by everyone, every day, everywhere in an organization. This transformation requires both leadership development and a disciplined problem-solving and improvement process. Kaizen events, highly structured improvement activities that are an effective shaping tool, are a second way to shift culture and begin reaping the significant benefits from achieving both high levels of employee engagement and rapid results.

In both cases, employees have ample opportunities to connect with organization purpose, a specific problem or opportunity, and each other. They use their creative potential in highly fulfilling ways. And they are given the level of control that all human beings need and deserve. In a word: they become deeply engaged. The people who do the work are the experts, not leaders nor consultants. Employees engage in conditions for engagement to occur for creating a proper kaizen culture on the way to achieve this.

2.25.2 The Role of Designer in the Process of Kaizen Implementation

Conceptualizing the design process as a flow of information lends itself to reducing waste by minimizing the amount of time before information gets used, the time spent inspecting information for conformance to requirements, the time spent reworking information to achieve conformance, and the time spent moving information from one design contributor to the next.

Kaizen design is the application of production principles, which promote the elimination of waste and non–value adding activities in processes, to engineering and design (Alarco´n & Javier Freir, 2002).

2.25.3 The Role of Contractors in the Process of Kaizen Implementation

A contractor is anyone who directly employs or engages construction workers or manages construction work (Mwila, 2004). Contractors therefore have an important role in planning, managing and monitoring their work to ensure any risks are controlled. Contractors are responsible for supplying the necessary equipment, material, labor, and services to complete the project. They hire specialized subcontractors to perform either a portion or all of the work. Contractors use subcontractor agreements to protect themselves and the subcontractors they hire.

2.26 Waste (Muda) Elimination

As (Womack. Jones. & D. T, 2003) citation, muda in Japanese means waste. The resources at each process, people and machines do not add value for activity is classified as muda in Japan. Work is a series of value adding activities from raw materials ending to a final product. Wastes are one means of productivity loss mechanism. So, to increase the production quality and quantity must apply wastes reduction methods in the working area. As (Thessaloniki, 2006) stated that, the main seven types of waste in the working area especially in construction industry are as follow:

- Muda of overproduction
- Muda of inventory
- Muda of repair/rejects
- Muda of motion
- Muda of processing
- Muda of waiting

- Muda of transport.

2.26.1 Muda of Overproduction

Muda of overproduction is a function of the mentality of the line supervisor to be on a safe side, due to uncertainties of machine filer, rejects and absentees. It results in raw material conception before they are needed, wasteful input of utilities and manpower, additions of machinery, increase in interest burdens, additional space to store, excess inventory, added transportation and administrative costs. Imai, perceived overproduction as a crime. When components are produced before they are required by the next downstream process, overproduction occurs. This has several negative effects. It creates a caterpillar effect in the production flow and results in the creation of excess work in progress. This leads to staging and therefore labor required to move the work in progress additional times. And it can hide defects that could have been caught with less scrap if processes were balanced to allow detection earlier as earlier use of the Work in progress (WIP) components would have revealed the defect in time to correct the issue.

Lean construction systems utilize several tools to combat overproduction. Takt time is used to balance production rates between cells or departments (Rooy & Ignatius , 2010). Measured and process-mapped jobs result in reduced setup time allowing efficient small batch flow. And in many industries, “pull” systems such as kanban can be used to help control or eliminate WIP.

Common causes of overproduction include:

- Unreliable process
- Unstable production schedules
- Inaccurate forecast and demand information
- Customer needs are not clear
- Poor automation
- Long or delayed set-up times

2.26.2 Muda of Inventory

Products kept in the inventory do not add any value to the organization rather they occupy warehouse, space, and demanding additional facilities such as warehouses and forklift. When market test or need changes product quality get worse and may even become

obsolete overnight. Items in the inventory gather dust (no value added), and their quality depreciate. When an inventory level is high, nobody gets series enough to deal with problems like quality, absenteeism and machine downtime and provides little room for kaizen. Lower inventory level however, helps to identify areas of problems and forces to deal with problems as they arise. He also asserted, when the inventory level goes down and reaches the one-piece flow line, it makes kaizen a mandatory daily activity.

2.26.3 Muda of Defects

Rejects or defects interrupt production and require expensive rework. (Thessaloniki, 2006), further discussed, too much paperwork and many design changes will also result in a muda of reworks. Defects impact time, money, resources and customer satisfaction. Examples of defects within a building constructions include lack of proper documentation or standards, large variances in inventory, poor design and related design documentation changes and an overall lack of proper quality control throughout the process workflow.

2.26.4 Muda of Motion

Motion costs money. This not only includes raw materials but also people and equipment. It may also include excess physical motion such as reaching, lifting and bending. All unnecessary motion results in non-value-added time and increases cost. Again, referencing core lean manufacturing methodology, process mapping should include facility layout and optimized workplace design that includes analysis of the distance of motion within the space as well as the location of parts, supplies and tools within the space as well. As an effective process map is developed, proper utilization of the space can be captured with well-designed and documented standard work.

Common motion waste examples include:

- Poor workstation layout
- Poor production planning
- Poor process design
- Shared equipment and machines
- Lack of production standards

2.26.5 Muda of Processing

At every step in which a work piece or a piece of information is worked on, value is added and sent to the next process. (Imai, 1986) refers here is muda of processing is modifying such a work piece or piece of information. He also mentioned inadequate technology or design and failure to synchronize process leads to muda in processing. Excess processing is a sign of a poorly designed process. This could be related to management or administrative issues such as lack of communication, duplication of data, overlapping areas of authority and human error. It may also be the result of equipment design, inadequate job station tooling or facility layout.

Process mapping is a lean waste elimination tool that helps define an optimized workflow that can eliminate over processing. As a key method within lean production, process mapping is not limited to the performance of production tasks. It also includes reporting, signoff and document control.

2.26.6 Muda of Waiting

Muda of waiting occurs when the hands of the operator are ideal due to line imbalances, lack of machine down time. Waiting can include people, material equipment (prior runs not finished) or idle equipment (mechanical downtime or excess changeover time). All waiting costs a company has in terms of direct labor dollars and additional overhead costs can be incurred in terms of overtime, expediting costs and parts. Waiting may also trigger additional waste in the form of defects if the waiting triggers a flurry of activity to "catch up" that results in standard work not being followed or shortcuts being taken.

In many ways, waiting is the opposite of overproduction. However, it can be eliminated with addressed through proper measurement of takt time and the creation of standard work.

2.26.7 Muda of Transportation

Though, transportation in the work place is an essential part of operations, moving materials or products adds no value stressed elimination of this muda will improve workplace operation. Poor plant design can cause waste in transportation. It can also trigger other wastes such as waiting or motion and impact overhead costs such as higher fuel and energy costs and higher overhead labor in the form of lift drivers as well as adding

wear and tear on equipment. It may also result from poorly designed processes or processes that have not been changed or updated as often as required.

Value stream mapping and partial or full changes in construction layout can reduce transportation waste.

2.27 Problem Solving

Where there are no problems, there is no potential for improvement. When you recognize that a problem exists, kaizen is already working. The real issue is that the people who create the problem are often not directly inconvenienced by it, and thus tend to not be sensitive to the problem. In day-to-day management situations, the first instinct is to hide or ignore the problem rather than to correct it (Shingo, 2010). By the nature the building construction industry is a complex industry due to the involvement of different stakeholders, materials, cost, plants, equipment and workers. So, it faces different problem in CI accordingly the kaizen philosophy is responsible to it, when you identify a problem, you must solve that problem. Once you solve a problem, you in essence surpass a previously set standard. This results in the need to set a new, higher standard and is the basis for the kaizen concept (Kothurd, 2017).

