

# The Implementation of Kaizen and 5S concept for Overall Improvement of an Agricultural Organisation

Wong Ai Moi, Sii How Sing

School of Engineering and Technology, University College of Technology Sarawak, No. 1, University Road, 96000 Sibul, Sarawak, Malaysia

## ABSTRACT

The objective of this study is to implement some of the Kaizen and 5S principles borrowed from Toyota's operation management systems and process improvements to help smallholder farmers become more productive and efficient. The paper systematically analyses, categorises, and reviews methodically the published literature. A series of case studies were conducted in an indoor hydroponic farm located in an urban area. The Kaizen and 5S principles in the organization have been implemented and analysed. Based on the outcomes of the case studies, it can be stressed that by the introduction and implementation of the Kaizen and 5S principles brings significant changes and improvements in the organisation in terms of increasing in effectiveness and efficiency in the operational processes, improved visual management of the process, improved safety and morale of the workers, improved housekeeping, waste elimination and standardization. The outcomes of this study have demonstrated that the Kaizen and 5S principles and techniques are equally applicable for agricultural organisations rather than manufacturing sectors.

**Keywords :** Kaizen, 5S, Toyota's operation management systems, continuous improvement, hydroponic indoor farms, ergonomics

## I. INTRODUCTION

Kaizen has two definitions (Maurer, 2014):

- using very small steps to improve a habit, a process, or product
- using very small moments to inspire new products and inventions

According to Masaaki Imai in his book Gemba Kaizen, the word "Kaizen" signifies improvement that involves everyone – both managers and employees at the workplace. The philosophy of Kaizen also assumes that our way of life should concentrate on the constant improvement of efforts in our working life, home life as well as social life (Imai, 1997). Kaizen, in

Japanese, means continuous improvement, where "kai" means to change and "zen" means good or well. The concept of kaizen has the potential to cause the alignment necessary between management and employees to exist as it requires all employees to actively participate in continuous improvements (Gondhalekar, Babu and Godrej, 1995). This research attempts to assess the effectiveness in implementing kaizen and 5S methods on the overall improvement of an agriculture-based organisation. It is a novel study as there is very little reports in literature on the use of kaizen in agricultural industry.

Hydroponics: The term hydroponics was originally coined in the mid 20<sup>th</sup> century. According to Smith (2013), "hydroponics" is a term used to express

technique for growing plants in a soilless medium. The advantages of hydroponics gardening are that water and natural resources can be conserved as well as more crops production of healthy and nutritious vegetables and fruits in a more sustainable manner.

Previous studies have reported that improved efficiency on agricultural farm level can lead to cost reduction and revenue increment by continuously improving and strengthening the competitiveness and sustainability of farms in long term (Andersson and Andersson, 2014). The hydroponics technology and indoor farming culture adopted by our collaborator is still considered new to the local community as well as to its own staff, hence, significant levels of in-house training and educational briefing are needed to boost up the productivity of the farm. In this juncture case, kaizen & 5S methods is identified as one of the highly appropriate operational method to boost the farm's productivity and workers' health and safety.

The main objective of this research study is to determine the effectiveness in implementing of kaizen and 5S operational methods in improving the farm's productivity and workers' health and safety of a hydroponic farm. Few tasks that are carried out to meet the objective of this research work are summarised as follows:

- (1) To identify the problems and opportunities for improvement of the current farm operational conditions.
- (2) To identify and eliminate the waste found within the operation.
- (3) To implement and evaluate the effectiveness of implementing the Five-Step Kaizen Methods - 5S.
- (4) To identify and implementing some small steps (kaizen) to improve productivity and workers' health and safety.

## II. LITERATURE REVIEW

### 2.1 Kaizen

This philosophy of small steps toward improvement was first introduced to Japan after the World War II, when General Douglas MacArthur's occupation forces began to rebuild that devastated country. Many of Japanese businesses were run poorly, with slack management and low employee morale. General MacArthur believed that a strong society could provide a bulwark against a possible threat from North Korea and it was essential to improve Japanese efficiency and raise business standards. He brought in the U.S. government's Training Within Industries (TWI) specialists, including those who emphasised the importance of small, daily steps toward improvement. At the same time MacArthur organised and developed a class in management and supervision for the Japanese businesses called the Management Training Program (MTP). (Maurer, 2014).

The Japanese were usually receptive to this idea and they listened closely to the Americans' lessons on manufacturing. Viewing employees as a resource for creativity and improvement and learning to be receptive to subordinates' ideas was an unfamiliar notion as it had been for Americans, but the Japanese of these programs gave it a try.

In U.S., Dr. Deming's series of strategies for enhancing the manufacturing process were largely ignored once the troops were home and production was back to normal. However, it was different in Japan, his concepts were already adopted as the central core value of the emerging Japanese business culture. In the late 1950s, the Japanese Union of Scientists and Engineers (JUSE) invited Dr. Deming, to consult further on their country's economic efficiency and outputs. Small steps toward improvement were so successful that the Japanese gave them a name of their own: Kaizen. (Maurer, 2014)

Kaizen and innovation are the two major strategies people use to create change. Where innovation demands shocking and radical reform, all kaizen asks is that you take small, comfortable steps toward improvement.

