

The significance of kaizen in Engineering Universities of Ethiopia:

A review

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ABSTRACT

Engineering universities are the firms where technical teaching and research activities are conducted. In this place, a variety of resources are accessed to transform the basic knowledge and skill of engineering and to solve real-world problems. These resources need a kaizen implementation for malfunction protection and waste reduction. Kaizen is a correction tool in the experimental laboratories of engineering universities. It is also applied every day by all individuals and everywhere to bring continuous improvement with low investment costs. The main objective of this review manuscript relies on the significance of kaizen for the reduction of waste in engineering universities. This review also focuses on the application of 5S (sort-set in order-shine- standardize –sustain), and PDCA (plan-do-check-act) cycles in the laboratories of engineering universities. Kaizen implementation methods may vary from organization to organization depending on the available resources like space, equipment, and consumable materials. Indeed, there are no sufficient research outputs related to the significance of kaizen in universities. However, some related research outputs from industries are adapted in universities with certain modifications. This review paper is a qualitative study and is achieved typically via summaries of previously published studies on kaizen implementation in industries, technical colleges, and universities. The findings of researchers on the practices of kaizen indicated promising results on housekeeping and waste reduction. In general, a comprehensive research study should be made on the implementation techniques and sustainability of 5S in the laboratories of engineering universities..

Keywords: Kaizen, 5M, 5S, 7wastes

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DOI: <https://doi.org/10.20372/pjet.v1i1.1278>



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Nomenclature: PDCA= Plan-do-check-act, EKI = Ethiopia Kaizen institute, TQC = Total quality control, TPM=Total productive maintenance

1. Introduction

1.1. The Rationale for Kaizen implementation

To achieve social and economic development, Ethiopian authorities are given higher education to their citizens. Over 35% of Ethiopia's budget range is going to education. Approximately 25% of her populations are presently in tertiary universities, and 46% of her population is literate. There are 83 private universities, 42 public universities, and more than 35 institutes of higher learning [1].

Engineering by nature is wondering and doing inquiry professions. Engineering combines a laboratory orientation with a huge theoretical presentation to offer university students the capabilities needed to work alongside expert engineers in a wide range of business and research settings. Consequently, the government of Ethiopia has given a massive emphasis and invested a massive budget to fulfill the requirement of laboratory equipment and machinery in all engineering universities. Moreover, there is a need to keep equipment and materials in safe conditions by applying the philosophy of kaizen. To acquire their need, large funding has been financed inside the practical engineering laboratories to equip them with research-grade equipment, machinery, and consumable materials [2, 3, and 4]. The flow system of consumable raw materials and machinery from buying to scrape management is presented below in Figure 1.

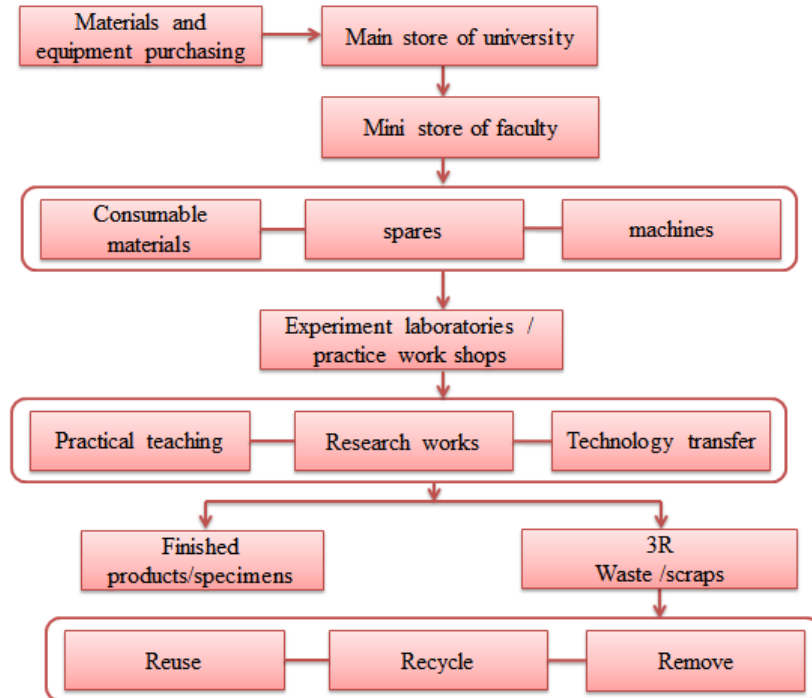


Figure 1. Materials flow system in laboratories of Ethiopian engineering universities (adapted by the author)

In this case, the wise utilization of resources and waste elimination can be maintained in each block by implementing kaizen (continuous improvement). In a general implementation of kaizen in engineering universities can provide many advantages such as reduction of defects, create more space, reduce searching for tools, reduce walking in the shop, improve ergonomics challenges, improved chance of accidents, bringing things within reach, acquiring better skills, save materials, make work faster, and make the workplace look neat and clean.