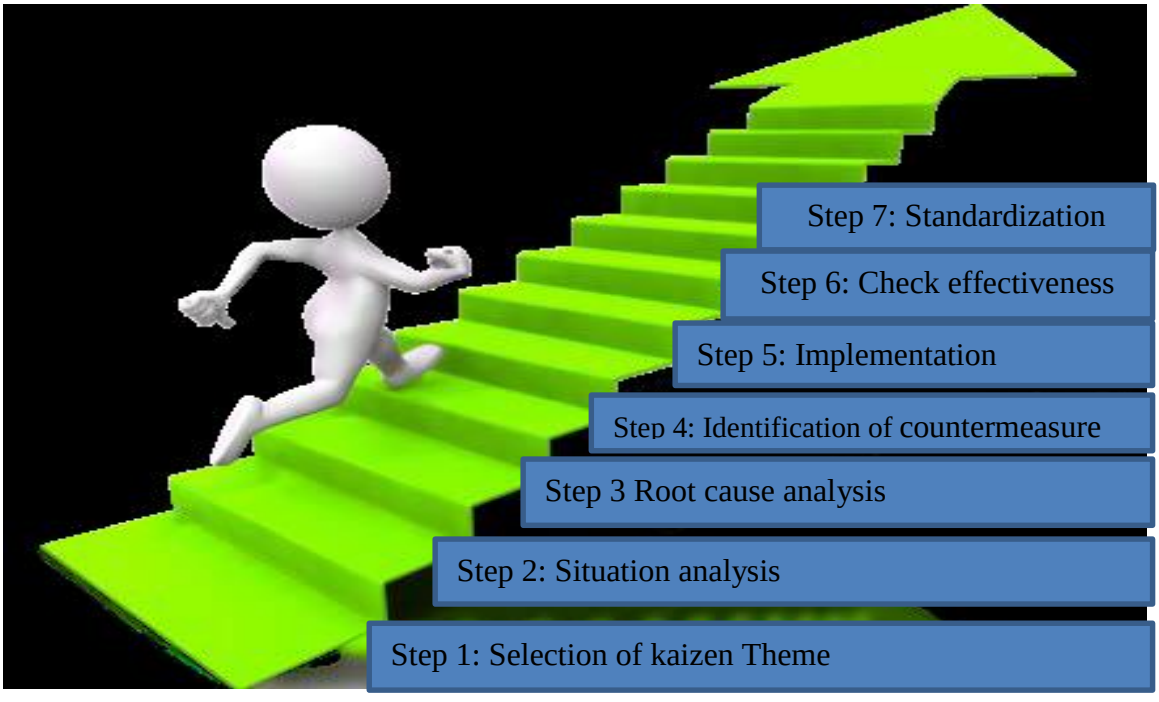


Figure 2.2:problem solving process

2.28 Principles of Sustainable Construction

The term sustainable construction was originally proposed to describe the responsibility of the construction industry in attaining sustainability (Ogunbiyi & Oyedolapo , 2014). The concept of sustainable construction addresses three main pillars: environmental protection, social well-being and economic prosperity (Steve & Odek, 2013.). Sustainable construction refers to the integration of environmental, social and economic considerations into construction business strategies and practice. According to (Steve & Odek, 2013.) sustainable construction is the set of processes by which a profitable and competitive industry delivers built assets (buildings, structures, supporting infrastructure and their immediate surroundings) which: enhance the quality of life and offer customer satisfaction, offer flexibility and the potential to cater for user changes in the future, provide and support desirable natural and social environments, and maximize the efficient use of resources. In view of this, there are many benefits that can be achieved by applying sustainable construction and these include environmental, economic, social, health and community benefits. The environmental benefits are improved air and water quality, reduced energy and water consumption, and reduced waste disposal. The economic benefits are reduced operating cost, maintenance cost, and increased sales price and rent while enhanced health and occupants comfort, and reduced liability are the health and community benefit (Luther, 2005).

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The study methodology leads to accomplish the research objectives. The first activity in this research was review literatures related to the research from different sources like: text books, research papers, journals, magazine, and web internet.

The population used in conducting the study was also being described. Sources of data, data analysis, interpretation and data presentation tools are explained in the chapter.

3.2 Study Area

The study area conducts at Jimma town, southwestern Ethiopia that is located in Oromia regional state, and 355 km distance from the capital city of Ethiopia.

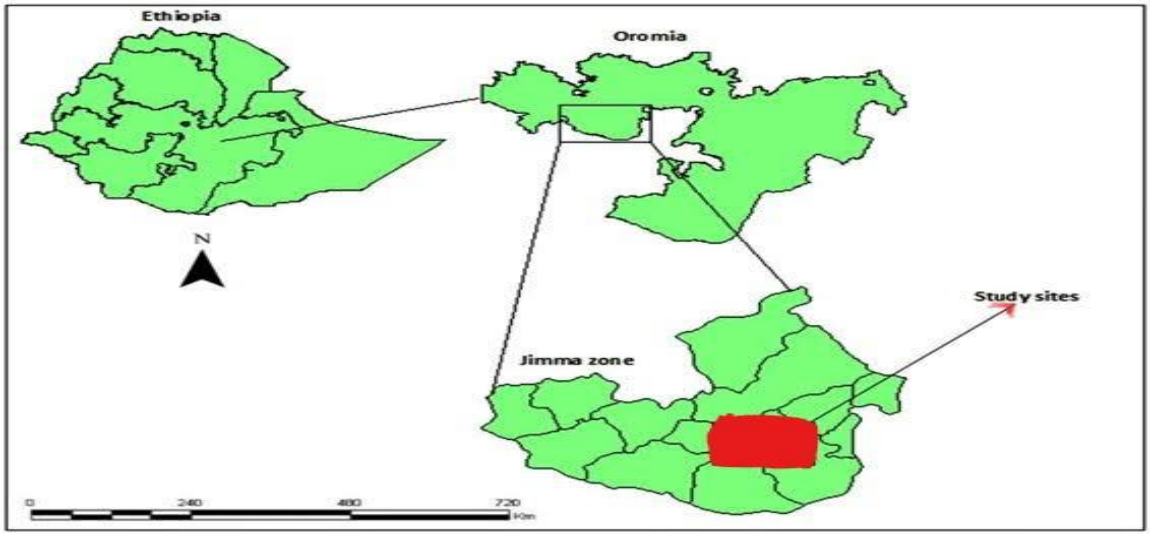


Figure 3.1:Map of Ethiopia, Oromia, Jimma zone and study sites(www.googlemap.com)

3.3 Research Design

In an attempt to get adequate and relevant information about the subject matter a combination of qualitative and quantitative data collection methods was used. Since this research focuses on assessment of kaizen principles of the building construction: the case of Jimma town, i.e. descriptive research design was used.

(Kumar & Signh , n.d.) explains that to describe the characteristics of a particular phenomenon, descriptive research is preferable. It is concerned with specific predictions,

with narration of facts and characteristics concerning individual, group or situation. According to (C.R.Kothari, 1985) descriptive research is concerned with: conditions or relationships that exist, practices that prevail, beliefs, points of views, or attitudes that are held, processes that are going on, effects that are being felt, or trends that are developing.

Mixed approach both quantitative and qualitative has been employed to answer the basic research questions. Mixed-method of research allows exploring relationships between variables in depth (Hassan & Norhidayah, n.d.). The researcher is guided by this particular method because of how the topic lends itself to being a phenomenon of study in addition to having a varied method of analysis for reliability. A mixed investigational design is used in an effort to describe the current practices of kaizen principle implementation in depth as (Hassan & Norhidayah, n.d.). This particular method not only provides statistical data through the use of survey but allows the researcher to obtain a more in-depth look into how to implement kaizen currently.

