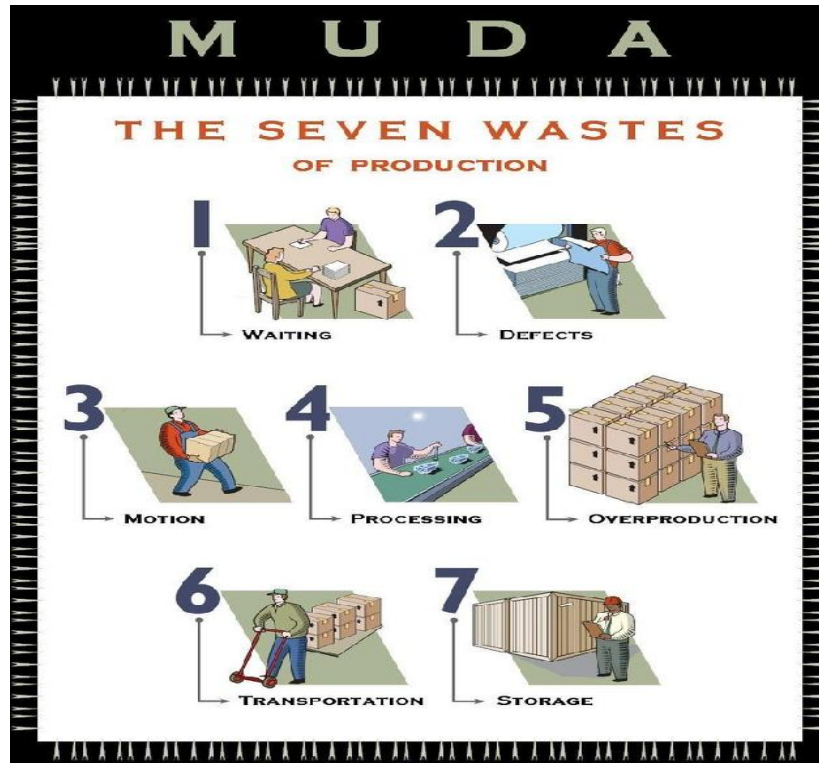


Building Electrical installation

Level-II

Based on June 2022, Curriculum Version 1



Module Title: - Prevent and Eliminate MUDA

Module code: EIS BEI2 M10 0822

Nominal duration: 35 Hour

Prepared by: Ministry of Labour and Skill

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Addis Ababa, Ethiopia

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Acronym and Abbreviation

PDCA	Plan, Do, Check, Act
QC	quality cycle
FIFO	First in First out
5M +Q+S	man, material, machine, method, management, quality, safety
4M1E	Man, Machine, Method, Material, Environment
5W1H	when, where, why, what, who, how
5S	sort, set in order, shine, standardize, sustain
WIP	Work In Progress

Introduction to the Module

This module is designed to meet the industry requirement under the Building Electrical Installation level II occupational standard, particularly for the unit of competency: **Preventing and Eliminating MUDA** which covers the knowledge, skills and attitude required by a worker to prevent and eliminate MUDA/wastes in workplace by applying scientific problem-solving techniques and tools to enhance quality, productivity and other kaizen elements on continual basis. It covers responsibility for the day-to-day operation of the work and ensures Kaizen Elements are continuously improved and institutionalized.

This module covers the units:

- MUDA and problem
- causes of a problem
- MUDA and Assess effectiveness of the solution
- occurrence of wastes and sustain operation

Learning Objective of the Module

- Identify MUDA and problem
- Analyze causes of a problem
- Eliminate MUDA and Assess effectiveness of the solution
- Prevent occurrence of wastes and sustain operation

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” given at the end of each unit and
5. Read the identified reference book for Examples and exercise

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Unit one : Identify Muda and Problem

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- 1.1 Concept of Muda/Waste
- 1.2 Methods for categorizing types of waste/Muda
- 1.3 Causes and effects of 7 types of wastes
- 1.4 Waste/Muda Identification
- 1.5 Methods and formats/checklists for Muda identification

This unit will also assist you to attain the learning outcomes stated in the coverage contents and topics. Specifically, upon completion of this learning guide, you will be able to:

- Explain the concept of Muda.
- categorizing types of waste/Muda
- Discuss causes and effects of Muda.
- Identification Waste/Muda
- Report wastes / Muda using Format and checklist

1.1. The Concept of Muda/Waste

Definition of Waste/ Muda

Wastes or Muda are activities which use resources, time or cost without adding value. Waste/Muda is any activity which consumes resources, such as money, time, energy, materials, etc, that does not create value and can be eliminated. Value-added means those activities that change raw material into value for the customer. Muda is a Japanese word meaning wasteful activity. It is anything unnecessary in operation. It increases production cost and affects the quality of the product and also delivery time. Reducing or eliminating Muda is, of course, one of the fundamental objectives of any quality-oriented person.

The three Categories of Operation

- a. Net Operation/Value Adding Operation
- b. Non-Value Adding Operation
- c. Muda/ waste

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a. Net Operation/Value Adding Operation

Part of an operation that adds value to make parts and products or deliver service. In other words, it is part of the operation that the customer exactly needs / willing to pay for.

Examples - Assembling and Welding, Printing/photocopying a document etc

b. Non-Value Adding Operation

Part of operation that adds no value but cannot be avoided rather it can be reduced.

Example Setting up / adjustments, loading paper to a photo copy machine/printer, etc

c. Muda

Muda is a Japanese word meaning Wasteful Activity which use resources, time or cost without adding value. In other words, it is anything unnecessary in operation that affects the quality of the product/service, productivity, delivery time and also production cost. Muda can be eliminated immediately.

Example:- Unnecessary motion/searching for tools, unnecessary transportation of materials, over production, Inventory, Waiting /idle time, making defects and over processing,etc.

Example

Very simple drill to elaborate the three Categories of Operation.

Operation:-To staple two papers using a stapler where the work place is disorganized.

Needed materials and tools for the activity

- Two pieces of paper
- Stapler
- Staples

Table 1. 1 the result in the disorganized sample work place is summarized

No.	Activities	Time taken	Category of the operation	Action to be taken to eliminate/reduce	How
1	Searching for Stapler	35 Sec	Muda	Eliminate	5S(Set-in-order)
2	Searching for Staples	30 Sec	Muda	Eliminate	5S(Set-in-order)
3	Putting the Staples into the stapler	8 Sec	Non-Value adding	Minimize	Load staples ahead
4	Putting the two papers together	3 Sec	Non-Value adding	-	
5	Staple the papers	2 Sec	Net Operation	-	

Lessons from the drill

Total time of operation=78 Sec

- Net Operation (Value adding) =2 Sec (2.6%)
- Non-Value adding operation=11 Sec (14.1%)
- Muda (Unnecessary operation) =65Sec (83.3%)

Can you imagine by how much the total time of the operation can be improved if we try to eliminate the Muda and minimize non value adding operations by applying 5S?

Targets of Customer

Customer is the one who buys products/services from manufacturers/service providers. So the customer does not bother how the manufacturer/service provider makes it. Now a days customers have many alternative manufacturers/service providers to buy the same type of product/service from and choose one that fulfills their targets which are listed below:-

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- Customer needs better quality
- On time delivery
- Reasonable price

Targets of Manufacturer/Service provider

The primary target of Manufacturers/Service providers is to earn profit. So as to meet his/her target, he/she needs to satisfy the targets of customers in such a way by providing better quality product/service on time and at a reasonable price. If he/she is able to do so, he can win customers' targets. Then to get higher profit the Manufacturer/Service provider needs to minimize his/her costs by reducing/eliminating wastes and following effective working procedures.

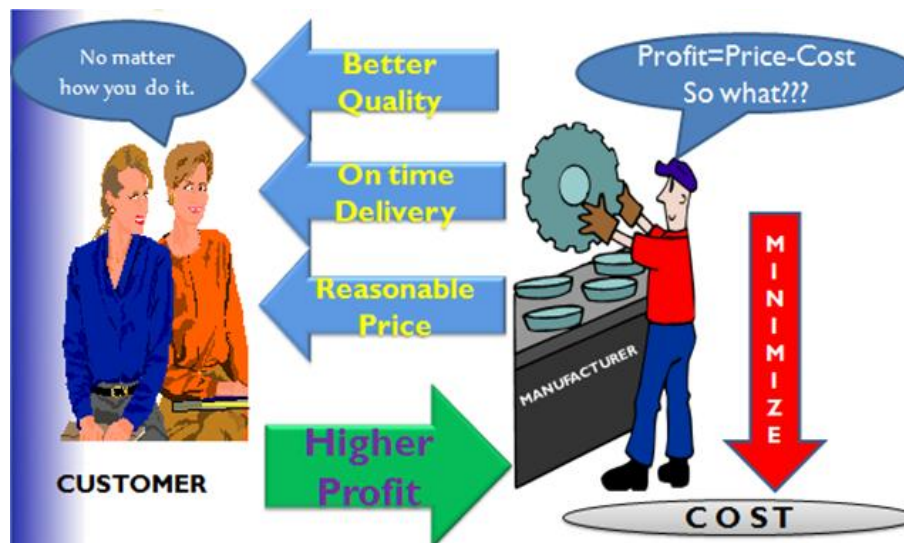


Figure 1. 1 following effective working procedures

Concept of Cost

Cost: - is the amount of money that is expended to accomplish a given task/operation.

Cost can be of Manufacturing or Service Delivering cost= (material + labor + facility + utility + others) cost

Determination of the sales price of the product/Service

Sales price= (manufacturing or service delivery) cost + profit

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Traditional Thinking of Price Setting

In traditional thinking of price setting, price is determined by the manufacturer/service provider rather than the market itself.

When there is shortage of supply then the manufacturer raises selling price.

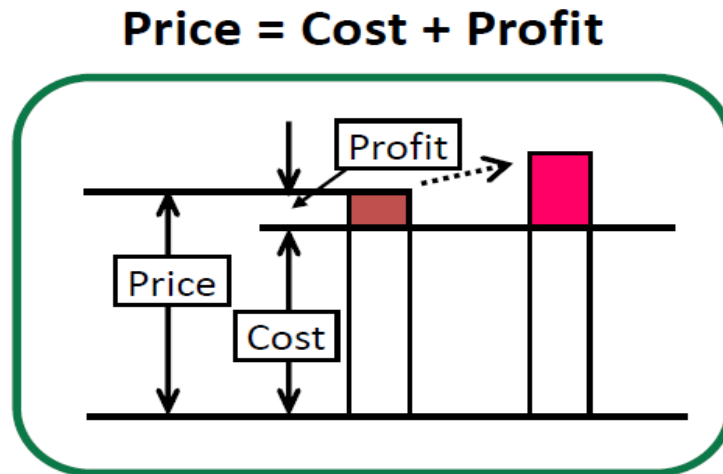


Figure 1. 2 Traditional Thinking of Price Setting

Kaizen Thinking of Price Setting

In modern time, there are a large number of manufacturers/service providers delivering the same type of product/service offering the customers a great deal of options to buy products/services. Price is determined by the interaction between market demand and supply. Manufacturers/service providers, who want to set selling, price above the market price, customers will not be willing to buy their products/services. Manufacturers/Service providers to be competent in the market they should provide Quality product/service on time and at the market price. Since today's economy is market based, we should focus on minimizing our costs and not maximizing selling price to maximize our profit.

