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# Understanding manufacturing industries and manufacturing sites

Soft Skill Text for  
Japan-India Institute for Manufacturing

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# Features of Japanese manufacturing

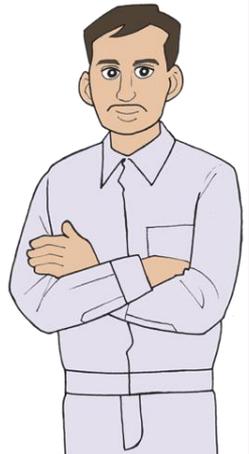
## **Text No. 3-1-1**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Features of Japanese manufacturing

## Contents

- ✓ **What are the features of Japanese Monodzukuri?**
- ✓ **Accumulation of various technologies**
- ✓ **Genba-principle (actual-site-principle) to emphasise sites of production**
- ✓ **Multi-skilled operators that can handle various types of work**
- ✓ **Emphasis on team work**
- ✓ **Commitment to manufacturing better products**



# What are the features of Japanese Monodzukuri?



Japanese Monodzukuri, which is a Japanese word meaning manufacturing, has various features. The word “Monodzukuri” is often used instead of “manufacturing” to distinguish it from ordinary manufacturing, because Japanese Monodzukuri is unique and different. The five typical characteristics of Japanese Monodzukuri are introduced here.

- 1. Accumulation of various technologies**
- 2. Genba-principle to emphasise the actual site of manufacturing**
- 3. Respect for multi-skilled operators for various operations**
- 4. Focus on team work rather than a single operator’s performance**
- 5. Sharing commitment by all to make better products**

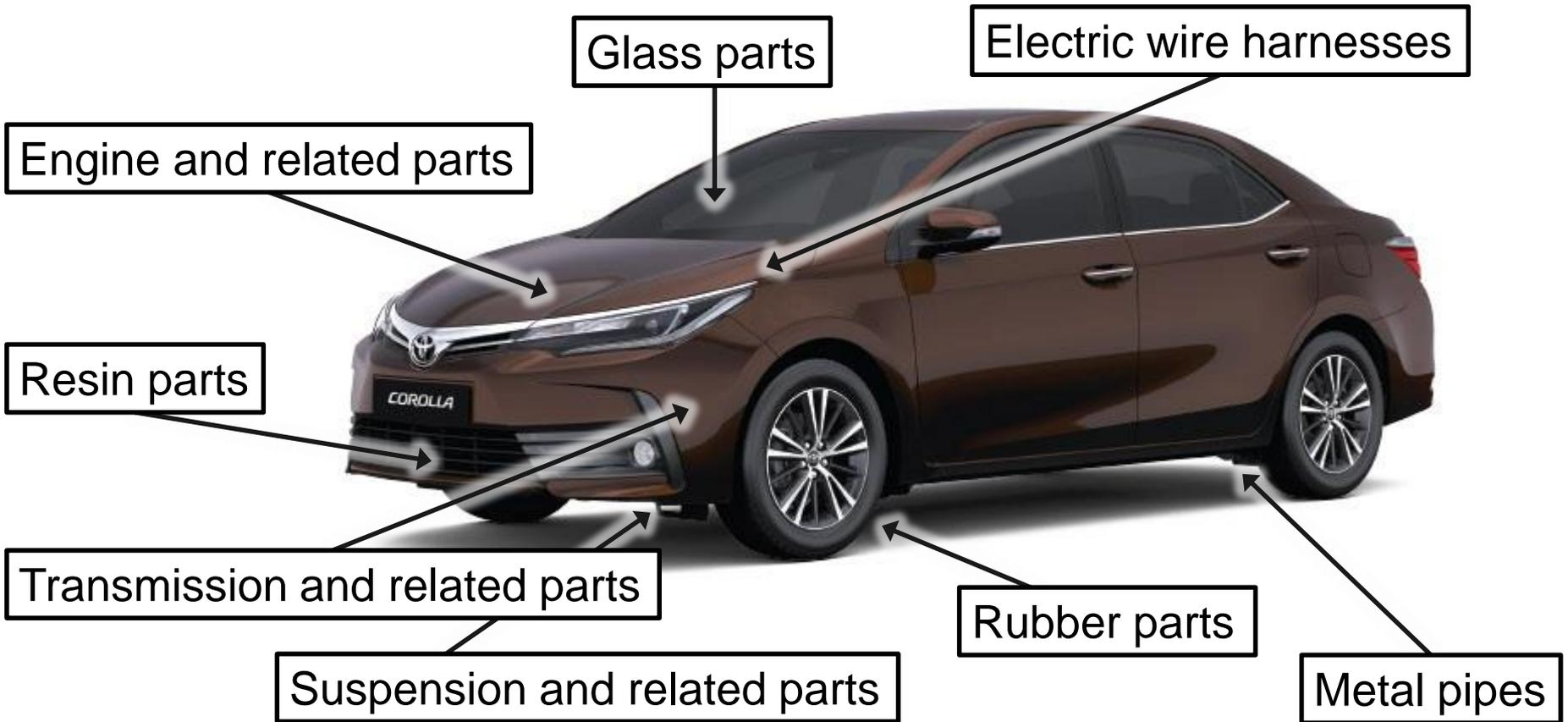
# Accumulation of various technologies-1



Japan is rich in technology resources and has skills needed in various fields. So, it is possible to procure anything, from materials to finished products, in Japan.

For example, an automobile consists of a lot of parts and materials such as plastics, electronics, metals, precision processed parts and chemicals. Japanese industries have good technical capability to deal with all of these demands.

# Accumulation of various technologies-2



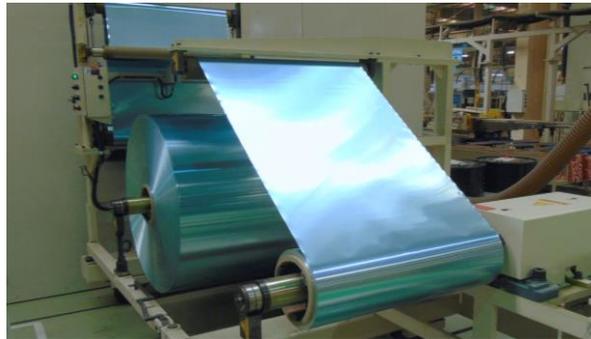
# Accumulation of various technologies-3

## Japanese factories



# Accumulation of various technologies-4

Various materials, parts, intermediate products



# Genba-principle emphasise sites of production-1

-  Traditional Japanese way of Monodzukuri is based on the idea of problem-solving at the actual site, on the actual part and in the actual situation.
-  When a problem occurs at the workplace, the people concerned get together and make their best efforts to solve it by finding the root cause by paying careful attention and giving their thorough consideration to the problem.
-  There are certain differences between Japan and other countries in the manufacturing method and its philosophy.

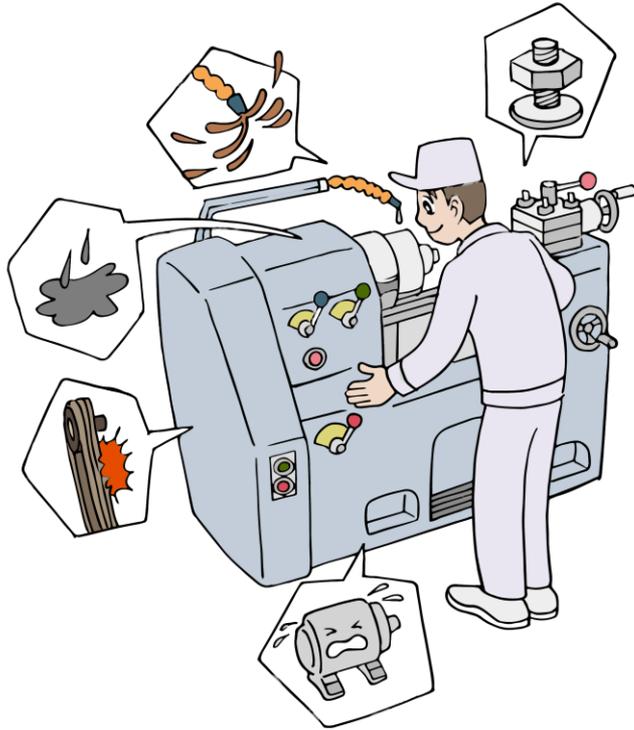
# Genba-principle emphasise sites of production-2



Genba is a Japanese word and means “the actual site.”  
Genba-principle is based on the following ideas.

-  It is in Genba that the production takes place and the actual values are added.
-  Operators are always observing Genba carefully and are ready to find solutions immediately, whenever a problem occurs.

# Genba-principle emphasise sites of production-3



A problem occurs unexpectedly at a site

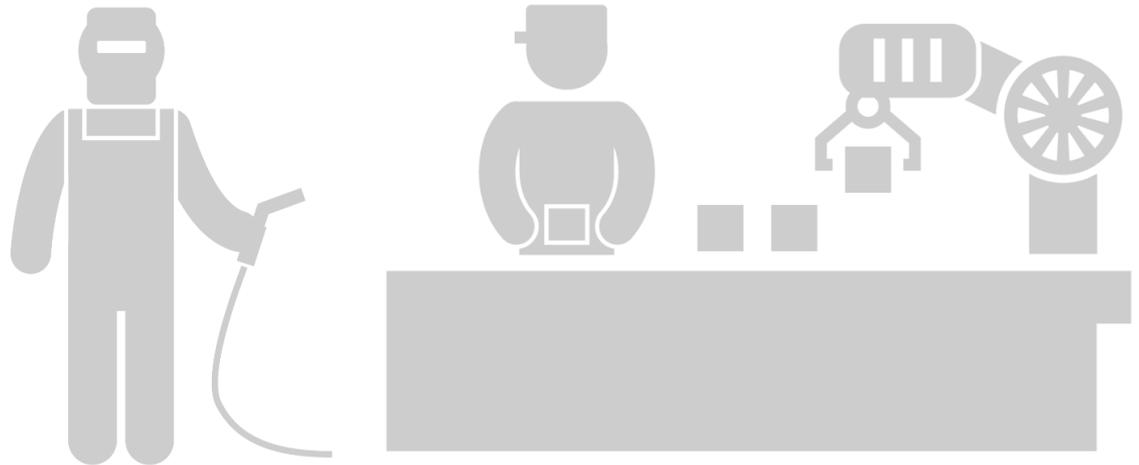


Workers at the site thoroughly consider the problem and cope with it by themselves

# Multi-skilled operators handle various types of work-1

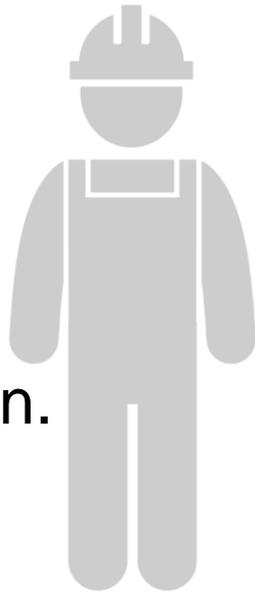


It's good for an operator to have multiple skills to improve for his abilities. It's also good for a company to have multi-skilled workers for flexible operation and high work efficiency. Multi-skilled operators can be seen today not only in small companies but also in large ones.



# Multi-skilled operators handle various types of work-2

- ➡ Production sites require a person to manage diversified types of jobs and being a multi-skilled operator is highly evaluated.
- ➡ Developing multi-skilled operators makes a great contribution to higher productivity.
- ➡ Multi-skilled operators are likely to think creatively and flexibly with a higher commitment to the operation.



# Multi-skilled operators handle various types of work-3

**U-shape  
line layout**



# Multi-skilled operators handle various types of work-4

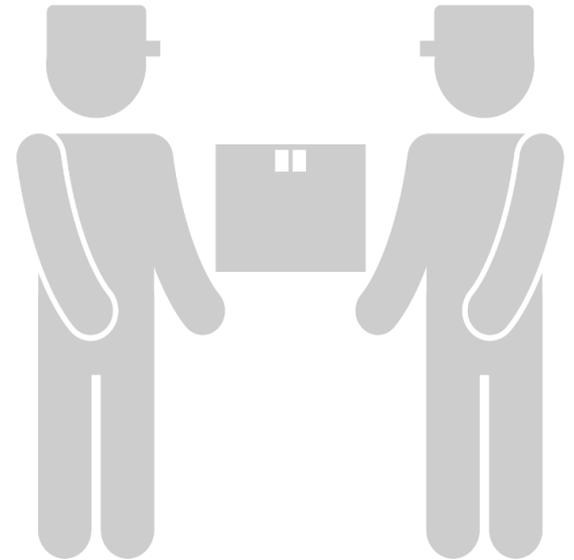


**Cell-based  
layout**

# Emphasis on team work-1



Japanese companies emphasise job execution by a team. For those who lead a team, strong leadership is required. The sense of togetherness and belonging in a team is usually very strong. Thus, working on a task together generates collective power leading to the competitiveness of Japanese companies.



# Emphasis on team work-2



At a production site, working together as a team is essential. Doing small group activities such as quality control circles, which are called QC circles, is encouraged in Japan.

“KAIZEN” is originally a Japanese word meaning improvement but nowadays it is commonly used as an English word. KAIZEN is also conducted as a small group activity.



# Emphasis on team work-3



Good products come from good teams.

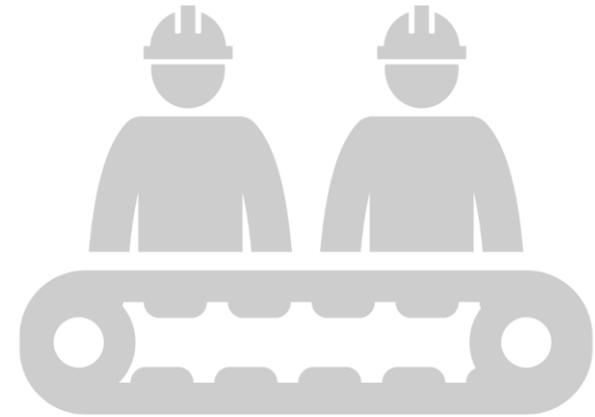


Problem solving  
conducted by a team

# Emphasis on team work-4



Good products come from good teams.



Problem solving  
conducted by a team

# Commitment to manufacturing better products-1



Japan has the tradition of having strong commitment to Monodzukuri. The spirit of Monodzukuri comes from traditional craftsmanship, which encourages the person to improve his skills as much as possible. In Monodzukuri, people are always expected to devote themselves to new challenges.



# Commitment to manufacturing better products-2



The spirit of traditional Japanese craftsmanship is alive in a passionate and uncompromising attitude in current Monodzukuri, where the dedication to better products is strongly encouraged. This long-standing tradition helps cultivate a sense of togetherness as a team, promoting a cooperative atmosphere and motivating the team to have a spirit that eagerly takes on challenges.



# Commitment to manufacturing better products-3



# PQCD and 4M

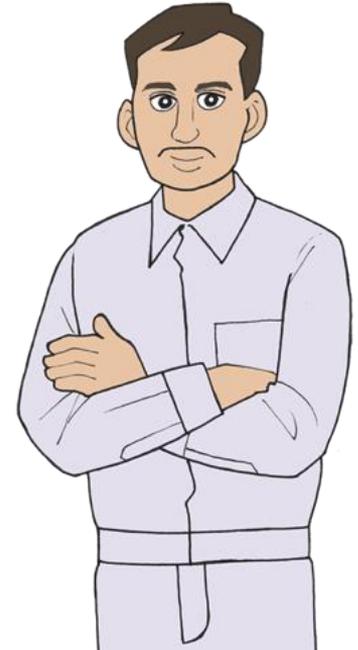
## **Text No. 3-1-2**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# PQCD and 4M

## Contents

- ✓ **What is PQCD?**
- ✓ **Position of suppliers and/or purchasers regarding QCD.**
- ✓ **What is 4M?**
- ✓ **KAIZEN of 4M to improve QCD**



# What is PQCD? -1



QCD is the most important indicator to evaluate products and thereby suppliers and to see whether they are good or bad.

Q: Quality

C: Cost

D: Delivery



P: Products



Customers

Manufacturers should continue KAIZEN to improve QCD all the time.

# What is PQCD? -2

**P: Product**  
Motorcycle



	What kind of indicator?	Evaluation
Q	Fuel consumption Engine power Design Durability Function	Good Poor Excellent Good Average
C	Initial cost Operating cost Maintenance cost	High Average Low
D	Lead time	Long

# Supplier's or purchaser's position regarding QCD-1



The contents required for QCD differ depending upon the position and whether it's a supplier or purchaser.

## Supplier's responsibility

Q: Quality

To provide products and services with good quality

C: Cost

To lower production cost to offer satisfactory price

D: Delivery

To adjust lead time and meet delivery date



## Customer's demand

Want to buy...

- Good products and services
- With reasonable price
- At a time when they want to have

# Supplier's or purchaser's position regarding QCD-2

## Purchaser

Purchasers want to buy a product and/or a service with good quality, at a reasonable price, at the time when they want to have it. If a product and/or service turns out to be inferior to others in Q, C and D, customers will not buy it again.

## Supplier

Q, C and D are critical factors to determine whether a product and/or a service is good or bad. Among them, Q is the most fundamental condition. Suppliers need to provide their products and/or services with good quality (Q), at a low cost (C), on a required delivery date (D) to the customers.

# What is 4M? -1



The meaning of 4M is as follows:

4M is called the 'four elements of manufacturing.'



**Man**

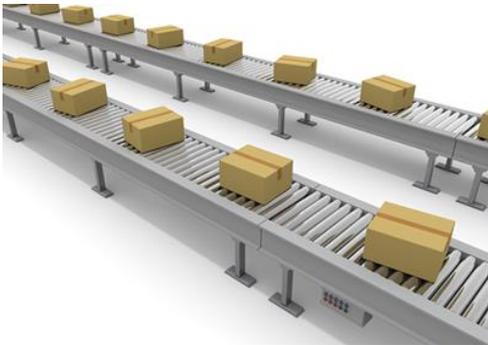
**Material**



**4M**

**Machine**

**Method**



# What is 4M? -2

-  We produce our products by using humans (M1: Man), machinery (M2: Machine) and materials (M3: Material) with various methods of production (M4: Method) in a factory.
-  Manufacturing of products with excellent QCD requires all of these M elements as very critical factors.
-  Manufacturing at a factory needs the continuous quest for QCD with attention to productivity and safety while combining these 4M elements efficiently.

# What is 4M? -3



Maintaining safety & zero defects while improving productivity

## **M1: Man**

- Operators
- Foreman/Leader
- Technical staff
- Supervisor

 Safe and efficient actions!

## **M2: Machine**

- Machinery
- Jigs and tools
- Transport equipment
- Maintenance tools
- Utilities

 Pursue zero breakdowns and trouble!

## **M3: Material**

- Raw materials
- Purchased parts
- Subcontract parts
- Auxiliary materials

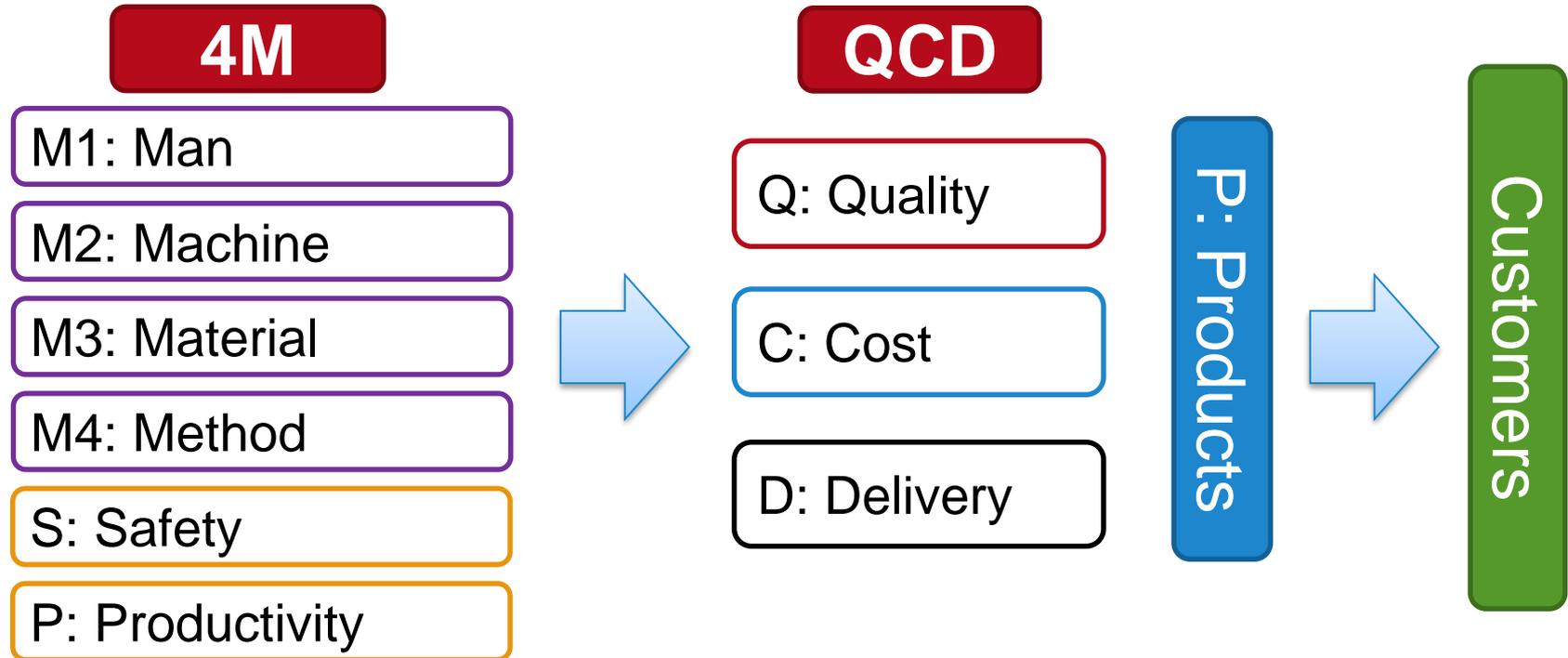
 Never allow defectives to mix.

- M4: Method**
- Try various 'production methods' for products.
  - Be creative in the combination of M1/M2/M3 for better productivity.

# KAIZEN of 4M to improve QCD-1



A satisfactory combination of 4M is essential to make good products and satisfy the customers with QCD.



# KAIZEN of 4M to improve QCD-2

## 4M

### What is the KAIZEN Point?

M1

- Which of M1, M2, M3, or M4 should be improved?  
And how to improve?

M2

M3

- Which kind of KAIZEN should be carried out?

M4



## QCD

### Bad Conditions

Q

- Many defective items
- Many engine troubles
- Many scratches on the surface

C

- Material yield is bad
- Parts' cost is high

D

- Supply lead time too long

## Products



# Basic quality control

## **Text No. 3-1-3**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Basic quality control

## Contents

- ✓ **What is quality?**
- ✓ **What is quality control?**
- ✓ **Quality control in the manufacturing process**
- ✓ **Quality control by PDCA**
- ✓ **Tools necessary for quality control**
- ✓ **How to improve and maintain quality**



# What is quality? -1

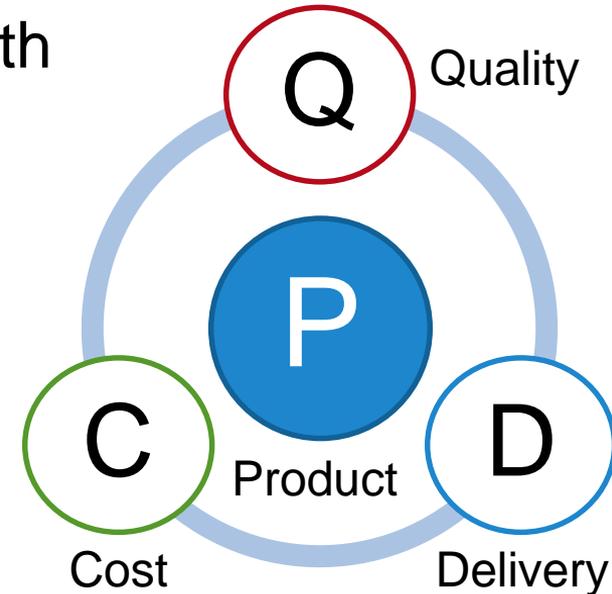


Products must be offered to customers with excellence in QCD that includes quality.



What is quality?

The attribute of quality includes many aspects such as performance, design, function, durability, reliability, usability, safety features, appearance, etc, by which the value of products or services is to be evaluated.



**A good quality product or service means that it has a proper function for use and is in a condition that can be used. This can then give satisfaction to customers.**

(Note) See Text No.3-1-2 for details.

# What is quality? -2



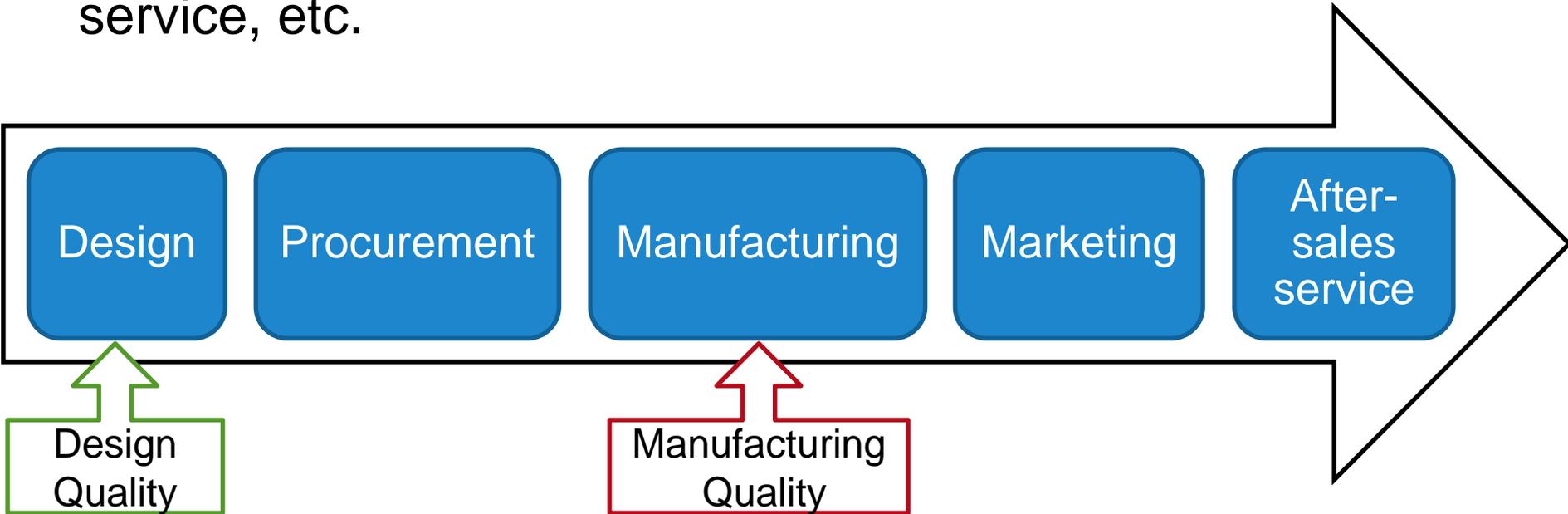
'Quality' can be different depending upon the viewpoints of persons who may be engineers, manufacturers, users and so on. The most important quality for customers is product quality.

Required quality	Quality that consumers expect to have
Design quality	Quality that is specified in design and engineering
Manufacturing quality	Quality that is assured in manufacturing processes
Quality in use	Quality that is kept in customer's use

# What is quality control?



Quality control is a system to make products with required quality which covers product design, procurement of parts and materials, manufacturing processes, marketing, after-sales service, etc.



# Quality control in the manufacturing process



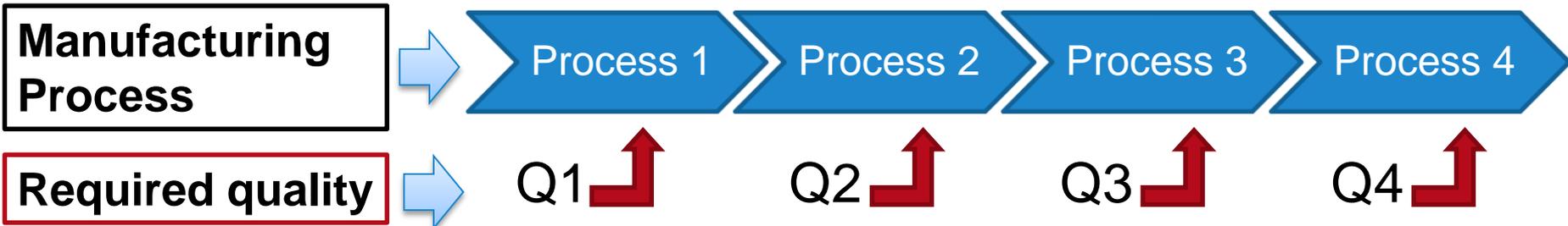
Try to keep the following points to improve and maintain quality in manufacturing processes.

To make “good/bad” quality visible in each process

To make no defects

To maintain product quality within the targets  
(Prevent product quality from varying)

To complete the required quality in each process



# Quality control by PDCA



PDCA cycle should be followed in the quality control process.

Set policy and goal of quality improvement and make an execution plan for KAIZEN solution.

**P**

**Plan**

Implement the plan and take data of quality achieved.

**D**

**Do**

**PDCA  
cycle**

**Action**

**A**

Take necessary measures to fix the problem and improve quality. The result should be reflected in the “P” stage of the next cycle.

**C**

**Check**

Examine data carefully. Find the root cause of a problem. Use QC 7-tools in the process. Refer to the quality standard and specification.

# Tools necessary for quality control-1

Tool for analysis	Description
QC 7-tools (See Text No.3-3-7 for details.)	A set of tools for visualisation of quality achievement data for problem solving
QC story and 5-why	Effective methods for identifying a proper sequence for quality improvement as well as causal analysis of a problem
QC Process Flow Chart	Chart of quality check point in each process
Quality control chart	Every product cannot be free from dispersion. This chart makes the level of dispersion of each item of data visible with upper and lower limit.
Process capability index	A statistical value to indicate chance of defects

# Tools necessary for quality control-2

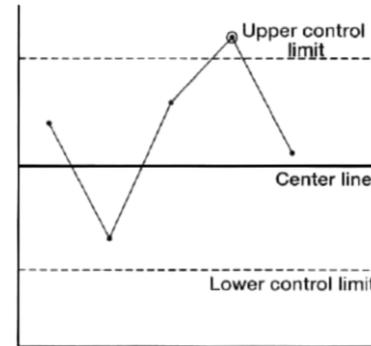
## Seven tools for quality control

(See Text No.3-3-7 for details.)

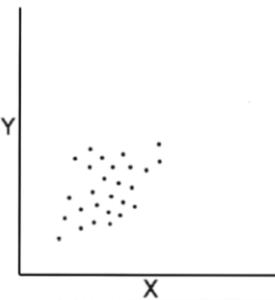
Check sheet

	A	B	C	D	E
1	//	//	##		
2		##	//		
3			##	//	
4	//	/	//		
5	/		/		
6	//	//		//	
7	/		##		

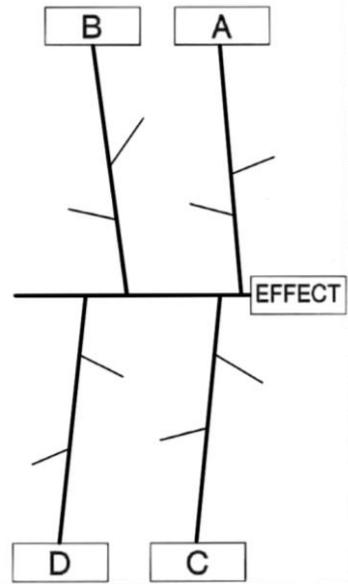
control chart



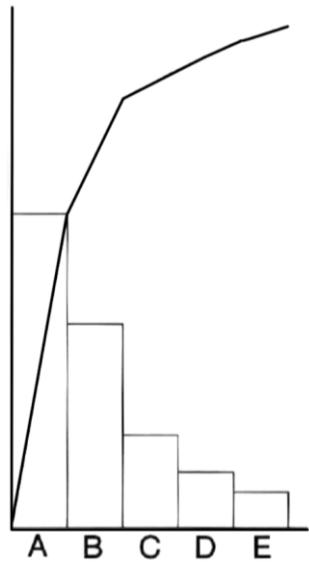
Scatter diagram



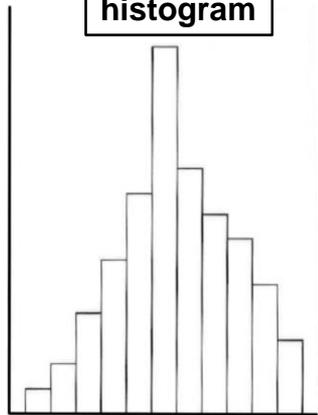
Cause-and effect diagram



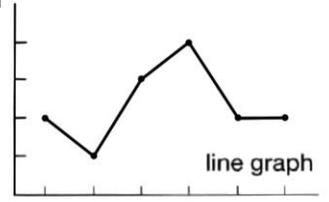
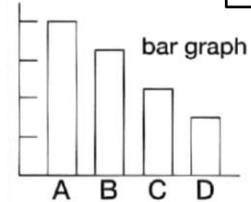
Pareto diagram



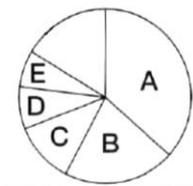
histogram



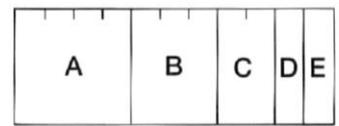
graph



circle graph



belt graph

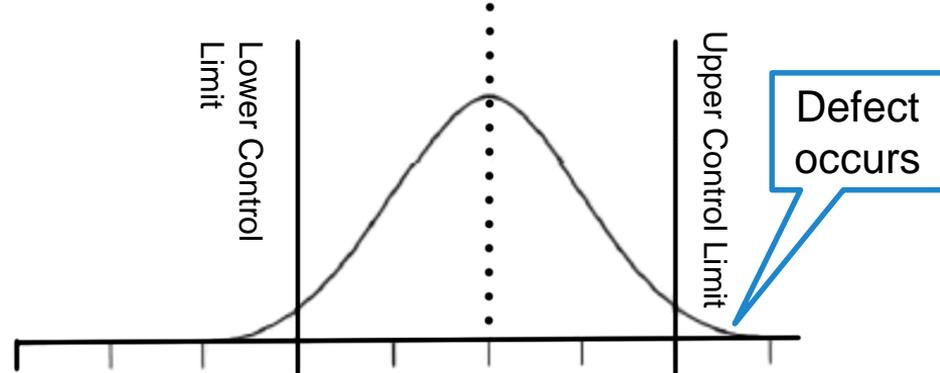
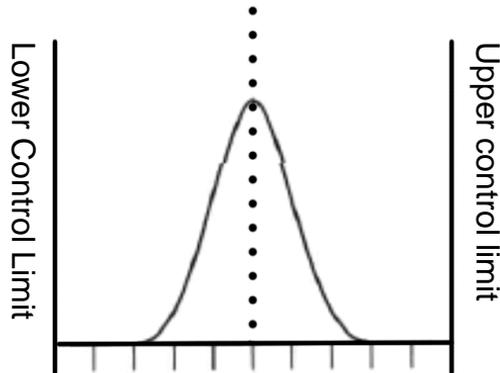


# Tools necessary for quality control-3

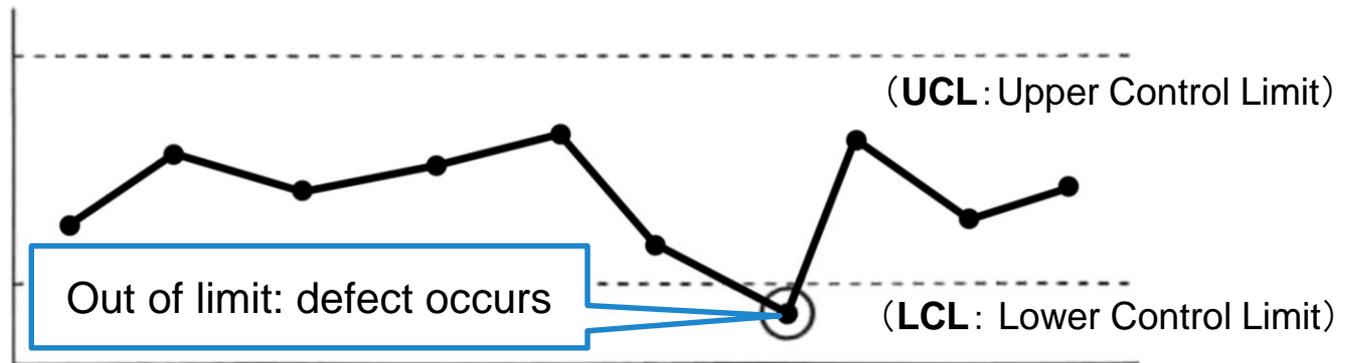
Process capability is high.  
(Less likely to get defects with smaller dispersion)

Process capability is low.  
(More likely to get defects with larger dispersion)

**Process  
capability  
index**



**Quality  
control  
chart**



# How to improve and maintain quality-1

The most critical thing in quality control at the work site is not to allow any defects to occur. Let's comprehend types of Muda\* created by defects.

\* "Muda" means a waste of resources such as time, materials, labour resources, etc.

Muda generated by the defect itself: Everything including material, labour and all other expenses used for that product becomes a waste item
--

Muda of reworking and correction
----------------------------------

Muda by temporary stopping of work and discontinued production
--

Muda to sort out defectives
-----------------------------

Fatal Muda to lose trust by delivering defectives to customers due to poor inspection
---

# How to improve and maintain quality-2

## Five actions not to make any defects

- 1 Observe a standardised work procedure.
- 2 Stop production line whenever a problem is found.  
(Otherwise the defective part will travel to the next process.)
- 3 Look for a cause on the spot.  
(Pursue the root cause by 5-Why.)
- 4 Set and implement counter measures.  
(If necessary, change the standardised work as well.)
- 5 Never send the defective part to the next process.

# How to improve and maintain quality-3

(e.g.) **QC circle activity to reduce the defect rate**

**Implement KAIZEN  
by teamwork**

**Make improvement  
plan**

**Find problems and  
defects**

**Make analysis using  
QC tools**



# Cost and productivity for manufacturing

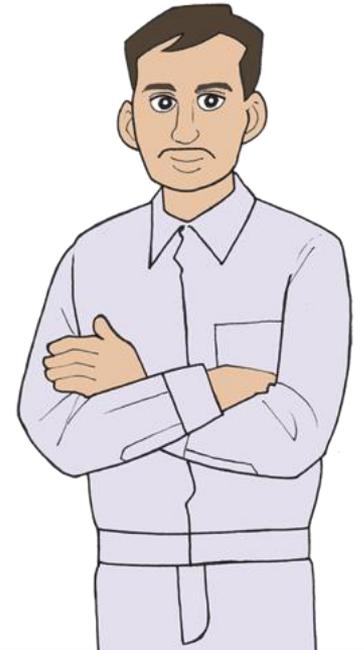
## **Text No. 3-1-4**

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# Cost and productivity for manufacturing

## Contents

- ✓ **Cost in corporate activities**
- ✓ **Cost and profit for a corporation**
- ✓ **Breakdown of corporate cost**
- ✓ **Breakdown of manufacturing cost**
- ✓ **Direction to lower manufacturing cost**
- ✓ **Productivity**



# Cost in corporate activities-1

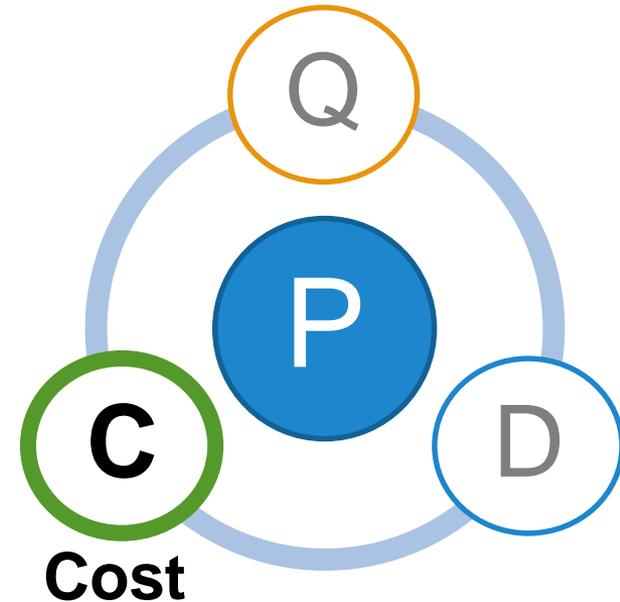


A company consumes various materials and labour in order to produce and sell its products. Any money spent for all these activities is regarded as cost.

Cost is one of QCD of a product.

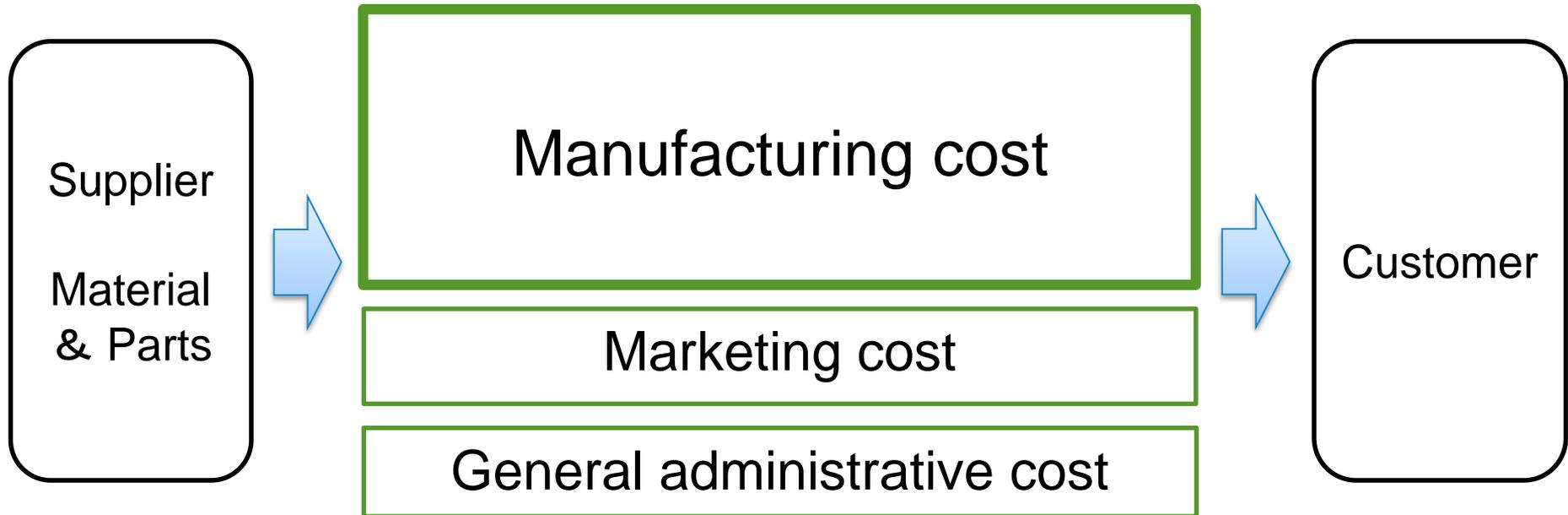
More specifically, what kind of costs are there and how should they be reduced?

Lowering cost by KAIZEN activity is an important task in any production site.



# Cost in corporate activities-2

Costs generated in corporate activities are divided into three categories as shown below. Among them, the largest one is manufacturing cost.



# Cost and profit for a corporation-1



Profit of a corporation should be determined by:

$$\text{Profit} = \text{Sales} - \text{Cost}$$

Incoming money                      Outgoing money

A task required for a corporate activity is to achieve the following.

Increase sales and reduce costs.

Indicator to measure  
production efficiency

$$\text{Productivity} = \frac{\text{Produced result}}{\text{Resources input}}$$

# Cost and profit for a corporation-2

Manufacturing cost should be determined by market-in thinking.

$$\text{Profit} = \text{Price} - \text{Cost}$$

To determine manufacturing cost based on sales price set by the market.

## Market-In

Priority is put on those who buy



Cost reduction should be carried out continuously by thorough Muda elimination.

$$\text{Price} = \text{Cost} + \text{Profit}$$

To determine sales price based on manufacturing cost.

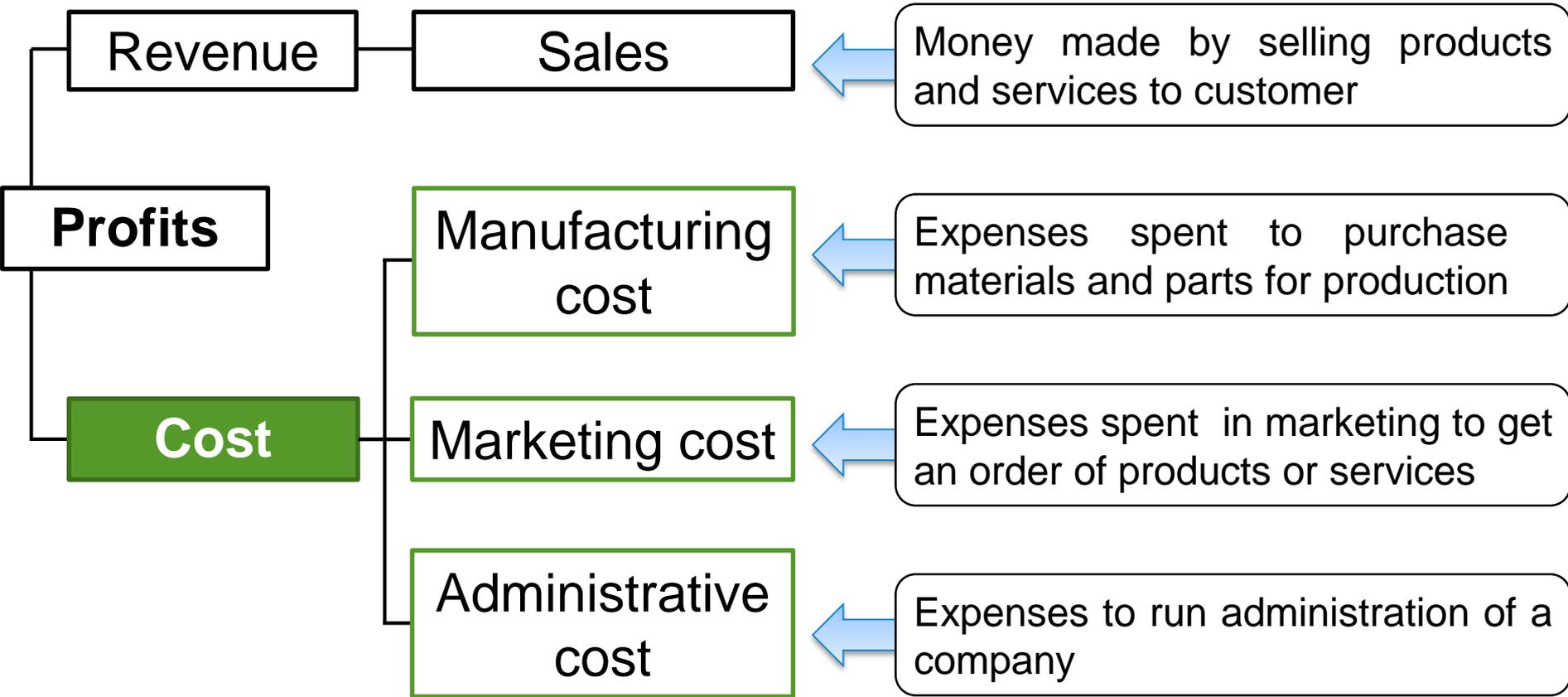
## Product-Out

Priority is put on those who sell



With priority on sales expansion, measures to reduce cost become inactive.