Suárez-Barraza, Ramis-Pujol and Kerbache (2011) identify that some have applied the concept of kaizen through the participation of staff in improvement suggestion schemes while others have utilised kaizen as a group of techniques and tools for reducing or eliminating waste. They also claim that kaizen is practically an approximation to management approaches such as the West's total quality management (TQM), company-wide quality control (CWQC) in Japanese form, the Toyota Production System (TPS) and the Lean manufacturing. Paul Brunet and New (2003) have found out three key notions which are focused by other authors:

- (1) Kaizen is continuous improvement which is implied that it is a never-ending practice towards efficiency and quality;
- (2) Kaizen is in contrast to major management which is initiated with the reorganizations or technological innovation; and
- (3) Kaizen is participative which is concerning with the involvement and intelligence of employees.

Wittenberg (1994) points out that standardization is one of the important features of kaizen by establishing a standard, maintaining it and then improving on it. He also holds the view that kaizen refers to small improvement obtained by a continuing effort. Berger (1997) has proposed three core features of continuous improvement or kaizen based on the Imai's contribution:

- (1) Kaizen is process-oriented in which the processes must be improved before the results or outcomes can be obtained or improved.
- (2) Kaizen promotes improving and maintaining standards, where ongoing efforts are combined

with innovations in order to improve and maintain the standard performance levels in the company.

- (3) Kaizen is people-oriented which means everyone in the company from upper management to employees at the shop floor must be involved and participate actively.

Application process of kaizen event basically consists of (Asada et al., 2000; Imai, 2008; Imai, 1986; Krazewski, 2005; Suzuki, 1993):

- Definition of the area to be improved
- Key problem analysis and selection
- Identification of cause of improvement
- Measuring, analysing and comparison of the results
- Standardise systems

Kaizen covers many techniques which includes Kanban, total productive maintenance, six-sigma, automation, just in time, suggestion system, productivity improvement (Imai, 1986).

## 2.2 5S – The Five-Step Kaizen Movement

The five-Step Kaizen Movement - 5S is a manufacturing technique for organizing a workplace and implementing lean condition (Shaikh *et al.*, 2015). The 5S framework is developed by Hiroyuki Hirano. The concept of 5S concentrates on how the visual workplace can be used to eliminate inefficiencies that have occurred during the manufacturing process and to improve the work environment consistent with the tenets of Lean manufacturing systems. Besides, the safety of workplace can also be enhanced through 5S practice. Hirano also indicates that without the successful implementation of 5S in the organization, the other Lean manufacturing tools are more likely to fail (Otterlei and Myrold, 2012).

Peterson and Smith states that 5S is a system of steps or procedures and techniques that can be utilized by

individuals and groups to arrange the workplace in the best method to optimise overall performance, comfort, safety, hygiene and cleanliness (Andersson and Andersson, 2014). Sii (2004) defines 5S as the common sense in the fundamental study, design and maintenance of working environments and their components, work practices, and work procedures for the benefit of the worker's productivity, efficiency, effectiveness, health, comfort and safety.

The literature highlights about 5S and that an implementation of 5S will enhance organizational efficiencies and improve overall performance of workers in the workplace. Sii (2004) also mentions that 5S is a fusion of art and science of suiting or fitting the working areas to the employees. It is a method which is utilised for cultivating, maintaining and establishing a quality working environment in an organization (Sii, 2004).

The Five-Step Kaizen Movement - 5S takes its name from the initials of five Japanese words that start with **s**: *siri*, *seiton*, *seiso*, *seiketsu*, and *shitsuke*. As part of the visual management of an overall program, signs that repeat the steps are often posted in the workshop or office (Imai, 1986) (Sii, 2005) (Agrahari, Dangle and Chandratre, 2015).

Step 1: **seiri** (straighten up or sorting) – Differentiate between the necessary and the unnecessary and discard the unnecessary.

- Work-in-process
- Unnecessary tools
- Unused machinery
- Defective products
- Papers and documents

Step 2: **seito** (set in order or put things in order) – things must be kept in order so that they are ready for use when needed. An American mechanical engineer recalls that he used to spend hours searching for tools and parts when he worked in Cincinnati. Only after

he joined a Japanese company and saw how easily the workers were able to find what they needed did he realize the value of seiton.

Step 3: **seiso** (shine or clean up) – Keep the workplace clean.

Step 4: **seiketsu** (standardise or personal cleanliness) – Make it a habit to be clean and tidy, starting with your own person.

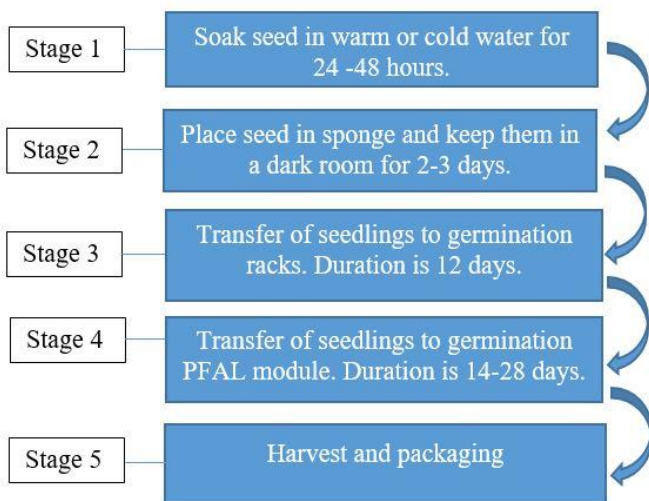
Step 5: **shitsuke** (sustain or discipline) – Follow procedures in the workplace.