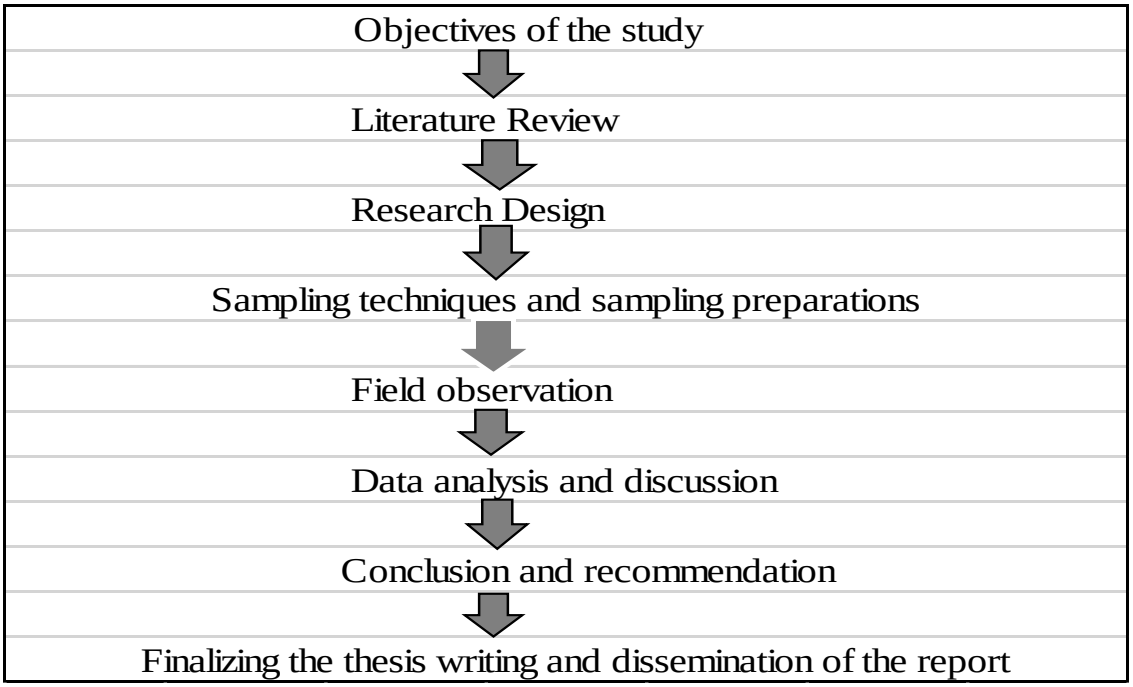


Figure 3.2: Research method and used approaches

3.4 Study Period

The research has taken seven months and it was started on July 2019 and it was ended on January 2020, which was including from data collection up to the final paper submission.

3.5 Population for the Study

A population is any group that is the subject of research interest (C.R.Kothari, 1985). The primary focus of this study is the kaizen principle of building construction: the case of Jimma town. The research followed a sampling process to select participants of the survey so as to fairly generalize the study of sample characteristics to the population (Esayas Alemayehu, 2018). Therefore, the populations for this research were all ongoing building construction project sites in Jimma town and the main sources of the information were contractors, consultants, clients and other civil engineer professionals were also involved in the interview as a way of triangulating the data obtained from the sites.

3.6 Sample Size and Sampling Procedures

(C.R.Kothari, 1985) define, a sample as a set of elements which ideally is representative of the population. A probability sampling would be used. With probability samples the chance, or probability, of each case being select from the population is known and is usually equal for all cases. The sample size of test to find the output of the research needs standards and specification based on population size. In the determination of the sample size, the most common technique is to compute the number of sampled representatives by considering the total population size.

3.7 Study Variables

3.7.1 Dependent Variables

Implementation of the kaizen principle in the building construction

3.7.2 Independent Variables

Awareness of stakeholders factors such as: training and education, commitment, involvement, management, communications, recourses, organizational objectives.

3.8 Data Gathering Method

Primary and secondary data sources were used for this research work, the researcher have been gathered questionnaires and interview for the primary data. Researchers tend to gather this type of data when, what they want cannot be find from outside sources (W. & Creswell , 2009). The questionnaire was distributed to the owner, contractors, site manager, storekeeper and other involvement to the project were ongoing process of the building construction in the Jimma town. The interview was conducted from site manager,

supervisor, owner, contractor and store keeper. To collect primary data, the researcher was distributed both opened ended and closed ended questions. In addition, secondary sources such as, company records, study findings, previous reports, working papers, and online references were also consulted.

3.8.1 Questionnaire

Questionnaire was developed based on: questions of the study, review of literature, and theories of the kaizen philosophy as a management tool in building construction. The questionnaires were closed-ended and open-ended; respondents have direct involvement of kaizen practical application in the project company. Further, the questionnaires can be detailed and help to cover many subjects or issues can be easily and quickly analyzed once the field data gathering work is completed. A rating is a measured judgment of some sort. While opened-ended questionnaires were used for respondents to explain their feeling and understanding freely as much as possible based on the question rises.

The questionnaires were distributed to the respondents by using hand to hand method. Every respondent has been given enough time to answer the questionnaire's questions. Only questionnaires that were fully completed were accepted, while those partially filled were not considered for the analysis. The valid questionnaire returned for analysis were 80 out of 85 distributed copies.

3.8.2 Interview

Interview is a form of verbal questioning and it is a principal means of data gathering. It is one of the most popular techniques in survey research (Catherine & Dawson , 2009). The research is used structured interviews to collect more detail information about the topic. For this, interview guides a written list of open items were prepared by the researcher and present to face to face interaction. This method was selected because it provides uniform information, which ensures the comparability of the data (Kumar & Douglas, n.d.). In order to triangulate the data obtained through questionnaire, a structured interview was conducted with the site manager, foreman, supervisors, store keeper and other worker’s involvement in the project.

3.8.3 Observation

The researcher conduct observation on selected project company production such as: management system of the company, ware houses, equipment, materials, daily workers, machine outline of the company, the company data records and other related issues in the sample selected.

3.9 Methods of Data Analysis and Presentation

Both qualitative and quantitative data analysis techniques were used in the study for the understanding of the complete picture of the implementation of the kaizen principle in the building construction. For quantitative analysis, micro soft office excels 2016 were used, and also for qualitative analysis descriptive statistics such as frequency, mean, standard deviation and percentage, were used to analyze the data obtained from questionnaire and interview.

3.10 Ethical Consideration

To do data collection process would have been conducted only after getting the letter of permission from Jimma University, Jimma Institution of Technology postgraduates research and publication director office.

3.11 Data Quality Assurance

The data have good quality by following the procedure guidelines such as: supervision and inspection area, checking quality of material using instrument, recording data properly, giving full attention to the work and use field visualization test, official work activities and fieldwork manuals.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 General and Particular Information

Generally, the response rate of the questionnaire was calculated as table 4.1 is 94.10 % which allowed further data analysis.

Table 4.1 : Returned Questionnaires from respondents

Respondents	Total distributed	Total responded	percent %
Owner	5	4	5
Contractor	4	3	3.75
Site manager	28	27	33.75
Foreman	28	27	33.75
Store keeper	20	19	23.75
sub-total	85	80	100

Table 4.1 above shows that out of 85 questionnaires distributed, 80 (94.10%) of the respondents were site manager is 27(33.75%), were storekeeper 19(23.75%), contractors 3(3.75%), owner 4(5%) and were foreman 27(33.75%) returned. Among the questionnaires returned the site manager and foreman are more responded than the other respondents.

4.2. Bio Data of the Respondents

Finding out the general information of the respondents is very important because it enables the researcher to gauge the reliability and validity of the data received and to know the type of people that he/she is dealing with. This information includes years or period in operation.

Table 4.2: distribution by sex

Sex of the respondents	Frequency	Percent(%)
male	58	72.50%
female	22	27.50%
sub-total	80	100%

As it indicated above table 4.2 according to the respondents, in this research males are more participated than female in building constructions in the case of Jimma town.

4.2.1 Distribution by Age

Age plays a critical role in understanding how people of different ages view the implementation of projects, to a larger extent an older employee is more experienced and is likely to relate issues more directly than relatively younger employees, while the younger employees are perceived to be more receptive to new technologies in the work place. It was also meant to determine whether the respondents were young, mature or old.

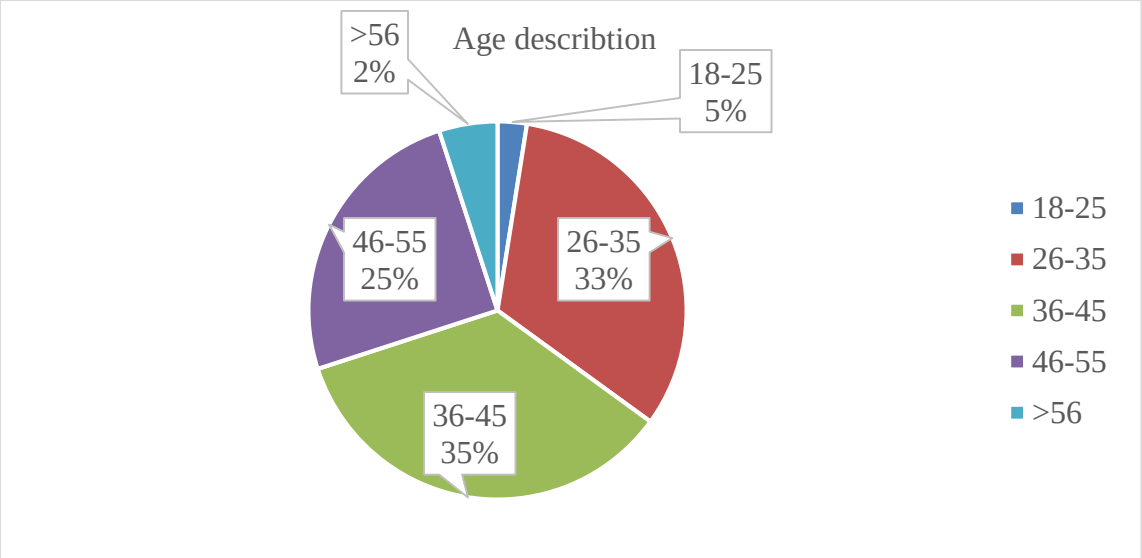


Figure 4.1: Age descriptions of the respondents

From the above figure 4.1 indicate that most of the respondents stated their age to be between 36 to 45 years represented by 35% of all the respondents have the highest percentage than the other respondents. This indicates that individuals involved in project development in the area relatively matured. This may imply that they can be able to adapt to new technologies and modern practices with ease. This outcome indicates that almost half of the respondents are categorized under the productive age and experienced group.

