The Concept & Methodology of Kaizen

A Review Paper

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***Abstract*—Now-a-days the ultimate goal of all industries is to enhance productivity through simplified system and incremental improvements by applying some modern available techniques. "Kaizen" is one of the most recognized techniques of continuous improvement. An application of effective Kaizen will lead to success and growth of an organization. This paper discusses various literatures and presents a Concept & Methodology of Kaizen which will helpful to new research in different fields. Besides this, one representative "Kaizen Idea Sheet Format" is presented in this paper which may be useful to different kinds of Industries and this will helpful to the Kaizen users and researchers.**

***Index Terms*—Concept of Kaizen, Continuous Improvement, Kaizen Methodology, Kaizen Toolbox, Lean Manufacturing System, 7 Wastes (Muda).**

I. INTRODUCTION

Kaizen was created in Japan following World War II. The origin of Kaizen can be traced back to the Quality Guru **Dr. W. Edwards Deming**, but it was **Masaki Imai** who popularized the concept of Kaizen to become a revolution around the world.

Kaizen is a combination of two Japanese words (kai+zen), literally means "Change for the Better" [1]. It is a compound word involving two concepts: **Kai (change)** and **Zen (for the better)** [2]. This is translated as **"Continuous Improvement"** in English. The word Kaizen indicates a process of Continuous Improvement of the standard way of work [3].

The concept of Kaizen focuses on improving a work space of an organization in step by step improving process and eliminating wastes. The review indicates that the application of Kaizen promises to reduction/elimination of wastes and improves process efficiency.

II. WHAT IS KAIZEN?

Kaizen is a system that involves everyone – upper management to the cleaning team. Everyone is encouraged to come up with small improvement suggestions on a regular basis [4]. Kaizen is based on making changes anywhere improvements can be made. Kaizen is an approach that [5],

- Starts with people
- Focuses its attention on people's efforts
- Processes are continually improved
- Improved processes will improve results
- Improved results will satisfy the customers

III. LITERATURE REVIEW OF A CONCEPT OF KAIZEN

The Kaizen philosophy has made great impact on researchers because it enhances the productivity of an organization and also helps to produce high quality products with minimum efforts. The following authors have discussed the concept of Kaizen:

According to Imai (1986), Kaizen is a continuous improvement process involving every one, managers and workers [6].

Watson (1986) says that the origin of Plan–Do–Check–Act (PDCA) cycle or Deming Cycle can be traced back to the well known statistics expert Shewhart who has introduce the concept of PDCA in 1920s. The PDCA cycle is also known as Deming Cycle/Deming Wheel/Shewhart Cycle [7].

Suzaki (1987) refers that CI is a philosophy generally practiced in manufacturing and quality circles. It gives inspiration that there is no end to make a process better [8].

Wickens (1990) highlights the impact of the teamwork on Kaizen. Teamwork and commitment do not approach from involving the representatives of employees, but from direct contact and communication between the individual and his boss [9].

Teian (1992) explains that Kaizen stand for the daily struggles occurring in the work area and the way to overcome it. Thus it is more than just a means of improvement. Kaizen can be applied to any area where there is a requirement of improvement [10].

Hammer et al. (1993) describes that Kaizen creates process-oriented thinking. Hence processes to be improved before superior results are obtained. Improvement can be separated into CI and innovation [11].

Bassant and Caffyn (1994) define the CI concept as 'an organization-wide process of focused and sustained incremental innovation'. These processes of incremental innovation are supported by various tools and techniques [12].

Deming (1995) describes that organizations are developed at a greater rate than at any time in recorded history. Thus a highly competitive and constantly changing environment recommends major managerial chances as well as challenges. Many managers have squeezed the philosophy of a Kaizen to effectively tackle this situation [13].

Deniels (1995) explains that the way to achieve fundamental improvement on the shop floor is to make possible operators to establish their own measures, to support business strategies and to use them to drive their Kaizen activities [14].

