Lean Manufacturing principles,Just in time(JIT),5Why analysis,Check sheet,Flow chart,KAIZEN principles,Pokayoke,Statistical Process Control (SPC) principles

Lean Manufacturing principles

Topics

1. Definition, LEAN approach, LEAN idea
2. Waste (Muda)
3. Major types of non-value adding waste in business
4. LEAN methods
5. LEAN mangement principles
6. Objectives of LEAN management
7. LEAN management tools
8. LEAN company

Lean Manufacturing principles
Introduction

The approach of LEAN come from the japanese ideology (manufacturing industry). It is consider as a set of tools that assist in the identification and steady elimination of waste. As waste is eliminated, quality of the product improves while production time and cost reduces dramatically. In order words, LEAN means creating more value for customers with fewer resources.

The idea of LEAN in terms of value creation:

a) Customer needs: adding value to the customer needs, that are useful for customer and which they are willing to pay for.

b) Organization: LEAN idea in terms of value creation shows to the organization the way to detect and organize value adding activities in order to eliminate 8 kind of waste.

c) Wastage: waste elimination is the main target of Lean management activities that doesn't add any value to the organization.

Lean Manufacturing principles

LEAN ideology

Lean aims to make the work simple enough to understand to do and to manage.

WASTE (MUDA)

Lean ideology is known that is focus on reduction of 7 kinds of waste in order to improve overall customer value. Waste need to be eliminated at a reduce cost at quality level of the material/parts which enhence satisfying customer needs/wants and this can be achieve with regard to customer requirements and specifications.

Lean Manufacturing principles

Major types of non-value adding waste in business or production process are

- Overproduction
- Waiting or time on hand
- Unnecessary transport or conveyance
- Over processing or incorect process
- Excess inventory
- Unnecessary movement
- Defects
- Unused employee creativity

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Seven kinds of waste (MUDA)

- Over production
- Motion (of operator or machine)
- Waiting (of operator or machine)
- Conveyance
- Processing itself
- Inventory (raw materials)
- Correction (rework and scrap)

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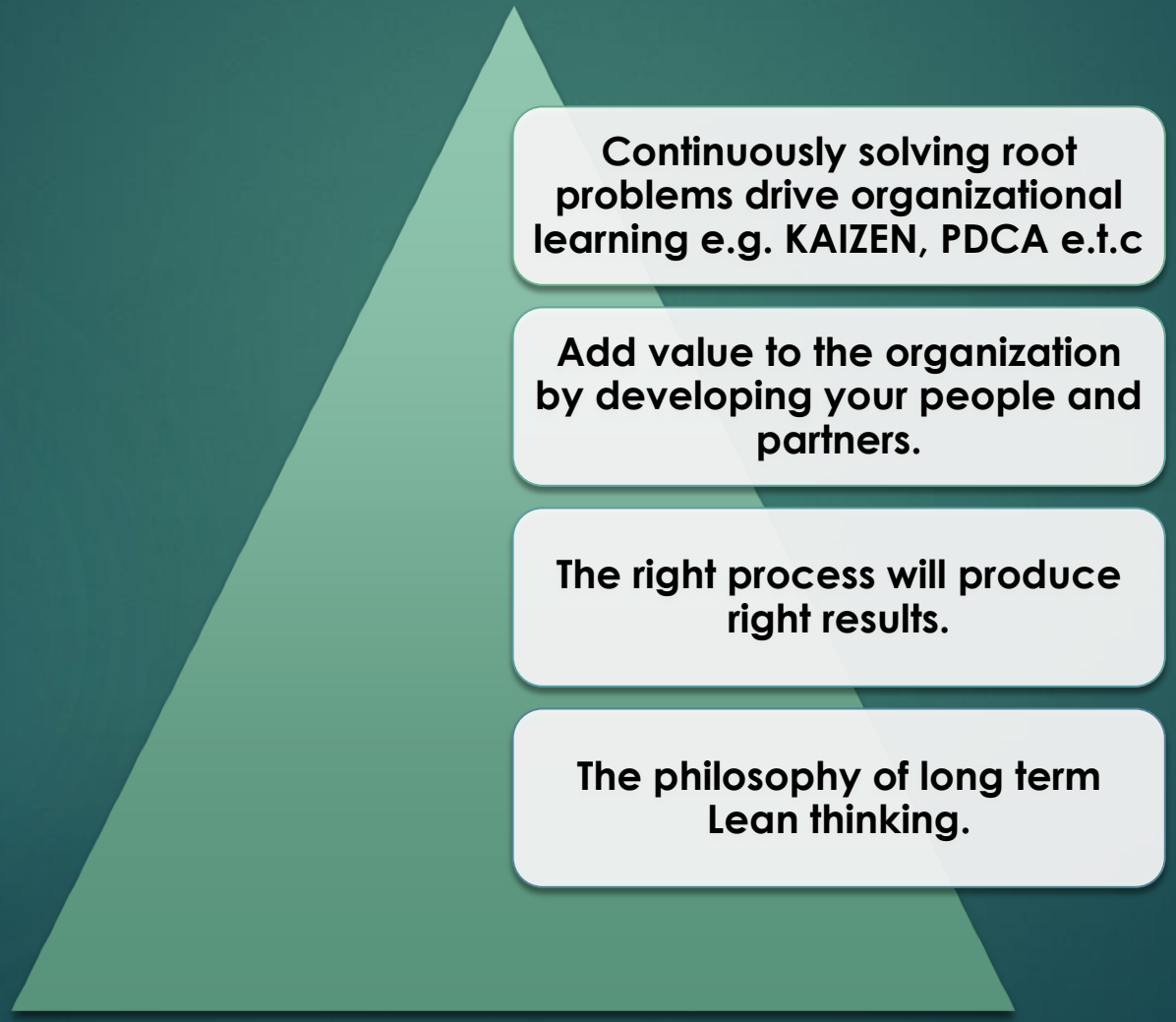
Four approach to waste elimination in an organizarion