Profit = Price - Cost

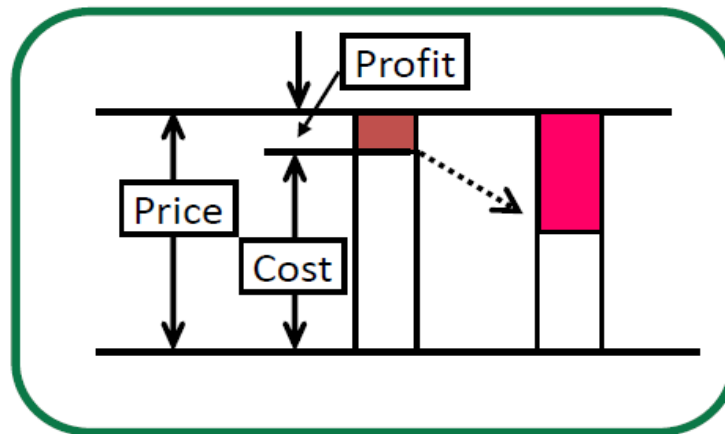


Figure 1. 3 Kaizen Thinking of Price Setting

Value

Value is defined by the next customer (Know your Customer's Need). The next process is your customer. The activity/effect exactly what the next customer needs is value adding activity.

There are two types of customers:-

- Internal customer
- External customer

Internal customer: - is the customer within a production line/service delivering sequence that is next to the previous process and makes his/her own process.

External customer: - is the customer that buys the final out put product/service of the enterprise.

1.2. Methods for categorizing types of Wastes/Muda

A number of methods for categorizing types of waste have emerged. We will review some of these models to get a deeper understanding of what waste is and how to find it and eliminate it.

- The three Mus
- The 5M + Q + S
- The flow of goods
- The seven deadly wastes

a. The Three MUs

In this way of thinking about waste, the goal is to achieve a condition where capacity and load are about equal. In other words, there are just the right amount of workers, materials and machines to make just the right amount of product that is being ordered and deliver it on time to the customer. In Japanese this is expressed with the terms muda, mura and muri.

- Muda (waste) = Capacity exceeds load.
- Mura (inconsistency or variation) = capacity sometimes exceeds the load and the load sometimes exceeds capacity.
- Muri (irrationality/physical or mental overburden) = load exceeds capacity.

By focusing improvement activities on eliminating the non-value added activities throughout the production/service delivering process, and establishing production flow, a balance is naturally achieved between capacity and load.

b. The 5M + Q + S

Another way of thinking about waste is to focus on the areas where waste may occur: the 5M (man, material, machine, method and management), plus quality and safety. See the next figure.

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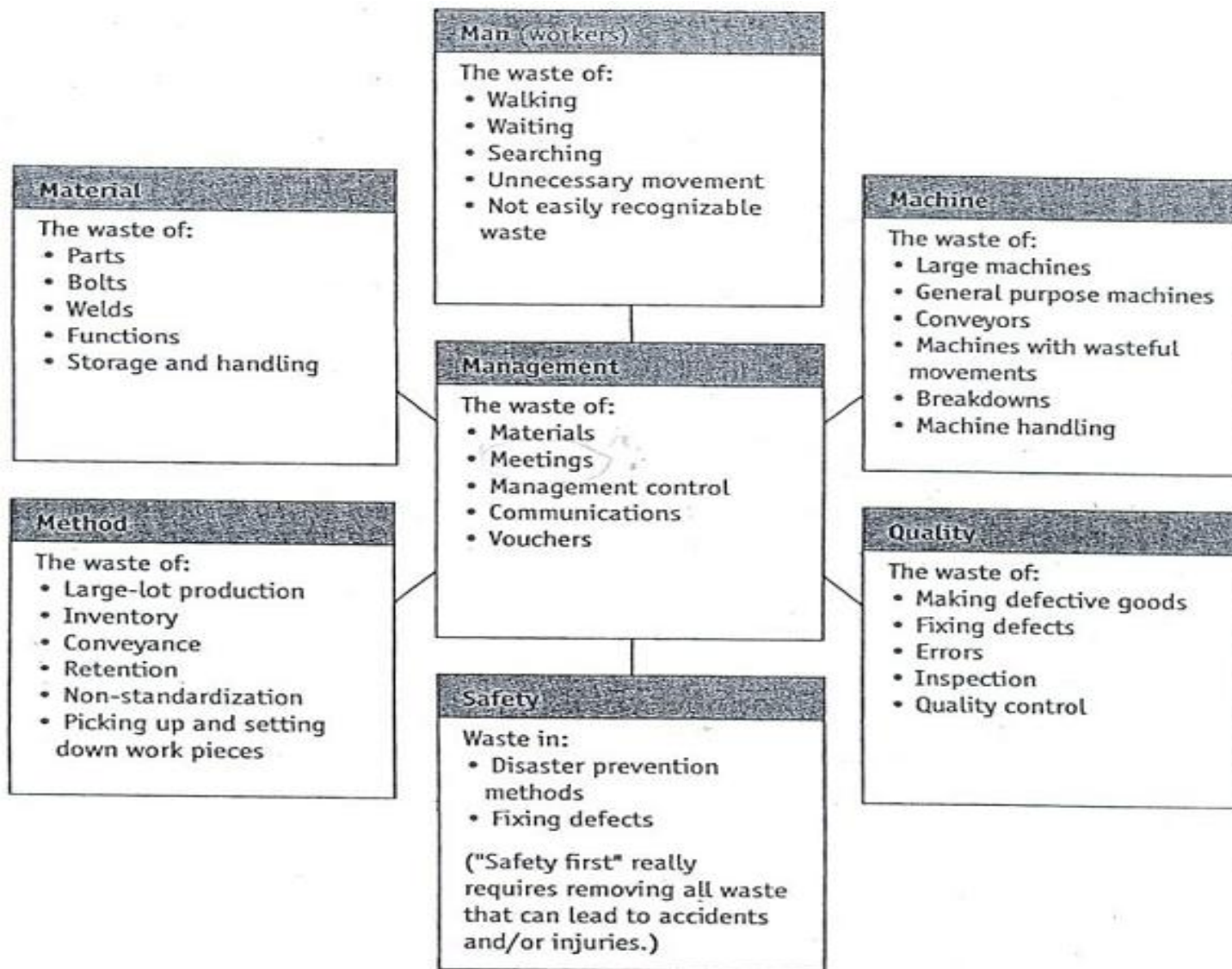


Figure 1. 4 The detail explanation of 5M + Q + S

Some of the main forms of waste that you will uncover by focusing on these aspects of production include, walking, waiting, searching, material storage and handling, large machines, conveyers, wasteful production methods, inventory, defective goods, errors, inspection, etc.

The Flow of Goods

A third way of thinking about waste is to focus on the flow of goods in production. The flow of goods typically looks like this:

- **Materials are procured**
- Materials are retained in the warehouse
- Materials are conveyed to processes on the production line
- Materials are retained at the process equipment (WIP)
- Materials are picked up for processing
- Materials are processed
- Processed goods are set down and retained on the other side of the processing machine (WIP)
- Goods are conveyed to an inspection point Goods are retained until inspection
- Goods are picked up and inspected
- Goods are set down and retained on the other side of inspection process
- Inspected goods are conveyed to the finished goods warehouse
- Finished goods are retained prior to shipment

Finished goods are delivered to the customer.

If you look carefully at this you will notice there are really only four things going on:

- retention
- conveyance,
- processing and
- inspection

Retention means stopping the flow of goods without adding any value to them. It is called stockpiling, warehousing, temporary storage, and so on. Retention produces inventory: materials inventory before

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processing, work-in process inventory, or finished goods inventory. Inventory occurs for variety of reasons:

- The upstream process moves faster than the downstream process.
- Goods flowing from several lines to one process or goods waiting to go from one process to several different lines tend to pile up.
- There is waiting for machine changeover.
- Materials are purchased and processed for expected end-of-the month rushes.
- Materials are purchased in advance of orders.
- Spare parts are purchased in advance for after-sales service.

Retention adds cost without adding value. It is easy to think that inventory solves production flow problems but in fact it just hides them. When you eliminate retention points the real problems in the production flow must be addressed directly. This is the only path to waste-free production flow, or lean production.

Conveyance refers to transporting goods without adding value. Movement between a retention points is often called “conveyance” and movement between a retention point and a process is often called “material handling.”

Processing means adding value. We either alter the raw materials or parts or we assemble parts to add value. Improvement of processes includes identifying how a process can best fulfill its purpose or identifying how a process can be done more efficiently. You will ask, why are we drilling holes? Why are we putting in screws? You may discover many operations that can be replaced by better solutions or even eliminated.

Inspection identifies and eliminates defects from the production flow. It does not add value because it does not eliminate the source of the defect but only its result. Once you change your focus from “finding” defects to “reducing” defects you are on your way to eliminating waste. Ultimately, lean production aims to prevent all defects from occurring.

The Seven Deadly Wastes

The most well-known category of wastes is the “seven deadly wastes,” which captures the essence of all the ideas discussed above and simplifies them to help you root out waste throughout your production process. You will need strongly motivated people with an instinct for seeing and removing waste. Identifying and eliminating these seven types of waste will forge the path to lean production.

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- Overproduction
- Inventory
- Motion
- Conveyance/Transportation
- Waiting/ Idle time
- Defect making
- Processing

Overproduction:- To produce things more than necessary in terms of type, time, and volume. It is called “the worst kind of Muda” since it hides all the other wastes.

Inventory: - The situation where items such as raw materials, work in process and finished goods are stagnant or which are not having value added to them. Some are located in the warehouses, and others are in-process inventory.

Motion: - These are non-value adding movements or more than necessary movements of workers, equipment, and machines, such as looking for goods, bending, stretching, walking, lifting, reaching etc.

Conveyance/Transportation: - It is unnecessary transportation of parts between processes caused by unnecessary transportation distance, temporary storage, and relocations or re-piling up. Transportation does not create any value added except for transportation companies. Transportation is usually difficult to be totally eliminated but reducing is possible.

Waiting/ idle time: - Refers to both human and machine waiting.

This includes all kinds of waste of time such as workers or parts waiting:

- For an upstream process to deliver.
- For a machine to finish processing.
- For incoming parts or materials.
- For process that has a long wait time.

Defect making: - This includes defects, inspections for defects in-process, and claims, rescheduling, and resource loss.

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Processing: - This consists of processing and operations primarily unnecessary. It is processing beyond the standard required by the customer.

1.3. Causes and Effects of 7 types of Wastes/Muda

Table 1. 2 cause and effects of seven types of Muda/ wastes

Causes of Muda of Overproduction	Effects of Muda of Overproduction
➤ Large-lot production ➤ Anticipatory production (producing product in advance of demand) ➤ Inability to achieve short changeover times with the large equipment used in mass production systems ➤ Creating enough stock to replace the number of defective parts produced ➤ Overstaffing or too much equipment ➤ Machines that turn out parts too quickly	Companies often have overproduction as a result of large-lot manufacturing methods or mass production. there are several unfortunate effects of over production: ➤ Anticipatory buying of parts and materials ➤ Blocked flow of goods ➤ Increased inventory ➤ No flexibility in planning ➤ Occurrence of defects

Causes of Muda of Inventory	Effects of Muda of Inventory
➤ Acceptance of inventory as normal or as a “necessary evil” ➤ Poor equipment lay out ➤ Long changeover times ➤ Shish-kabob or large lot production ➤ Obstructed flow of goods ➤ Anticipatory production ➤ Defective parts ➤ Upstream process is too fast for the downstream process	➤ Waste of space ➤ Needs for inspection, and transportation ➤ Expansion of working fund ➤ Shelf life may expire ➤ It ties up cash ➤ Makes FIFO inventory management more difficult

Causes of Muda of motion	Effects of Muda of motion
➤ Isolated operations ➤ Low employee morale ➤ Poor work layout	➤ Increase in manpower and processing ➤ Unstable operation ➤ Increases production time

➤ Lack of training ➤ Undeveloped skill	➤ Can cause injury
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Causes of Muda of Conveyance/Transportation	Effects of Muda of Conveyance/Transportation
➤ Poor layout ➤ Shish-skilled workers ➤ Sitting to perform operations ➤ The need for conveyance systems is assumed	➤ Waste of space ➤ Production deterioration ➤ Expansion of transportation facilities ➤ Occurrence of scratches ➤ Increase production time and cost ➤ wastes time and energy

Causes of Muda of Waiting/ Idle time	Effects of Muda of Waiting/ Idle time
➤ Obstruction of flow ➤ Poor equipment layout ➤ Trouble at the upstream process ➤ Capacity imbalances ➤ Large Lot-production	➤ Waste of manpower, time, & machines ➤ Increase in the in-process inventory ➤ Failed delivery dates ➤ Poor workflow continuity

Causes of Muda of Defect making	Effects of Muda of Defect making
➤ Emphasis on downstream inspection ➤ No standard for inspection work ➤ Omission of standard operations ➤ Material handling and conveyance	➤ Increase in material cost ➤ Productivity deterioration ➤ Increase in personnel & processes for inspection ➤ Increase in defects and claims ➤ Invite reworking costs

Causes of Muda of Processing	Effects of Muda of Processing
➤ Inadequate study of processes	➤ Unnecessary processes or operation

➤ Inadequate study of operations ➤ Incomplete standardization ➤ Materials are not studied	➤ Increase in manpower and man-hour ➤ Lower workability ➤ Increase in defects ➤ Can reduce life of components
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1.4. Waste/Muda identification

Muda type I non value-adding, but necessary for end customers. These are usually harder to eliminate because while classified as non- value adding, they may still be necessary.