Yeo et al. (1995) represents the concept of 'Zero Defects' and "Do It Better Each Time'. 'Zero Defects' represents CI over quality by detection of defects. A phrase 'Do It Better Each Time' (DIBET) strategy is associated with constant, conscious and committed efforts to reduce process variation. They conclude that CI is the most important way to manage business through these strategies [15].

Newitt (1996) has stated that the thinking of management and employees will be released if Kaizen philosophy is applied. This will enhance creativity and value addition can thrive [16].

Womack and Jones (1996) refer to Kaizen as a lean thinking and lay out a systematic approach to help organizations systematically to reduce waste. They describe waste as any human activity that absorbs resources but creates or adds no value to the process. The process of Kaizen carries many other benefits as well [17].

Ghalayini et al. (1997) explains that Kaizen is characterized by operatives on the shop floor, identifying problems and proposing solutions—the essence of spontaneous, bottom-up change [18].

Imai (1997) describes that the improvement can be divided into Kaizen and innovation. Kaizen signifies small improvements as a result of ongoing efforts. Innovation involves a drastic improvement as a result of large investment of resources in new technology or equipment as shown in Fig. 1 [19].

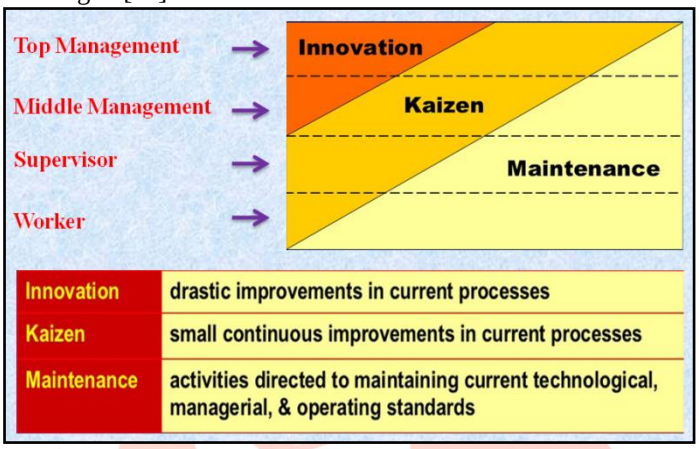

Fig. 1 – Source: Imai (1997)

Williamson (1997) highlights the concept of 'Target Costing' and 'Kaizen Costing' concept. Target Costing is a process that ensures that the products are designed in such a way that the company can sell them at cheaper rare and make a fair profit. Kaizen Costing focuses on the value and profitability of the manufacturing phase, both of new and existing products [20].

Cheser (1998) explains that Kaizen means making small changes on a regular basis by reducing waste and continuously improving productivity, safety, and effectiveness. Kaizen has historically been applied to manufacturing sectors but it is now commonly applied to service business processes [21].

Kim and Mauborgne (1999) highlight incremental improvement as 'imitation' and not 'innovation'. According to them, companies should focus on a positive strategy (value innovation strategy), which focuses on the creation of new customers as well as sustaining existing customers [22].

Williams (2001) describes that CI techniques are the popular way of making considerable reduction to production costs. Quality Function Deployment (QFD) is a well-known technique for translating customer requirements for a product into functional specification [23].

Doolen et al. (2003) explains that impact of Kaizen activities on human resource is measured by various 'Variables' that include attitude toward Kaizen events, skills gained from event participation, understanding the need for Kaizen, impact of these events on employee and work area, and the overall impression of the relative successfulness of these events [24].

Chen and Wu (2004) explain that CI can be generated and sustained through the promotion of good improvement model and management support. In fact, it is not easy in reality. The improvement case may fail without carefully examining the problem in the activity [25].

Hyland et al. (2004) describes the major potential benefits of CI are as: increased business performance (in terms of reduced waste, setup time, breakdowns, and lead time) and increased 'people performance' in the form of improved development, empowerment, participation, and quality of work life of employees; all of which address contemporary societal needs [26].