Advantages after implementing the 5S have been found in a number of research papers, journals, articles and books. For instance, Agrahari, Dangle and Chandratre (2015) conclude that implementation of 5S in the manufacturing company V.M. Auto Pvt. Ltd has increased efficiency and process growth, shortened the time needed for searching tools or items, reduced the cost of machine maintenance, decrease in the number of injured workers, caused better usage of the workplace, prevented the loss of tools and increased the number of customers. Furthermore, Peterson and Smith claims that implementing 5S within the organization has successfully decreased cycle times, lead times and search times, increased floor space improved working conditions, improved information access, better work team performance, improved delivery time, improved inventory management, improved work morale, and enhanced levels of commitment (Andersson and Andersson, 2014). According to the author Nikhil Shil, the greatest benefits of successful implementation of the 5S are that it can increase efficiency and performance in an organization, boost work morale and create high quality impressions on customers (Otterlei and Myrold, 2012). The effect on continuous improvement can lead to faster lead times, quality improvement and waste reduction. Hence, the Five-Step Kaizen Movement - 5S framework is believed to be an essential quality technique and step for

improving and optimising the efficiency as well as the overall performance of an organization.

### 2.3 Hydroponics City Indoor Farm

Hydroponics city indoor farm refers to the cultivation of crops in an urban, controlled indoor environment. Hydroponics means growing the plants without using soil, but by using water or nutrient-based solutions under environmentally controlled condition (Smith, 2013). There are five stages of hydroponic plant growth as illustrated in Figure 1. To plant hydroponically, the first stage requires the seeds to be soaked in warm or cold water for 24 to 48 hours. Then, the seeds are placed in sponge and kept in a dark room for two to three days. The next stage involves the seedlings being transferred to germination racks. The seedlings are left there for 12 days. After that, the seedlings are transferred to PFAL (Plant Factory with Artificial Light) module. The duration for this stage is approximately 14 to 28 days (depending on the type of vegetables planted). The final stage is harvesting and packaging of the mature plants.



**Figure 1** : A generic cycle of hydroponics plant growth

### 2.4 Time and Motion Study

Muhamad *et al.*(2005) highlights that time and motion study can eliminate the unnecessary work and

design the most effective as well as suitable methods to specified individuals while performing their tasks. In the authors` point of view, it also offers the methods of how to measure work so that a productivity index for an individual, a group of employees, a department or for an entire organisation can be determined. The study conducted by the authors concludes that implementation of time and motion study can enhance or increase productivity, quality improvement, job efficiency and operation time per part is reduced.

Bon and Daiyanni Daim (2010) stresses that time and motion study is a method to determine the actual time required to complete a task. The author also highlights that by stating the time standard for the manpower process, the production rate in a rice-based company in Sabah has increased and the cost has been reduced at the same time (Bon and Daiyanni Daim, 2010). This case supports the view that time and motion study can be applied in an agricultural-based industry in order to improve productivity with less time needed and with a lower cost of production.

### 2.5 Ergonomics in the Workplace

McCormick and Saunders (1993) states that “Ergonomics applies information about human behaviour, abilities and limitations and other characteristics to the design of tools, machines, tasks, jobs and environments for productive, safe, comfortable and effective human use.”(*Ergonomics in the workplace*, 2006). Sii (2004) explains that ergonomics is the study and design of working environments such as machinery control rooms, process design, plant layout and their components, work practices and work procedures for the benefit of the worker`s efficiency, effectiveness, health, comfort and safety. According to International Ergonomics Association (2015), ergonomics or human factors is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that

applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

Jeffrey E. Fernandez and Michael Goodman (1995) has outlined the advantages of applying ergonomic principles in the workplace. The advantages of application of ergonomic principles are that it is complied with the Occupational Safety and Health Administration (OSHA) standards; productivity is increased; health and safety of workers is improved; job satisfaction is improved; work quality is enhanced; workers` morale is improved; worker turnover rate is decreased; lost time at work is reduced; workers` compensation claims is lowered; and absenteeism rate is reduced.

## 2.6 Research Gap

Based on previous literature review in the previous sections, it appears that there is none that has been devoted to the implementation of kaizen and the Five-Step Kaizen Movement -5S operational methods in hydroponics farm. Therefore, this research study is noble and it will try to close or minimize this gap by offering a new dimension and positive opportunity in the application of Toyota kaizen methods in the field of agricultural sectors.

Previous studies mostly focus on the Lean or kaizen application in manufacturing sector since it was developed initially for the manufacturing field and successfully used by Toyota. There is a lack of empirical research with quantitative findings carried out in kaizen researches in relation to agricultural industries. Hence, this research study attempts to bridge the gap as it is considered as vital and necessary to clarify the logic behind the theoretical framework that recommends to the implementation of kaizen management in improving the productivity of crop harvesting in hydroponics farm.