Muda type II non value-adding and unnecessary for end customers. These contribute to waste, incur hidden costs and should be eliminated.

Some of the benefits of identifying and eliminating waste/Muda

To the company

Benefits to the company include:

1. Cutting the hidden costs of production-It is estimated that 80 percent of production activities and associated costs are non-value-added, or waste. When factories begin to focus on identifying and eliminating waste, the impact on the bottom line is astronomical.

2. Increased customer satisfaction- Customer satisfaction rises as a direct result of implementing lean production. When waste is eliminated from production, deliveries occur on time and product quality goes up.

To Shop floor workers

Benefits to individuals include:

1.Increased job satisfaction- No longer will you spend hours looking for missing tools, waiting for materials to arrive, walking around piles of inventory, lifting and setting down heavy parts or tools, working in unsafe conditions and all the other things you have to do that are not essential to your job. The frustrating non-value-added aspects of your job will disappear and what you are trained to do and enjoy doing will be the major part of how you spend your time.

2. Contributing to improvement- Your ideas about how to improve your job will be listened to and you will participate in taking the frustration out of the workplace. Part of your job will be to

find root causes and to create solutions that last. You will not have to make short-term fixes or live with someone's short-term fixes that no longer solves the problems you face.

Procedure for Waste/Muda Identification

It is not easy to find waste when you look at the production line or the warehouse or an operation. If you have never been involved in improvement activities you will find it even harder to discover waste that may be right in front of you. Waste is everywhere, in every operation; it is so common and you are so used to it that it is hard to see.

The steps to effective waste identification are:

1. Make waste visible
2. be conscious of the waste
3. be accountable for the waste
4. Measure the waste

1. Make waste visible

Waste can be made visible in several ways such as:

- Shop layout analysis
- Process flow analysis
- Take photos/video

Shop layout analysis and Process flow analysis

There are several tools you can use to analyze current conditions of shop layout and process flow quickly and effectively. We will describe some of them.

The Arrow Diagram

The Arrow Diagram focuses on the flow of goods to discover waste. (Arrow diagrams have recently been renamed value stream maps.) We include here a simple method for creating an arrow diagram to get a good understanding of your production process and to see where the waste exists in your workplace.

The factors to be identified in your arrow diagram are retention, conveyance, processing and inspection. There are specific symbols you use to indicate each of these aspects of a production process as indicated below:

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Table 1. 3 showing symbols used in Arrow Diagram

Analysis factors	Symbols	Description	Amount of waste
Retention		When the work-in-process flow is stopped (for other than conveyance, processing, or inspection)	Large
Conveyance		When the work-in-process is moved from one place to another	Large
Processing		When the work-in-process is changed physically or chemically for added value	There may be some waste in the process
Inspection		When goods are inspected for conformance to quality and dimensional standards	Large

The Workshop Checklist for Major Waste Finding

The Workshop Checklist for Major Waste Finding allows you to identify in a more general way the seven types of waste in a work area. You might want to use this checklist before using the detailed checklists. Checklists are good tools for identifying waste and recording improvement ideas.

Table 1. 4 Workshop Checklist for Major Waste Finding

Workshop Checklist for Major Waste Finding											
Workshop Name:								Date:			
#	Process Name	1 Overproduction waste	2 Inventory waste	3 Conveyance waste	4 Defect waste	5 Processing waste	6 Operation waste	7 Idle time waste	Waste Magnitude Total	Improvement Ranking	Improvement Ideas and Comments

Use these four steps to follow to discover and remove waste

- I. Choose several processes or work areas and look for waste.
 - a. Using the above figure find the major forms of waste at each process.
 - b. Note the magnitude of each waste (Using the figure below).
- II. Rank the improvements that are needed. Focus improvements on the process with the greatest total when you add up the magnitude columns.
- III. Choose the first process to be improved from the workshop checklist.
 - a. Using the more detailed waste-finding checklists provided, find more specific instances of waste.
 - b. Observe the types and magnitude of the detailed waste.

IV. Brainstorm improvement ideas and then carry out them

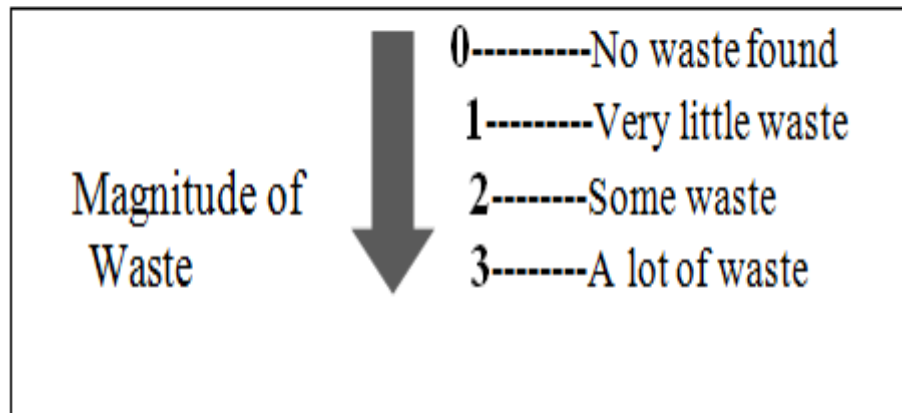


Figure 1. 5 showing Four Level of Magnitude of waste

1. Taking photos/Video: - Taking photos and videos and analyzing are also valuable techniques to find waste.
2. be conscious of the waste :When something is denied as waste, it also cannot be stopped.
3. be accountable for the waste: When one refuses to accept responsibility for the waste, then he/she will not eliminate it.
4. Measure the magnitude of the waste

When the waste is not measured, people may think it is small or insignificant and therefore will not be motivated to stop it. What is not measured is not improved. Appreciate its size and magnitude.

- Do time study by work element
- Measure Travel distance
- Measure Total steps
- Make list of items/products, who produces them and who uses them & those in warehouses, storages etc.

Tools and Equipment for Waste/Muda Identification

- Tape/Meter
- Video Camera
- Stop watch
- Calculator
- Photo Camera

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Use of Tools and Equipment

Tape/Meter - is used to measure distances or lengths.

Stop watch – is used to measure operation/processing or waiting/idling times.

Photo Camera – may be necessary to take pictures, such as shop layout, for analysis.

Video Camera – may be necessary to record video of each work element to study and identify wastes, such as motion, processing, waiting ...etc.

Calculator – required making arithmetic calculations.

1.5. Reporting methods and formats/checklists for Muda identification

Table 1. 5 Overproduction Waste-finding Checklist

Overproduction Waste-finding Checklist					
Process:		Date:			
Description of waste		Yes	No	Magnitude	Causes and/or Improvement plans
1	No production schedule of control boards.				
2	No leveling of production schedule.				
3	Productions not in synchronize with production schedule.				
4	Items missing				
5	Defective goods produced.				
6	Equipment breakdowns.				
7	Too much manual assistance required.				
8	Machines have too much capacity.				
9	Lots are grouped in to batches.				
10	Using “Push” production.				
11	Caravan style operations.				
12	Not balanced with next process.				

Total					

Table 1. 6 Inventory Waste-finding Checklist

Inventory Waste-finding Checklist					
Process:		Date:			
Description of waste		Yes	No	Magnitude	Causes and/or Improvement plans
1	Lots of inventory on shelves and floors.				
2	Shelf and floor storage takes up lots of space.				
3	Inventory stacks block walkways.				
4	In-process inventory accumulates within individual operation.				
5	In-process inventory is stacked up between operators.				
6	In-process inventory is stacked up between processes.				
7	Impossible to visually determine quantities of in-process inventory.				
Total					

Table 1. 7 Motion Waste-finding Checklist

Motion Waste-finding Checklist					
Process:		Date:			
Description of waste		Yes	No	Magnitude	Causes and/or Improvement plans
1	Walking				
2	Turning around				
3	Leaning sideways				
4	Bending over				
5	Too wide arm movements.				
6	Unnecessary wrist movements.				
7	Left or right hand is idle.				
8	Poorly utilized idle time.				
9	Wasteful work piece set up/removal.				
10	Non-standardized repetition of operations.				
11	Worker operates using different motions each time.				
12	Operations divided into too many little segments.				
Total					

Table 1. 8 Conveyance/Transportation Waste-finding Checklist

Conveyance/Transportation Waste-finding Checklist					
Process:		Date:			
Description of waste		Yes	No	Magnitude	Causes and/or Improvement plans
1	Pile up during conveyance.				
2	Change of conveyance devices in mid transfer.				
3	Previous and/or next process is on another floor.				
4	Conveyance requires manual assistance.				
5	Conveyance distance is too long.				
Total					

Table 1. 9 Waiting/Idle Time Waste-finding Checklist

Waiting/Idle Time Waste-finding Checklist					
Process:		Date:			
Description of waste		Yes	No	Magnitude	Causes and/or Improvement plans
1	Work piece delay from previous process.				
2	Machine busy status.				
3	Missing item(s).				
4	Lack of balance with previous process.				

5	Lack of planning				
6	Lack of standard operations.				
7	Worker absence.				
8	Too many workers (more than two).				
Total					

Table 1. 10 Defect Waste-finding Checklist

Defect Waste-finding Checklist					
Process:		Date::			
	Description of waste	Yes	No	Magnitude	Causes and/or Improvement plans
1	Complaints from next process.				
2	Defects within the process.				
3	Human errors.				
4	Defects due to missing part(s).				
5	Defects due to wrong part(s).				
6	Omission(s) in processing.				
7	Defect(s) in processing.				
8	No human automation.				
9	No mistake-proofing.				
10	No inspection within process.				
11	Defects not addressed by improvement activities.				

Total					

Table 1. 11 Processing Waste-finding Checklist

Processing Waste-finding Checklist					
Process:		Date:			
Description of waste		Yes	No	Magnitude	Causes and/or Improvement plans
1	Process is not required for product function.				
2	Process includes unnecessary operations.				
3	Process can be replaced by something less wasteful.				
4	Part of process can be eliminated without detracting from product.				
Total					

Self-Check 1

Choose the best answer

- Which of the following are some tools and equipment used to identify and measure Waste/Muda?
 - Tape
 - Stop watch
 - Photo Camera
 - Video Camera
 - all
- _____ are activities which use resources, time or cost without adding value?
 - Wastes
 - Muda
 - both
- Which of them are following Japanese word?
 - Muda
 - Kaizen
 - a and b
 - all
- Which of the following are targets of customer?
 - Better quality
 - On time delivery
 - Reasonable price
 - all
- Which of the following is the primary target of Manufacturers/Service providers?
 - Earn profit
 - cost
 - price
 - quality
- In traditional thinking of price setting, price is determined by _____ rather than the Market itself.
 - Manufacturer
 - service provider
 - both
- In Kaizen Thinking of Price Setting, Price is determined by the interaction between _____ and _____.
 - Market demand
 - supply
 - a and b
 - all
- Which of the following are types of customers?
 - Internal customer
 - External customer
 - both
 - all of the above
- Which of the following are Categories of Operation?
 - Value Adding Operation
 - Non-Value Adding Operation
 - Muda
 - Net Operation
 - all
- Which of the following are seven deadly types of waste/ muda?
 - Overproduction
 - Inventory
 - Motion
 - Conveyance/Transportation
 - all
- Which of the following are the steps to effective waste/muda identification?

