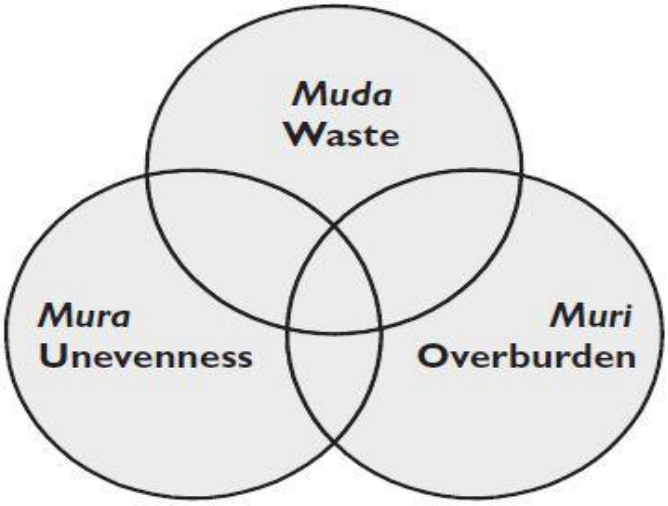
Automotive Electrical & Electronics Level-II

Based on March 2022, Curriculum Version 1



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Acronym

PDCA	Plan, Do, Check Act
OHS	Occupational safety and health
ILO	International Labor Organization
LAP Test	Learning Activity Performance Test
SI	International Standard
TTLM	Teaching, Training and Learning Materials
WHO	World Health Organization
RCA	Root Cause Analysis
WHS	Workplace health and safety
SOP	Standard Operating Procedure

Introduction to module

In Automotive field of study; **Prevent and Eliminate MUDA** is one of important activity for the mechanic for each activity. A worker to prevent and eliminate MUDA/wastes in his/her workplace by applying scientific problem-solving techniques and tools to enhance quality, productivity and other kaizen elements on continual basis.

This module contain how to identify and analyze problem causes of a problem, eliminate MUDA, assess effectiveness of the solution and prevent occurrence of wastes and sustain operation.

This module is designed to meet the industry requirement under the automotive mechanics level II occupational standard, particularly for the unit of competency: **Prevent and Eliminate MUDA.**

This module covers the units:

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

Learning Objective of the Module

- Prepare for work
- Identifying MUDA and problem
- Analyzing causes of a problem
- Eliminating MUDA and Assessing effectiveness of the solution
- Preventing 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” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

1. Unit one: Prepare for work

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

- Job requirement work instructions
- OHS requirements
- Appropriate materials for work
- Safety equipment and tools

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

- Determining job requirement work instructions
- OHS requirements for personal protection
- Selecting appropriate materials for work
- Identifying and check Safety equipment and tools

1.1 Job requirement work instructions

A Job can be defined as:

- A piece of work, especially a specific task done as part of the routine of one's occupation or for an agreed price.
- A post of employment; full-time or part-time position
- Anything a person is expected or obliged to do; duty; responsibility
- An affair, matter, occurrence, or state of affairs.
- The material, project, assignment, etc., being worked upon.
- The process or requirements, details, etc., of working.
- The execution or performance of a task.

The requirements for a job vary according to the nature of the job itself. However, a certain work ethic must be cultivated to succeed in any job and this is fundamental to an individual's sense of himself as a worker, as part of production relations and a fundamental economic being. The basic requirements for a job remain the same no matter what the job is, where it is located or what professional and educational qualifications are required for it. These are as follows:

Discipline: Nothing is possible without discipline. Any job requires a fundamental core of discipline from the worker or the employee and this is a quality which is independent of age, post, stature, job and so on. Discipline is absolutely indispensable and provides the impetus for work that can be strenuous, repetitive, boring and even unsatisfactory at times.

Enthusiasm: Enthusiasm for work is also a pre-requisite for any job. An innate love for the job, which in modern parlance is known as job satisfaction, is a core requirement for any job. The drive to succeed, to innovate, to do well and to make one's profession into one's livelihood is a critical drive which needs to be present in the employee or cultivated as soon as possible. No job, however perfectly carried out, can evoke the feeling of satisfaction of a job well done without the instinct for success.

Qualifications: This is a more material, tactile need for a job which can be conveyed through degrees and certificates. However education is not limited to what is taught in colleges or vocational training courses. It is the burning desire to learn more, to reach the depths of knowledge about a particular field of interest, to complete the job and learn from it that marks the true enthusiast and the truly learned.

Soft Skills: Soft skills include those skills which ensure that a job is executed well, and the employee can carry himself in the proper manner too. For example, good and smooth communication, computer skills, proficiency in language if needed, presentable appearance, the ability to manage crises are all soft skills which are fundamentally important in any job and which must be cultivated consciously.

Thus, the requirements of a job, though specific to it, cover also a general spectrum. These make for better employees and better individuals.

- ✓ **Work Instruction**
  - Information about the work
- ✓ **Describe what workers need to be able to do on the job**
  - Work functions
  - Key activities of each work function
  - Performance indicators
- ✓ **Describe what task to be done or work roles in a certain occupation**

Work instruction is a description of the specific tasks and activities within an organization. A work instruction in a business will generally outline all of the different jobs needed for the operation of the firm in great detail and is a key element to running a business smoothly.

In other words it is a document containing detailed instructions that specify exactly what steps to follow to carry out an activity. It contains much more detail than a Procedure and is only created if very detailed instructions are needed. For example, describing precisely how a Request for Change record is created in the Change Management software support tool.

Many people confuse “procedures” with “work instructions”. In fact, most people write work instructions and call them procedures. Knowing the differences of procedures vs work instructions can help you understand the documentation process much better and, therefore, procedure documentation.

Procedures describe a process, while a work instruction describes how to perform the conversion itself. Process descriptions include details about the inputs, what conversion takes place (of inputs into outputs), the outputs, and the feedback necessary to ensure consistent results. The PDCA process approach (Plan, Do, Check, Act) is used to capture the relevant information.

Questions that need to be answered in a procedure include:

- Where do the inputs come from (suppliers)?
- Where do the outputs go (customers)?
- Who performs what action when (responsibilities)?
- How do you know when you have done it right (effectiveness criteria)?
- What feedback should be captured (metrics)?
- How do we communicate results (charts, graphs and reports)?
- What laws (regulations) or standards apply (e.g., ISO 9001, 8th EU Directive, IFRS, Sarbanes-Oxley)

1.2 OHS requirements for personal protection

OHS requirements are legislation/regulations/codes of practice and enterprise safety policies and procedures. This may include protective clothing and equipment, use of tooling and equipment, workplace environment and safety, handling of material, use of fire-fighting equipment, enterprise first aid, hazard control and hazardous materials and substances.

Personal protective equipment include those prescribed under legislation/ regulations/codes of practice and workplace policies and practices. Safe operating procedures include the conduct of operational risk assessment and treatments associated with workplace organization. Emergency procedures include emergency shutdown and stopping of equipment, extinguishing fires, enterprise first aid requirements and site evacuation.

Occupational safety and health (OSH) also commonly referred to as occupational health and safety (OHS) or workplace health and safety (WHS) is an area concerned with the safety, health and welfare of people engaged in work or employment. The goals of occupational safety and health programs include fostering a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. In the United States the term occupational health and safety is referred to as occupational health and occupational and non-occupational safety and includes safety for activities outside work.