2. Objective of the review

The main objective of this review manuscript is to focus on the significance of practices of kaizen in Ethiopian engineering universities and recommend the research gaps for further study to sustain 5S and waste reduction by the accountability of assigned workers.

3. Methods and materials

The methods to review this paper are achieved typically via surveys and summaries of previously published studies on kaizen implementation in industries, TVET colleges, and technical universities in Ethiopia. Since the implementation procedures and methods can be adapted easily with slight modifications. The sources of review include training power points, journals, peer-reviewed articles, books, thesis or dissertations, websites, proceedings, and personal observations. The study is a qualitative one that is descriptive in nature. The manuscript concentrates on suggesting a technique for applying kaizen in academic engineering universities. For this reason, the idea of 5S, waste elimination techniques, and the PDCA (Plan-Do-Check-Act) cycle has been presented right here.

4. Literature review

4.1. Principles of Kaizen

Agreeing with Masaaki Imai (1986), a Japanese expert in kaizen practices and philosophies and an organizational theorist, kaizen is implemented based on three pillars such as housekeeping, waste removal, and standardization [2]. Kaizen is applied every day by all persons and everywhere persistently to carry continuous development. Subsequently, conscious employees in engineering universities have a large impact to create a conducive work area and manage types of machinery and consumable materials efficiently and effectively. The successful cultural kaizen can be evolved by summing up excellent attitudes on individual and institutional efforts, popular team works by subtracting the existing waste, after which multiplying it by using uninterrupted efforts. Kaizen implementation venture constitutes the Organizing of a quality control circle (QCC), 5S implementation, and removal of wastes (MUDAs) [3, 4]. The three actors put into effect kaizen within the organization are top managers, middle managers & front-line employees. All employees should perform the required duties with commitment, true participation, and motivation in step with their assigned responsibilities and obligations to carry continuous development.

The kaizen manager realizes that improving the method will enhance the result because kaizen is processed and action-orientated. The change result is slow but not modern. The buildup of small changes in each component has a big effect on the development of the business enterprise. The principal reasons for the failures of sustainability of 5S are lack of refreshment training, considering kaizen as short-term activi-

ties, enforcing in a heavily bureaucratic system, lack of commitments, and inactive control to aid kaizen tasks [4].

4.2. Progression of kaizen from Japan to Ethiopia

The history of current kaizen in manufacturing industries started after World War II when Toyota first carried out excellent practices in its manufacturing method. It turned into first delivered in the Toyota production plant in Japan in the early 1950s, and it has been considered the fact that ends up as one of Japan's fundamental motives for its success. [2]. Kaizen becomes adapted to Ethiopia in 2009 with JICA's technical help. The Ethiopian Kaizen Institute (EKI) was established in 2011 [3]. A review of the diverse manuscripts issued with the aid of JICA and EKI indicates that Kaizen in Ethiopia is taken into consideration to be a success and flagship task [3]. Kaizen has an endless global hobby and unfolds with the aid of global groups and their personnel to enhance high quality and productivity. Currently, the Ethiopian Kaizen Institute (EKI) plays a first-rate function in introducing the Kaizen philosophy into the operational implementation of several production corporations, however; the tool is not always properly understood by the other sectors and the public at large. The best-acting employees have to be identified, and the praise systems have to be linked with the output as well as exceptional labor [4]. The kaizen movement commenced by running massive-scale corporations likes the sugar and textile industries as well as large creation tasks in Ethiopia. It changed into a venture and a possibility for the short-track development of EKI specialists. EKI reached 473 institutions between 2012 and 2016 [5]. The information on establishments reached is given in Table 1.

