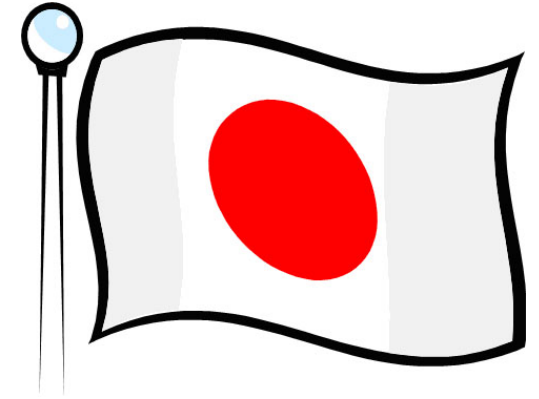


Poka-Yoke

Contents

- History
- What is Poka Yoke
- Why is it important?
- Example
- Key Principle
- Types of Poka Yoke
- Poka Yoke System Design
- Sources

What does 'Poka-Yoke' mean?



POKA



“Mistake”

YOKE (yokeru)



“Avoid”

History

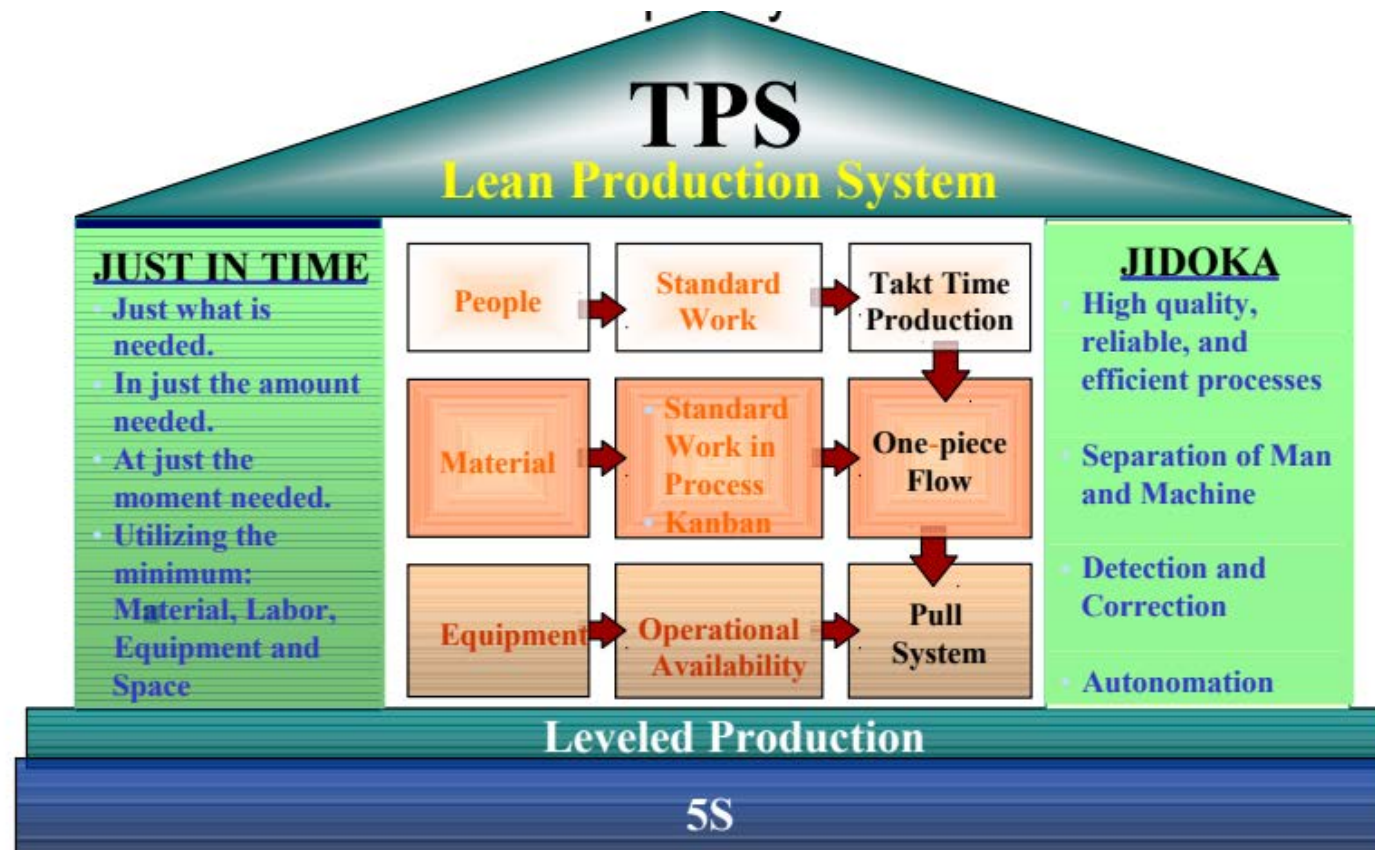
This term Poka-Yoke was adopted by Dr. Shigeo Shingo as part of the *Toyota Production System* in 1960.



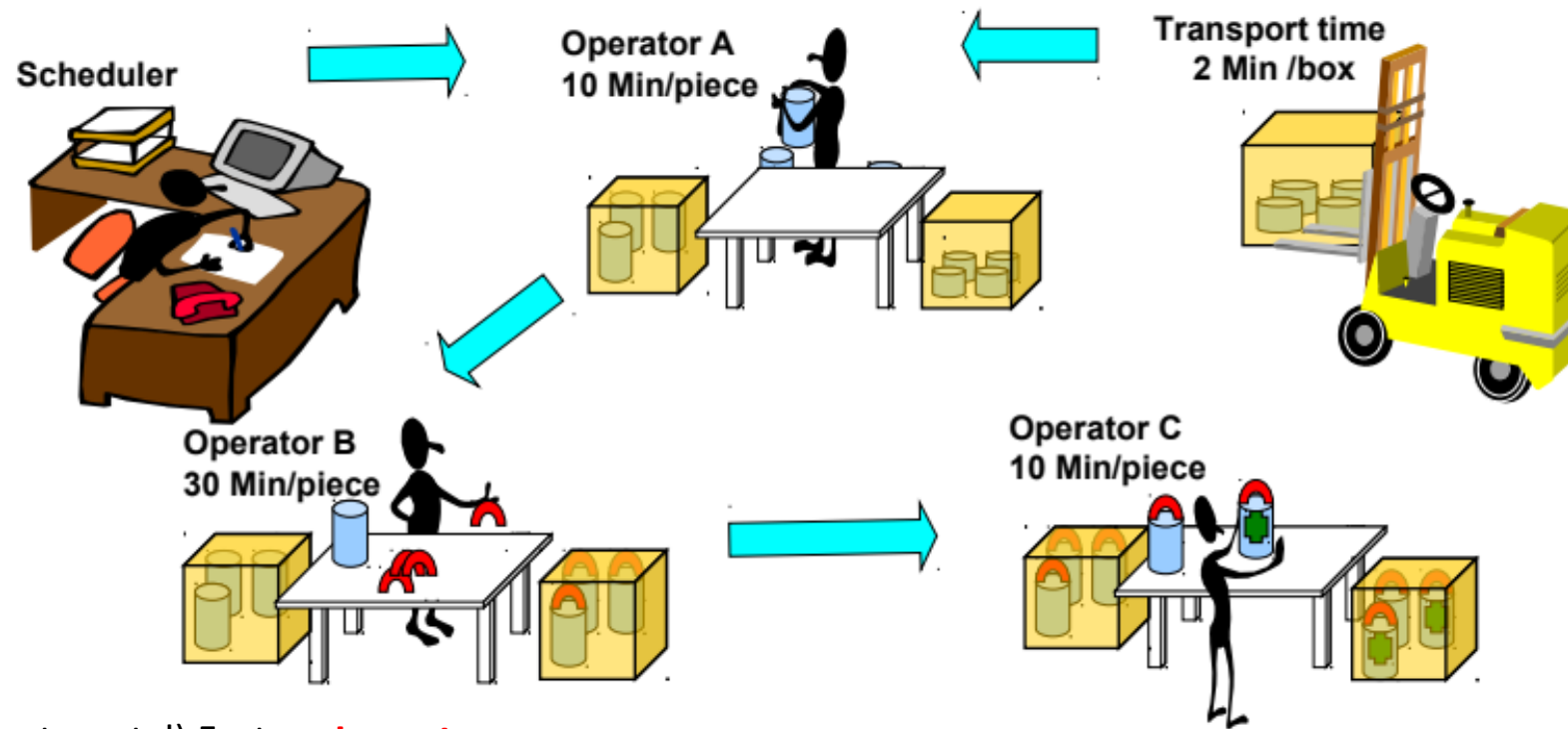
It was originally described as “**baka-yoke**”, but this name means “**Fool Proofing**”, so the name was changed to the **Poka-Yoke**.