Occupational safety and health can be important for moral, legal, and financial reasons. In common-law jurisdictions, employers have a common law duty (reflecting an underlying moral obligation) to take reasonable care for the safety of their employees. Statute law may build upon

this to impose additional general duties, introduce specific duties and create government bodies with powers to regulate workplace safety issues: details of this will vary from jurisdiction to jurisdiction. Good OSH practices can also reduce employee injury and illness related costs, including medical care, sick leave and disability benefit costs.

As defined by the World Health Organization (WHO) "occupational health deals with all aspects of health and safety in the workplace and has a strong focus on primary prevention of hazards." Health has been defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Occupational health is a multidisciplinary field of healthcare concerned with enabling an individual to undertake their occupation, in the way that causes least harm to their health. It contrasts, for example, with the promotion of health and safety at work, which is concerned with preventing harm from any incidental hazards, arising in the workplace..

The definition reads: "The main focus in occupational health is on three different objectives:

i. the maintenance and promotion of workers' health and working capacity;
ii. the improvement of working environment and work to become conducive to safety and health and
iii. Development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking.

Joint ILO/WHO Committee on Occupational Health: those in the field of occupational health come from a wide range of disciplines and professions including medicine, psychology, epidemiology, physiotherapy and rehabilitation, occupational, occupational medicine, human factors and ergonomics, and many others. Professionals advise on a broad range of occupational health matters. These include how to avoid particular pre-existing conditions causing a problem in the occupation, correct posture for the work, frequency of rest breaks, preventative action that can be undertaken, and so forth.

Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.

1.2.1 Workplace hazards

Although work provides many economic and other benefits, a wide array of workplace hazards also present risks to the health and safety of people at work. These include "chemicals, biological agents, physical factors, adverse ergonomic conditions, allergens, a complex network of safety risks," and a broad range of psychosocial risk factors.

A. Physical and mechanical hazards

Physical hazards are a common source of injuries in many industries. They are perhaps unavoidable in certain industries, such as construction and mining, but over time people have developed safety methods and procedures to manage the risks of physical danger in the workplace. Employment of children may pose special problems. Falls are a common cause of occupational injuries and fatalities, especially in construction, extraction, transportation, healthcare, and building cleaning and maintenance.

An engineering workshop specializing in the fabrication and welding of components has to follow the Personal Protective Equipment (PPE) at work regulations 1992. It is an employer's/workers duty to provide 'all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work which protects him against one or more risks to his health and safety'. In a fabrication and welding workshop an employer would be required to provide face and eye protection, safety footwear, overalls and other necessary PPE.

Machines are commonplace in many industries, including manufacturing, mining, construction and agriculture, and can be dangerous to workers. Many machines involve moving parts, sharp edges, hot surfaces and other hazards with the potential to crush, burn, cut, shear, stab or otherwise strike or wound workers if used unsafely. Various safety measures exist to minimize these hazards, including lockout-tag out procedures for machine maintenance and roll over protection systems for vehicles.

The transportation sector bears many risks for the health of commercial drivers, too, for example from vibration, long periods of sitting, work stress and exhaustion. These problems occur in Europe but in other parts of the world the situation is even worse. More drivers die in accidents due to security defects in vehicles. Long waiting times at borders cause that drivers are away from home and family much longer and even increase the risk of HIV infections.

Confined spaces also present a work hazard. The National Institute of Occupational Safety and Health defines "confined space" as having limited openings for entry and exit and unfavourable natural ventilation, and which is not intended for continuous employee occupancy. Spaces of this kind can include storage tanks, ship compartments, sewers, and pipelines. Confined spaces can pose a hazard not just to workers, but also to people who try to rescue them.

Noise also presents a fairly common workplace hazard: occupational hearing loss is the most common work-related injury in the United States, with 22 million workers exposed to hazardous noise levels at work and an estimated $242 million spent annually on worker's compensation for hearing loss disability. Noise is not the only source of occupational hearing loss; exposure to chemicals such as aromatic solvents and metals including lead, arsenic, and mercury can also cause hearing loss.

Electricity poses a danger to many workers. Electrical injuries can be divided into four types: fatal electrocution, electric shock, burns, and falls caused by contact with electric energy

Vibrating machinery, lighting, and air pressure (high or low) can also cause work-related illness and injury. Asphyxiation is another potential work hazard in certain situations. Musculoskeletal are avoided by the employment of good ergonomic design and the reduction of repeated strenuous movements or lifts. Ionizing (alpha, beta, gamma, X, neutron), and non-ionizing radiation (microwave, intense IR, RF, UV, laser at visible and non-visible wavelengths), can also be a potent hazard

In Victoria, workplace health and safety is governed by a system of laws, regulations and compliance codes which set out the responsibilities of employers and workers to ensure that safety is maintained at work.

B. Act of OHS

The Occupational Health and Safety Act 2004 (the Act) is the cornerstone of legislative and administrative measures to improve occupational health and safety in Victoria.

The Act sets out the key principles, duties and rights in relation to occupational health and safety. The general nature of the duties imposed by the Act means that they cover a very wide variety of circumstances, do not readily date and provide considerable flexibility for a duty holder to determine what needs to be done to comply.

C. Regulations of OHS

The Occupational Health and Safety Regulations 2007 are made under the Act. They specify the ways duties imposed by the Act must be performed, or prescribe procedural or administrative matters to support the Act, such as requiring licenses for specific activities, keeping records, or notifying certain matters.

D. Guidance of OHS

Effective OHS regulation requires that Work Safe provides clear, accessible advice and guidance about what constitutes compliance with the Act and Regulations. This can be achieved through Compliance Codes, Work Safe Positions and non-statutory guidance ("the OHS compliance framework"). For a detailed explanation of the OHS compliance framework, see the Victorian Occupational Health and Safety Compliance Framework Handbook.

E. Policy of OHS

Not every term in the legislation is defined or explained in detail. Also, sometimes new circumstances arise (like increases in non-standard forms of employment, such as casual, labour hire and contract work, or completely new industries with new technologies which produce new hazards and risks) which could potentially impact on the reach of the law, or its effective administration by Work Safe. Therefore, from time to time Work Safe must make decisions about how it will interpret something that is referred to in legislation, or act on a particular issue, to ensure clarity. In these circumstances, Work Safe will develop a policy. A policy is a statement of what Work Safe understands something to mean, or what Work Safe will do in certain.

1.3 Selecting appropriate materials for work

Tools and Equipment are required to identify and measure Waste/Muda in work stations. The following are some tools and equipment used to identify and measure Waste/Muda:

- Tape (any length measuring device)
- Stop watch

- Photo Camera
- Video Camera
- Calculator

1.4 Identifying and check Safety equipment and tools

Tools and Equipment for Waste/Muda Identification Tape/Meter Stop watch, Photo Camera Video Camera Calculator

1.4.1 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 to make arithmetic calculations.

1.4.2 Tools and techniques

- ✓ Plant Layout
- ✓ Process flow
- ✓ Other Analysis tools
- ✓ Do time study by work element
- ✓ Measure Travel distance
- ✓ Take a photo of workplace
- ✓ Measure Total steps

Self-Check: 1.1

Name…….……ID……Date……..

Directions:

Instruction I choose the best answer

1. _____The Occupational Health and Safety Regulations 2007 are made under the Act

A. Regulations B. Guidance C. Policy D.ALL

2. _____Effective OHS regulation requires that Work Safe provides clear, accessible advice and guidance

A. Regulations B. Guidance C. Policy D.ALL

3. _____ include those skills which ensure that a job is executed well, and the employee can carry himself in the proper manner too

A. Soft Skill B. Enthusiasm C. Qualification D.ALL

4_____ not every term in the legislation is defined or explained in detail

A. Policy B. Enthusiasm C. Qualification D.ALL

Operation Sheet 1

Prepare tools and equipment for identification and measuring Muda.