# Breakdown of corporate cost

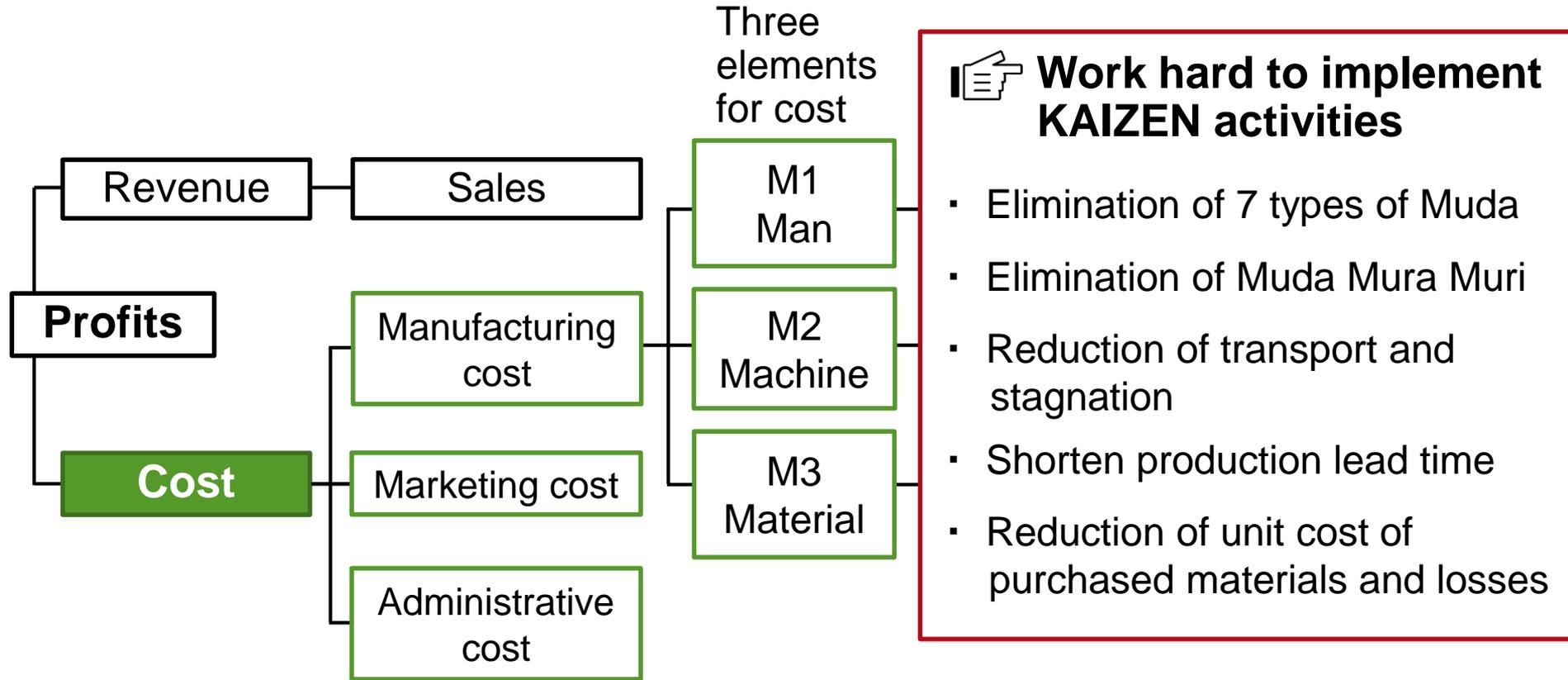


# Breakdown of manufacturing cost

Manufacturing cost accounts for the largest portion in the total cost of a company. It can be divided into M1, M2 and M3.

Sales	Profit	Higher productivity as well as lower cost of M1, M2 and M3 should be sought by removing various types of Muda by KAIZEN.	
	Administrative cost		
	Marketing cost		
	<b>Manufacturing cost</b>	<b>M1 Personnel expenses</b>	Personnel cost of designing and manufacturing
		<b>M2 Machine</b>	Machinery running cost, repair cost and other expenses
		<b>M3 Materials</b>	Materials, parts purchased, auxiliary material, consumables

# Direction to lower manufacturing cost

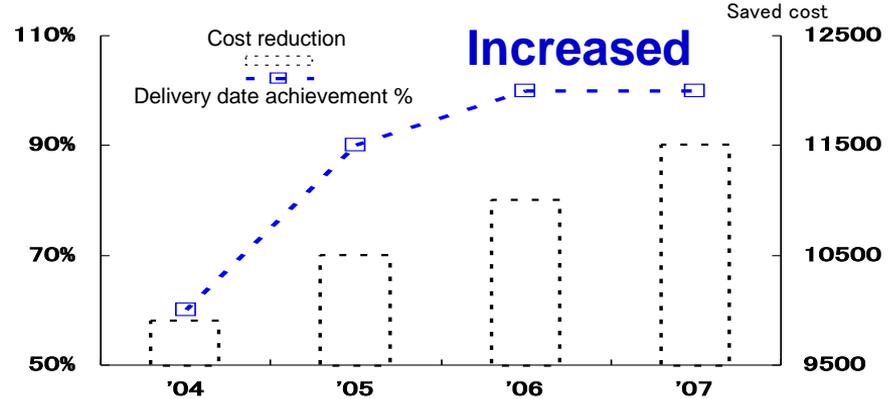


# Productivity-1

\*Productivity is an indicator to show **'Result'** obtained by **'Input'**

Produced  
result

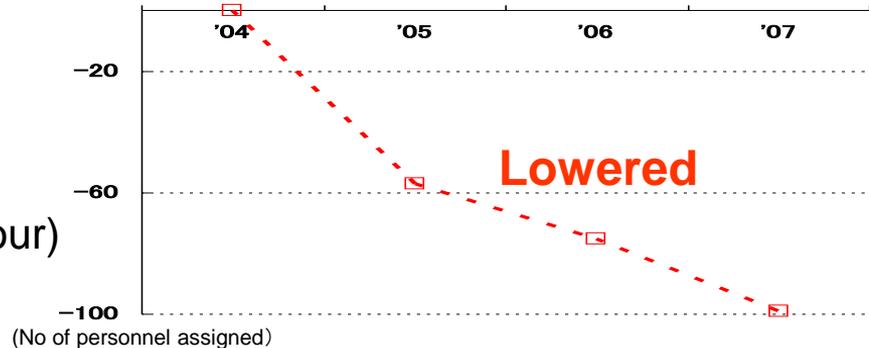
- Sales turnover
- Added value
- Profit
- Customer satisfaction
- Quality



**Productivity =**

Resources  
input

- Man
- Machine
- Material
- Time (man-hour)



# Productivity-2

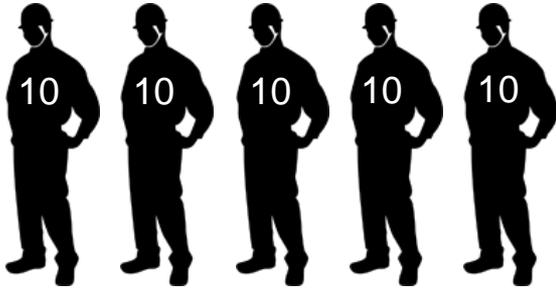
## Examples of productivity index

1 Resources input	2 Produced result	Formula	Productivity Index
Number of people	Product quantities	$2 \div 1$	Product quantities per employee
Material cost	Product quantities	$1 \div 2$	Material cost per one product
Manufacturing cost	Product quantities	$1 \div 2$	Manufacturing cost per one product
Time (Hours)	Product quantities	$2 \div 1$	Product quantities per hour for manufacturing

# Productivity-3

**Q** Which productivity is better?

Case 1



Product quantities 50 sets

Productivity = 50 sets ÷ 5 persons  
= 10 sets / one person

Case 2



Product quantities 60 sets

Productivity = 60 sets ÷ 5 persons  
= 12 sets / one person

# Basis of preventive maintenance

## **Text No. 3-1-5**

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# Basis of preventive maintenance

## Contents

- ✓ **What is machinery maintenance?**
- ✓ **Outline of machinery maintenance**
- ✓ **Major activities of preventive maintenance**
- ✓ **Seven major losses by machinery**



# What is machinery maintenance? -1



Production activities need 4M; among these “machine” has a critical role. There are many machines at a production site, but once trouble occurs with any of the machines, productivity and product quality can be affected very seriously.

The machine may not be able to operate at a time when it's needed to!

It may stop suddenly during operation!



**Machinery maintenance means keeping and improving performance of machinery to avoid such troubles.**

# What is machinery maintenance? -2

## Purpose of Machinery Maintenance



Activities to maintain and improve performance of machinery



Work consisting of check-up, inspection, adjustment, maintenance and repair of machinery

1

**Prevention**  
of deterioration

Daily care including lubrication to prevent deterioration

2

**Measurement**  
of deterioration

Measure machinery performance and judge the degree of deterioration

3

**Recovery**  
from deterioration

Restore machinery performance by replacing parts and so on

# What is machinery maintenance? -3

## Machinery without maintenance



## Machinery with maintenance



Keeping and improving performance of machinery

Check-up, inspection, adjustment, maintenance and repair of machinery

# Outline of machinery maintenance



Machinery maintenance is divided into 4 major approaches based on the characteristics of the machinery, namely:

<b>Breakdown maintenance</b>	To repair after a breakdown has occurred
<b>Preventive maintenance</b>	To repair before a breakdown happens by predicting it in advance. This approach is most commonly used
<b>Corrective maintenance</b>	To improve performance of machinery so that breakdown is unlikely to occur
<b>Maintenance prevention</b>	To design machinery with the aim of minimising maintenance cost

# Major activities of preventive maintenance-1



Preventive maintenance needs daily check-ups and scheduled inspections. What specifically should be done?

Cleaning of machinery	Prioritised work among various daily check-ups	Daily
Daily check-up	Detect abnormalities like strange noises and vibration in advance by daily checking	Daily
Lubrication	Basic work to prevent machine deterioration	Scheduled
Tightening	Many cases of noise and vibration can be fixed by further tightening of bolts and nuts	Scheduled
Replacement of worn parts	Define expendables to be changed by each piece of equipment	Scheduled
Overhaul	Solution for inner wear and deterioration that are hard to see from outside	Scheduled

# Major activities of preventive maintenance-2

## Preventive maintenance activities

- Cleaning of machinery
- Daily check-up
- Lubrication
- Tightening



# Seven major losses by machinery-1

From the viewpoint of operating time, losses caused by machinery can be divided into three types (A-C). From the viewpoint of work, they can be divided into seven types (1-7).

Load time of machinery	
Operating time	
A: Loss caused by stopping	
Net operating time	
B: Loss caused by performance	
Value-adding operating time	C: Loss caused by defect

# Seven major losses by machinery-2

Description of 3 types of losses (A-C) and 7 types of losses (1-7)

A: Loss caused by stop	1. Loss by breakdown	Stopping time by breakdown
	2. Loss by changeover and adjustment	Changeover time of moulds and jigs
	3. Loss by cutting tool change	Changing time of cutters for machinery
	4. Start-up loss	Time spent without expected performance right after start

# Seven major losses by machinery-3

Description of 3 types of losses (A-C) and 7 types of losses (1-7)

B: Loss caused by performance	5. Loss by idle run or temporary stop	Time during idle running or loss by temporary stop
	6. Loss by lower speed	Loss by slower speed than original capability
C: Loss caused by defect	7. Loss by defect and rework	Loss by defect and rework

# Basis of a production system

## **Text No. 3-1-6**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Basis of a production system

## Contents

- ✓ **What is a production system?**
- ✓ **TPS: Toyota Production System**
- ✓ **TPS: How it works**
- ✓ **JIT and Kanban system**
- ✓ **Jidoka (Autonomation)**



# What is a production system? -1



There are many kinds of production systems being applied to manufacturing for each product. According to the conditions described below, from 1 to 3, various systems can be used. Actual production systems are made considering these three conditions carefully.

1. Order requirement and delivery date
2. Product type and features
3. Facility features

# What is a production system? -2

1. Order requirement and delivery date	Lead time for delivery long/short; Special or standard product; Price high/low
2. Product type and features	Product type difference; Size large/ small; Production volume
3. Facility features	Facility size large/small; Specialised or general purpose machinery

# What is a production system? -3

Production systems can be categorised as shown below:

Basic condition	Production by type		Major application
1. Order requirement and delivery date	Forecast production	Continuous production; Assembly line	Standardised parts for series production; Consumer goods
	Production by order		Specialised machinery; Special order products

# What is a production system? -4

Production systems can be categorised as shown below:

Basic condition	Production by type		Major application
2. Product type and features	High-mix small lot	Single piece production	High price products for small production
	Middle-mix middle lot	Production by lot	Intermediate between single piece and continuous production
	Small variety large lot	Continuous production	Lower price products for mass production

# What is a production system? -5

Production systems can be categorised as shown below:

Basic condition	Production by type	Major application
3. Facility features	Arranged by product Assembly line	Seen in many forecast products including automobiles
	Arranged by function	Dies and moulds for machining
	Fixed by product	Aircraft; Shipbuilding

# What is a production system? -6



# TPS: Toyota Production System

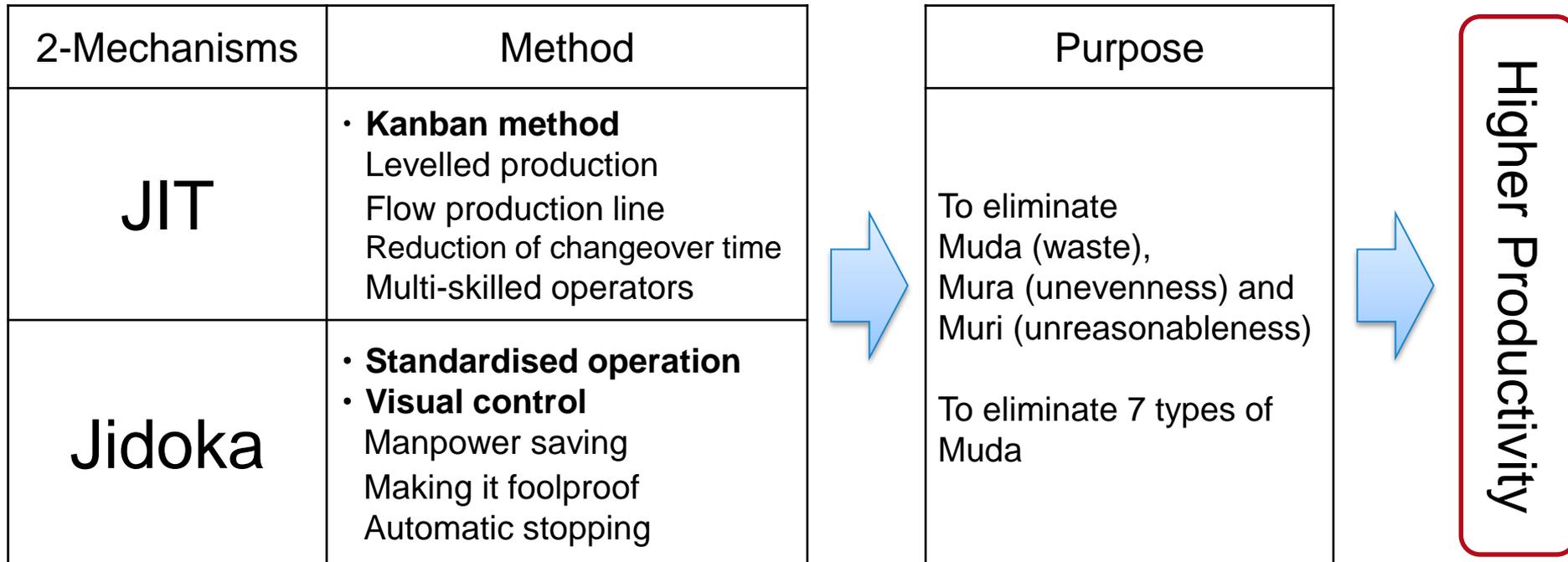
This section is devoted to the Toyota Production System (TPS).

## Basic concept of TPS

Key word	Description
<b>Timely</b>	To provide customers with better quality, and lower priced products in a timely manner
<b>Muda</b>	To pursue thorough elimination of all kinds of Muda
<b>Visualisation</b>	A production system with mechanisms to visualise Muda when it occurs

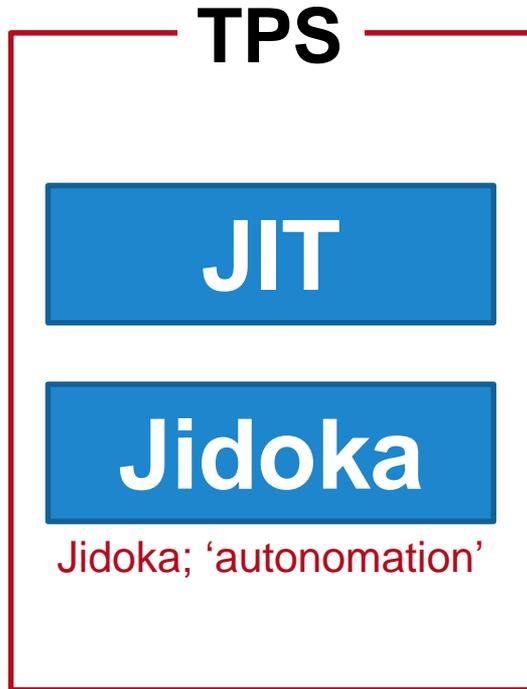
# TPS: How it works-1

TPS consists of two mechanisms, that is the **JIT (just-in-time)** method and **Jidoka** (Autonomation; automation with a human touch).

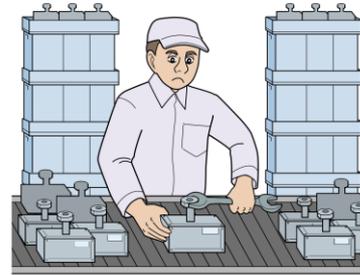


# TPS: How it works-2

## Purpose and target of TPS



Muda of over production



Muda of inventory



Muda of transportation



# JIT and Kanban system-1

## 1 Production by JIT at-a-glance

Is there any good production method that meets customers' needs without Muda?

- Produce just the amount to sell
- Eliminate Muri, Mura and Muda
- Eliminate Muda by over production, inventory and transportation



To realise production by JIT (Just In Time)

The underlying idea: Making 'what is needed, when it is needed and in the amount that is needed.'



# JIT and Kanban system-2



What should we do to realize JIT production?

- Use the next-process-withdrawal method
- Define production time per unit product (tact time) according to the volume of sales
- Rearrange production processes so that products can flow in order



What tools and methods should be used to make it work?

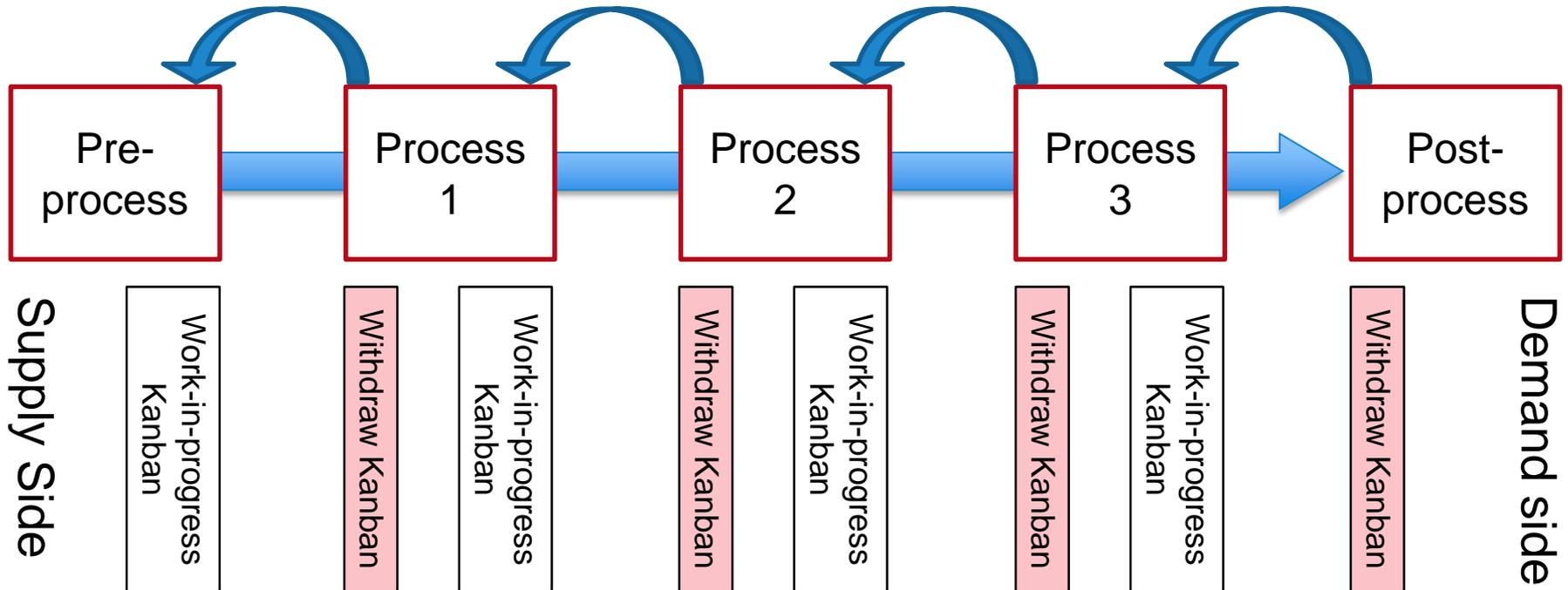
- Use KANBAN for transfer of information
- Make production levelled (Not intermittent)
- Production by standardised operation
- Shorten production lead time

All these and others should be practiced.

# JIT and Kanban system-3

## 2 How KANBAN works

Production order information to pre-process by Kanban withdrawal



# JIT and Kanban system-4

What “Pull system” means:

Withdrawing the amount that was just used at (on the demand side; in conjunction with that),

Process 3 produces exact amount as used by post-process.

Process 2 produces exact amount as process 3 used.

Process 1 produces exact amount as process 2 used.

This means that the production amount corresponds to the required amount from the demand side, while such a required amount can be transferred to previous processes by being withdrawn.

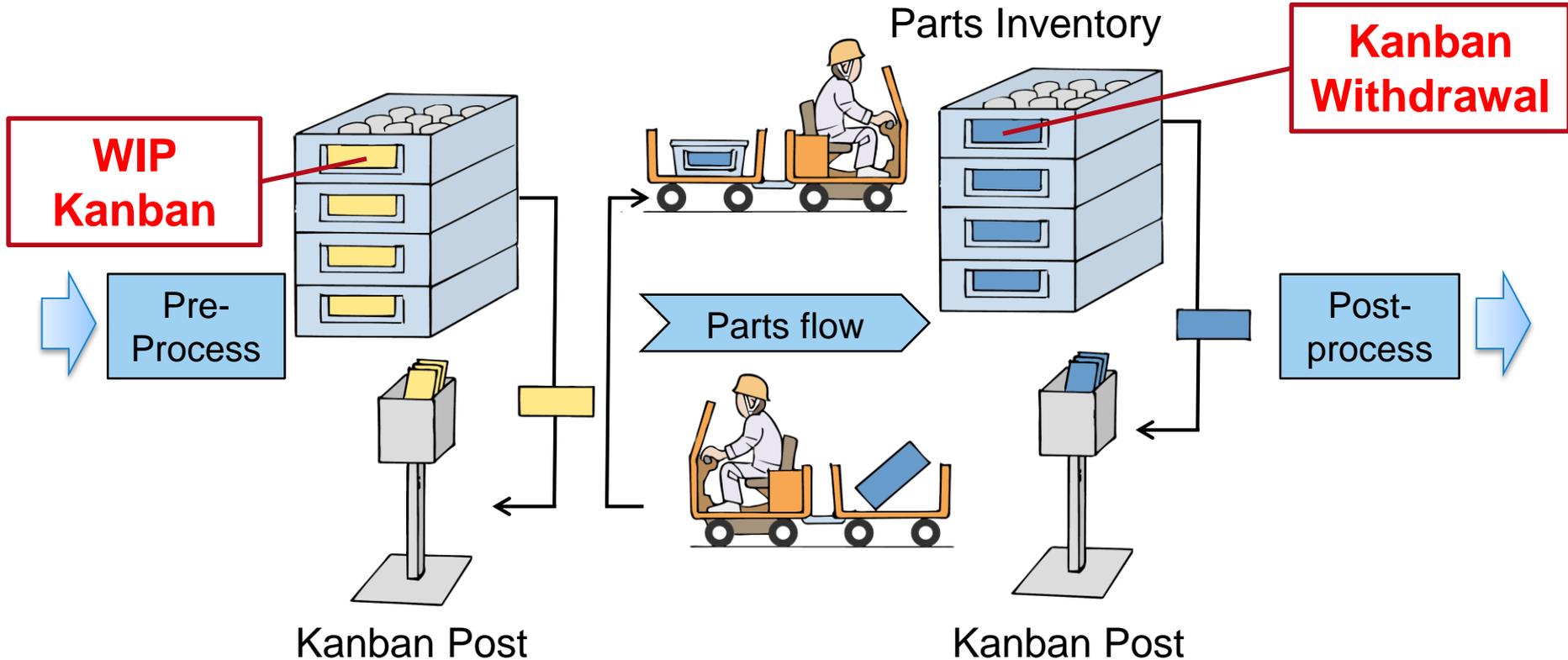
Role of Kanban:

Kanban Withdrawal: To instruct production to pre-processes

WIP(Work-in-Progress) Kanban: To instruct production within its own process

# JIT and Kanban system-5

How Kanban Withdrawal / WIP Kanban works



# Jidoka (Automation)-1

Is there any method to produce only non-defective item while eliminating muda?

- Muda to produce defective items
- Muda to keep producing defective items by automation machine
- Muda to watch machinery; Muda of waiting



To make it Jidoka

Its underlying idea: It must stop itself when it detects a defect.  
Don't allow it to continue producing defectives.



# Jidoka (Autonomation)-2

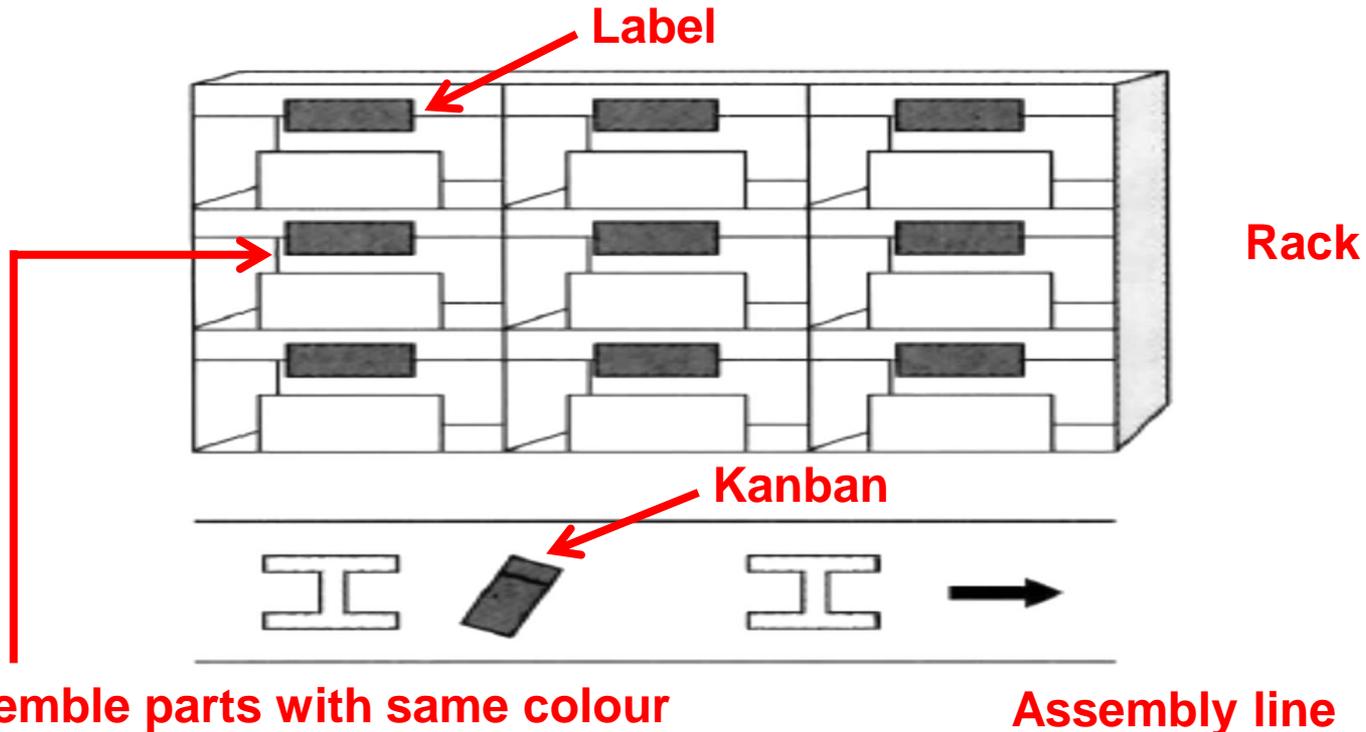


## How to realise 'Jidoka'

1. To practice visual control
2. To deal with Muda caused by defects:
  - Automatic stopping at a time of abnormality occurrence
  - Use error-proof
3. To deal with Muda caused by waiting:
  - Abolish machine watchers: Divide jobs between humans and machinery
  - Develop multi-skilled operators who are able to operate multi-units, thereby reducing number of operators

# Jidoka (Automation)-3

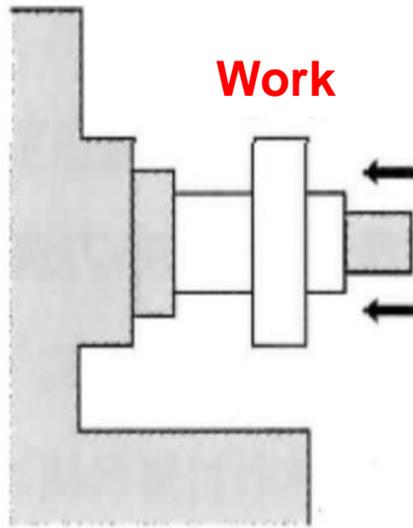
## Case 1 Instruction of parts to use by colour



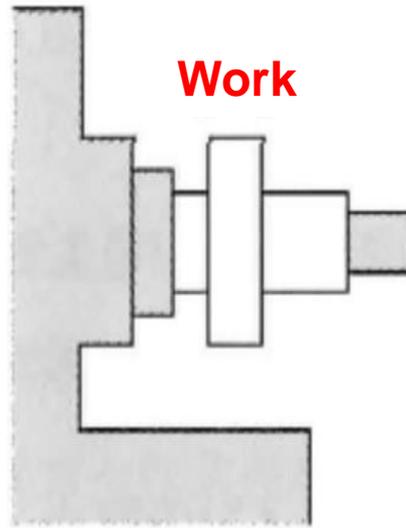
# Jidoka (Automation)-4

## Case 2 Error-free idea in work attachment

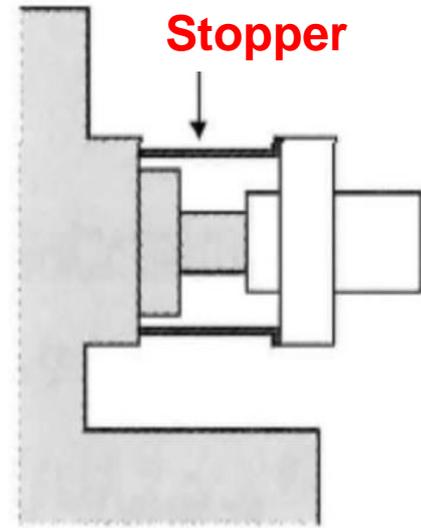
Machine



Normal attach



Reverse attach

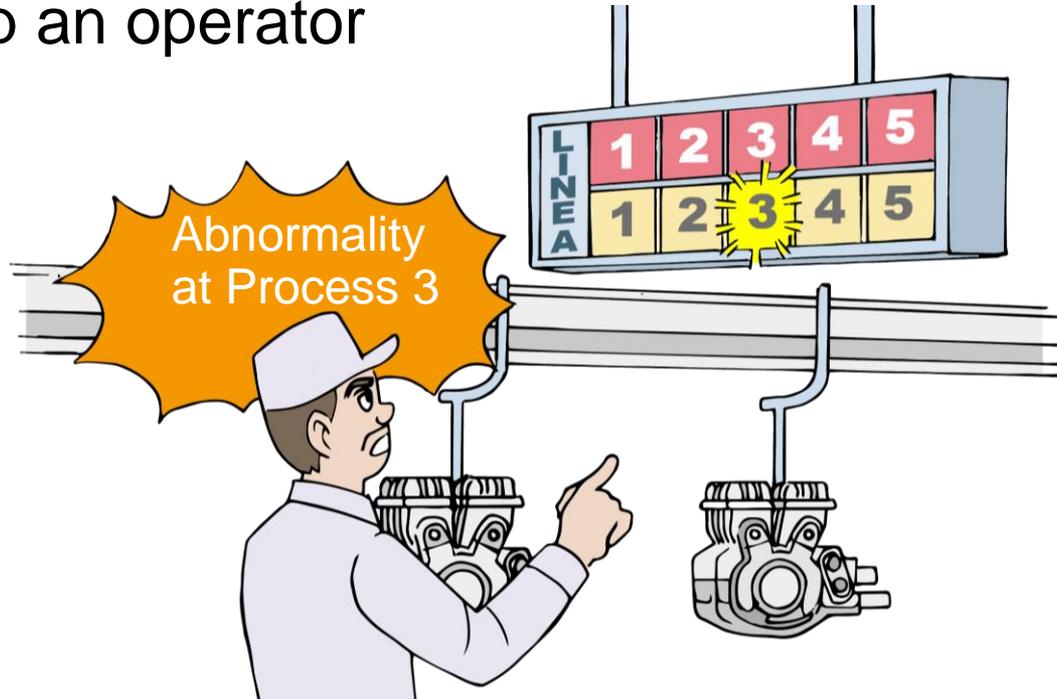


Stopper installed

# Jidoka (Automation)-5

## Case 3

ANDON at Assembly line: When the lamp turns yellow (in case of an abnormality), a supervisor rushes to help an operator



# Basic health and safety

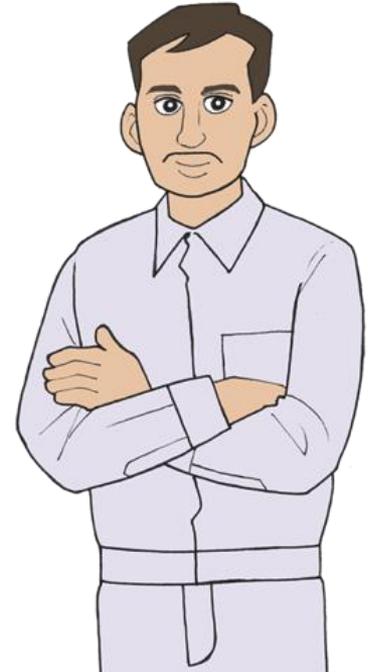
## **Text No. 3-2-1**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Basic health and safety

## Contents

- ✓ **Significance of health and safety**
- ✓ **Accidents and hazards**
- ✓ **Safe work environment**
- ✓ **Safety first**
- ✓ **Your job starts with safe work**



# Significance of health and safety

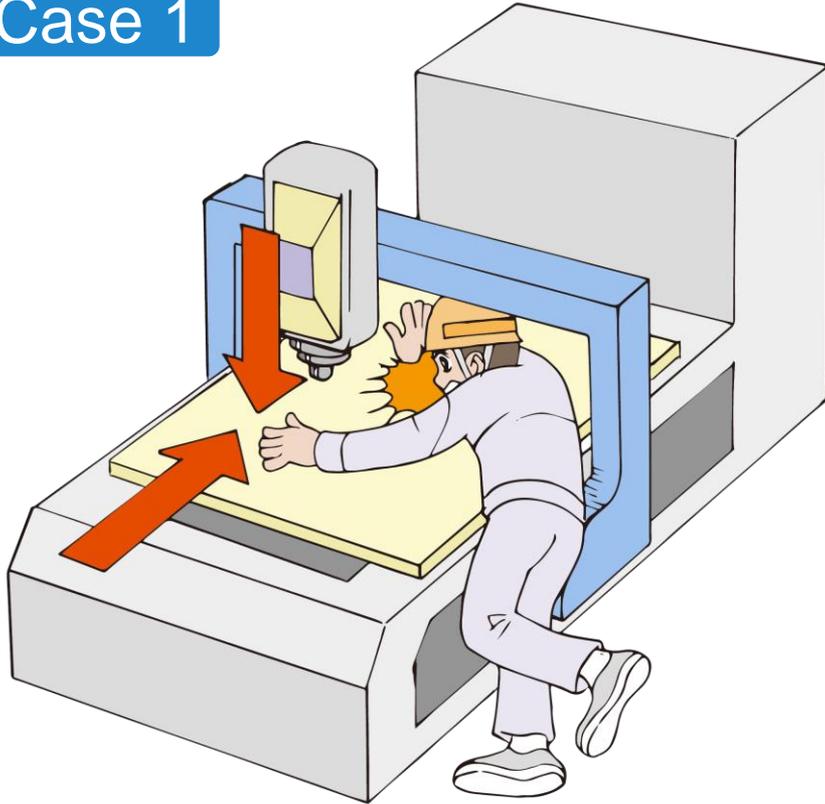
## Health and Safety

This is an activity to maintain safety at the workplace and prevent 'accidents' and 'hazards'. There are two types of risk prevention activities such as:

-  **Activities for prediction and prevention of risk.**
-  **Activities to eliminate human errors that may cause risk.**

# Accidents and hazards-1

## Case 1

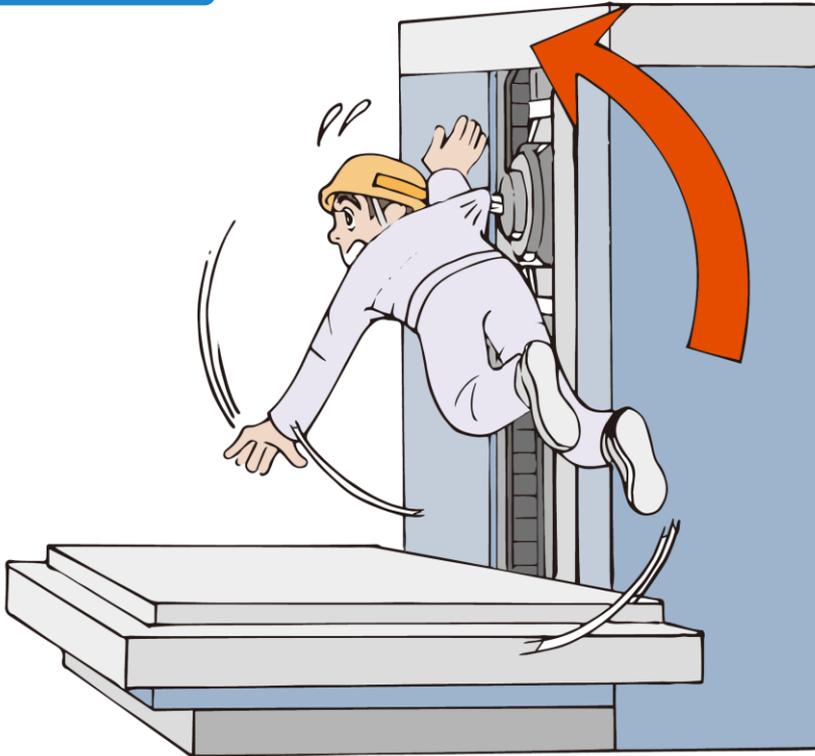


### Accident situation

When an operator came close to the frame during plywood processing work using an NC router, he was caught between the moving table and the frame.

# Accidents and hazards-2

## Case 2

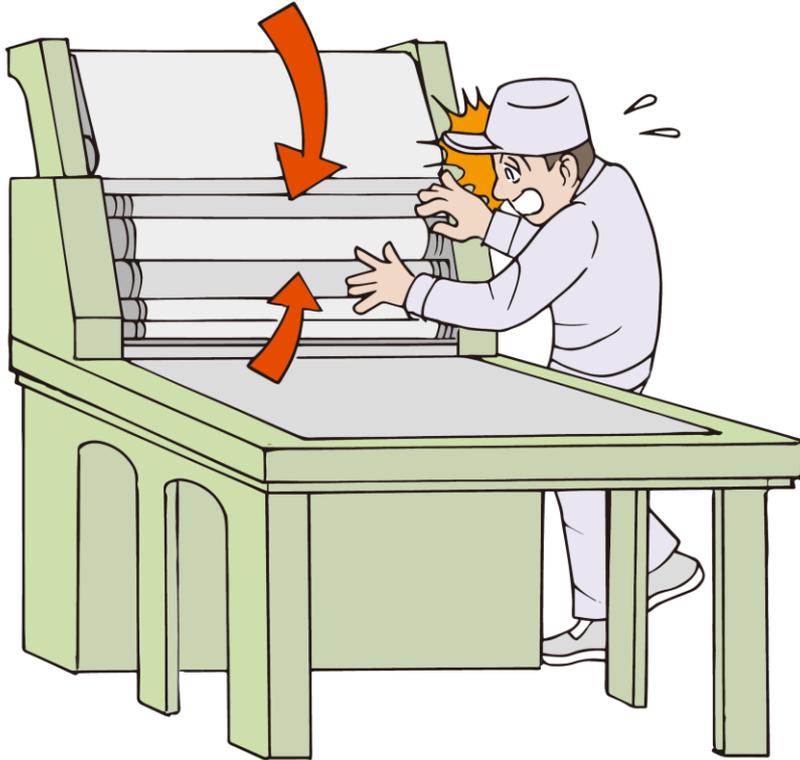


### Accident situation

During warm-up operation of an NC machine used for moulding work, part of the worker's clothes were caught in the drill.

# Accidents and hazards-3

## Case 3



### Accident situation

An operator removing paper jammed in the printing machine was trapped by rollers of the machine which suddenly began to move.

# Accidents and hazards-4



Big loss for the company and society

With production stopped, the company can't manufacture and accept an order; The credibility of the company will be lost.



Unhappy for you and your family

Your everyday life will be interrupted severely. You might be caught by a tragedy including death; Everyone will become unhappy.

# Safe work environment

No progress in **Quality** and **Productivity** can be expected in the workplace where safety and security are not ensured. Securing safety must always come first and this will lead to work efficiency.



Adding unnecessary extra work means adding one more **factor of risk**. Unnecessary extra work is considered as **Muda**.



A safe workplace starts by eliminating **Muda**.

# Safety first

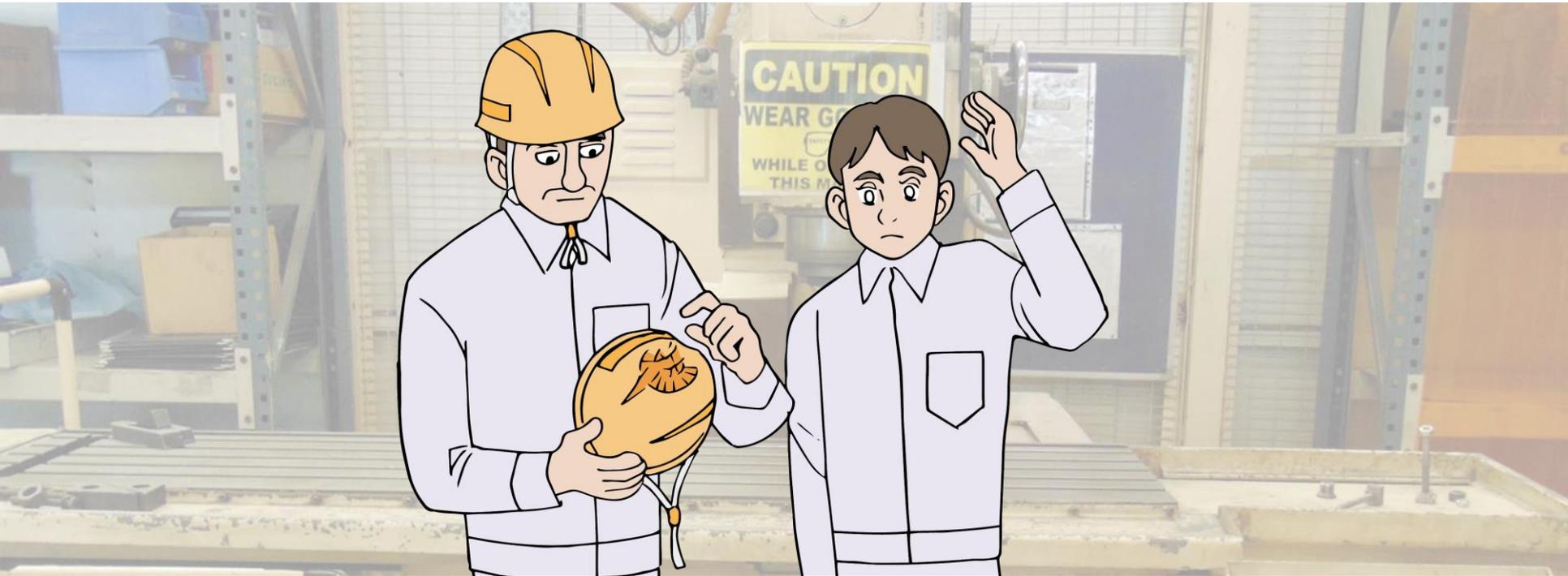
- ☞ Securing of safety should come with maximum priority
- ☞ Securing of safety is the essential condition for your life
- ☞ Respect for humanity should be a primary concern
- ☞ Basis of all work should be on the 'Safety First' principle



# Your job starts with safe work-1



Efficient and high quality work is not feasible unless you are able to perform 'safe work'.



# Your job starts with safe work-2

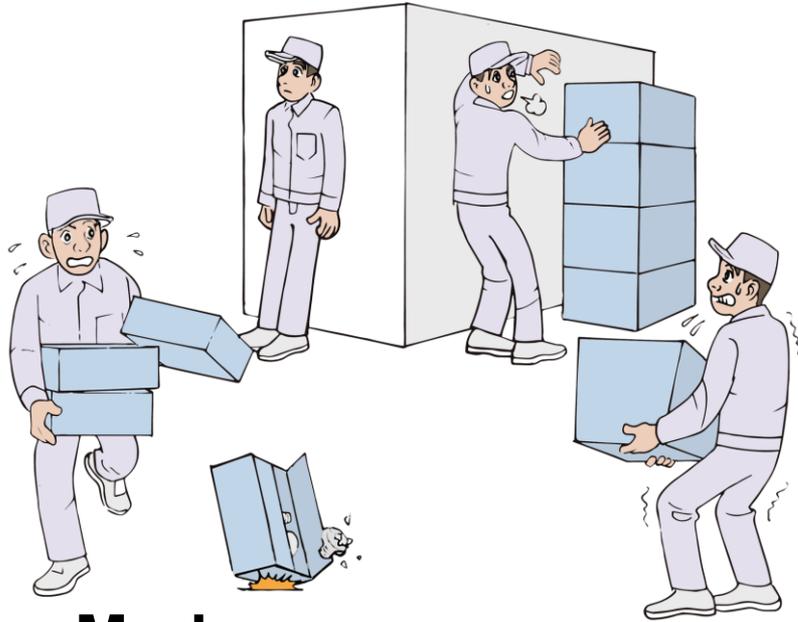


Priority in work should be in the following order:

- 1 Safe work:** Working without 'Muri-Mura-Muda'
- 2 Good work:** Keeping rules and working without negligence
- 3 Proficient work:** Developing techniques and skills in addition to 'safe and good work'

# Your job starts with safe work-3

## Mura



**Muda**

**Muri**

- Muda means unnecessary jobs
- Muri and Mura generate Muda
- Remove Muri-Mura-Muda from your workplace

# Work and risk

## **Text No. 3-2-2**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Work and risk

## Contents

- ✓ **Accidents, hazards and risk**
- ✓ **Why do accidents and hazards occur?**
- ✓ **Prevention of risk**
- ✓ **Five types of risks at the workplace**
- ✓ **Cases of accidents/hazards**



# Accidents, hazards and risks

## Accident

An incident that may possibly injure humans

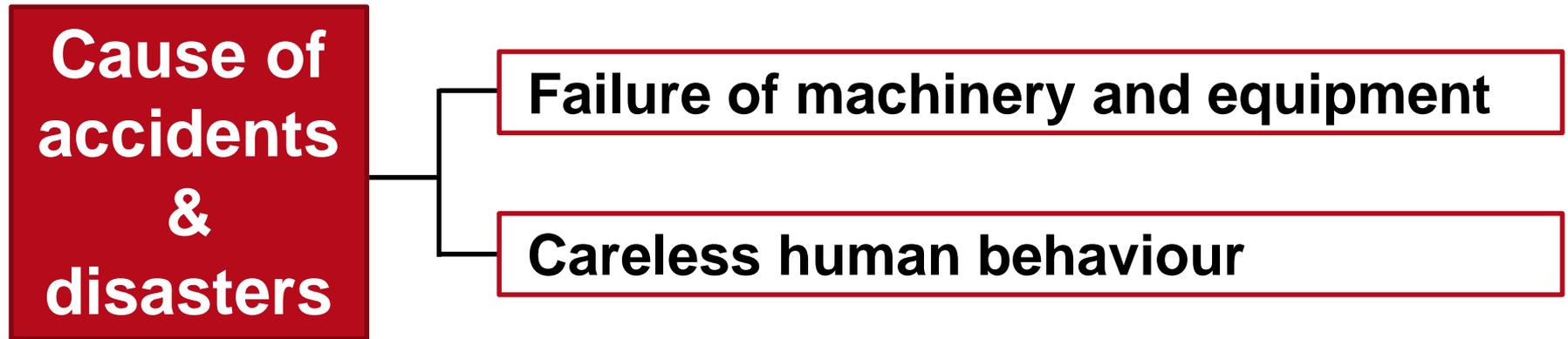
## Disaster

An accident that causes injury and/or death of humans

## Hazard

Dangerous place, condition, machinery, object, motion, etc. ⇒ All those hazards may cause an accident and/or a disaster

# Why do accidents and hazards occur?



Human beings often make errors.

More than 80% accidents/disasters are caused by careless human behaviour.