Abdolshah and Jahan (2006) describe that various CI tools are applied in different life periods of an organization. Methodologies of applying both quantitative and qualitative tools in different life periods of an organization have been discussed [27].

J. Michalska and D. Szewiexzek (2007) refer that one of the most useful Kaizen Tool is "7 Quality Control Tools". 7 QC tools are practical methods of registration and analysis of data; the most popular are: Checklist, Pareto Chart, Ishikawa Diagram (fish-bone diagram), Histogram, Flow Chart, Scatter Diagram, and Control Charts [28].

Farris et al. (2008) describes that Kaizen event is ―a focused and structured improvement project, using a dedicated cross-functional team to improve a targeted work area, with specific goals, in an accelerated timeframe [29].

Radnor and Walley (2008) explains that the immediate benefits attained through Kaizen events may be difficult to sustain, particularly when Kaizen events are used in an ad-hoc manner, because, given the short-term ―focus, they may be less likely to be used in conjunction with long-term activities [30].

Jagdeep Singh and Harwinder Singh (2009) describe the review of literature for Kaizen concept, case studies and survey. This will illustrates that Kaizen is widely accepted philosophy in manufacturing industries [31].

Wiljenna Jackson Glover (2010) refers that major obstacles for many organizations is to sustain the improvements from a Kaizen event over time. The inability to sustain Kaizen event outcomes may have significant consequences for the progress of a work area [32].

Vineet Kumar (2011) explains that the Kaizen philosophy assumes that our way of life – it is our working life, social life, or our home life – should be the focus of constant improvement efforts [33].

IV. METHODOLOGY OF KAIZEN

There is a standard methodology of Kaizen which can be used in different fields like engineering, manufacturing, management and other supporting processes in the organization. The methodology of Kaizen is also known as **Deming's PDCA Cycle** or **Shewhart Cycle**. The methodology of Kaizen is illustrated in following Fig. 2 [34].

Fig. 2 - Methodology of Kaizen

Kaizen will help in teaching people how they can perform tasks in a rapid way through experiments and this will lead to identify & reduce/eliminate wastes in the process and the selected process can be improved.

There are **10 basic rules for practicing Kaizen** at the Gemba [5]:

1. Discard conventional, fixed ideas concerning production.
2. Think of how to do it, not why it cannot be done.
3. Do not make excuses. Start by questioning current practice.
4. Do not seek perfection. Do it right away, even if for only 50% of the target.
5. Correct mistakes at once.
6. Do not spend money for Kaizen.
7. Wisdom is brought out when faced with hardship.
8. Ask "why" 5 times and seek root causes.
9. Seek the wisdom of 10 people rather than the knowledge of 1.
10. Kaizen ideas are infinite.

V. KAIZEN TOOLBOX

Research defines that there are no standard technique/instruments are used for implementation of Kaizen. The Kaizen Toolbox contains various tools related with Kaizen are as following [35-41]:

1. **5 Why Technique**
   - Basic for kaizen and at the same time the simplest organizing technique simultaneously.
   - The primary goal of the technique is to determine the root cause of a defect or problem.
   - Captivated in motto "when you find a problem, ask why five times"; it ask so many times as you will find the deepest reason of problem. The primary goal of the technique is to determine the root cause of a defect or problem.
   - Fig. 3 expresses an example of finding root cause by "5 Why" Technique [42].

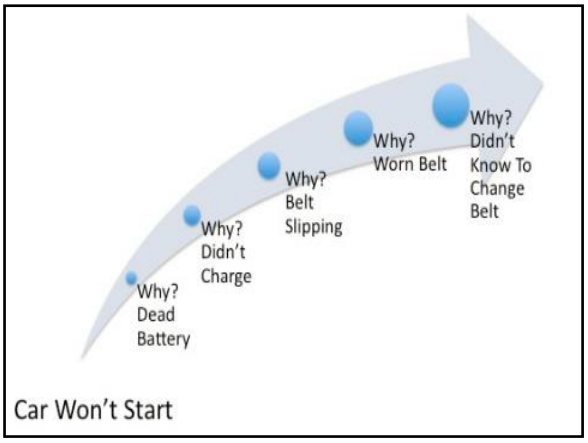

Fig. 3 – 5 Why Technique

2. **5S (Workplace Organization)**

- It is a methodology for organizing, cleaning, developing, and sustaining a productive work environment.
- It's one of the simplest Lean tools to implement, provides immediate return on investment, crosses all industry boundaries, and is applicable to every function with an organization. Fig. 4 explains the concept of 5S (Workplace Organization) [43].