Procedures

1. Discuss and plan to prepare tools and equipment for Muda identification.

2. Prepare tools and equipment for Muda identification.

LAP Test 1

Practical Demonstration

Name: _____ **Date: _____**

Time started: _____ **Time finished: _____**

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

Task 1: Identify and prepare tools and equipment for measuring and identification of Muda.

2. Unit Two: Identify MUDA and problem

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

- Identify problem and prepare Plan for MUDA
- Causes and effects of MUDA
- Statistical tools and techniques list
- List and post on Kaizen Board
- Relevant procedures on MUDA

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

- Identifying problem and prepare Plan for MUDA
- Discussing causes and effects of MUDA
- Using statistical tools and techniques list Kaizen problems
- Analyzing list and post on Kaizen Board
- Identifying and measure relevant procedures on MUDA

2.1 Identifying problem and prepare Plan for MUDA

Motion

Do you move unnecessarily during a process or activity? Ever make 3 trips back into the house for things you forgot before finally leaving?

Transportation

Do you move materials or supplies unnecessarily? This isn't about you moving this is about moving stuff. I've walked miles in the kitchen carrying ingredients back and forth; maybe better organization could cut down on how much we have to carry stuff?

Inventory

Having too much, or too little of supplies. Sticking with the kitchen theme, how much does it cost in time, energy and gas when you have to run out at the last minute for missing ingredient? On the other end buying too much of anything is a waste as well. I've still got dozens of pipe fittings I purchased 8 years ago (just in case!) during a kitchen renovation.

Over-processing

Doing more than really necessary. Scrubbing the same spot after it's already clean, repetitive mouse clicks because we don't know the computer's shortcut commands, or too much packaging peanuts and such for a non-fragile item are all examples of over-processing.

Rework

As the saying goes, "if you don't have time to do it right the first time, when will you have time to do it over." – John Wooden. Rework is just that, having to do anything a second time because it was unacceptable the first. Be it cleaning, repairing, filling out forms a second time we all experience the pain and frustration of rework.

Time

The most obvious to most of us, waiting for another person company or process before we can move forward is a huge waste. Waiting for the computer to finish processing a page, waiting at the doctor's office long past your appointed time, or waiting in line at the local grocery store costs us all. The more inefficient others are, the less efficient we can be.

2.2 Discussing causes and effects of MUDA

2.2.1 Causes 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

Effects of Muda of Overproduction

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

2.2.2 Causes 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 good

Effects of Muda of Inventory

- ✓ Waste of space
- ✓ Needs for inspection, and transportation
- ✓ Expansion of working fund
- ✓ Shelf life may expire
- ✓ It ties up cash

2.2.3 Causes of Muda of motion

- ✓ Isolated operations
- ✓ Low employee morale
- ✓ Poor work layout
- ✓ Lack of training
- ✓ Undeveloped skill

2.2.4 Causes of Muda of Conveyance/Transportation

- ✓ Poor layout • Shish-skilled workers
- ✓ Sitting to perform operations

Effects of Muda of Conveyance/Transportation

- ✓ Waste of space
- ✓ Production deterioration
- ✓ Expansion of transportation
- ✓ Facilities
- ✓ Occurrence of scratches
- ✓ Increase production time and cost
- ✓ Wastes time and energy

2.2.5 Causes of Muda of Waiting/ Idle time

- ✓ Obstruction of flow
- ✓ Poor equipment layout
- ✓ Trouble at the upstream process
- ✓ Capacity imbalances

Effects of Muda of Waiting/ Idle time

- ✓ Waste of manpower, time, & machines
- ✓ Increase in the in-process inventory
- ✓ Failed delivery dates

2.2.6 Causes of Muda of Defect making

- ✓ Emphasis on downstream inspection
- ✓ No standard for inspection work
- ✓ Omission of standard operations
- ✓ Material handling and conveyance

Effects of Muda of Defect making

- ✓ Increase in material cost
- ✓ Productivity deterioration
- ✓ Increase in personnel & processes for inspection
- ✓ Increase in defects and claims
- ✓ Invite reworking costs

2.2.7 Causes of Muda of Processing

- ✓ Inadequate study of processes
- ✓ Inadequate study of operations
- ✓ Incomplete standardization
- ✓ Materials are not studied

Effects of Muda of Processing

- ✓ Unnecessary processes or operation
- ✓ Increase in manpower and man-hour
- ✓ Lower workability • Increase in defects

Talent and Ideas – Consultants that teach these philosophies are sometimes including the waste of talent and ideas as the 8th type of waste. In the heat of the moment, we get frustrated because of wasteful activities, we ponder that there must be a better way. By not taking action and changing our ways we are wasting our capabilities and opportunities.

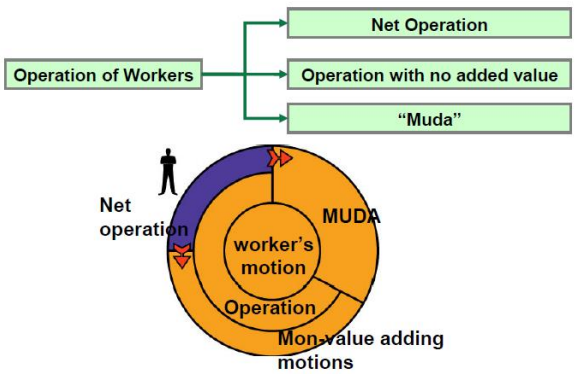
Cash – A 9th form of waste appropriate to personal financial growth is just plain cash. How many times have you purchased a product or service but never used it? Have you ever bought food that was never eaten, clothes that were never worn or software that was never used?

By training yourself to see the Muda you will find that it is easier to save a dollar than to make a dollar. It's that recognition, which in part, prompted this blog.

There are probably other ways we can categorize waste that are not "official" according to Lean Management. Where else do we have waste in our lives? Please contribute if you can add to the list.

The Three M's

- Imbalance (inequality) (Mura)
- Excessive (too much) (Muri)
- Wasteful (Muda) Works



Classification of waste

A number of methods for classification of waste have emerged. Here are some of them:-

- The 3MU's
- 5M+Q+S
- The flow of goods
- The Seven deadly wastes

Muri:-Mental and physical overburden on operators, and overburden on production machinery

We should not force hard work on Employees in the name of productivity improvement

- Mental and physical **overburden** on operators, and overburden on production machinery



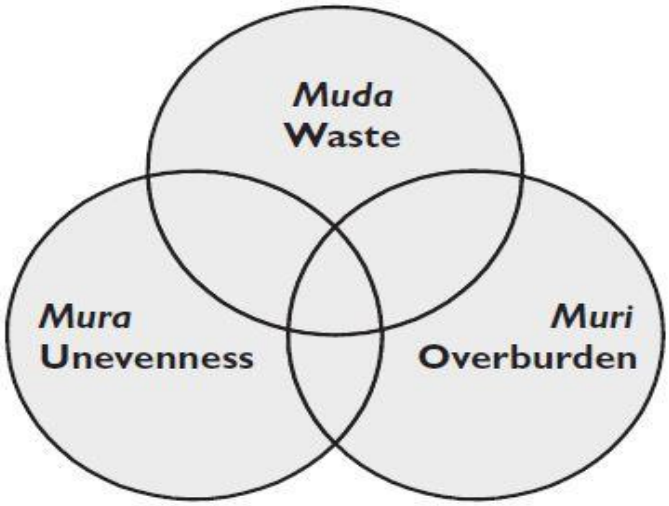
Mura

- Variation in work distribution, production capacity of machinery, and material specifications



Relationship between the 3 M's

- Usually Mura creates Muri which in turn lead to generation of Muda



2.3 Using statistical tools and techniques list Kaizen problems

Kaizen tools are primarily used in the manufacturing industry to eliminate 8 wastes or DOWNTIME (Defects, Overproduction, Waiting, Non-utilized talent, Transportation, Inventory, Motion, and Extra-processing) and optimize business processes for global competitiveness

Four tools that are essential to pulling off a Kaizen.