# Prevention of risk



There are two approaches to preventing risks, namely:

## **Kiken-Yochi** **(Risk prediction)**

To avoid risks by predicting a potential hazard that may lead to an accident and/or disaster.

## **Hiyari Hatto** **(Near miss)**

A tiny incident without any injury. But this near miss case gives an important clue about a potential hazard. Be sensitive to it to prevent an actual accident.

# Five types of risks in the workplace

- 1 Mechanical risk**
- 2 Chemical risk**
- 3 Electrical and heat risk**
- 4 Risk in working conditions**
- 5 Risk in own behaviour**

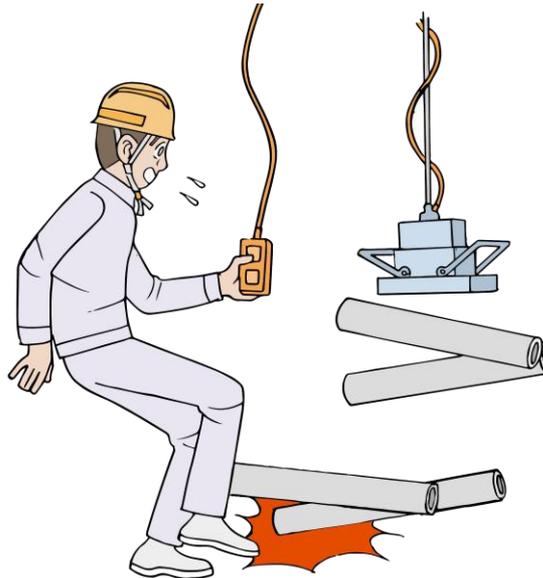
# Mechanical risk

## Case 1



Hand sandwiched in press work

## Case 2



Metal bar dropped from hoist

## Type of accident

Get caught in; Drawn in; Falling; Rolling down; Machine broken; Machine ruptures

## Cause of risk

Stamping machine; Assembly robot; Machine tools; Transfer equipment; Crane; Boiler; High pressure tank, and more

# Chemical risk

## Case 3



Thinner poisoning during  
tank washing

### Type of accident

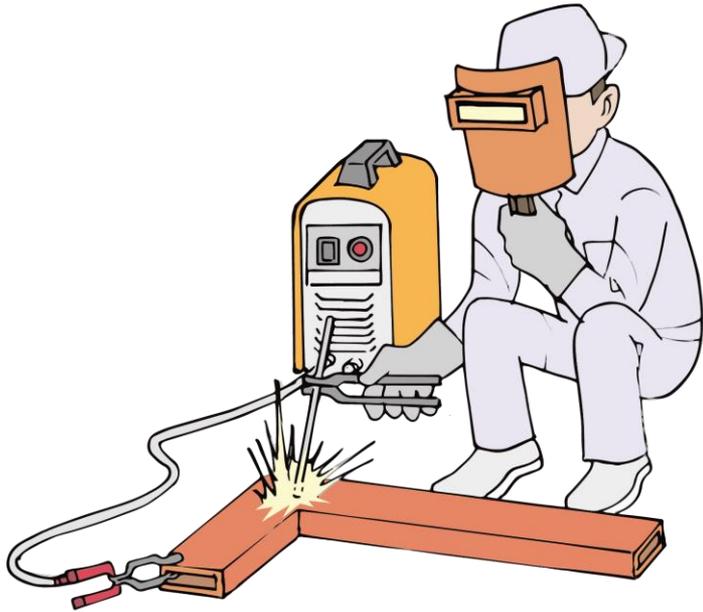
Damage by explosive; Inflammable /ignitable/combustible materials; Damage by corrosive liquid or poisonous material

### Cause of risk

Explosive compound; Petrol; Kerosene; Hydrogen gas; Sulfuric acid; Hydrochloric acid, and more

# Electrical and heat risk

## Case 4



Dust spattering by arc

## Type of accident

Electrification; Fire; Overheat;  
Electric leak; Burn injury; Eye injury

## Cause of risk

Electric appliance; Electric spark;  
Power wire failure; Heat generating  
equipment; Boiler, and more

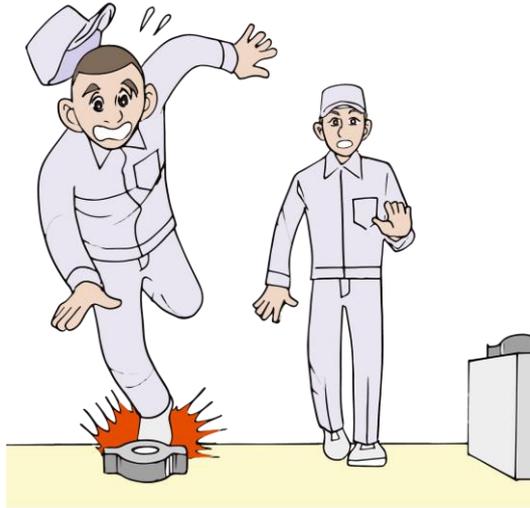
# Risk in working conditions

## Case 5



Falling from deck  
of a truck

## Case 6



Stumbling by tripping  
over a part left on the  
floor

## Type of accident

Get caught in; Drawn in; Falling;  
Rolling down; Machine broken;  
Collision

## Cause of risk

Construction; Civil engineering;  
Manufacturing; Transporting,  
and more

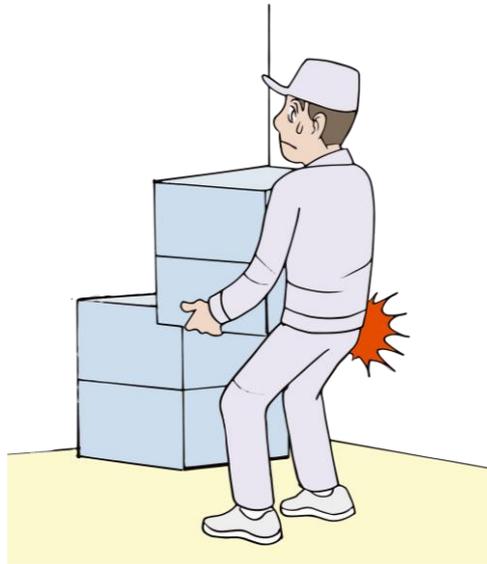
# Risk in own behaviour

## Case 7



Metal chips jump into eyes during deburring work with a handheld grinder

## Case 8



Lower back pain by lifting heavy object

## Type of accident

Accidents caused by carelessness and improper behaviour including all of these cases exemplified in previous slides.

## Cause of risk

Risky personal behaviour triggers the accidents explained here.

# Safety and work

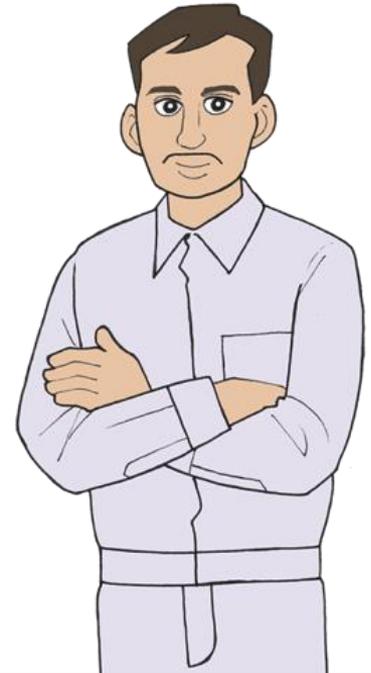
## **Text No. 3-2-3**

Soft Skill Text for  
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# Safety and work

## Contents

- ✓ **Enhancement of safety readiness**
- ✓ **Proper attitude towards work**
- ✓ **Work uniform and protective gear**
- ✓ **Complete practice of 4S**
- ✓ **Safety traffic and safety signs**
- ✓ **For proper operation**



# Enhancement of safety readiness-1



There are activities to keep the workplace safe and prevent accidents and disasters from occurring. Two specific hazard prevention activities are introduced below.



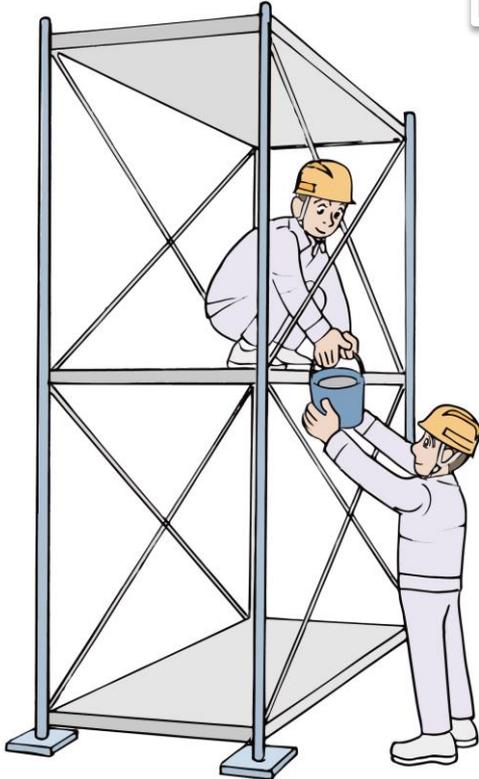
**Activity to predict risks and take necessary actions**



**Activity to eliminate human errors that may cause a hazardous situation**

# Enhancement of safety readiness-2

## Case 1



You are passing a bucket filled with sand to another operator on scaffolding. What risk (accident) may happen next?

## Predict risks

What sorts of risks can you imagine in this situation? Falling? Dropping? Stumbling? Crashing? Explain the reason why you think that way.

# Proper attitude towards work



Keep regular sleeping and eating patterns.

Don't have irregular habits like staying up late at night.

Don't put your hands in your pockets during work.

Exchange greetings.

Be punctual.

Practice Hou-Ren-Sou (Japanese compound word meaning reporting-communication-consultation).

Source: National Institute of Advanced Industrial Science and Technology (AIST)

# Work uniform and protective gear-1



Always wear a clean work uniform.

Choose a work uniform that fits your body.

Keep your clothes buttoned properly to avoid being caught in machinery.

Wear clothes properly even in hot weather or while working in a hot place.

Don't put anything unnecessary for work in your uniform pockets.

Don't commute wearing your work uniform, because it might be contaminated by oil and/or harmful substances from the workplace.

Observe rules about wearing protective gear without fail, if it's required in the workplace.

# Work uniform and protective gear-2

## Always check your protective gear before work

### **Helmet:**

To protect your head from the danger of falling or falling objects

### **Chin strap:**

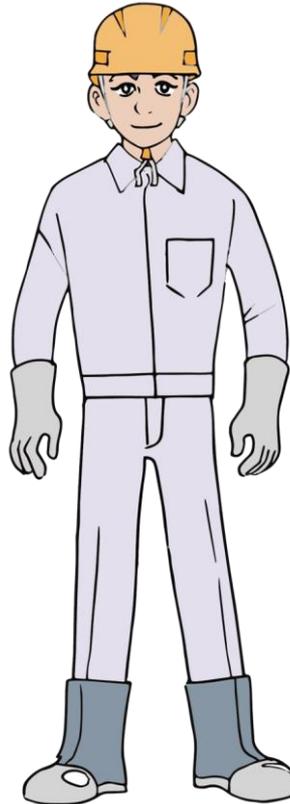
To prevent your helmet from coming off when you fall or stumble

### **Wrist cover:**

To protect your wrists from being injured

### **Legging:**

To protect your ankles from being injured



### **Eye protector:**

To protect your eyes from flying objects

### **Buttons/zipper:**

To protect your chest from backlash of steel and others

### **Gloves:**

To protect your hands from being injured

### **Safety shoes:**

To protect your feet from falling objects

# Work uniform and protective gear-3

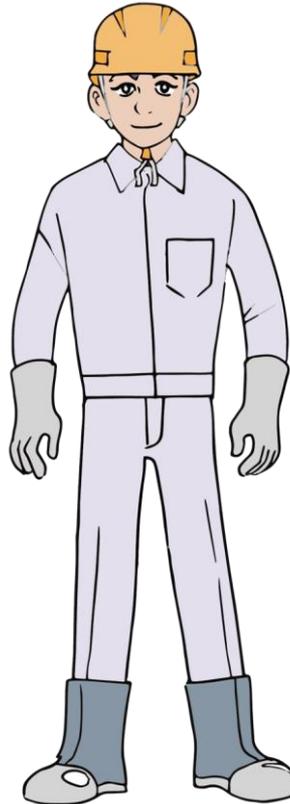
## Safety check points of your uniform/safety gears

Are you wearing a protective hat and keeping the chin strap tight?

Is it good protection for both falling objects and falling risks?

Are you using a safety harness for working at a place 2m or higher above the ground?

Are you wearing gear to protect your feet including safety shoes?



Are you wearing clothes properly?

Aren't you wearing a towel around your neck?

Are your sleeves kept tidy?

Isn't there any tear or ripping in your uniform?

Are you using a safety harness hook with a diameter of less than 50mm? Is the rope shorter than 1.5 meters? Isn't there any break or damage on the rope and harness?

# Complete practice of 4S -1

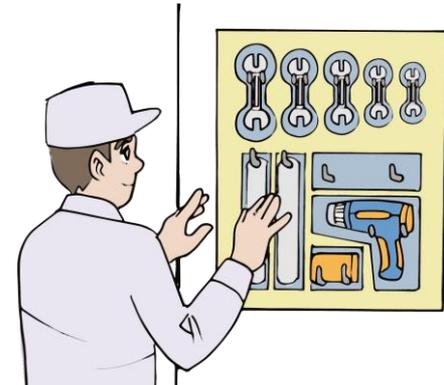
💡 4S (Seiri/Seiton/Seiso/Seiketsu) is the basis of safety.

## Seiri

Sort out what you need and what you don't need, and dispose of the unnecessary. (If you don't dispose of those unnecessary items, you may stumble on them or your work efficiency will be reduced.)

## Seiton

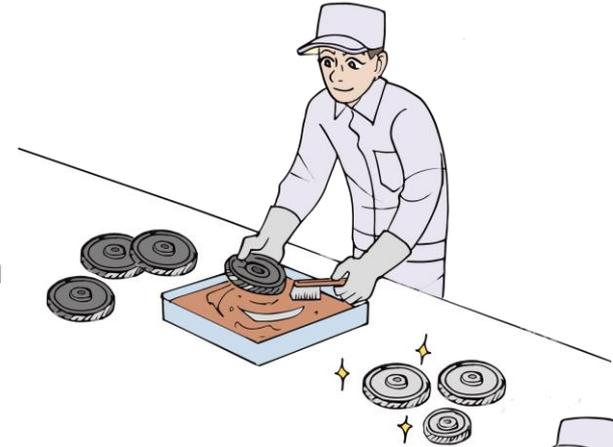
Keep everything in order so that you can find any necessary item quickly. (Searching for things lowers your work efficiency; in the case of the food sector, Seiton makes it easier to find any irregularities such as missing necessary tools and the detection of mixing of foreign matters quickly.)



# Complete practice of 4S -2

## Seiketsu

Get rid of dirt and keep everything around you clean. Cleaning is necessary to maintain normal operation of machinery.



## Seiso

Remove dirt, dust, trash and stains from machinery, desks, floor, and so on. Wiping a wet floor so it will dry immediately is important to prevent people from slipping.



# Safety traffic and safety signs-1



Leave no materials and obstacles in passage ways.

Maintain appropriate lighting.

Keep passages free from being slippery and avoid stumbling.

Display entrances/exits and emergency escape routes.

No shortcuts. No going out of permitted routes.

Follow staff instructions for certain operations such as crane work.

Stop before crossing passages, entrances, and T-junctions and look left and right for safety.

Walking with your hands in pockets is strictly prohibited.

Use the handrail when you go up and down stairs.

# Safety traffic and safety signs-2

Prohibition marks: to prohibit any dangerous actions



# Safety traffic and safety signs-3

Attention marks: Warning to dangerous things, places and conditions



# For proper operation-1

## 1 Follow operation rules

Work in compliance with the company's regulations and rules. Operations must be based on standardised work instructions and work standards.

## 2 Follow safety rules

Follow your company's own safety rules. Comply with the state rules and regulations of safety in India.

(Example in Japan) Factories prohibit anyone from walking with their hands in their pockets; this is one of the rules to be followed.

# For proper operation-2

## Basic Rules in Factory



Wear your uniform, cap, safety shoes and protective gear properly. (Uniform: no rolling up of sleeves, no turning up of trouser bottoms, no lifting up of hems, no turning up of collars)

Don't put your hands in your pockets while walking.

Practice 5S (Seiri/Seiton/Seiso/Seiketsu and Shitsuke) in the workshop.

Work with the proper license if it's required.

Cut off the power source without fail at the time of error, repair or inspection. (Electric/pneumatic/hydraulic source)

Don't stay under suspended things.

Don't get close to a running forklift.

# For proper operation-3

## Automobile body assembly (automobile factory)



Don't pull air tools carelessly.

Use air tools and hand tools properly.

Don't throw an empty box.

Wear protective gears (ear plugs, protective glasses).

Inform a line supervisor whenever finding a breakdown.

Don't touch machinery while it's running.

# For proper operation-4

## Welding work



Wear protective gear: Protective glasses, mask, gloves, apron, foot covers, ear plugs

Don't hit parts to be assembled by a hammer excessively.

Don't touch a clamping section of an air cylinder.

Don't touch the edge of a pipe with your bare hands because it's very sharp.

Don't come within working range of automatic conveyers.

Keep a flash shield down so as not to bother other operators.

Report to your supervisor whenever some error occurs and follow his/her instructions.

# KYT and KYK

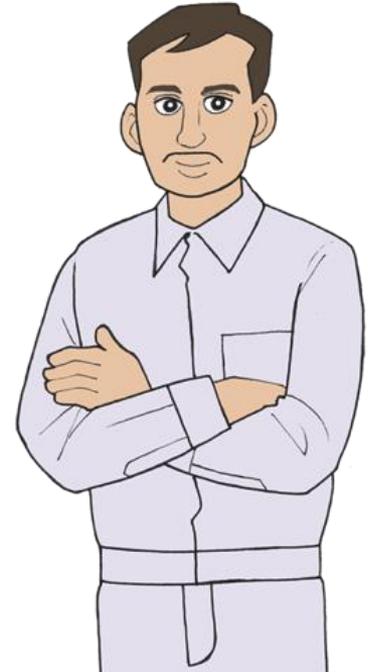
## **Text No. 3-2-4**

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# KYT and KYK

## Contents

- ✓ **What is KY, risk prediction?**
- ✓ **KY training and KY activities**
- ✓ **KY training by yourself**
- ✓ **KYT by team**
- ✓ **Try of 4R-KYT (Case 1-4)**



# What is KY, risk prediction?

Accidents and hazards are invisible. Nobody knows when he/she will be suddenly involved in an accident.



Accidents cannot be avoided unless you can sense the-danger. How can we avoid the risk of an accident?



Sharpen your **sensitivity** to a danger. Predict a possibility of an accident.

**Let's enhance risk predicting ability!**

# KY training and KY activities



Your daily training to get higher risk predicting ability and its practice in daily work will lead to the risk prevention.

**Risk prediction training  
(KY training)**



**Risk prediction activity  
(KY Katsudou)**

**K: Kiken (Risk)  
Y: Yochi (Prediction)  
T: Training (Training)**

**K: Kiken (Risk)  
Y: Yochi (Prediction)  
K: Katsudou (Activity)**

# KY training by yourself-1



Enhance your risk prediction ability by imagining latent risks that you might be involved in. Think of some cases using the sentence pattern “You may xxx.”

**You may xxx !**



Be pinched

Be caught

Be hit

Stumble

Be poisoned by gas

Fall

Be burned

Be electrified

Injure back

Be deprived of oxygen

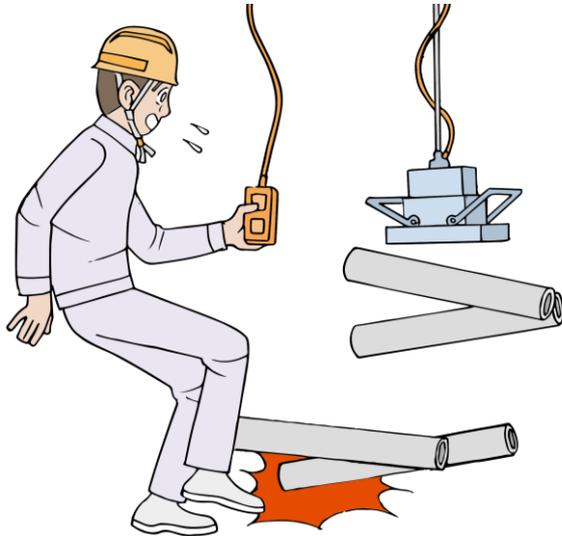
Source: Manual of Safety Health Education for Unskilled labor in Manufacturing Sector, Compiled by labor Standard Office, Prefectural labor Offices and the Ministry of Health, labor and Welfare

# KY training by yourself-2



Enhance your risk prediction ability by imagining latent risks that you might be involved in. Think of some cases using the sentence pattern “It may xxx.”

It may **xxx** !



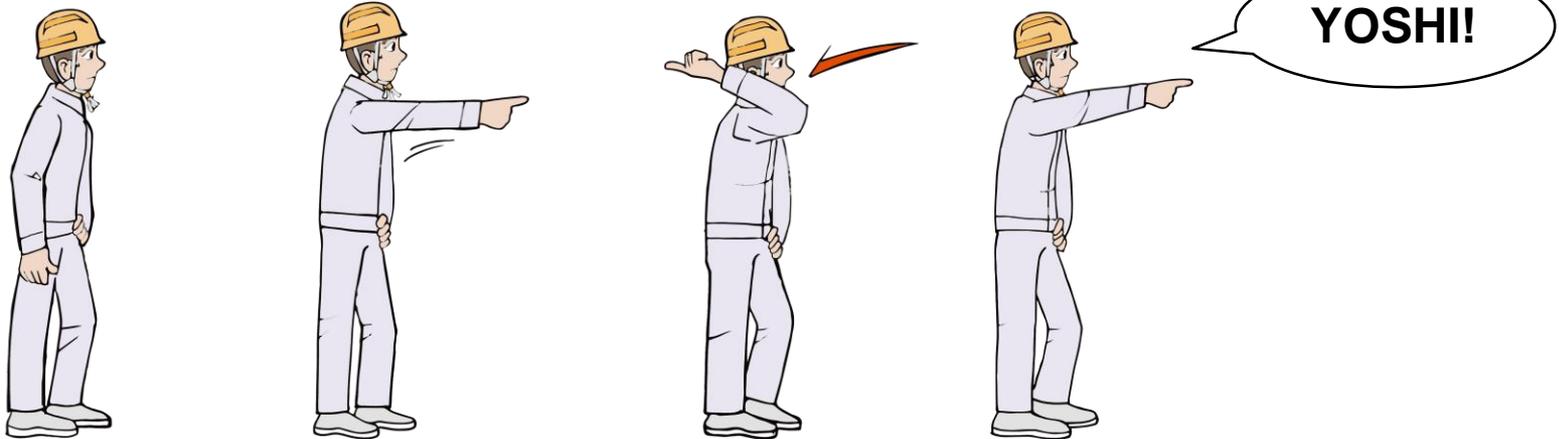
Move	Go down
Revolve	Collapse
Jump	Explode
Fall	Leak
Drop	
Burn	

# KY training by yourself-3



## Practice of pointing and calling

The result of an experiment indicates that people who practice pointing and calling become three times more accurate in their behaviour than people who do not practice.



**Watch the object ➡ Point at it with your index finger ➡ Raise your hand to the level of your ear ➡ Say YOSHI! (OK) and put your hand down**

# KYT by team



4R method by 5-6 people is effective as a training method.

Round	KYT four round	How to do KYT
Round 1	Identify hidden risks (grasp the current circumstances).	Imagine and express potential risks of accidents that might be caused by an unsafe behaviour and/or condition.
Round 2	Narrow down the risks.	Select the most dangerous risk from the ones identified in Round 1.
Round 3	Think of the solutions.	Think how to prevent that selected risk as a team.
Round 4	Take an action according to the model.	Select the best solution as a model among the ones thought of in Round 3.

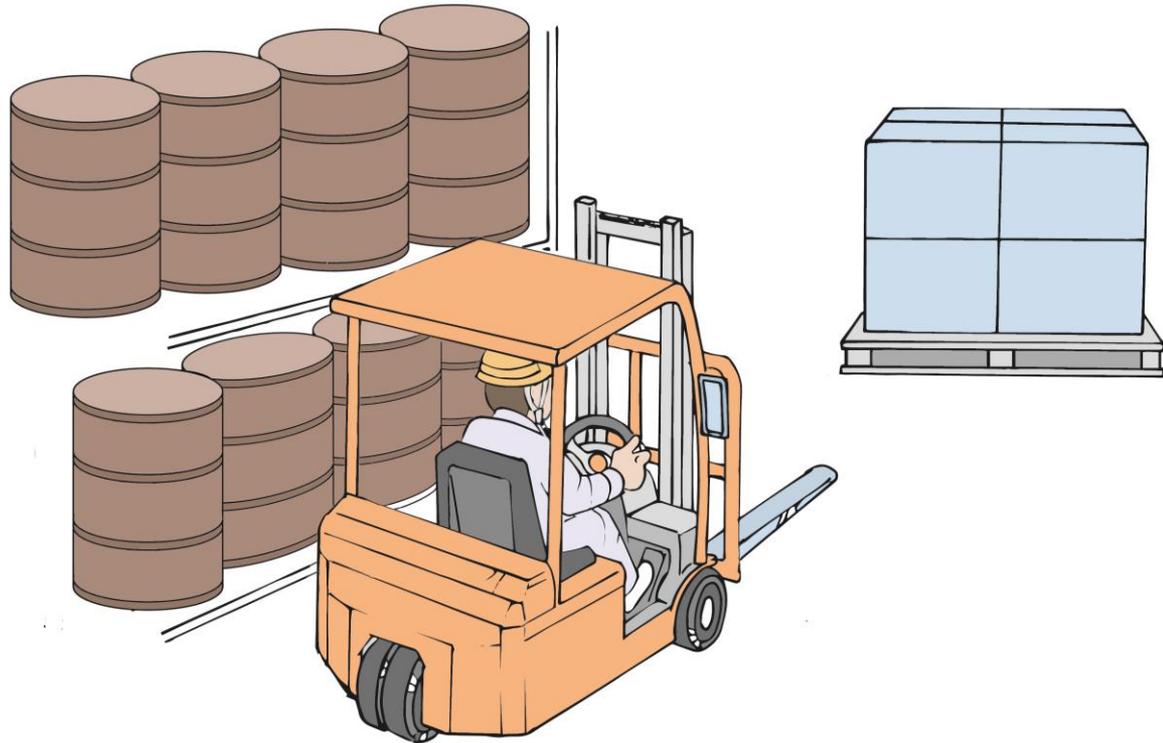
# Try round 1 of KYT-4R -1

Q

What risks are hidden?

## Case 1

You are now moving cargo inside a warehouse by a forklift.



# Try round 1 of KYT-4R -2

Q

What risks are hidden?

## Case 2

You are trying to close a valve in a polyvinyl chloride pipe while standing on the second level of an outside staircase.

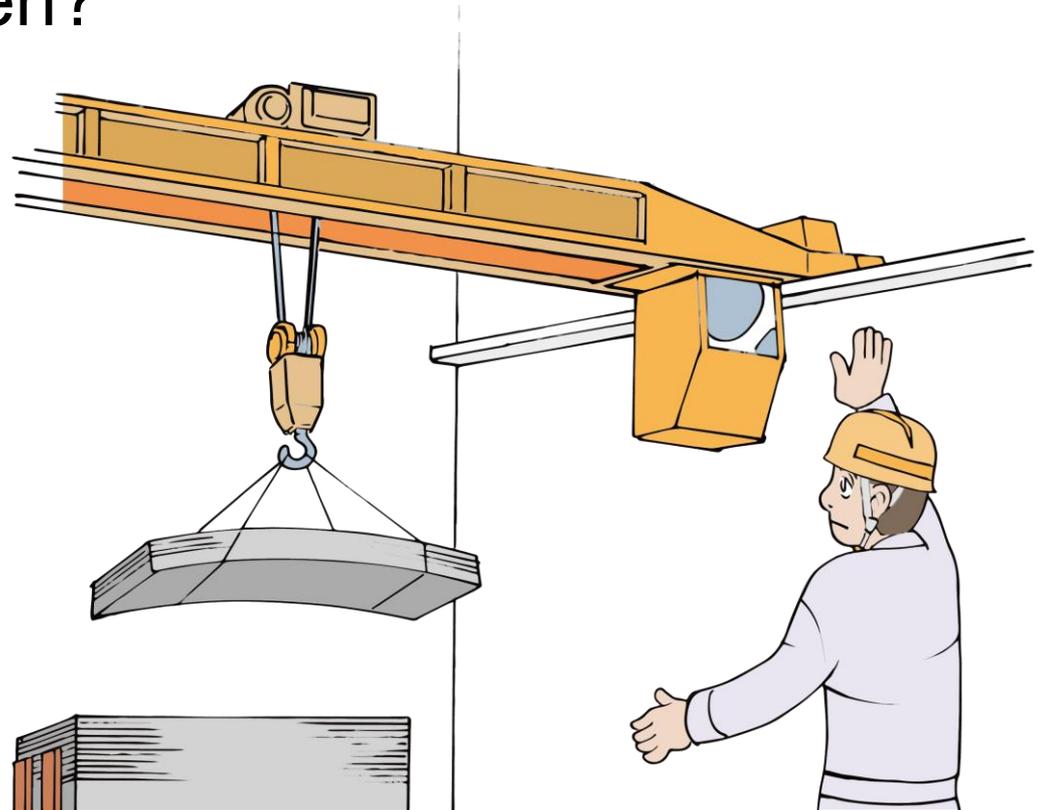


# Try round 1 of KYT-4R -3

**Q** What risks are hidden?

## Case 3

You are guiding an operation to lift and move suspended steel sheets by an overhead crane.



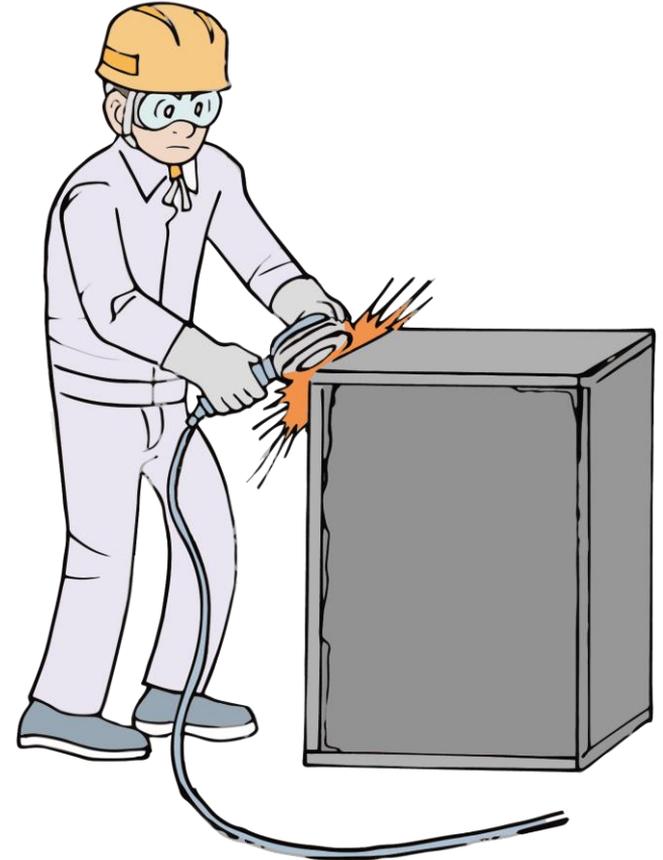
# Try round 1 of KYT-4R -4

Q

What risks are hidden?

## Case 4

You are grinding the edges of a steel box with a hand-held grinder after welding has finished.



# Hiyari-Hatto activities

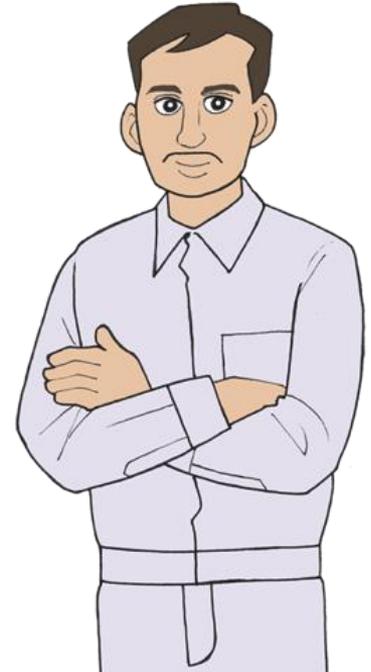
## **Text No. 3-2-5**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Hiyari-Hatto activities

## Contents

- ✓ **What is Hiyari-Hatto?**
- ✓ **Heinrich's Law**
- ✓ **Risk prevention by Hiyari-Hatto**
- ✓ **Cases of Hiyari-Hatto**



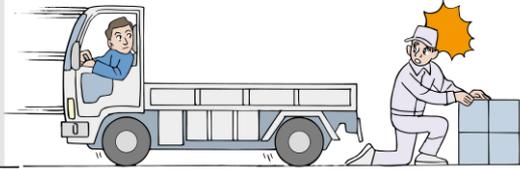
# What is Hiyari-Hatto?

## Hiyari-Hatto (HH)

Haven't you ever felt that you were nearly in an accident or a startling event during commuting or while working? It was dangerous but fortunately it did not lead to an accident. This is referred to as a serious incident that might have developed into a serious accident with just one single misstep.



You were about to collide with a car dashing out of an alley.



You were about to get run over by a backward moving truck.



You were almost hit by a right-turning car.

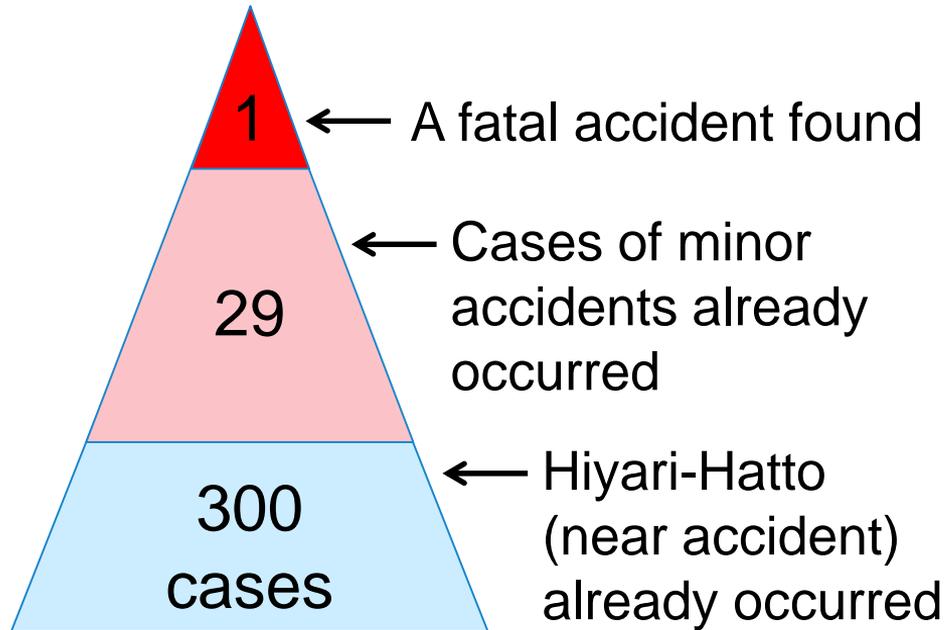


Falling steel pipes nearly hit your body.

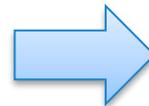
# Heinrich's Law-1



No fatal accidents happen suddenly!



Each occurrence of HH has a cause.



**1:29:300** of Heinrich's Law



A Hiyari-Hatto (near accident) case is a precursor of a serious accidents.



There are many risks and dangerous actions and conditions.

# Heinrich's Law-2



Hiyari-Hatto always has a certain cause for something to happen.

Classification	Specific examples
<b>Unsafe actions</b>	<ul style="list-style-type: none"><li>• Negligence of inspection; deficient joint work</li><li>• No safety gear/safety shoes/anti-dusk masks were put on</li><li>• Operation standards and rules were not observed</li></ul>
<b>Unsafe conditions</b>	<ul style="list-style-type: none"><li>• Wrong ways to place/stack things; insufficient 3S</li><li>• Things were not placed in designated areas</li><li>• Wrong way to secure things</li></ul>

Identification and taking measures for the cause of HH can prevent serious accidents.

# Risk prevention by Hiyari-Hatto -1



To prevent more serious accidents, it all starts with identifying relevant causes of Hiyari-Hatto (HH) by careless and unsafe actions.

## Visual Control of HH

You are the only person who experienced it. Others don't know about it.

Record HH cases and compile them into a Hiyari-Hatto report.

Make each HH experience visible to other workplace members.

Regard it as a precursor of an accident.

Try to look for any sign or cause at the HH stage.



# Risk prevention by Hiyari-Hatto -2



A Hiyari-Hatto report should be compiled with 5W1H.

HH Record		How to record with 5W1H
1	When	Record time and date as well as the weather.
2	Who	Who all were involved?
3	Where	Describe information and environment of the place.
4	What were they doing	Record operations and behaviours before and after the HH incident.
5	What happened	What HH occurred? Write it specifically.
6	What damage	State of damage or injury as well as Yes/No.
7	Why	Record why that HH occurred.

# Risk prevention by Hiyari-Hatto -3



Think of effective preventive measures against serious accidents based on records obtained from Hiyari-Hatto.

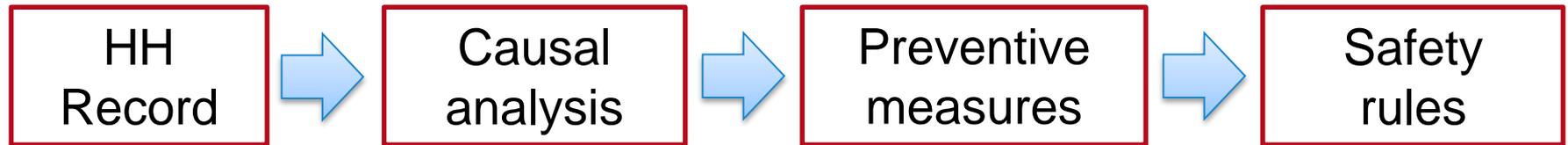
## Actions for hazard prevention

Find out for the reasons why HH (near accident) occurred.

Then, identify the relevant causes that might lead to serious accidents.

Think about preventive measures from that analysis.

Adopt the measures as new safety rules of your operation.



# Risk prevention by Hiyari-Hatto -4

What to see		What to think
1	What caused it?	What incomplete 'conditions' or 'behaviours' caused it?
	Behaviours	e.g.) Insufficient check/confirmation; Violation against the rules
	Conditions	e.g.) No rules and compliance with 3S: No definition of how and where to place things
2	Predicted patterns of accidents	Falling, crashing, collapsing, getting caught or wound; being cut or rubbed
3	Preventive measures	Think of all feasible preventive measures and choose the most effective one
4	Safety rules	Select and apply rules to be observed at your workplace

# Cases of Hiyari-Hatto -1

## State of HH

While cleaning a milling machine work table, the rolled-up sleeve of the worker's uniform was about to get caught in the machine. The machine was operating for oil-refilling during a regular check-up.

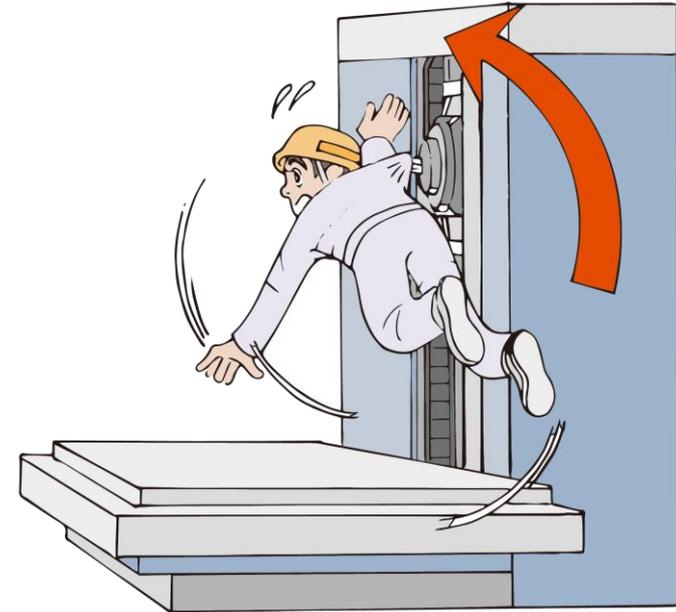
## Cause and Prevention

Improper uniform

Work procedure of oil-filling during regular checking

How to clean machinery while it is running

## Case 1



‘Get caught in’ a machinery

# Cases of Hiyari-Hatto -2

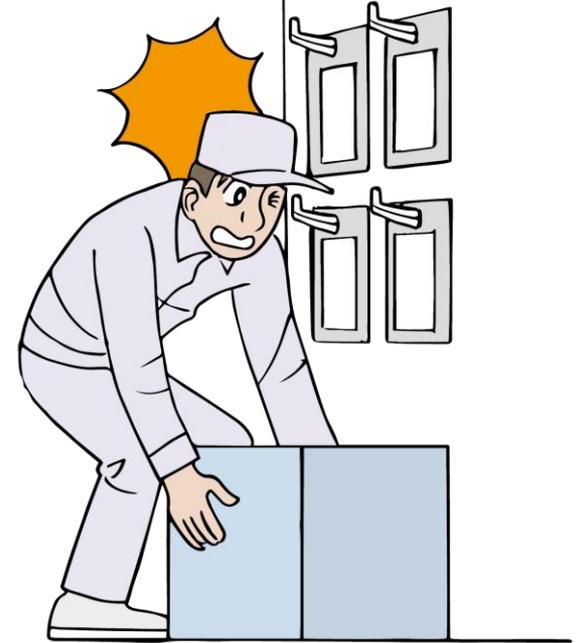
## State of HH

When trying to lift a product up from the floor in a warehouse, the worker's left eye was almost hit by a hook keeping merchandise on the wall.

## Cause and Prevention

Change the position of the hook  
Rules on where to keep products  
Through practice of 3S: designation of storage places

## Case 2



‘Contact’ with dangerous object

# Cases of Hiyari-Hatto -3

## State of HH

While doing welding work and moving about inside the workplace, the worker was about to fall by tripping over some cluttered arc welding cables on the floor.

## Cause and Prevention

Thorough practice of 3S; designation of storage places

Making rules when using them

Appointing a person to be in-charge

## Case 3



‘Falling’ in a dangerous place

# Cases of Hiyari-Hatto -4

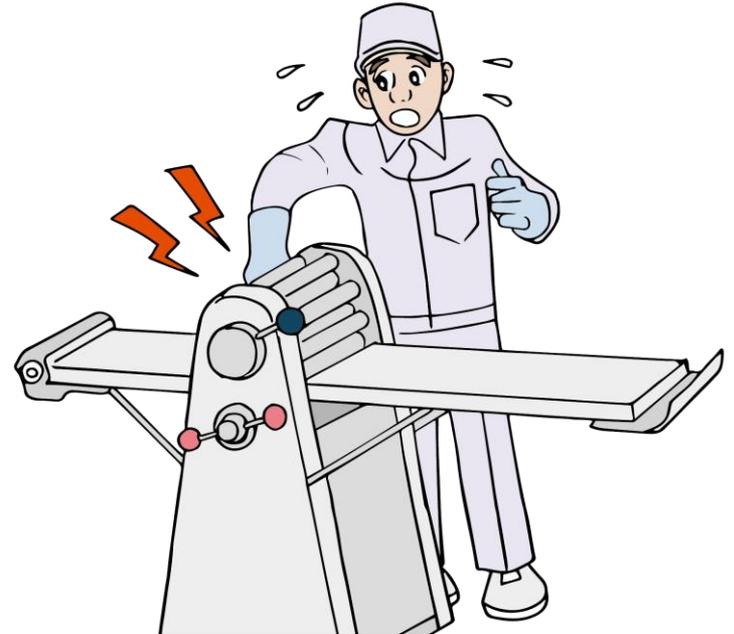
## State of HH

While cleaning a food rolling machine with its rollers still running, a worker's hand was about to get caught in the machine, because the cover was off.

## Cause and Prevention

When cleaning any rotating mechanism including rollers, confirm the power is turned off and then start cleaning manually.

## Case 4



‘Getting caught in’ machinery

# Cases of Hiyari-Hatto -5

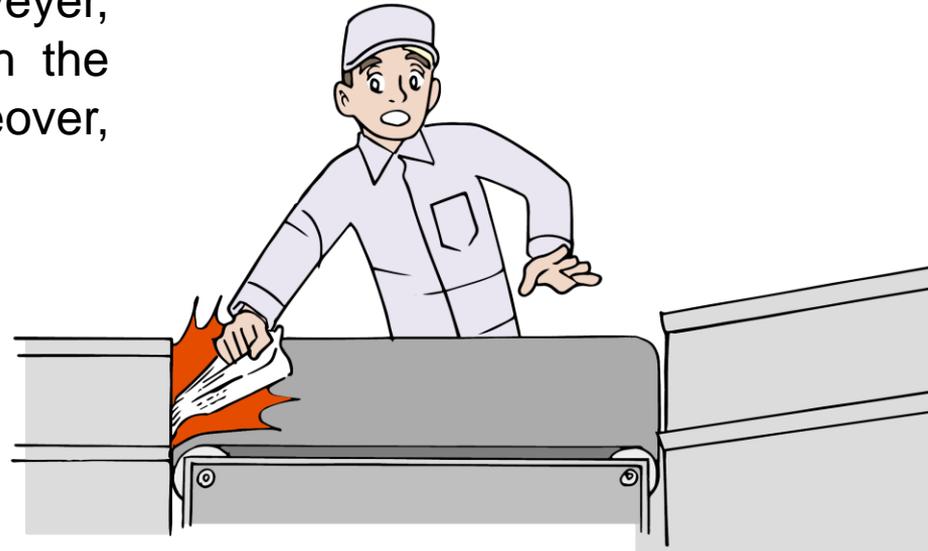
## State of HH

During cleaning of a product transfer conveyer, it suddenly started running and the cloth the worker was holding got caught in it. Moreover, he too was about to get caught in it.

## Cause and Prevention

Clarify 'Don'ts' during clearing work.  
Make it a rule that the machine must be switched off during cleaning.

## Case 5



'Getting caught in' a conveyer

# Cases of Hiyari-Hatto -6

## State of HH

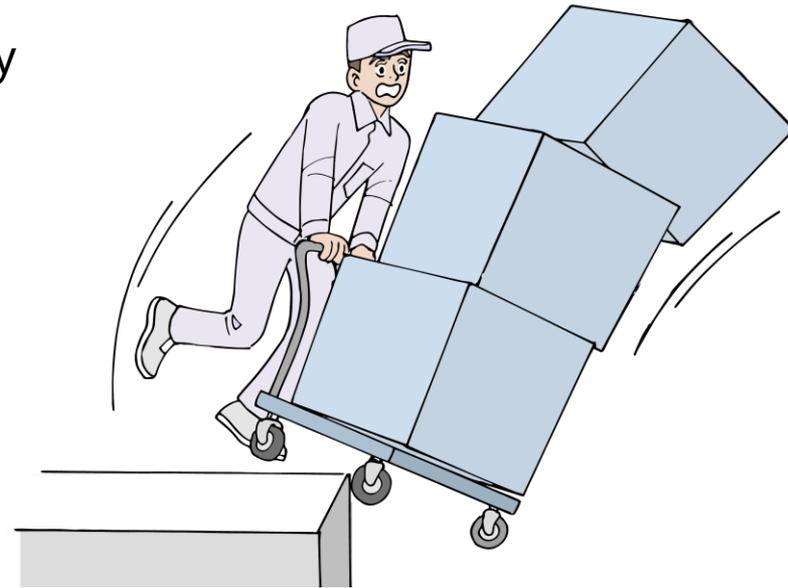
Merchandise stacked very high on a carriage made it hard to see ahead, and the worker nearly fell with the carriage from the platform in the delivery centre.

## Cause and Prevention

Visualise the proper way to load and carry merchandise.

Heavier things should be placed at the bottom of a carriage and carry a modest volume to maintain visibility.

## Case 6



‘Falling’ during transportation

# Outline & purpose of KAIZEN

## **Text No. 3-3-1**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Outline & purpose of KAIZEN

## Contents

- ✓ **What is KAIZEN?**
- ✓ **Purpose of KAIZEN**
- ✓ **Outline of KAIZEN activities**
- ✓ **Important thinking of KAIZEN activities**
- ✓ **Three kinds of Muda (waste)**
- ✓ **7 types of Muda**
- ✓ **Muda in four essential processes**
- ✓ **Muda by Mura or Muri**



# What is KAIZEN? -1



KAIZEN means continuous improvement.

It means activities to enhance productivity while eliminating Muda continuously. Further elimination of Muda requires a new and better way of production because you can't expect more when you just follow the same way as before.