- a. Make waste visible b. Be conscious of the waste c. Be accountable for the waste
- d. Measure the waste. E. all

12. Which of the following shows the Magnitude of waste/muda?

- a. 0(no waste found) b. 1(very little waste) c. 2(some waste) d. 3(A lot of waste) e. all

Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the targets of customers? (9 points)
2. What is the target of manufacturer/service provider? (3 points)
3. What is the difference between traditional and kaizen thinking on price setting, cost and profit? (3 points)
4. What is value? (2 points)
5. List out the three categories of operation. (3 points)
6. Define the three categories of operation. (6 points)
7. Describe the 3MU's and their relationships. (9 points)
8. What are seven deadly wastes/Muda? (7 points)
9. Describe the seven deadly wastes/Muda? (7 points)
10. What are the focus areas of 5M + Q + S? (7 points)
11. What are the four things going on during the flow of goods? (4 points)
12. Explain the four things going on during the flow of goods in relation to waste? (8 points)
13. Write at least two causes and effects of each type of seven deadly wastes/Muda. (8 points)
14. What are the benefits of identifying and eliminating wastes/Muda to a company? (4 points)
15. What are the benefits of identifying and eliminating wastes/Muda to the workers of a company? (4 points)
16. Write down the steps to identify wastes/Muda. (4 points)
17. List out at least three ways to make waste visible. (3 points)
18. What are the four factors to be identified in arrow diagram? (4 points)
19. What is the focus of Operation Analysis Table? (2 points)
20. What is the focus of a Standard Operation Combination Chart? (2 points)

Operation Sheet 1

1.1 Procedures for identifying categories of operation

1. Select one operation.
2. Identify and write your customer.
3. Identify/Define what your customer needs.
4. Observe and list out the contents of the operation.
5. Categorize the contents of the operation as Net operation/Value adding operation, Non-value adding operation and Muda.
6. Measure the three categories of the operation (Time).
7. Compare them.
8. Write the action needed to be taken for the three categories of the operation.

1.2 Procedure for analyzing the existence of Mura, Muri and Muda.

1. Select a workplace.
2. Write the work load on each machine/worker in process.
3. Recognize the actual capacity of each worker/machine in the process.
4. Compare capacity against work load of workers/machines.
5. Explain the existence of Mura, Muri and Muda on each machine/worker.
6. Write their causes.

LAP Test

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within --- hours.

Task 1: In the given operation, identify the three categories of operation, measure their magnitude in terms of time and compare them.

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Task 2: In the given workplace and check the existence of Mura, Muri and Muda in each process and list out them.

Task 3: Using appropriate method identify the Seven types of Muda in the workplace.

Task 4: Using the given template list out the types of Muda identified and analyze their causes and measure their magnitude.

Unit two: Analyze causes of a problem

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

2.1. Causes of a problem

2.2. Eliminate the most critical root cause

This unit will also assist you to attain the learning outcomes stated in the coverage contents and topics. Specifically, upon completion of this learning guide, you will be able to:

- Identify and analyze Causes of a problem using **4M1E**
- Using **creative idea generation** Eliminate the most critical root cause

2.1. Causes of a problem

Some have noted that problem-solving procedure is patterned and organized in a way that everybody is assured to reach a solution in the most efficient way. Most anyone who uses this procedure can solve even difficult problems in a fast and efficient way. One uses an already existing procedure, while making use of one's own specialized skills; it will lead to an efficient way of solving problems.

Problem solving Procedure

- 1. Theme Selection:** At the first stage, members select a theme from among the problems in the workplace a theme concerning problems for which they think solutions would be most beneficial. This is to provide clear vision on the objectives for the activity. Members ask themselves, “What kinds of problems do we have and how do we improve them?”
- 2. Grasping Status and Goal Setting:** After a theme is selected, members try to understand the current situation of the problem. They list all of the possible problems related to the process, use data to validate that the “problems” are indeed problems, select the priority problem, and again use data to define the extent of this problem. The main objective of

these steps is to gather information and grasp the status of the problem so that members can establish a detailed set of goals.

- 3. Establishment of Activity Plan:** Based on the data acquired in the second stage, the members establish an activity plan, according to the 5W1H concept. In this concept, five W questions and one H question are addressed. The members decide the issues to be tackled (what), the rationale for tackling them (why), the detailed time scheduling of the program (when), and the place and resource allocation (where, and who and how).
- 4. Cause Analysis:** In problem-solving processes, it is very important that results are examined in line with causes, thus identifying the cause–effect relationship. Members consider all possible causes of the problem and see if there is any correlation among them. Then they use data to verify the causes, narrow these down to root causes, and finally select the most critical root cause. They then consider all possible solutions to eliminate the most critical root cause, select the best solution, and establish a detailed plan on how to implement it.
- 5. Their examination of countermeasures and their Implementation:** After causes are identified, countermeasures are examined, evaluated, and selected. This stage aims both to correct the root causes and to establish the most effective measures to prevent the reoccurrence of the problems. All the people concerned on the issue are gathered to discuss it, considering factors such as effectiveness, cost, condition of restrictions, and impacts on the other factors. Members then implement countermeasures in daily operations, according to the plan, and monitor the results.
- 6. Assessment of Effectiveness:** Then an assessment is carried out to see whether the impediments have been overcome or to what extent the initial objectives have been met. It is carried out together with evaluation for further improvement of the work. The Circle identifies the tangible and intangible results, verifies those using data, and compares them with the initial goal. Tangible results are results targeted through changes in processes, whereas intangible results are those in areas such as improvement in employee learning skills and education. If the results do not meet the goal, then the Circle needs to return to previous stages and reexamine the processes.
- 7. Standardization and sustain operation:** Finally after effective methods are identified, they are standardized and made a permanent part of daily operations. Based on the standardization, members train the people concerned. Also, new training manuals are

created and disseminated among the people concerned, and evaluation is carried out from time to time, aimed at ensuring that the process is maintained appropriately. The last step in this stage is for the Circle to determine the next problem to tackle, which may be chosen from the list generated in the beginning of the first QC Story.

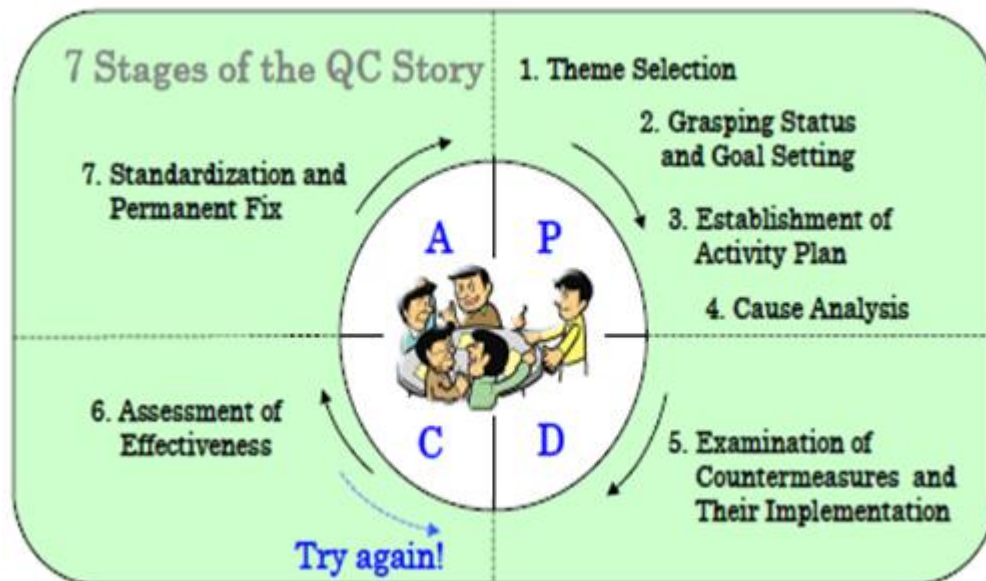


Figure 2. 1 Stage of Problem solving Procedure

Cause and Effect Diagrams

Analysis Cause of the Problem Using 4M1E

This diagram composed of lines and symbols is designed to represent the relationship between effects and their causes. It is sometimes called an Ishikawa diagram, after Dr. Kaoru Ishikawa who is considered the father of QC Circles. Others call it a fishbone diagram due to its resemblance to a fish skeleton. It is a very effective tool for analyzing the causes of a problem, even household problems like high consumption of electricity.

The Cause analysis means seeking the causes for the variability identified in fact analysis. One common approach is to formulate a hypothesis, narrow the factors down, verify them with facts, and slowly work your way down to the underlying causes.

The main objective of this stage is to confirm which measures can be taken for what kinds of problems. After a theme/ idea is selected, the causes and effects of problems are to be identified. This is the most important stage of the process, as it identifies the root causes of the problems and shows what needs to be changed.

In problem-solving processes, it is very important that results are examined in line with causes, thus identifying the cause–effect relationship. Members consider all possible causes of the problem and see if there is any correlation among them. Then they use data to verify the causes, narrow these down to root causes, and finally select the most critical root cause. They then consider all possible solutions to eliminate the most critical root cause, select the best solution, and establish a detailed plan on how to implement it.

How to precede cause analysis?

List all possible causes of the problem

The Circle brainstorms on the causes of the problem. A very important question in this step begins with the word why. Why the orders are incorrectly served? The Circle members enumerate their answers to this question until they have exhausted all possible causes.

Think of the causes

Come up with as many factors as you can that could contribute to causing the variance (nonconformance) highlighted in fact analysis.

How to construct cause and effect diagrams

Write the problem on the right side and box it.

Step1: Draw a main arrow from left to right, with the head of the arrow pointing to the problem.

Step 2: Identify all of the main categories of causes of the problem, for example, man, method, materials, machine, and environment. In below figure 4, these factors were grouped as appliances, occupants, household procedures, and household food supplies. Use branch arrows to connect the categories to the main arrow.

Step 3: Using twig arrows, connect the individual main causes identified in step 2 to their respective branch arrows.

Step 4: Identify the detailed causes of each main cause and connect them to the twig arrows, using even smaller twig arrows.