Table 1. Different institutions reached by EKI [5]

| No. | Institutions | Numbers |
|-----|----------------------------------|---------|
| 1 | Manufacturing | 80 |
| 2 | Services | 12 |
| 3 | Construction | 11 |
| 4 | Universities | 16 |
| 5 | TVETs (Institutions and regions) | 9 |
| | | 7 |
| 6 | Schools | 10 |
| 7 | Kindergartens | 5 |
| 8 | Cities | 4 |

| | | |
|-------------|-----------------------|------------|
| 9 | Towns | 2 |
| 10 | Projects (MSEs +LMEs) | 307 |
| Grand Total | | 473 |

Source: Compiled from EKI Annual reports (2012 – 2016)

EKI has developed standards to acquire data before and after the implementation of kaizen. Every month, enforcing businesses furnish reviews to EKI on the progress of upgrades and the usage of reporting formats developed via the institute. The reporting formats have two parts, specific quantitative and qualitative achievements. Now a time, the notion of kaizen is progressively increasing in many institutions. However, the implementation methods and sustainability are no longer sustained. Many engineering universities have made an effort to put in force kaizen in their workshops and look up laboratories to preserve the required standards [5].

4.3. Practices of Kaizen in laboratories of engineering universities

Kaizen philosophy focused on small enhancements performed persistently over a long period. If you mix the kaizen requirements into your place of job, you may additionally see noticeable enhancements suited away, and extraordinarily appropriate enhancements within a long time. And you will get those results without spending a lot of money on a new way of working method, due to the fact the outcomes come not from expensive innovation, but from the initiation of workers. This is actively worried about making small enhancements to the workplace. The standard work factors and tactics of an important kaizen implementation are introduced below in Figure 3.

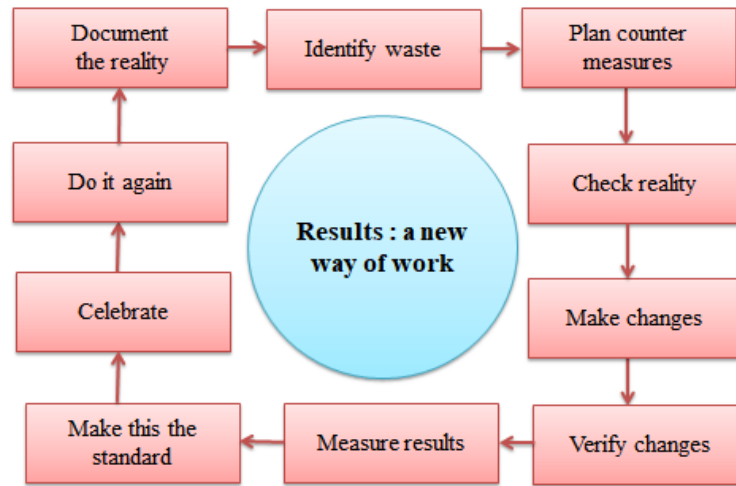


Figure 3. The work implementation cycle of Kaizen (adapted by the author)

Kaizen is the thing to do for improvement in constantly revolving cycles. The implementation cycle of kaizen is very helpful to become aware of problems in each section of activities and resulting in a new way of working techniques and approaches to reap persistent results. At the beginning stage of kaizen, documenting the truth of the work location is achieved via taking photographs and recording the current data and information. Then planning activities with the aid of figuring out waste are very essential for further change-making and evaluation. To enforce successful kaizen events, the goal of a kaizen implementation should be clear and concise. It should be to prioritize problems, remove waste, increase fine education and implementation, and create an administrative center of endless detection of perfection during the organization. The kaizen tools are helpful to control and maintain the 5M's (manpower, machines, materials, techniques, and measurements) in engineering universities [6]. The skill degree of every employee, super working know-how of every computing device and tool, going with the flow of materials, having standardized methods, and having result measuring methods will ensure that kaizen creates long-lasting outcomes in your productivity, group morale, protection, and ultimately, your profits. By usually maintaining an eye on the 5 M's, the managers will be capable to see when something is no longer working on a procedure [6].

4.4. Applying PDCA Cycle

Edwards Deming, was a pioneer of the fantastic management movement, in the 1950s. The PDCA Cycle has many different names, including Deming Circle, Deming Wheel, Shewhart Cycle, Control Cycle, and PDSA: plan-do-study-act. When there is a desire to improve, there must be to discover a problem and waste in the workplace. One of the very correct systematic methods for discovering possibilities is PDCA Cycle. It is a tool that can assist you in consistently enhancing your products, services, and organizational processes. The PDCA Cycle is an important tool to keep away from *evaluation paralysis* as it gets to check out rapidly ideas for further implementation [7].