KAIZEN is to improve things today so that they are better tomorrow and therefore it's a never-ending challenge.

# What is KAIZEN? -2



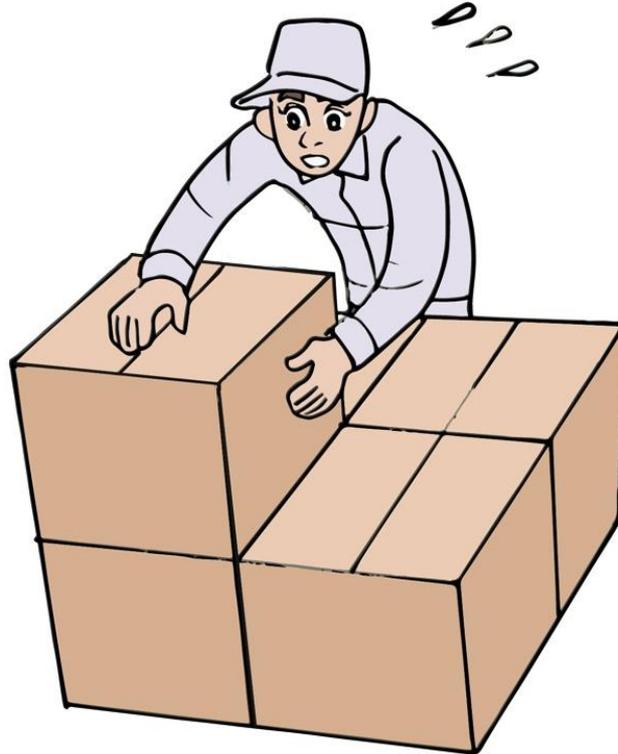
KAIZEN activities are focused on the thorough elimination of Muda. What we have to do first is to identify Muda by making them visible.

5S activities are effective for this purpose and are the basis of KAIZEN.

# What is KAIZEN? -3

What kinds of losses and waste can you find in production situations?

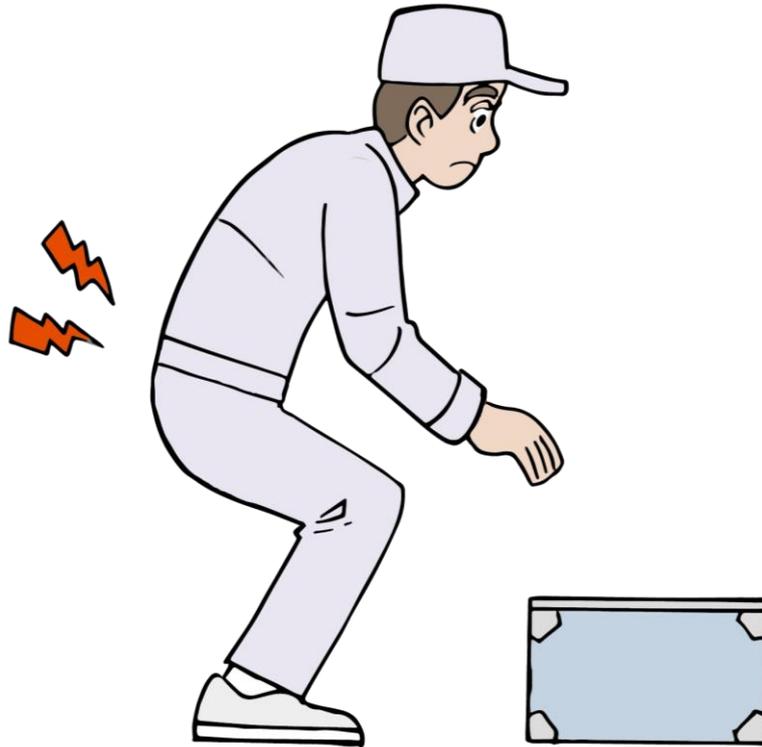
## Case 1



# What is KAIZEN? -4

What kinds of losses and waste can you find in production situations?

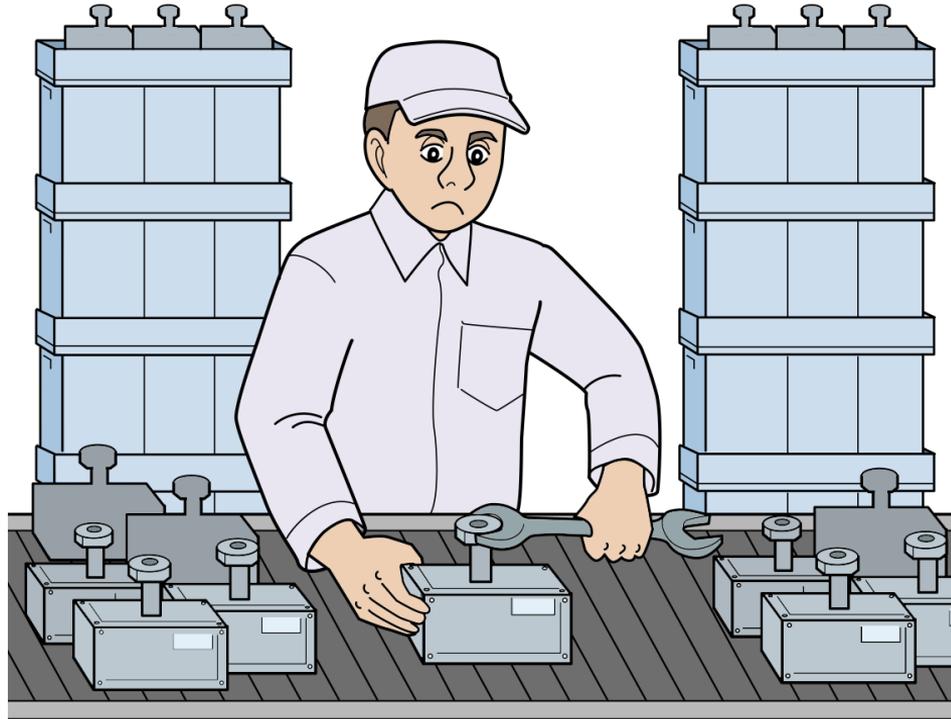
## Case 2



# What is KAIZEN? -5

What kinds of losses and waste can you find in production situations?

## Case 3



# What is KAIZEN? -6

What kinds of losses and waste can you find in production situations?

## Case 4



# What is KAIZEN? -7

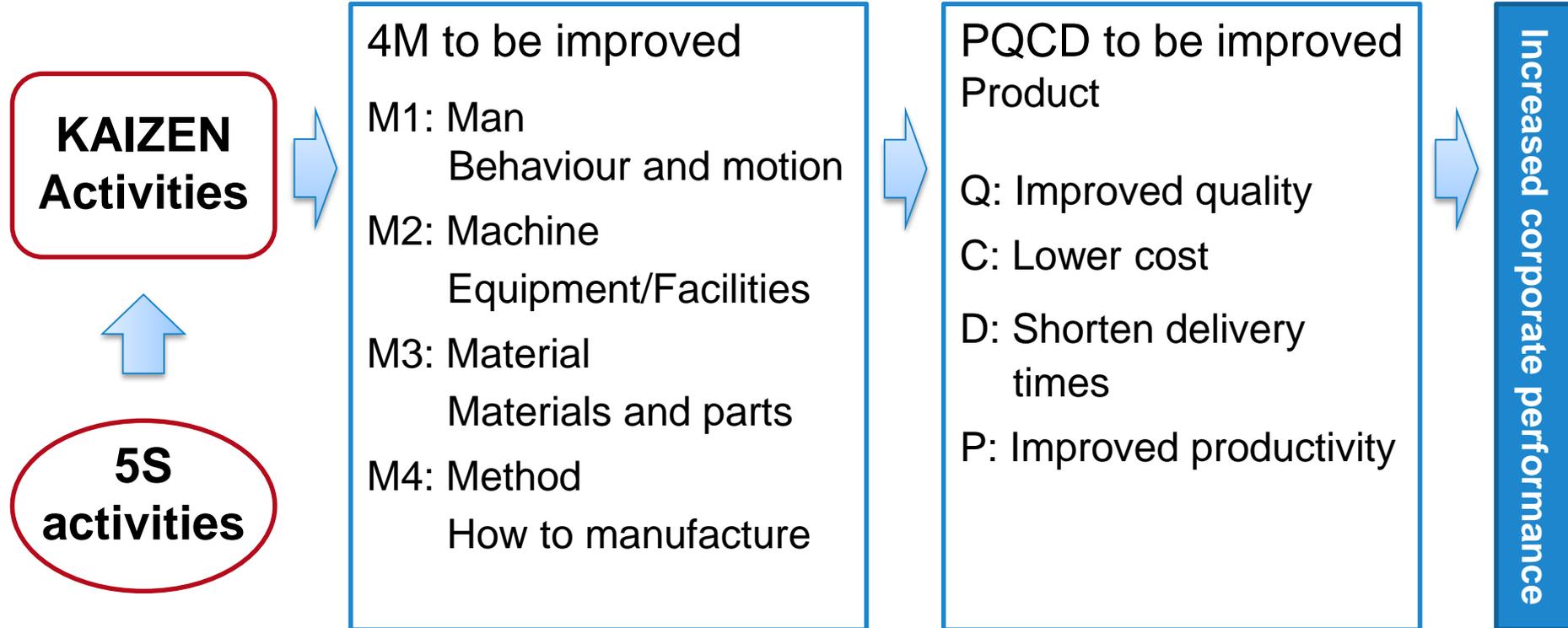
What kinds of losses and waste can you find in production situations?

## Case 5



# Purpose of KAIZEN

 Purpose of KAIZEN is to increase corporate performance.



# Outline of KAIZEN activities-1



KAIZEN activities are focused on the thorough elimination of Muda. 5S activities are the basis of KAIZEN.

## KAIZEN activities

### Muda in brief

3M: Muda/Mura/Muri  
7 types of Muda  
Muda during transportation or stagnation

### How to eliminate Muda

IE Tools  
7 Tools of QC  
Standardised operation  
Application of ECRS  
Visualisation  
Other methods

### Company-wide activities

TQM

TPM

5S is to visualise Muda

5S is the basis of KAIZEN

**5S Activities: 1. Seiri 2. Seiton 3. Seiso 4. Seiketsu 5. Shitsuke**

# Outline of KAIZEN activities-2

## Basic conditions for 'Muda elimination'

- 1 Since manufacturing, including KAIZEN, is being performed by people, the making of better products requires better people to be developed.
- 2 KAIZEN can't be done by a single person. It can be done by 'everyone's participation (as a team).'
- 3 For KAIZEN, Muda has to be seen by everyone. Otherwise KAIZEN can't progress successfully.

# Three kinds of Muda (waste)



Any action simply consuming human labour, material and money but without enhancing added values is classified as Muda.

Many kinds of Muda can be classified into the following three points.

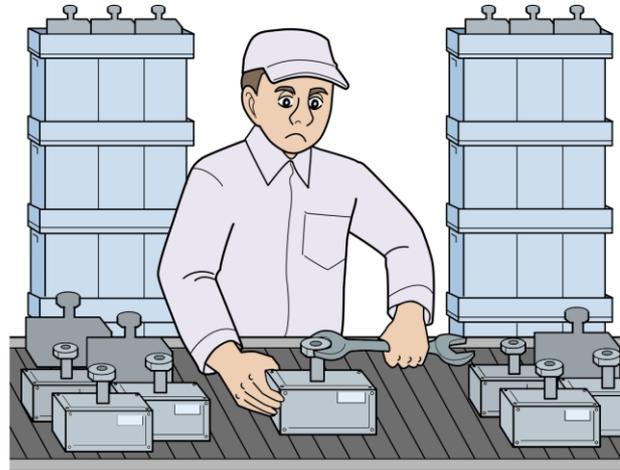
1. Seven types of Muda	The next page shows 7 kinds of Muda seen in typical production situations.
2. Muda seen from material movement	We can classify the material movement into four processes; that is, transportation, stagnation, processing and inspection. However, except for processing, all others are Muda, especially stagnation is the largest Muda.
3. Muda seen from work load and capability	It means a kind of Muda generated from Mura (unevenness) and Muri (beyond capability).

# 7 types of Muda-1

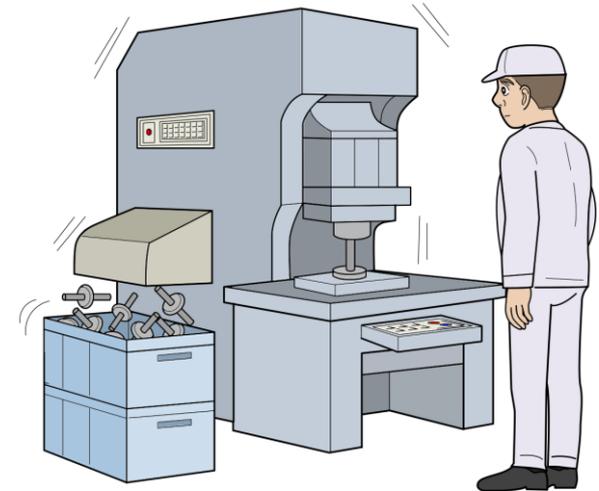
## Seven Muda

Overproduction  
Just waiting/  
Just monitoring  
Transporting  
Processing  
Extra inventory  
Just motion  
Defect making  
or rework

### Overproduction



### Just waiting Just monitoring

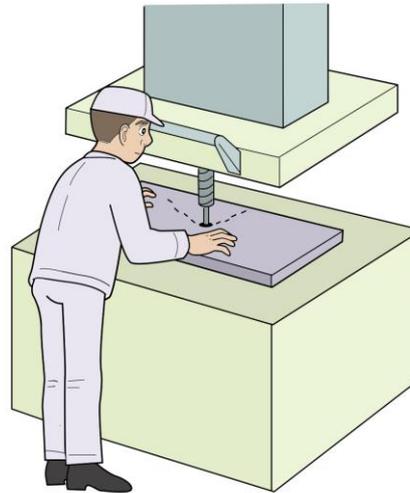


# 7 types of Muda-2

Transporting



Processing



Extra inventory



# 7 types of Muda-3

Just motion



Defect making  
or rework



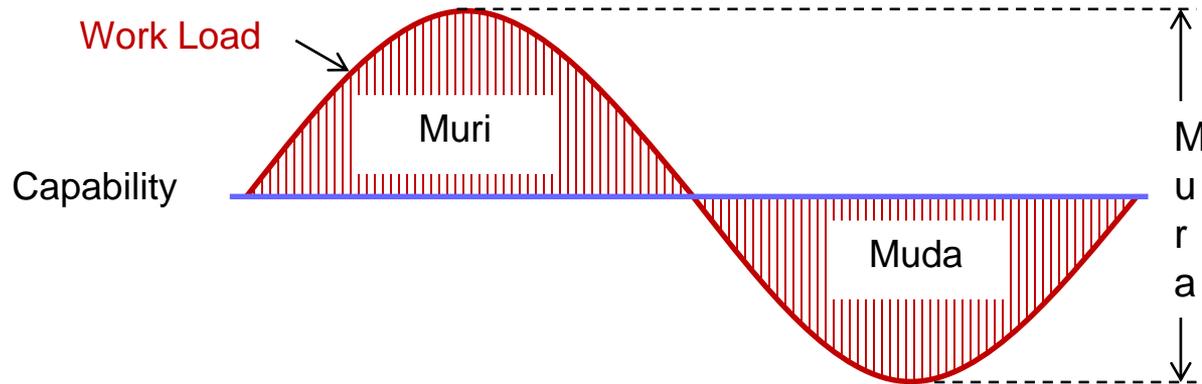
# Muda in four essential processes

Process element	Process description	Added value	Level of Muda
1. Processing	Process to change a shape or characteristics of the production object. For example; Machining, Welding or Painting.	Added value (making of money)	No Muda found
2. Transportation	Change of the positions of the production object	Not added value	Necessary Muda
3. Stagnation	Condition of the production object; whether it's being stored for some reason, or stagnating unplanned	Not added value	Unnecessary Muda
4. Inspection	Quantity and quality checking of the production object to judge on its conformity with standards	Not added value	Necessary Muda

# Muda by Mura or Muri



There is a kind of Muda caused by Mura or Muri. Therefore, if you eliminate Mura or Muri, you can delete Muda caused by them.



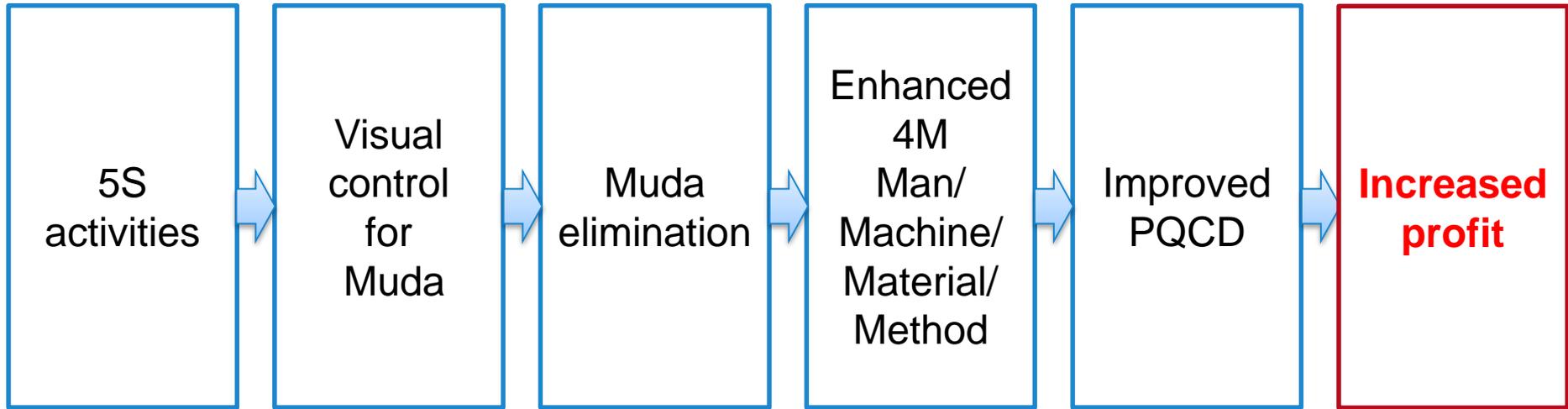
**Load** = Capability.....Good productivity  
**Load** < Capability.....Muda  
**Load** > Capability.....Muri

} Mura...Poor Productivity

You can eliminate Mura and Muri by levelling work load to available capability.

# Appendix

A flow of KAIZEN activities;  
from 5S activities, Muda elimination to increased profit



# Purpose and meaning of 5S

## **Text No. 3-3-2**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Purpose and meaning of 5S

## Contents

- ✓ **What is 5S?**
- ✓ **Seiri (sorting)**
- ✓ **Seiton (setting in order)**
- ✓ **Seiso (shining)**
- ✓ **Seiketsu (standardising)**
- ✓ **Shitsuke (sustaining the discipline)**



# What is 5S? -1

## Seiri

To distinguish between what is and isn't needed; To remove what isn't needed from the situation.

## Seiton

To get ready to pick what you need when you need it at once; To return it to the right place at once.

## Seiso

To keep your workplace clean by removing rubbish, dust or dirt; To keep machinery to be ready to work with at once.

## Seiketu

To repeat Seiri-Seiton-Seiso according to a predetermined schedule, improve the workplace environment and maintain it in good condition all the time.

## Shitsuke

To observe what has been decided; To train people to observe it; To make an improvement at any time if it turns out necessary.

# What is 5S? -2

**Is 5S a clean-up tool?**

**Is 5S just cleaning?**



# What is 5S? -3

5S helps to expose the problems (visualisation).

5S helps to improve the productivity.

5S helps to eliminate the Muda (waste).

5S helps to improve the customer's reputation.

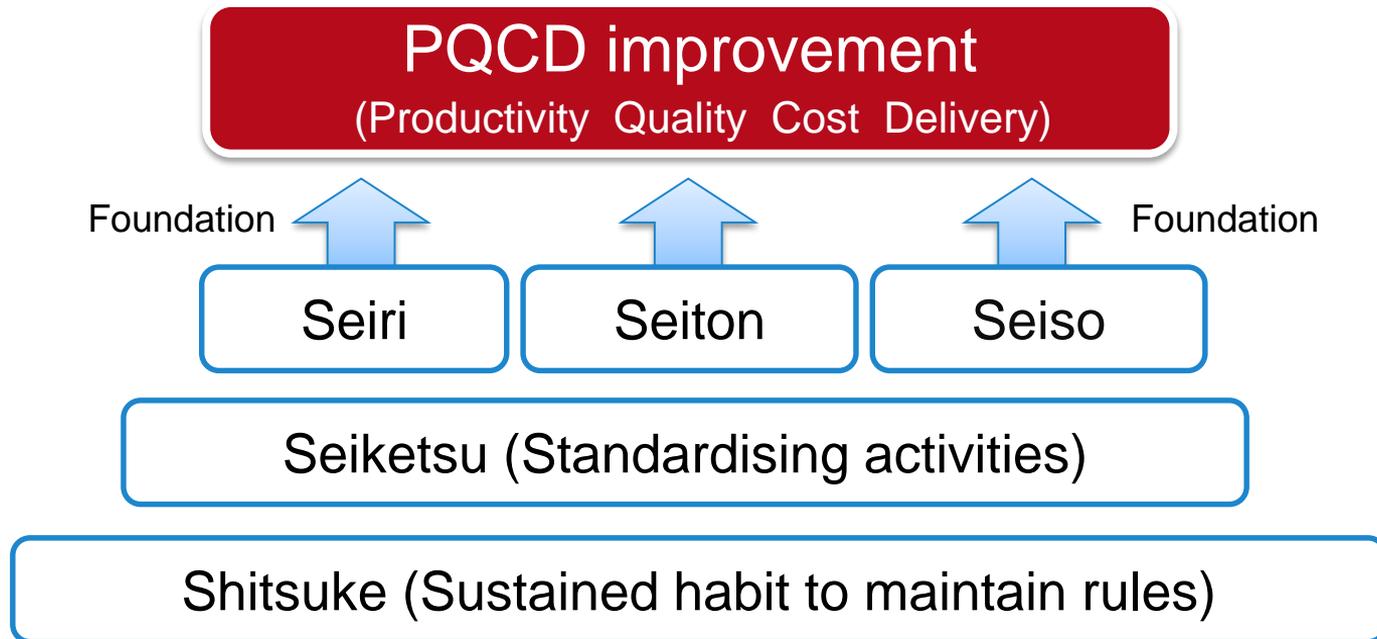
But it's more than that.

**5S is the educational tool to promote behavioural change. Any company that uses 5S only as a clean-up tool, will fail to make an improvement.**

# What is 5S? -4



5S is the foundation of all improvement activities and management.



# Seiri-1



Classify unnecessary items in the workplace, dispose of them, and keep the items only necessary for the current production.



Unnecessary  
items

Necessary  
items

**Distinguished  
and  
Separated**

# Seiri-2

## Important points

- Distinguish between what you need and what you don't.
- Separate important items from unimportant ones.
- Distinguish between frequently used items and less frequently used ones.
- Distinguish between expensive items and inexpensive ones.
- Seiri should be carried out depending upon the situation in each workplace.
- Separate production parts (work-in-progress) from tools.

# Seiton-1



Decide the designated place to keep necessary items in the workplace where they would be easy to access. Arrange things so that the necessary item can be found immediately, returned easily and replenished properly.

The following three pieces of information should be clearly displayed to enable anyone to take out necessary items.



**What?**



**Where?**



**How many?**

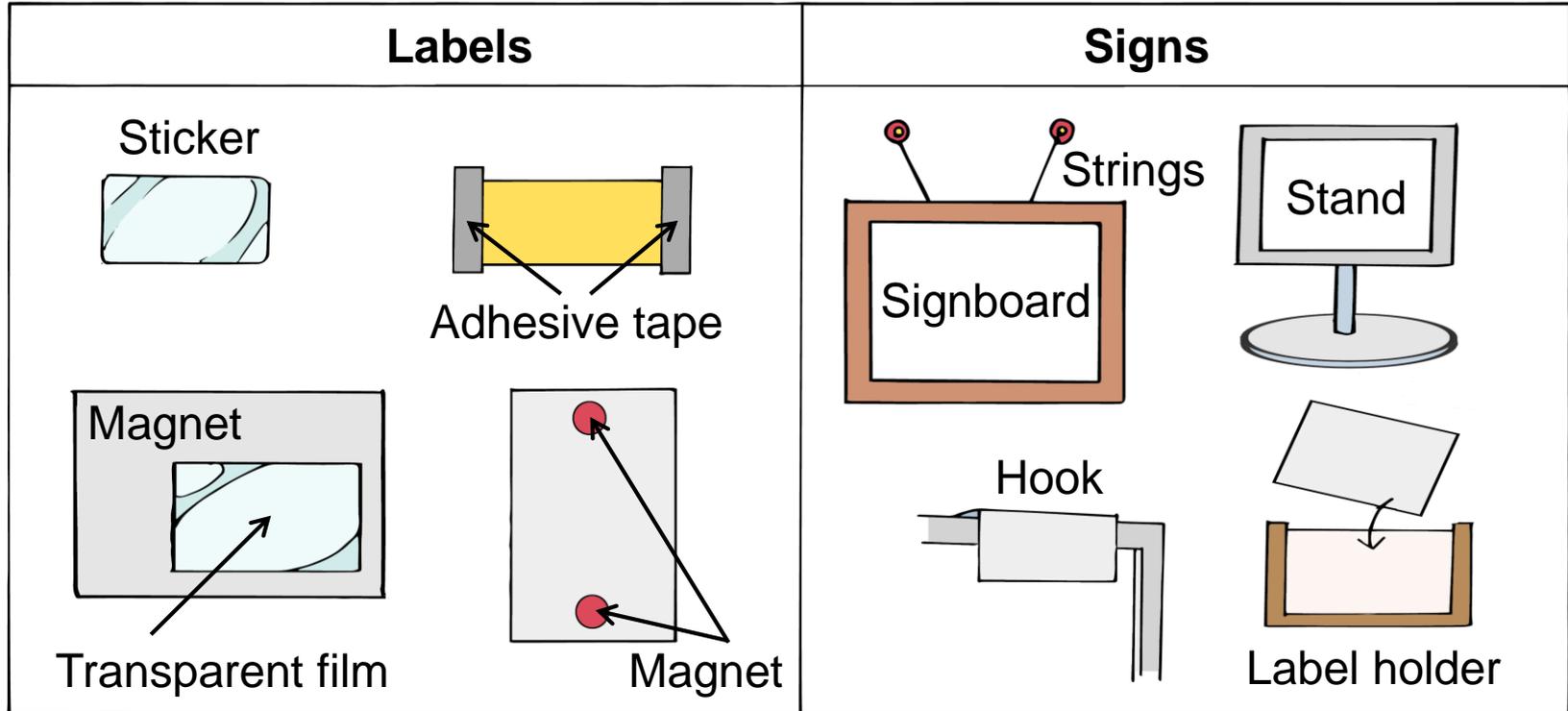
# Seiton-2

## Important points

- Decide what, where, and how many items should be kept.
- Decide what kind of condition is required to keep the necessary items.
- Make it easier to take out the necessary items.
- Decide who is responsible for management of things kept in each place.

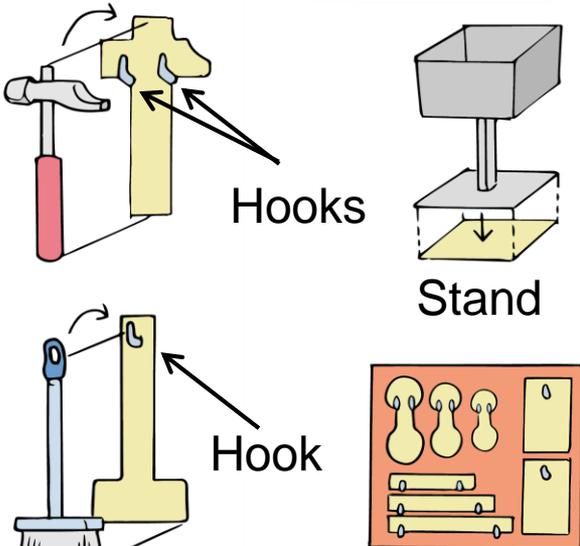
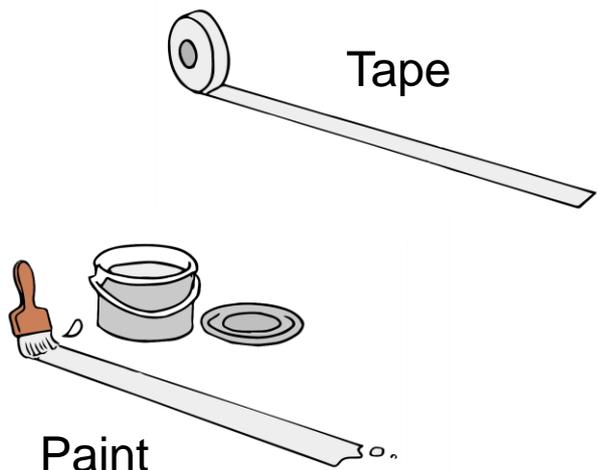
# Seiton-3

## Methods and tools for making Seiton



# Seiton-4

## Methods and tools for making Seiton

Figures	Partition lines
 <p>The 'Figures' section contains four illustrations. Top left: A hammer with a red handle is shown hammering a yellow metal hook into a vertical yellow bar. An arrow points to the hook with the label 'Hooks'. Top right: A grey rectangular box sits on a vertical metal post, which is mounted on a yellow base. An arrow points to the base with the label 'Stand'. Bottom left: A blue-handled tool is shown attaching a yellow hook to a vertical yellow bar. An arrow points to the hook with the label 'Hook'. Bottom right: A red-bordered shadow board is shown with several yellow hooks and tools (screws, washers) arranged in their respective slots. An arrow points to the board with the label 'Shadow board'.</p>	 <p>The 'Partition lines' section contains two illustrations. Top: A roll of white tape is shown unrolling from a circular dispenser. An arrow points to the tape with the label 'Tape'. Bottom: A paintbrush is shown dipping into a bucket of white paint. A small white tray is also visible. An arrow points to the paint bucket with the label 'Paint'.</p>

# Seiton-5

## Example 1: Board of tools

Before Seiton



After Seiton



# Seiton-6

## Example2: Book filing

Before Seiton

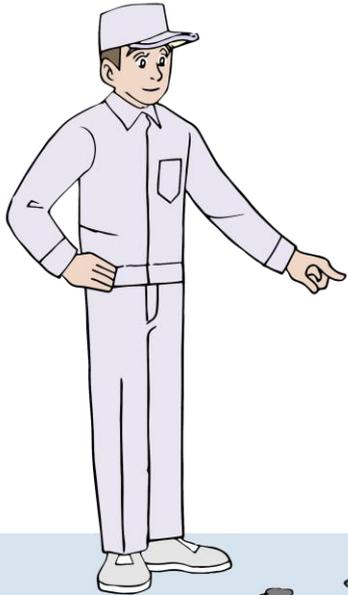


After Seiton



# Seiso-1

What is the purpose of Seiso? To clean and at the same time check; the detailed condition of Seiri and Seiton.



Clean/polish the workplace's floors, equipment and facilities. Provide conditions for easy inspection and put them in good operating conditions. (We call it MIERUKA)

# Seiso-2

## Important points

- Remove unnecessary items from the workplace.
- Eliminate all trash from the workplace.
- Remove dirt adhering to facilities and objects in the workplace.
- Find out sources of dirt and dust and eliminate the causes so they will not return.
- Confirm that all items in the workplace are placed in a designated spot/area.

# Seiketsu-1



Make rules in order to maintain the workplace in a clean condition using Seiri, Seiton, and Seiso activities. These activities must be integrated into everyone's regular work.



**Make rules with all members**



**Make a manual & a checklist**



**Keep 3S with members**

# Seiketsu-2

## Important points

- Keep clothes clean, neat and tidy.
- Determine the lanes and line markings that distinguish equipment areas, aisles, storage spaces, etc.
- Make checklists, manuals, rules, etc., in order to keep the area and things clean.
- Appoint a responsible person for the activities to maintain a clean workplace.

# Shitsuke-1



The basis of social life and work life is to comply with the established rules and regulations. In the workplace, work is done collaboratively. So if someone doesn't follow the rules and regulations, it will cause confusion. Selfish actions are not allowed.



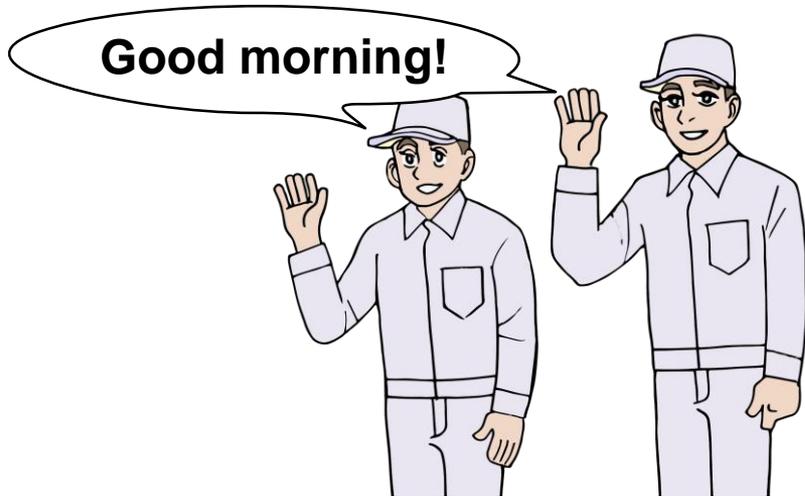
Shitsuke is a Japanese word having the combined meaning of education, training, discipline and so forth. By Shitsuke people learn the mindset to follow social rules, workplace rules and/or business etiquette such as being punctual, greeting each other and/or keeping work standards.

# Shitsuke-2

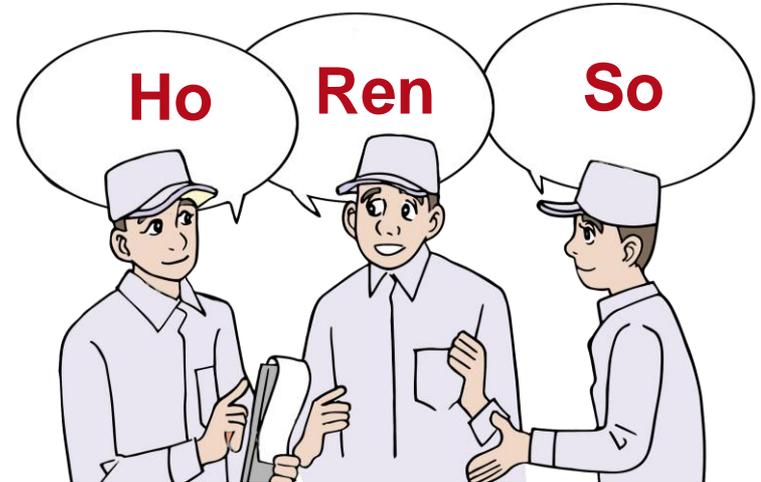


To realise Shitsuke;

- Teach rules, etiquette, etc., over and over again.
- Start in an easy matter such as everyday greetings.



Shitsuke here is to teach the necessity of greeting each other.



Training to practice Hou-Ren-Sou is one part of Shitsuke.

# Shitsuke-3

## Important points

- Determine each standard condition of Seiri, Seiton, Seiso, and Seiketsu.
- Make work-standards, checklists, manuals and rules on how to proceed with 5S.
- Confirm all the rules and agreements that already exist.
- Be sure to observe work-standards, checklists, manuals and existing rules.

# Seiri of 5S

## **Text No. 3-3-3**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Seiri of 5S

## Contents

- ✓ **Seiri in 5S activities**
- ✓ **Seiri, the starting point of 5S**
- ✓ **Criteria to distinguish between the necessary and unnecessary**
- ✓ **Why do unnecessary things exist?**
- ✓ **Red label for disposable items**
- ✓ **Visual control for unnecessary things**
- ✓ **Sorting of unnecessary things**



# Seiri in 5S activities

## Seiri

To distinguish between what is and isn't needed; To remove what isn't needed from the situation.

## Seiton

To get ready to pick what you need when you need it at once; To return it to the right place at once.

## Seiso

To keep your workplace clean by removing rubbish, dust or dirt; To keep machinery to be ready to work with at once.

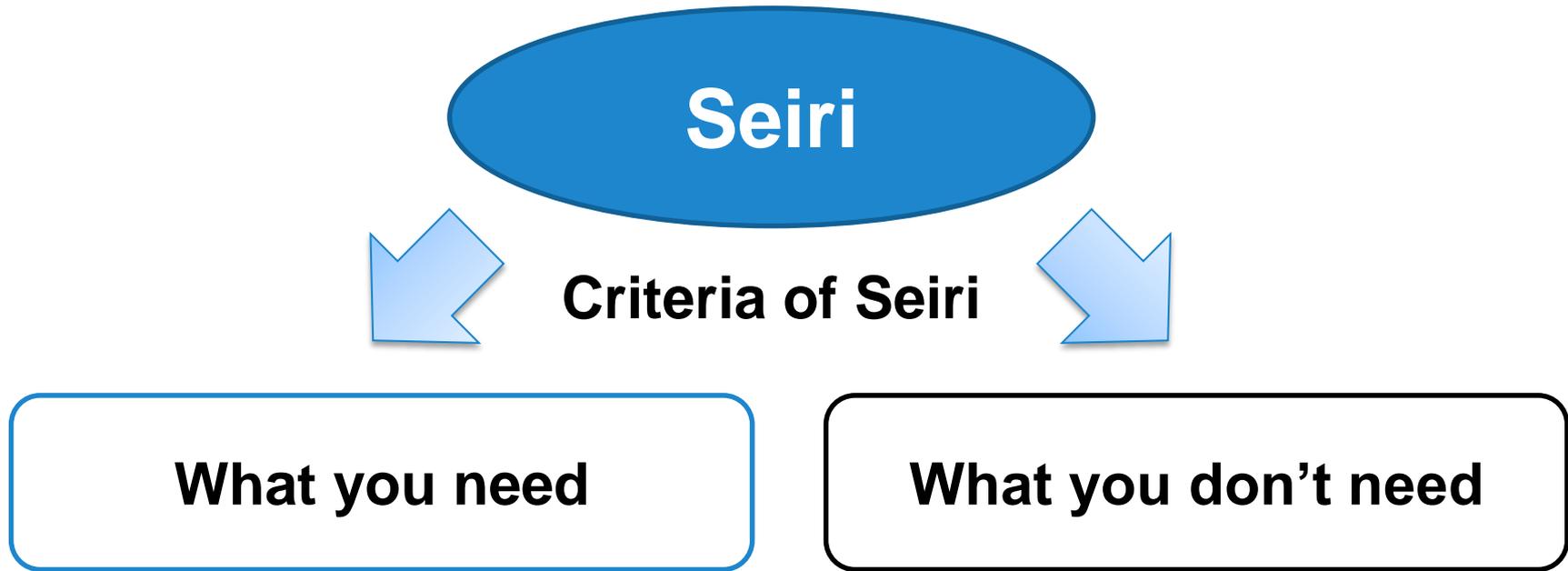
## Seiketu

To repeat Seiri-Seiton-Seiso according to a predetermined schedule, improve the workplace environment and maintain it in good condition all the time.

## Shitsuke

To observe what has been decided; To train people to observe it; To make an improvement at any time if it turns out necessary.

# Seiri, the starting point of 5S -1



Cut waste by Seiri!

All things that you find that you don't need are Muda

# Seiri, the starting point of 5S -2

## Seiri



# Criteria to distinguish the necessary & unnecessary-1

## Criteria of use/disuse

### Factors to define judgement criteria

Property of product

With or without deterioration and its stored duration

With or without corrosion/decay and its stored duration

With or without expiration date and its stored duration

### How long it has been unused

Unused for over half a year

Being left intact over a year

Being left intact over two years

# Criteria to distinguish the necessary & unnecessary-2

## Disposal criteria of disuse

You should classify the things that have been categorised as “unnecessary” even further with the following criteria.

1. Things which can be used by reworking
2. Things which can be recycled
3. Things which should be disposed of immediately

# Why do unnecessary things exist? -1

## Why do we see so many unnecessary things around us?

The following are the possible reasons:

- Little consciousness about Seiri. You keep it, because you think that you will have a chance to use it someday.
- There are no fundamental rules or standards for Seiri. The definition between “necessary things” and “unnecessary ones” is ambiguous.
- The concept of Muda isn't necessarily understood properly. Some people don't regard 'over-production', 'extra work-in-progress' or 'extra inventory' as Muda.

# Why do unnecessary things exist? -2

## Why do you keep those unnecessary things?

1. Keeping them as they may sell or be used someday.
2. Keeping them as they may become useful for something.
3. Keeping them without any special reason, though the person knows they aren't necessary.



Keeping unnecessary things causes a lot of Muda.

1. Keeping these unnecessary things requires extra space.
2. It needs time and labour to control them. It simply costs without gain.
3. It's just increasing loss and Muda.

# Red label for disposable items-1

## Red label activity: How to do it?

Affix a 'red label' to unnecessary things so that everyone can see what is needed and what isn't at first glance.



1. Set up criteria to distinguish between what is needed and what isn't.
2. Make red labels.
3. Determine when the red label activity should be conducted with date and time.

# Red label for disposable items-2

## When to affix red labels?

<p>By schedule</p>	<p>It should be practiced all together on a regular basis. (Like at 3 p.m. every Friday or at 3 p.m. of the last day of each month.)</p>
<p>When it's required</p>	<p>Affix a red label when you find defects. (Be careful not to mix up non-defective and defective items.)</p>

# Visual control for unnecessary things-1

## 5W1H

## Making a list of unnecessary things

What	What is unnecessary; Record the name.
Where	Where it is; Record the place.
When	How long it has been placed there; Record the duration.
Who	Who instructed to manufacture or purchase them; Record the name of organisation or person.

# Visual control for unnecessary things-2

## 5W1H

## Making a list of unnecessary things

Why	Find a reason why they became unnecessary and record it.
How many	Identify amount of things that became unnecessary; Record the number.
Measures	Describe the recurrence prevention measures, if it's taken. Record the contents of the measures, the date when it was made and its effect.

# Sorting of unnecessary things-1

**Seiri**

```
graph TD; Seiri([Seiri]) --> Criteria[Criteria of Seiri]; Criteria --> Needed[What is needed]; Criteria --> NotNeeded[What isn't needed]; NotNeeded --> Sorting[Sorting criteria of unnecessary things];
```

**Criteria of Seiri**

**What is needed**

**What isn't needed**

**Sorting criteria of unnecessary things**

# Sorting of unnecessary things-2

## Sorting criteria of unnecessary things

Reuse after reworking	Comply with the quality standards specified in drawings, specifications, etc.
Recycle	Set up the recycling standards including how to separate recyclable things from others.
Disposal	Comply with applicable laws and regulations for disposal.

# Sorting of unnecessary things-3

## Detailed contents of red labels affixed to unnecessary things

1. Classification	1. Raw material 3. Semi finished 6. Dies and Jigs	2. Work in progress 4. Product 7. Tools	5. Machinery 8. Others
2. Product name			
3. Product Model / Product number			
4. Quantity / Monetary value			
5. Reason for being unnecessary thing	1. Disuse 4. Waste	2. Defect 5. Unknown	3. Not urgent 6. Others
6. Solution	1. Discard area	2. Return 4.Storage	3. Move to red label 5. Others
7. Date	Label affixed date : Enforcement date :		
8. Reference No.			

## List of unnecessary things

**Fiscal year 2019**

**Fiscal year 2018**

**Fiscal year 2017**

Record the history of how they became unnecessary things.



Take measures to prevent the same kinds of unnecessary things from being made again.

# Seiton of 5S

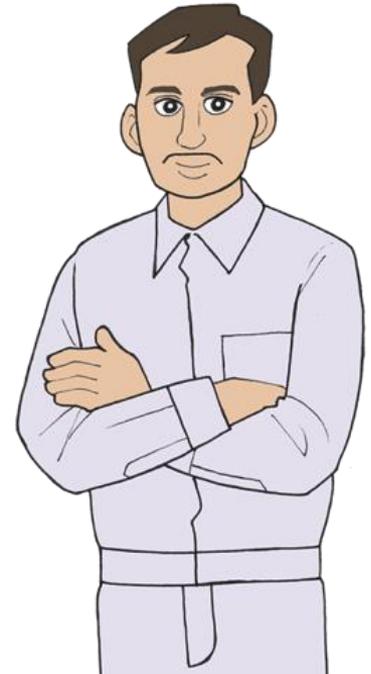
## Text No. 3-3-4

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Seiton of 5S

## Contents

- ✓ **Seiton in 5S activities**
- ✓ **Seiton 'visualises' what you need**
- ✓ **How to determine 'where to place'**
- ✓ **Making a map for 'places'**
- ✓ **Determine how to place it**
- ✓ **Key points of Seiton for jigs and tools**
- ✓ **Key points of Seiton for machinery**



# Seiton in 5S activities

## Seiri

To distinguish between what is and isn't needed; To remove what isn't needed from the situation.

## Seiton

To get ready to pick what you need when you need it at once; To return it to the right place at once.

## Seiso

To keep your workplace clean by removing rubbish, dust or dirt; To keep machinery to be ready to work with at once.

## Seiketu

To repeat Seiri-Seiton-Seiso according to a predetermined schedule, improve the workplace environment and maintain it in good condition all the time.

## Shitsuke

To observe what has been decided; To train people to observe it; To make an improvement at any time if it turns out necessary.

# Seiton 'visualises' what you need-1



Seiton means making it possible for anyone to find necessary things at the necessary time and return them to the right place easily.

## Purpose of Seiton

Anyone can find a storage place immediately.

Appropriate amount is to be stored to avoid shortage and/or excess of stock.

Things should be placed in the right direction so that anyone can pick and return them easily.

## Definition of three 'Tei' elements

Tei-ichi: Meaning a pre-determined place.

Tei-ryo: Meaning a pre-determined amount.

Tei-hoko: Meaning a pre-determined direction.

# Seiton 'visualises' what you need-2

## Requirement for Seiton

Anyone should be able to find a necessary thing immediately whenever it's required and return it to the right place after it's used.

Conditions to meet this requirement:

- Decide where to keep them with a certain regularity.
- Display the name, a drawing number, etc., of each item to be kept.
- Make a map of all storage places.

# Seiton 'visualises' what you need-3

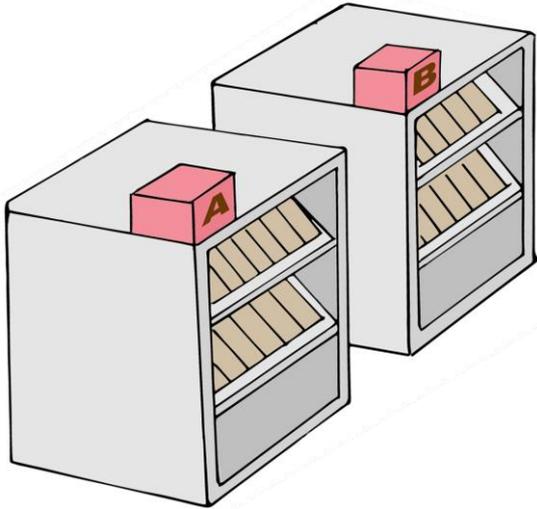
## Purpose of Seiton

Everyone should be able to find a necessary item easily at the time when it's needed, use it and return it to the right place.