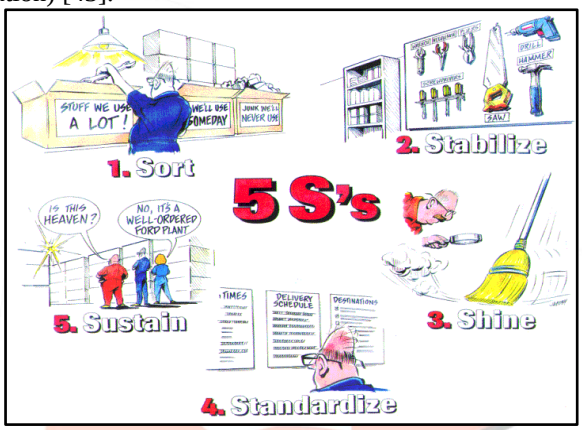

Fig. 4 – 5S (Workplace Organization)

- ✓ **Sort:**-Perform "Sort Through and Sort Out," - red tag all unneeded items and move them out to an established "quarantine" area for disposition within a predetermined time. "When in doubt, move it out!"
- ✓ **Set in Order (Stabilize):**-Identify the best location for remaining items and label them. "A place for everything & everything in its place".
- ✓ **Shine (Systematic Cleaning):**-Clean everything, inside and out. Use visual sweeps to ensure everything is where it should be and that junk is not accumulating.
- ✓ **Standardize:**-Create the rules for maintaining and controlling the first 3 S's. Use visual controls.
- ✓ **Sustain:**-Ensure adherence to the 5S standards through communication, training, self-discipline and rewards.

3. **Elimination of 7 Wastes (Muda)**

- A key concept in implementing Kaizen is to understand what value is and then to eliminate completely (or at least minimize) all non-value added activities.
- Everything, which does not add value, is a waste. Fig 5. describes the classification of 7 Wastes (Muda) [44]:

Fig. 5 – 7 Wastes (Muda)

1) **Over Production:-**Producing items for which there are no orders, which generates such wastes as overstaffing and storage and transportation costs because of excess inventory.
2) **Excessive Inventory:-**Excess raw material, work-in-process, or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage costs, and delay. Also, extra inventory hides problems such as production imbalance, late deliveries from suppliers, defects, equipment downtime, and long setup times.
3) **Waiting:-**Workers merely serving to watch an automated machine or having to stand around waiting for the next processing step, tool, supply, part, etc., or just plain having no work because of stock outs, lot processing delays, equipment downtime, and capacity bottlenecks.
4) **Motion:-**Any wasted motion employees have to perform during the course of their work, such s looking for, reaching for, or stacking parts, tools, etc. Also, walking is waste.
5) **Transportation:-**Carrying work in process long distances, creating inefficient transport, or moving materials, parts, or finished goods into or out of storage or between processes.
6) **Rework/defects:-**Production of defective parts or correction. Repair or rework, scrap, replacement production, and inspection mean wasteful handling, time, and effort.
7) **Over Processing:-**Taking unneeded steps to process the parts. In efficiently processing due to poor tool and product design, causing unnecessary motion and producing defects. Waste is generated when providing higher-quality products than necessary.