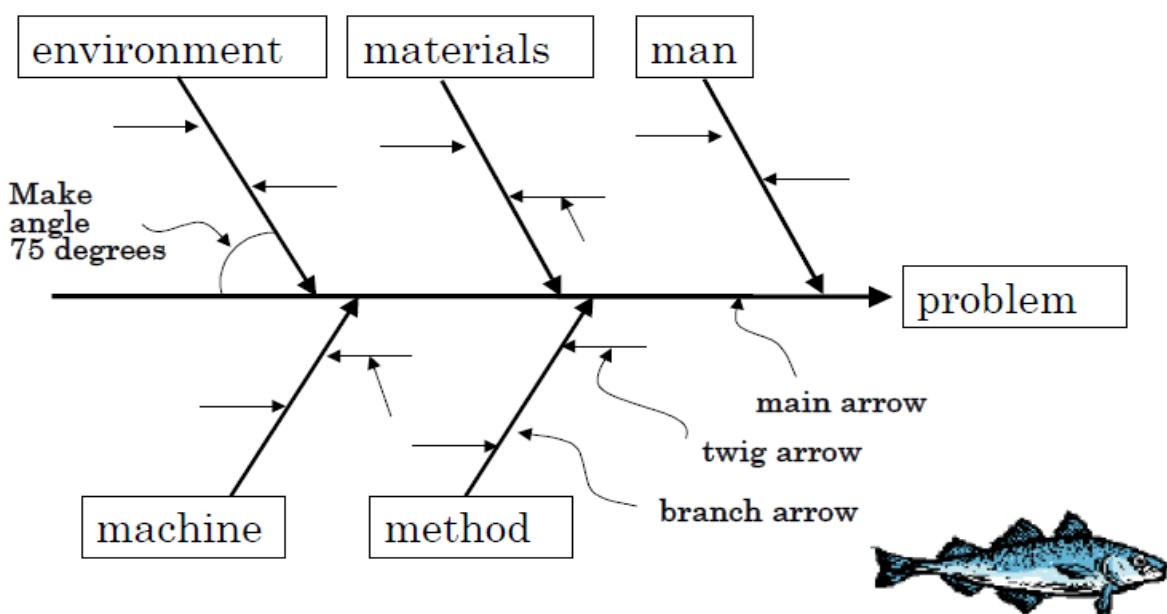


Figure 2. 2 Cause and Effect Diagram using 4M1E

Example : why Electric Bill is High for house hold cause and effect diagram using 4M1E

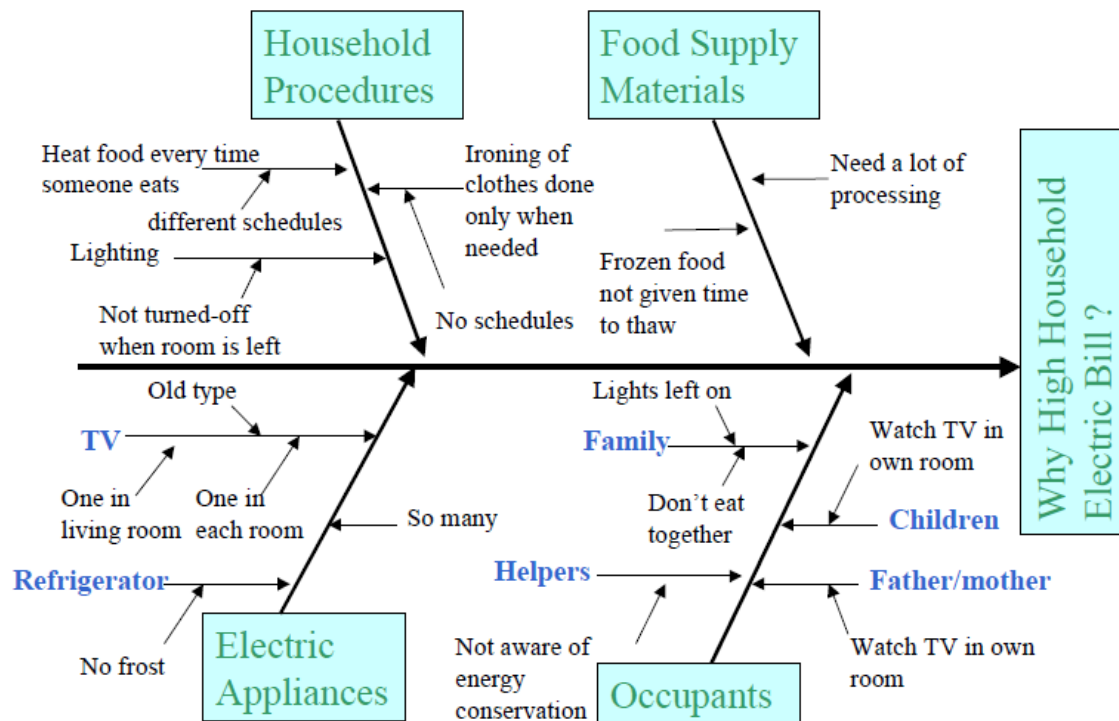


Figure 2. 3 cause and effect diagram using 4M1E Electric Bill High for house holds.

2.2. Eliminate the Most Critical Root Cause

Root Cause Analysis

Steps 1 - Analyze the diagram.

Analysis helps you identify causes that warrant further investigation. Since Cause-and-Effect Diagrams identify only possible causes, you may want to use a **Pareto Chart** to help your team determine the cause to focus on first.

- ✓ Look at the “balance” of your diagram, checking for comparable levels of detail for most of the categories.
- ✓ Look for causes that appear repeatedly. These may represent root causes.
- ✓ Look for what you can measure in each cause so you can quantify the effects of any changes you make.
- ✓ Most importantly, identify and circle the causes that you can take action on.

Step 2: Select root causes

From the valid causes, the QC Circle selects the root causes. If there is a direct relationship between the cause and the problem and this cause is seen repeatedly in the cause and effect diagram, then it is a root cause.

- ✓ **Seek root cause relentlessly and narrow them down**
- ✓ Narrow the long list of factors down to the critical cause.
- ✓ Use facts, data, past history, and personal opinions to focus on the most important factors.
- ✓ Draw on management and administrative techniques, as well as specialist expertise, to narrow down the number of factors.

Step 3: Select most critical root cause

Among the root causes, the Circle selects the one that is most directly related to the problem. Voting can be used to decide which root cause to work on.

Step 4: List all possible ways to eliminate the most critical root cause

Again the QC Circle brainstorms to generate ideas from the members. The leader must be able to challenge the members to **be creative**, to let go of their preconceptions. If a QC Circle hits a mental block that is, it is not able to come up with ideas it leaves the list where everyone can see it (e.g., on a wall in the workplace) and add new ideas easily. This helps provide a longer list for consideration at the next meeting.

Step 5: Select a best solution

The suggested solutions must be carefully evaluated and tested for potential complications. The QC Circle can use **matrix diagrams** to select the best solution.

Plan the countermeasures action

Plan the countermeasures action so that the cause identified in cause analysis does not recur.

- ⇒ Plan corrective actions for each confirmed cause.
- ⇒ Do not worry about the practicality of the countermeasures actions at this point. Come up with a wide range and large number of suggestions.
- ⇒ Put the priority on those actions that your circle can implement on its own authority.
- ⇒ Narrow down the countermeasures action plans and focus on the one(s) you want to implement.
- ⇒ Actively solicit management and staff opinions.

Points to remember:

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1. Make a table that shows the problems, the corrective actions, what you are trying to accomplish, how you intend to accomplish it, and who is going to be responsible for doing it.
2. This is an excellent way to show the linkage between the problems and the countermeasure actions. It shows clearly how the countermeasure actions address the problems identified in the cause analysis stage, thereby highlighting the cause analysis's effectiveness.
3. Be sure to indicate what the actions are intended to accomplish and who is going to do what.
4. Adding information on each of countermeasure actions helps every one understand what is being done, how, and why.

Self-check-2

Choose the best answer

1. Which one of the following problem solving procedure?
 - a. Assessment of Effectiveness b. Cause Analysis c. Theme Selection d. all
2. Which one of the following categorizing under plan stage problem solving procedure?
 - a. Theme Selection b. Grasping Status and Goal Setting Establishment of Activity Plan
 - c. Cause Analysis d. all
3. Which of the following are steps of Root Cause Analysis to eliminate the Most Critical Root Cause of Muda / waste?
 - a. Analyze the diagram
 - b. Select root causes
 - c. Select most critical root cause
 - d. List all possible ways to eliminate the most critical root cause
 - e. Select a best solution

- f. All of the above

Written test

1. Draw a horizontal arrow to the right, write the effect (*computer downtime*), and draw a box around it. (2 points)
2. Identify the main causes contributing to the effect. (2 points)
3. Draw boxes around the main categories and connect the boxes to the horizontal arrow with diagonal arrows to form the fishbone. (2 points)
4. For each branch, identify specific factors which may be the causes of the effect. (2 points)
5. Add increasingly detailed levels of causes. (2 points)
6. Analyze the diagram and circle causes that you can take action on. (10 points)
7. List and explain the steps of root cause analysis. (20 points)
8. Make a detailed countermeasure plan for the given suggested solution. (10 points)

Unit three: Eliminate MUDA and Assess Effectiveness of the Solution

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- 3.1. Adopt the basic principles for improvement
- 3.2. Reduce and eliminate wastes
- 3.3. Record results

This unit will also assist you to attain the learning outcomes stated in the coverage contents and topics. Specifically, upon completion of this learning guide, you will be able to:

- Adopting the basic principles for improvement
- Reducing and eliminating wastes
- Recording results

3.1. Adopt the basic principles for improvement

The ten basic principles for improvement

1. Throw out all of your fixed ideas about how to do things.
2. Think of how the new method will work- not how it won.
3. Don't accept excuses. Totally deny the status quo.

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4. Don't seek perfection. A 50 percent implementation rate is fine as long as it's done on the spot.
5. Correct mistakes the moment they are found.
6. Don't spend a lot of money on improvements.
7. Problems give you a chance to use your brain.
8. Ask "why?" At least five times until you find the ultimate cause.
9. Ten people's ideas are better than one person's.
10. Improvement knows no limits.

3.2. Reduce and eliminate wastes

There are many practical ways to reduce waste. Work out your own ways of eliminating waste from your work, eg by using left over materials from one job on the next one. This is usually cheaper than having to dispose of waste and is better for the environment look for the shortest cabling route whenever possible and making sure you comply with wiring regulations.

Effective Ways to Reduce Waste:

- ⇒ Know what you're wasting.
- ⇒ Stop wasting energy. Good news: we're moving in the right direction.
- ⇒ Stop wasting food. Food waste is a big problem.
- ⇒ Stop wasting plastic.
- ⇒ Stop wasting money.
- ⇒ Stop wasting time.

3.3. Record results

Tangible and Intangible Results

The Circle (PDAC) identifies the tangible and intangible results, verifies those using data, and compares them with the initial goal. Tangible results are results targeted through changes in processes, whereas intangible results are those in areas such as improvement in employee learning skills and education. If the results do not meet the goal, then the Circle needs to return to previous stages and reexamine the processes.

Identify tangible and intangible results

Tangible results are those that can be quantified, like when a defect rate is reduced by a certain percent. Intangible results on the other hand are those that are qualitative, like when teamwork among the

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members is improved. The Circle must be able to establish at this point that the project gains also bring them direct personal benefit.

Compare the target value and the actual value (for tangible effects)

- See if the target value was met. See in below figures
- If the target value was not met, go back over the previous steps to see what went wrong, correct it, and try again.
- The effect should be measured using the same QC methods and criteria as used in fact analysis.
- The effect should be confirmed for each corrective action.
- If the target has been determined as a first priority, make sure to see what impact this has had on the whole.

Verification of Results Using Various Types of Diagrams

Line graphs: are used to show actual situations given points in time. They may also be used to predict future trends. They may be broken lines or straight lines.

Steps to construct a line graph

Step 1: Draw the horizontal and vertical axes of the graph, using the horizontal axis for the period and the vertical axis for the value.

Step 2: Plot the points corresponding to the values.

Step 3: Connect the points.