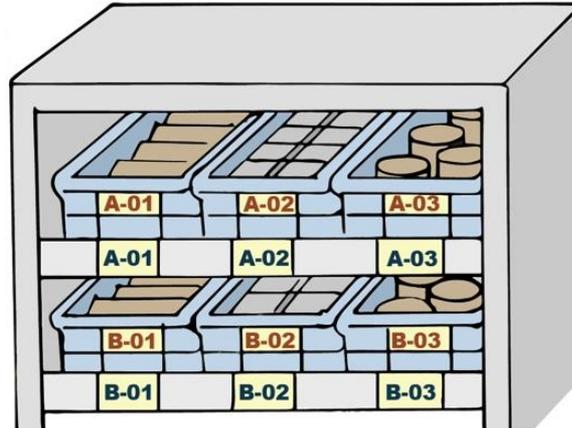


# Seiton 'visualises' what you need-4

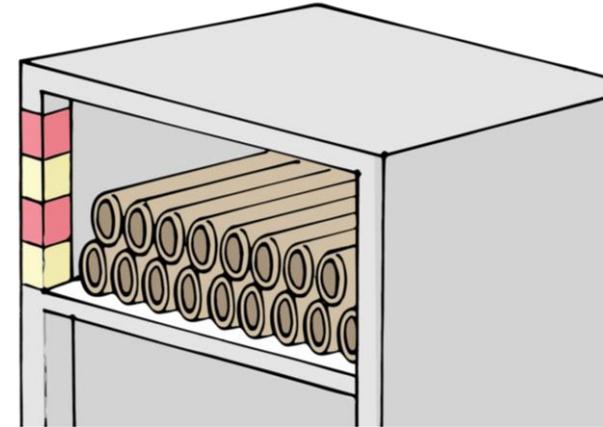
## Examples of 3-Tei



Tei-ichi (Place)



Tei-ryo (Amount)



Tei-hoko (Direction)

# How to determine 'where to place'-1

**Sort the following things by type to determine where to place them:**

-  Purchased materials and parts
-  Work-in-progress during processing
-  Finished products
-  Tools and auxiliary materials

# How to determine 'where to place'-2



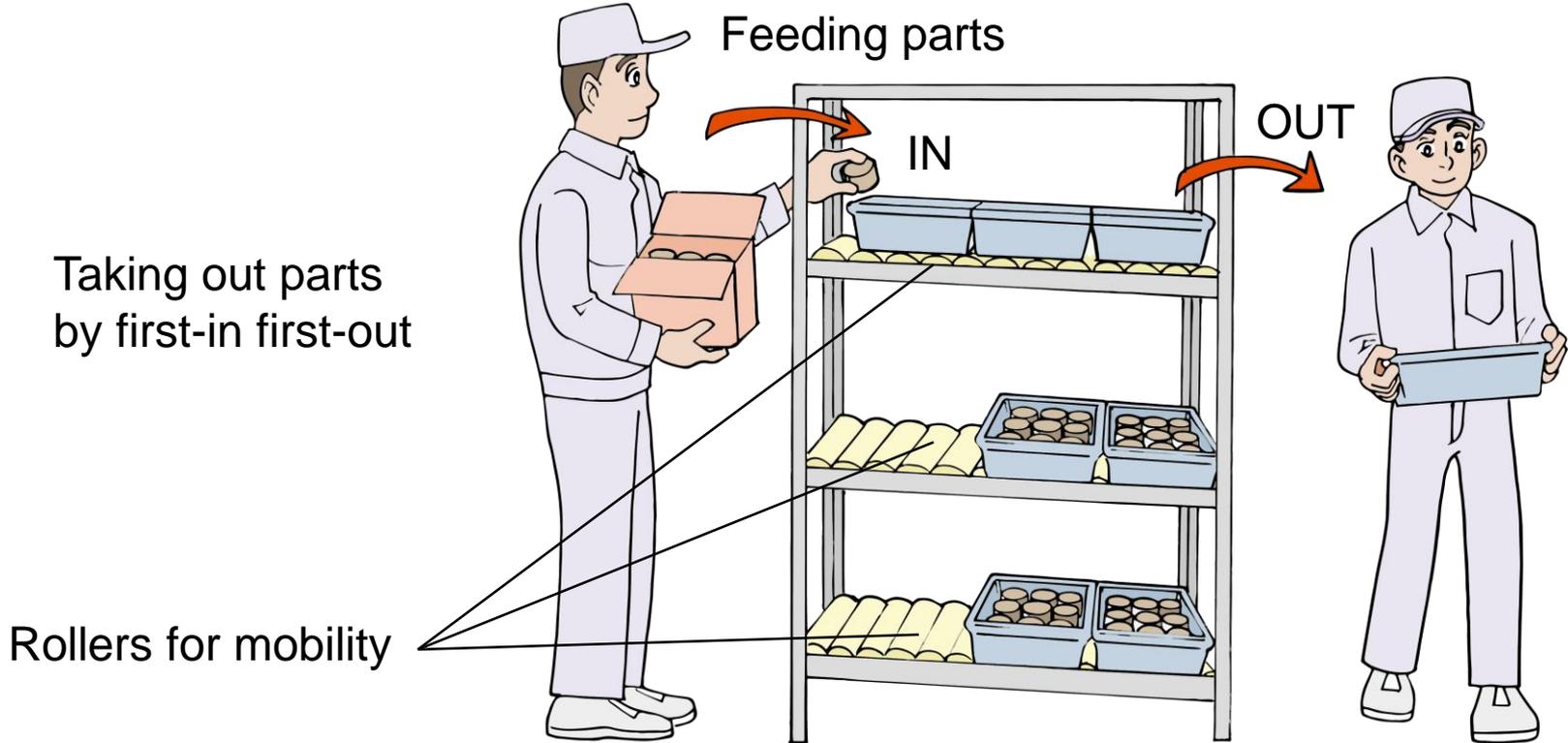
Determine a storage place that's good for efficient operation after defining the shape and the amount of the stored items.

-  Keep them at a nearby place for use.
-  Make it easier to take and/or return them.
-  Place heavy things on the lower level and light ones on the upper level.
-  Make a good arrangement for first-in first-out operation.

# How to determine 'where to place'-3

## Case 1

## First-in, first-out



# How to determine 'where to place'-4

## Case 2

**Keeping parts and tools at a nearby place for use**



# Making a map for 'places'-1



Make everyone aware of the storage place by making a map with addresses.

## Key points of location map

1. Show the location of the storage place such as the location of shelves and racks on a **layout drawing** of the workplace/factory.
2. Divide the workplace/factory into small areas and **assign an address** to each divided area with regularity. Now the shelves and racks have addresses/numbers of the area in which they are placed.
3. After defining the locations of shelves and racks by numbers, add a detailed block number on each shelf and rack as **branch addresses**.

# Making a map for 'places'-2



ASSEMBLY SHOP 3		
RACK 1		
LOCATION		DESCRIPTION
T R A Y 5	VSR BIN 1	BIT SOCKET MAGNET 8X200
	BIN 2	BIT SOCKET MAGNET 10X75
	BIN 3	BIT SOCKET MAGNET SPR. 10X75
	BIN 4	BIT SOCKET MAGNET 10X100
	BIN 5	BIT SOCKET MAGNET SPR.10X100
	BIN 6	BIT SOCKET MAGNET 10X150
	BIN 7	BIT SOCKET MAGNET SPR.10X150
	BIN 8	BIT SOCKET MAGNET SPR.10X200
	BIN 9	BIT SOCKET MAGNET 12X75

ASSEMBLY SHOP #



RACK #



TRAY #



BIN #

# Determine how to place it-1



After deciding where to keep an item, you should decide how it should be placed and stored. Consider the things such as storage shape, type, method and other things to which attention needs to be paid.

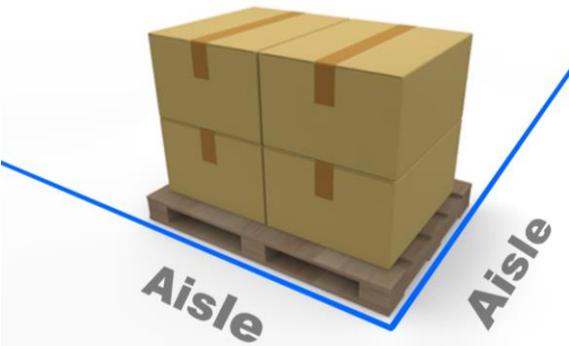
## Key points of placing

1. Place things in parallel or perpendicular to an aisle or a shelf.
2. Place them so they will not collapse.
3. Don't place them directly on the floor.
4. Take necessary action to prevent quality deterioration.
5. Place them not to fall in case of earthquakes, etc., and so on.

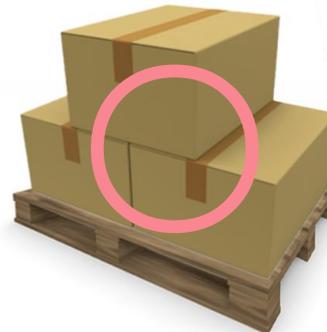
# Determine how to place it-2

Place them in parallel or perpendicular to a shelf or an aisle.

Don't allow them to collapse while they are stored.



## How to place them



Don't place them directly on the floor.

# Key points of Seiton for jigs and tools-1

## Key points of Seiton for jigs and tools

1. Sort out jigs and tools by types and shapes and arrange them with a certain regularity.
2. Arrange them by sizes in the same group of types and shapes.
3. Paint contours where they will be placed.

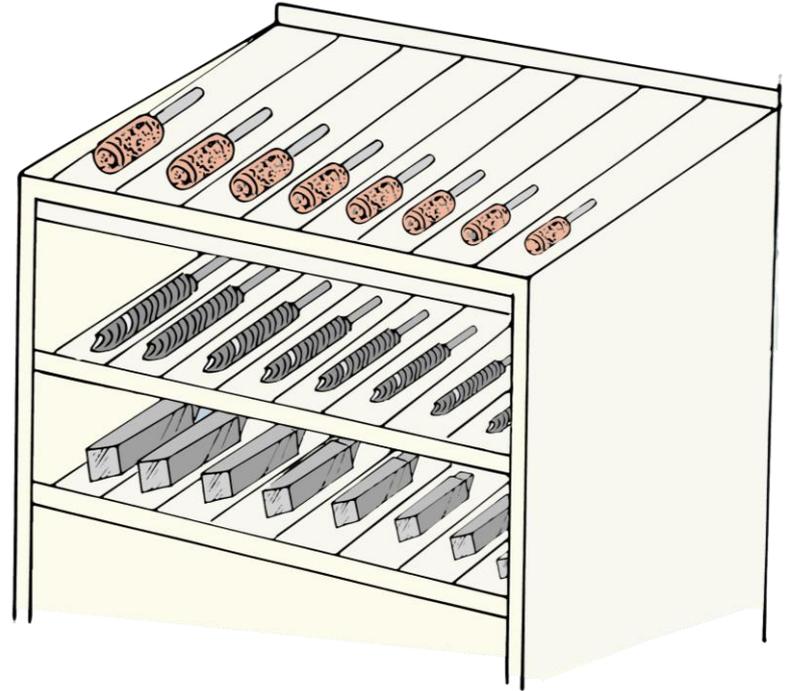
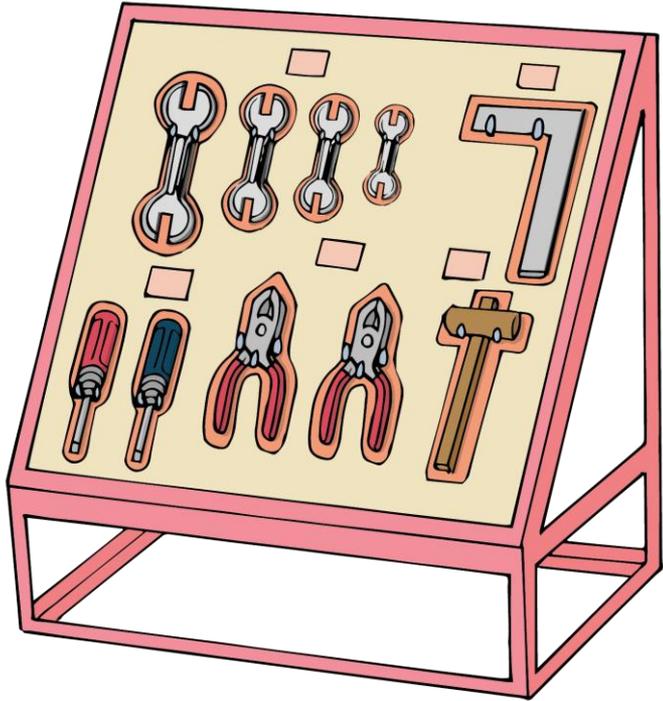


Shorter setting up time and higher work efficiency



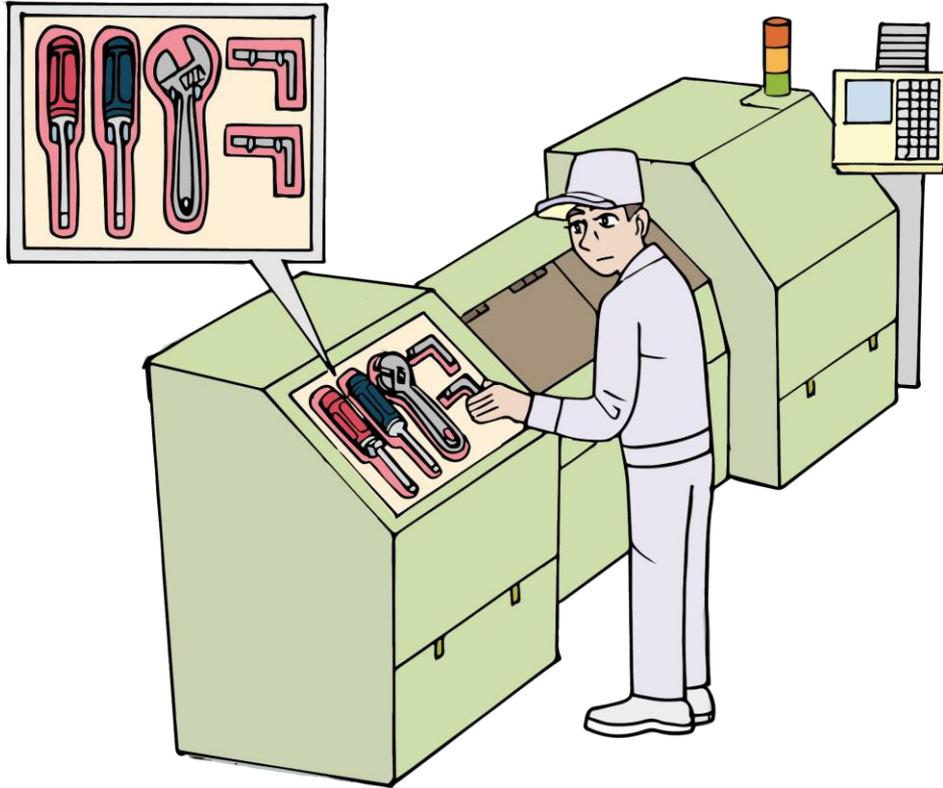
Higher productivity and profitability

# Key points of Seiton for jigs and tools-2



Tools should be kept in an open space

# Key points of Seiton for jigs and tools-3



Where should the tools be placed?

Should be easily recognisable.

Should be near the place they will be used.

# Key points of Seiton for machinery

## Key points of Seiton for machinery

1. Daily check; Implement a daily check with an inspection check sheet.
2. Cleaning and maintenance; Practice cleaning and maintenance according to the procedures and manuals. Review and update them regularly.
3. Define the communication method for the time when a problem is found.



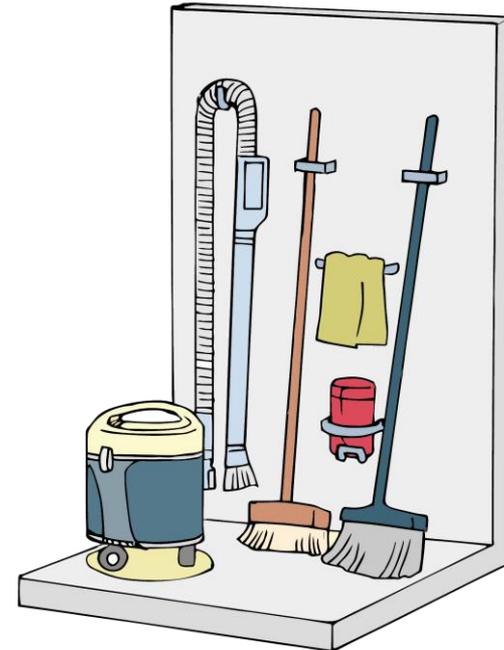
Shorter setting up time and higher work efficiency



Higher productivity and profitability

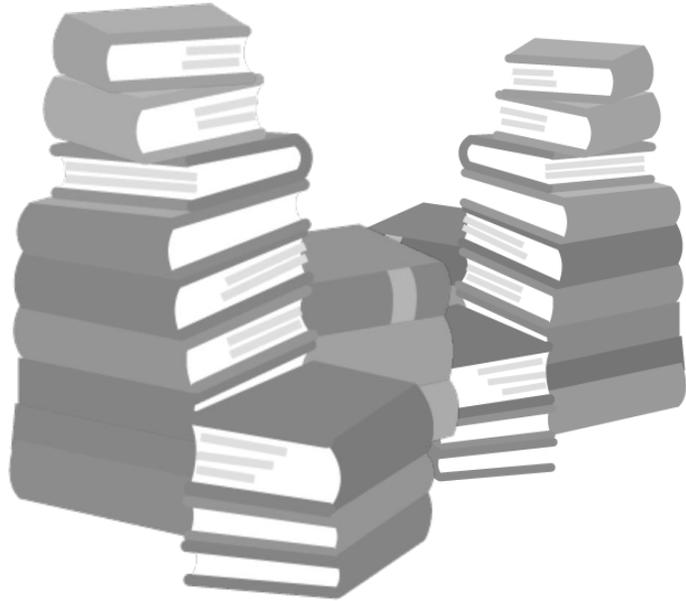
# Example of Seiton-1

Open control is important for Seiton of cleaning tools



# Example of Seiton-2

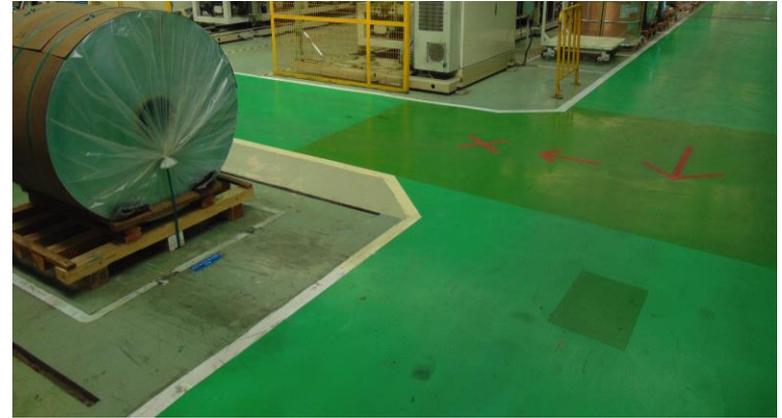
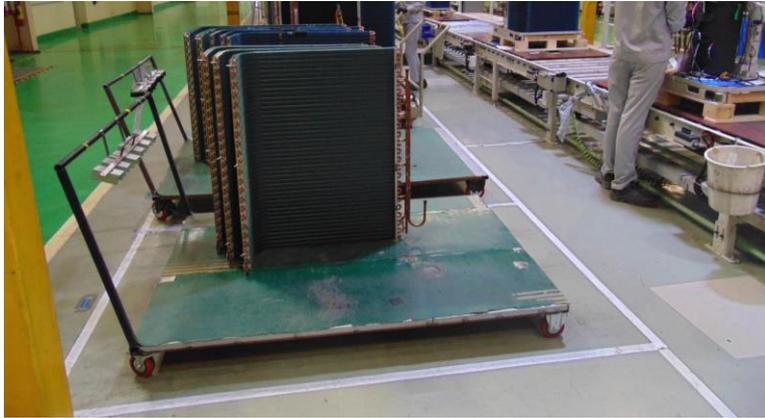
Before



After



# Appendix



# Seiso of 5S

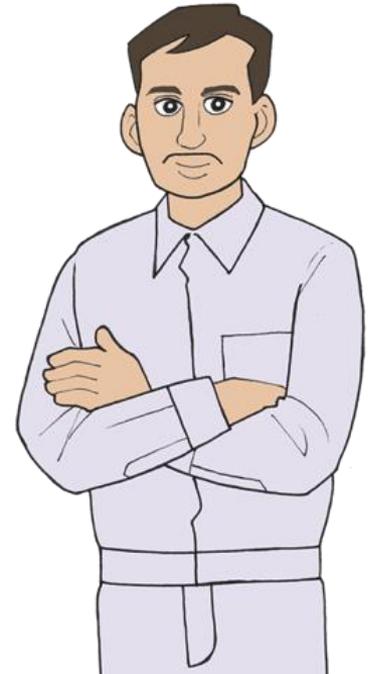
## Text No. 3-3-5

Soft Skill Text for  
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# Seiso of 5S

## Contents

- ✓ **Seiso in 5S activities**
- ✓ **What is Seiso?**
- ✓ **Important point of Seiso activities**
- ✓ **Prepare tools for cleaning**
- ✓ **Seiso means checking of the workplace**
- ✓ **Plan for Seiso implementation**
- ✓ **Seiso of aisles and floors**
- ✓ **Seiso of machinery**
- ✓ **Muda becomes visible by Seiso**



# Seiso in 5S activities

## Seiri

To distinguish between what is and isn't needed; To remove what isn't needed from the situation.

## Seiton

To get ready to pick what you need when you need it at once; To return it to the right place at once.

## Seiso

To keep your workplace clean by removing rubbish, dust or dirt; To keep machinery to be ready to work with at once.

## Seiketu

To repeat Seiri-Seiton-Seiso according to a predetermined schedule, improve the workplace environment and maintain it in good condition all the time.

## Shitsuke

To observe what has been decided; To train people to observe it; To make an improvement at any time if it turns out necessary.

# What is Seiso?



Purpose of Seiso is not just sweeping, wiping or cleaning your workplace.

**Seiso**

```
graph TD; A[Seiso] --> B[Visualisation and detection of Muda/abnormalities]; B --> C[Making defects/breakdowns/accidents zero]; C --> D[Higher productivity];
```

**Visualisation and detection of Muda/abnormalities**

**Making defects/breakdowns/accidents zero**

**Higher productivity**

# Important point of Seiso activities

1. Let everyone understand the purpose of cleaning.
2. Prepare tools for cleaning.
3. Maintain those tools in good shape. (Seiri and Seiton)
4. Identify the person responsible along with the area that has to be clean.
5. Define the area to be cleaned periodically.
6. Keep a record of any abnormality found during cleaning on the checklist and take measures.

# Prepare tools for cleaning-1

**First step of Seiso is to prepare necessary tools for cleaning.**

## 1. Cleaning tools to be prepared

- Broom, mop and vacuum cleaner to clean a floor.
- Scrubbing cloth to clean work tables, desks and shelves.
- Waste cloth, scrub brush, thinner, detergent and tools to clean machinery and equipment.
- Stepladder and chair to use for cleaning high places.
- Paint to draw lines such as a line separating work areas from aisles.

# Prepare tools for cleaning-2

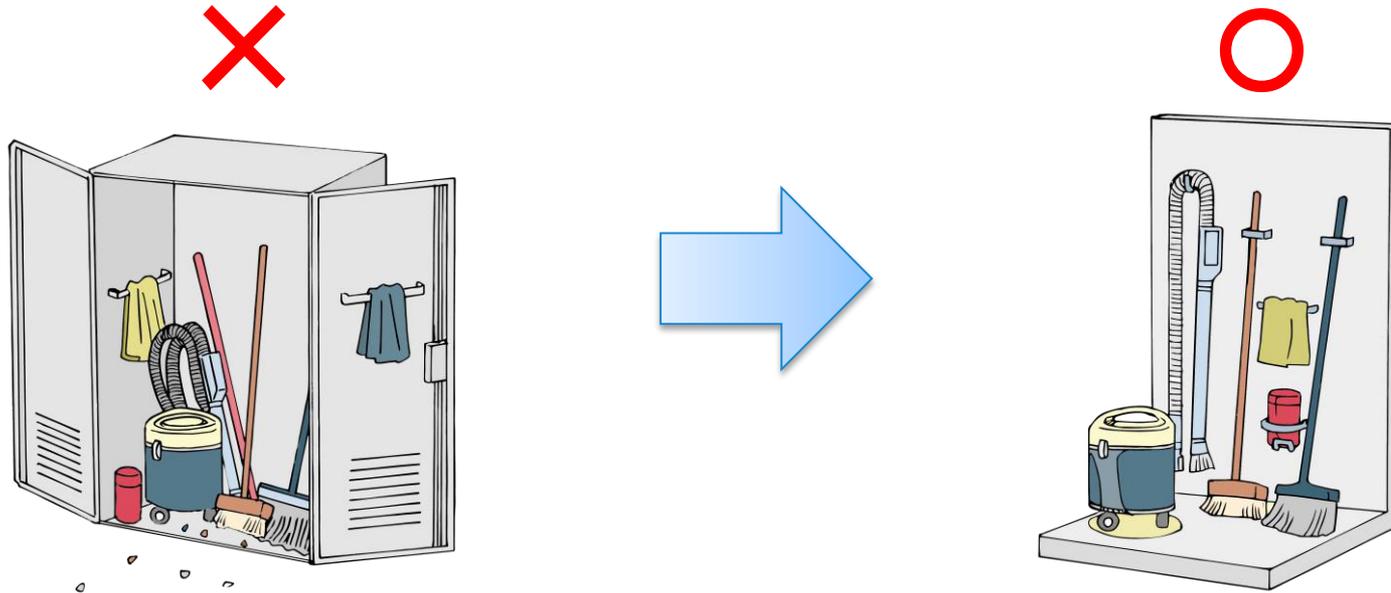
**First step of Seiso is to prepare necessary tools for cleaning.**

## 2. Better management of those tools

- Appoint persons to be in charge.
- Decide where and how they should be kept.
- Decide when and how they should be checked.
- Demonstrate how to use those tools and confirm that all concerned have understood.

# Prepare tools for cleaning-3

Open control is important for Seiri & Seiton of cleaning tools



The cleaning tools should be kept in an open space. Don't put them in a closed space like a cabinet. They should be always visible for everyone.

# Prepare tools for cleaning-4



# Seiso means checking of the workplace-1



Clean and check with an attitude not allowing any small stain.

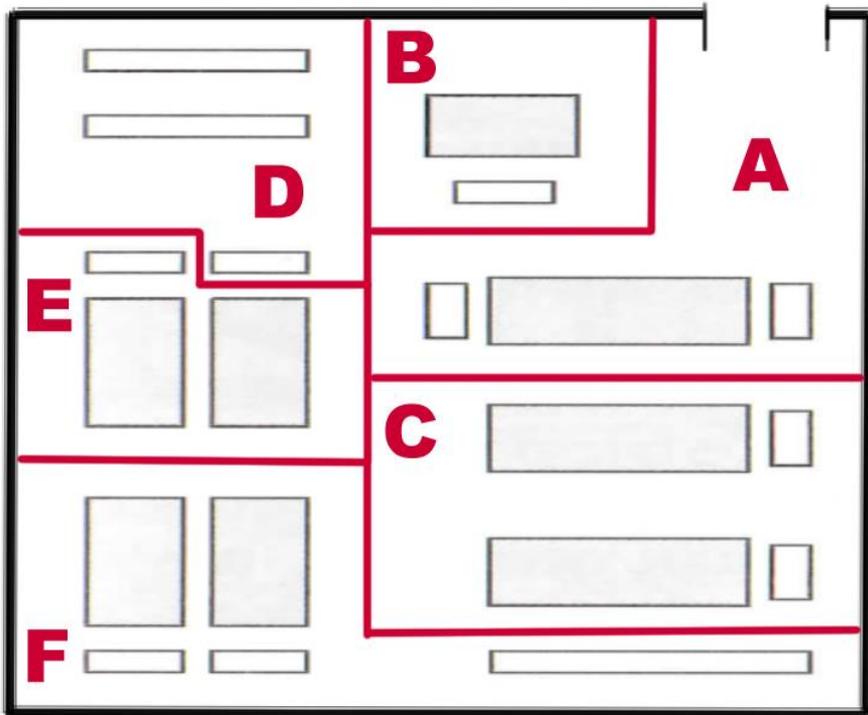
Step		Seiso activities of workplace
1	Cleaning for checking	You cleaned the area yesterday. But it's already dirty today! You are able to notice the dirt because you once made it clean. That means your cleaning work makes it possible to detect an abnormality. In a clean environment, the difference from a normal condition becomes easily noticeable.
2	Analysis of dirt cause	Why it gets dirty? Look for the cause.
3	KAIZEN solution	By knowing the cause, you can take necessary measures to remove the cause.

# Plan for Seiso implementation-1

	Daily check	Periodical check
Time and frequency	<ul style="list-style-type: none"><li>• Work start time, work finish time, changeover time</li></ul>	<ul style="list-style-type: none"><li>• Weekly (every Monday)</li><li>• Monthly (last day of the month)</li><li>• Bimonthly (first day of the odd month)</li></ul>
Object of cleaning	<ul style="list-style-type: none"><li>• Critical parts for safety and quality</li><li>• Parts easy to clean and check</li></ul>	<ul style="list-style-type: none"><li>• Less critical parts for safety and quality</li><li>• Parts hard to clean and check due to location and time</li></ul>
Remarks	<ul style="list-style-type: none"><li>• As for parts that are difficult to clean but are still critical for safety and quality, some measures need to be devised to make cleaning possible.</li><li>• Set up checking rules considering the effects on safety and quality.</li></ul>	

# Plan for Seiso implementation-2

## Example; Seiso checking map



Check List for Weekly Seiso

	A	B	C	D	E	F
Mon.	✓	✓	✓	✓	✓	✓
Tue.	✓	✓	✓	✓	✓	✓
Wed.						
Thu.						
Fri.						
Sat.						

# Seiso of aisles and floors-1



It is essential to start Seiso from the aisles and floors first, do it thoroughly and finally expand 5S activities to all areas.

Points for Seiso of aisles and floors	<ul style="list-style-type: none"><li>• Clean-up for work preparation and cleanup after work</li><li>• First step to start 5S</li></ul>
Effects by cleaned aisles and floors	<ul style="list-style-type: none"><li>• Higher work efficiency and better productivity brought by a removal of work obstacles</li><li>• Better safety by removing the risk of fall while walking</li><li>• Prevention of production errors caused by mixing of foreign objects</li></ul>

# Seiso of aisles and floors-2



# Seiso of machinery-1



Seiso of machinery and equipment means not only keeping it clean but, more importantly, examining its condition.

## Points of Seiso of machinery

- Is there any sign of abnormality like dirt or scratches at sliding parts?
- Is there any strange noise or abnormal temperature rise during operation?
- Is lubrication supplied adequately? Is there any oil leak?
- Is there any error in instruments like pressure gauges, current gauges, etc.?
- Are those attached instruments showing normal range readouts?
- Is there any abnormality in the finish of products/parts after processing?
- Are there any oil drops or metal chips spread around the area?

# Seiso of machinery-2

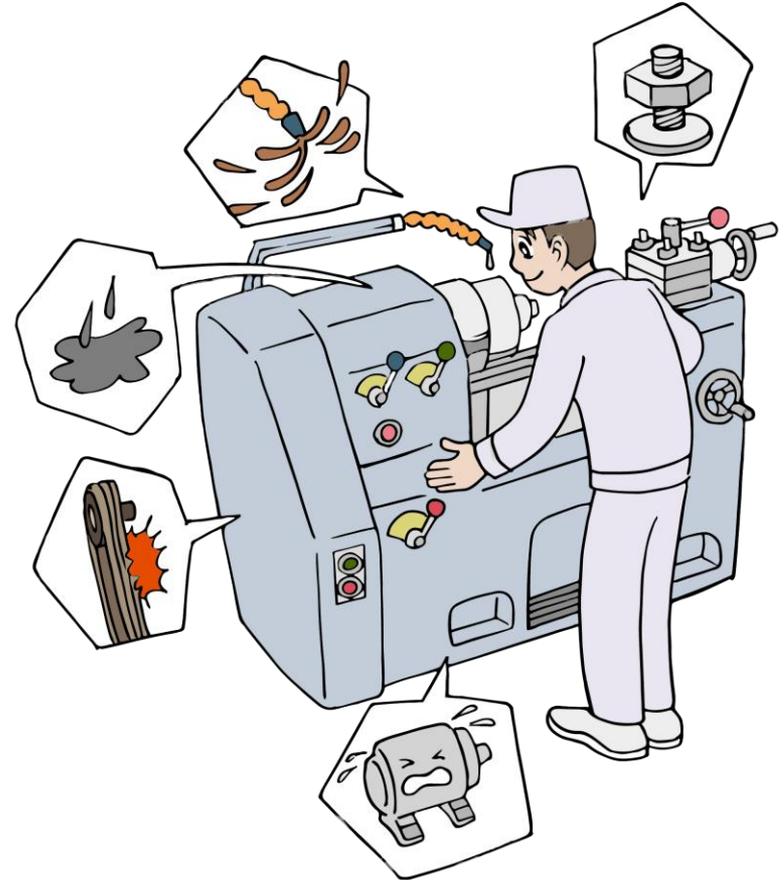
## Effect of Seiso of machinery

- It enables you to operate that machine normally whenever you want to use it.
- It enables you to secure quality of products.
- It enables you to detect any abnormality with machinery and prevent it from breaking down.
- It prevents metal chips and cutting oil from spreading and secures safety of operation.

# Seiso of machinery-3

## Cleaning points

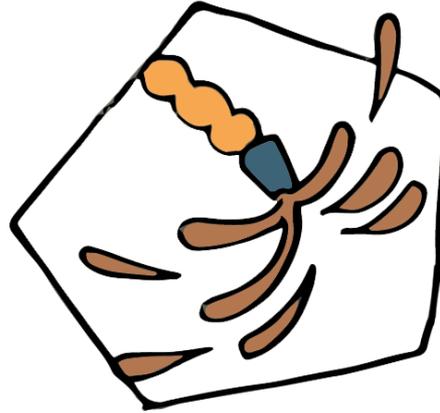
- Is there any sign of abnormality like dirt or scratches at sliding parts?
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- Is lubrication supplied adequately?  
Is there any oil leak?
- Is there any error in instruments like pressure gauges or current gauges, etc.?
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- Is there any abnormality in the finish of products/parts after processing?
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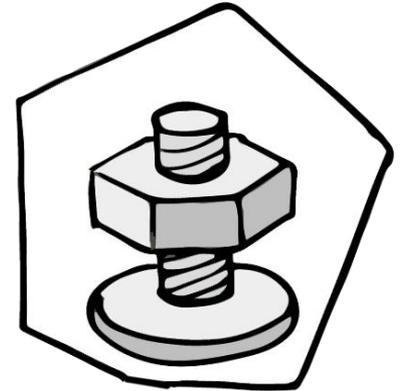
# Seiso of machinery-4



- Are there any oil drops or metal chips spread around the area?



- Is lubrication supplied adequately?
- Is there any oil leak?



- There is some abnormal sound from the machine.
- Might it be caused by a loose bolt?

# Muda becomes visible by Seiso



Keeping your place clean makes other dirty areas and abnormality more visible spontaneously.

Muda is hard to find when something stays in messy and/or dirty conditions.



Messy and/or dirty work place has more Muda inside.



So, a messy and/or dirty work place is poor in productivity.

# KAIZEN Workshop by Japanese Origami

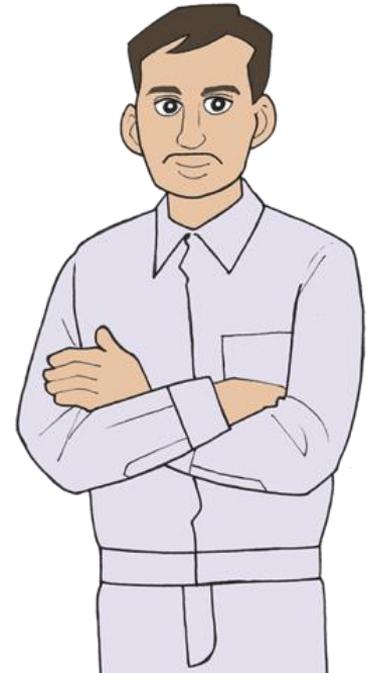
## **Text No. 3-3-6**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# KAIZEN Workshop by Japanese Origami

## Contents

- ✓ **Purpose of Origami workshop**
- ✓ **How to make Shuriken Origami**
- ✓ **Procedure of Shuriken workshop**
- ✓ **Shuriken workshop**
- ✓ **Comparison of actual workshops**
- ✓ **Appendix**



# Purpose of Origami workshop

- To learn KAIZEN, or to learn how work should be improved, through hands-on exercise of making Shuriken (Ninja throwing star) by introducing Origami work
- Objectives for KAIZEN: Work allocation; Work process; Work motion
- To learn KAIZEN using IE methodology
- To study process analysis, utilisation rate study and motion study

(Note) Shuriken was actually used by Ninja. Ninja was a secret agent in feudal Japan who was highly skilled in stealth and secrecy. See Appendix1.

# How to make Shuriken Origami

1. See the picture of finished work of a Shuriken as a piece of Origami work, a cultural legacy of Japan.

Material: Two sheets of paper, square shaped (15cm x 15cm, two sheets of different design colored paper)

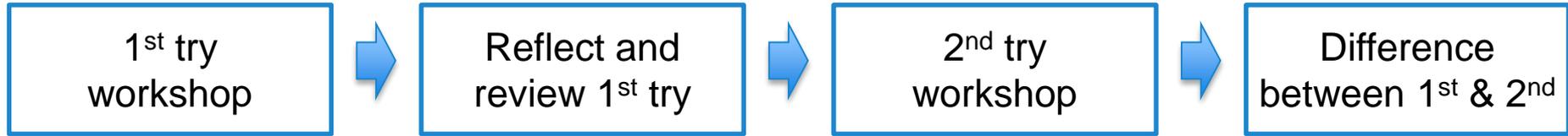
2. For the sequences to make a Shuriken, see Appendix 2-1 ~2-5.
3. Practice how to make Origami Shuriken: make one or two sets. Practice time : About 30 minutes



Completed unit of Shuriken

# Procedure of Shuriken workshop

Make 5 sets of Shuriken in a team of two persons  
→ Execute this job twice.



- ✓ Define roles between two and produce 5 sets of Shuriken.

- ✓ Keep record of the work in Appendix 3-1.

- ✓ Identify what was wrong in the 1st try for KAIZEN. Reflect on how to work and review.

- ✓ Keep record of the work in Appendix 3-3.

- ✓ Execute job #2 based on your review.

- ✓ Keep record of the work in Appendix 3-1.

- ✓ Compare 1st & 2nd job execution to identify what points should have been improved.

- ✓ Keep a record of what you found in Appendix 3-1.

# Shuriken workshop-1

(1) First try ..... Each team will produce as they like.

(2) Record of the first work.

1) Allocation of work: How did you divide roles to make a Shuriken?

2) Work time: • Time taken for the first unit's completion.  
• Time taken for completion of the five units.

3) Quality inspection (appearance and precision level)

• Knife point: A for Good, B for Ordinary, C for Poor

(Are all four points sharp enough?)

• Precision: Cross of Shuriken (vertical and horizontal lengths)

(Note) Quality inspection should be performed by a third party team.

(The third party team should record on a form of Appendix-3)

Operation time for the work of (1) and (2): 40 minutes

# Shuriken workshop-2

## (3) Review and KAIZEN of the first time work.

Find a better way of working from viewpoints of below 1) to 3).

- 1) KAIZEN of job allocation
- 2) KAIZEN of job sequence (process)
- 3) KAIZEN for motion

Consider the KAIZEN points from the work #1 and write them in Appendix 3. All these should be completed within 30 minutes.

## (4) Second try.

- 1) Produce five units by introducing your KAIZEN points.
- 2) Record the job performance same as the first try in Appendix 3-1.  
Operation time of 1) and 2): 30 minutes

# Comparison of actual workshops

## (5) Compare job results (within 30 minutes)

- 1) See and compare before and after KAIZEN work.
- 2) Find another ideas for KAIZEN by paying further attention to roles, sequence and motion.

(Note) Use Appendix 3-3 for recording of all these.



# Appendix 1 Shuriken (throwing star)

Shuriken is very famous as a weapon of Ninja or Japanese secret agent.



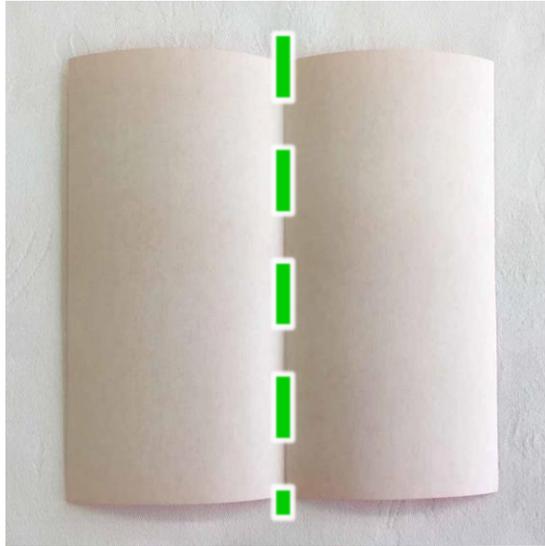
Japanese Ninja; Spy



Shuriken; Throwing star

# Appendix 2-1 How to make Origami Shuriken-1

1. Fold a sheet of paper vertically in half.



2. Fold both left and right toward the centre.



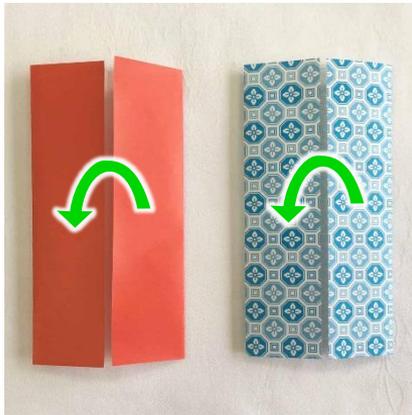
3. Do again on another sheet.



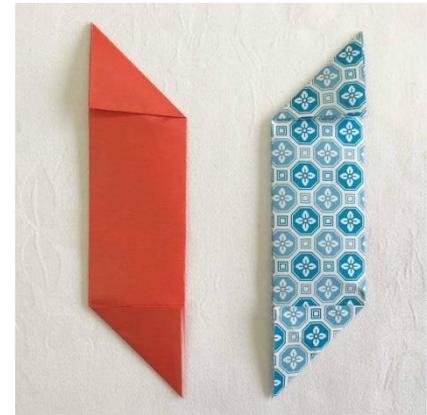
Square paper (15cm x 15 cm):  
Get two sheets with different design.

# Appendix 2-1 How to make Origami Shuriken-2

4. Fold the two sheets to the left side as shown in the picture below.

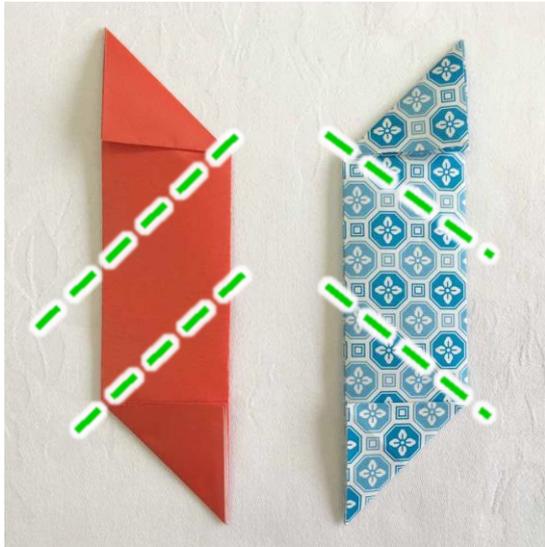


5. Now fold both sheets to become left-right symmetric as shown by the broken lines in the picture below.

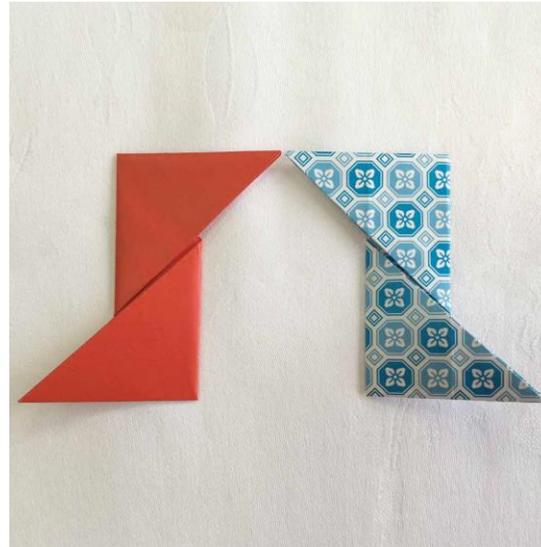


# Appendix 2-1 How to make Origami Shuriken-3

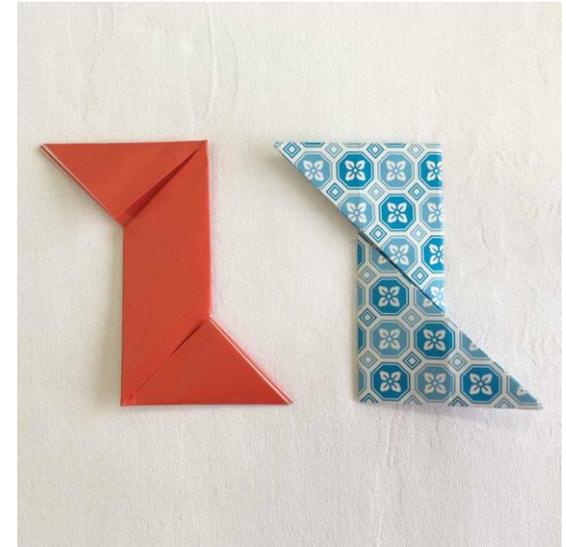
6. Fold again along the broken lines in the picture.



7. They must become like these.



8. Turn the left part over.

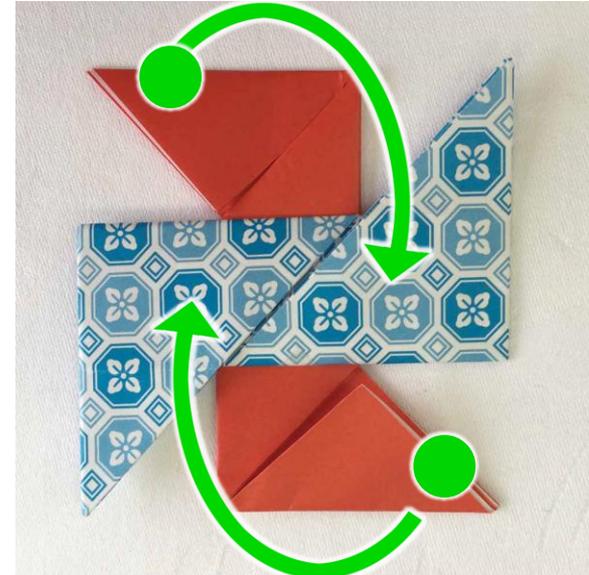


# Appendix 2-1 How to make Origami Shuriken-4

9. Lay the red part below and the blue part above as the picture shows.



10. Insert the edges of the marked parts of the red ones to the middle points of the blue ones.

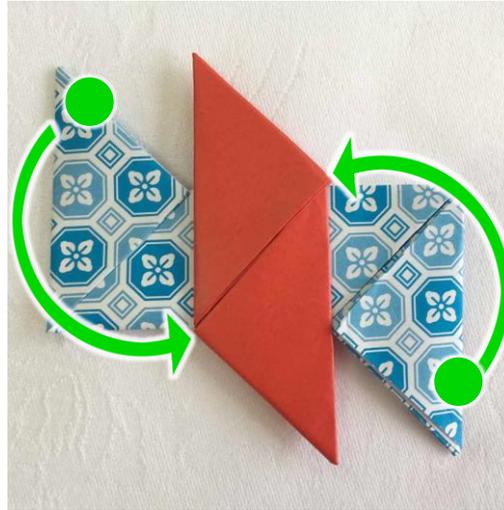


# Appendix 2-1 How to make Origami Shuriken-5

11. They must become like this.



12. Turn it over.



13. Now your Shuriken is completed.



The edge of the blue parts shown with a mark should be inserted to the middle of the red ones.

# Appendix 3-1 Workshop record memo

Work results		1st try workshop	2nd try workshop	Difference Between 1 <sup>st</sup> & 2 <sup>nd</sup>
<b>Work Method</b>	(1) How you allocated jobs			
	(2) Work sequence			
	(3) Idle time found			
<b>Work Time</b>	1) Time taken until the first unit was completed (minutes)			
	2) Time until all five units were completed (minutes)			
<b>Quality (1) Edge condition</b>	See four edges: A: Only one edge is poor B: 2 edges are poor C: 3+ edges are poor	A=( )set B=( )set C=( )set (Note) Inspection by other team	A=( )set B=( )set C=( )set (Note) Inspection by other team	
<b>Quality (2) Visual inspection</b> *Balance *Sharpness	See the Whole Shape A: Good B: Ordinary C: Bad	A=( )set B=( )set C=( )set (Note) Inspection by other team	A=( )set B=( )set C=( )set (Note) Inspection by other team	

Note : <Quality Inspection> Quality inspections (1) and (2) should be performed by the third party group.

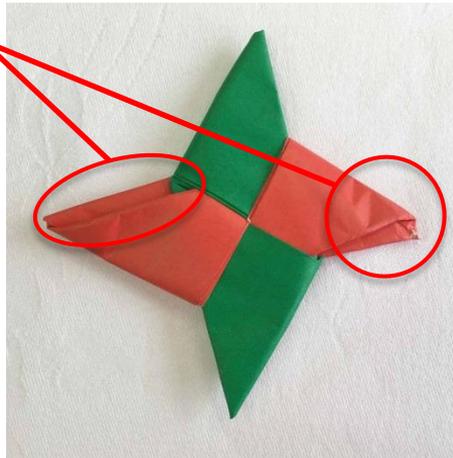
# Appendix 3-2 Workshop record

**Quality Inspection** This should be performed by a third party group.

Quality (1) State of edge: Four edges of Shuriken should be sharp enough (without any deviation from correct folding lines): Deviation of over 2mm is judged as “Bad”. Less than that is “Good”.

Quality (2) Appearance: Visual check of “Balance” and “Sharpness” for evaluation by three grades A/B/C.