- 5S. During a Kaizen event, there will be questions regarding quality management that need to be answered.
- Value Stream Mapping. To study how the value of a product flows through a process, teams use value stream mapping (VSM).
- Fishbone Diagram.
- Pareto Analysis.

2.3.1 Techniques list Kaizen problems

The (Plan – Do – Check – Act) PCDA Cycle is another excellent continuous improvement technique. Similar to the scientific method, the PCDA cycle is a way of identifying and testing PDCA Cycle: PDCA cycles are cycle that is often implemented when completing Kaizen strategies. This cycle can be used employees of all levels in the organization and is an effective introduction to Lean manufacturing. There are 4 phases of the cycle: Plan > Do > Check > Act that allows a continuous structure for kaizen strategies to be implemented and assessed while providing a framework for continuous Improvement.

- Gemba: means the real place. Often managers and supervisors can get valuable information by actually going down to the production line and talking with employees. Gemba is often used in the form of Gemba walks, which are scheduled walks for managers and supervisors observe processes up close and talk with frontline employees.
- Jishuken: can be translated into an autonomous study groups or self-study. This concept encouragers managers to be more directly involved and learn about the processes they are responsible for and how they can work to improve them.
- 5 Whys: This is an important tool when it comes to identifying the root cause of an issue. It is difficult to make an impactful change in the workplace if the root cause has yet to be considered. The 5 Whys is exactly like the name implies; after a problem arises you should ask yourself why five times.
- Value Stream Mapping: Mapping out processes and streams in a facility can be very beneficial for a business practicing Kaizen. These maps are usually hand-drawn and include a diagram of materials moving through the different areas of the workplace. It is important to remember these are just a few tools that fall under the umbrella of Kaizen.!

2.4 Analysing list and post on Kaizen Board

2.4.1 Process Kaizen

Process Kaizen happens at the individual / team level, taking small, targeted steps to improve efficiency, productivity, communication, and transparency. Because it is simply the process of making incremental improvements, process Kaizen is accessible to anyone looking to improve their performance, regardless of whether their organization is undergoing a Lean initiative.

Process Kaizen examples could include:

- ✓ Reducing the number of team members involved in a particular process
- ✓ Implementing limits on work in process (WIP) to increase speed
- ✓ Analyzing productivity data from your Kanban board every week as a team

2.4.2 Using a Kaizen Board

If the following scenario sounds familiar to you, a Kaizen board might help: You have a super-productive team meeting, one where everyone contributed awesome ideas for working smarter and

getting more done. A week or two goes by… and none of the ideas have been implemented. You have another meeting to discuss the ideas, and everyone gets energized once more – but once again, nothing actually gets done.

This is where a Kaizen board becomes useful. It's difficult to make time and devote energy to work that isn't treated like work, but rather, a side project. Using a Kaizen board at the team or organizational levels can help turn good ideas into actionable cards, which the group collectively manages. As long as the team (or organization) commits to reviewing the board as a group (and prioritizing the work alongside other work), a Kaizen board can make your improvement ideas a reality.

2.5 Identifying and measure relevant procedures on MUDA

Muda isn't just about the typical waste, most people would have thought of garbage. That's not wrong but it's not all that there is. In TPS and lean management, Muda is subdivided in seven categories. Originally created by the chief engineer in Toyota the seven wastes (commonly abbreviated

A. Inventory

This waste is materials that aren't used or finished goods that haven't been sold. Inventory can take up a lot of real estate and can be costly to store. Finished goods that are sitting around can deteriorate or expire if it's a perishable good. Work in process inventory can turn into waste if it was scrapped or if it isn't actively used in production.

B. Transportation

This type of waste represents the unnecessary steps between the production processes. For example, during the transportation of materials from one location to another, is there any movement that can be eliminated or reduced? Additionally, it's considered Muda if the load of the vehicle used to transport these materials is under capacity. Another example is documentation. Documentation includes a lot of steps such as filling out paperwork, signing documents, passing these documents to different departments, etc. There are a lot of tools available that can make this process more efficient such as using software and applications.

C. Motion

Unlike transportation which is between the processes, motion is a waste when there is unnecessary movement within the process. Transportation is about the movement of product and materials while motion is waste from people and equipment. This is the waste that affects the

people working on the product and the machines used during production. Are the workers doing more steps than necessary or were any injured during their shift? Did the equipment experience any downtime?

D. Waiting

This waste is generated when there are idle tasks. Sometimes there is no remedy but to wait. For example, workers taking breaks in between tasks. Another example, when there is a queue for the next process of the production line due to the equipment's capacity to finish the current load.

E. Over processing

This waste is generated when more work is done to finish a task or output. A method to eliminate this Muda is to determine the root cause of the additional steps or processes conducted. Is the over processing caused by human error or is there any equipment and machine that needs to be maintained or repaired?

F. Overproduction

It's wasteful to produce more than what can be shipped out and delivered. Overproduction also affects other Muda categories such as inventory and transportation.

G. Defects

It's a waste when a finished product has defects. Most defective products are scrapped and thrown away which increases costs and leads to reproduction. Two ways to reduce defects is to conduct product testing and set routine inspections during the production process.

Self-check: 2

Name…… ID…… Date…….

Directions:

Instruction I choose the best answer

1._____ it's a waste when a finished product has defects. Most defective products are scrapped and thrown.

A. Defects B. Overproduction C Over processing D.ALL

2. _____ also affects other Muda categories such as inventory and transportation.

A. Defects B. Overproduction C Over processing D.ALL

3._____ is generated when there are idle tasks. Sometimes there is no remedy but to wait.

A. Defects B. Overproduction C Over processing D. Wait

4 _____ is about the movement of product and materials while motion is waste from people and equipment.

A. Transportation B. Overproduction C Over processing D. Wait

Instruction II Short answer question

1_____Consultants that teach these philosophies are sometimes including the waste of talent and ideas as the 8th type of waste

2_____ Variation in work distribution, production capacity of machinery, and material specifications

Operation Sheet 2

Identify MUDA and problem

Procedure for analyzing the existence of

1. **Mura,**
2. **Muri and**
3. **Muda**

Steps1 Select a workplace.

Step2 Write the work load on each machine/worker in process.

Step3 Recognize the actual capacity of each worker/machine in the process.

Step4 Compare capacity against work load of workers/machines.

Step5 Explain the existence of Mura, Muri and Muda on each machine/worker.

Write their causes

LAP Test 2

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 30 min.

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

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.