Figure Line Graph

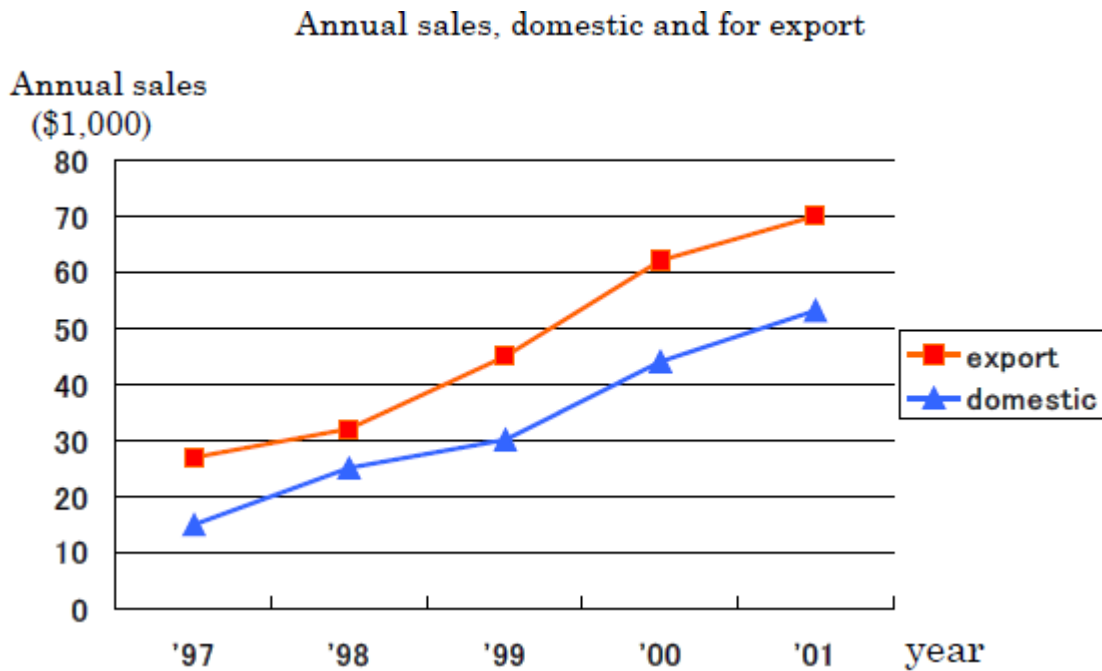


Figure 3. 1 line graph

Bar graphs: are used to show trends (e.g., of a product or service). They make use of bars whose lengths represent the size of the factors under consideration. The bars may be positioned vertically or horizontally.

Steps to construct a bar graph

- Step 1:** Draw the horizontal and vertical axes of the graph, using the horizontal axis for the period and the vertical axis for the value.
- Step 2:** Divide the horizontal axis into equally spaced vertical columns, each column representing a period.
- Step 3:** Divide the vertical axis into as many equally spaced horizontal rows as required, each higher row representing a higher value.
- Step 4:** Draw the bars.

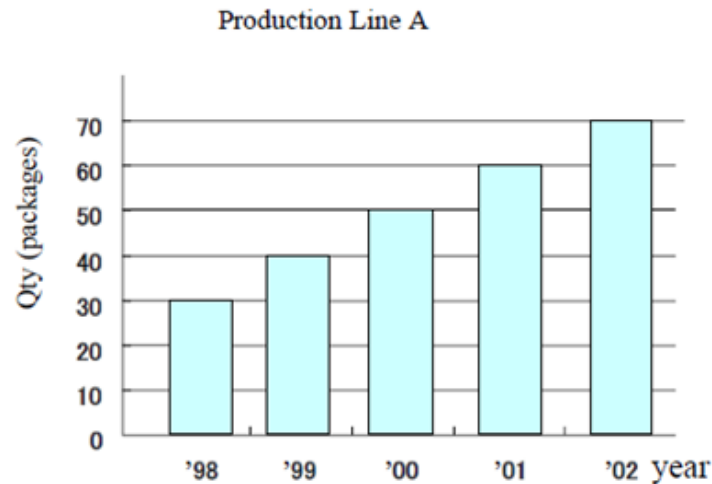


Figure 3. 2 shows bar graph

A pie chart: is used to denote relative portions of a situation; each slice of pie represents a percentage of the whole.

Steps to construct a pie chart

Step 1: Draw a circle.

Step 2: Divide the circle into slices that correspond in size to the relevant percentages.
For instance, if you divide the circle into four equal slices, then each is 25 percent of the whole.

Step 3: Moving clockwise from the topmost part of the chart, arrange the items in order of percentage size, unless another order is inherently logical.

Step 4: Indicate the name of the item and its percentage.

Step 5: Consider what color or pattern to use for identification of items.

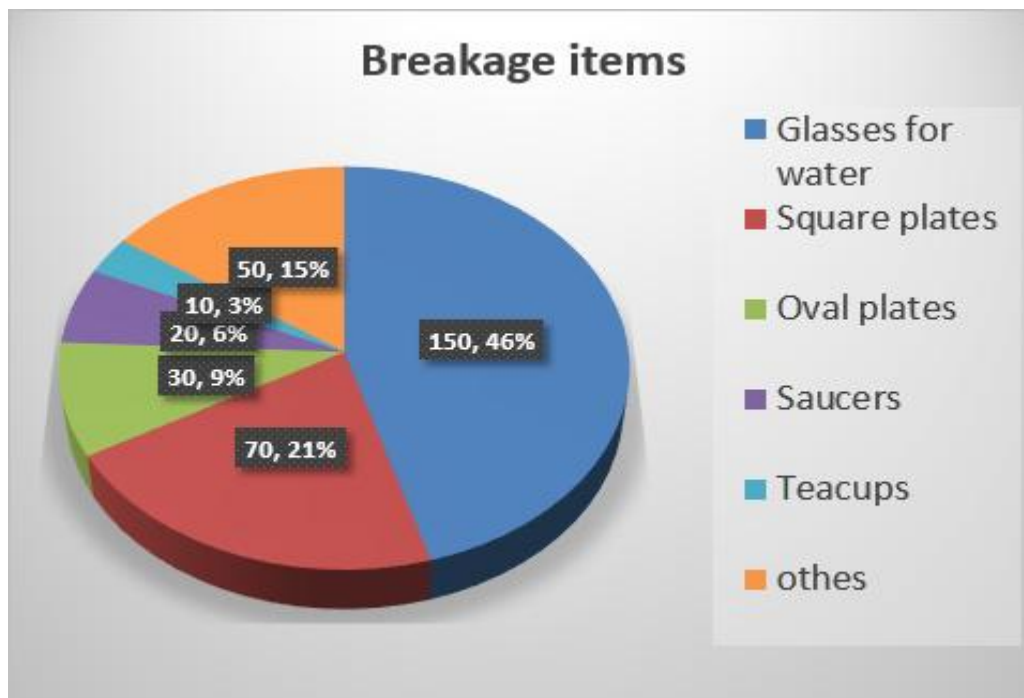


Figure 3. 3 show pie graph

The by-objective bases of selecting a graph:

When comparing the size of numbers

- bar graph, band graph

When showing a change over time

- line graph

When giving a breakdown

- pie graph, band graph

A scatter diagram: examines the relationship between paired data. This tool is usually used by the QC Circle when it wants to establish the relationship between cause and effect, the relationship between one cause and another or a relationship between one cause and two causes.

Examples include the relationship between an ingredient and the hardness of a product, the relationship between the speed of cutting and the variation in the length of parts cut, the relationship between the level of illumination in a room and mistakes in validating a bank transaction slip.

The scatter diagram is used when a number of people or procedures are producing widely varying results. The scatter diagram may show that two variables have positive correlation, have negative correlation, or have no correlation at all.

Steps to construct a scatter diagram:

Step 1: Collect data samples of pairs whose relationship is to be studied. Enter these data in a data sheet .

Step 2: Draw a vertical axis (effect); calibrate it from smallest to largest value (from top to bottom).

Step 3: Draw a horizontal axis (cause); calibrate it from smallest to largest value (from left to right).

Step 4: Plot the paired values. If values are repeated, make concentric circles (in the graph indicated as pink).

Step5: Plot data in a graph, with material content.

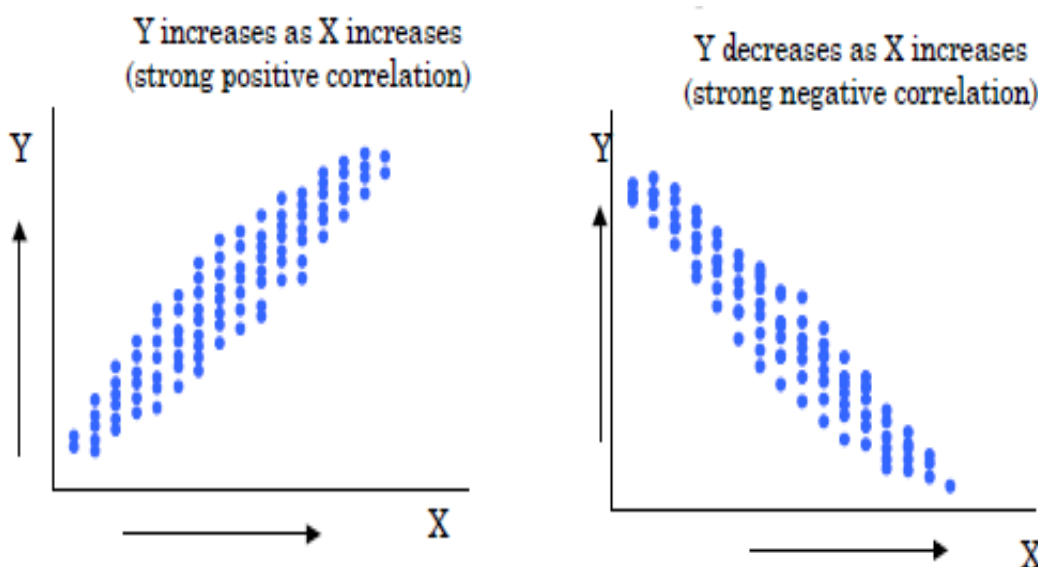


Figure 3. 4 shown below common Scatter Diagrams

Affinity diagram: is a tool to clarify the nature of an uncertain problem or chaotic event by coordinating ideas and obtaining concepts through the integration of relevant verbalized data on the basis of affinity. Preparation of an Affinity Diagram When preparing an affinity diagram, two approaches are recommended: one by individual action, the other by group action. As for management or staff personnel, individual preparation is better when trying to do the following. Identify the facts related systematically to the chaotic and unknown problems or areas.

Summarize one's own ideas without interference of others. Establish one's own creative ideas that may be in conflict with conventional ones.

Preparations of affinity diagram

- Determine a theme.
- Collect data by way of brainstorming.
- Get an understanding of all verbal information collected from every member. In some cases the data must be rewritten to prevent any misinterpretation or misunderstanding.
- Do the same as for individual preparations' steps C and D.

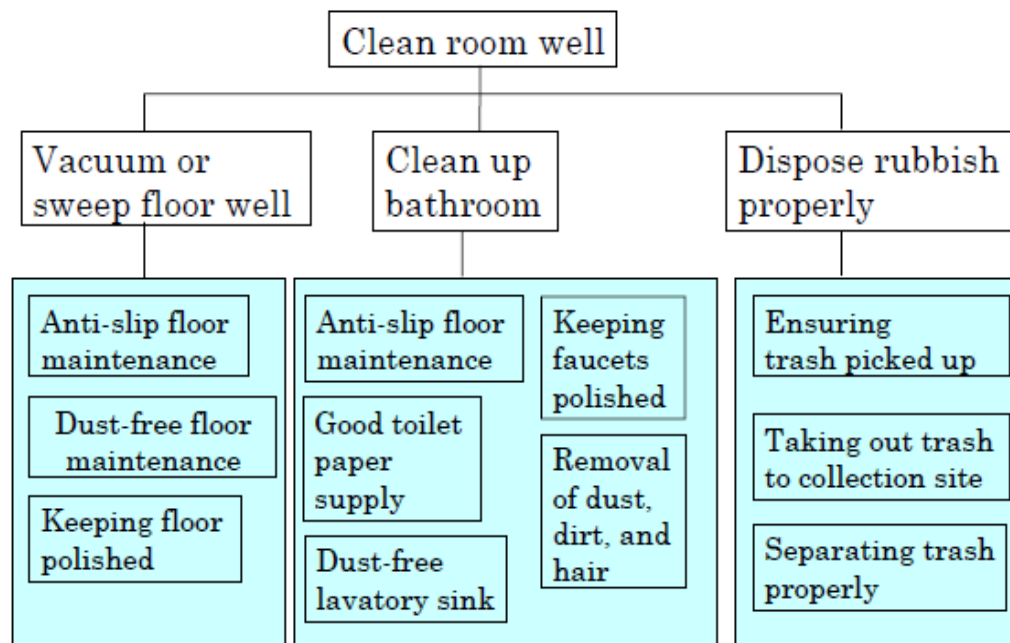


Figure 3. 5 In Figure could show affinity Diagram for House Cleaning

Self-check-3

Choose the best answer

1. Which of the following Tools and Techniques used to eliminate Wastes/Muda?
b. 5S b. layout improvements c. U-line d. all the above
2. Which of the following are important methods used for maintaining a waste-free production environment?
a. Standardization b. Visual controls c. Auditory controls d all

Written test

1. Write down and describe the steps of tangible and intangible results? (6 points)
2. What is difference between tangible and intangible results? (4 points)
3. Write down and describe various types of diagrams for Verification of results? (15 points)

Unit Four: Prevent Occurrence of Wastes and Sustain Operation

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- 4.1 Preparation of standards
- 4.2 Prevent occurrences of wastes
- 4.3 Waste-free workplace

This unit will also assist you to attain the learning outcomes stated in the coverage contents and topics. Specifically, upon completion of this learning guide, you will be able to:

- Preparing standards
- Preventing occurrences of wastes
- Creating waste-free workplace

4.1. Preparation of standards

The Concept of Standard Operation Procedure (Sop)

Standard defines the acceptance criteria for judging the quality of an activity. In the Kaizen context Standards refers to rules, procedures and guidelines for activities carried out in the workplace.