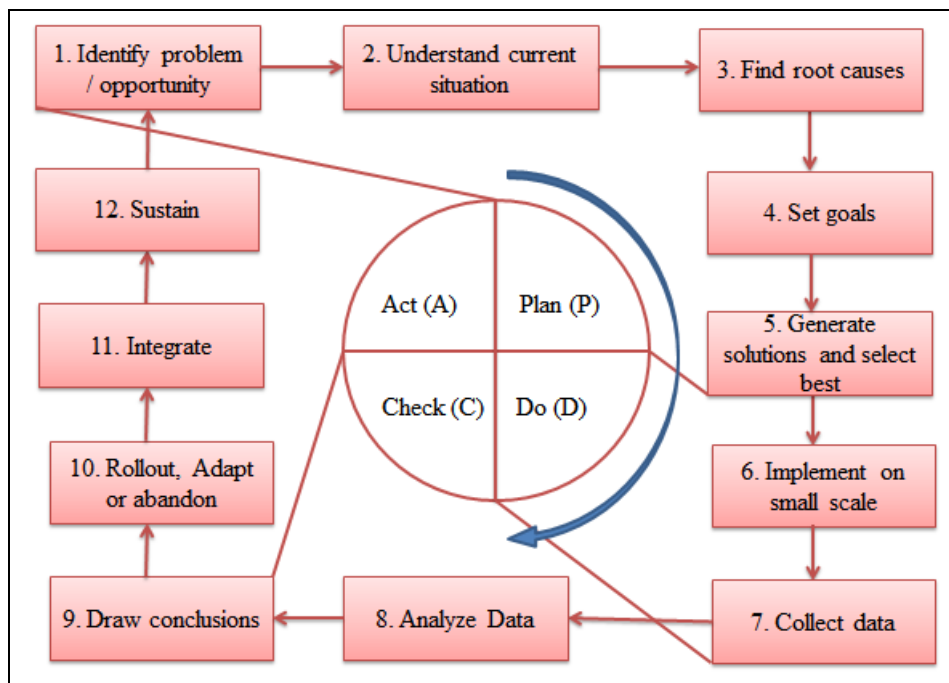


Figure 4. PDCA cycle [7]

The PDCA cycle is a device to ensure the continuation of the Kaizen principles. A new baseline after every cycle sustains the improvement; allowing every cycle to construct on the preceding cycle so first-class improve continuously over time. The PDCA Cycle is a terrific device for attaining a purpose or introducing enhancements in a sustainable, thoughtful, and long-term way. Each cycle starts with a planning stage in which someone becomes aware of and recognizes issues. Next to this step, generating solutions and picking out the best one for action is compulsory. On the do

stage, implementing the reaction in a small-scale way is followed. In addition, check the consequences in the Check segment to see whether an expected result or not. Finally, if your solution performs as hoped, you roll it out in full in the active stage earlier than opening the PDCA cycle again [7].

4.5. Performing Waste reduction

Any non-value-adding resource is categorized as Muda (a Japanese phrase that means waste). The 2nd pillar of Kaizen is to eliminate waste. According to Wisner et al. (2012), the goal of Kaizen is to remove all forms of waste in the production process [8]. The preferred outcome of waste removal is profit enhancement. Firms can thus reduce expenses and add fees to their merchandise and offerings by removing waste from their productive systems. Any things to do that the consumer is no longer willing to pay for is a waste inherent in manufacturing strategies and have to be identified and eradicated [8, 9]. The three “Mu” comes from the Japanese words *Muda, Mura, and Muri* [10]. Muda is any activity that consumes sources that include time but creates no profit for a customer. Mura is a variation in the operation of a process now not brought on by way of the stop customer. Muri is overburdened on equipment, facilities, and human beings caused by the aid of Mura and Muda. Muda is the most known as it describes waste. The seven sorts of waste detected in the work area are TIMWOOD stands for *transport, inventory, motion, overproduction, overprocessing, and defective components* [9, 10]. These sorts of waste are without difficulty seen with the aid of watching working processes. Kaizen seeks to enhance work techniques to eradicate the seven kinds of waste as identified in lean management. Table 2 below gives a description of the existing common wastes in laboratories of Ethiopian engineering universities.