4.2.2 Distribution by Education Level

The level of education was critical in this study as it indicated in the chapter two of theoretical concepts exposure for the respondents that may influence their job performance.

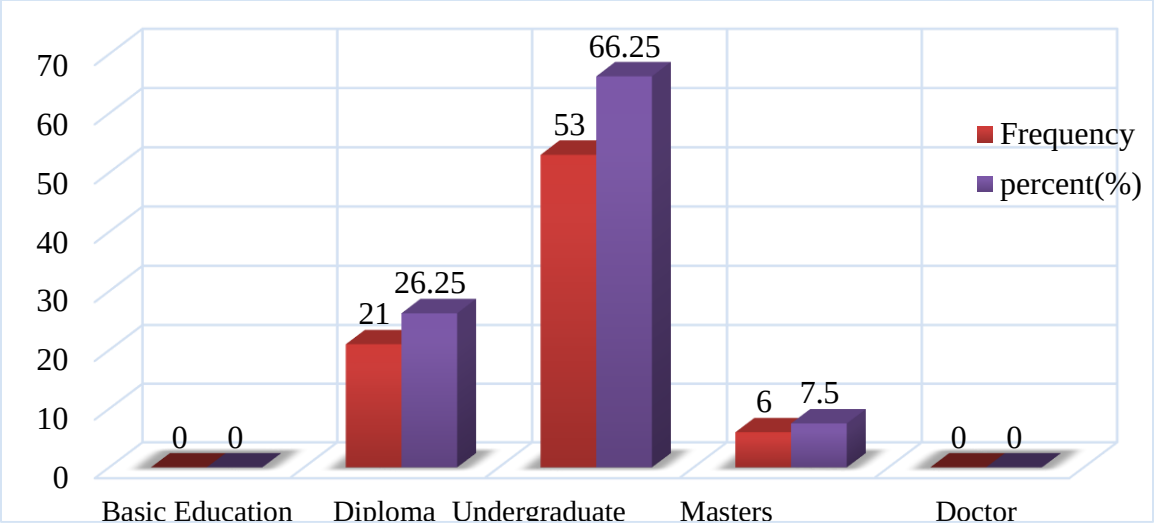


Figure 4.2: Respondents educational level

From the above figure undergraduate degrees were more involved in the project works than others. Overall the figures above indicate that most of the building construction employees are professional workers. This shows a good representative of the respondents in this study have a good educational background which is good for this study and significant for sustainability of kaizen.

4.2.3 Distribution by Career Level

The role played by the respondents in project delivery was important to be able to understand their responsibility in ensuring timely completion of the project.

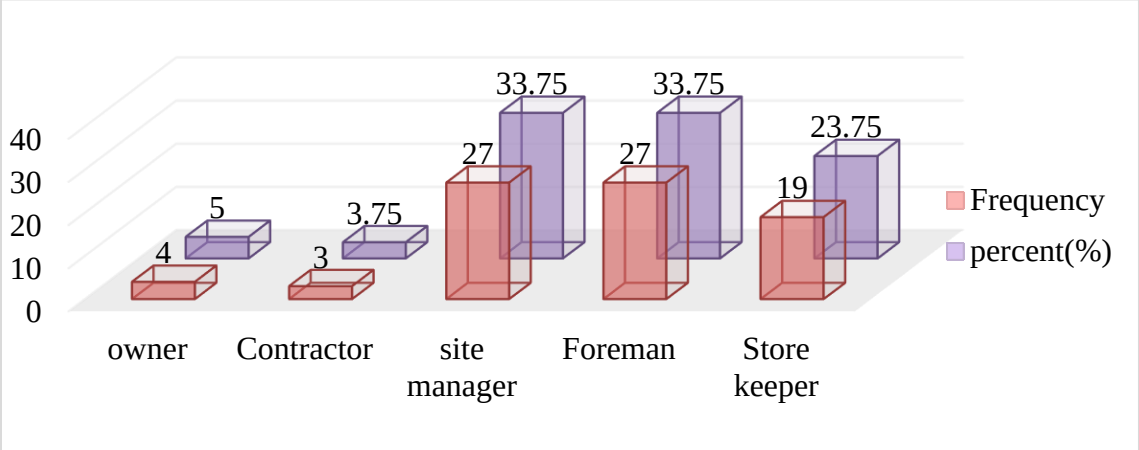


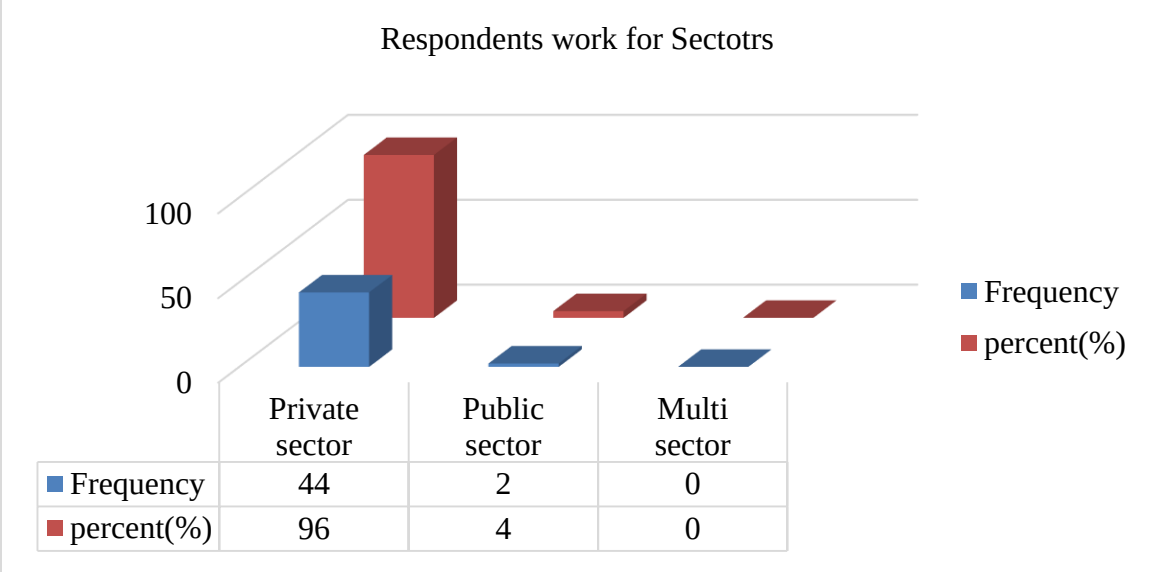
Figure 4.3: Distributions by career level of the respondents

From the above figure 4.3 the category of respondents was the key project stakeholders comprising 27(33.75%) were site manager and 27(33.75) were foreman are the most career level than the others who included in the general public and private sector buildings. These stakeholders were people who had been involved directly or indirectly in the implementation of the projects identified in the study.

Table 4.3: Respondents' years of experience

Years	Frequency	percent(%)
0 – 5	16	20
6 – 10	29	36.25
11 – 15	17	21.25
15 – 20	9	11.25
>20	9	11.25
sub-total	80	100

From table 4.3 above present the experience of the respondents were divided into five levels (0-5years, 6-10years, 11-15years,15-20 and above 20 years). From survey data 6-10 years were experienced workers are more participated in building constructions in Jimma town than the others levels of experienced.