“No standard, There can be No Kaizen”

- ✓ There can be no basis for comparison (before/after).
- ✓ One cannot objectively tell if there was a difference or change.
- ✓ No improvement is possible in regards to Time, Quality, Quantity, Cost, etc.

Standardization

- ✓ Formulation, publication, and implementation of guidelines, rules, and specifications.
- ✓ Is a standard specification, unit, instruction or something that is understood globally?
- ✓ Standardization promotes effective teamwork by teaching employees similar terminology, skills and rules of play at the work place.

Why Implement Standard Work?

- ✓ To make it possible to identify and eliminate variations in operators’ work “Variability is the breeding ground of defects, and high costs.”
- ✓ Team member own choices are dramatically reduced, eliminating the “Do it your own way”.

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- ✓ Abnormal conditions are clearly defined and tracked.
- ✓ To sustain the gains achieved from improvement activities.
- ✓ To provide a baseline for future improvement.

Kaizen will succeed only if you pay regular attention to Standard Work.

Standardization

- ✓ Reduces Variation
- ✓ Enables Flow
- ✓ Eliminates Waste
- ✓ Fuels Continuous Improvement

Standardized work place and working materials



Figure 4. 1 show the Standardized work place and working materials

Steps to Standardization

1. Identify and set a standard
 - ✓ The standard method must be established and should be regarded as a “good” method.
 - ✓ But the standard method is only “good” - not “best”. Each method challenges us for a better way.
 - ✓ The consistent updating of Standard Operations is the cornerstone of Continuous Improvement.
2. Ensure everyone in organization understand & commit to the standard.
3. Confirm the standard is reasonable & fair.

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Continuous improvement

- a. Improving every aspect of every activity every day – forever
- b. Think of continuous improvement as a journey rather than a destination.
- c. *Continuous Improvement enhances “people supportive practices”*
 - ✓ Provides new skills to employees, empowering them to design and improve their own work.
 - ✓ By standardizing on a new method, it gives people the ability to reduce variation.

Continuous Improvement is needed:

- ✓ Increased competition.
- ✓ Customer demands for lower prices.
- ✓ Expectations for higher quality.
- ✓ Changing technologies.
- ✓ Need for improved participation and self-direction.
- ✓ Wider base of knowledge.
- ✓ Safer, better workplace.
- ✓ Zero accidents.

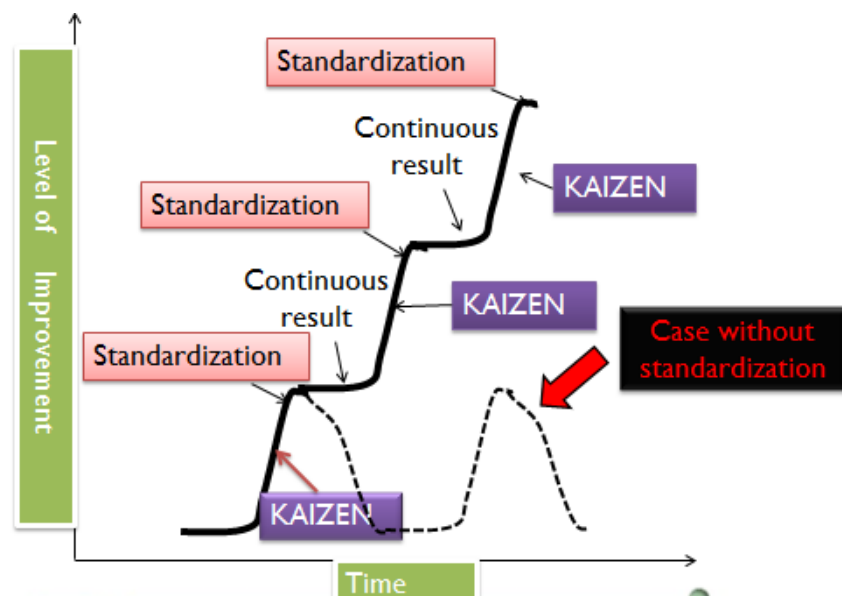


Figure 4. 2 Kaizen and Standardization

Continuous Improvement Process Steps

1. Observe current method.
2. Document current method.
3. Identify improvements (steps to eliminate).
4. Implement improvements.
5. Validate quality and productivity of new method.
6. Standardize new method.
7. Document “Before” and “After” conditions.
8. Recognize achievements.
9. Look for next improvement.

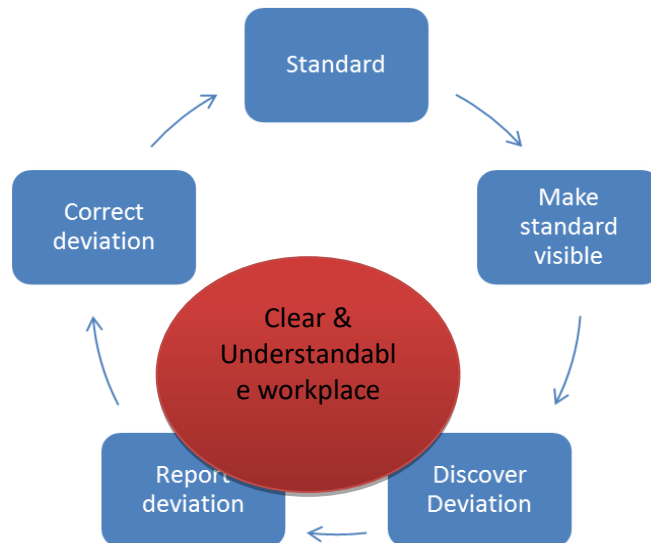


Figure 4. 3 Standardization as waste Elimination tool

Standard Operation and Its Benefits

Standard Operation

- ✓ It deals with detailed procedures to perform an operation efficiently by anyone assigned for the task.
- ✓ An efficient production system which eliminates wasteful procedures by bringing together a number of jobs focused on the movements of workers.
- ✓ In the KAIZEN context standard operation means creating a consistent way that an operation or a task is performed so that anyone can perform it.

'U' shaped work units.

- ❖ Eliminates isolated islands.
- ❖ Integrates processes.
- ❖ Reduces transport and handling of parts.
- ❖ Enhances teamwork.
- ❖ Increases visibility
- ❖ Enhances cross training
- ❖ Improves safety
- ❖ Reduces inventory

Standardized processes are intended to:

- ✓ Ensure customer satisfaction
- ✓ Drive consistent output
- ✓ Ensure consistent quality
- ✓ Drive consistent cost and time

Benefits of Standard Operation

- ✓ Ensure Safety
- ✓ Stable Quality
- ✓ Reduce cost & Increase Productivity
- ✓ Visualize what is normal vs. abnormal
- ✓ Stabilizes delivery times
- ✓ Eliminates Wastes
- ✓ Simplifies process
- ✓ Create base line for KAIZEN

Three Elements of Standard Operation Procedure (Sop)

a. Take time

- ✓ The rate at which the end product or service must be produced and delivered in order to satisfy a defined customer demand within a given period of time.
- ✓ Is the time that is allotted for making one unit of product?

b. Standard in process stock

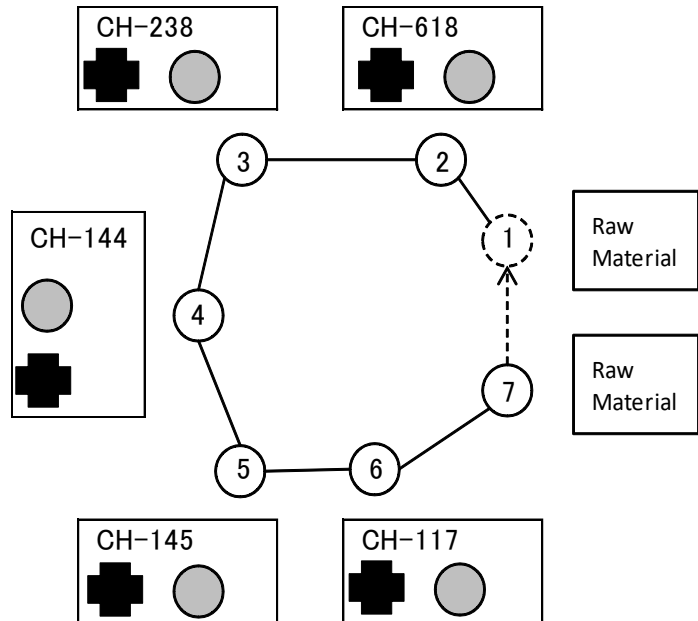
- ✓ It is the minimum quantity of parts always on hand for processing during and between sub-processes.
- ✓ It allows workers to do their jobs continuously in a set sequence, repeating the same operation over and over in the same order.

c. Operating Procedure

- ✓ Enter the layout of facilities and pallets in the sheet.
- ✓ Observe the target operator closely.

1. It is necessary to talk about the Operation Base (OB) and Starting Point (SP) with the target operator in advance.
2. If the “waiting” is expected during operation, it is also necessary to decide the point of waiting and the timing to resume the operation.
 - OB = the place the operator is located when starting the operation
 - SP = the tool showing the timing when the operator start working.
3. Enter operator’s movement using numbers and flow lines in line with the procedure.
4. Record work elements and time measured in numerical order.
5. Enter the quantity of Standard In-Process Stock (*) in the bottom of the format
6. Enter the items about quality inspection and safety operations in symbols, if any.
7. Enter the information necessary to help control and make follow up actions afterwards.

Table 4. 1 An Example Standardized Work Chart

ACME Corp.			Plant: ACME				Product: Pinion gear		
Standard Work Chart			Area: Machining				Op. 1 of 1		
Date: 2-2-2010			Process: Exercise				Pg. 1 of 1		
By: John T.			Shifts: 2				Takt Cycle		
Approved by: Alex S.			Volume: 600				Time: 44.5 sec. Time: 44 sec.		
Number	Major Steps	Man Time	Auto Time	Wait Time	Walk Time	 Working sequence  Walking  Return to start	Safety	Swip	Quality
									
1	Pick up raw material	1	-	-	2				
2	Unload, load part and start M/C GC618	4	38	-	2				
3	Unload, load part and start M/C GC234	6	7	-	2				
4	Unload, load part and start M/C GC144	6	38	-	2				
5	Unload, load part and start M/C GC145	5	30	-	2				
6	Unload, load part and start M/C TS117	7	3	-	2				
7	Pack FG in pallet	1	-	-	2				
		30		0	14				

“**Standard Operation Sheet**” is subject to change after examining the effects of the corrective measures at the working site discussing with operators there.