Table 2. The types of the seven wastes and possible causes in the laboratories [10].

| No. | Types of waste | Description | Possible causes |
|-----|--------------------|---|---|
| 1 | Transporting waste | ○ Restacking, long moves, pick up/put down | ✓ Poor lab layout. ✓ Far material store ✓ Disorganized workplace. |
| 2 | Waiting Waste | ○ Time wasted waiting for anything such as equipment to be rectified, | ✓ No coordinated process. |

| | | | |
|---|-----------------------|---|--|
| | | suppliers, management approvals, people, machine downtime, etc. | ✓ Long set up ✓ Unplanned machine downtime. ✓ Lack of attitude on time management |
| 3 | Over processing waste | ○ Working procedures that do not add value, Processing beyond what is needed such as repeating laboratory activities on clear sessions. | ✓ Vague work instructions. ✓ In proper value analysis. ✓ Excess refinement. |
| 4 | Motion waste | ○ Unnecessary movement of workers such as walking back and forth between lab equipment, disorganized laboratory area, etc. | ✓ Poor housekeeping. ✓ Disorganized workplace. ✓ Non-standardized work routines. |
| 5 | Defects waste | ○ Products, services, and/or information that is late, inaccurate, or incomplete like wrong design flow. ○ Defects cause customer dissatisfaction and lead to waste of production time, and materials. | ✓ Lack of appropriate lab equipment and materials. ✓ Departmental rather than focusing on total quality sub-optimization. ✓ Unskilled personnel. |
| 6 | Inventory waste | ○ It arises from ordering excess materials just in case they are needed. ○ The one goal of kaizen is to improve communication and relationship with suppliers to facilitate (Just in time inventory management (JIT)). | ✓ Imbalanced orders of inputs ✓ High rework rates. ✓ Lack of materials requisition and materials issuance documents. ✓ Long lead times. |
| 7 | Overproduction waste | ○ Producing lab specimens more than required. ○ The Kaizen goal is to improve and streamline processes so that a firm produces exactly what customers order exactly when they order it. | ✓ Ineffective production planning. ✓ Lack of responsibility |

Work standards by making use of 5S are very fantastic in the reduction of all seven sorts of waste. Three primary areas need to be regarded when developing standards: **Takt time** (The period given for a sure job to be completed), **Work sequence** (The step-by-step order in which all processing meeting work is to be done), **Standard inprocess stock** (The choicest quantity of parts in method at any given time). A less difficult way to assume about standards is that laboratory activities will be performed to set specifications. Benefits of standardizing work include waste elimination, low costs, secure workflows, and increase productivity.

4.6. Applying 5S

The heart and soul of visual management in kaizen implementation is 5S. 5S is an entrance to kaizen and is the foundation building of any other kaizen activities. The term "5S" is derived from the first letters of various English (Japanese) words known as five practices leading to a manageable and clean workstation: Sort (Seiri), Set in order (Seition), shine (Seiso), Standardize (Seiketsu), and Sustain (Shitsuke). Table 3 below gives a brief description and guide on how to implement the 5S framework [8, 9, 10].

Table 3. Description of 5S and its implementation procedures

| Terms 5S | Description | Implementation procedures |
|---------------------------|---|--|
| Sort (Seiri) | Remove anything, both materials, and tools that are not needed in the work-place for the current process. | <ul style="list-style-type: none"> ➤ Add a red tag to things that are not or may be considered not needed in the current process. ➤ Add a red tag to anything that does not belong to the workstation. ➤ Give all employees a chance to show that any red-tagged item is needed. ➤ Remove all red tagged things that no employee says are needed. ➤ Ideally, sell them to employees, or scrap dealers, put in the trash, or give them away. |
| Set in order (Seition) | Setting up the work-place so that tools | Analyze and find the right place for every-thing. |