History – *The Toyota Production System (TPS)*

The *Toyota Production System* strives for efficient use of resources (people, materials, and equipment) by continually **eliminating waste**. *Quality* improves along with productivity as defects are discovered quickly and *eliminated*.

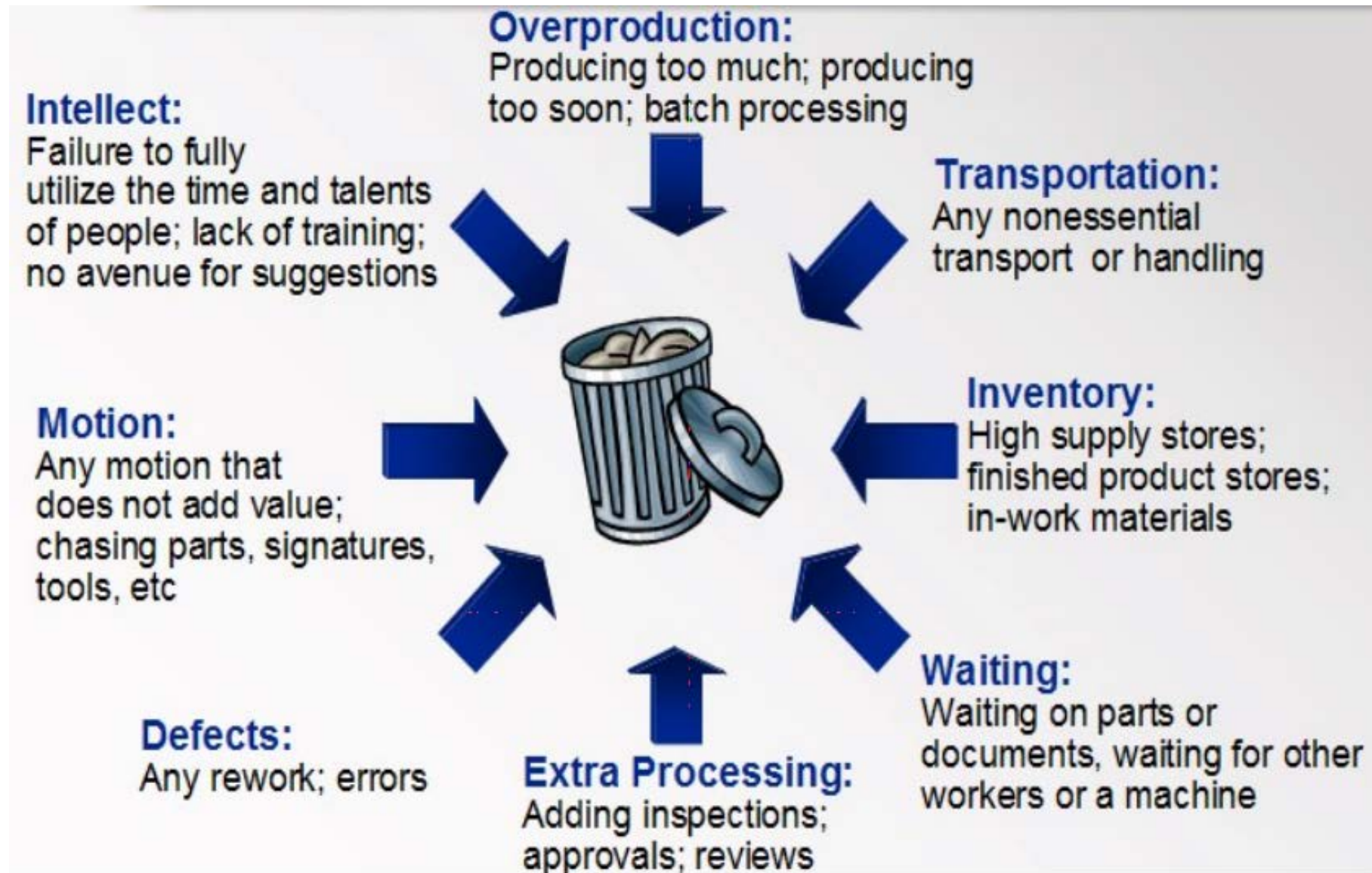


Traditional Batch Production

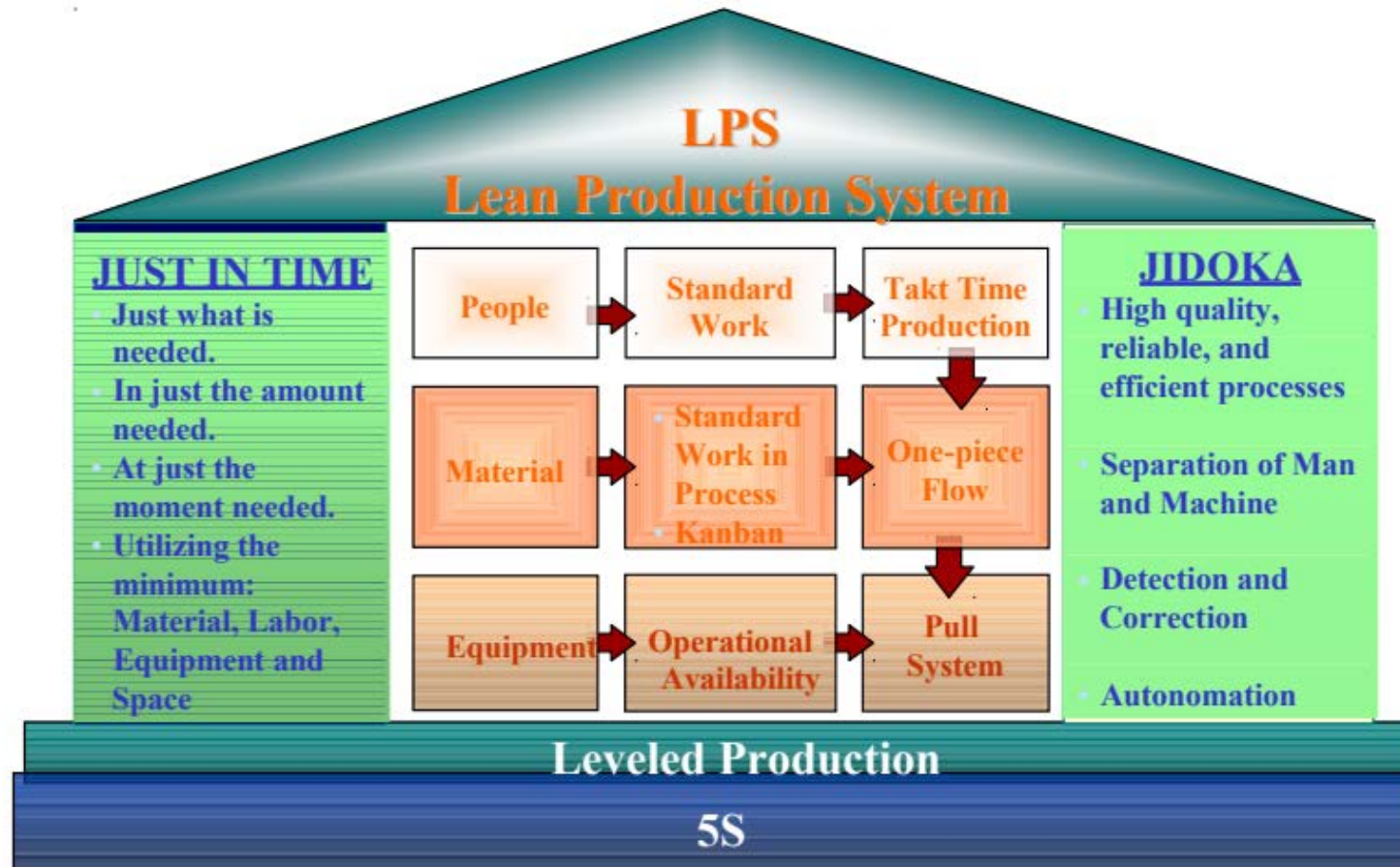


- Process (or departmental) Factory **Layout**
- Production processes separated by long **distances**.