This unit is developed to provide you the necessary information regarding the following content coverage and topics:
• All possible cause of problem • Cause using 4M1E • Creative idea generation eliminate critical root cause • Action plan suggest solution

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

- Listing all possible cause of problem
- Analyzing cause using 4M1E
- Using creative idea generation eliminate critical root cause
- Preparing action plan suggest solution

3. Unit Three: Analyze causes of a problem

3.1 Listing all possible cause of problem

Problems can have a single underlying cause. One very effective approach to effective problem solving is Root Cause Analysis (RCA). RCA is one of the most widely used tools/techniques for detecting issues.

The power of Root Cause Analysis lies in its ability to analyze the situation and pinpoint the root of the problems – rather than treating the symptoms. This systematic approach focuses on identifying both, active problems and latent errors, which cause adverse situations and events. It focuses on identifying the main cause of the problem.

The root cause of all problems is ignorance."

And to be clear, "problem solving" and "improvement" are learning processes. If you didn't learn, you didn't solve the problem, and you didn't improve anything

3.2 Perform a Root Cause Analysis in 5 Steps

1. Define the problem. Analyze what you see happening, and identify the precise symptoms so that you can form a problem statement.
2. Gather data.
3. Identify causal factors.
4. Determine the root cause(s).
5. Recommend and implement solution

3.3 Possible cause of problem

1. waste of overproduction (largest waste)
2. Waste of time on hand (waiting)
3. Waste of transportation.
4. Waste of processing itself.
5. Waste of stock at hand.
6. Waste of movement.
7. Waste of making defective products.

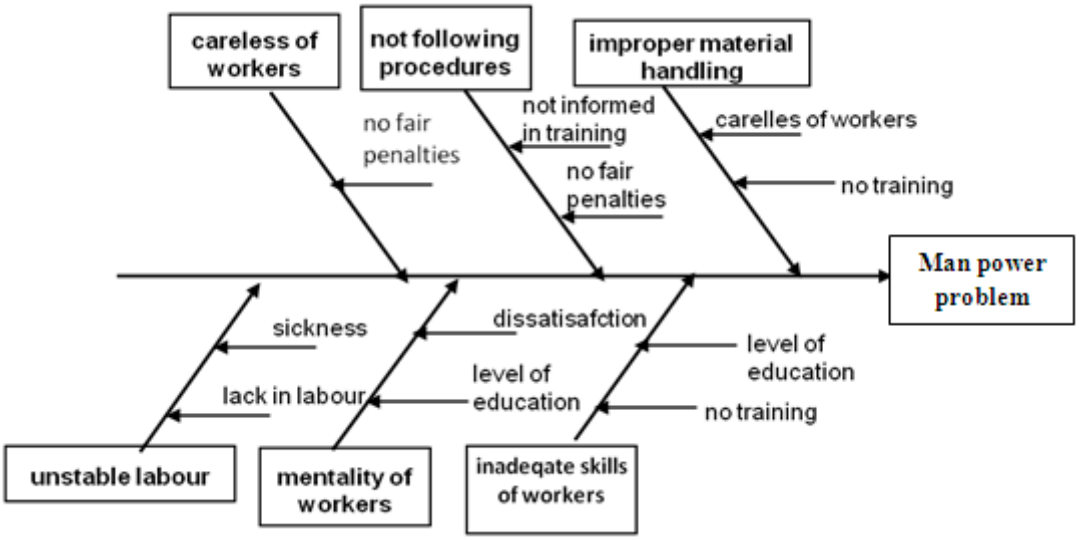
The identification and selection of appropriate options for addressing a problem should be guided by an understanding of its cause. Such insights may also lead to the original framing choice being changed. Often the causes of health systems problems are complex and uncertain and it may be more appropriate to consider underlying factors without attributing causation. The process of clarifying the cause or underlying factors is unlikely to be simple or linear. And although it may be possible to reduce uncertainty about the cause, it may be equally or more important to clarify uncertainty about the cause. Strategies for clarifying the cause of health system problems include

using either broader or more specific frameworks, brainstorming, reviewing relevant research evidence, and interviews with key informants.

3.4 Analyzing cause using 4M1E



Cause and effect analysis concerned Man, Machine, Material, Method and Environment (4M1E) which were applied in this process . It was revealed that the number of tentative causes was 12 factors as shown in Table 2. These factors were used for further analyzing the relationship between cause and related effect using the cause and effect matrix.



3.5 Using creative idea generation eliminate critical root cause

Creativity can be an important trait of an entrepreneur. In that discussion, we learned about creativity's role in innovation. Here, we will look in more depth at creativity's role in *problem-solving*. Let's first formally define creativity as the development of original ideas to solve an issue. The intent of being an entrepreneur is to break away from practical norms and use imagination to embrace quick and effective solutions to an existing problem, usually outside the corporate environment.

An idea is a thought, suggestion, or a mental image about a possible outcome or course of action that can be used to help achieve a particular goal. Ideas can be tangible or intangible. Tangible ideas are those that are well-formed and that can be clearly described, expressed, or put into action. Intangible ideas are the opposite; they are not easily defined or clear in the person's mind. Idea generation is a creative process that is used to form new ideas or concepts and to help convert intangible ideas into tangible ones. This process is also referred to as ideation. Idea generation involves coming up with many ideas in a group setting, finding ways to use these ideas, and then transferring the ideas to real-world instances.

3.5.1 Using Creativity to Solve Problems

Entrepreneurs are faced with solving many problems as they develop their ideas for filling gaps, whether those opportunities involve establishing a new company or starting a new enterprise within an existing company. Some of these problems include staffing, hiring and managing employees, handling legal compliance, funding, marketing, and paying taxes. Beyond the mundane activities listed, the entrepreneur, or the team that the entrepreneur puts in place, is indispensable in maintaining the ongoing creativity behind the product line or service offered. Innovation and creativity in the business are necessary to expand the product line or develop a groundbreaking service.

It is not necessary for the entrepreneur to feel isolated when it comes to finding creative solutions to a problem. There are societies, tools, and new methods available to spur the creativity of the entrepreneur that will further support the success and expansion of a new enterprise.[14] Learning and using entrepreneurial methods to solve problems alleviates the stress many startup owners feel. The entrepreneur's creativity will increase using collaborative methodologies. Some entrepreneurial collaborative methodologies include crowdsourcing, brainstorming,

storyboarding, and conducting quick online surveys to test ideas and concepts, and team creativity activities.

The four steps are as follows:

- Analyze— understand the root cause.
- Plan— determine how to resolve the problem.
- Implement—Put the resolution in place.
- Evaluate—determine if the resolution is producing the desired results.

3.6 Preparing action plan suggest solution

An action plan consists of seven steps: setting objectives, assessing the objectives, identifying action required to meet the objectives, working out how to evaluate the activity, agreeing a time-frame for action, identifying resources (human, financial and technical), finalizing the plan, and evaluating the results.

1. **Set objectives**

You need to identify clear objectives that will guide your work to achieve the resource center's aims. Objectives need to be achievable - do not be over-ambitious. They need to be measurable (for example, a certain number of activities carried out within a certain period), so that you can know whether you have achieved them.

Ask yourself:

- What do we want to achieve?
- *Example of an aim:* To disseminate information that will improve local health workers' knowledge of local health problems.
- *Example of an objective:* To produce and distribute an information pack on malaria diagnosis and management to all health clinics in the district the next three months.