| | | |
|---------------------------|--|--|
| | and materials are easy to find, use, and put back. | Keep tools on peg board; reassign cabinets, racks, spaces, etc. Arrange items so that they are easy to use. Label the items so that they are simple to locate and place back. |
| shine (Seiso) | ➤ This step requires management to ensure that dirt, filth, dust, soot, and stains are removed from the workplace. | ✓ Divide the workstation into zones and allocate a specific person the responsibility of keeping it clean. ✓ Determine the order of cleaning, type of cleaning needed, etc. ✓ Wash and paint to provide an attractive appearance. ✓ Clean tools, oil and grease them, and inspect them for abnormalities. |
| Standardize (Seiketsu) | ➤ Make the first 3 steps of the 5S framework an easy routine in the laboratories of engineering universities. | ✓ Document guidelines and procedures for each of the first 3S of the 5S framework. ✓ Develop a quick checklist for the first 3S and train employees to follow them. ✓ Conduct regular evaluations using the checklists. |
| Sustain (Shitsuke) | ➤ Standardization and self-discipline. | ✓ Set up a cleaning schedule. Ideally, use downtime to straighten and clean areas. |

The aim of 5S implementation inside the laboratories can help to improve safety, reduces waste, promotes workflow, encourages visible management, complements outstanding services and products, enhances the commitment to standard work, reduces unplanned downtime, reduces inventory, increase work quality, and expose waste and abnormalities. The implementation phase of 5S is grouped as the preparation section and implementation section. The activities to be accomplished in the preparation section are setting up a kaizen organization (QCC), figuring out the implementation location, know-how the prevailing reality, putting goals, planning, preparing

finances, and then kicking off 5S implementation. In the implementation phase, the activities that have to be applied in the work area are sorting, setting in order, shining, standardizing, and maintaining. The maximum not unusual visual manipulation techniques of 5S implementation are the signboard approach, color-code strategy, outlining a strategy, Kaizen board method, etc. there are numerous methods to preserve the implementation of 5S which includes the usage of decided on the motto, posterizing, kaizen board, auditing checklist, and rewarding and many others.

5S and kaizen implementation cannot be achieved if we are forcing people to work harder and faster. To make successful 5S and kaizen systems most important factors are participation, commitment, and support from top-level management. By implementing the first 'S' first change seen will be unwanted items are eliminated and searching time is reduced. Thereby there is an improved working environment and the space utilized is maximized. Implementing the second 'S' results in easy storage and retrieval of the items. There is a place for everything which prevents misplacing. The third 'S' helps in having a clean, safer environment and making a good impression on the visitors. Implementing the fourth 'S' will ensure better workplace standards and visual control systems. Development of team spirit and discipline can be achieved by implementing the fifth 'S'. The work environment becomes more enjoyable resulting in job satisfaction of the employee and higher employee morale.

4.7. The effort of kaizen researchers in Ethiopia

Kaizen is something that is practiced most effectively through the organization individuals themselves with their very own initiative and remedy. Many research works on kaizen have been performed by many scholars and researchers in Ethiopia for a decade. Some of them are presented below in Table 4.

Table 4. Summary of previous research works on Kaizen implementation in Ethiopia

| No. | Authors (year) | Materials and methods | Results and gaps | Ref. |
|------------|---------------------------|---|--|-------------|
| 1 | Asayehgn Desta | checking the effectiveness of the Kaizen philosophy on the | * In doing kaizen standards, the Methara Sugar Factory has achieved a | [11] |

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|---|------------------------|--|--|------|
| | (2014) | <p>Methara sugar organization, this is implementing the Kaizen method to reap higher productivity.</p> <p>The 5S, reduction of space in the workplace, material handling, and the lowering of scrap rates have been applied.</p> | <p>nationwide average sugarcane crop yield of 126.93 tons per hectare. Currently, both the sugarcane plantation and sugar production have increased by 35% and 37% respectively.</p> <p>*The production cost of one unit quintal of sugar has decreased by about 23 Ethiopian birr and the overall time efficiency has increased by about 20% since the company embarked on kaizen (Methara Sugar Company, June 2013).</p> | |
| 2 | Michael Tadesse (2014) | <p>* Document and monitor the availability of continuous improvement at the Wonji / Shoa, Ethiopia sugar factory, a time series study is helpful.</p> | <p>* Kaizen is all approximately organizational traditional change through interminable education and improvement. Therefore, setting up schooling and improvement machines in the business enterprise is essential not longer best for the implementation of the program but also for the sustainability of this system.</p> <p>* The organization has fully achieved the foundation stage of kaizen 5S and has partially attempted to standardize the operation. However, the company has faced a shortage of safety materials and fire extinguishers. Hence, the company should give serious attention to the Health and safety of workers.</p> | [12] |
| 3 | Admasu Abera | <p>* The objective of this paper is to discuss different kinds</p> | <p>* Implementations of kaizen vary considerably between organizations.</p> | [13] |