- Items are transported in **batches** with high **work-in-process** (WIP) **inventory** levels.
- Long **lags** between defect creation and **detection** at next process
- Long lead times from raw materials to finished product.
- **Waste** of labor and equipment loading/un-loading and moving batches.
- Requires **complex** system for scheduling and accounting for inventory.

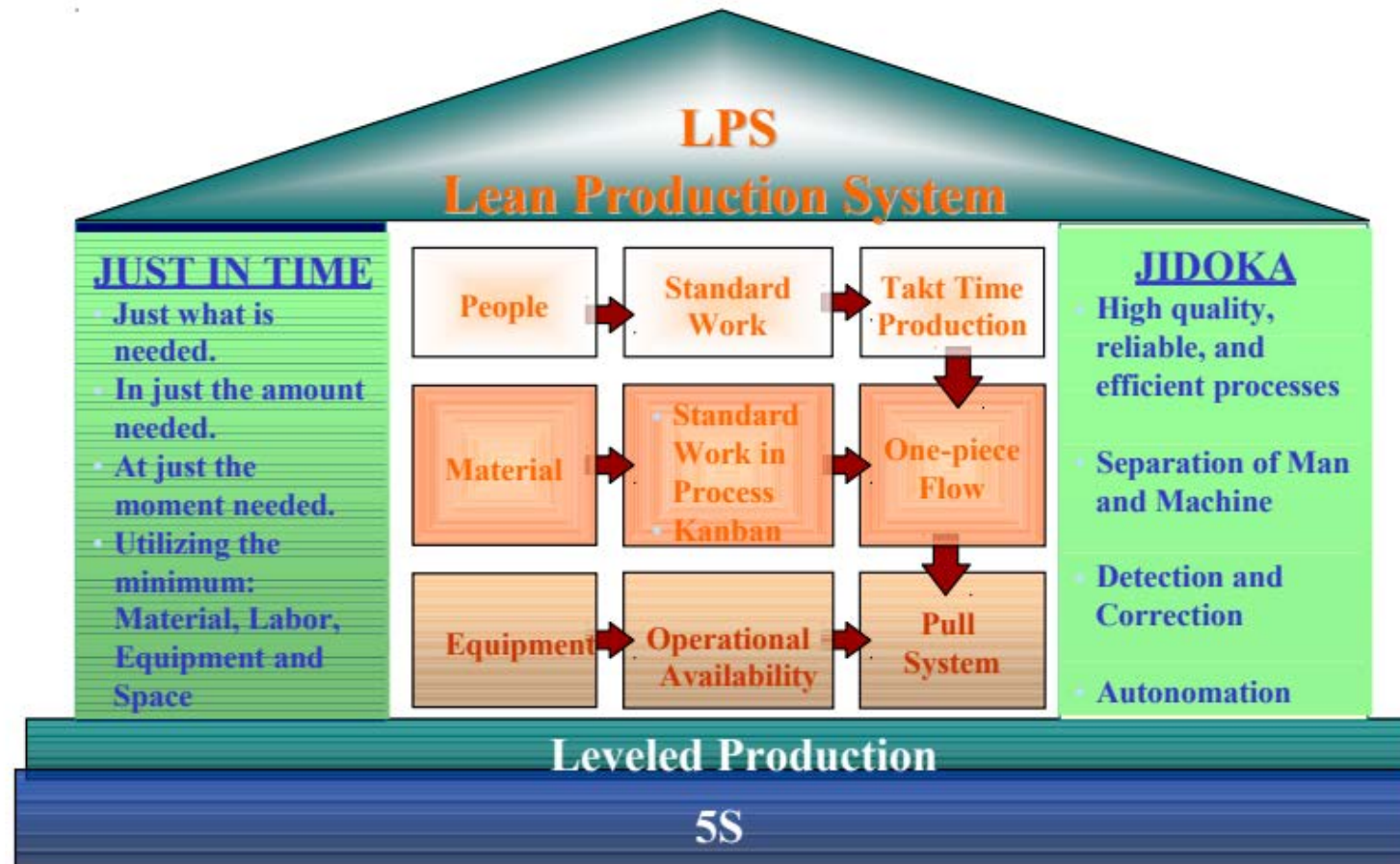
Wastes – Mudras often found within traditional production systems