4. 7 QC Tools

- Practical Methods of registration and analysis of data. Fig. 6 describes 7 QC Tools [45]:

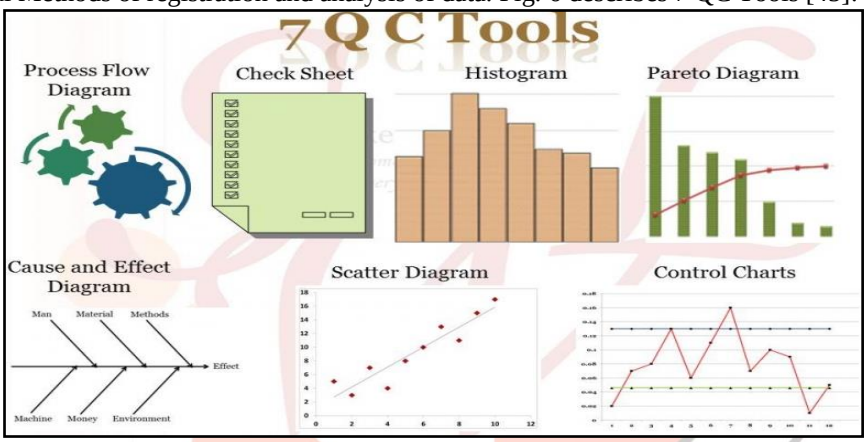

Fig. 6 – 7 QC Tools

- ✓ **Check Sheet:-**It helps in organizing data by category. It shows how many times each particular value occurs.
- ✓ **Pareto Chart:-**A graphical tool for ranking causes from most significant to least significant. It quickly draws everyone's attention to the most important factor – providing an at – a glance snapshot of priorities.
- ✓ **Flow Chart / Process Map:-**It is a graphical tool that shows the major steps in a process. Flow charts are a useful tool for examining how various steps are related to each other. By studying these charts individuals and teams can often uncover potential sources of trouble and/or identify steps to be taken to improve or error-proof a process.
- ✓ **Ishikawa Diagram (Fish-Bone diagram):-**It is a tool for analyzing and illustrating a process by showing the main causes and sub causes leading to an effect.
- ✓ **Histogram:-**A graphic summary of a set of data that reveals the amount of variation that a process has within it.
- ✓ **Scatter Diagram:-**A graphical technique to analyze the relationship between two variables.
- ✓ **Control Chart:-**A run chart with upper and lower control limits on which values of some statistical measure for a series of samples or subgroups are plotted.

5. Jidoka (Autonomation)

- It may be described as "Intelligent automation" or "automation with a human touch". Fig. 7 explains the concept of Jidoka [46].

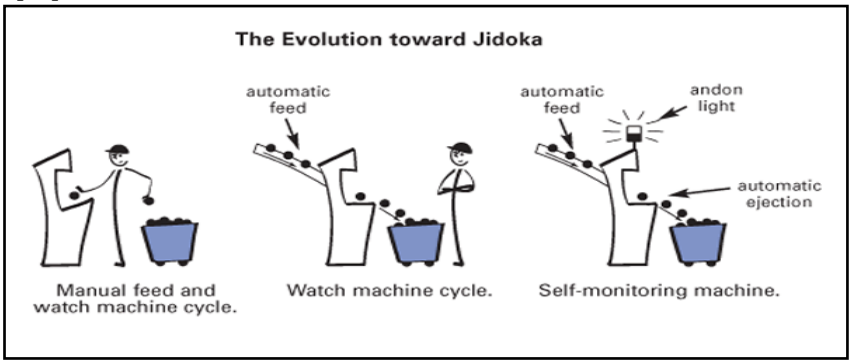

Fig. 7 – The Concept of Jidoka

- The purpose of autonomation is that it makes possible the rapid or immediate address, identification and correction of mistakes that occur in process.
- Control process held, one of the basic solutions improving assurance of the quality production, defects of the processed part are automatically found by the machine, which immediately stops its working mode.

6. PDCA Cycle

- PDCA is an iterative four step management method used in business for the control and continuous improvement of processes and products.
- It is also known as the Deming Cycle /Deming Circle / Deming Wheel / Shewhart Cycle as shown in Fig. 8 [47].