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|---|------------------------------|---|---|------|
| | (2015) | of literature that have been published in this field and presents a review of literature that will be helpful to new research in this field. | This may include identification of the improvement area, selection of the key problem, implementation of the improvement idea, analysis, and comparison of the results and standardization. * More emphasis should be given to the influence of training in the kaizen implementation. | |
| 4 | Tamrat Tatek Fantaye (2016). | <ul style="list-style-type: none"> * The researcher employed descriptive research type. * The researcher has used convenience and stratified random sampling for managerial and non-managerial respondents respectively. * Quantitative data collected using a questionnaire had been computed with the Microsoft Excel program. | <ul style="list-style-type: none"> * Sino-Ethiopia Associate (Africa) PLC is aggressively working on the integration of the kaizen system. * The company should give high priority to the training and motivation of staff so that the system is owned and sustainability is achieved. * the challenges encountered by the company turn around the way of thinking of some staff members which may perceive the implementation of kaizen wrongly and separate tasks. | [14] |
| 5 | Ademe et al (2016) | <ul style="list-style-type: none"> * In August 2013, multiple case study using mixed quantitative and qualitative methods was used. * There are about 299 medical devices in three Jimma zone hospitals, in Ethiopia. | <ul style="list-style-type: none"> * More than one-third of the medical devices in the three study hospitals were not functional and not in use. * Insufficient or no motivation for professionals, and less sense of accountability were among the reasons mentioned by the participants that | [15] |

| | | | | |
|---|-----------------------------------|---|--|------|
| | | | affect the proper utilization of devices. | |
| 6 | Kinfe Adere (2018) | <p>* The study aimed to assess the practices and challenges in the application of kaizen at Yeka and Arada sub city in the case of manufacturing small and micro enterprises in Addis Ababa City, Ethiopia Administration.</p> <p>*The researcher used a descriptive research design with a mixed approach. Data were collected from 32 enterprise owners through questionnaires and from 13 key informants using semi-structured interviews.</p> | <p>* The quantitative data were analyzed through descriptive statistics, (percentage, mean and standard deviation) using SPSS Version 24.</p> <p>*The findings indicated that there were challenges that derived from various sources, like gaps in knowledge of enterprise owners and their negative attitude towards the kaizen implementation, and gaps in the capacity and capabilities of the management body.</p> <p>* The general public of the respondents elicited that the education the remarks they had been furnished on kaizen implementation turned into not enough and encouraging for the easy operation of kaizen.</p> | [16] |
| 7 | Sara Abraham Gebremichael (2019). | <p>* Using a descriptive research design; particularly, this research was designed to answer the level of successfulness of kaizen implementation and examine whether the Implementation of kaizen brings better performance.</p> <p>* Data were collected from 92 randomly selected train-</p> | <p>* In principle majority of the trainers believed that kaizen affects organizational performance such as productivity and quality improvement, elimination of waste, and improvement of health and safety records; however, in practice, this was not in place.</p> <p>* The management body should be concerned and assign entities who follow and supervise the implementa-</p> | [17] |

| | | ers. | tion of kaizen. | |
|----|---|--|--|------|
| 8 | Abebe Nigatu (2019) | <p>* The findings of this research made on kaizen in Ethiopia indicated that in one of the piloted projects of a company called Kadisco Chemical Industry in Addis Ababa, Ethiopia</p> | <p>* The implementation of the kaizen culture was found to increase labor productivity by reducing, on average 50%, time wastage for searching tools; improving a defect ratio that ranged from 50% to 70%; and improving lead time in the range of 16% to 90%.</p> | [18] |
| 9 | Yabibal A. Abate, and Tibletie Mengesha (2020). | <p>* This study aims to investigate factors affecting the successful implementation of kaizen in Ethiopia.</p> <p>*After reviewing prior Literature, they have identified six factors as determinants of the successful implementation of kaizen that are proper communication, top management support, commitment, training, teamwork organizational culture, and education.</p> <p>* After checking for the reliability and validity of the data, Structural Equation, and modeling Technique was used to test the developed hypotheses.</p> | <p>* The authors found that top management commitment support, education level, teamwork, and organizational culture have a positive and statistically significant relationship with the successful implementation of kaizen.</p> <p>* On the other hand, communication was found to be an insignificant determinant of the successful implementation of kaizen in Ethiopia.</p> <p>*Training was a significant mediator of the relationship between identified factors and the implementation of kaizen. Ethiopian Kaizen Institute as well as implementing organizations should focus on these factors that are found to be significant determinants of the successful implementation of kaizen.</p> | [19] |
| 10 | Solomon | * The study aimed to exam- | * The study found that most sampled | [20] |