Bad for both (1) & (2)

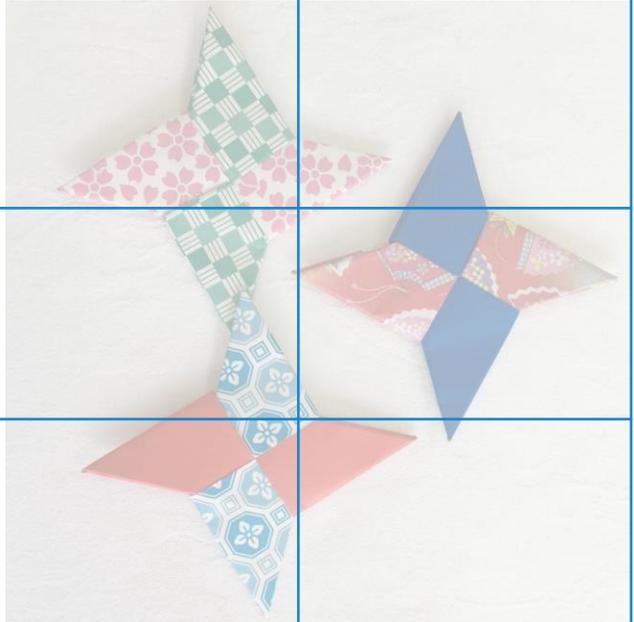


Good for 2mm or less difference



# Appendix 3-3 KAIZEN point list

Think of a better way of working and apply KAIZEN to the first try from the viewpoints shown below 1) - 3).

	KAIZEN points from the first try	Remarks
1) Reconsider job allocation		
2) Reconsider job sequence		
3) Reconsider motion and the way in which things are placed		

# QC story, 7-Tools and 5-Why

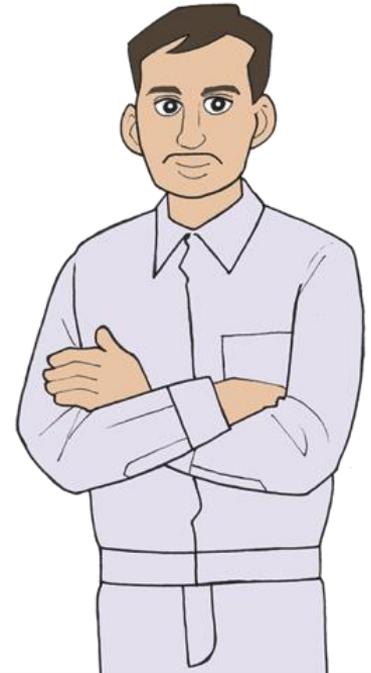
## **Text No. 3-3-7**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# QC story, 7-Tools and 5-Why

## Contents

- ✓ **QC story**
- ✓ **What is 5-Why?**
- ✓ **Usage of QC 7-Tools**
- ✓ **Each tool**



# QC story-1

-  QC story refers to a set of procedures to solve problems using QC 7-Tools in production places.
-  It is widely applied in production places in Japan and represents an essential way of thinking for KAIZEN.
-  It is widely used in other fields as well.

# QC story-2

Basic steps of QC story are shown below.

<Case> Defects are found.

**1. Set the target and grasp the current situation**



**2. Analyse the current situation  
(Identify problems)**



**3. Analyse the causes  
(Find the root cause)**



**4. Plan the solution  
(Attack on causes)**



**5. Check the effect and take the preventive measures against recurrence**

• Grasp the situation of defects quantitatively including frequency, ratio, etc.

• Identify problems to focus. Use a Pareto diagram.

• What causes the problem? Extract relevant causes and identify the root cause by repeating the question as to why it happened many times. Use the 5-Why analysis.

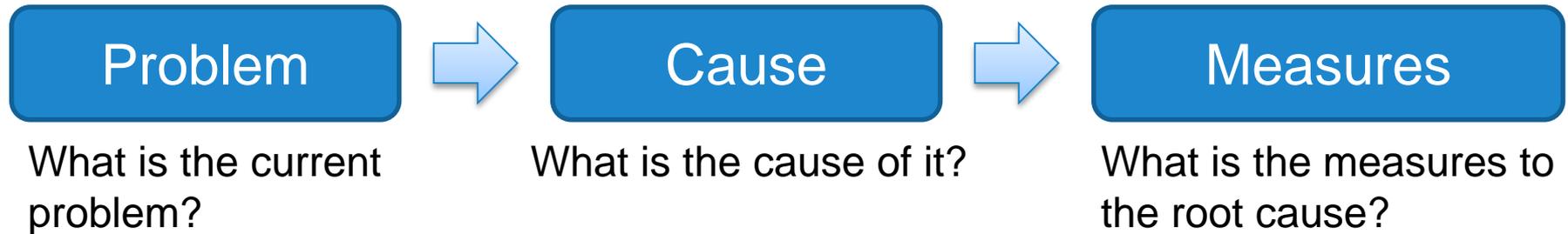
• Conceive solutions to get rid of the cause of the defect.

• Check the effect of the solution after implementation. Take the measures such as a work standard to prevent the same defect from occurring again.

# What is 5-Why? -1



5-Why analysis is the method to investigate the root cause of a problem by asking the question “Why” repeatedly, until you finally reach the root cause.



The cause found here may not be the root cause. If it's not the root cause, measures taken here won't be effective. That is why you have to repeat the question “Why” many times, until you find the root cause.

# What is 5-Why? -2



How you should think when trying to solve a problem

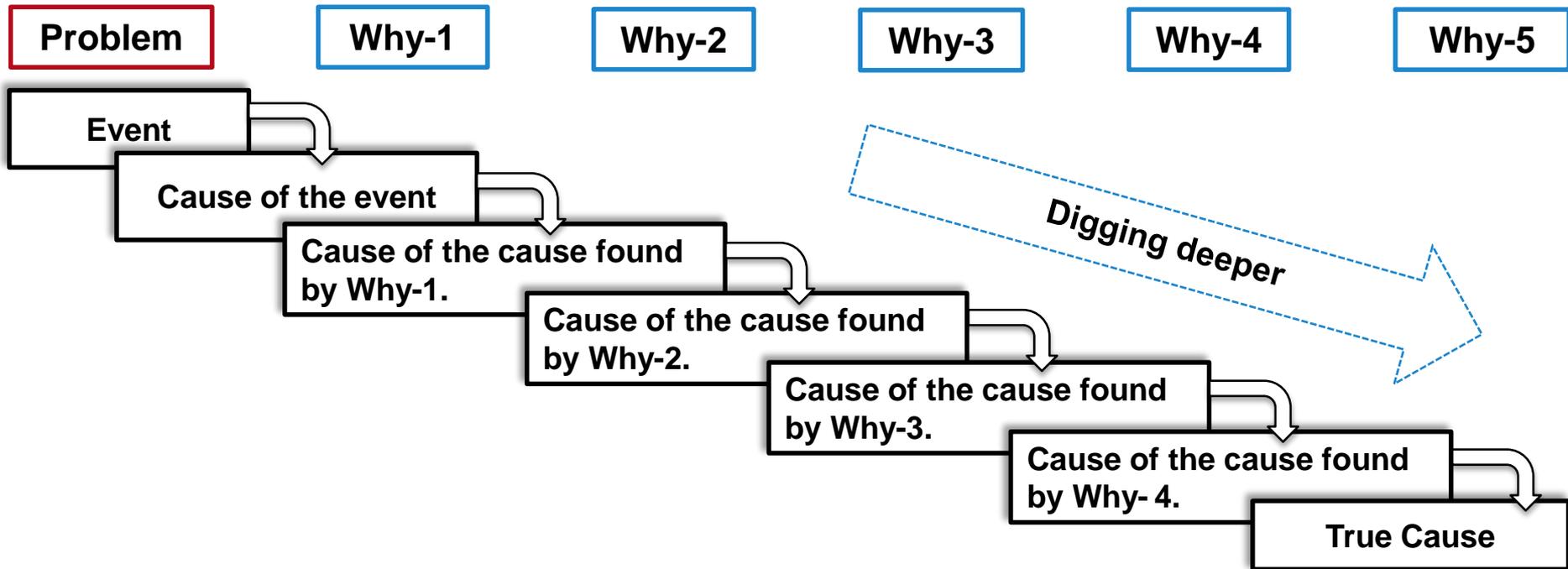
## Thinking in problem solving

<p>1. Genchi-Genbutsu Principle</p> <p><b>3G</b></p>	<p>It is also called the 3-Gen Principle. (Genchi; actual place, Genbutsu; actual thing, Genjitsu; fact)</p> <ul style="list-style-type: none"><li>• Look at an actual scene closely.</li><li>• Check the actual thing directly to comprehend the fact.</li><li>• Based on data, look for the real cause of the problem.</li></ul>
<p>2. Pursuit of the real cause</p> <p><b>5-why</b></p>	<p>Investigate the root cause of the problem with 5-Why. Cause → Result → Cause → Result → Cause → Result (Why?)                      (Why?)                      (Why?)</p> <ul style="list-style-type: none"><li>• The root cause should be identified to find effective measures.</li></ul>

# What is 5-Why? -3



Ask the question “Why” repeatedly, until you finally reach the root cause.



# Usage of QC 7-Tools -1

## Purpose of QC 7-Tools:

It is a set of tools used in KAIZEN and QC activities for visualisation.  
They are widely used beyond the area of quality control.

## Usage of QC 7-Tools:

1. As tools to find problems
2. As tools to identify causes of a problem
3. As tools to confirm if the problem was resolved

# Usage of QC 7-Tools -2

QC 7-Tools	Usage and description
1. Cause-effect diagram	<ul style="list-style-type: none"><li>▪ Also called a 'Fishbone chart'. Effects and relevant causes are organised like fish bones and it is used to identify causes.</li></ul> <p>(NOTE) This should be used with 5-Why analysis</p>
2. Check sheet	<ul style="list-style-type: none"><li>▪ Often used to prevent overlooking something.</li><li>▪ It is a table or list for the easy checking of predetermined items.</li><li>▪ It can help you to confirm a fact or obtain information by item.</li></ul>
3. Pareto chart	<ul style="list-style-type: none"><li>▪ A chart named after Pareto, an Italian economist.</li><li>▪ Items shown are arranged by size. It's also called an ABC analysis chart.</li><li>▪ Vital few, trivial many; The theorem states that important things are fewer while things with no importance are many.</li></ul>

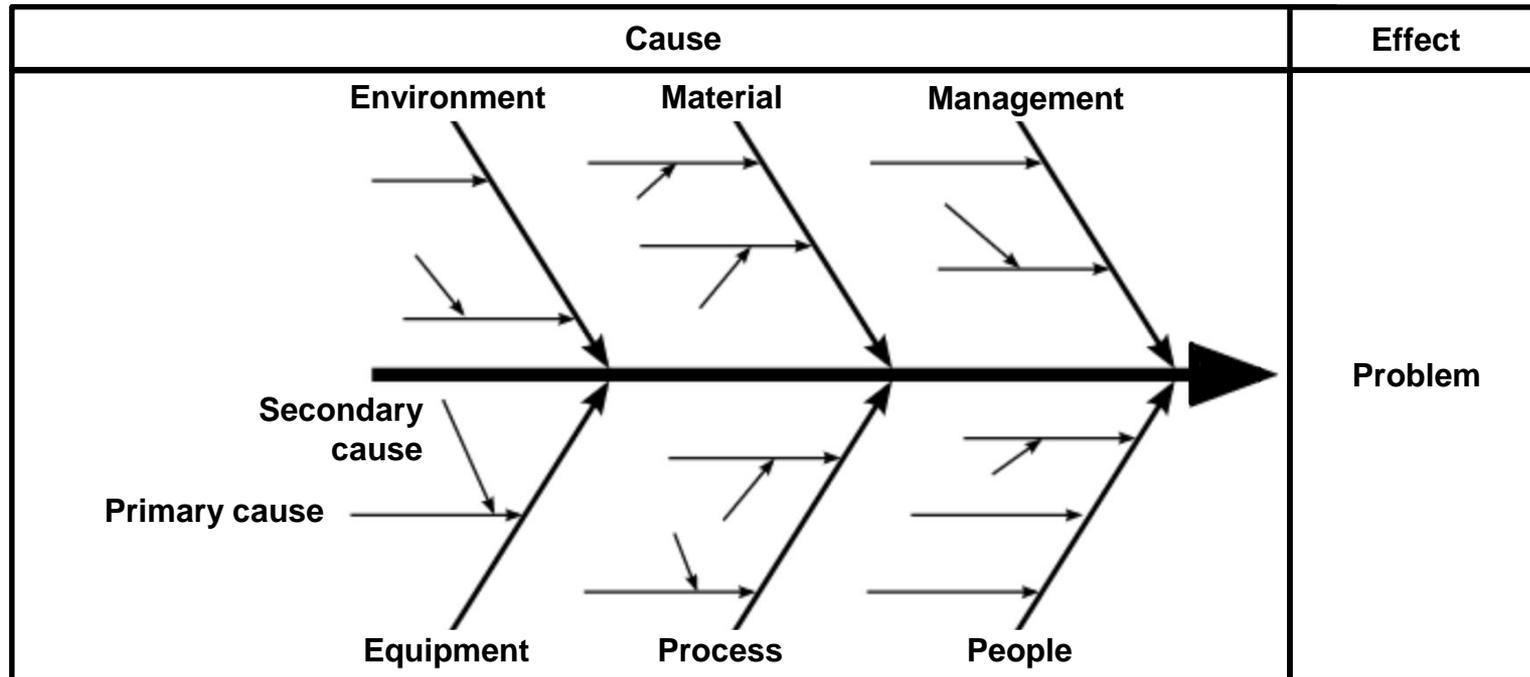
# Usage of QC 7-Tools -3

QC 7-Tools	Usage and description
4. Scatter diagram	<ul style="list-style-type: none"><li>• A pair of data are loaded on vertical and horizontal axis, representing the paired data by dots for plotting. You can identify distribution patterns of the two data items and see if a correlation exists.</li></ul>
5. Histogram	<ul style="list-style-type: none"><li>• Used to see dispersion of data.</li><li>• Also called a 'Column diagram'. It shows a state of distribution of data.</li></ul>
6. Graph/Control chart	<ul style="list-style-type: none"><li>• A control chart is used to manage variation in your process with upper and lower control limits as well as mean values for selected data such as dimension tolerance.</li></ul>
7. Stratification	<ul style="list-style-type: none"><li>• This is a method to compare things with different characteristics. It's very useful to deal with data and make them visualise.</li></ul>

# Each tool-1 Cause-effect diagram

## Purpose and How to Use it

Used to organise causes of problems such as troubles and flaws in a systematic way;  
Extracting various causes to find effective counter measures for problem solving.



# Each tool-2 Check sheet

## Purpose and How to Use it

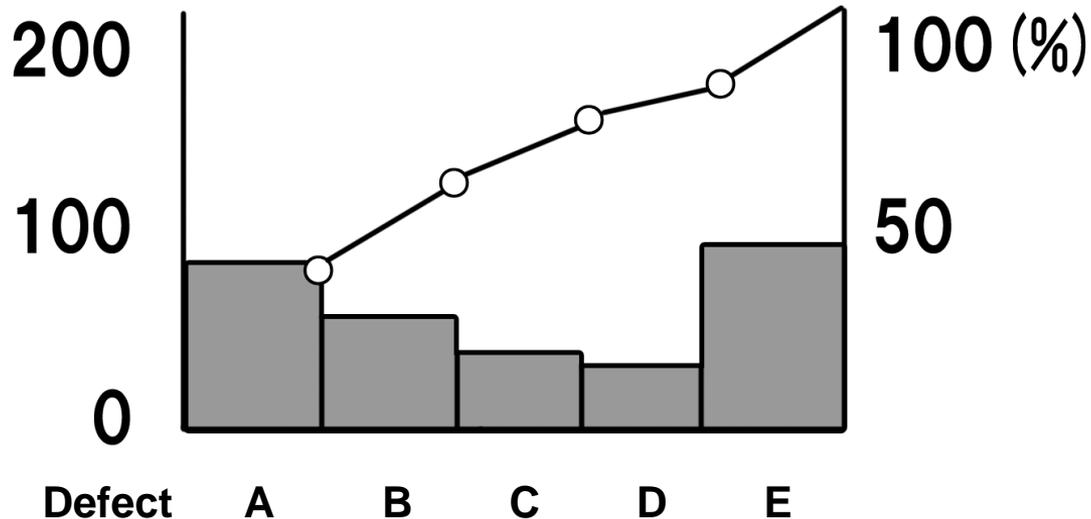
- It is either a table or a diagram made for easy identification of results and is very good for checking data.
- It is useful in collecting data and preventing any missed or overlooked data.

Date	4/1	4/2	4/3	.....	Total
Defect A	//	/	/	.....	6
Defect B	//// /	///	//// ///	.....	21
Defect C	/	///	/	.....	8
.....	.....	.....	.....	.....	
Total	23	18	29		85

# Each tool-3 Pareto chart

## Purpose and How to Use it

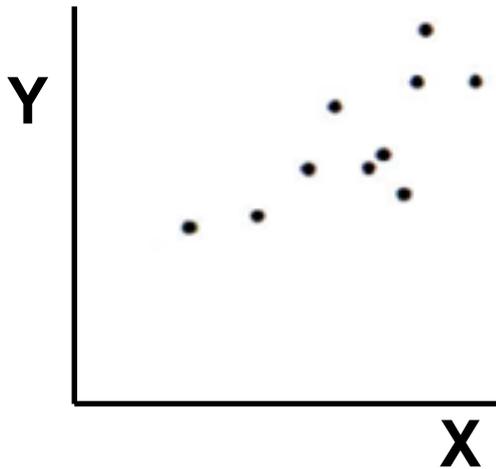
- Used for analysis of important issues.
- Used to choose the most influential issue.
- A highly important and effective tool.



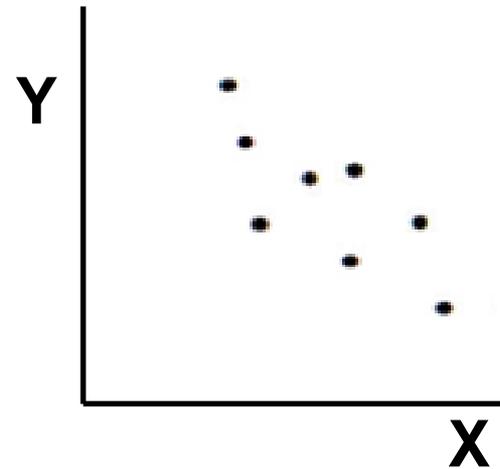
# Each tool-4 Scatter diagram

## Purpose and How to Use it

- Used to data clarify if there is a correlation between two sets of data.
- Paired is to be plotted on X and Y axis to see if a correlation exists.



A positive correlation exists

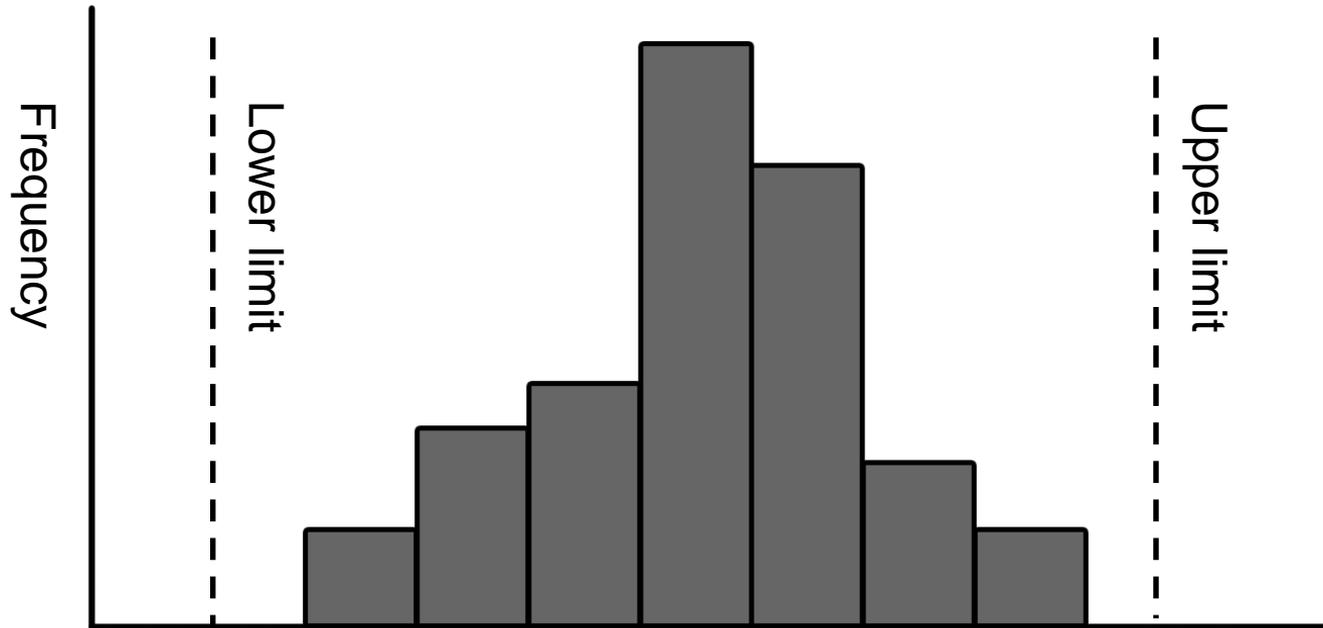


A negative correlation exists

# Each tool-5 Histogram

## Purpose and How to Use it

- Used to examine dispersion of data.
- Data has dispersion and this tool is used to clarify the shape of data distribution.



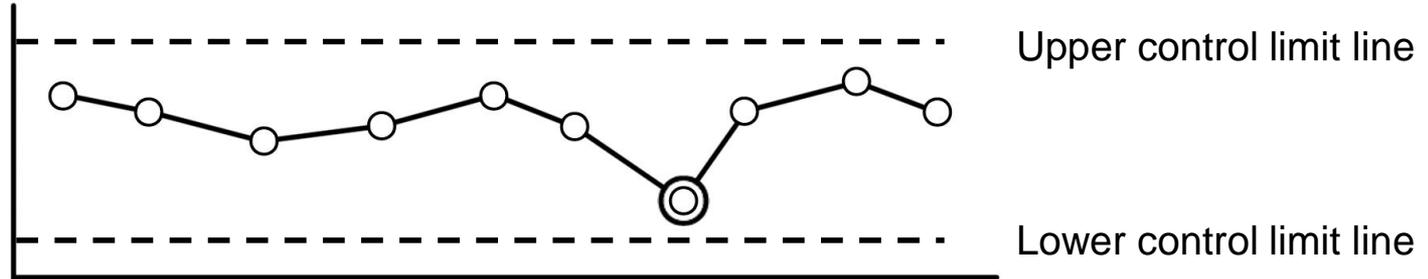
# Each tool-6 Control chart

## Purpose and How to Use it

Data is displayed by line graph with upper and lower control limit lines. When data falls outside control limit lines, it is considered that there is an abnormality in the process.

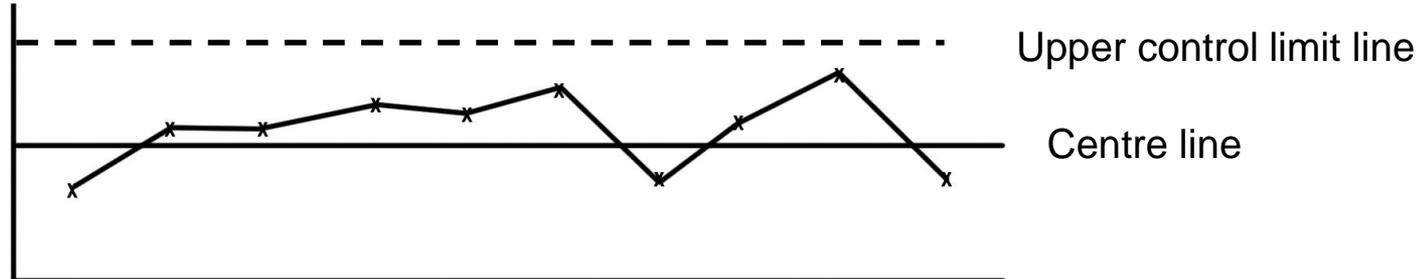
X Control Chart

X= mean value of data



R Control Chart

R= a range of data (Max-Min)



# Each tool-7 Stratification

## Purpose and How to Use it

- It is a tool to visualise a large amount of data by sorting it out according to the conditions.
- For instance, a defect may be a result of many causes; sorting them out like cause by operator, cause by machinery, cause by material and such to visualize the case.
- It is used with other tools.

	Scratch	Dirt	Defect	Others	Total
Process A	////	//	///	//	12
Process B	//	/	//// //	//	13
Total	7	3	11	4	25

# Four principles (E CRS) of KAIZEN

## **Text No. 3-3-8**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Four principles (E CRS) of KAIZEN

## Contents

- ✓ **What is E CRS?**
- ✓ **Four rules of E CRS**
- ✓ **Using E CRS: Sequence**
- ✓ **How to use E CRS**
- ✓ **Case of KAIZEN with E CRS**



# What is ECRS? -1

## **ECRS's meaning**

As one of the improvement methods to eliminate Muda at production sites, ECRS represents the essence of four types of thinking to promote KAIZEN.

ECRS is an abbreviation of:

- Eliminate ( to remove or to get rid of )
- Combine ( to combine or to separate )
- Rearrange ( to replace or to substitute )
- Simplify ( to make it simple and easy )

# What is ECRS? -2

## Purpose of ECRS

- ☞ The ECRS method, with focus on process flow, physical movement and people's motion, can give us new ideas to eliminate Muda.
- ☞ It is a simple and easy way of thinking. Apply this in the workplace.



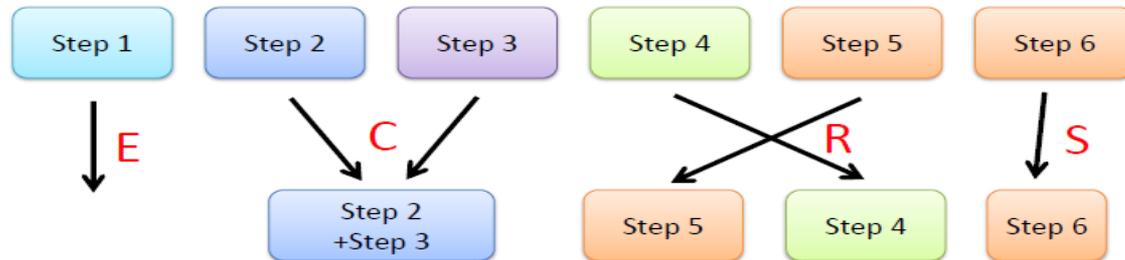
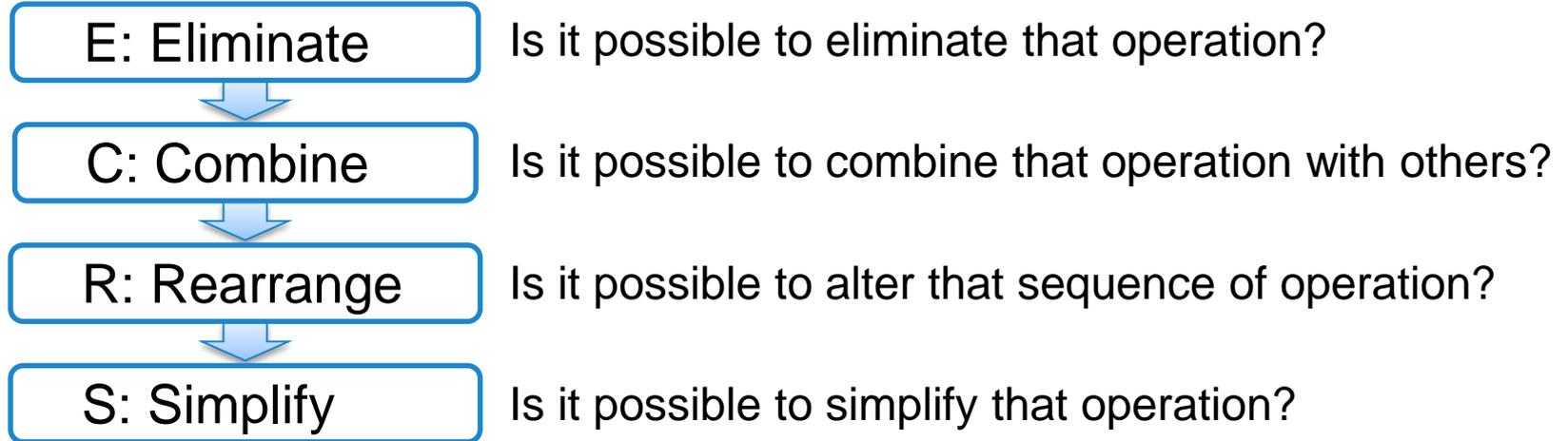
# Four rules of ECRS

Rule	Guide for KAIZEN	Point for KAIZEN
E Eliminate	Can it be stopped? What happens if it's cancelled?	What is that for? Can that operation be cancelled?
C Combine	Can they be combined? Can they be separated?	Can different roles and operations be combined into one? Or, can they be separated?
R Rearrange	Can that sequence be changed? What happens if it's changed?	Can the sequence of operations be switched?
S Simplify	Can it be simplified?	Can it be reduced? Can it be skipped?

**Effects of KAIZEN: E > C > R > S**

# Using ECRS: Sequence

The ECRS method should be applied in the order of E to C to R to S.



# How to use ECRS



How can the ECRS method be applied to eliminate various elements of Muda hidden in the following four processes of A,B,C and D at production sites places?

A: Processing

**Operation with added values**

→ Should reduce processing time.

B: Inspection

**Necessary Muda**

→ Should try to reduce it as much as possible.

C: Transport/Move

**Necessary Muda**

→ Should try to reduce it as much as possible.

D: Stagnation/Storage

**Pure Muda**

→ Should always try to eliminate it to zero.

# Case of KAIZEN with ECRS-1



## How to reduce Muda of transportation

1. Improve or change the production process.
  - Change the inventory place.
  - Change the procedure of production and others.
2. Improve or change the production condition, the transportation method and the transportation distance/frequency.
  - How is the workplace?
    - Make it easier and simpler.
  - How often is material transported?
    - Reduce the number of times it needs to be transported to as few as possible.

# Case of KAIZEN with ECRS-2



How to reduce Muda of transportation

Before



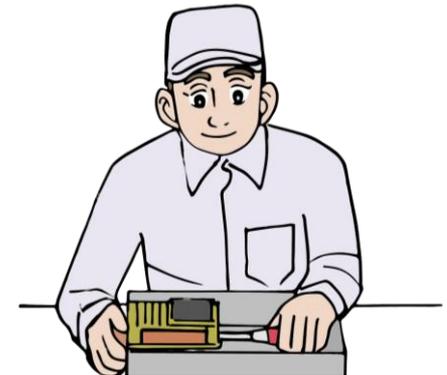
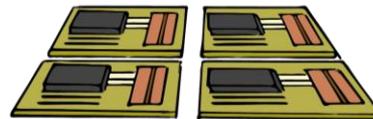
Muda



Muda



After



## **Text No. 3-3-9**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Basic approaches to improving productivity

## Contents

- ✓ **Eight approaches to improving productivity**
- ✓ **Process analysis**
- ✓ **Operation analysis**
- ✓ **Motion study**



# Eight approaches to improving productivity-1



There are eight approaches to improving productivity.

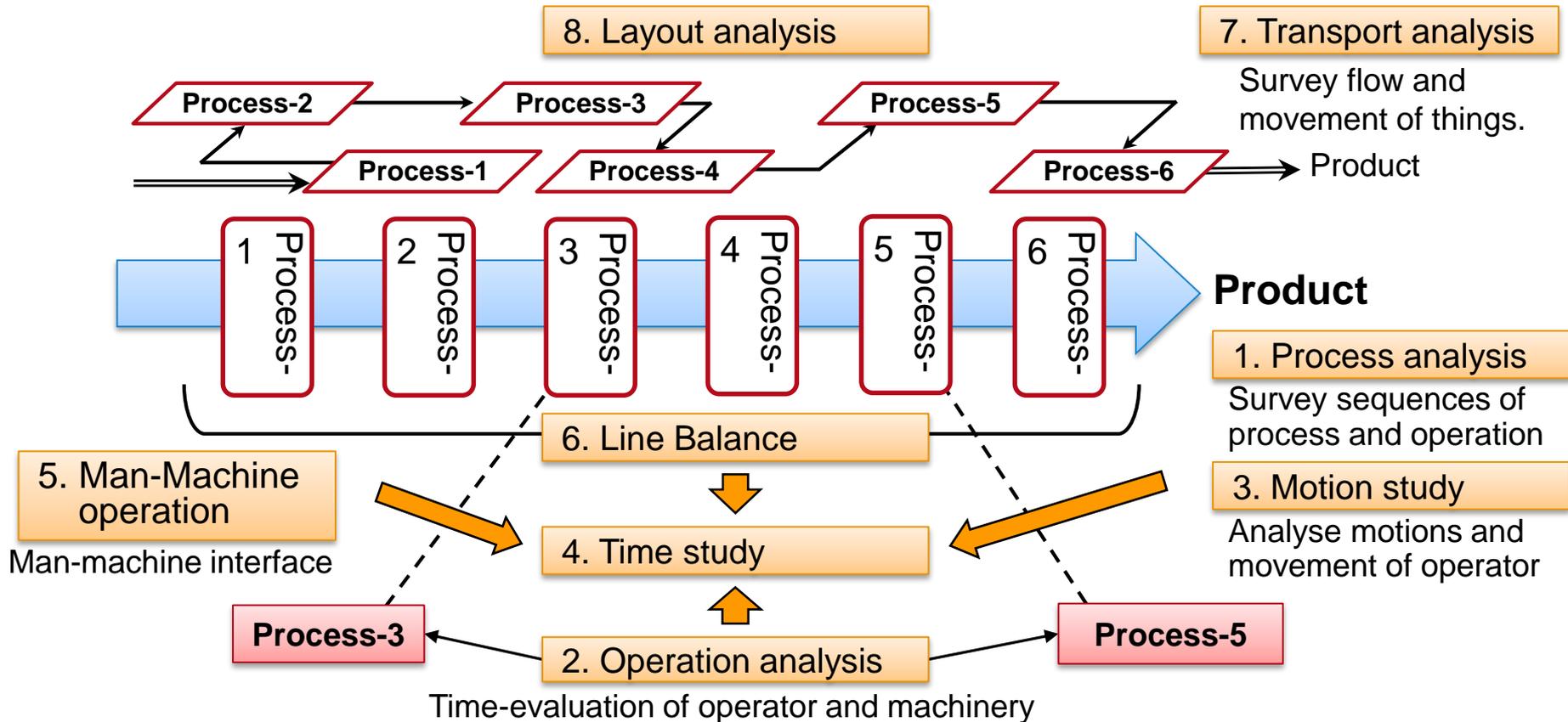
1. Process analysis
2. Operation analysis
3. Motion study
4. Time study
5. Man-Machine operation
6. Line balance analysis
7. Transport analysis
8. Layout analysis



**Eliminating Muda and  
Improving productivity**

The most important three (items 1,2, and 3) of the eight approaches will be described in this textbook.

# Eight approaches to improving productivity-2



# Process analysis-1

Purpose of process analysis:

1. To make a process flow diagram by dividing an operation into the four categories of processing, transport, inspection and stagnation.
2. To detect any process with problems by visualising the operation time for each process.
3. To reduce a lead time and Muda in operations by applying KAIZEN to the process with problems.

# Process analysis-2

## Four elements in a process

Element in process	Contents of process	With/without added value	Level of Muda
Processing	This means processing an object to change its shape or nature to make a needed product. (e.g., machining, welding, painting)	Value added	No Muda
Transport	This means changing the location of the object in production.	No value added	Necessary Muda
Stagnation	The object in production is either → stored for some reason, or → simply stagnating against schedule.	No value added	Unnecessary Muda
Inspection	This means inspecting the object in production for quantity and quality, and then comparing the results with standards to judge its conformity.	No value added	Necessary Muda

# Operation analysis-1

## Purpose of operation analysis:

1. To grasp the current state of operation by surveying the contents of operator/machinery job such as operation time, etc.
  - How much of the time the operator/machinery is not working.
  - Why the operator/machinery is not working.
  - Investigate the cause and find a hint for improvement.
2. To obtain the time ratio used for each operation category.
3. To define the standard time for standard operation. For example:

Category	Main operation	Associated operation	Allowance	Non working	8 hrs
ratio	30%	35%	25%	10%	100%

# Operation analysis-2

## Classification of work contents

Classifications		Contents	Examples
Work time	Main operation (Net opr)	Value-adding operation to transform material and change parts	<ul style="list-style-type: none"> <li>• Direct processing time (Grinding, Drilling, Assembly, Screw driving, Soldering)</li> </ul>
	Associated operation	Associated operation taking place before and after main operation	<ul style="list-style-type: none"> <li>• Supplying and removing material,</li> <li>• Machinery operation, Taking parts and tools</li> </ul>
Allowance time	Work allowance	Not directly related associated operation but necessary time	<ul style="list-style-type: none"> <li>• Daily checking of machinery, Maintenance of tools</li> <li>• Transporting of materials and products</li> </ul>
	Management allowance	Common time at a work place	<ul style="list-style-type: none"> <li>• Machine trouble</li> <li>• Waiting due to lack of materials</li> <li>• Clerical work: Instructions, Morning meeting</li> </ul>
	Personal allowance	Time required for physiological needs	<ul style="list-style-type: none"> <li>• Lavatory, Drinking water, Wiping sweat, Getting warmth</li> </ul>
	Fatigue allowance	Recess to restore fatigue	<ul style="list-style-type: none"> <li>• Recess (rest due to high temp., high humidity work, lifting heavy loads, etc.)</li> </ul>
Non working time		Due to operator's laziness	<ul style="list-style-type: none"> <li>• Chatting, Loitering</li> </ul>

# Operation analysis-3

## Investigation state of operation

Watching movement of operators and machinery, measure working time and study if there is any time to be reduced.

### **Associated operation**

=Not adding value but necessary job (such as changeover, fixing/removing products)

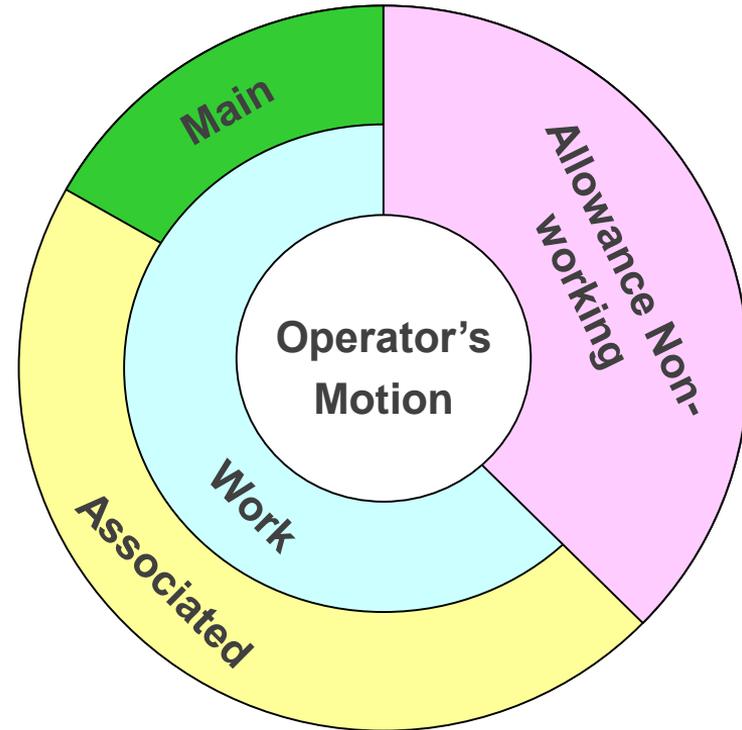
**Can this operation be shortened?**

### **Allowance and Non-working**

= Wasting time without adding any value

**Minimise it to as little as possible**

**Can it be replaced with any other operation?**



**Reduced by changing process/conditions**

# Motion study-1

Purpose of motion study:

1. To visualise any useless motion by analysing each motion of the operator thoroughly.
2. To reduce time by detecting useless motions and eliminating them. To find a better motion to reduce fatigue.
3. To promote a motion-oriented mind for better work efficiency by repeating this approach.  
For fast, correct, easy, clean and inexpensive work.

# Motion study-2

What has to be considered in a motion study?

Points of view	Contents in 'motion study'
1. Object of analysis	Movement of human 'body' and 'eyes'
2. Point of thinking	Exercise motion-oriented mind (consciousness of motions) Understand the difference between a good and bad motion. Be aware of improvement order of motions Manual work → Jigs → Mechanisation → Automation
3. Method of motion analysis	A. Both-hand work analysis: Four jobs ①Work ②Transport ③Hold ④Carry B. Micro-motion analysis: 'Therblig' analysis to analyse and evaluate work by breaking it down to 18 basic motions.

# Motion study-3

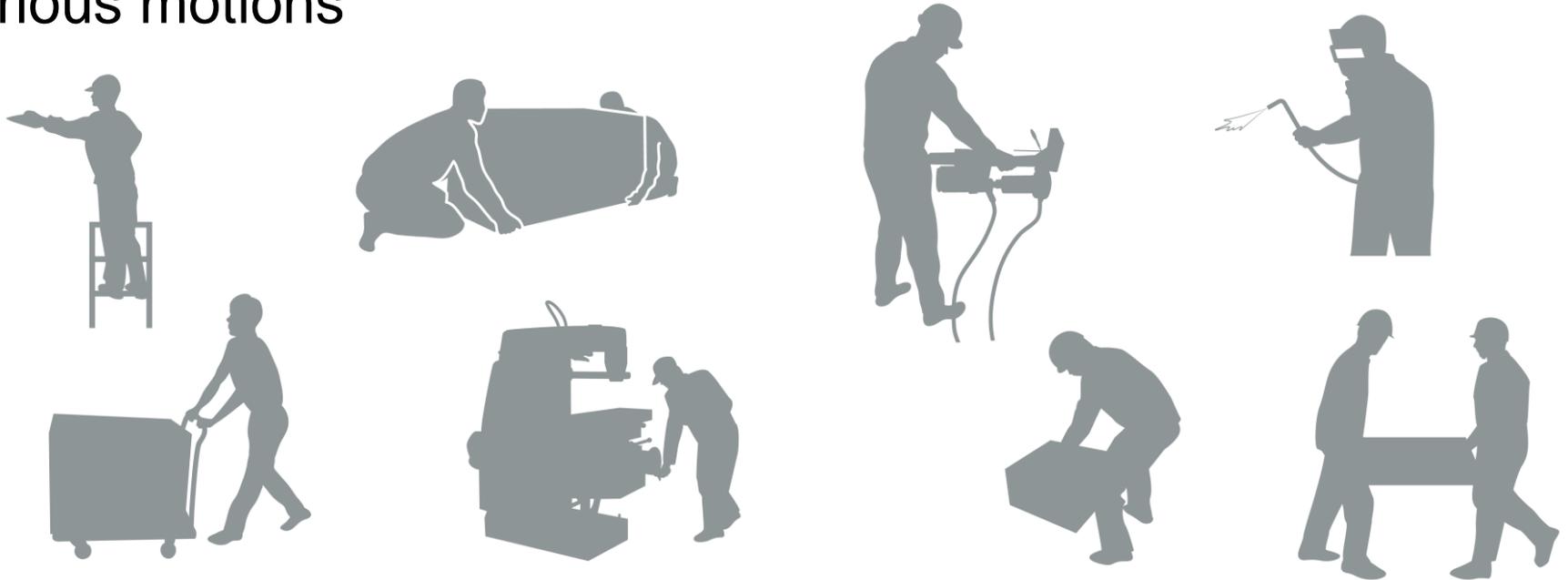
## Therblig motion analysis

1. According to the Therblig analysis, human work can be divided into 18 basic motions.
2. Those 18 basic motions can be categorised to three classes by criteria of value.
3. The motions having added value are categorised in Class 1, but those having no-added value are categorised in Class 2 or 3. (Note) This theory was advocated by Gilbreth.

Classifi- cation	18 basic motions for work	Value	What to change
Class 1	1 to extend arm 2 to grab 3 to transport 4 to assemble 5 to use 6 to disassemble 7 to release 8 to check	Motions with value	<b>Minimise supplementary work if any</b>
Class 2	9 to search 10 to select 11 to find 12 to pre-position 13 to finish positioning 14 to think	Necessary motions but without value	<b>Devise a way to eliminate these</b>
Class 3	15 to hold 16 an unavoidable delay 17 an avoidable delay 18 to rest	Motions without value	<b>Devise a way to eliminate these</b>

# Motion study-4

## Various motions



**Find the motion for eliminating unnecessary motion and working safely, correctly and efficiently.**

# Standardised work

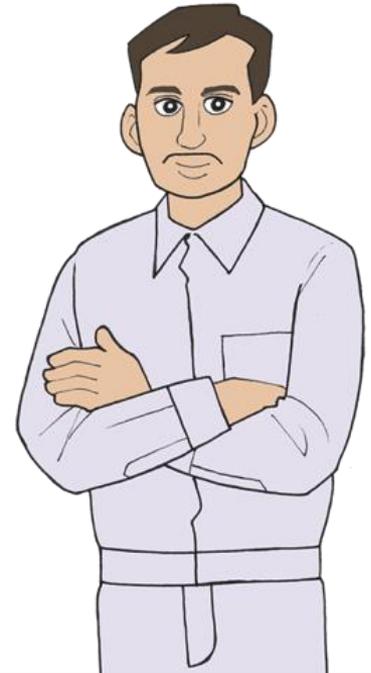
## **Text No. 3-3-10**

Soft Skill Text for  
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# Standardized work

## Contents

- ✓ **What is standardised work?**
- ✓ **Purpose of standardised work**
- ✓ **Three elements for standardised work**
- ✓ **Tools for standardised work**

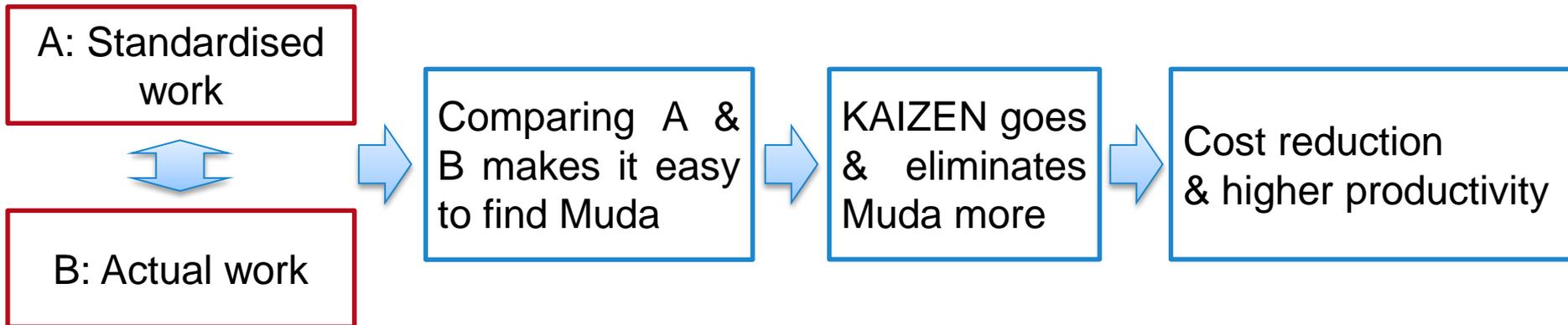


# What is standardised work?

If manufacturing in a factory is performed in each person's own way, the product quality and cost will vary greatly and then it won't be possible to produce good and inexpensive products with stability. Also, in some cases the same product has to be manufactured in a different factory. So, in order to maintain a good level of quality and cost consistently, the manufacturing process has to be standardised with a good combination of 3M (Man/Machine/Material) for a Muda-free, safe, easy, fast and accurate production way.

# Purpose of standardised work-1

- 👉 Standardised work is an important tool for KAIZEN.
- 👉 By comparing standardised work (A) with actual work (B), various Muda become visible.  
(e.g.) Difference of operation time, bottleneck process, inventory of work-in-progress and waiting hours, etc.



# Purpose of standardised work-2

## Muda becomes visible

1. Muda becomes visible for everyone.
2. Waiting becomes visible.
3. Can find a root cause as you repeat the same work?
4. Processes with bottlenecks become visible?
5. Changing volume of work-in-progress becomes visible.
6. Can tell you the needs of new layout?



## Muda elimination by KAIZEN

We can reduce:

- Muda of waiting
- Muda to add extra motions
- Muda of processing itself

Solve processes with bottlenecks.

Reduce work-in-progress.

Enhance production capability.  
(with lower man-hours)

Re-examine the layout to reduce transporting.



**Cost reduction, Higher productivity**

# Three elements for standardised work-1

What kind of operations should the standardised work be applied to?

- Human motion-centric operations
- Operations with repeated actions

Three elements for standardised work	Parametres to define
1. Tact time Cycle time	• Required work speed per 1 cycle of operation • Time taken to make one part
2. Work sequence	Sequence to complete an operation such as: Attachment of parts to machinery → Processing → Detachment → Assembly
3. Standard Stock	In order to repeat the work sequence, a certain level of stock is required. Define necessary but minimum stock of work-in-progress.