2. **Assess the objectives**

Assessment helps to determine whether or not the objective is appropriate. It may result in confirming the objective, abandoning it or revising it. Ask yourself:

- Is the objective compatible with the resource center's aims and objectives?
- Are the necessary resources (funds, equipment, staff) available to reach this objective? If not, are they obtainable?
- What problems might arise in working to achieve this objective?
- *Example of resources needed to carry out the objective:* staff time, relevant materials in the resource center or obtainable from elsewhere, stationery, photocopier, postage.
- *Example of revised objective:* To produce and distribute an information pack on malaria diagnosis and management to 20 health clinics and training institutions within the next six months.

3. Identify action required to achieve the objective

A series of tasks needs to be identified for the objectives to be achieved. List these as steps. Ask yourself:

- What tasks are necessary, in what order, to meet the objective

  Example:

1. Plan the content of the information pack and decide how to distribute the packs, in consultation with other staff and users.
2. Calculate costs and staff time, and make sure that funds and time are available.
3. Allocate responsibilities.
4. Gather information for the pack (search resource center, contact other organizations).
5. Request permission from publishers to photocopy material.
6. Photocopy material and prepare packs.
7. Distribute packs.

4. Work out how to evaluate the activity

Plans for finding out how far the activity has achieved its objectives need to be built into the action plan. Ask yourself:

- How will we know whether we have achieved our objectives
- *Example:*
    - Contact five clinics to see whether they have received the packs.
    - Include an evaluation form in the pack, asking health workers whether the information has improved their knowledge, how they have used the information, and how future packs could be improved. Assess the feedback from the forms.

Then incorporate plans for evaluation into your action plan.

Example (showing plans for evaluation in *bold italics*):

1. Plan the content of the information pack, *including evaluation forms*, and decide how to distribute the packs, in consultation with other staff and users.
2. Calculate costs and staff time, and make sure that funds and time are available.
3. Allocate responsibilities.
4. Gather information for the pack (search resource centre, contact other organisations).
5. Request permission from publishers to photocopy material.
6. *Prepare evaluation forms.*
7. Photocopy material, prepare packs.
8. Distribute packs.
9. Contact clinics to see if they have received packs.
10. Revise plans for distributing packs if they have not reached some clinics.
11. Assess the feedback from the evaluation forms and use it to plan future work.

5. Agree a time frame

As you identify each task, work out how long it will take and when it needs to be done. This will help you to see whether your action plan is on schedule or whether you need to modify the schedule.

Ask yourself:

- ✓ What is the actual time required for each individual task? (Be careful not to under-estimate)

- ✓ When will each step be completed?

  Example: Total of 18 days over a three-month period

6. Assess the action plan

Ask yourself:

- How will you know whether the individual tasks have been achieved?
- Have you allowed for possible interruptions?
- Have you tried to do too much or too little?

An action plan must be realistic if it is to work. It is easy to over-estimate what you can do, leading to disappointment and failure. *For example*:

1. Leaflets that you had planned to include in the pack may have run out and need to be reprinted. Can you substitute something else, or will you need to arrange for them to be reprinted before you can finish preparing the packs?
2. The member of staff preparing the pack will take annual leave for six weeks during the period in which the pack was planned to be prepared. Can you re-schedule the work, or can someone else do it?

7. Finalize the action plan

Revise the action plan. Obtain feedback and comments from colleagues, and revise it again if necessary.

Self-check: 3

Name……..……..……ID……

Date…….

Directions:

Instruction I choose the best answer

1. _____Decision tree analysis is the process of drawing a decision tree, which is a graphic representation of various alternative

A. Decision tree B. Cause C. effect D.ALL

2._____can be an important trait of an entrepreneur. In that discussion, we learned about creativity's role in innovation.

A. Creativity B. Decision tree C. effect D.ALL

3. _____As you identify each task, work out how long it will take and when it needs to be done.

A. Agree a time frame B. Assess the action plan C. Assess the objectives D. None

4. _____ identifies clear objectives that will guide your work to achieve the resource centre's aims.

A. Agree a time frame B. Assess the action plan C. Assess the objectives D. None

5 _____Assessment helps to determine whether or not the objective is appropriate

A. Agree a time frame B. Assess the action plan C. Assess the objectives D. None

Operation sheet 3

Procedures of Analyze causes of a problem

Step 1 Analyze

Step 2 Understand the root cause.

Step 3 Plan— determine how to resolve the problem.

Step 4 Implement—Put the resolution in place.

Step 5 Evaluate—determine if the resolution is producing the desired results.

LAP Test 3

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 1 hours.

Task 1: After confirming the result, prepare a new standard procedure that is capable of preventing recurrence of Muda eliminated.

Task 2: Prepare action plan to implement and follow up the standard procedure using the given template.

4. Unit four: Eliminating MUDA and Assess effectiveness of the solution

This unit is developed to provide you the necessary information regarding the following content coverage and topics:
This unit is developed to provide you the necessary information regarding the following content coverage and topics: • Plan of MUDA • Ten basic principles of eliminate waste/MUDA • Tools based on OHS procedures • Tangible and intangible results • Types of diagrams using tangible results • Improvements elimination of waste/MUDA This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Implementing Plan of MUDA • Adopting ten basic principles of eliminate waste/MUDA • Using Tools based on OHS procedures • Identifying Tangible and intangible results • Comparing various types of diagrams using tangible results • Reporting gain improvements elimination of waste/MUDA

4.1 Implementing Plan of MUDA

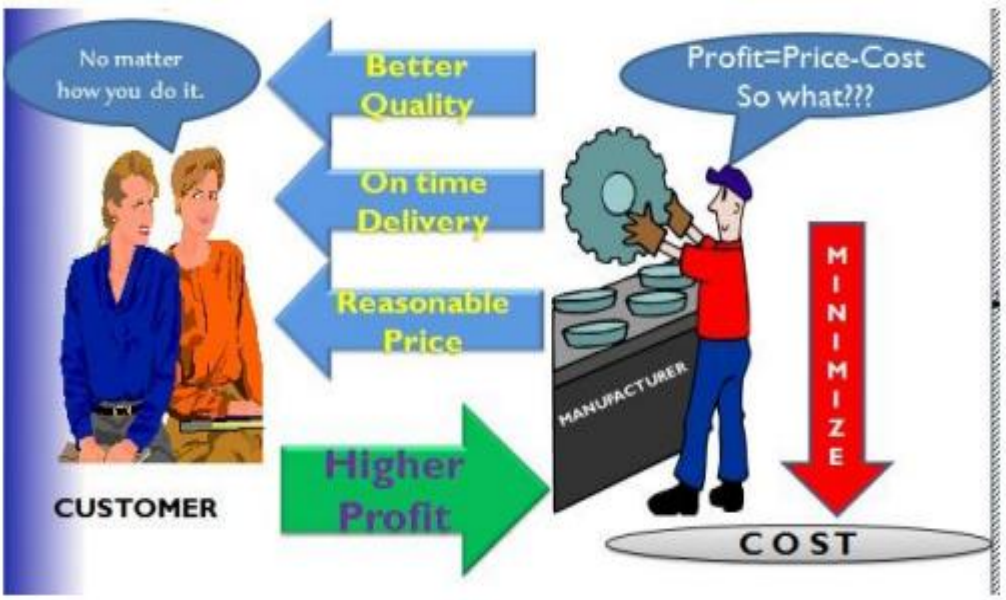
4.1.1 Targets of Customer

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 day's 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:-

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

4.1.2 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.