	Private sector	Public sector	Multi sector
Frequency	44	2	0
percent(%)	96	4	0

Figure 4.4: Respondents sectors work

According to the survey result outputs from the figure 4.4 above, the private building construction on going were more than the others sectors in Jimma town.

4.3 Technical Information of the Respondents

Table 4.4: Knowledge of kaizen in building construction

Are you have knowledge of kaizen?	Frequency	percent(%)
Yes, I have good knowledge	15	18.75
Yes, I have a little knowledge	19	23.75
No, I don't have good knowledge	46	57.5
sub-total	80	100

From the above table 4.4 with regard to respondents' perception on their knowledge regarding continuous improvement (kaizen), 18.75% respondents confirmed adequate knowledge of continuous improvement, 23.75% respondents have little knowledge and the rest 57% respondents don't have a good knowledge of kaizen in building constructions.

As described in the literature review, kaizen is about organizational culture change; it is about changing the status quo (the mind set). In this regard, overcoming the traditional hierarchical work trend needs long way to go. This result shows almost half of the total respondents have no better kaizen knowledge, Therefore, they need further training on kaizen to provide good results in their projects.

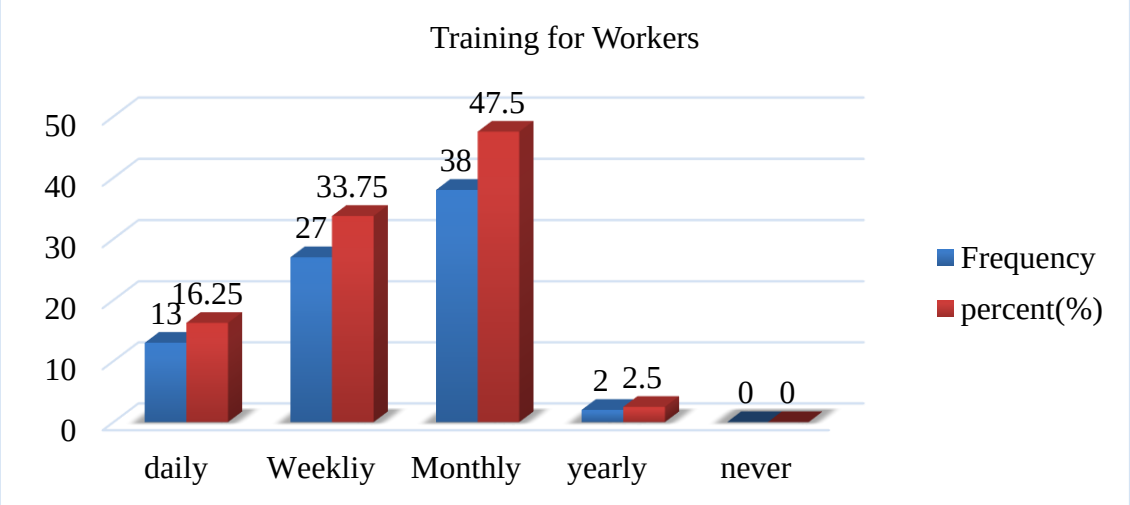


Figure 4.5: Respondents on workers training for continuous improvement

In the above figure were 38(47.5%) argue on the company has given training for their workers monthly and well-known system of the training of the respondents are positive impression on it. This results show it need further training for sustainable continuous improvement in building construction.

Table 4.5: brought radical change of kaizen in your company

Is kaizen radical change in your company?	Frequency	percent(%)
Yes, it can bring	25	31.25
No, I don't think so	55	68.75
sub-total	80	100

From the above table 4.5 survey results, the radical change of kaizen in the building construction companies were not agreeing to it. So the company needs to give training for their workers from top management to floor workers in order to adopt kaizen principles in their company.

4.4. Performance Methods of Kaizen in Building Construction

As described in the chapter two "5S" rules have immediate and significant effects on the sequence of activities, thus influencing the performance of processes in the company. It is a philosophy and checklist for good management to achieve greater order, efficiency and discipline in the workplace. In the management of five S activities survey, each "S" holds different questions as shown in the table below.

Sorting Activities responses -1st "S"

Table 4.6: " 1S" Sorting activity responses

No.	Question on "1S" (sorting)	μ	S.D
1	The team clear all non-value added items from the site	4	0.85
2	Sorting criteria established (e.g. frequency of use; actual quantity needed-no buffer)	3.6	0.864
	Average	3.8	0.857

On the basis of the first "S" sorting, the above two questions were examined. Therefore, the average mean value is 3.8 and standard deviation of 0.857. A response related to agree by the respondents. The range is almost reply on the agree among the Likert scale. Therefore, the company is sort what is not needed from the project area.

Setting in order activities responses - 2nd "S"

Table 4.7: "2S" Setting in order activities responses

No.	Question on setting in order	μ	S.D
1	Kelbu arranges and label needed items to use easily.	3.686	0.98
2	Improvement opportunities listed, discussed, and prioritized	3.637	0.856
3	Ideas for making the workplace more visually instructive	3.562	0.762
	Average	3.6	0.866

On the basis of the second "S" setting in order, the above three questions were examined. Therefore, the average mean value is 3.6 and standard deviation of 0.866. The range is almost reply on the agree among the Likert scale. Therefore, most building construction project company make things visible to perform the activities.

Shining Activities responses – 3rd "S"

Table 4.8: "3S" Shining Activities responses

No	Question on shining activities	μ	S.D
1	The kelbu keep thing shine in a condition so it is ready to be used when needed	3.587	0.957
2	Uses personal protective equipment (e.g. gloves, boots, safety glasses)	3.987	0.992
3	Observations shared among team members about inspection activity	3.287	0.96
	Average	3.62	0.97

On the basis of "3S" shining, the above three questions were examined. Their average mean value is 3.62 and standard deviation of 0.97. A response related to agree by the respondents among the Likert scale. Therefore, scrub everything that remains in the project.

Standardizing Activities responses – 4th "S"

Table 4.9: "4S" Standardizing Activities responses

No.	Question on standardize	μ	S.D
1	The company standardize to integrates sort, set in order, and shine into a unified whole.	3.8	0.878
2	Standard operating activity procedure	3.4	0.836
3	Documentation record standard	4.2	0.996
	Average	3.8	0.902

On the basis of "4S" standardize, the above three questions were examined. This activity include the companies standardize to integrate the above three activities (sorting, setting in order and shining) into a unified whole, ideas generated for establishing standard operating procedures and documentation created and updated. According to table above the following results were registered. The average mean value is 3.8 and standard deviation of 0.902. A response related to agree by the respondents among the Likert scales. Therefore, spread the clean/check routine is important. When others see the improvements in the kaizen area, give them the training and the time to improve their work area.

Sustaining activities responses - 5th "S"

Table 4.10: 5"S" Sustaining activities responses

No.	Question on sustaining	μ	S.D
1	Properly maintaining procedures and discipline to avoid backsliding.	3.86	0.874
2	Ideas generated for continuously improving company's 5S approach	3.675	0.948
3	Sustain methods clearly defined, with responsibilities and target dates identified	3.737	0.854
	Average	3.75	0.89

The result on sustaining shows that from the above table a mean average value is 3.75 and a standard deviation is 0.89. Based on the result, it can be deduced that kaizen implementation using" 5S" has helped the building construction to achieve improvements in light of such parameters as organization of work place, cost reduction and wise utilization of time and other resources. Therefore, standardization and self-discipline. established a cleaning schedule, use downtime to clean and straighten area.

Totally, all the 5S activities analysis indicates that they are successfully implemented on the building construction companies according to the survey source output.

4.5. The Key Challenges Faced to Implement kaizen in Building Construction

As described in literature review kaizen focused on eliminating waste (muda) and losses from the processes. As it discussed in chapter two waste as any activity that creates or adds no value to the process defined by ultimate customer. The seven types of waste caused by: overproduction, unnecessary inventory, inappropriate processing, unnecessary motion,

excessive transportation, defects and waiting. As previously discussed, one objectives of kaizen as seen in the literature reviews are to reduce waste or muda based on non-value adding activities includes removing unnecessary wastes caused by people and machine on inventories, lead time, defects, set-up time, handling, and a lot size of in the process. This could be happened by project company may have more than necessary equipment, materials or people for quantity production. Muda or waste elimination can be the most cost effective way of improving productivity and reducing operating costs.