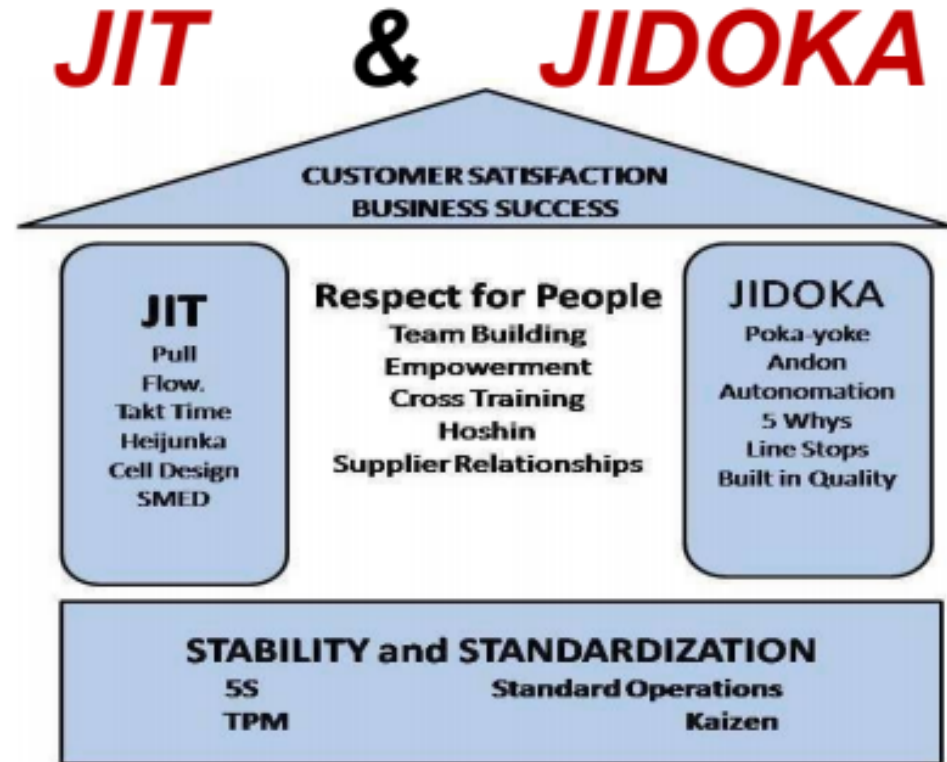
The **5S** system eliminates waste in the workplace making it easy to identify abnormal conditions. It also establishes the discipline to practice **Just-In-Time** and **Jidoka**.



Levelled Production is the ability to produce *different* product models simultaneously on the same production line. Distributing the production of many models evenly enables the efficient use of manpower and equipment.



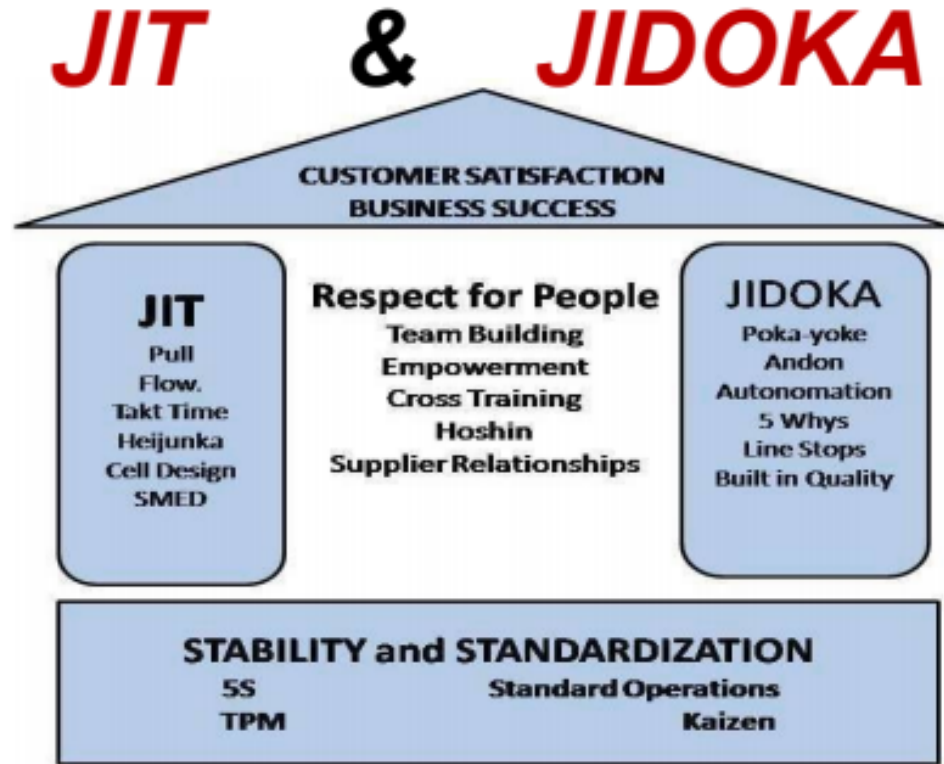
Pillars of Lean Production System



Just-in-time: making only what is needed, only when it is needed, and only in the amount needed; though simple in principle, requires dedication and careful, hard work to implement properly. Just-in-time production **eliminates** traditional Production kind of **Waste**.

It eliminates the need for maintaining large inventories, which reduce financing costs and storage costs. JIT eliminates the waste of stock rendered worthless by changes in specifications or customer demand. It also eliminates the waste that occurs when defects go undetected in large batches of idle inventory.

Pillars of Lean Production System

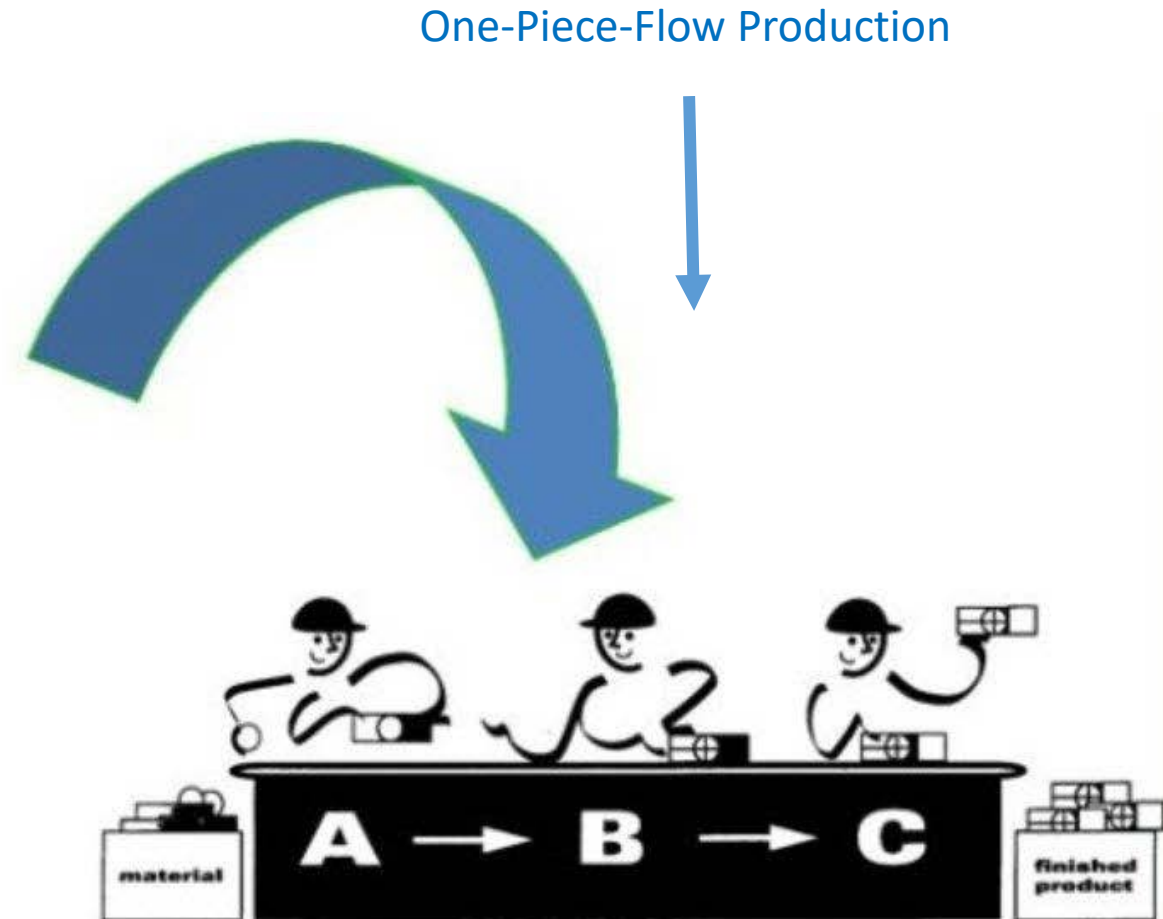
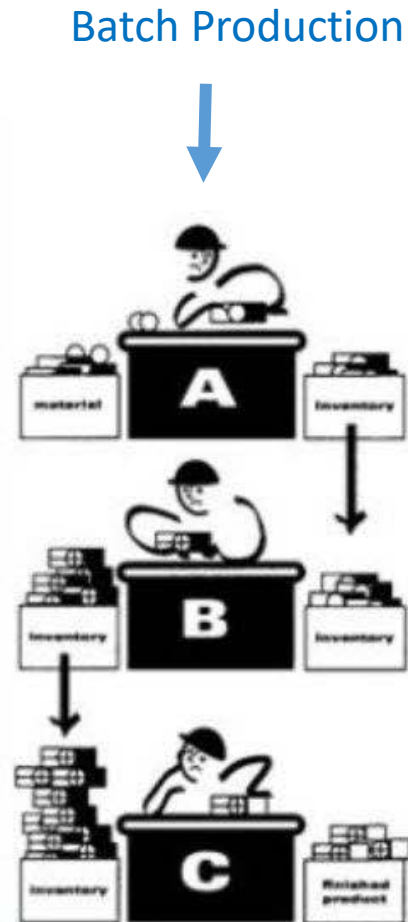