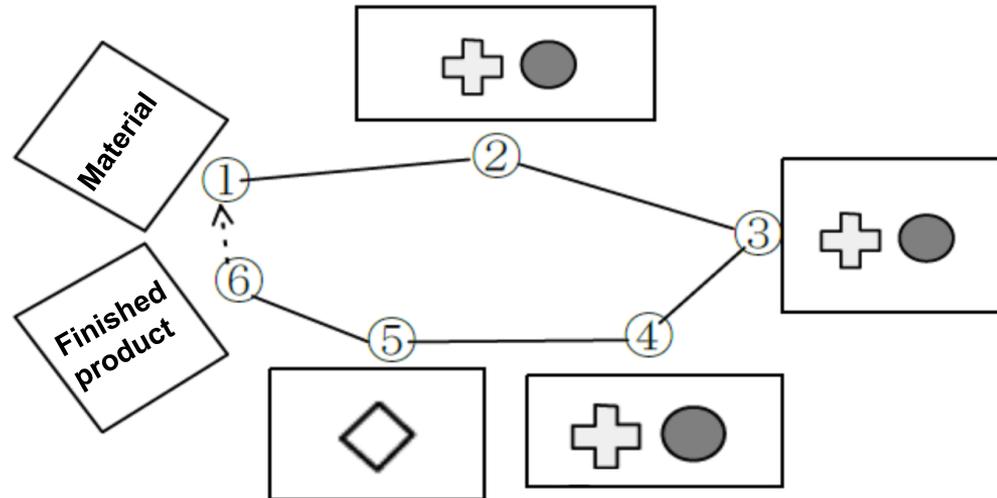
# Three elements for standardised work-2

A case of standardised work

Processes:

① Start → ② → ③ → ④ → ⑤ → ⑥ Completion

Operations	From picking up raw material
	To placing finished product



Quality Check	Safety	Std Stock	Stock Vol	Takt Time	Net Time
◇	+	●	3	3''	3''

# Tools for standardised work-1

## Five forms to implement standardised work

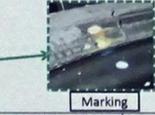
Five form tools	Parametres to decide
<b>1. Process capability table</b>	A tabulation of production capability (volume and time) by process.
<b>2. Standardised work combination table</b>	To indicate types of machinery and sequence performed by an operator in one cycle (time and sequence).

# Tools for standardised work-2

Five form tools	Parametres to decide
<b>3. Work manual</b>	To show how job should be done such as operation of machinery, exchange of cutting tools, changeover, parts processing, assembly, etc.
<b>4. Work tutorial</b>	To show the entire scope of jobs to be performed by an operator with an indication of essential points of quality and safety.
<b>5. Standardised work sheet</b>	Extracting a part of the work tutorial, especially the critical parts, to be seen by operators at worksite.

# <Specimen> Tools for standardised work

## Work Instruction Sheet

WIS	Work Instruction Sheet	CONTROL NO	AS3-YBA-CH-29	PAGE No.	2/2	Creation date		DRAFTED BY	AREA SUP	QUALITY INCHARGE	DPH																																																												
						1/11/2015	3/9/2016																																																																
APPLICABLE MODEL(S)		YBA	PROCESS NAME	SAFETY ITEMS TO BE USED (Do Not Underline the applicable items)		SYMBOLS USED		SIGNATURES																																																															
Follow work guide for safety & quality			TYRE SUB ASSY	HELMET, GOGGLES, WRIST COVER, ARM PROTECTOR, SAFETY SHOES, COTTON GLOVES, HEAR-GLOVES, HEAR-EAR MUFFS, SAFETY EAR PLUGS, DUST MASK, PROTECTION DRESS		+	◇	○	Signature	Signature	Signature	Signature																																																											
S.NO	OPERATION PROCEDURE	CAT	KEY POINTS	POSSIBLE DEFECT	ADDITIONAL INFORMATION / SKETCH / PHOTO / EXPLANATION / REFERENCE																																																																		
5	Put the tyre on rim and apply soap solution on tyre as per fig-5  जब Fig-5 में दिखाए अनुसार टायर फिट पर टायर जमा कर टायर पर जेल लगाए।	◇	टायर वाले रिम पर टायर जमाने जमाने टायर की जाँचिंग टायर की सफाई हो व जेल को टायर की कीज पर ही लगाए।	टायर will get wrong fit to rim if tyre marking not upward side.	 Fig-5 Tyre Beed	 Fig-6 Work Over Switch																																																																	
6	Press the work over switch and forward the rim & tyre to mounting air filling & weight balancing process.  इस पर जोर देकर टायर बजा कर रिम व टायर को जाँचिंग (टायर फिटिंग व वेट बैलेंसिंग प्रोसेस) को फिटो जमाने है।		दरमियन पर वेट लगाने जमाने टायर वाली रिम व टायर की जाँचिंग जमाने हो। (फिगर-7, 8, 9 के को।)	Wheel balancing will not get proper, if not match the rim & tyre marking.	 Fig-7 Marking	 Fig-8 Marking																																																																	
7	Work safely during working at station  स्टेशन पर काम करते जमाने जेकरी का इस्तेमाल करी।	+	Use PPE to work safely.  जेकरी पर काम करते जमाने जेकरी उपकरण का इस्तेमाल करी।	Injury can occur if not used PPE.	 Fig-9 Marking	 Fig-10 Marking	 Fig-11 Marking																																																																
<table border="1"> <thead> <tr> <th>Symbol</th> <th>Revision day</th> <th>Reason for the revision</th> <th>Signature</th> <th>Approved (DPH)</th> <th>Symbol</th> <th>Revision day</th> <th>Reason for the revision</th> <th>Signature</th> <th>Approved (DPH)</th> <th>REFERENCE DWG NO.</th> <th>REMARKS</th> </tr> </thead> <tbody> <tr> <td>△</td> <td>10/2/2016</td> <td>JIG PHOTO ADD.</td> <td></td> <td></td> <td>△</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>△</td> <td>3/9/2016</td> <td>Information Addition</td> <td></td> <td></td> <td>△</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>△</td> <td></td> <td></td> <td></td> <td></td> <td>△</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>△</td> <td></td> <td></td> <td></td> <td></td> <td>△</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Symbol	Revision day	Reason for the revision	Signature	Approved (DPH)	Symbol	Revision day	Reason for the revision	Signature	Approved (DPH)	REFERENCE DWG NO.	REMARKS	△	10/2/2016	JIG PHOTO ADD.			△							△	3/9/2016	Information Addition			△							△					△							△					△																
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<p>1. Training method to new workmen - (a) Do the process by Self as per WIS (Check by self) (b) Do the process by Self and show the new workman key points and steps. (c) Make the workman do, check the result and give feedback.</p> <p>2. In case of any issue / abnormality to follow WIS, please "STOP - CALL - WAIT" for supervisor and give feedback.</p> <p>3. Conditions for key points - (a) Consequences : It will determine whether work will be OK or NG. (b) Safety : There is risk of getting injured. (c) To make the work easier : Know-How (Experience)</p> <p>4. Content of key points - This can be (a) Key points mentioned in Engg dwg. (b) Usage of jig/consumable/ special tools. (c) Torque range &amp; set torque value (with if applicable) (d) Important sequence of operation. (e) Application of colour check mark (as per Engr Dwg). (f) Process Specific Safety Instructions (If any)</p>																																																																							

# Visual control

## **Text No. 3-3-11**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Visual control

## Contents

- ✓ **What is visual control?**
- ✓ **How to realise visual control**
- ✓ **Making it visible by visual control**
- ✓ **How to practice visual control**



# What is visual control? -1



Firstly, a visual control makes it possible to grasp the workplace situation at first glance whether it's in a normal operation or not.

By a visual control, anyone including supervisors and operators can immediately tell the current situation in the workplace such as work progress, occurrence of defects, operating status of machinery, sudden troubles, etc.



Secondly, it's helpful and essential to eliminate Muda.

By a visual control, the hidden problems and Muda will come to light and become a tangible target subject to KAIZEN continuously.

# What is visual control? -2

 The problems and Muda become recognisable due to a visual control and therefore can be shared by all members concerned. Under these circumstances, the necessary action can be taken quickly by a team and not just by a single person.

 The visual control is therefore a very important mechanism to improve the performance in a workplace.

# How to realise visual control



There are some activities, work standards and production methods to realise a visual control like the ones below :

- Seiri and Seiton by 5S
- Production using Kanban
- Jidoka (Automation)
- Standardised work
- Flow production

**Visual control is the most important mechanism for KAIZEN.**

# Making it visible by visual control-1



This is a summary about what can become visible by each method of a visual control.

Method	What becomes visible
1. Seiri/Seiton by 5S	Whenever the parts and/or products can't be found in the places predetermined by Seiri-Seiton, it shows the occurrence of their irregular movements suggesting an incompliance with rules and thereby a disorganised work environment.
2. Production using Kanban	For example the following items are to become visible: <ul style="list-style-type: none"><li>• Muda of overproduction</li><li>• Muda of waiting</li><li>• Actual situation of machinery operation (The number of KANBAN sheets tells the situation of machinery utilisation.)</li></ul>

# Making it visible by visual control-2

Method	What becomes visible
3. Jidoka (Autonomation)	Troubles at production lines and facilities become visible to everyone. (by ANDON display)
4. Standardised work	The comparison with the standardised work enables people to see the problems such as a delay in operation, inappropriate work sequence, etc.
5. Flow production	The products should be constantly flowing during a normal operation. Therefore any irregularity of product flow makes stagnation and Muda of transport visible and suggests a hint of KAIZEN.

# How to practice visual control



This section is dedicated to the introduction of specific examples of 'visual control.'

## Case 1

Information display board (called ANDON) at a production line and the site of machinery

## Case 2

Use of a production control board

## Case 3

Use of KANBAN

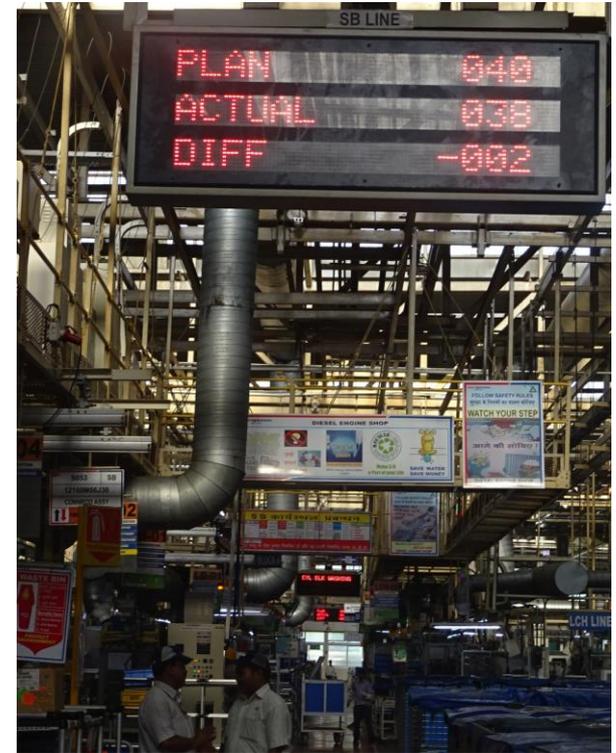
# How to practice visual control: Cases

What is ANDON? One of the tools for visual control

-  ANDON means to visualise states of the assembly line and machinery. It's a tool for 'visual control' to inform the people concerned of necessary information in a timely manner.
-  ANDON shows abnormality information and it also gives other information such as:
  - Direction of quality check
  - Time to change cutting tools
  - Instruction for transport

# Case 1: ANDON at production line and machinery #1

## ANDON to show production output



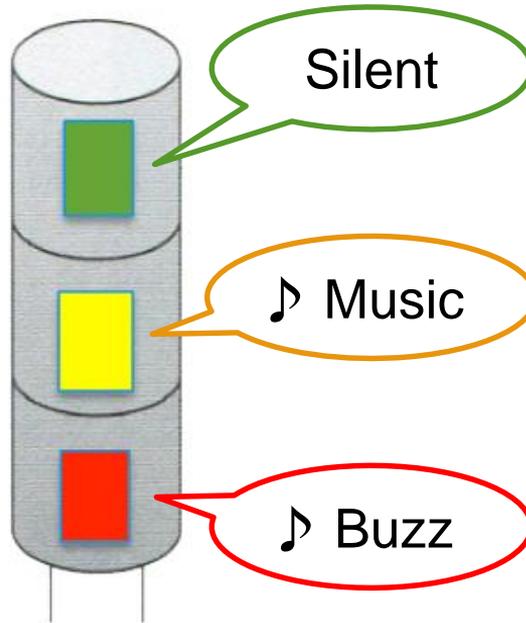
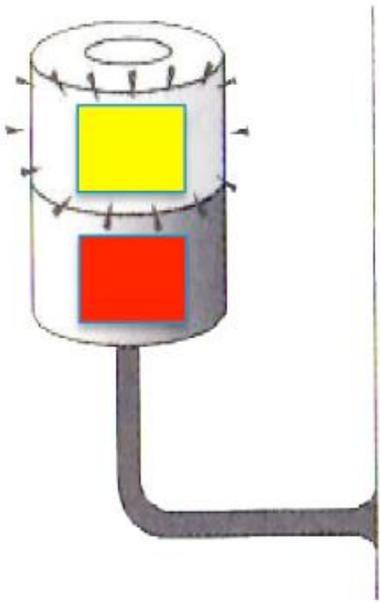
# Case 1: ANDON at production line and machinery #2

ANDON to show operation status



# Case 1: ANDON at production line and machinery #3

## ANDON to call emergency attention



Green lights during normal operation

When abnormality occurs such as parts in short or a defect, the operator presses an alarm button to change the colour to yellow

Red lights when a line is stopped

# Case 2: Visual control by production monitor board

MEETING TIME - 8:50 AM - 9:00

## FINAL LINE EFFICIENCY REPORT

DATE - 01/05/2017

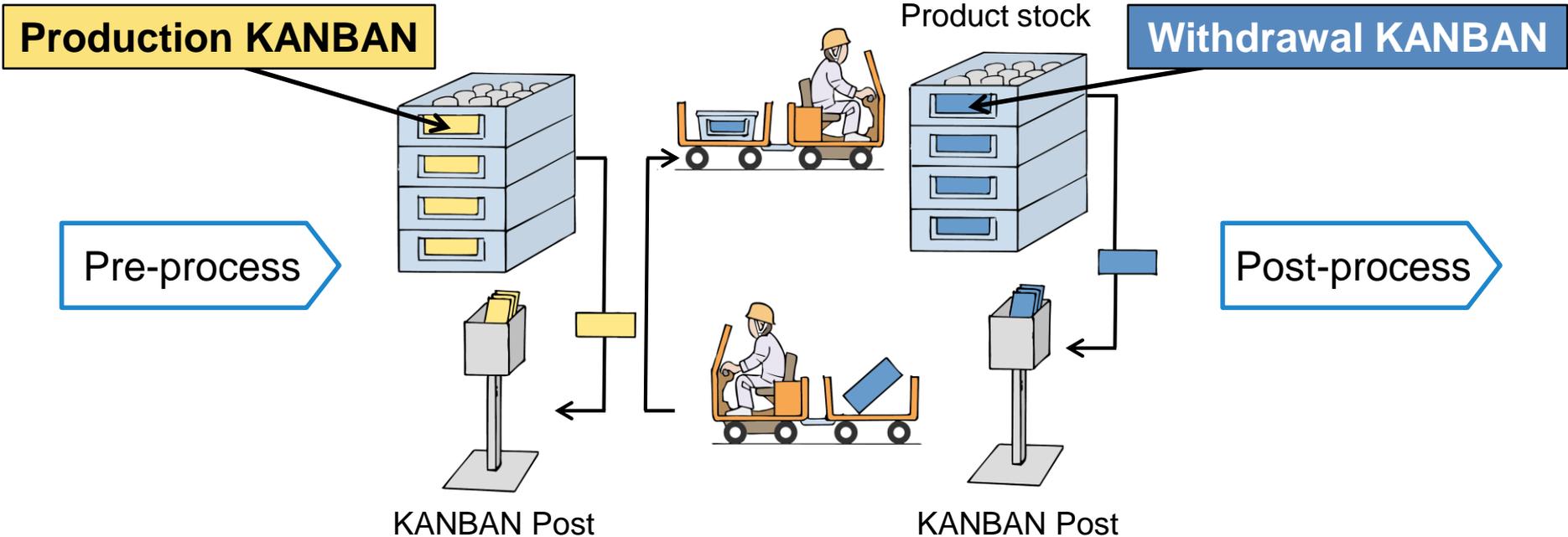
	FREQUENCY		TIME (IN MIN.)		COMMENTS	REMARKS
	YESTERDAY	PRV. DAY	YESTERDAY	PRV. DAY		
<b>1. TOTAL FINAL LINES STOPPAGE (ACTUAL) A</b>						
FINAL C/V STOPPAGE (ANDON) B	208	195	35:55	11:07		
FINAL C/V STOPPAGE FROM CH-2	98	95	20:57	8:15		
FINAL LINE STOPPAGE TARGET: 100%	110	106	14:58	7:52		
<b>2. STOPPAGES DUE TO CLW.</b>	47	42	3.2	2.7		
CLW 20 STN 65BA RS Wheel not loose	11		00:38			
CLW 18 STN 76L RS Stopper Bolt	4		00:26			
CLW 14 STN 66R RH FR Cap	3		00:21			
CLW 35 STN 72R front Wiper	3		00:20			
<b>3. STOPPAGES DUE TO PIKA-PIKA</b>	11	20	0.7	1		
PKPK 96 STN 54R TPC	3		00:13			
PKPK 94 STN 62L Rear Wiper	1		00:09			
PKPK 192 STN 64L Poly bar Conv	2		00:08			
<b>4. STOPPAGES DUE TO PAUSE &amp; EMG.</b>	10	12	1.1	0.7		
1. PAUSE BRAKE oil	2		00:37		Process delay	AS-2
FINAL EXIT PAUSE	8		00:26		Break fail	AS-3
<b>5. STOPPAGE DUE TO EQUIPMENT</b>	29	17	3.4	3.1		
RR 24 DR HD EMG Door	1		1:24		Door Computer Breakdown	MP-2
RR 14 DR HD OVER RUN	12		00:42		Door Manipulator Breakdown	MP-2
VED P21 EMG	4		00:32		Stop	MP-1
fuel filter Operation delay	2		00:19		fuel lid not opened	AS-2
2nd SW HD OVER RUN	7		00:17		New Operator (on Training)	AS-1

A monitoring board installed at production scene can show progress of work, any trouble and occurrence of Muda.

→ More commitment to KAIZEN

# Case 3: Visualisation by KANBAN-1

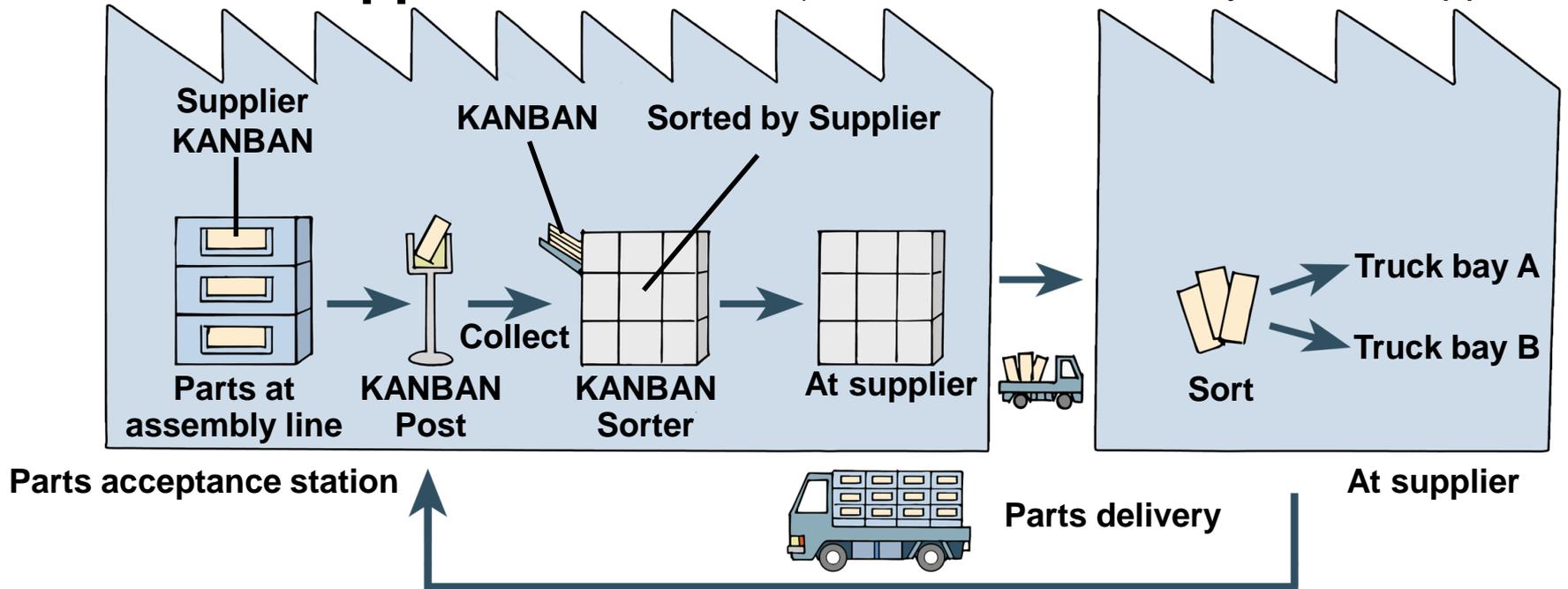
## A case of Withdrawal KANBAN and Production KANBAN



From the number of KANBAN sheets in Kanban post, we can see the production situations of both pre- and post-processes.

# Case 3: Visualisation by KANBAN-2

## A case of Supplier KANBAN (used between a factory and its suppliers)



From the number of KANBAN sheets in KANBAN post, we can see production situations and inventory level of suppliers.

# PDCA cycle for KAIZEN

## **Text No. 3-3-12**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# PDCA cycle for KAIZEN

## Contents

- ✓ **What is the PDCA cycle?**
- ✓ **How to follow the PDCA cycle**
- ✓ **The PDCA cycle in KAIZEN activities**



# What is the PDCA cycle? -1

-  The PDCA cycle method was originally conceived for the smooth operations in quality control and production control.
-  It is a method to set a goal and achieve it by monitoring a process and identifying a progress (with visualisation). It is a very important way of thinking.
-  It's very useful not only for KAIZEN activities but also for any kinds of activities to achieve goals based on plans.

# What is the PDCA cycle? -2



PDCA is the abbreviation of the following words.

**P = Plan**    **D = Do**    **C = Check**    **A = Action**

The PDCA cycle method is very useful for smooth implementation of the following.

- KAIZEN activities
- Production control
- Quality control
- Other business management



# How to follow the PDCA cycle-1

Key points are described below on how to proceed with the PDCA cycle to promote KAIZEN and other activities.

## Points to make best use of the PDCA cycle

<p>P (Plan)</p>	<p>You have to make an implementation plan on what you need to do with its purpose. It is important that your goal setting must be expressed in a quantitative manner. The PDCA cycle can't start and work without an appropriate plan. <b>The plan should be made based on 5W1H: What/Who/Why/When/Where/How</b></p>
<p>D (Do)</p>	<p>Implement what was decided in Plan. When doing so, you need to have a mechanism to record it. <b>What you have implemented must be recorded and reported as an achievement.</b></p>

# How to follow the PDCA cycle-2

## Points to make best use of the PDCA cycle

C  
(Check)

Compare the result with the Plan and evaluate what you have done. Check and review should be done periodically. **Difference between Plan and Do such as delay and accomplishment should be monitored and comprehended.**

A  
(Action)

The original plan should be re-examined because it needs to be modified to move to the next cycle. It is critical to extract and review all points to be improved in order to reflect those points to the next P. **Your check (review and evaluation) should be reflected to the next plan. This is considered as a process to follow the PDCA cycle.**

# How to follow the PDCA cycle-3

1. It is critical to comprehend a difference between :
  - Plan (what you had planned)
  - Do (what you have accomplished)

The annual plan can become the basis to follow the monthly PDCA cycle and monitor the progress of each month. Every month you should compare the latest achievement with the original plan so that your findings can be reflected to the next month's PDCA.

# How to follow the PDCA cycle-4

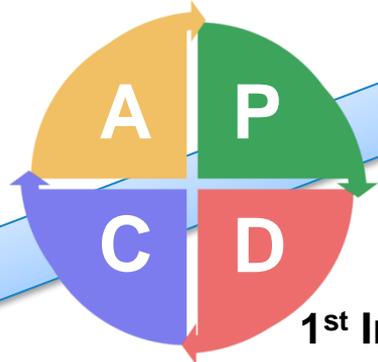
## 2. Plan should be clarified based on '5W1H'

5W1H	What to do	'Example' at KAIZEN activities
<b>What</b>	Job contents; Type; Volume	What are the tasks for KAIZEN?
<b>Why</b>	Purpose; Aim; Background	What is the purpose/aim/necessity of KAIZEN?
<b>Who</b>	Supervisor; Person in charge; Group members	Who is the person responsible? Who are the team members?
<b>When</b>	Start time; Delivery date; Schedule; Due date	What is the schedule? By what time should it be finished?
<b>Where</b>	Place; Location; In/Out workshop; Outdoor/Indoor; Branch	Which workplace is the target of KAIZEN?
<b>How</b>	Means; Method; Work procedure; Operation sequence; Job items	How to proceed with KAIZEN? What procedure is to be used?

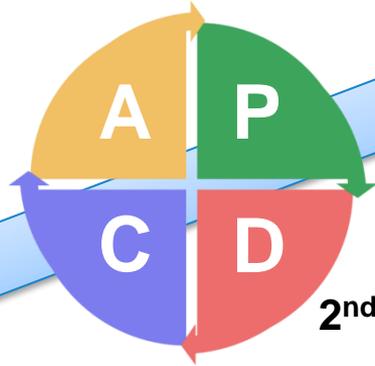
# PDCA cycle in KAIZEN activities-1

**KAIZEN** is a continuous improvement spiral.

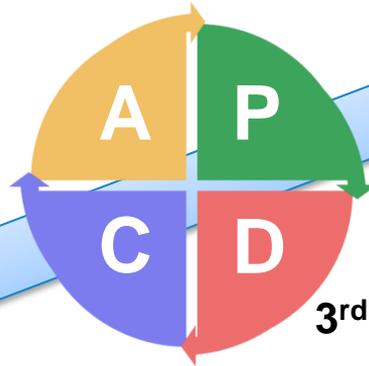
Each PDCA cycle may not one cycle



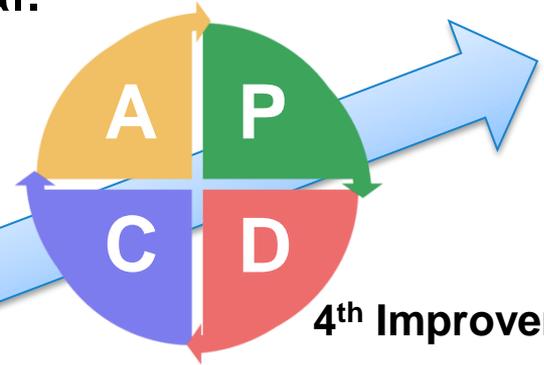
**1<sup>st</sup> Improvement**



**2<sup>nd</sup> Improvement**



**3<sup>rd</sup> Improvement**



**4<sup>th</sup> Improvement**

Endless PDCA improvement cycle

# PDCA cycle in KAIZEN activities-2

## Rising-up spiral of the PDCA cycle

1. The continuous improvement has to be made by repeating the PDCA cycle. By doing so, the level of KAIZEN is raised every year like a spiral rising upward.
2. It's important to connect Check and Action with Plan of the next cycle.
3. Without proper C and A in a cycle, KAIZEN may even go backward like a spiral falling down.
4. The time period of the PDCA cycle should be changed according to the needs of the activity like by a week, a month or a year.

# PDCA cycle in KAIZEN activities-3

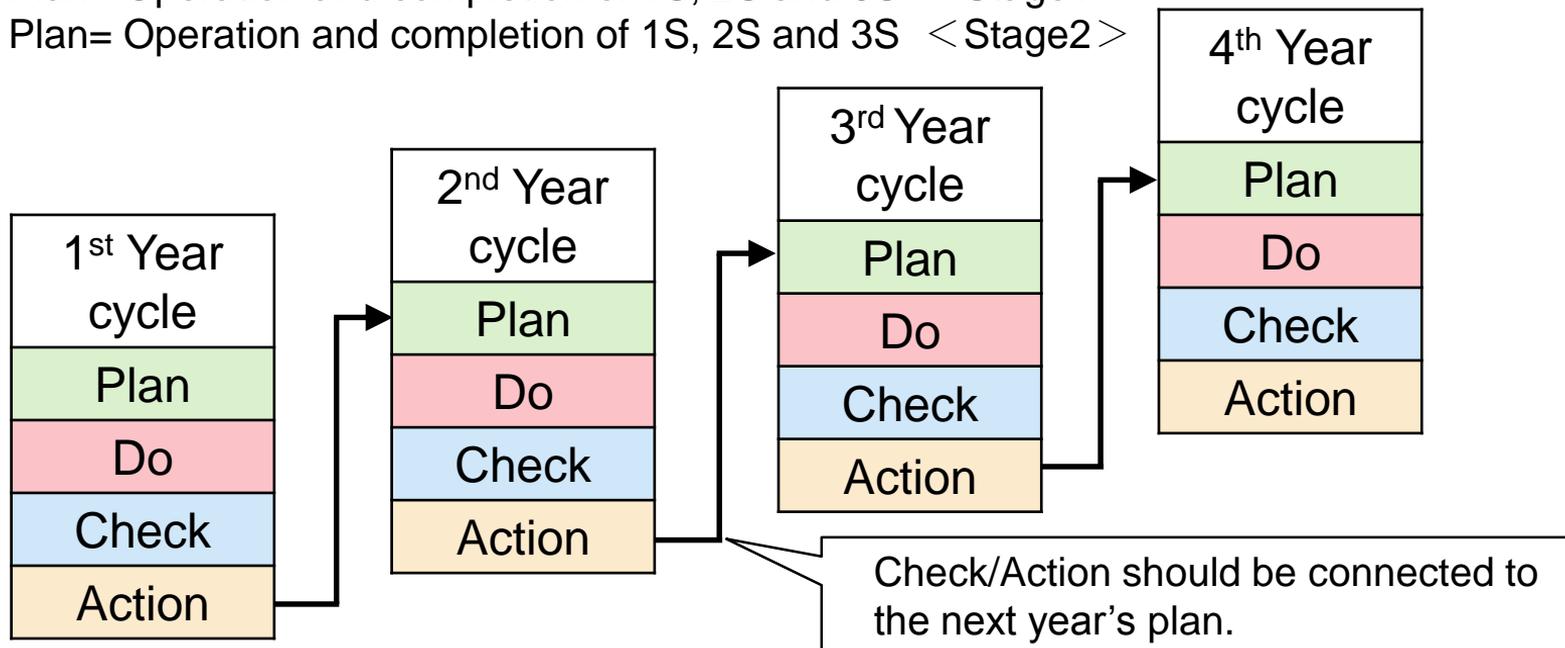
## PDCA for 3S (Seiri/Seiton/Seiso) activity

1<sup>st</sup> PDCA Plan= Introduction of 1S and 2S

2<sup>nd</sup> PDCA Plan= Completion of 1S and 2S + Introduction of 3S

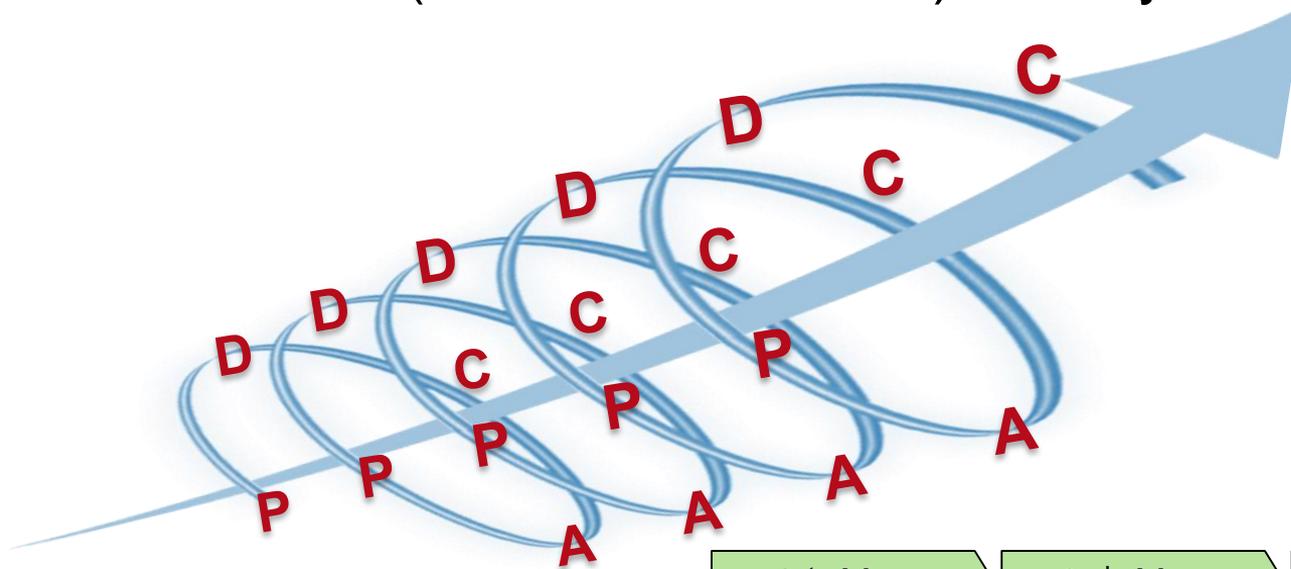
3<sup>rd</sup> PDCA Plan= Operation and completion of 1S, 2S and 3S < Stage1 >

4<sup>th</sup> PDCA Plan= Operation and completion of 1S, 2S and 3S < Stage2 >



# PDCA cycle in KAIZEN activities-4

PDCA for 3S (Seiri/Seiton/Seiso) activity



Continuous  
KAIZEN

1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year
Introduction of 1S and 2S	Completion of 1S and 2S + Introduction of 3S	Operation and completion of 1S, 2S and 3S <Stage1>	Operation and completion of 1S, 2S and 3S <Stage2>

# Appendix

## Column

Dr. W. E. Deming (1900-1993) visited Japan from the United States in 1950. It was the very beginning of the use of the PDCA cycle as Dr. Deming taught it as a control tool for quality improvement.

The concept of the PDCA cycle spread much wider in Japan than the U.S. and it made a great contribution to quality improvement of Japanese manufacturing sectors. Today, the PDCA cycle is also called the Deming cycle in honour of the American scholar.

This has been applied not only to KAIZEN and 5S activities but also other areas of corporate activities including sales and marketing as a versatile and useful method. It can also be applied to individuals as well as businesses.

# 3M (Muda/Mura/Muri) for KAIZEN

## **Text No. 3-3-13**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# 3M (Muda/Mura/Muri) for KAIZEN

## Contents

- ✓ **What is Muda?**
- ✓ **Three viewpoints of Muda**
- ✓ **Muda of 3M (Muda/Mura/Muri)**
- ✓ **Muda in the four element process**
- ✓ **Seven Muda at the production site**



# What is Muda? -1



All those activities that are just consuming labour, materials and money but not adding any value are regarded as Muda, which means waste.

What kinds of Muda can you find?

There are many kinds of Muda at a production site. Focusing on human motions and machinery, all of the following things are Muda.



**KAIZEN means activities to eliminate all these Muda.**

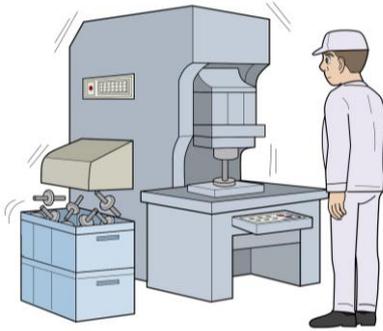
## Seven Muda

- ① Overproduction
- ② Just waiting
- ③ Just transporting
- ④ Wasteful process
- ⑤ Extra inventory
- ⑥ Wasteful motion
- ⑦ Defect making

# What is Muda? -2



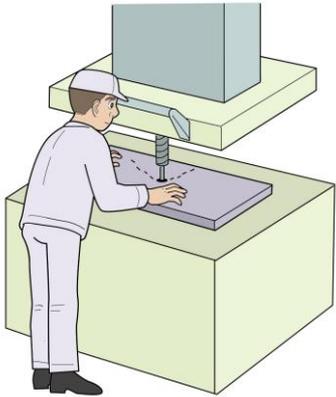
① Overproduction



② Just waiting or just monitoring



③ Just transporting



④ Wasteful process



⑤ Extra inventory



⑥ Wasteful motion



⑦ Defect making

# Three viewpoints of Muda

Muda can be classified by the following three viewpoints :

Type		Contents of Muda
1	<b>Muda of 3M</b>	This Muda focuses on the relation between workload and capacity, which namely refers to Muda caused by Muri (unreasonableness) and Mura (unevenness).
2	<b>Muda of physical movement</b>	This Muda can be divided into four types: ① transport, ② stagnation, ③ processing and ④ inspection. All of them except ③ are practically considered as Muda. Especially ② is the largest Muda.
3	<b>7 types of Muda</b>	The idea of 'Seven types of Muda' caused in production sites has been introduced. This classification was conceived by Toyota Motor Corporation in the first place.

# Muda of 3M (Muda/Mura/Muri) -1

3M	Relation between request & resource	Relation among 3M
<b>Muda</b>	All non-value-adding things (waste); they are cost increase factors. <ul style="list-style-type: none"><li>• Request &lt; Resource</li></ul>	Mura and Muri often generate Muda.
<b>Mura</b>	Mura means unevenness. The relation between request and resource changes in accordance with Muda and Muri conditions.	At a time of decrease in production, it causes waiting, while it causes more reworking or working all over again at peak production.
<b>Muri</b>	Overwork on machine, operator etc. Excessive demand on volume, specifications, etc. <ul style="list-style-type: none"><li>• Request &gt; Resource</li></ul>	It causes errors in production, inferior quality and rejections that call for more reworking or working all over again.

# Muda of 3M (Muda/Mura/Muri) -2

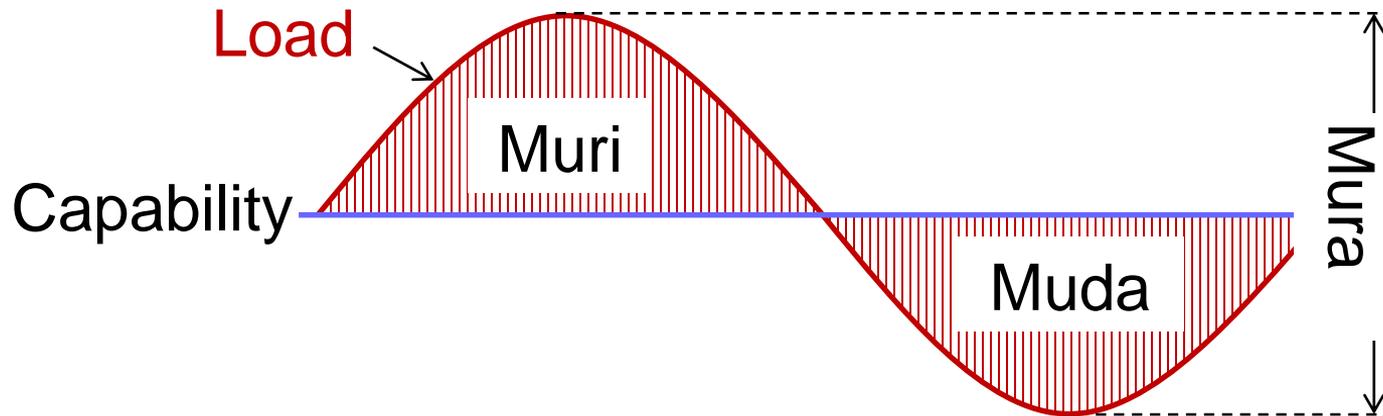


- Muda means unnecessary jobs.
- Muri and Mura generates Muda.
- Remove Muri-Mura-Muda from your workplace.

# Muda of 3M (Muda/Mura/Muri) -3



By levelling a load Mura and Muri can be reduced or eliminated.



**Load** = Capability ..... High productivity  
**Load** < Capability ..... Muda } Mura ..... Low productivity  
**Load** > Capability ..... Muri }

# Muda of 3M (Muda/Mura/Muri) -4

Productivity seen from the relation between load and capability.

Productivity	Relation between request and resource	Example -1 Load: Work volume equivalent of 10 man-hour by standard man-hours
High	Load = Capability	Capability: One person works for 10 hours, or two persons work for 5 hours each.
Low	Muda Load < Capability	Capability: One person works for 12 hours, or two persons work for 6 hours each.
	Muri Load > Capability	Capability: One person works for 8 hours, or two persons work for 4 hours each.

# Muda of 3M (Muda/Mura/Muri) -5

Productivity seen from the relation between purpose and means.

Productivity	Relation between purpose and means	Example-2 Purpose: Carry two cartons of beer in 350ml cans ( $0.38\text{kg} \times 48 = 18.4\text{kg}$ )	Example-3 Purpose: Dig a small hole
High	Purpose = Means	Means: Carried by a dolly	Means: Dug by a shovel
Low	Muda Purpose < Means	Means: Carried by a forklift	Means: Dug by a bulldozer
	Muri Purpose > Means	Means: Carried by hand	Means: Dug by hand

# Muda in the four element process-1



All physical movements at a production site fall into one of the following processes of (1) to (4). Those four processes are explained in the following few pages. Among them we should remember that only process (1) generates added value. The rest of them, (2)(3) and (4), are all considered as Muda, that they should be reduced as much as possible by KAIZEN.



# Muda in the four element process-2

Process by element	Content of process	Value added	Level of Muda
(1) Processing	The object of production is changed in shape or nature. e.g., machining, welding, painting	Value added (Contributing to making profits)	No Muda
(2) Transport	This changes the location of the object in production.	No value added	Necessary Muda

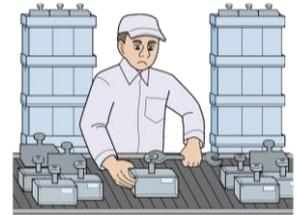
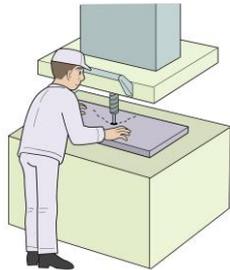
# Muda in the four element process-3

Process by element	Content of process	Value added	Level of Muda
(3) Stagnation	The object in production is either →stored for some reason, or →simply stagnating against schedule	No value added	Unnecessary Muda
(4) Inspection	This inspects the object in production for quantity and quality, and then compares the results with standards to judge its conformity.	No value added	Necessary Muda

# Muda in the four element process-4



Can you identify Muda operations that don't create values?  
Among Muda, can you tell what is necessary Muda and what is unnecessary one?



# Muda in the four element process-5

## Value

## Description of activities

Actions such as processing or assembling products in a factory to add new value to materials or parts.

Creating value



# Muda in the four element process-6

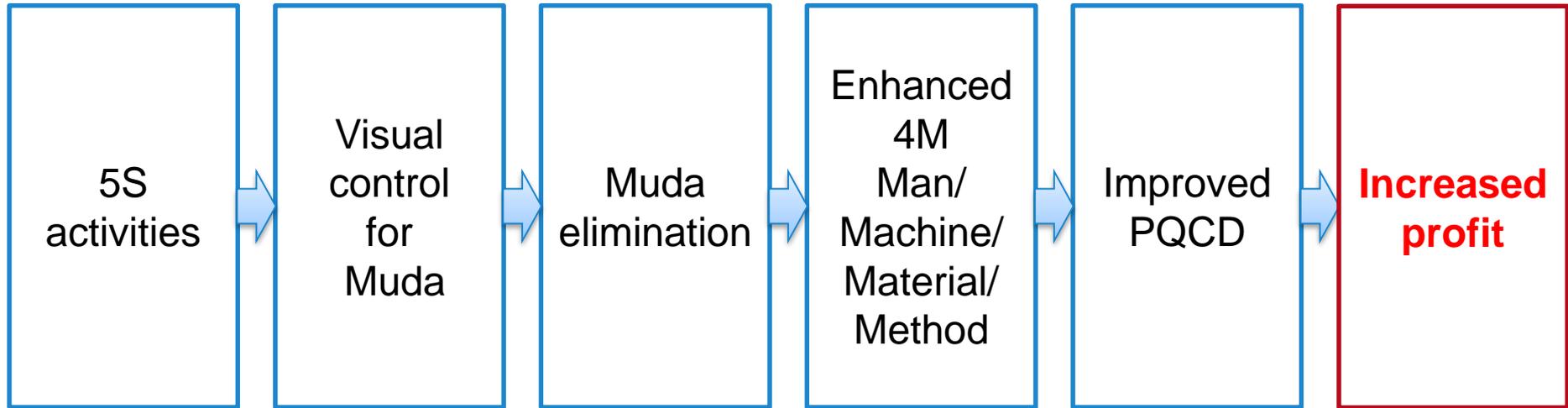
Value	Description of activities
Creating no value	<p data-bbox="672 317 1802 432">Actions to help those activities that increase the value of things.</p> <ul data-bbox="736 445 1715 626" style="list-style-type: none"><li>• Changeover, exchange of tools or works</li><li>• Transport of products or parts.</li><li>• Inspection and others.</li></ul>
	<p data-bbox="672 680 1827 794">Actions that do nothing to increase the value of things. They may hamper other valuable actions.</p> <p data-bbox="672 811 1396 992">e.g. • job error    • extra motion • monitoring of machinery • waiting</p>

# Seven Muda at production site

7 Muda		7 Muda at production factory
1	<b>Overproduction</b>	Excessive production. More than expected sales.
2	<b>Waiting</b>	Just waiting without any rational reasons.
3	<b>Transporting</b>	Simply transporting some parts or products.
4	<b>Processing</b>	Wasteful processing. Adding no value or even adding negative value.
5	<b>Inventory</b>	Keep too much stock. Extra inventory.
6	<b>Motion</b>	Too many motions or just moving without necessity.
7	<b>Defect making</b>	Reworking and waste caused by defective production.

# Appendix

The flow of KAIZEN activities:  
from 5S activities, Muda elimination to increased profit



# Seven Muda for KAIZEN

## **Text No. 3-3-14**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Seven Muda for KAIZEN

## Contents

- ✓ **Muda in the production site**
- ✓ **Meaning of added value of work**
- ✓ **Seven Muda at the production site**  
(Muda of overproduction/waiting/transporting  
processing/inventory/motion/defect making)



# Muda in production site

## 1. For high quality product with low cost

It is essential to eliminate waste (Muda) as much as possible.

## 2. What is Muda?

- Just simply to use manpower, material and money for production without adding any value. It is Muda.
- Elimination of Muda increases profit because production cost can be reduced.
- Elimination of Muda is a kind of KAIZEN meaning improvement.

# Meaning of added value of work

What is value-added work? It's the work adding value to a product.

**Working:** Adding value by changing shapes and/or characteristics.

**Motion:** Adding no value by looking for something, just storage, or simply moving or transferring some parts.

4 processes in production

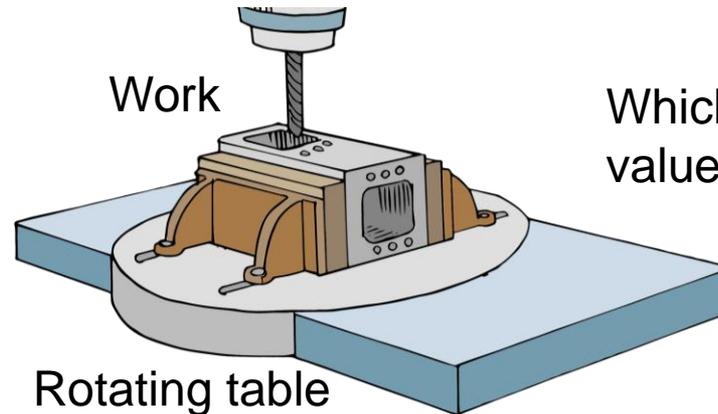
Transport

Stagnation

Processing

Inspection

In Muda operation no value is added while the cost is increased.

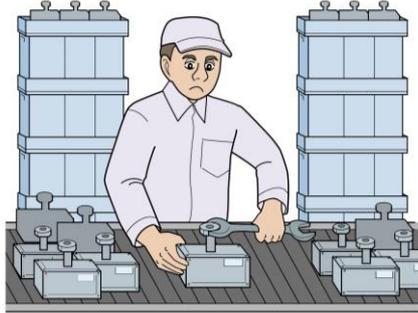


Which process generates value in drilling?