Table 4.11: Summarized 7"M" muda elimination activities output

No.	Pillars of Muda	Questions	μ	S.D
1	Overproduction	The company does not produced more than immediate use.	4.5	1.12
2	Unnecessary inventory	Any raw material or work in process that not exceed what company needs.	4.2	0.916
3	Inappropriate processing	Adding more value than the agreed standard work process procedures or systems	4.2	0.932
4	Unnecessary motion	There is no poor workplace organization, resulting in poor ergonomics for example excessive bending or stretching	3.35	0.876
5	Excessive transportation	There is no unnecessary movement of products, materials or information resulting in wasted time, effort and cost.	3	0.766
6	Defects	There is no defect production that results in rework.	2.85	0.69
7	Waiting	Non activity period for operator or machine is reduced.	2.5	0.60

In the chapter two, the seven types of waste elimination are discussed. Each type of waste has one question that the respondents are answered. Therefore, there are seven questions. From table 4.11 above the summarized mean and standard deviation score for waste reduction activity of kaizen implemented factors were calculated based on Likert scale.

Out of seven activities stated above, overproduction, unnecessary inventory, inappropriate processing activities had a mean value greater than 4 and standard deviation related to 1.0. This is an indication that, almost all of the respondents, had variations in the rating of their level of identified wastages in building construction in their activities while a minority of

three had a mean value less than 4 and standard deviation less than 0.9 indicating some level of agreement among the respondents' ratings.

According to the respondents the mean of overproduction, unnecessary inventory, and inappropriate processing is greater than 4 which lies on the range of "agree". This show that there is no overproduction, unnecessary inventory and inappropriate processing in the project site area according to the survey data output. On the other hand, the highest level of muda was reported for muda of excessive transportation, unnecessary motion, defects and waiting less than 4 mean (μ) value. Therefore, they are rated lies on the range of "Neutral". As regarded the sample building construction project sites, the level of all the seven types of waste in the building construction production process needs an improvement to get more value added to the projects.

4.6 Factor Contributions of Kaizen Implementation

The factor affecting the sustainability of kaizen implementation event in building constructions are contains two parts. Part one the main stakeholders in building construction such as developer/owner, main contractor, designer. Part two the factors contributions for kaizen principles in building construction such as: commitment, employee involvement (team work, opinion and suggestion), training system, management encouragement, clear objective setting and measurement, availability of resources and existence of cross-functional teams are among the factors contributing to the success of kaizen implementation based on interviews with kaizen team members of the project site.

4.6.1 The Main Stakeholders Factors Contributions in Building Construction

Researcher were asked different questions regarding the factors contributions in building constructions affecting for kaizen implementation and kaizen sustainability activity. Based on the responses on the survey their responses are organized and the key success factors of the kaizen implementation evaluated according to table 4.12 survey result in the following manner.

Table 4.12:The main stakeholders in building construction

Questions	Respondents on owner						
On owner		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total
Gives complete knowledge about the project	Frequency	0	3	21	43	13	80
	Percent(%)	0	3.8	26	54	16	100
Improves the capacity of teams to control costs efficiency	Frequency	0	2	13	51	14	80
	Percent(%)	0	2.5	16	64	18	100
Facilitate costs for life cycle of project based on kaizen	Frequency	23	29	22	4	2	80
	Percent(%)	29	36	28	5	3	100
Delays in financing the project by the owner	Frequency	0	2	23	46	9	80
	Percent(%)	0	2.5	29	58	11	100
On designer	Respondents on Designer						
Allows the design team based on kaizen	Frequency	19	24	21	10	6	80
	Percent(%)	24	30	26	13	8	100
Integrating the team during the design phase through kaizen	Frequency	10	29	33	5	3	80
	Percent(%)	13	36	41	6.3	4	100
Inadequate details of drawings	Frequency	36	32	12	0	0	80
	Percent(%)	45	40	15	0	0	100
Uses of the kaizen in project execution phases	Frequency	26	34	11	9	0	80
	Percent(%)	33	43	14	11	0	100
Facilitate the designs of constructive solutions	Frequency	0	0	6	51	23	80
	Percent(%)	0	0	7.5	64	29	100
On main contractor	Respondents on main contractor						
Uses of kaizen knowledge in building construction	Frequency	12	39	24	5	0	80
	Percent(%)	15	49	30	6.3	0	100
Produce good quality product and service	Frequency	0	0	4	53	23	80
	Percent(%)	0	0	5	66	29	100
Execution of project use the kaizen principle	Frequency	6	21	29	21	3	80
	Percent(%)	7.5	26	36	26	4	100
Avoid problems related to the projects using kaizen	Frequency	9	27	32	8	4	80
	Percent(%)	11	34	40	10	5	100
Uses kaizen principle during supervision	Frequency	23	28	24	5	0	80
	Percent(%)	29	35	30	6.3	0	100

4.6.1.1 Respondents on the Owner

The developer/ owner, is one of the major factors in the building construction to achieve the project implementations process to full fill the financial flows. According to the table

4.12 above present the opinions of the respondents on owner gives complete knowledge about the project 43 (54%) were agree, improves the capacity of teams to control costs efficiency were 51 (64%) agree, facilitate costs for life cycle of project based on kaizen were 29 (36.25%) disagree, delays in financing the project by the owner were 46(57.5%) agree. So according to the respondent's owner more participate to improves the capacity of teams to control costs efficiency were 51 (63.75%) agree. From the survey output source, the owner is relying on the "agree" among the Likert scale than the other stakeholder's factors. Therefore, the owner is take more major contributing factors on the implementations of kaizen in building construction rather than the other stakeholders.

4.6.1.2 Respondents on the Designer

Table 4.12 above present the opinions of the respondents whether the developer/ owner, designer and main contractors are the major factors in the building construction for the kaizen implementation in their projects. According to the respondents the designer allows the design team based on kaizen were 24(30%) disagree, Integrating the team during the design phase through kaizen were 33 (41.25%) neutral, inadequate details of drawings were 36 (45%) strongly disagree, uses the kaizen in project execution phases were 34(42.5%) disagree, facilitate the designs of constructive solutions were 51(63.75%) agree. So according to the respondents the designer is, facilitate the designs of constructive solutions were 51 (63.75%) agree is greater than the other questions. From the survey output source, when totally seen the values of the respondents under the designer based on data output source the designer is relying on the "Disagree" among the Likert scale which means that the question was need negative response than the other stakeholder's factors. This shows that the designer is not familiar with the kaizen issue during the design. Therefore, the designer might be experienced using appropriate methodology for problem solving in all his/her job activities.

4.6.1.3 Respondents on Main Contractors

A contractor is anyone who directly employs or engages construction workers or manages construction work. Contractors therefore have an important role in planning, managing and monitoring their work to ensure any risks are controlled. Contractors are responsible for supplying the necessary equipment, material, labor, and services to complete the

project. So from the above table 4.12 the opinions of the respondents on the main contractors uses of kaizen knowledge in building construction were 39 (48.75%) disagree, to produce good quality product and service were 53 (66.25%) agree, to execution of project use the kaizen principle 29 (36.25%) were neutral, avoid problems related to the projects using kaizen 32(40%) were neutral, to uses kaizen principle during supervision 28(35%) were dis agree. So according to the respondents the main contractor participates more to produce good quality product and service were 53 (66.25%) agree is greater than the other. From the survey output source, based on the respondents the main contractor is relying on the "Neutral" among the Likert scale than the other stakeholder's factors. This result shows that the main contractor doesn't contribute to use of kaizen in building construction. Therefore, the contractors might to adopt the kaizen issues in his/her works to complete the building construction according to the given specification, schedule, budget to produce good quality product and service in a good manner.

4.6.2 Factors Contribution of Kaizen Implementation in Building for the Workers

Researcher were asked different questions regarding to the factors contributions in building constructions affecting for kaizen implementation and kaizen sustainability activity in building construction given for the workers in the work areas. Based on the responses on the survey their responses are organized and the key success factors of the kaizen implementation evaluated according to table 4.13 survey output results in the below.