Jidoka refers to building quality into the production processes.
Mechanical Jidoka is:
Autonomation

Autonomation – means giving machines the human capability to detect a defect when it is created and stop immediately. As a result only one defective product is made and the source of the problem can be investigated.

JIT – Continuous Flow

- Product flows continuously through the manufacturing processes ideally *one-piece at a time*.
- Work-in-process inventory greatly reduced.
- Lead-time greatly reduced.
- **Defect detection is immediate.** (particularly where **Poka Yoke** is applied)
- Flow of work is *simple and visual*.
- Imbalance in operator work load easy to identify.

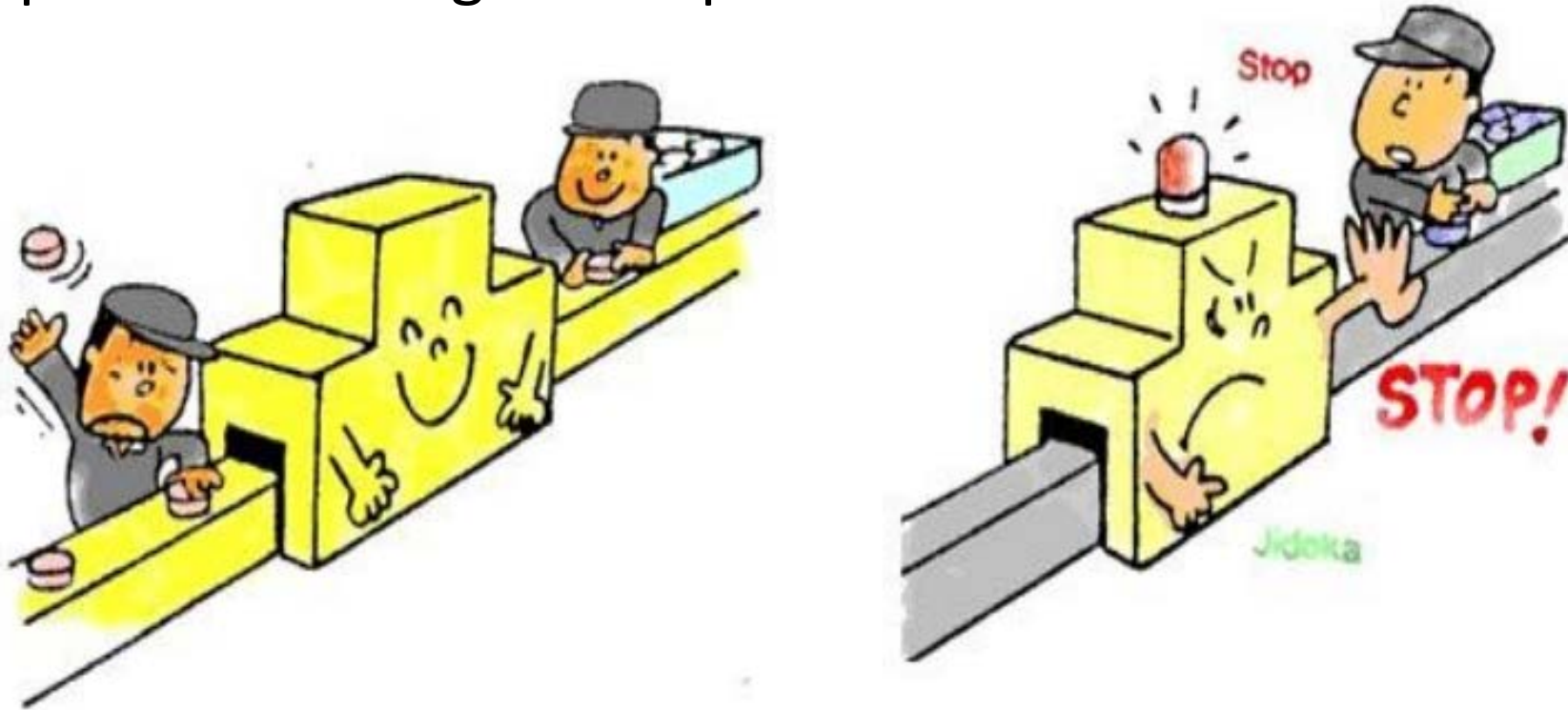


Enablers for Continuous One-Piece-Flow

Jidoka – Build Quality into the Process

Jidoka - Automation

Jidoka frees the operator from watching the machine, now one operator can monitor many machines (reducing cost). By giving machines the ability to perform simple repetitive tasks, then human can focus on problem-solving and improvement.



Jidoka – Transferring Human Intelligence

Jidoka

The principle of stopping work immediately,
when a problem occurs.
(central to Lean)



"automation with a human element,"

Defects, rework, and scrap add **cost** and represent **waste** that must be eliminated.

Lean factories apply a **Jidoka** to detecting and eliminating the sources of defects.

As a result lean factories simultaneously **reduce cost** and **improve quality**.