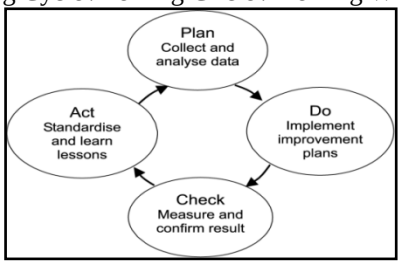

Fig. 8 – Deming Cycle

- ✓ **Plan:-**The objective is to plan for changes predict the results.
- ✓ **Do:-**The plan is executed by taking small steps in controlled circumstances.
- ✓ **Check:-**The results are studied.
- ✓ **Act:-**The organization takes action to improve the process.

7. Poka-Yoke

- Poka-Yoke is a Japanese term that means "Mistake Proofing".
- It is any mechanism in a Lean manufacturing Process that helps an equipment operator avoid (Yokeru) mistakes (Poka). Fig. 9 indicates the concept of Poka-Yoke [48].

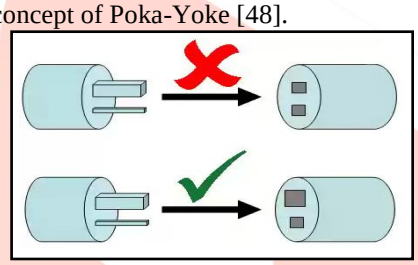

Fig. 9 – Poka-Yoke

- Its purpose is to eliminate product defects by preventing, correcting or drawing attention to human error as they occur.
- System of means eliminating defects being the results of inaccuracy; Poka-yoke solutions find application in stable processes and enable to drop of frequency of defects for six sigma level.

8. Andon

- Andon is a manufacturing term referring to a system to notify management, maintenance, and other workers of a quality or process problem.
- The centerpiece is a signboard incorporating signal lights to indicate which workstation has the problem.
- The alert can be activated manually by a worker using a pull cord or button, or may be activated automatically by the production equipment itself. Fig. 10 indicates the concept of Andon and its usage [49].

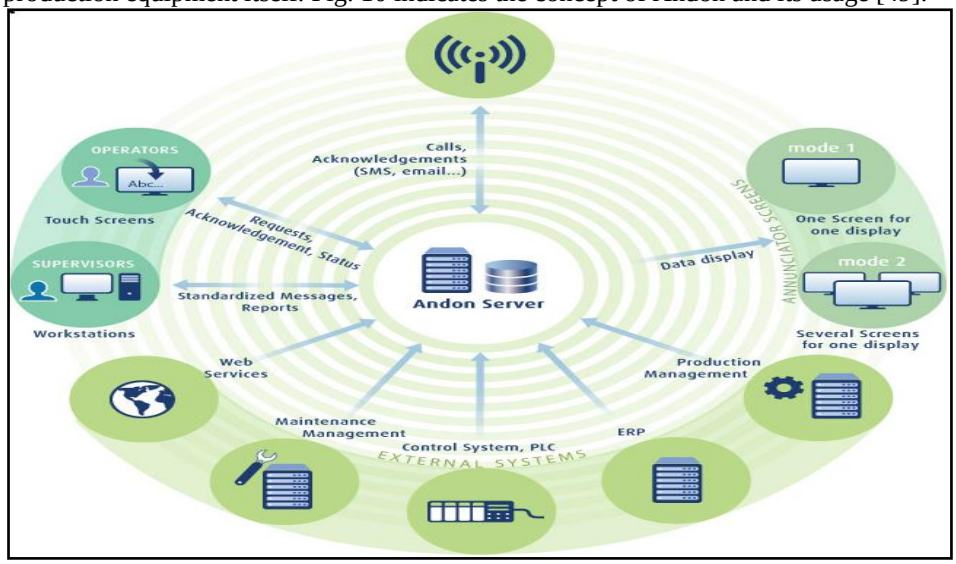

Fig. 10 – The concept of Andon

VI. The Results achieved through Implementation of Kaizen

The results taken from Kaizen Blitz projects conducted at the companies: Connecticut Spring and Stamping, Farmington, Conn., Critikon (a Johnson and Johnson company), Southington, Hamilton Standard, Windsor Locks, Jacobs Manufacturing, Bloomfield, Meriden Manufacturing, Meriden, plastic Design, Inc., Middletown, Pratt & Whitney, West Hartford, East Hardfort, and Farmington, United Tool & Die, West Hartford, Wiremold etc. [4].