Table 4. 13: Factors contributions for kaizen implementation in building constructions

No.	Factors	(μ)	S.D
	Education and training for workers		
1	Luck of regular training of workforce has influenced principles of kaizen improvement outcome in your company.	3.7	0.845
2	Skilled manpower is one of the capacity constraint to withstand kaizen	3.2	0.97
3	Employees demonstrate, by words and actions, that they understand the mission, vision and values of their project company	3.41	0.98
4	There is no experience using an appropriate methodology, techniques and tools for problem solving.	1.85	1
	Average	3.04	0.95
	Commitment		
5	Site manager work commitment has been improved as a result of implementation of kaizen	2.76	0.87
6	Employee commitment and innovativeness is one of the challenges facing Kaizen principle	2.94	0.93
7	Employees attitude towards teamwork has been improved.	4.1	1.14
8	There is an interest in changing or adopting Kaizen activities	2.72	0.816
	Average	3.13	0.939
	Involvement		
9	There is a site managers involvement and support towards the adopting of kaizen principles	2.21	0.838
10	Having positive attitude to actively involved labors in problem solving, quality & productivity improvement	4.1	1.03
11	There is no enough expertise involvement on how to implement Kaizen activities.	3.9	1.1
12	Team problem solving habit has been established	3.88	1.06
13	Employer feedback enhancing our company's kaizen implementation.	2.53	0.94
	Average	3.32	0.99
	Communication		
14	There is a good communication and coordination between stakeholders and workers.	4.175	1.2
15	There is regular feedback and communication system between site engineer and daily labor.	4.25	1.2
	Average	4.2	1.2
	Resources		
16	There is no enough time for the company to currently implement Kaizen activities.	3.11	0.9
17	Financial constraint is a challenge facing in our company for Kaizen implementation	3.325	0.96

18	There are no enough spaces to implement kaizen principles in your work unit	2.63	0.908
	Average	3.02	0.922
	Organizational objectives		
19	Employee work culture has been improved as a result of implementation of kaizen principle	1.96	0.87
20	The workers structure affects principles of kaizen	2.55	0.86
21	There is good supervisor responsibility to encourage and facilitate positive change in your project.	4.125	1.13
22	Lack of infrastructure can affect the principles of kaizen	4.01	0.98
23	Kaizen improve the project working process.	2.33	0.85
24	Uses of kaizen event results ensuring job security	2.25	0.916
25	Kaizen implementation improves safety and health issues	2.35	0.98
	Average	2.8	0.94
	Management		
26	your top manager is support about kaizen issue.	2	0.99
27	There are clear standards for considered acceptable work	4.13	1.03
28	Processes have been documented with measures to understand performance of kaizen output.	2.83	0.95
29	Ineffective performance measures of Kaizen is affect Kaizen success	3.225	0.83
30	There is periodical evaluation of 5S activities with PDCA and other tools for further improvements	4	0.93
	Average	3.237	0.946
	Strategic planning		
31	your company has clear corporate strategies for continuous improvement.	4.06	1.21
32	The company has a long-term plan and follow up on a day-to-day activity.	4.14	1.3
33	Establish policies has enabled to sustain Kaizen improvement outcome.	2.425	0.936
	Average	3.54	1.14
	Motivation		
34	There is a rewards and recognition system to motivate workers to increase performance	4.025	1.27
35	Daily labors are satisfied with their jobs and be interested in working to continuously improve their performance	4.03	1.17
36	Monetary incentives, such as bonuses and salary or wage increases for workers	4.31	1.14
	Average	4.12	1.19

From above table 4.13 there are nine factors contribution for the kaizen implementations and sustainability in the building construction with holding different questions in each

factors. From the survey data output the respondents responded, both the communication and motivation factors are the most contribution factors rather than the other. The communication mean value is 4.2 and standard deviation 1.2, and motivation factors were mean value 4.12 and standard deviations 1.19. This shows all the project building sites communications and motivations in the project area rely on agree among the Likert scale and they have a good communication and motivation in the company according to the respondents.

Communication is an important factor in successful kaizen implementation. Therefore, communication is critical to the work processes in building.

Motivation factor is associated with people and all employee's encouragement. In this main factor rewards and recognition, job satisfaction and monetary incentive for workers are included. This result indicates that, kaizen implementation in this project insure that the improvement as they expected regarding to the motivation of the workers with the uses of kaizen principles performance in the building construction.

But organizational objectives factors were the mean value 2.8 and standard deviations 0.94 is the most least among the factors. This result indicates that, kaizen implementation in this project not insure the improvement as they expected regarding to the organization objectives with the uses of kaizen principles.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusions

According to the data collected and analyzed in this research study, implementation of the kaizen principles of building construction in the Jimma town has highly contributed to meeting its strategic objectives on waste minimization, boosted team spirit culture, and has encourage quality products. Thus, implementation of kaizen in building construction has increased the practice of improving most of the project production systems and it contributed a lot to every other projects improvement through reducing production cost, resource utilization and avoiding non value adding activities.

On the basis of the findings, the first phase performance methods of activities using these identified kaizen principle factors has been successfully implemented in all project sites.

Therefore, kaizen has paved the way for the building construction bright future through mobilizing resources, enhancing management work commitment, facilitating team building. Much more, the employee attitude towards teamwork has been improved; that is, it has been possible to create effective team and work accomplishment. Furthermore, as has been discussed in the data analysis, Kaizen implementation in building construction in the case of Jimma town has brought significant achievements on each stakeholders, worker's attitude, equipment and working environments.

Even if all the benefits of the above are found in the project site, the kaizen implementation program has been not yet in pervious time in the building construction in Jimma town. The reasons for not used in the previous time of kaizen philosophy are, most of the stakeholders in the building constructions are not familiar with kaizen principles in the building construction.

The personal interviews and questioner's response shows implementation of kaizen has not increased the practice of improving in the sample project site and project objectives. In general, kaizen is an endless journey; all the project site that have interrupted the implementation must work hard and return to this philosophy.

5.2. Recommendation

On the basis of findings and conclusions drawn from the study, the following recommendations are proposed.

- Contractors, consultants, clients and other professionals working in the construction should increase their resource commitment to staff training and development in construction materials management so as to develop the necessary skills, update their knowledge, and enhance new product development for the reduction of problems and wastages.
- The contractors should be dedicated to change existing working culture to improve the productivity improvement practices in building construction area.
- The site managers give special attention to understand the basic key success factors of the kaizen principles and providing effective training within a specified time frame when implements the kaizen philosophy to the organization during building constructions.
- The site manager should follow the scientific thinking mechanisms to solve problem solving, and PDCA cycle approach extensively for process control and improvement.
- The project manager gives special attention to understand the basic key success principles of kaizen for the projects and providing effective training for workers.
- The project manager actively adopts the culture of training and developing their staff with new managerial tools and techniques of kaizen principles in construction.
- All the stakeholders of the company should establish evaluation systems to measure the performance of the employees to better follow the problem solving analysis work in progress
- The building project company should establish kaizen institute to have scheduled visiting program in all kaizen implemented origination to give his assistance when it needed.

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APPENDIX I

JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

SCHOOL OF GRADUATE STUDIES

FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING

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Dear respondents, I am a postgraduate student of the above mentioned institution and currently undertaking a research on "**Assessment of the Kaizen principle of building construction: The case of Jimma Town"**

Your project company is one of the few companies chosen for the research. Your participation in the study is completely voluntary.

The purpose of the questionnaire is to obtain information, based on your personal view, on how the Kaizen principle implementation impact your performances and the challenges encountered upon implementation in your company projects.

The quality of the result of this research is based on the accuracy of the information you provided. The research work is for academic purpose only. Thus, the research will assure the information provide is going to be reported and communicated in collective data only with no personally identifiable. Any information obtained in connection with this study will remain strictly confidential nothing will be tied back to any individual names.

In order for your responses to be useful, all responses to the items contained in this questionnaire should accurately reflect your true opinions. Please take a few minutes to provide your honest opinion about each statement. Your honest opinion is very valuable to the success of this study.

Note

- ✓ You are not required to write your name.

- ✓ Put in the box provided □ a Tick symbol.
- ✓ Question related to your opinion please write shortly and precisely on the space provided.
- ✓ Your response will be confidential and it will be used only for research purpose.

The questionnaires are framed into different parts: such as: part I. General Information, part II. Technical questions, part III: 5 "S" activities, part IV. Muda /waste/ elimination activities, part V. The major contributing factors for the effective implementation of Kaizen, and part VI. In-depth interview questions.