Jidoka – Poka-Yoke



POKA – YOKE

- Translated from Japanese means **mistake-proofing**
- Modify the production system so that abnormalities cannot occur, as opposed to detecting abnormalities which have already occurred.
- Mistake Proofing **eliminates** the possibility for a defect from occurring.
- If mistakes aren't made in the first place, then we don't have to spend extra time and money **fixing** them.

Build Quality into the Processes



Costs of Defects

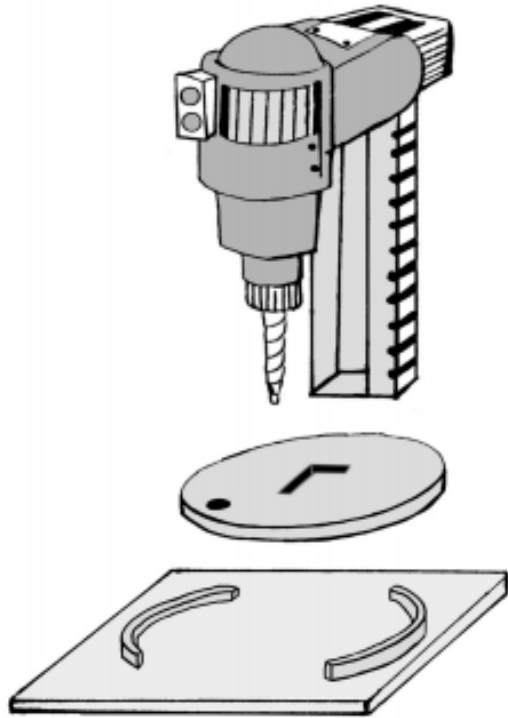
Does it cost more to make the process better? **No!**

Improving the process leads to reduced:

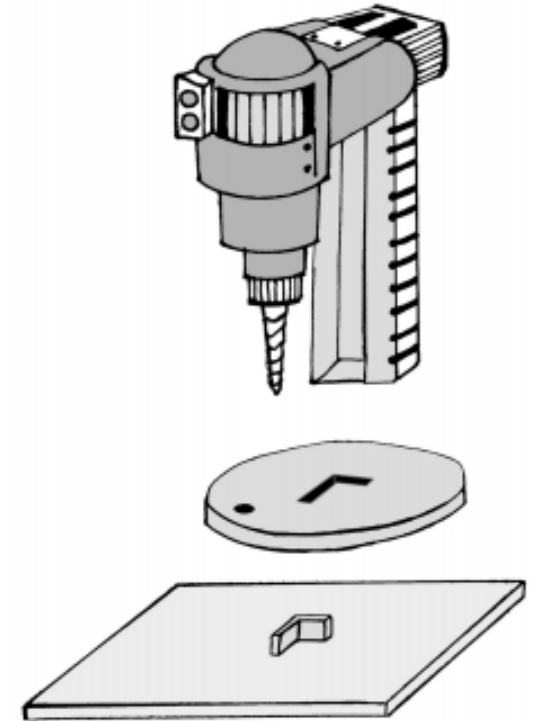
- ➡ Defects
- ➡ Rework
- ➡ Scrap
- ➡ Wastes



Build Quality into the Processes



Example: A cast part must have a hole drilled in it in order to be used in assembly. The original jig required that the operator carefully orient the part on the drill press table in order to ensure a proper fit during the assembly process.



Taking advantage of the “L” shaped slot on the part, a piece of angle iron has been attached to the drill press table which matches the slot in the part, allowing the part to be loaded only with the correct orientation.

Origin of Poka-Yoke

Shigeo Shingo applied Poka-yoke in the 1960s to industrial processes designed to prevent human errors.



Shingo redesigned a small switch assembly process in which factory workers, often forget to insert a spring under the switch buttons.

In the redesigned process, the worker would perform the task in two steps, first preparing the two required springs and placing them in a placeholder, then inserting the springs from the placeholder into the switch.

Origin of Poka-Yoke

When a spring remained in the placeholder, the workers knew that they had forgotten to insert it and could correct the mistake effortlessly.



Shingo distinguished between the concepts of inevitable human mistakes and defects in the production. Defects occur when the mistakes are allowed to reach the customer.

The aim of poka-yoke is to design the process so that mistakes can be detected and corrected immediately, eliminating defects at the source.

Poka Yoke Approach

- **Proactive Approach:**

- A fully implemented ZERO DEFECT QUALITY system requires Poka Yoke usage at or before the inspection points during the process.
- Poka Yoke will catch the errors before a defective part is manufactured 100% of the time.

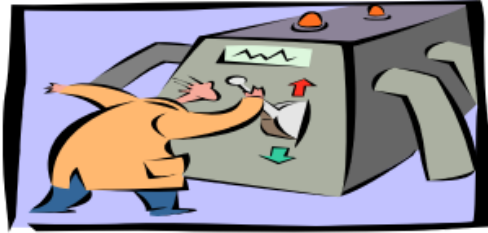
- **Reactive Approach:**

- Check occurs immediately after the process.
- Can be an 'operator check' at the process or successive check at the next process.
- Not 100% effective, will not eliminate all defects.
- Effective in preventing defects from being passed to the next process.

Poka Yoke Approach

Three Ways of Preventing Mistakes

When an error is predicted or detected, there are three ways of prevention:



1) Shutdown the process



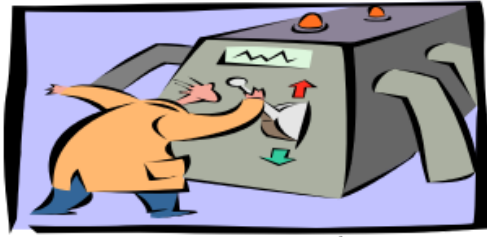
2) Control to prevent an error going ahead or a mistake occurring



3) Warning is sent to indicate an error may occur

Poka Yoke Approach

Types of Poka Yoke in prevention



Control – eliminates the possibility of a mistake occurring (automatic machine shutdown)

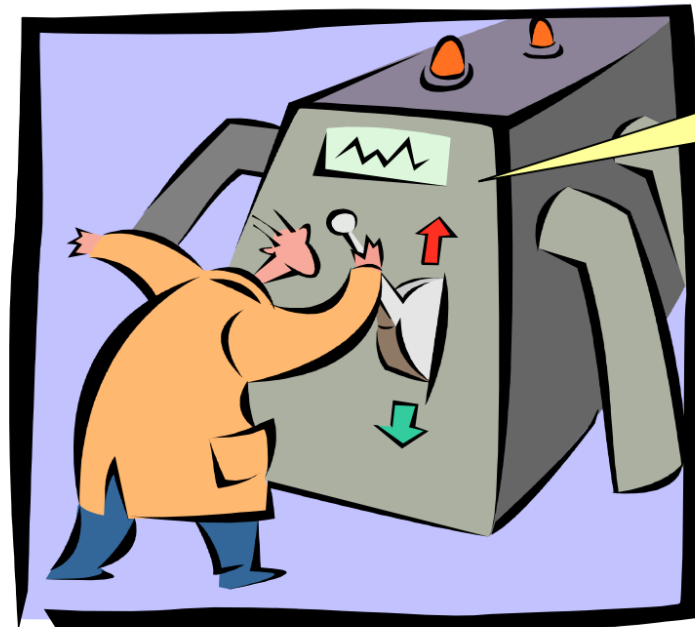


Warning – signals that a mistake can occur (strobe light, audio alarm etc.)