4.1.3 The concept of Cost

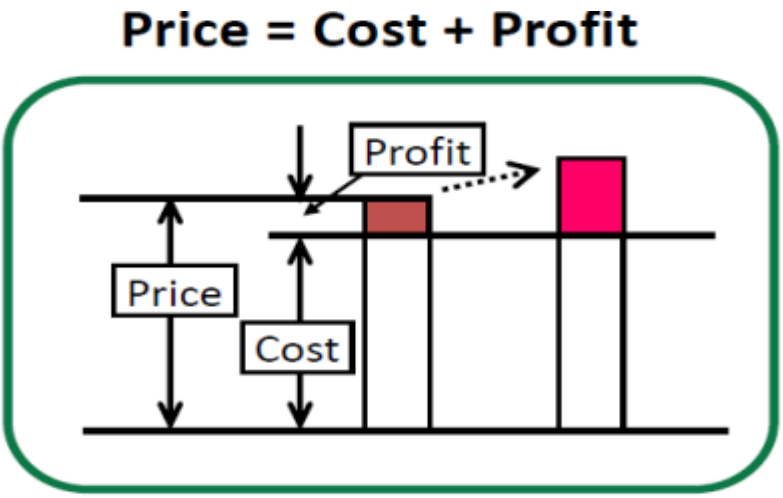
Cost: - is the amount of money that is expended to accomplish a given task/operation. Cost can be of Manufacturing or Service Delivering cost=(material + labor + facility + utility + others)cost

- Determination of the sales price of the product/Service

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

4.1.4 Traditional Thinking of Price Setting

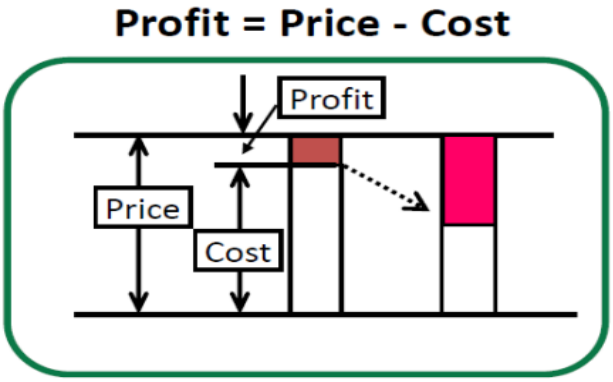
In traditional thinking of price setting, price is determined by the manufacturer/service provider rather than the market itself. When there is shortage of supply then the manufacturer raises selling price.



4.1.5 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.

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 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: - 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.

The three Categories of Operation

1. **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 - Milling, Turning, Grinding, Assembling and

Welding. - Printing/photocopying a document etc.

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

1. **"Muda"**

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

The result in the disorganized sample work place is summarized below.

No	Activities	Time taken	Category of the operation	Action to be taken to	How
1	Searching for stapler	35 sec	Muda	Eliminate	5S(set-in-order)
2	Searching for stapler	30sec	Muda	Eliminate	5S(set-in-order)
3	Putting the staples into the stapler	8sec	Non -value adding	minimize	Load staple ahead
4	Putting the two papers together	3sec	-		
5	Staple the papers	2sec	-		

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%)

4.2 Adopting ten basic principles of eliminate waste/MUDA

4.2.1 Adopting the Necessary Attitude

First you must adopt an attitude that supports your ability to see waste. Waste is hard enough to find when you want to find it; if you don't want to find it, or if your response to find it is denial or resistance, then it will never be possible for you to root out waste and make your work environment stress free.

It is very important that you understand that one purpose of discovering waste is to take the frustration out of your work.

Many people will resist see the waste in their work. Just don't let it be you. You may hear yourself or others saying things like: "Let's not fix what is not broken." "Can't we live well enough alone?"

"This is just another attempt to make us work harder for the same amount of money." "It looks good on paper, but it will never work on the floor." "We tried that twenty years ago. It didn't work then; it won't work now." "That is not my job." And so on.

You know the lines. You have probably said one or two of them at one time or another. We all have. Resistance is normal. Just don't let it keep you from learning to see the waste in your work. In the end, you are the one who suffers most from the results of waste.

4.2.2 The Ten Basic Principles for Improvement

2. Throw out all of your fixed ideas about how to do things.
3. Think of how the new method will work-not how it will not.
4. Don't accept excuses. Totally deny the status quo.
5. Don't seek perfection. A 50 percent implementation rate is fine as long as it is done on the spot.
6. Correct mistakes the moment they are found.
7. Don't spend a lot of money on improvements.
8. Problems give you a chance to use your brain.
9. Ask "Why?" at least five times until you find the ultimate cause.
10. Ten people "s ideas are better than one person".
5. Improvement knows no limit

4.3 Using Tools based on OHS procedures

4.3.1 Eliminate the seven types of Wastes/Muda

How to Eliminate Overproduction Wastes

In order to balance capacity and load without overproducing, you must implement the advanced methods of lean production:

- ✓ Full work
- ✓ Line balancing Pull production using Kanban
- ✓ Quick-changeover operations.
- ✓ Level production - small-lot, mixed production.

How to Eliminate Inventory Wastes

U-shaped manufacturing cells, layout of equipment by process instead of operation.

- ✓ Production leveling
- ✓ Regulating the flow of production
- ✓ Pull production using Kanban
- ✓ Quick changeover operations

How to Eliminate Motion Wastes

- ✓ Gradually switch to flow production
- ✓ Create U-shaped cell layout of equipment
- ✓ Make standardization through
- ✓ Increase training
- ✓ Increase operator awareness about motion during an operation.

Where as many kinds of movement may be unnecessary, work is the movement you do to add value to the product. Movement that does not add value is waste. Find ways to reduce the amount of movement to do your value added work. Start by looking at the movement of your feet, then your hips, shoulders, arms, hands and fingers.

How to Eliminate Conveyance/Transportation Wastes

Basically, conveyance waste is corrected by redesigning equipment layout to create a flow between operations. Then you will be able to take out much of the complexity in the conveyance system and decrease material handling to a minimum. Some of the lean production methods that address conveyance flow:

- ✓ U-shaped manufacturing cells
- ✓ Flow production
- ✓ Multi skill workers
- ✓ Standing to perform operations
- ✓ Higher utilization rate
- ✓ Water beetles (material handlers in the kanban system of pull production)

How to Eliminate Waiting/Idle Time Wastes

- ✓ Production leveling
- ✓ Product-specific layout
- ✓ Mistake-proofing
- ✓ Human automation
- ✓ Quick changeover
- ✓ Autonomous maintenance
- ✓ Line balancing

How to Eliminate Defect Wastes

- ✓ Standard operations
- ✓ Mistake-proofing devices
- ✓ Full-lot inspection
- ✓ Building quality in at each process
- ✓ Flow production
- ✓ Elimination of the need to pick up and set down work pieces

To reduce defects, their root cause must be found. Inspection that only sorts out the defective parts is not a solution to defective waste; it is actually one of the major defectrelated wastes. Until you initiate back-to-the-source inspection and build quality into every process through standardization, the effects of defects will continue to disrupt the flow of goods and decrease productivity.

How to Eliminate Processing Wastes

- ✓ More appropriate process design
- ✓ Review of operations
- ✓ Promotion of value analysis(VA) and value engineering(VE) techniques
- ✓ Improvement of jigs using automation
- ✓ Thorough standardization

How to Eliminate Defect Wastes

- ✓ Standard operations
- ✓ Mistake-proofing devices
- ✓ Full-lot inspection
- ✓ Building quality in at each process
- ✓ Flow production

4.4 Identifying Tangible and intangible results

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 them 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.