Questionnaire

Part I. General Information

Instructions: Please answer by making a tick √ in the given rectangle (□) accordingly:

1. Kindly indicate your gender. Male □ Female □

2. Which one best describes your age?

18-25 years□ 26-35 years □ 36-45 years□ 46-55 years□ above 56 years□

3. Kindly indicate the highest level of your education.

Basic Education□ Diploma □ Undergraduate□ Masters□ Doctor□

4. Kindly indicate your careers. owner □ contractor □ site manager□

Foreman □ store keeper□

5. For how long have you worked for your current Company?

0 – 5 years □ 6 – 10 years□ 11 – 15 years□ 15 – 20 years□ above 20 years □

6. What is the sector type you work for?

Public building Sector□ Private building Sector□ Multi□

Part II. Technical questions

1. Do you think you have enough knowledge about Kaizen? Yes, I have good knowledge□

I have a little knowledge□ I don't have any knowledge□

2. How often the workers have training for continuous improvement activities?

daily □ weekly □ monthly □ yearly □ never □

3. Do you think Kaizen has brought radical change in your company?

Yes, it can bring □ No I don't think so □

4. If your answer is " yes" for question number 3, what are the radical changes? Explain…….

……

……

5. If your answer is " no" for question number 3, Why? Explain……...

……

……

Part III: The 5 "S" activities in building construction to minimize effort

1. Does the site manager support 5S kaizen initiatives in your company?

Yes □ No □ Don't know □

2. Is there a typical timeline for teams to meet their work goals?

Yes □ No □

3. If your answer for 2 is yes, How often Kaizen group activities?

Daily □ weekly □ two-weeks □ monthly □

Use the scale given below to appropriately answer the questions that follow by ticking **(√)** accordingly.

1= Strongly Disagree, 2= Disagree, 3= Neutral 4= Agree, 5= Strongly Agree

Note: 5S stands for: Seiri (Sort), Seiton (Straighten/set in order), Seiso (Shine), and Seiketsu (Systematize / Standardize), and Shitsuke (sustain /Self-Discipline)

Kelbu means Development of team work

Pillars	5"S" activities	Strongly disagree	Disagree	neutral	Agree	Strongly Agree
		1	2	3	4	5
Seiri (Sorting)	Team clear all items none value added from the site					

	Sorting criteria established (e.g frequency of use; actual quantity needed-no buffer)					
Seiton (Straighten/set in order)	The Kelbu arranges and label needed items so that they are easy to use.					
	Improvement opportunities listed, discussed, and prioritized					
	Ideas for making the workplace more visually instructive					
Seiso (Shining)	The Kelbu keep thing shine in condition so it is ready to be used when needed					
	Personal Protective Equipment (e.g. gloves, boots, safety glasses) distributed					
	Observations shared among team members about inspection activity					
Seiketsu (Systematizing / Standardizing)	The company standardize to integrates Sort, Set in Order, and Shine into a unified whole.					
	Standard operating activity procedure					
	Documentation record standard					
Shitsuke (sustain /Self-	Properly maintaining procedures and discipline to avoid backsliding.					
Discipline)	Ideas generated for continuously improving company's 5S approach					
	Sustain methods clearly defined, with responsibilities and target dates identified					

Part IV; Challenge faced during implementation of kaizen (7Muda)

Note:7M stands for seven muda(wastage): Such: Overproduction, Unnecessary inventory, Inappropriate processing, Unnecessary motion, Excessive transportation, Defects, Waiting

PDCA: Plan, Do, Check, Act

Pillars of 7M	Muda /waste/ elimination activities	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
		1	2	3	4	5
Overproduction	The company does not Produced more than immediate use.					
Unnecessary inventory	Any raw material or work in process that not exceed what company needs.					

Inappropriate processing	Adding more value than the agreed standard work process procedures or systems					
Unnecessary motion	There is no poor workplace organization, resulting in poor ergonomics for example excessive bending or stretching					
Excessive transportation	There is no unnecessary movement of products, materials or information resulting in wasted time, effort and cost.					
Defects	There is no defect production that results in rework.					
Waiting	Non activity period for operator or machine is reduced.					

Part V; <u>The major contributing factors for the effective implementation of Kaizen</u>

Use the scale given below to appropriately answer the questions that follow by ticking **(√)** accordingly. 1= Strongly Disagree, 2= Disagree, 3= Neutral 4=Agree, 5= Strongly Agree

no	The Main Stakeholders in Building Construction	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
	Owner					
1	Gives complete knowledge about the project					
2	Improves the capacity of teams to control costs efficiency					
3	Facilitate costs for life cycle of project based on kaizen					
4	Delays in financing the project by the owner					
	Designer					
5	Allows the design team based on kaizen					
6	Integrating the team during the design phase through kaizen					
7	Inadequate details of drawings					
8	Uses the kaizen in project execution phases					
9	Facilitate the designs of constructive solutions					
	Main Contractor					
10	Uses of kaizen knowledge in building construction					
11	To produce good quality product and service					
12	To execution of project use the kaizen principle					
13	Avoid problems related to the projects using kaizen					

14	To uses kaizen principle during supervision					

No	Factors contribution for the kaizen principle	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
		1	2	3	4	5
a. Education and training for workers						
1	Luck of regular training of workforce has influenced the principles of Kaizen improvement outcome in your company.					
2	Skilled manpower is one of the capacity constraint to withstand Kaizen					
3	Employees demonstrate, by words and actions, that they understand the mission, vision and values of their project company					
4	There is no experience using an appropriate methodology, techniques and tools for problem solving.					
b. Commitment						
5	Site manager work commitment has been improved as a result of implementation of kaizen					
6	Employee commitment and innovativeness is one of the challenges facing Kaizen principle					
7	Employees attitude towards teamwork has been improved.					
8	There is an interest in changing or adopting Kaizen activities					
c. Involvement						
9	There is a site managers involvement and support towards the adopting of kaizen principles					
10	Having positive attitude to actively involved labors in problem solving, quality & productivity improvement					
11	There is no enough expertise involvement on how to implement Kaizen activities.					
12	Team problem solving habit has been established					
13	Employer feedback enhancing our company's kaizen implementation.					
d. Communication						
14	There is a good communication and coordination between stakeholders and workers.					
16	There is regular feedback and communication system between site engineer and daily labor.					
e. Resources						

16	There is no enough time for the company to currently implement Kaizen activities.					
17	Financial constraint is a challenge facing in our company for Kaizen implementation					
18	There are no enough spaces to implement kaizen principles in your work unit					
	f. Organizational objectives					
19	Employee work Culture has been improved as a result of implementation of kaizen principle					
20	The workers structure affects principles of Kaizen					
21	There is good supervisor responsibility to encourage and facilitate positive change in your project.					
22	Lack of infrastructure can affect the principles of Kaizen					
23	Kaizen improve the project working process.					
24	Uses of kaizen event results ensuring job security					
25	Kaizen implementation improves safety and health issues					
	g. Management					
26	your top manager is support about kaizen issue.					
27	There are clear standards for considered acceptable work					
28	Processes have been documented with measures to understand performance of kaizen output.					
29	Ineffective performance measures of Kaizen is affect Kaizen success					
30	There is periodical evaluation of 5S activities with PDCA and other tools for further improvements					
	h. Strategic planning					
31	your company has clear corporate strategies for continuous improvement.					
32	The company has a long-term plan and follow up on a day-to-day activity.					
33	Establish policies has enabled to sustain Kaizen improvement outcome.					
	I. Motivation					
34	There is a rewards and recognition system to motivate workers to increase performance					
35	Daily labors are satisfied with their jobs and be interested in working to continuously improve their performance					
36	Monetary incentives, such as bonuses and salary or wage increases workers moral					

Part VI: In-Depth Interview Questions

Thank you for making the time for this interview. The purpose of this interview is to gain how continuous improvement (kaizen) principle is applied into your project company.

Date…….

Project Company Name……

Position …….....

Job Title……

1. How is the Kaizen principle uses in building construction with minimum effort?
2. What are the challenges faced during building construction in the implementation of Kaizen?
3. Which of these challenges are your companies still facing?
4. What are the major contributing factors to the effective implementation of Kaizen?
5. How do you solve the problems that occurred in your company?
6. Who takes accountability when problem was occurred in your company?
7. What are the best practices from your company in applying Kaizen?
8. Are there strong commitment on 5S and waste elimination practice?
9. Do you think Kaizen implementation improve the performance of the company in terms of quality, time, work flow process and cost?
10. What are significant positive outcomes for the company based on kaizen adoption?
11. How do you communicate goals and strategies with your employees?
12. How do you reward workers for their performance?
13. How does kaizen improve quality and productivity?
14. Any other comments on kaizen principles regarding to building construction?

Thank you again for your time.