## III. RESEARCH METHODOLOGY

In this research paper, the researchers would like to investigate how the kaizen and the Five-Step Kaizen Methods - 5S techniques can be implemented in an indoor hydroponics city farm with the overall aim in improving the productivity of the operation, the workers` health and safety level, as well as to reduce waste generation. The aspect of ergonomics in the workplace is also taking into consideration such as the level of safety and health of workers would be identified and assessed based on the guidelines provided by Department of Occupational Safety and Health (DOSH). According to the literature review that application of ergonomic principles in the workplace can improve the performance of an organisation (Fernandez & Godman, 1995).

This research starts with literature reviews on related field according to a number of journals, articles, books, theses and dissertations or conference papers. Then, it is followed by identifying the existing problems encountered and the waste produced within the organisation. Case study method through observation or direct observation of the working process and structured personal interviews with the management personnel and employees in the organisation under study are carried out. These methods will be further explained in detail in following section. This step is crucial to fulfil the first research task which is to identify the problems and opportunities for improvement of the current conditions.

After identifying the problems and waste found, it is necessary to develop or generate alternative solutions to eradicate the root causes of problems for improvement. The approaches such as time and motion study method and ergonomics in the workplace are suggested. If the workers follow the ergonomics principles in the workplace, the risk of getting hurt as well as the workers` medical claims can be minimized. For time and motion study method, stopwatch time study is preferred which is further

explained in section 3.3. Hence, these two suggested approaches are essential in generating the appropriate solutions to overcome the existing problem. This step is vital to meet the fourth research task: to explore some opportunities to use Kaizen approach to improve productivity, and to cut cost with minimum capital investment.

Then, the best possible solutions of Kaizen approach for improvement will be selected. It is then followed by implementing the Kaizen and the Five-Step Kaizen Methods - 55 techniques. The implementation process will briefly introduced and the outcomes of implementing not be covered in this research proposal but it will be further explained in the next stage of this research. These steps are believed to fulfil the second and third research tasks which are to eliminate the waste found within the operation under study as an overall focus; and to implement 5S and evaluate the 5S after a period of implementation. Eventually, the results upon implementation in term of productivity will be assessed or evaluated as to achieve the main objective of this research: to determine whether Kaizen and 5 Steps of Kaizen Methods to improvement can be fully utilised in improving the productivity in the field of indoor hydroponics city farm.

### 3.1 Case Study Method

Yin (2009) has defined case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Several methods and tools which are frequently used to gather data from a number of units by a direct observer can be utilized to conduct case study. The data collection result will not be influenced by any experimental control or manipulations (Meredith, 1998).

The case study can be conducted either in a qualitative or quantitative approach. The purpose is to

fully understand the phenomenon that has been studied in a real life situation, in which the research is the implementation and assessment of kaizen approach in an indoor hydroponics farm. Besides, it is crucial to ensure that the accumulation of multiple entities as supporting evidences to make sure that the data gathered are correct and trustable (Meredith, 1998). Thus, observation and personal interviews methods are required to carry out in order to ensure the validity and truthfulness of data obtained.

The case study method has several disadvantages, for instance, the requirements that are required to carry out the method such as the time usage, cost, access to information obstacles and the need for utilising several methods and entities for surveying (Meredith, 1998). Hence, these disadvantages must be considered before carrying out the observation study and personal interview.

### 3.2 Observation/Direct Observation Method

Observation is a natural and obvious technique to examine the real world context (Andersson and Andersson, 2014). Effectiveness is the major benefit of direct observation as the only requirement is to observe and listen with no questions are required when carrying out observation. Nevertheless, the researcher needs to be concerned about the risk of interpreting a condition or situation in the wrong manner. Observation method can be supportive in complementing and setting data in perspective. The evidence that obtained via observation method is often useful in providing additional information (Yin, 2009).

In this research project, direct observation method is favourably preferred especially during conducting personal interviews. This is because direct observation is used to analyse and substantiate or justify the interviews. Impressions and insights of the interviewee during the interviews will only be captured directly by observation on the spot.

Furthermore, the observation obtained contributes towards a deeper understanding to the research study particularly when visiting the company under study, the existing or current problems that occur in the company can be identified through observation. The researcher should observe the overall working process in the company and it is necessary to record every detail from the beginning until the end of the working process based on direct observation.

### 3.3 Stopwatch Time Study

Stopwatch time study is also required during direct observation since the function of stopwatch is to measure work. Bon and Daiyanni Daim (2010) points out that time study using stopwatch can determine the policy guidance for future improvements. In addition, this method is used to analyse the efficiency and effectiveness of qualified workers in carrying out specific task in terms of time. It also measures the time needed to complete the work process (Bon,A.T and Daiyanni Daim, 2010).

### 3.4 Interviews Method

Interviews are widely utilized as a research method (Andersson and Andersson, 2014) There are three categories of interviews which are structured, semi-structured and unstructured. In this research, a structured personal interview method is more preferable than others in order to obtain more in depth answers from the interviewee or respondents. Otterlei and Myrold (2012) claims that the advantages of using structured personal interview are that the reactions that respondents might have can be observed by the interviewer and also the respondents can be convinced by the interviewer to answer all the questions. This further secures that the respondents are able to understand the questions and thus misunderstandings can be avoided throughout the structured personal interview session.