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 members is improved.

The Circle must be able to establish at this point that the project gains also bring them direct personal benefit. Therefore, a very important question that each QC Circle must answer is "What is in it for me?" By answering this question, the members realize that they themselves, in addition to the company, benefit from the project, which induces personal satisfaction as well as a sense of achievement. This sense of achievement is the most important intangible result of QC Circle activities. Take, for example, a case in which a defect rate is reduced by 90 percent. Obviously this is good for the customer, and what is good for the customer is good for the company, but how is it good for the Circle members? A member who is sold on the QC Circle philosophy will say, "It is good for me because now I can be proud of my work, whereas before, I was ashamed of the defective parts that I was making."

1. **Verify results**

The QC Circle verifies the results over time. For instance, has the 90 percent reduction in defects been sustained over a period of two weeks, over a month, over a quarter? Is improved teamwork manifested in all activities at the workplace or only during QC Circle–related activities?

2. **Compare tangible results with goals**

The QC Circle may achieve some results but these must be compared with the goal set in stage 3 step 4. Various types of diagrams can be used, but accurate comparisons cannot be made between diagrams of the different types—that is, the same type must be used consistently.

4.5 Compare various types of diagrams using tangible results

4.5.1 Plan and 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:

- ✓ Make waste visible
- ✓ Be conscious of the waste
- ✓ Be accountable for the waste.
- ✓ Measure the waste.

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

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

Figure showing symbols used in Arrow Diagram

Steps for creating your arrow diagram.

1. **Understand the purpose**-The purpose is to discover major forms of waste. The arrow diagram will help your improvement team "see" the waste.

2. **Select the product to be analyzed-** You can do a product/quantity (PQ) analysis to compare products and quantity. Choose products with a large output and those with many production problems as starting points for your analysis of current conditions using the arrow diagram.

3. Prepare a factory layout diagram- Include the entire factory layout, indicating the position of machines, worktables and other equipment. Store the original in a safe place so that you can make a copy of it each time you want to analyze another product line.

4. Make the arrow diagram- Do this on the factory floor. Use the symbols below to show the different types of activities that occur. The map will make the waste more obvious to you and your team than when you are simply standing on the factory floor observing standard operations. Connect the symbols with lines that show the direction of the flow and the sequence of product through each operation. Create other symbols as you need to. At all conveyance points, note the conveyance distance and type of conveyance. At all retention points, note average work-in- process inventory.

4.6 Reporting gain improvements elimination of waste/MUDA

4.6.1 Some of the benefits of identifying and eliminating waste

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.

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 short-term fixes that no longer solves the problems you face.

There is no question that when production waste is rooted out everyone is happier. The flow of materials creates a hum in the workplace: a rhythm of the flow of materials from supplier to customer emerges as the value-added processes are freed up to operate at the rate of customer demand.

Self-Check -4

Directions:

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

1. What is the benefit of Muda?
2. What is the different between tangible and intangible
3. How visual and auditory controls does maintains a waste free environment?

Operation Sheet-4
Operation title: Ways of effective Waste/Muda identification

Method Using Arrow Diagram

1. Select the product to be analyzed-

2. Prepare a factory layout diagram

3. Make the arrow diagram

LAP Test 4

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

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

- ✓ **Task 1:** In the given operation, identify the three categories of operation, measure their magnitude in terms of time and compare them.
- ✓ **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 five: Preventing occurrence of wastes and sustain operation

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

- Prevention and implementation Plan of MUDA
- Machines operation procedure
- Wastes/MUDA visual and auditory control methods
- Waste-free workplace using 5W and 1H sheet

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Preparing prevention and implementation Plan of MUDA
- Preforming machines operation procedure
- Preventing wastes/MUDA visual and auditory control methods
- Creating waste-free workplace using 5W and 1H sheet

5.1 Preparing prevention and implementation Plan of MUDA

We have discussed how you discover waste and what to do to remove it; but it doesn't end there. Unfortunately, problems always crop up, and 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
- ✓ 5Wand1HSheet

5.1.1 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

5.2 Preparing machines operation procedure

A standard operating procedure is a set of written instructions that describes the step-by-step process that must be taken to properly perform a routine activity.

While you can write your standard operating procedures according to your organizational needs, a conventional SOP follows one of the following methods:

- Checklists.
- Step-by-Step List.
- Hierarchical Lists.
- Process Flowchart.
- Time-saving.
- Ensure the safety of employees.
- Ensures compliance standards are met.
- Improved communication.

5.3 Preventing wastes/MUDA visual and auditory control methods

5.3.1 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 – You probably did this at the beginning of your improvement activities when you implemented 5S. If not, do it now: 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.

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- Boarders 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.

5.4 Creating waste-free workplace using 5W and 1H sheet

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.

What is the problem?	Where does the problem happen?	When does it happen?	Who is responsible?	How does it happen?
Order slips are not filled out correctly	At the tables	During the lunch peak	The waiters	The waiters fill out the order slips while welcoming other guests or acknowledging other guests' requests for assistance
Why is it a problem?	Why does it happen there?	Why does it happen then?	Why is this person responsible?	Why does it happen that way?
The food served is not what the guests ordered.	This is where the order-taking is done.	There are so many guests.	They are the ones taking the orders from the guests.	There are not enough waiters during lunch, so the waiters try to respond to the needs of many customers at the same time

5W1H Approach (II)

What should be done?	**Where should it be done?**	**When should it be done?**	**Who should be responsible?**	**How should it be done?**
Why should it be done? Is there a better way?	Why should it be done there?	Why should it be done then?	Why should this person be responsible?	Why should it be done this way?

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": • 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.

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.

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.

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 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.

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

5.5 Updating practices Standard Operating Procedures (SOPs)

Standard operating procedure is a set of written instructions that describes the step-by-step process that must be taken to properly perform a routine activity.

Fundamental Steps to Creating Powerful Standard Operating Procedures

Step 1 – Develop a list of processes that you believe need SOP creation

Step 2 – Plan the process for developing and managing SOPs.

Step 3 – Collect information for the content of your SOP.

Step 4 – Write, review and publish your SOP.

Step 5- Maintaining your SOP over time

Self-check 5

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

1. What are the four methods for maintaining a waste free production environment?
2. How standardization does maintains a waste free environment?
3. How 5W and 1H sheet does maintains a waste free environment?
4. Write at least two methods how to eliminate each of the seven deadly wastes.

Operation Sheet 2

Planning and procedures for elimination of Muda.

1. The documents of the already identified wastes in several processes or work areas are analyzed.

2. Rank the improvements that are needed. Focus on improvements on the process with the greatest total when you add up the magnitude of its wastes.

3. 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.

4. Set target

What? Decrease/Eliminate the amount of the waste specified.

When? By the End of ----

How many? Minimize the problem from –to –

5. Prepare Activity Plan
6. Examine causes of the waste.
7. Brainstorm improvement ideas.
8. Implement the countermeasure.

	Why?	What?	Where?	Who?	When?	How?
	Objectives	Items to be implemented	Location	Person(s) charge	Time/Duration	Method
P						
D						
C						

Lap test 5

Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hour.

Task 1: Choose the first process to be improved, set target and prepare action plan.

Task 2: Set countermeasure to eliminate/reduce the wastes, implement them and check the result.

Task 3: Prepare a report by using the Appropriate Format.

Reference

- ✓ *Gemba Kaizen 2nd Edition*

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