Principle of Standard Formation

- ✓ **Enhanced:** Standard of Improved situation.
- ✓ **Acceptability:** Acceptable Standard to all employees.
- ✓ **Practicality:** Easy to Implement Standard.

Standardizing New Improvements

If the goal is achieved, the new procedure should be standardized. If the goal is not achieved, then the QC Circle must retrace its steps, starting with analysis of the causes. Standardization ensures that the solution stays permanent.

Incorporate the most effective corrective actions into your operational and other standards in order to sustain the effect. In standardizing, seek to integrate and simplify procedures so that anyone can follow them and achieve the same results.

Key points

- ✓ Standardize effective corrective actions.
- ✓ Develop operating procedures into rules. Establish or revise standards, specifications, rules, and manuals.
- ✓ Be sure that the standards specify who, when, where, what, why, and how, and are easy to implement.
- ✓ Look at the relationships between the operation under review and the upstream and downstream processes. Standards should also be revised in other departments as necessary.
- ✓ Specify when the new standards are to go into effect.

Points to remember in using the 5W1H in standardization

1. Decide clearly on the 5W1H category items and who is going to be responsible for doing what. Be sure to include items to keep the problems from recurring.
2. State explicitly what operating standards are to be followed and what the standard times are, thereby making the standard themselves explicit.

3. Draw up quality and check sheets and exercise ingenuity to see the management tools used.
4. Draw up a graph of actual process progress and show explicitly that affect is being sustained.

Standardization Procedure

Once a corrective action has been incorporated into the standards, follow the registration procedures and make it official.

- ✓ Be sure to follow the official procedures for establishing, revising, and discontinuing standards.
- ✓ Management approval is prerequisite for establishing or revising any operating standards. Take the time to explain the new standards and the reasons for them to everyone's satisfaction.
- ✓ Do not revise or discontinue standards until after you have cleared this with the upstream and downstream departments that will be affected.

4.2. Prevent occurrences of wastes

Waste prevention involves strict avoidance of waste generation. It also involves qualitative and quantitative reduction at the source of waste production. Reuse of products is also a key aspect of **waste prevention**. **Waste prevention** does not include recycling of materials and separate waste collection. Waste prevention is also known as source reduction. However, **waste prevention** is the first and often the most important step in **waste** management hierarchy and a key factor in efficient and sustainable resource management. According to the **Waste** Framework Directive, reducing the amount of **waste** generated at source and reducing the hazardous content of that **waste** is regarded as the highest priority. Waste prevention programs involve 3 key steps - **reduce, reuse, and donate or exchange**.

We prevent them from becoming sources of waste we will be right back where we started in no time at all. That is one reason why one of the very first things mentioned about discovering waste adopting the right attitude. If everyone is paying attention to keeping waste from taking hold, then you have a good chance of sustaining production flow. There are four important methods you can use for maintaining a waste-free production environment:

- Standardization
- Visual controls

- Auditory controls
- 5W and 1H Sheet

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Standardization

The primary purpose of standardization is to create and sustain a waste-free process. Standardization means establishing standard procedures for every operation so that anyone can understand and use them – and everyone does. There are many aspects to standardization. Standards must be created, documented, well-communicated, adhered to, and regularly re-assessed.

Standards are required for:

- Machines
- Operations
- Defining normal and abnormal conditions
- Clerical procedures
- Procurement

Visual and Auditory Controls

One way waste enters into operations is when standards are not improved to meet changing conditions. Even standardization fails to sustain waste-free production if not systematically updated to take advantage of new materials, new technology, and worker improvement ideas. If the slightest defect occurs, the standard must be reconsidered.

The factory is a living thing and must constantly be adjusted to stay responsive to changes in the environment. Responsiveness must be systematic so that problems are addressed without losing the solid foundation of the waste-removing methods already established. The best way to do this is through visual and auditory controls.

Red-tagging: put a red tag on everything in the factory that is not necessary to the current operations of the production process. After everyone has had time to notice red-tagged items and claim any that are needed in their area, remove the remaining red-tagged items from the environment. Management can decide what to do with them: they can be sold, thrown out, or moved to a location where they are needed. Always keep the production floor free of any thing that is not directly part of the production process.

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Signboards- The purpose of workstations and the names of the workers who operate them should be displayed at every processing point. Signboards can also identify equipment and processes so that everyone knows what things are and what they are used for. Standard quantities should be included on supply bins or carts. The products produced on each line or in each cell can be displayed, and so on.

Outlining- Borders around tools and equipment, big and small, help people find and return things. Outlining can also create patterns of work-flow by using the floor to indicate where and where not to place things, where to walk, safety zones and danger zones. Outlining to indicate goods to be processed or parts that have been processed becomes a signal to material handlers for replenishing or for delivery to the next process.

Andons- Different colored lights can report the status and needs of a system and signal when defects or abnormal conditions occur so that problems can be solved immediately.

Kanban- These little signs accompany work-in-process. They are the flexible production instructions or work orders that trigger materials supply and production in a pull system, the hallmark of lean manufacturing.

Pitch and Inspection Buzzers- These indicate when operations get out of sync with demand or when defects are around. They keep awareness focused on solving problems and keep waste from taking root.

The 5W and 1H Sheet

The 5W and 1H (five “whys” and one “how”) is a powerful method and one that never stops being wasteful in sustaining a waste-free production environment. The 5W and 1H sheet is a tool that will help you systematically apply this method.

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5W and 1H Sheet		
	Problem: The line stopped.	
Why no. 1:	Why no. 1: Why did the line stop occur?	Why no. 1:
	↓	
Current status:	Current status: The line stopped when a dimensional defect was found in a processed item.	Current status:
Why no. 2:	Why no. 2: Why did the dimensional defect occur?	Why no. 2:
	↓	
Current status:	Current status: Two work pieces got processed at once.	Current status:
Why no. 3:	Why no. 3: Why did two work pieces get processed at once?	Why no. 3:
	↓	
Current status:	Current status: The two work pieces got stuck together.	Current status:
Why no. 4:	Why no. 4: Why did two work pieces get stuck together?	Why no. 4:
	↓	
Current status:	Current status: The wrong drill bit was used.	Current status:
Why no 5:	Why no 5: Why was the wrong drill bit used?	Why no 5:
	↓	
Current status:	Current status: Drill bit storage is inadequate (drill bits are kept in a casual pile).	Current status:
Improvement proposal (How):	Improvement proposal (How): Devise storage improvement and reinforce the 5S.	Improvement proposal (How):

Figure 4. 4 showing 5W and 1H Sheet

HOW TO PREVENT WASTE

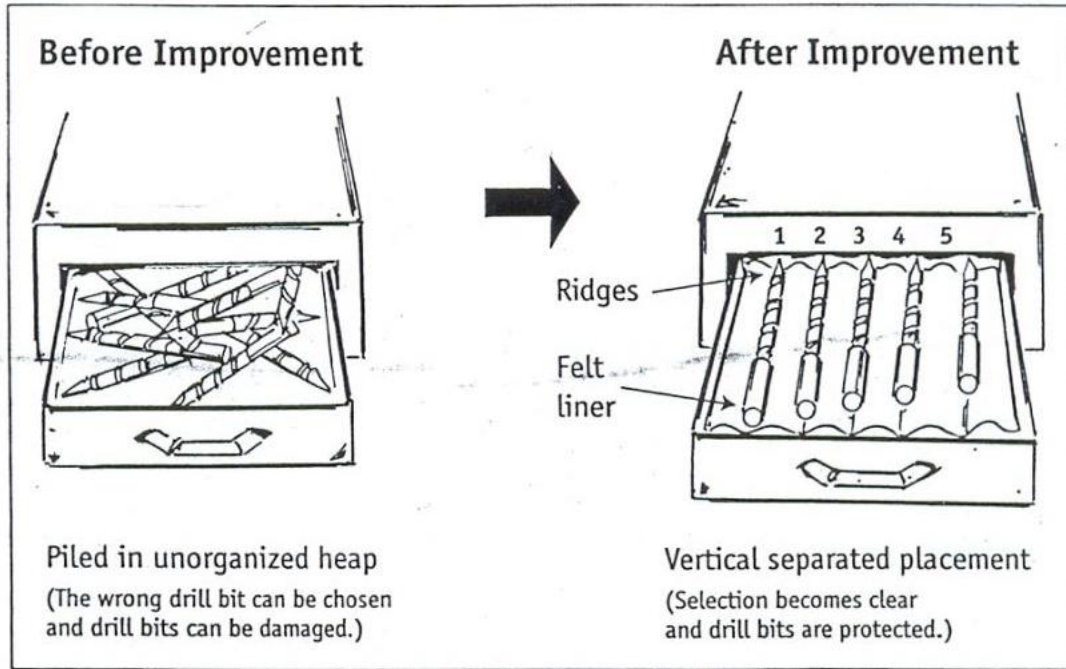


Figure 4. 5 showing *Improvement in Drill Bit Storage*

Five Key Concepts for Asking “Why” and “How”

Following these principles suggested by Hiroyuki Hirano when you are asking the 5”whys” and 1”how”:

- 1. Look with the eyes of a child-** All improvement begins with the first why. Never cease looking and never cease asking that first why. As you practice this, the result will follow.
- 2. Remember three essentials for fact finding-** (1) Go to where the problem occurred.(2) See the problem first-hand. (3) Confirm the facts based on your own observations.
- 3. Be a walker and an observer-** Supervisors and managers must continually work through the factory to see that standards are being followed and to practice seeing waste. Operators need to continually examine their own operations to stay alert for new problems and new ideas for solving them that may come to mind as they do their jobs.
- 4. Break down fixed thinking-** If you ask “why” and “how” often enough you will eventually run out of “known” answers. At this point you may reach internal mental resistance to the discovery of what you

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don't know. Get in the habit of asking why and how beyond this point of fixed thinking. That is when you will make the big discoveries about waste and how to solve it.

5. Do it now- Don't wait. Put your ideas into practice immediately!

4.3. Create waste-free workplace

7 ways to create a waste free workplace

1. If it ain't reusable, try try again.
2. Create an anti-printing culture. Print smarter and go (nearly) paperless.
3. Join the Spare Harvest movement.
4. Encourage 'bring your own' lunch and snacks.
5. Pre-cycle your work products.
6. Reuse, recycle and discover better ways of doing things.
7. Purchase wisely. Wherever possible by secondhand equipment and machines

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Self-Check 4

Choose the best answer

1. Which of the following are important methods used for maintaining a waste-free production environment?
a. Standardization b. Visual controls c. Auditory controls d. all
2. Which of the following can be considered as the medical science of machines?
a. TPM b. kaizen c. QCC d. 5S
3. Which of the following are types of maintenance?
a. Breakdown maintenance b. Preventive maintenance c. Corrective maintenance
d. Maintenance prevention e. all of the above
4. Which of the following are the Factors affecting equipment effectiveness?
a. Equipment failure (breakdown) b. Setup and adjustment downtime
c. Idling and minor stoppages d. all of the above

Written test

Directions: Answer all the questions listed below.

1. What are the four methods for maintaining a waste free production environment? (4 Points)
2. How standardization does maintain a waste free environment? (4 Points)
3. How a visual and auditory control does maintain a waste free environment? (4 Points)
4. How 5W and 1H sheet does maintain a waste free environment? (3 Points)
5. What is the difference between standard and standardization? (2 points)
6. Write down and describe steps of standardization? (6 points)
7. Write down nine steps of continuous improvement process steps? (9 points)
8. What are the elements of standard operation producers (**SOP**)? (3 points)
9. How to standardize new improvements? (20 points)
10. How to introduce new SOP to employees? (10 points)

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