## IV. RESULTS AND FINDINGS

### 4.1 Case Study #1

This case study mainly focuses on the application of kaizen methods for process design incorporated with time motion study method. For kaizen methods, the researchers have suggested to study the overall productivity in carrying out plant transplant in the following ways: (i) to engage more worker to perform the repetitive tasks simultaneously, (ii) to engage one group of worker to perform one task and the other group perform the next task, (iii) to use a simple kaizen transplant tray in transferring the net pot onto the planting rows on the rack, (iv) to combine (iii) and (iv). For time-motion study, stopwatch study method is preferred as stopwatch is used to measure the time required to complete the work process. Each scenario is conducted for ten trials to obtain the mean time. Six scenario are considered here:

- Scenario #1: One operator is assigned to carry out all the four steps as mentioned earlier (without the aid of simple transplant tray).
- Scenario #2: Two operators (A & B) are assigned to carry out all the four steps separately by their own (without using the transplant tray).
- Scenario #3: Two operators are engaged, Operator A carried out the first two steps while operator B carried out the last two steps (without using simple transplant tray) as well.
- Scenario #4: Three operators are engaged, operator A carried out the first and last steps while operator B and C carried out the second and third steps respectively, operator transplants 5 net pots at one go (without using the transplant tray).
- Scenario #5: Four operators are asked to carry out each step separately (without using the transplant tray).
- Scenario #6: Four operators are engaged, each operator is required to repeat the same steps separately but the last operator who transferred



the net pots onto the planting rows is required to use a simple transplant tray.

The time taken to complete a plant to be transplanted for each scenario is depicted in Table1.

Table 1: Mean time taken to complete a plant to be transplanted onto the PFAL

Scenario	Mean time taken (seconds)	Remarks
Scenario #1	27.3 seconds	Without using transplant tray
Scenario #2	23.9 seconds	Without using transplant tray
Scenario #3	14.1 seconds	Without using transplant tray
Scenario #4	8.22 seconds	Without using transplant tray
Scenario #5	11.2 seconds	Without using transplant tray
Scenario #6	7.42 seconds	With the aid of a transplant tray

The shortest mean time taken for transferring one net pot onto the planting rows at PFAL is Scenario #6, where four operators are engaged in carrying out specified task each and with the aid of a simple kaizen transplant tray. These outcomes have demonstrated that kaizen is indeed effective in small steps toward improvement. These results also indicate that operators’ productivity can be improved while performing manual, repetitive task with less number of steps (comparing Scenario#2 & 3). With the aid of a simple “kaizen” transplant tray, the mean time taken for completing the task is much lower because the tray can accommodate more net-pots at one time which means that the speed of transferring net pots onto the planting rows become faster. Thus, kaizen methods offer useful and effective tools for process design.

## 4.2 Case Study #2

In this case study, the Five-Step Kaizen Movement, 5S is implemented in the operation of our collaborator’s indoor hydroponic farm. The 5S Kaizen movement started with problem identification by using direct observation at workplace and having interview with workers and manager. This is followed by a series of briefing provided to the workers and manager to ensure they understand the purpose of implementing 5S and the importance of their participation. Then the 5 steps of the 5S movement are implemented one step in a week to allow workers to allow workers to form a new habit at workplace.

### 4.2.1 Problems Identification

Upon observations made at the workplace, the following problems are identified:

1. No proper utilization of storage for raw material.
2. It is tedious to locate the right type of seeds for daily germination.
3. It takes time to find the right type of seedlings for transplanting in darkroom.
4. No proper labelling of type of vegetable at PFAL.

### 4.2.2 Implementation of 5S Kaizen Movement

Step 1: *seiri* (sort) - The main focus of this step is to sort or clear the necessary from the unnecessary items in one’s workplace and eliminate waste or unnecessary items. All the necessary and unnecessary items available in the working area must be sorted and classified accordingly. Several guidelines and rules for performing Step 1 are listed below:

- Eliminate all the unnecessary items which causes the mixing of things
- Put back all the necessary item to its original position after use.
- Organize the items according to the frequency of their usage
- Check whether all necessary items are sorted in its own position.

- To place frequently used items near to reach.
- Work-in-process, finished product and rejected need to be separated.
- To remove workplace clutter and freeing up valuable.

Outcomes after implementing Step 1:

- The production flow in the working area is greatly enhanced and the utilization of space is maximized as well.
- By eliminating the unnecessary items, the working bench/desk becomes neat and tidy which may enhance the employees` daily task performances.
- Workers can identify the materials, equipment or necessary items easily through sorting.
- A clean and organized workplace improves the efficiency of searching and reaching for items required, thus, the operation running time is shortened.

Step 2: *seiton* (straighten or put things in order) - The main emphasis is on effective organizing what was left after Step 1, i.e., the necessary items in the workplace. The remaining necessary items should be organized neatly and systematically for easy retrieval and return to the designated locations after being used.

Several guidelines and rules are outlined:

- Label every item and its storage area clearly.
- Do not stack all the items together.
- Use racks or shelves to organize the items.
- Use see-through containers to store items for better visibility.
- Put all the important material or equipment in an accessible position.
- Put names on the containers of nutrient solution.
- All tools or equipment must be separated accordingly on the basis of frequency of use.