Control System

Takes human element out of the equation; does not depend on operator or assembler.

- Has a high capability of achieving zero defects.
- Machine stops when an irregularity is detected.



“There must have been an error detected; the machine shut down by itself!”

Example of 'Control' Poka Yoke in Prevention

A simple Poka-Yoke 'control' is demonstrated when a driver of the car equipped with a Auto gearbox must have the gear in the "Park" or "Neutral" position before the car can be started (a process step, therefore a poka-yoke) prior to starting an automobile.



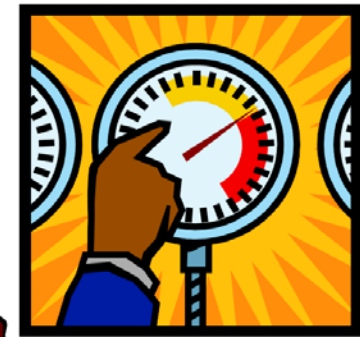
The interlock serves to
prevent
unintended
movement of
the car.

Example of a 'Warning' Poka Yoke in Prevention

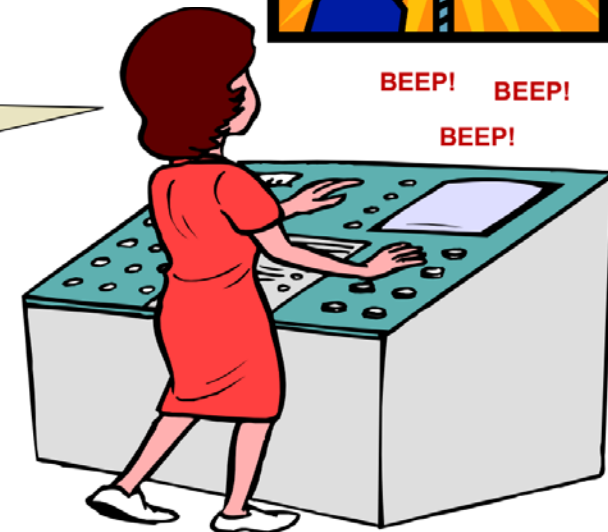
Sometimes an automatic shut off system is not an option. A warning or alarm system can be used to get an operator's attention.

Right is an example of an alarm system using dials. Colour coding is also an effective non automatic option. Lights and sounds are also used as warning to bring attention to the problem.

"I'm glad the alarm went off, now I'm not making defects!"



BEEP! BEEP!
BEEP!



Top 10 Errors that Cause Defects

1. **Processing omissions** (a step was forgotten)
2. **Processing errors** (something was done incorrectly)
3. **Error in setting up the work piece**
4. **Assembly omissions** (a part was forgotten)
5. **A wrong part / item was included**
6. **Wrong work piece**
7. **Operations errors** (incomplete information, procedures not followed)
8. **Adjustment, measurement, dimensional errors**
9. **Equipment maintenance errors**
10. **Errors in preparation of tools, fixtures, blades, etc**

Error: When any condition necessary for successful processing is wrong or absent.

What is the culture in your workplace? What is your approach?

Other Defect Causes

- Forgetfulness
- Language Barriers- (i.e. English as a second language)
- Misunderstanding instruction or procedure
- Errors in identification (e.g.: part and/or placement recognition)
- Errors made through lack of experience
- Pace (too fast or too slow)
- Lack of standards, expectations, procedure, or instructions
- Incomplete information
- Incorrect or incomplete processing (parts, dwell times, etc)
- Out of tolerance tools, fixtures, and jigs -adjustment or placement errors

Are any of these defect causes seen in your workplace?

Poka Yoke Philosophy

The mistake-proofing philosophy recognizes that people sometimes forget and make errors. The approach uses common-sense ideas and methods in both process and product to eliminate human and mechanical errors.

- Historically, great efforts have been made in applying these concepts to Safety and accident prevention.
- The same approach must drive intolerance for scrap and rework.



Fact: People Make Mistakes.

A good Poka Yoke implementation makes it impossible to make a mistake

Poka-Yoke Culture

Focus on building quality into the process.

- Remember to consider the sources of variation, engage GB and BB support.
- Make it impossible to create a defect.

Believe that inadvertent errors can be eliminated.

- Engage the people in the process. 10 heads are better than one.

Implement the best ideas after you find the root cause

- Chase through the five 'why's', then brainstorm to get to the best solution to attack root cause.

Build a culture that finds a way to do it right the first time and does not tolerate errors!

Some Background on Inspection

Traditionally, quality has been synonymous with inspected quality...

- **Judgment Inspection:** Separating good from bad after processing.
- **Informative Inspection:** Inspect then take action to eliminate future occurrence.
- **100% or Sampling Inspection:** based on SPC (Statistical Process Control) methodologies.



Inspection:

- assumes defects are inevitable.
- believes the process of inspection will reduce defects.
- can reinforce 'quality' is responsibility of the quality department.
- May be required (regulatory compliance)
- **is not 100% effective.**

All of the above tolerate some level of defects. How do we achieve 0 defects?

“Self-Check” Inspection

ROI (reliance on operator inspection) emerged in the 1980's. A **self-check** occurs when the person performing the work checks the work before the work moves to the next process step.

On the downside...

- sometimes compromises are made & proper corrective action skipped.
- blind to your own mistakes.
- compliance can be marginal if not part of standard work.
- key features, characteristics, interface relationships not always understood.

On the upside ...

- 100% coverage is likely.
- instant learning and correction are possible.
- potentially less resistance when self-discovered.



“Successive-Check” Inspection

A **successive-check** occurs when the previous work is completed and that work is checked by the next person in the process.

On the downside ...

- corrective action still required and happens after the point of error.
- compliance can be marginal if not part of standard work.
- can create friction between workers

On the upside...

- often catches errors overlooked by self-checking process.
- can build a sense of cooperation between process participants.

Self-check and successive-checks are only required because the process allows errors to occur.

Contrasting Cultures

NEGATIVE APPROACH

Mistakes are Inevitable

- people make mistakes
- place blame
- detect at final inspection
- sampling inspection
- errors are inevitable
- no time, no money
- **no support**

POSITIVE APPROACH

Mistakes Can Be Eliminated

- create the 'right' environment
- focus on the process deficiency
- ask “why?”, then “how?”
- learn from the opportunity
- apply mistake-proofing methods
- train everyone to challenge errors
- show them it's possible; share examples

What is the culture in your workplace? What is your approach?

Poka Yoke Device Example

A **critical condition detector** is a device that detects two type of conditions:

1) the presence or absence of a specific, visible pre-set quantity such as the correct number of parts, correct weight, height, volume or depth



2) fluctuations in a non-visible condition such as pressure, temperature, current and non- visible fluids (air).



Poka Yoke Device Example

How it works: A critical manufacturing condition (pressure, current, temperature, time, etc.) is measured -

and work cannot proceed if the value is not within a predetermined range as indicated on the detector.



Critical Condition Device Example

Fluid Element Detectors:

Detect changes in air streams occasioned by the placement or removal of objects (useful in detecting broken drill bits).

Pressure Change Detectors:

Detect interruptions in flow through pressure gauges or pressure-sensitive switches.

Temperature Change Detectors:

Detect temperature change and variation through thermometers, thermostats, thermistors, thermocouples, etc.