| | | | | |
|--|----------------------------|---|--|--|
| | Terfasa Dinka (2021) | ine kaizen implementation and its challenges in small and medium manufacturing firms of Woliso town. * The study employed Descriptive research adopted a quantitative research approach; the researcher used 55 small and medium manufacturing firms in Woliso town. In addition, the study employed primary data collected through open-ended and close-ended questionnaires. | firms lack awareness about kaizen because of a lack of training opportunities. Similarly, the Kaizen philosophy is considered exhaustive and routine the attitude of owners, managers, and employees in Kaizen implementation is very weak. *Finally, the study recommended that it is important to provide continuous training programs for employees and managers of small and medium manufacturing firms. Most importantly, to extend kaizen's philosophy, it is essential to incorporate it into the school curriculum. | |
|--|----------------------------|---|--|--|

As presented in Table 4 above, many researchers have attempted efforts to study on practices and challenges of kaizen implementation in Ethiopia. Their findings show that productivity and efficiency are significantly being improved in the company who have implemented. The critical challenge for manufacturing sectors in Ethiopia and like most other developing economies is the lack of managerial methodologies like kaizen [20]. It is also true that the lack of capital and technological capabilities in Ethiopia are major problems in the manufacturing and service sectors, the most feasible and that can be easily and quickly to be improved with a little investment and resources is changing the managerial capacity with Kaizen tools [9]. However many researchers exerted their effort in industries kaizen, and the studying output can be applied in engineering universities with minor adjustments for better and continuous improvement.

In Ethiopia, nowadays, both manufacturing and service sectors are trying to implement the kaizen philosophy. According to the Ministry of industry (2015) report, the

following results were achieved from the selected industries of both organizations that have successfully implemented kaizen. Accordingly, productivity improvement accounts for about 37.20%; waste and defect reduction accounts for 55.26% and 31.30%, respectively; cost reduction accounts for about 6% to 60%; searching time reduction accounts for 95%; industrial accidents were reduced by 49.5% to 15% [8]. Similarly, before the implementation of kaizen, employees faced many problems to solve. However, post-implementation, employees solved 50.3% of the identified problems using basic kaizen tools and techniques [8]. These results indicated that proper kaizen implementation has a significant impact on waste reduction in all working sectors.

5. Conclusion and recommendation

Kaizen aims to continuously improve the work environment, people, processes, procedures and any other factors that impact quality of activities in universities. Engineering universities have high-cost materials, machinery, and equipment, as do other manufacturing industries. Therefore, the requirement of implementation of kaizen in their experiment laboratory is unquestionable. In the present day, colleges and universities want to be acknowledged as sources of good quality higher education by improving significant changes in cost reduction, waste reduction, and workflow and delivery time improvement. As a result, Kaizen is the best tool to meet their needs especially in the lab work area. Some of the universities have attempted to implement a task-oriented procedure for implementing the kaizen philosophy targeting the increase in efficiency and quality of higher education, and waste reduction, in general, to achieve the three pillars of kaizen. However, Kaizen has a significant impact on changes in worker attitudes, quality, productivity, competitiveness, conscious personality, safe workplace, attractive and well organized workplace, etc. in engineering universities, 5S implementation is not yet sustainable in many areas of kaizen implementation due to many factors. Therefore, there should be significant research in future work that finds suitable methods for sustainability according to work area situations. Some of the research gaps that need further studying are: the development of mathematical modeling on kaizen lacks of improved implementation procedures for 5S sustainability, development of kaizen auditing checklists for sustainable implementation in the universities, and waste reduction methods at a lower cost. Finally the

authors recommended that it is important to apply case study research activities, continuous refreshment training for all employees and managers to have similar understanding and to reduce pitfalls during implementation of kaizen. Most importantly, to spread kaizen philosophy in many work area, it is essential to incorporate it into the school curriculum.

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