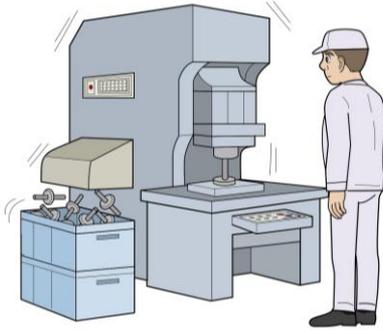
# Seven Muda at production site-1

7 Muda		7 Muda at production factory
1	Overproduction	Too much material for production
2	Waiting	Just waiting due to process
3	Transporting	Only transportation of some parts and manufacture
4	Processing	Waste processing also exists
5	Inventory	Have too much inventory
6	Motion	Too much motion and just moving
7	Defect making	Many defective production

# Seven Muda at production site-2



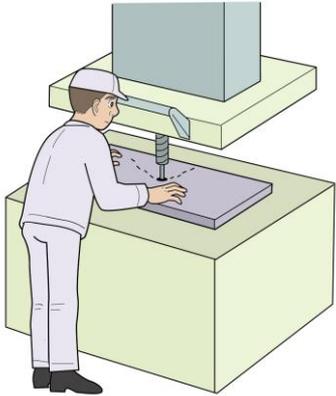
① Overproduction



② Just waiting or just monitoring



③ Just transporting



④ Wasteful process



⑤ Extra inventory



⑥ Wasteful motion



⑦ Defect making

# Muda of overproduction-1



Every product stocked in progress, and every material/part stocked in works is cost. Every object in the work area might become Muda. Do you think all of them will be used sometime? If you don't, you have to do something to reduce them.

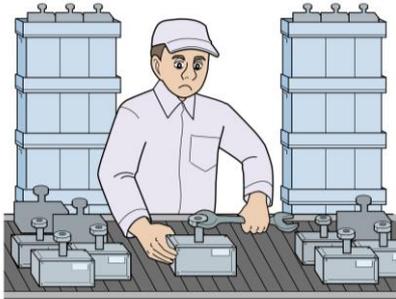
## Harmful effects

- Deterioration of turnover ratio of funds
- To lose flexibility against market change
- To lose flexibility in production planning
- To hide Muda of waiting
- To need more space to stock

# Muda of overproduction-2

Muda of overproduction will generate new Muda (waste).  
Waste creates new Waste. (Negative chain reaction)

Manufactured but unsold  
excess products.



**Muda of overproduction**

Transporting and  
handling those unsold  
products.



Muda of transporting  
Muda of waiting

Renting extra storage space,  
inventory control, product deterioration,  
additional running funds, due to the  
overproduction.

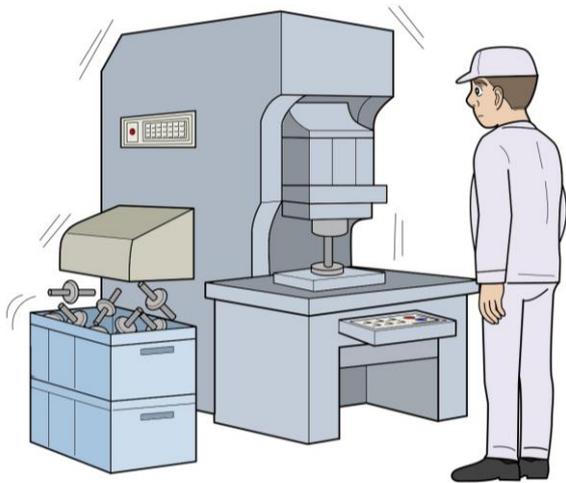


**Muda of inventory**

# Muda of waiting-1



If a worker is just waiting until the process is completed, it's a waste of time, Muda.



## Harmful effects

- Waste of manpower and machine utilisation
- Increase of in-process inventory
- To create a moral hazard

Why the waste of time occurs?

What is the cause of it?

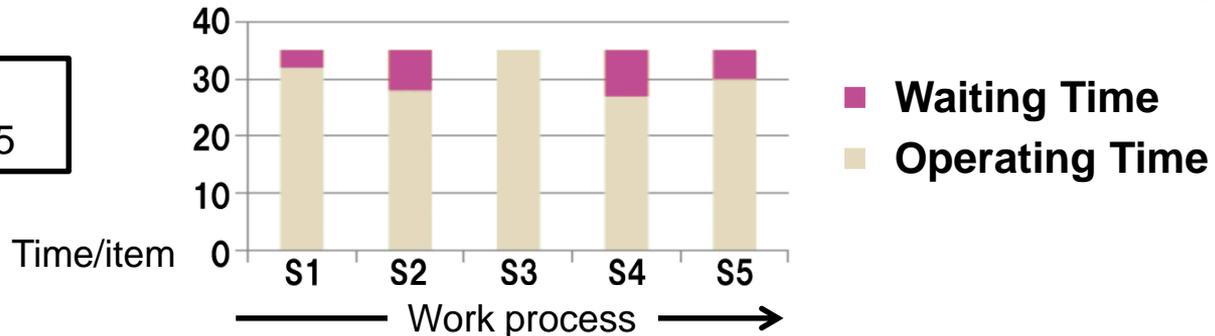
# Muda of waiting-2

- In Muda of waiting, a worker can't work because the previous process has not been completed yet. Therefore, he has to simply wait while doing nothing.
- Muda of waiting is caused by various reasons such as excessive production, lack of parts, machine trouble, etc.

## How to eliminate/reduce waiting MUDA

- Find a process of waiting. (Observe a workplace objectively from outside.)
- Level each process as evenly as possible.
- Re-arrange operations of each process to level each operating time. (Resource re-arrangement)

Levelling each process S1 to S5



# Muda in transporting-1



Transporting various kinds of items such as materials, parts and products is inevitable in production. However, the transport itself doesn't add any value to a product but incurs some cost. Therefore, it's classified as unnecessary Muda. For this reason the transport should be reduced or avoided as much as possible.

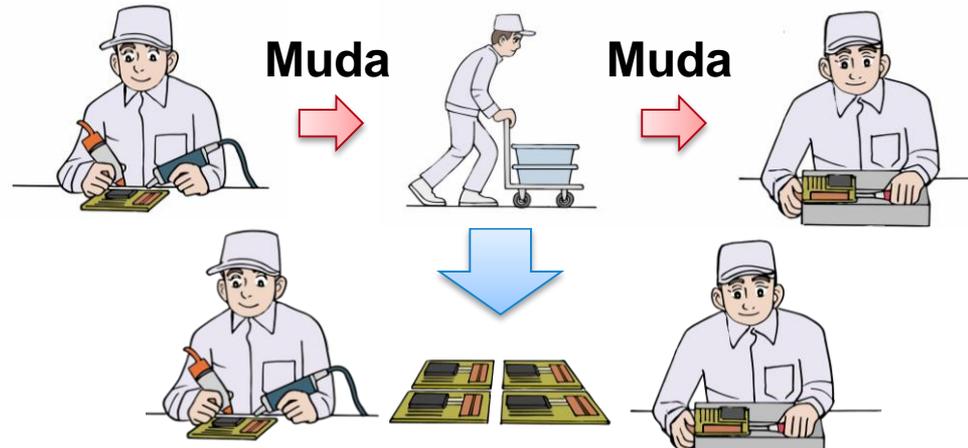


# Muda in transporting-2

## How to reduce Muda in transporting.

1. Improve or change the production process.
  - Change the layout of the production area.
  - Change the storage place.
  - Change the procedure of production, etc.
2. Improve or change the method of transport.
  - Change the means of transport.
  - Change the frequency.  
How often materials and/or products are transported.
  - Change the distance.

Reduce frequency and distance as much as possible.



# Muda in processing-1

1. Try to find an unnecessary process such as an unnecessary machine. Look at the current process from a different viewpoint. Think about the required functions and/or characteristics carefully and avoid excessive ones.
2. Remember that people are usually reluctant to change the current process, when it has been used for a long time and they are used to it. Therefore you have to have a tenacious attitude to think if there is some possibility of improvement in the current process at all times.
3. There is an advancement in the production method and technology at any time. That means we always have a good chance of improvement, KAIZEN.

## Harmful effects

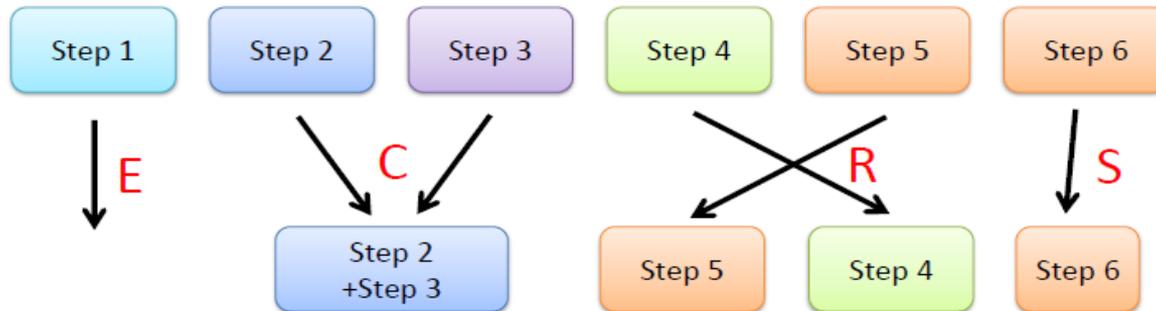
- To need additional materials and labour
- Increase of defects

# Muda in processing-2



How to reduce unnecessary processes? Waste in the process can be reduced by using the principle of ECRS. Refer to the following ECRS method. (Refer to No.3-3-8 in detail)

- E: Eliminate → Is it possible to eliminate some process?
- C: Combine → Is it possible to combine some process with others?
- R: Rearrange → Is it possible to change the order of process?
- S: Simplify → Is it possible to simplify some processes?



# Muda of inventory

1. The inventory itself may not look useless. However if the products aren't sold as expected, they will bring a huge loss.
2. Keeping stock carries cost and wastes time. Inventory (stagnation), as well as transport and inspection, doesn't generate any value. It is Muda, waste, so it should be reduced as much as possible and hopefully eliminated.

## Harmful effects

- To need more working capital
- To hide other Muda (However a great deal of stock indicates the presence of Muda.)
- To need more space to stock



# Muda of motion-1

1. Unnecessary motion in production is waste. It may cause unsafe conditions, quality problems and/or cost increase.
2. Removal of waste in motion is essential for safe work, good quality and cost reduction.

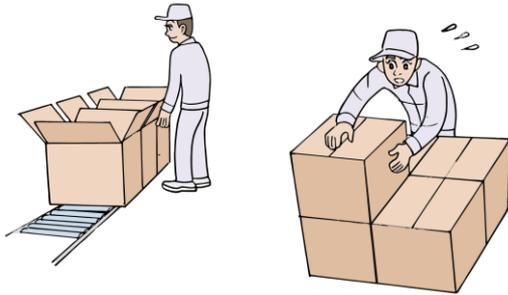
## Harmful effects

- To waste time. It may effect cycle time.
- Instability of operation
- Defects caused by fatigue of an operator

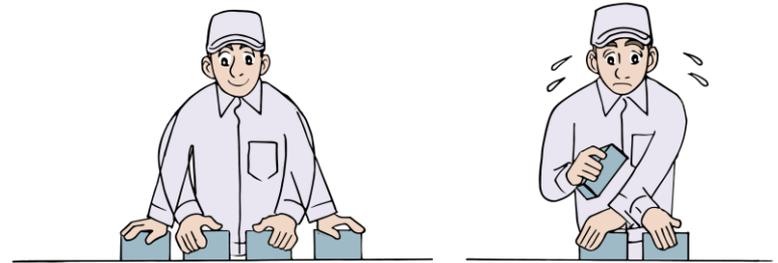
# Muda of motion-2

**Principle of motion economy:** A method for eliminating unnecessary motion and working safely, correctly and efficiently.

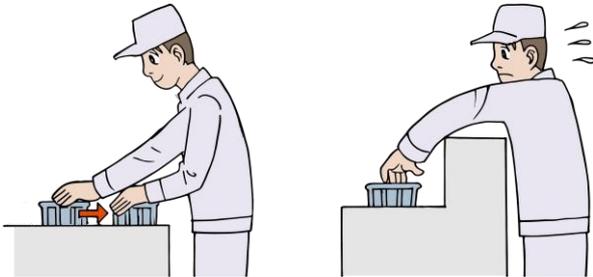
Reduction of steps and motion itself.



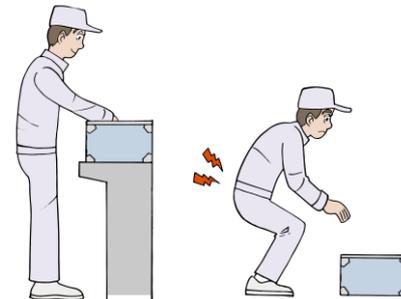
Do some types of work simultaneously.



Reduction of motion distance.



No complication. Work simply & easily.

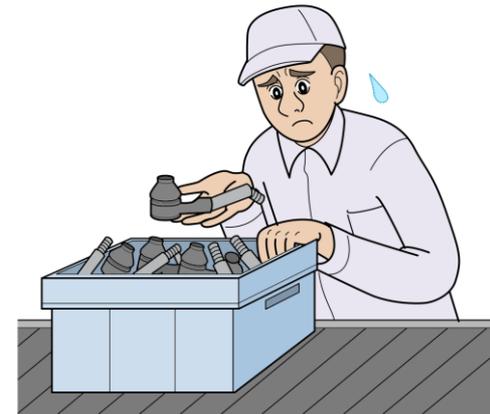


# Muda of defect making-1

When defective products are made, all resources used in their production process such as time, labour and material become Muda. More importantly, you will lose the customers' confidence and he/she won't give you another order. We should remember that good products are made by good workers. So what you have to do first in order to make good products, is to develop good people. They should have a high work ethics and morals and be motivated not to produce defective products.

## Harmful effects

- To need extra cost to rework a defective product
- To damage the customers' confidence



# Muda of defect making-2

## What are the required qualities of a good worker?

- To have a good personality
- To practice 5S activities consistently
- To be a good role model, exercise workplace rules, follow work standards, and share useful information such as his/her failure experience, management knowledge, etc., with co-workers.

## **Text No. 3-4-1**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Ho-Ren-So for communication

## Contents

- ✓ **What is Ho-Ren-So?**
- ✓ **Purpose of Ho-Ren-So**
- ✓ **How to implement Hokoku**
- ✓ **How to implement Renraku**
- ✓ **How to implement Sodan**
- ✓ **Quick Ho-Ren-So for bad information**

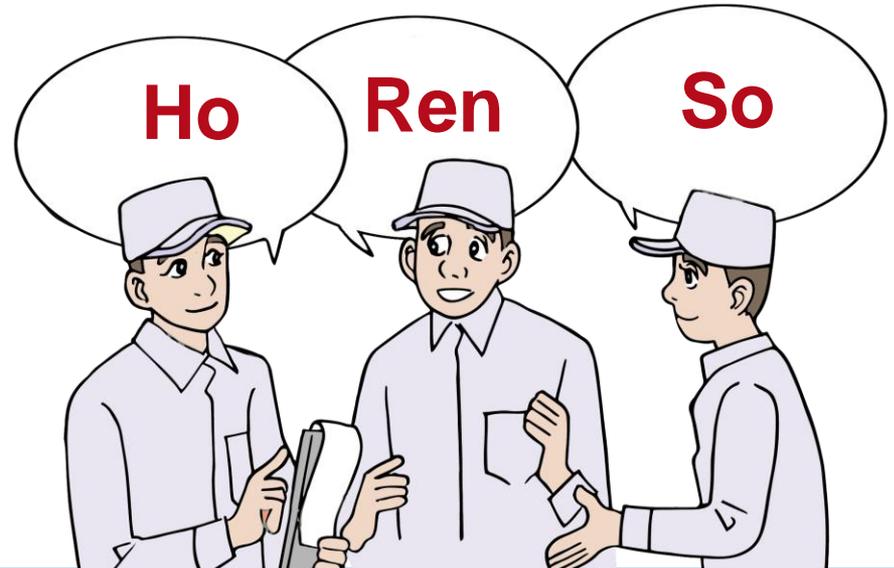


# What is Ho-Ren-So?



Manufacturing is never possible by one person's work. It should be done by team work. It is very important to work by helping each other with mutual understanding of the situations.

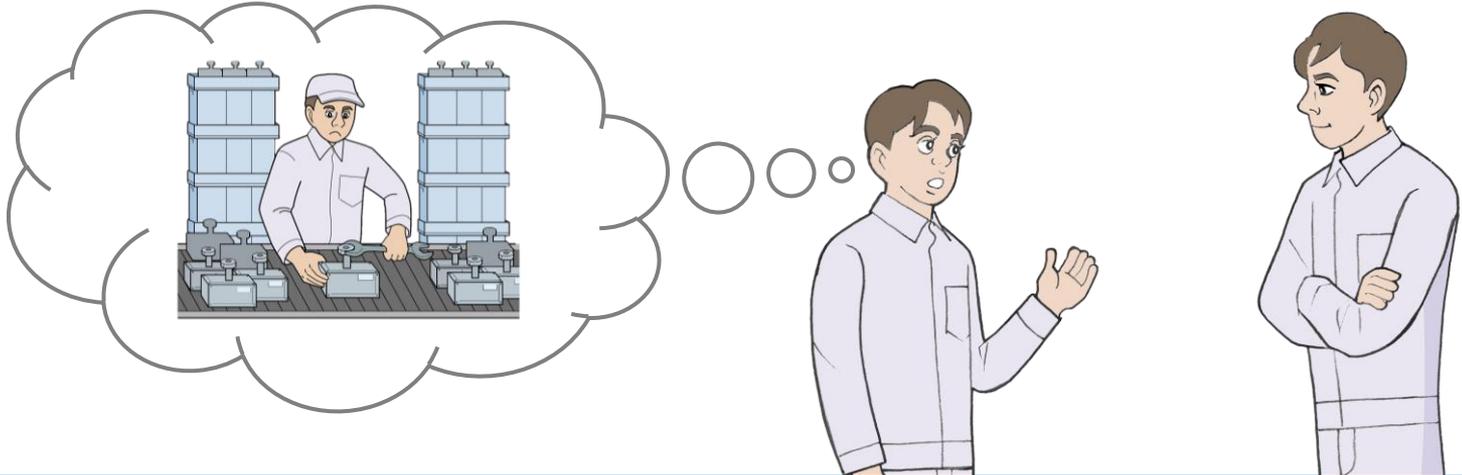
- Mutual communication is essential to complete the work successfully.
- **Ho-Ren-So** is the fundamental communication means for team work.



# Purpose of Ho-Ren-So -1

**Ho-Ren-So** has the following three meanings

<b>Hokoku</b>	To report to your supervisor
<b>Renraku</b>	To inform your supervisor and/or teammates
<b>Sodan</b>	To consult with your supervisor and/or teammates



# Purpose of Ho-Ren-So -2

## **Specific purposes**

- To prevent operations from stagnation
- To detect problems early and solve them in advance
- To prevent troubles
- To upgrade your work skills

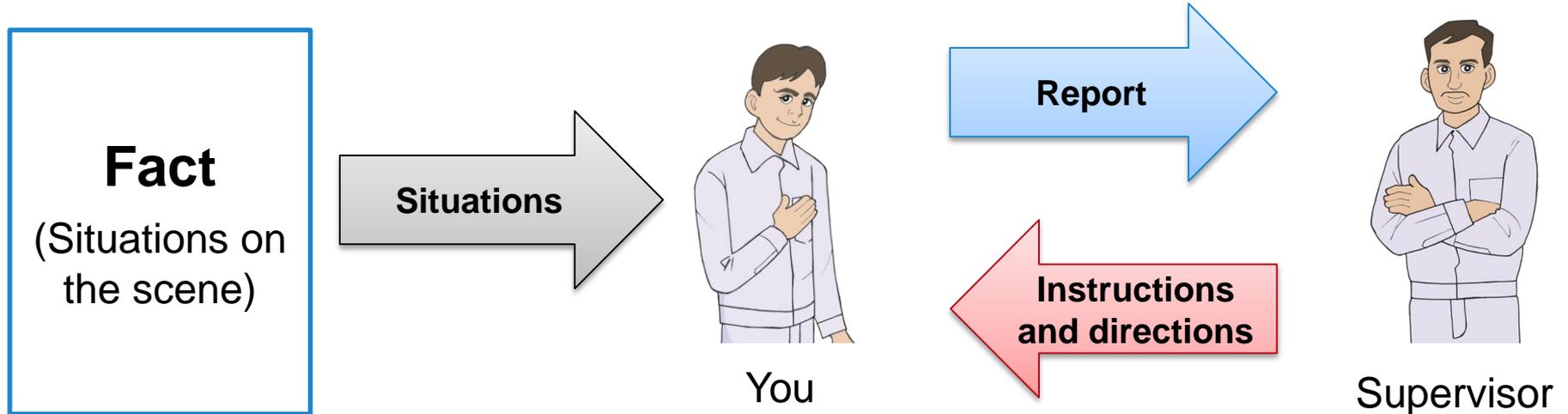


## **Fundamental purposes**

- To prevent any problem in advance so that work can proceed efficiently
- To create a strong team with the spirit of working together

# How to implement Hokoku-1

**Hokoku:** to report to your supervisor



For any instructed or directed jobs, you are supposed to report the following things to your supervisor.

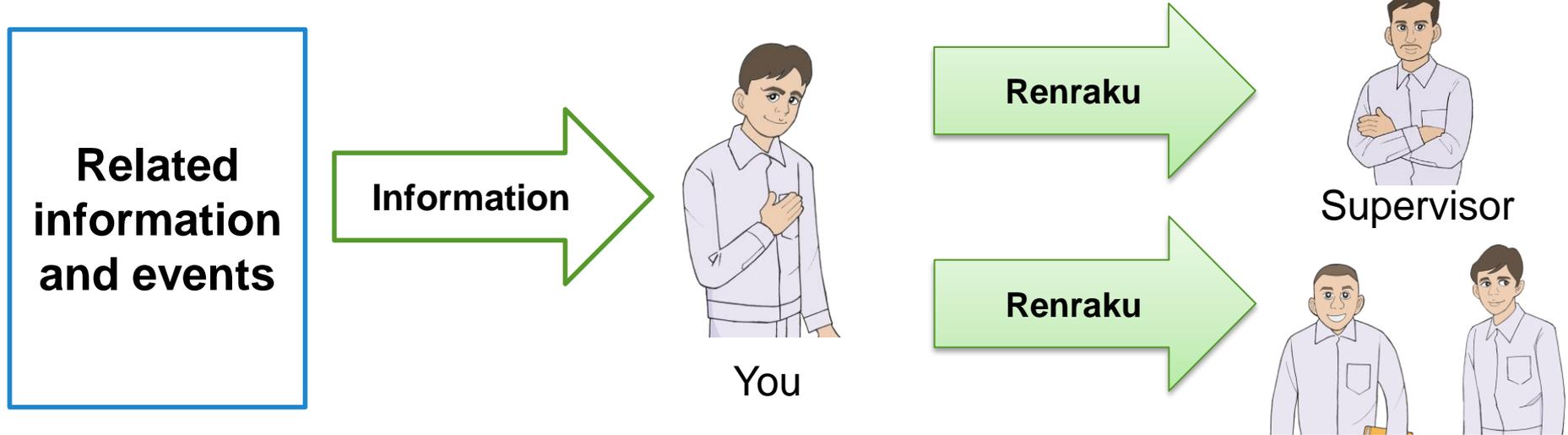
- Fact until now, progress and result
- Forecast of what may happen from now

# How to implement Hokoku-2

Hokoku: How to report		Points
1	<b>Report conclusion first</b>	<ul style="list-style-type: none"><li>• Report consequences of what you have been instructed or directed to do.</li><li>• Report by adding supplementary remarks like background or progress relating to that conclusion.</li></ul>
2	<b>Report by separating fact from speculation</b>	<ul style="list-style-type: none"><li>• Report facts precisely, honestly and briefly.</li><li>• Don't mix a fact with your opinion. → Prevent your superior from misjudgment.</li></ul>
3	<b>Quick, honest and accurate report of bad news!</b>	<ul style="list-style-type: none"><li>• Don't work too much to solve a problem alone.</li><li>• Distressing cannot solve it; Report it openly and honestly.</li><li>• Sooner you report it, faster you can come out with better solutions.</li><li>• Report with your own opinion and judgement.</li></ul>
4	<b>Keep reporting</b>	<ul style="list-style-type: none"><li>• Start with reporting everything</li><li>• Don't set priority by your own standard</li><li>• Report progress as well as result.</li></ul>

# How to implement Renraku-1

**Renraku:** to inform your supervisor and/or teammates



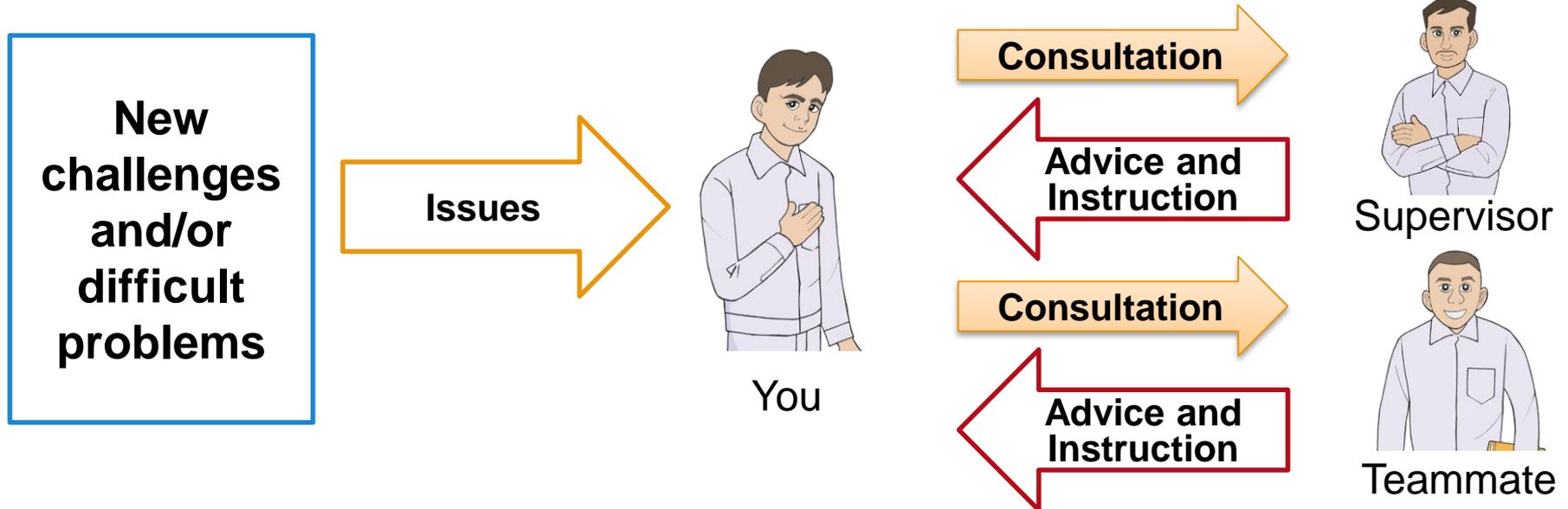
For any instructed or directed jobs, you are supposed to inform all the people concerned of any newly obtained information in a timely manner. **Note: The bad news and/or events that may cause trouble in your job should be informed quickly.**

# How to implement Renraku-2

Renraku: How to inform		Points
1	<b>Organise what you should inform others</b>	<ul style="list-style-type: none"><li>• Organise your information with 5W1H to prevent any omission. What: subject                      Who: who is in charge Why: reason or cause      Where: place When: schedule                  How: methods</li><li>• Don't give irrelevant information to confuse others</li></ul>
2	<b>Comprehend the whole situation</b>	<ul style="list-style-type: none"><li>• Comprehending the whole situation while judging importance and urgency, and select the information you need to give.</li><li>• Give the information in the order of priority.</li></ul>
3	<b>Confirm if you've successfully informed others of the information</b>	<ul style="list-style-type: none"><li>• Check if your important and urgent information was understood by others.</li><li>• Have the ability to distinguish between 'just told' and 'informed.'</li></ul> <p>( just told: Your point of view after transmitting information informed: Receiver's point of view of information)</p>

# How to implement Sodan-1

**Sodan:** To consult with your supervisor and/or teammates



You are supposed to ask your superior and/or teammates for instruction, second opinion or advice. Or, whenever you have some issues and can't make the decision yourself about things such as new challenges or difficult problems, etc.

# How to implement Sodan-2

## Sodan: How to consult

## Points

1	<b>Consultation should begin after having your own opinion</b>	<ul style="list-style-type: none"><li>• What is the subject you are consulting about? Clarify issues and problems. (e.g.) Is it a problem about troubled equipment or poor quality or defective parts?</li><li>• Have your own opinion or plans for that problem. Just consulting does not mean to use your wisdom.</li><li>• Listen to the opinions of others after you share your opinion first.</li></ul>
2	<b>Consultation needs relaxation and honesty</b>	<ul style="list-style-type: none"><li>• Listen patiently when your opinion or assumption has been denied. Tell your opinion first.</li><li>• When instructed to examine again, you don't need to withdraw your opinion at once if you are confident of your own views.</li><li>• Confirm the intention of your superior and contemplate your plan all over again.</li><li>• Go to him again for consulting about revised plans.</li></ul>
3	<b>Result of activity after consultation should be reported without fail</b>	<ul style="list-style-type: none"><li>• The results of all advice you received in consultation should be reported. You should always give feedback as a sign of your confidence in your superior and teammates who advised you.</li><li>• Understand the difference between your opinion and their advice.</li></ul>

# Quick Ho-Ren-So for bad information



In order to prevent a latent problem from being realised and to promote a job efficiently, the information about unfavourable events, which may develop into a serious problem, including your error, should be subject to quick 'Ho-Ren-So'. The possible damage should be limited to the minimum. The priority level of reporting is shown below:

- Priority 1 Bad information requires more immediate Ho-Ren-So than others.
  - When trouble has already been found and is expected to worsen.
- Priority 2 When the situation is different from the normal condition, you should do Ho-Ren-So. (e.g.)
  - Found strange noise in the equipment.
  - Felt something strange with a part under assembly.
- Priority 3 If you have some question at your workplace, you should do Ho-Ren-Sou.

# Appendix

## Column

There are those who try to hide their job mistakes, fearing they will get a lower performance evaluation.

Think of this: Hiding your mistake to keep your assessment means you will be 'temporarily' protected but it will sacrifice your team and your workshop, leading to larger damage to the company you work for. That is why such behaviour is never positive for yourself or your organisation.

## **Text No. 3-5-1**

Soft Skill Text for  
Japan-India Institute for Manufacturing

# Teamwork & QC circle activities

## Contents

- ✓ **Monodzukuri and teamwork**
- ✓ **Job and teamwork**
- ✓ **What are QC circle activities?**
- ✓ **Key points of QC circle activities**
- ✓ **How to promote QC circles**



# Monodzukuri and teamwork



Manufacturing consists of various types of work.

A good product to satisfy a customer cannot be made by one person!

- No manufacturing can be completed by a single person.
- KAIZEN cannot be done by a single person, too.



A better product is produced by a better team.

A poor team cannot make better products.



A better way of manufacturing calls for better teamwork as a prime factor.

# Job and teamwork-1

Teamwork should mean:

To execute work by:

- 1 Defining everyone's role
- 2 Sharing everyone's wisdom
- 3 Helping each other

 A group in which team members don't help each other, act selfishly and never cooperate, can't exercise teamwork.

# Job and teamwork-2



**A better product is produced by a better team.**

A group in which team members don't help each other, act selfishly and never cooperate, cannot produce better quality products.

# Job and teamwork-3

What a good team means:

- **To be able to execute work as a team**
- **To be autonomous and high-spirited**
- **To be able to trust each other**
- **To be able to communicate (Ho-Ren-So) with each other**
- **To be able to maximise team power by drawing and gathering each member's strengths**
- **To have a leader who can take ownership and lead the team**

# What are QC circle activities?



A QC circle activity is a small group activity to set up a target and achieve it by members' cooperation.

## **Foundation of a QC circle**

1. Members at the workplace tackle the issues together as a team
2. To continue working on the problem solving and KAIZEN at their workplace
3. To execute an activity autonomously using each member's knowledge, skill, wisdom, etc.

## **Objectives and targets of a QC circle**

1. Improvement of Q (Quality), C (Cost) and D (Delivery)
2. To establish a cooperative and friendly work environment and develop good human resources

Many companies in Japan have applied the QC circle activity method in their workplaces and have shown successful results.

# Key points of QC circle activities-1

7 Points	What it means
1. Priority on quality	Quality always comes first. Anything can be the subject of quality improvement including working methods, etc.
2. Your next process is your customer	This is the most important idea.
3. PDCA cycle	Use the cycle of Plan/Do/Check/Act for betterment.
4. Fact-based management	Evaluate things by numeric values not by feeling.
5. Prioritising	Select prioritised themes for prioritised execution.
6. Process control	Improve work procedures and systems.
7. Standardisation and preventive measures	Make a mechanism that doesn't allow the situation to go back to the one before KAIZEN.

# Key points of QC circle activities-2

## 2. Your next process is your customer:

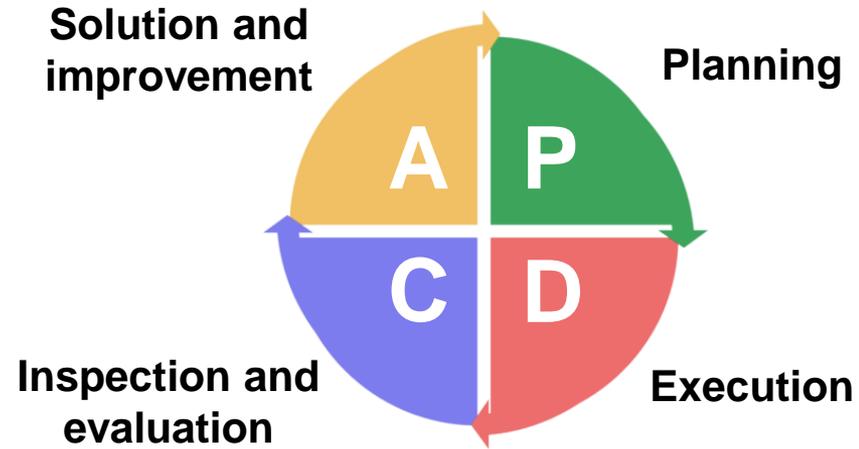
This indicates that you should always deliver the parts/products with perfect quality down to the next process and satisfy people working there, like you do for your customers.



Previous process      Your process      Next process

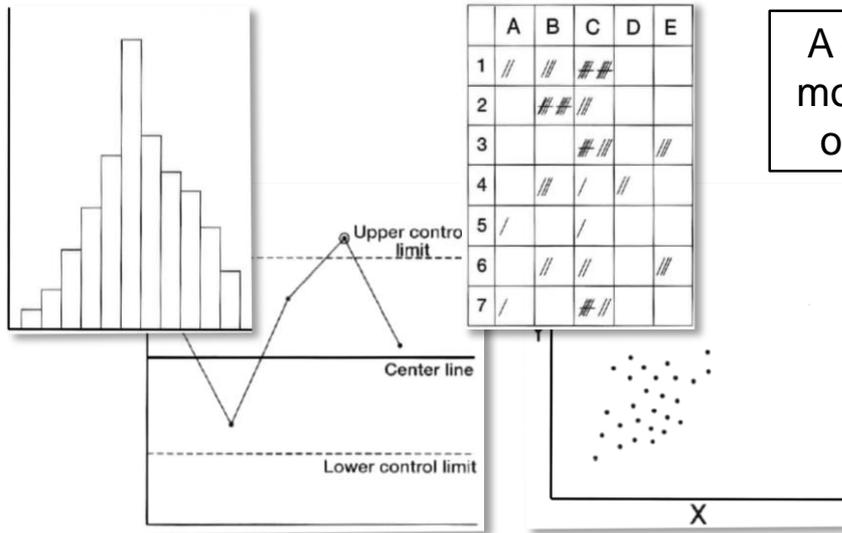
Progress of any quality improvement and KAIZEN should be based on **PDCA cycle** methodology.

## 3. PDCA Cycle



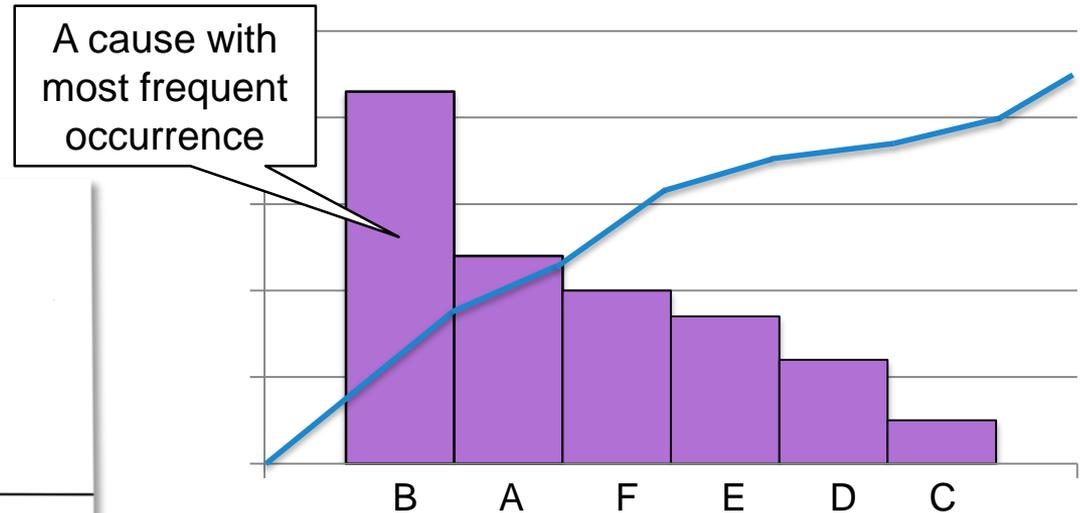
# Key points of QC circle activities-3

## 4. Fact-based management



Problems as well as achievements should be assessed by numerical values and they are visualised. Don't assess them by feeling.

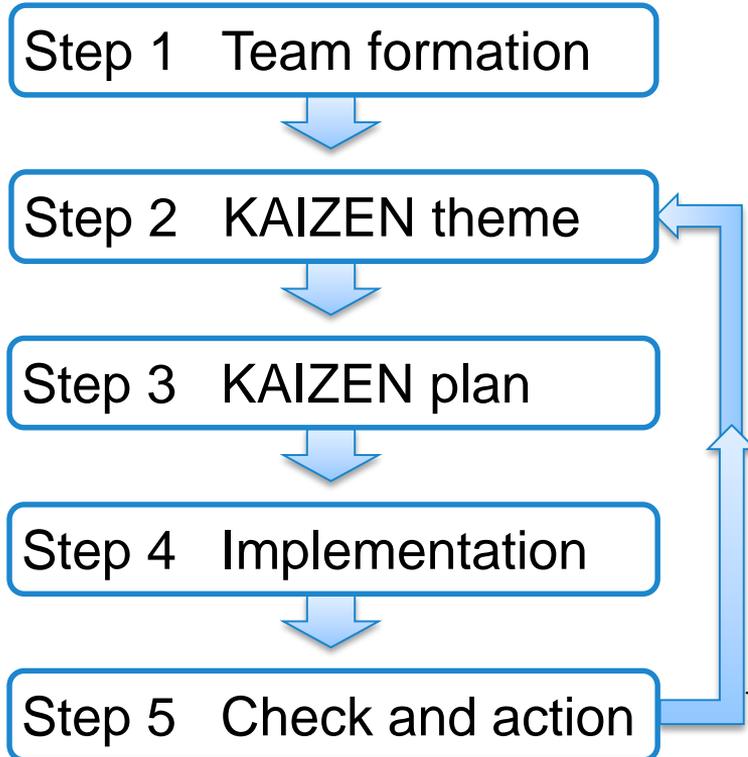
## 5. Prioritising



For the problem solving, prioritise problems first. Then start working on the ones with higher frequency or number of occurrence.

# How to promote QC circles-1

## Basic procedure



## Team management

- A QC circle should consist of front line members of a workplace. A QC activity should be promoted by teamwork.
- Establish good relations among team members to understand and help each other.
- A good team opens the way for success. (NOTE) If it's like a team with a poor teamwork spirit, it can't win in sport.

PDCA cycle

# How to promote QC circles-2

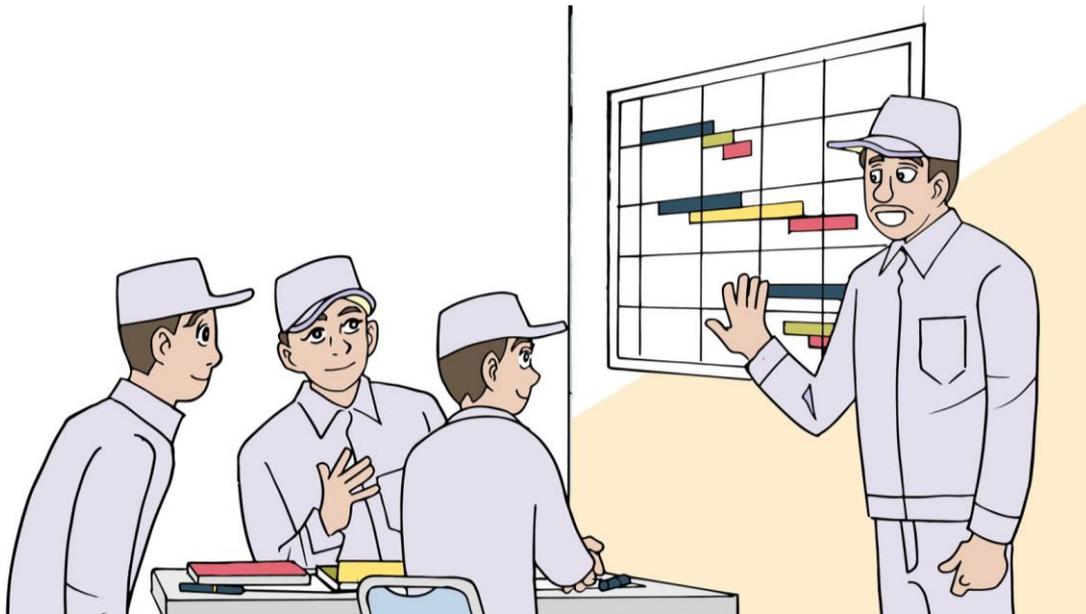
## Basic procedures

Step 1	Organise QC circles and decide members and a leader. Note: Members should be front line operators.
Step 2	Decide a theme of KAIZEN and organise problems and issues.
Step 3	Make a plan of KAIZEN with a definition of roles and procedures. (Plan)
Step 4	Implement KAIZEN and manage the progress. (Do)
Step 5	Check the results and take a necessary action for the next cycle. Standardise activities. Use 7 QC tools. (Check & Action)

# How to promote QC circles-3



In the progress management of the PDCA cycle, PLAN is especially important.



QC circle activities call for teamwork led by a team leader.

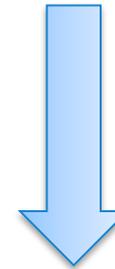
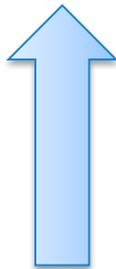
# How to promote QC circles-4

(e.g.) QC Circle activity for reducing defect rate

Implement KAIZEN by  
teamwork.



Find the problems and issues.



Make an improvement plan by  
looking at the actual worksite.



Analyse causes using  
QC tools.

# References: Chapter 3 1/3

Written/supervised/edited by	Title(translated in English)	Publisher	Year
Haruhiko Kato	Easy and Practical Production Management for Beginners (new edition)	JMA Management Center Inc.	2006
Hideaki Masaki	How to Visualize Workplace Wastes (for visible workplace and extra benefit)	Chukei Shuppan Publishing	2008
Hideto Ishikawa	Basic 5S and Implementation	SHUWA SYSTEM Co., Ltd.	2011
Hiroyuki Hirano	100 Q&A on Introduction of JIT	NIKKAN KOGYO SHIMBUN, Ltd.	1999
Hiroyuki Hirano, Makoto Furuya	Simple and Easy 5S	NIKKAN KOGYO SHIMBUN, Ltd.	2011
Ichibei Kudo, et al.	Contemporary Production Management	Doyukan, Inc.	1994
Isao Endo	Seven Conditions to Strengthen Gemba	Toyo Keizai Inc.	2005
Japan Industrial Safety and Health Association	Kiken Yochi Training (Practical Series for Zero Disaster)	Japan Industrial Safety and Health Association	2015
Japan Industrial Safety and Health Association	Collection of Useful KYT Illustrations	Japan Industrial Safety and Health Association	2015
Japan Society for Production Management	Toyota Production System (Production Management - Theory and Practice 11)	NIKKAN KOGYO SHIMBUN, Ltd.	2002
Jitsuho Yoshida, compilation editor	Initial Safety and Health Education Textbook for New Employees (newly revised edition)	Japan Personnel Research Institute	2015
Katsuya Hosotani	Seven QC Tools (Simple QC Tools Exercises) (based on new JIS)	JUSE Press, Ltd.	2006
Katsuya Hosotani	Easy Problem Solving - Must-have for Business Persons - Problem-solving, Task-achieving, and Policy Implementation Types	JUSE Press, Ltd.	2000
Katsuya Hosotani	QC Problem-solving Approach to Improve Problem-Solving Ability	JUSE Press, Ltd.	2013
Katsuyoshi Ishihara	Factory IE Textbook (first volume)	JUSE Press, Ltd.	2006

# References: Chapter 3 2/3

Written/supervised/edited by	Title(translated in English)	Publisher	Year
Kazuo Nishizawa	Handbook for Visual and Easy 5S Implementation	KANKI PUBLISHING INC.	2009
Kenichi Omi, Tetsuro Terada	How to Eliminate Wastes for Small and Medium-sized Manufacturers	NIKKAN KOGYO SHIMBUN, Ltd.	2006
Kenichi Omi, Tetsuro Terada	Management of Physical Flows and Locations - To Forget Toyota to Learn from Toyota	NIKKAN KOGYO SHIMBUN, Ltd.	2003
Management Practice Research Group	Seven IE Tools (practical series)	NIKKAN KOGYO SHIMBUN, Ltd.	1996
Masami Yamada	Pocket-sized Collection of Illustrations on 5S Key Points	SHUWA SYSTEM Co., Ltd.	2009
Mike Rother, John Shook	Diagrams to Show Flows of Goods and Information Based on Toyota Production System to Change Gemba Perspectives	NIKKAN KOGYO SHIMBUN, Ltd.	2001
Nagoya QS Study Group	Factory Visual Diagnosis (Practical Management and Kaizen at Gemba)	Japanese Standards Association	2003
Nikkei Information Strategy	50 Waste Elimination Examples for Better Performance	Nikkei Business Publications, Inc.	2010
QC Circle Headquarters of Japan	Basics Steps to Conduct QC Circle Activities	JUSE Press, Ltd.	2001
Rintaro Muramatsu	Production Management Basics	Doyukan, Inc.	1975
ROUDOCHOSAKAI Co.	New Employee Safety and Health Education Manual	ROUDOCHOSAKAI Co.	2015
Ryo Igarashi	Cost Reduction Dictionary for Entire Factories	NIKKAN KOGYO SHIMBUN, Ltd.	1991
Satoru Tajima	Basic and Effective Production Management	ANIMO Publishing Co., Ltd.	2015
Shigekazu Yasuda	Simple 5S Steps: Seiri, Seiton, Seiso, Seiketsu, Shitsuke	JMA Management Center Inc.	1994
Shigenori Kotani	Toyota Production System from Theory to Techniques	NIKKAN KOGYO SHIMBUN, Ltd.	2008

# References: Chapter 3 3/3

Written/supervised/edited by	Title(translated in English)	Publisher	Year
Tadao Suzuki	Toyota Production System and Safety Management	ROUDOCHOSAKAI Co.	2007
Tadashi Sugiura, Yoshiaki Yamada	Introduction to QC Story for QC Circles - To Develop Problem-solving and Reporting/Presentation Abilities	JUSE Press, Ltd.	2001
Taiichi Ono	Toyota Production System: Beyond Large-Scale Production	DIAMOND, Inc.	2005
Takuo Fukuda	Basic Textbook for Practical Production Management	JMA Management Center Inc.	1998
Toshimichi Hata, Supervised by Takahiro Fujimoto	How to Develop Human Resources for Manufacturing in the Future	JMA Management Center Inc.	2013
Toshiyuki Yamaguchi	How Production Factories Operate (Basic)	SHUWA SYSTEM Co., Ltd.	2006
Yasuhiro Monden	New Toyota System	Kodansha Ltd.	1991
Yoshihito Wakamatsu	How to Implement Toyota-style KAIZEN - To Create a Powerful Gemba	PHP Institute, Inc.	2013
Yoshihito Wakamatsu	How to Develop Toyota-style KAIZEN Capability - Successful Enterprise's Knowhow Works Anywhere	SEIBIDO SHUPPAN Co., Ltd.	2004
Yoshihito Wakamatsu	Toyota-style Speedy Problem Solving	PHP Institute, Inc.	2008
Yoshihito Wakamatsu	Toyota-style Development of Strong Employees	SEIBIDO SHUPPAN Co., Ltd.	2003
Yuichiro Fujisawa	Secrets for "Ho-Ren-So" Harmonious Management - Gemba Management	Shinsei Shuppan	2008