Outcomes after implementing Step 2:

- The efficiency of workers are increased and the time required for searching for necessary items is shortened.
- All the items such as seed packets are stored in orderly manner by using see-through container with label instead of plastic bags. This action can ease the effort needed to look for the required items without opening the plastic bags which can reduce the retrieval time.
- Labelling is done on the germination racks and nutrient solution containers. The workers are able to identify the things that they require easily by referring to the label attached on the racks.
- Every item is organized and arranged in systematic manner so that the workplace is neat and tidy and hence the overall performance of organisation is improved.

Step 3: *seiso* (shine or cleaning) – This step focus on the thoroughly cleaning of workplace. It ensures a safer and comfortable working environment for workers as well as a better visibility in order to reduce the retrieval time and enhance the quality of task performance (Agrahari et al 2015). It is vital to create a clean and tidy working environment because dust, wastes and dirt can affect the efficiency of the workplace (Shaikh et al., 2015). The workers` morale and productivity of the whole organisation are believed to be reduced if there is no clean working environment. Listed below are the guidelines and rules to perform Shine:

- Clean the work floor on daily basis
- Provide necessary cleaning to each water channel piping on the planting rows on weekly basis
- Every employee must bear the responsibility to carry out cleaning process
- Cleanliness at workplace must be maintained at all time
- If found any dirt such as nutrient solution leaks must be cleaned immediately to avoid any slip or fall of workers

- To implement daily follow-up cleaning process as it is absolutely essential to maintain a clutter-free workplace and a desirable working environment as stated by Agrahari et al (2015).
- Preparation of a checklist for the organisation to monitor the cleaning progress carried out by each worker on daily and weekly basis. Agrahari et al (2015) stresses that the checklists must serve as visual signpost to make sure that the daily cleaning requirements are conducted habitually as best practices in the workplace.

#### Outcomes after implementing Step 3:

- The working environment for workers is greatly enhanced and hence the workers are able to enjoy working in a clean and safe workplace.
- The efficiency of task performance will increase.
- The maintenance cost for equipment can be reduced if basic cleaning and maintenance is done regularly.
- By cleansing the inner part of the water channel piping, the growth or formation of mosses or lichens can be prohibited.
- The water flow in the entire planting row system is recycled all the time. If no proper cleaning process has been carried out for the water channel piping, the water being recycled will be contaminated as well. Consequently, this will affect the growth of the plants and the productivity of the crops as well. Thus, it is recommended to clean the water channel piping on weekly basis.
- The work floor are clean all the time and this will avoid any accident such as slip or fall of workers.

Step 4: **seiketsu** (standardize) – This step concentrates on standardizing. According to Kumar (2012), continuous implementation of the above 5S Kaizen Movement will ensure a high standard of workplace and therefore after implementing the first three steps of 5S practices, it is paramount to focus on standardizing the best practices all the time. In order to standardize, the standard operation procedures

(SOP) of the production flow and simple daily checklists must be prepared and displayed visibly at every corner of the working area. This is further supported by Agrahari et al (2015). The checklists prepared must be signed by every worker and validated by the upper management personnel such as operation manager or general manager in the organisation. It is to ensure that 5S Kaizen Movement's practices and guidelines as stated earlier are adopted and performed regularly or habitually by every personnel who is responsible in carrying his or her specific tasks as the best practices in the workplace.

#### Outcomes after implementing Step 4:

- By applying the standardized practices, the operation and the production flow of the organisation is improved as better workplace standards are established such as rules and standard operation procedure.
- The other benefits includes maintaining the good habits among the employees about cleanliness and the operation efficiency is thus further enhanced.
- A neat and orderly maintained workplace.

Step 5: **shitsuke** (sustain or self-discipline) - The final step in 5S Kaizen Movement is to sustain. Sustain in another word means to maintain. Sustain is a good habit that continually improve the organisation's culture and performance (Khedkar *et al.*, 2012). To maintain the above 5S practices, the researchers suggested to organise regular retraining sessions related to 5S techniques and practices for every personnel in the organization. Chugani et al., (2017) also highlighted that developing awareness related to the importance of 5S through retraining, reward and recognition of the endeavour of employees is essential to fulfil the requirement in the Step 5. Therefore, the manager of the company must organize a program regarding the 5S techniques and rules at least once every quarterly for the workers. Workers are also encouraged to participate the training program.

Outcomes after implementing Step 5:

- After performing Step 5, the benefits obtained include the workers` morale and awareness on 5S are increased
- Operational errors or mistakes of the workers are obviously reduced
- The relationship between workers is improved as the internal communication processes are enhanced.

Summary of Case study #2:

- Upon implementation of Kaizen 5S Movement, a positive workplace culture is developed in the indoor hydroponic farm.
- The production flow becomes smooth and the overall performance of the organisation has improved.
- The teamwork between employees and management is fostered through the implementation of 5S approach.

### 4.3 Case Study #3

The objective of this case study is to explore the opportunities of implementing Kaizen methods in ergonomics improvement for workers at workplace. Direct observation and interviews with workers are conducted at the collaborator’s hydroponics farm to identify the current ergonomics risk faced by the workers in their daily work routine. Then the researchers designed a few small steps toward improvement – Kaizen methods, intentionally aiming to reduce the ergonomics risk within the workplace. The initial assessment is carried out using ergonomics risk assessment (ERA) checklist, which is based on the guidelines provided by Department Of Occupational Safety And Health, Ministry Of Human Resource (2017). Four workers are involved in this initial ERA. The results obtained for the initial ERA are tabulated in Table 2.