Current Fluctuation Detectors:

Detect via meter relays occurrence of electric currents or secondary currents (important applications in spot welding).

POKA YOKE- Usage & Examples

These two Poka-yoke can further be classified into the following three types;

1 Contact



Poka Yoke

2 Fixed Value



Possible to use too little or too much.
Even possible to forget if dose given at all.

Fixed Dose.
Empty Packet as
Evidence of Use



3 Motion Stop



Contact Type Poka Yoke

Contact type Poka Yoke devices that have physical shapes that are used to prevent the use of incorrect components, pins that have to fit into holes from previous operations and so on, they physically make contact with the product and highlight when a mistake has been made or physically make it impossible to make the mistake.



Contact Type Poka Yoke



A three pin plug would fit into this category as it can only be plugged into a socket in one orientation.



The SIM card in your Hand-phone can only be fitted one way around in your phone..

Fixed Value Poka Yoke

Fixed Value Poka-yoke is a method that uses physical and visual methods to highlight that all components are available in the right quantities and have been used, sometimes combined with contact style sensors to make them more positive.

Poka Yoke



Possible to use too little
or too much.
Even possible to forget if
dose given at all.

Fixed Dose.
Empty Packet as
Evidence of Use



Examples would be egg
tray style containers that
present the operator with
exactly the right number of
fixings or pre-dosed
medication in a sachet
rather than relying on the
user to measure from a
larger container.

Motion-Stop Poka Yoke

These types of Poka-yoke devices ensure that the correct number of steps have been taken and possibly also the sequence of steps.



Example of this could be the use of a nut runner to tighten a specific number of bolts to a required torque;

if the correct torque is not reached or if the operator does not tighten all of the bolts the part will not be released to the next operation.

Poka Yoke Implementation Hints

Think about how to verify items by their characteristics

- weight, dimension, shape

Think about process sequence

can't perform next step if prior step not done

process flags if steps are omitted

Detect deviations from fixed values

counters, scales, odd part out, critical condition detection; pressure, temperature, current, time

The Contact Method

This method identifies product defects by testing the product's shape,size,color or other physical attributes.

Example:

Method / Type	Control or Shut Out	Warning or Attention
Contact	Mobile phone sim cards and the phone bodies are shaped to only allow the sim to be located correctly	Bolts are tightened with wrench dipped in paint. Bolts with no paint on them are still untightened.

The Fixed Value Method

This method alerts the operator if a certain number of movements are not made.

Example:

	Control or shut out	Warning & Attention
Fixed-value	Sensors determine if a pre-set number of bolt heads are present, if not the machine stops automatically.	A device on a drill counts the number of holes drilled in a work piece;a buzzer sound the work piece is removed before the correct numbers of holes have been drilled.

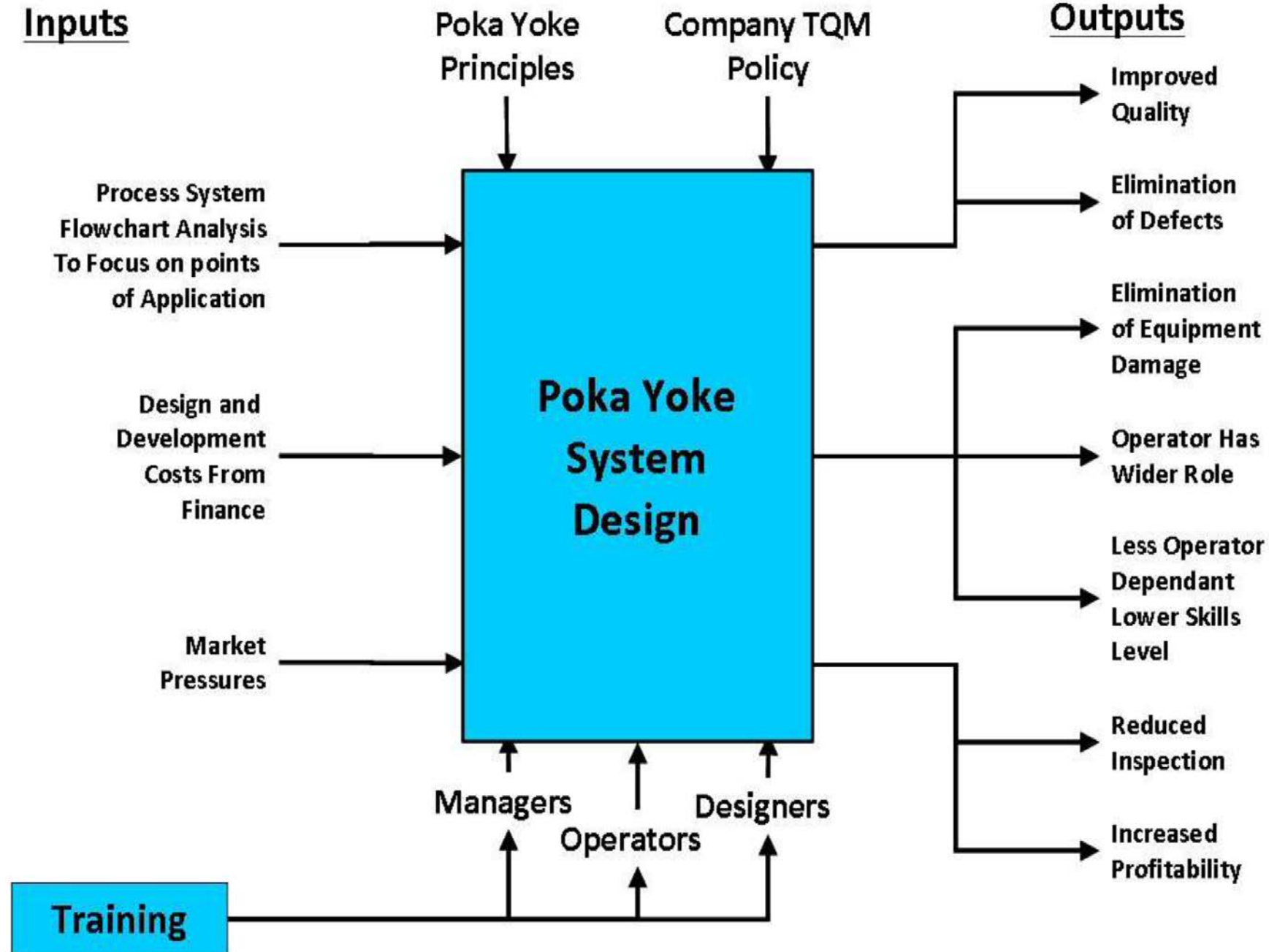
The Motion Step Method

This method determines whether the prescribed steps of the process have been followed.

Example:

	Control or shut out	Warning & Attention
Motion step	Electronic (PC) pilots pre-flight checklist which only enables the aircraft when completed in the correct sequence.	A sensor detects when a bolt is removed from a dispenser, if the required number of bolts are not dispensed a warning light & buzzer are activated

Inputs



Outputs

Sources

- http://www.tektron.ie/vision_sensors.htm
- <http://www.cognex.com/Connect/BlogMain.aspx?id=12365&blogid=1825>
- <http://en.wikipedia.org/wiki/Fail-safe>
- www.hubpages.com
- http://www.thetoyotasystem.com/lean_inventions/poka_yoke-you-can%E2%80%99t-go-wrong.php