- Setup time reduction 70-90%.
- Productivity improvement 20-60%.
- Process time reduction 40-80%.
- Inventory reduction 30-70%.
- Walking distance reduction 40-90%.

VII. The Benefits Resulting from Kaizen

Toyota is well-known as one of the leaders in using Kaizen. In **1999** at one **U.S. plant**, **7,000 Toyota employees** submitted over **75,000 suggestions**, of which **99% were implemented**. These continual small improvements add up to major benefits. With every employee looking for ways to make improvements, you can expect results such as [4]:

- Kaizen **reduces waste** in areas such as inventory, waiting times, transportation, worker motion, employee skills, over production, excess quality and in processes.
- Kaizen **improves space utilization**, **product quality**, use of **capital**, **communications**, and **production capacity** and **employee retention**.
- Kaizen provides **immediate results**. Instead of focusing on large capital intensive improvements.

VIII. Kaizen Idea Sheet

Literature Survey shows that there is **lack** of **easy Kaizen Idea Sheet** to be used. Fig. 11 illustrates one representative "Kaizen Idea Sheet Format" which may be used in different kind of Industries as template for Kaizen users and this will be helpful for Kaizen users and researchers.

Company - XYZ	Kaizen Idea Sheet					
XYZ	Department	Division	Machine / Area	Process Operation	Registration Date:	
					Registered By:	
					Manager's Sign	

Kaizen Theme	Kaizen Idea

Problem/Present Status	Technique used	Root Cause

Action to be taken	Kaizen Sustainance		
	What to do?	Benchmark	
		Target	
		Kaizen Start	
		Kaizen End	
	How to do?	Team Members	

Before Kaizen	After Kaizen	Result

Benefits through Kaizen	Cost of Kaizen	Scope and Plan for Horizon Deployment				
		Sr. No.	Machine No. / Shop	Target Date	Responsibility	Status
		1				
		2				
		3				
		4				
		5				

Fig. 11 – Kaizen Idea Sheet

"Kaizen Idea Sheet" will cover various contents and description of all these contents is explained below:

- Kaizen Theme – Aim of Kaizen Implementation.
- Kaizen Idea – Define the Key Suggestions which will be used to solve the Problem.
- Problem/Present Status – Summary of Problems and existing status.
- Technique used – Various kind of techniques/tools as defined in Kaizen Toolbox are used.
- Root Cause – Based on techniques define the root cause.
- Actions to be taken – Take actions such that the problem will be reduced / eliminated.
- Kaizen Sustain – It describes: 'How to do?' and 'What to do?'
- Before – After Kaizen – Attach a photograph which show the Before – After Condition
- Results – Mention the results obtained through Kaizen
- Benefits through Kaizen – Explain & Justify benefits through Kaizen.
- Cost of Kaizen – Calculate the cost of Kaizen.
- Scope and Plan Horizon Deployment – It is used for future scope & planning horizon deployment.
- General Information – This is the information about Department/Division, Machine/Area, Process Operation, Registration Date, Benchmark of Process, Target, Kaizen Start Date, Kaizen End Date, Team Members, etc.

IX. CONCLUSION

From the literature, it can be concluded that there is a great literature available on Kaizen philosophy, which gives a broad view of past practices and researches carried out across the globe. Kaizen is widely accepted philosophy in manufacturing industries and also more research work is required in this field, but the authors feel that Kaizen philosophy can also be applied to different areas like business, service, commerce, etc. Thus a great scope of research is available for new researchers in this field. So more research is required which could improve the awareness aspects, as these factors are highly important for the success of the Kaizen philosophy in most of the manufacturing industries across the world.

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