**Table 2:** Result of Initial ERA before Implementing Kaizen

Worker(s)	Total Score	Result of Initial ERA	Percentage Weighing (%) $\frac{Result\ of\ Initial\ ERA}{Total\ Score} \times 100\%$
Worker A	27	9	33.33
Worker B	27	8	29.63
Worker C	27	11	40.74
Worker D	27	10	37.04
<b>Average</b>		<b>9.5</b>	<b>35.19</b>

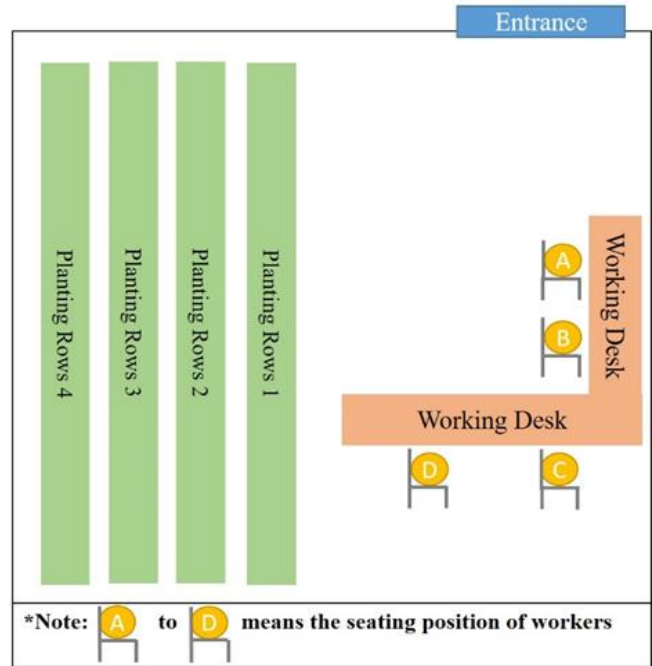
Based on the results obtained in Table 2, the average score of the initial ERA result is 9.5 out of 27 while the percentage is 35.19% out of 100.00% before any ergonomics improvement was made. The researcher had developed some ideas on improvement in term of minimizing the ergonomics risks faced by the workers. Then another round of ERA would be conducted again after the improvement solution has been implemented for four weeks.

#### 4.3.1 Kaizen Approach on Ergonomics Improvement

According to the initial ERA results, one of the ergonomics risk factors is due to the static and sustained work posture. Most of the workers work in a standing position with minimal leg movement for more than two hours on average continuously per working day. In addition, repetitive motion is also one of the main contributing factors to the ergonomics risk. The workers’ work involve repetition of the same tasks sequence of movement for more than three hours on a normal working day. Hence, the researchers proposed and implemented the following kaizen approach in order to reduce the ergonomics risks encountered especially in

transferring the seedlings from the germination racks onto the planting rows.

**Kaizen #1:** The first kaizen approach is to increase the number of working desk and ergonomically designed foldable chairs. Based on the observation, initially, only one working desk with no chair being provided was one of the main reasons why worker encountered ergonomics risk. Figure 2 illustrates the layout of the working area before and after implementing kaizen approach respectively. The number of working desk is increased to two due to the insufficient space for the workers to place and handle the equipment or seedlings while transferring the seedlings onto the planting rows. Additionally, the ergonomically designed foldable chair is preferred due to the back supporting function. The workers can lean against the back support of the chair to minimize the back discomfort or pain. The foldable function also enables the workers to fold the chairs and store the chairs properly when they are not in use. This contributes to the space saving of the working area.

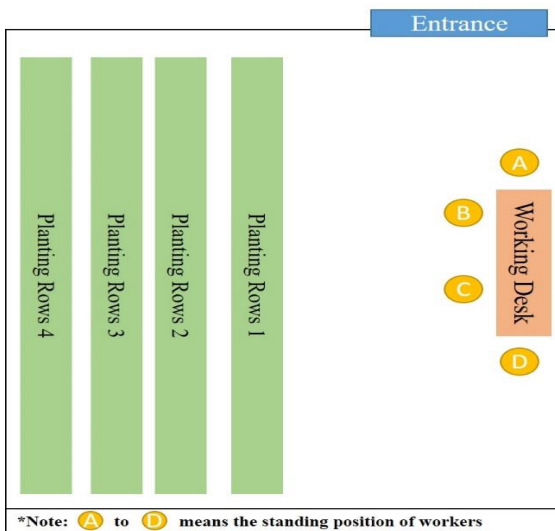


**Figure 2 :** Workplace layout before (Left) and after (right) implementing Kaizen

**Kaizen #2:** The next Kaizen method is to replace the existing ladder into a double step stool when the worker is required to transfer the net pots onto the higher levels of planting rows. A double step stool is preferred due to the wider surface which provides better stability and extra balance for the worker. Consequently, the ergonomic safety risk such as slipping or falling can be avoided.

**Kaizen #3:** In Kaizen method #3, a simple plastic transplant tray is suggested to replace the ordinary wooden transplant tray. Although the wooden transplant tray can accommodate up to 40 net pots at one time, it is much heavier than the plastic transplant tray as it is made up of wood. After a long period of use, the workers would feel muscle fatigue or even discomfort especially in their arms and hands in carrying the wooden transplant tray. This will definitely affect the efficiency of workers in conducting their specific tasks.

After applying the above three Kaizen approaches for ergonomics improvement, another round of ERA is conducted with the workers and the results is depicted in Table 3.



**Table 3** : Result of ERA after implementing Kaizen approaches

Worker(s)	Total Score	Result of Initial ERA	Percentage Weighing (%) $\frac{\text{Result of Initial ERA}}{\text{Total Score}} \times 100\%$
Worker A	27	4	14.81
Worker B	27	5	18.52
Worker C	27	5	18.52
Worker D	27	4	14.81
<b>Average</b>		<b>4.5</b>	<b>16.67</b>

By comparing the results obtained from Table 2 and Table 3, it can be concluded that the average score and the percentage of the ergonomics risk assessment after implementing the kaizen approach for four weeks have obviously decreased from 9.5 to 4.5 and from 35.19% to 16.67% respectively. Thus, applying kaizen approaches in improving the ergonomics practices in the workplace contributes to a higher level of occupational health and safety for workers in the farm.

## V. CONCLUSION

This research study describes the outcomes of implementation of Kaizen and Kaizen 5 Steps movement, 5S methods in improving the productivity of a hydroponics farm operations and improved workers' occupational health and safety conditions. The implementation of Kaizen and Kaizen 5 Steps movement is a very practical approach which is suitable for any industry or business, and it only requires small steps to continually moving toward improvement. In order to make successful Kaizen system most important factors are workers' participation and commitment and close support from top management. Kaizen finds problems as golden

opportunities for improvements with minimum or no capital investment is required. Kaizen creates a working atmosphere where workers' ideas and suggestions are valued. Work environment becomes more enjoyable resulting in job satisfaction of the workers and higher workers' morale. It can enrich the work experience and bring out the best in every worker.

## VI. REFERENCES

- [1]. Agrahari, R. S., Dangle, P. A. and Chandratre, K. V. (2015) Implementing of 5S methodology in the small scale industry: a case study, International Research Journal of Engineering and Technology (IRJET), 4(4), p. 180-187.
- [2]. Anderson, C. and Anderson, C. (2014) Lean leadership: the Toyota way in agricultural firms, (879)
- [3]. Asada, T., Bailes, J. C., and Suzuki, K. (2000) Implementing ABM with Hoshin Management, Institute of Management Accountant Publ., New Jersey.
- [4]. Berger, A. (1997) Continuous improvement and kaizen: standardization and organizational designs, Integrated Manufacturing Systems, 8(2), p. 110-117
- [5]. Bon, A. T. and Daiyanni Daim (2010) Time motion study in determination of time standard in manpower process, Proceedings of the 3rd Engineering Conference on Advancement in Mechanical and Manufacturing for Sustainability Environment, April 14-16, 2010, Sarawak, Malaysia, p. 1-6.
- [6]. Department of Occupational Safety and Health, Ministry of Human Resource, M. (2017), Guidelines on Ergonomics Risk Assessment at Workplace.
- [7]. Imai, M. (1986) Kaizen: The Key to Japan's Competitive Success, Random House Published, New York.

- [8]. Imia, M. (2008) *Gemba Kaizen, A Commonsense, Low, Approach to Management*, Kaizen Institute, Warsaw.
- [9]. Jeffrey, E. F. and Michael, G. (1995) *Ergonomics in the workplace*, Journal of Facilities, 13 (4), p. 20-27.
- [10]. Kraszewki, R. (2005) *Quality Management – Conceptions, Methods and Tools used by the World’s Business Leaders*, Scientific Society of Management Published, Torun.
- [11]. Meredith, J. (1998) *Building operations management theory through case and field research*, Journal of Operations Management, 16 (4), p. 441-454.
- [12]. Paul Brunet, A. and News, S. (2003) *Kaizen in Japan: an empirical study*, International Journal of Operations and Production Management, 23 (12), p. 1426-1446.
- [13]. Robert Maurer, 2014, *One Small Step Can Change Your Life: The Kaizen Way*, Workman Publishing Company, Inc., New York
- [14]. Robert K. Yin (2009) *Case study research – Design and methods*, Second edition, Sage Publications, London.
- [15]. Sii, H. S. (2005) *Cultivating a total quality culture – using Japanese’s common sense 5S*. ELC Press, Malaysia.
- [16]. Suarez Barraza, M. F., Ramis Pujol, J. and Kerbaqche, L. (2011) *Thoughts on kaizen and its evolution*, International Journal of Lean Six Sigma, 2 (4), p. 288-308.
- [17]. Wittenberg, G. (1994) *Kaizen – The many ways of getting better*, Assembly Automation, 14 (4), p. 12-17.

**Cite this article as :**

Wong Ai Moi, Sii How Sing, "The Implementation of Kaizen and 5S concept for Overall Improvement of an Agricultural Organisation", *International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET)*, Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 7 Issue 7, pp. 23-37, January-February 2020. Available at doi : <https://doi.org/10.32628/IJSRSET196656>  
Journal URL : <http://ijsrset.com/IJSRSET196656>