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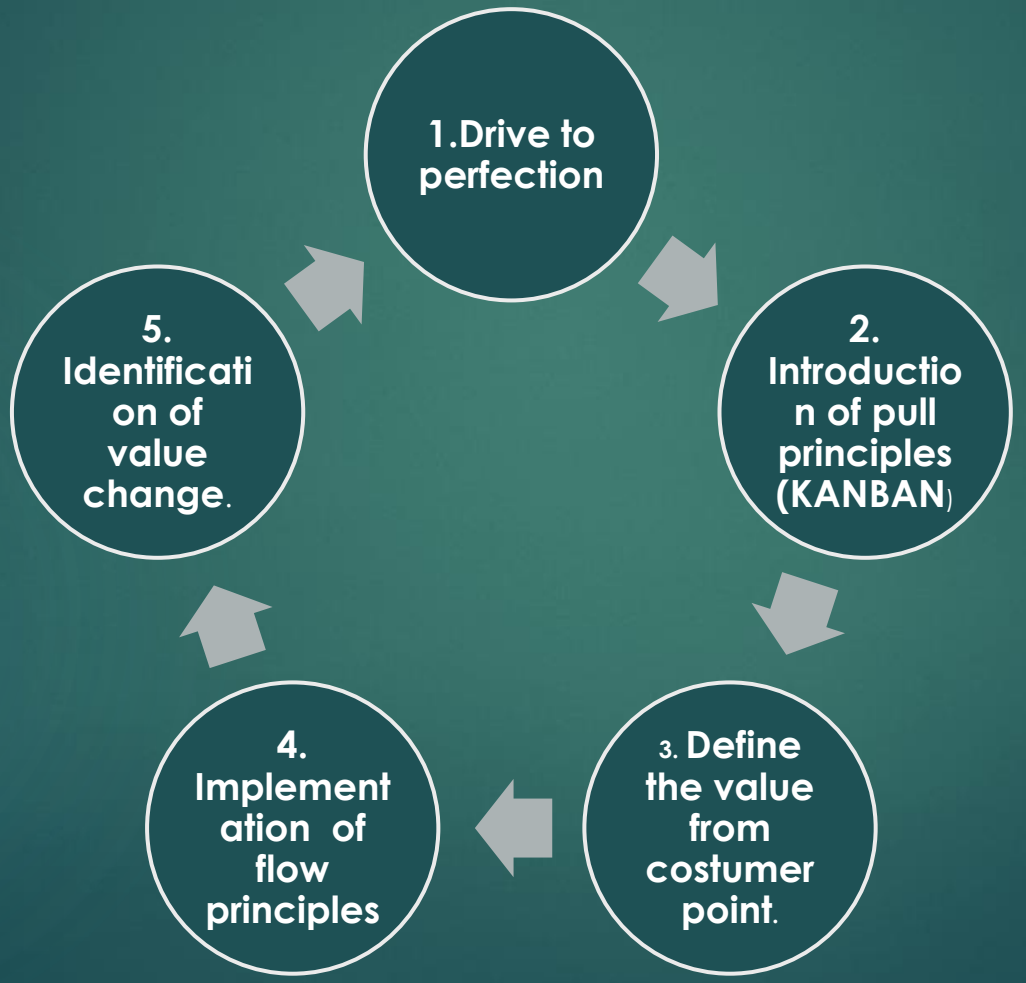
Lean Management principles

Lean management principles is centered on the following listed below points:



Lean Manufacturing principles

Six objectives of Lean Management

The six objectives of Lean managements are listed below:

a) Explicitly defined processes and workflows
b) Minimization of waste and process optimization
c) Reduction of error rates (scraps and rework activities)
d) Increasing productivity through elimination of unnecessary activities that might occur.
e) Establishment of a modern management and value structure.
f) Logical arrangement of responsibilities and channels of communication.

Lean Manufacturing principles

Lean Management Tools

Some of the LEAN magement tools are listed below.

- Histogram Diagram
- Quality control card
- Pareto diagram
- Correlation diagram
- Brainstorming techniques
- Ishikawa diagram (Fishbone analysis)

Lean Manufacturing principles

Lean Management Tools

Histogram Diagram

The histogram helps you analyze what is going on in the process and helps show the capability of a process, whether the data is falling inside the bell-shaped curve and within specification.

A histogram displays a frequency distribution of the occurrence of the various measurements. The variablw being measured is along the horizontal x-axis, and is grouped into a range of measurements. The frequency of occurence of each measurement is charted along the vertical y-axis.

Histograms depict the central tendency or mean of the data, and its variation or spread. A histogram also shows the range of measurements, which aids in the process capability.

Lean Manufacturing principles

Lean Management Tools

Histogram Diagram

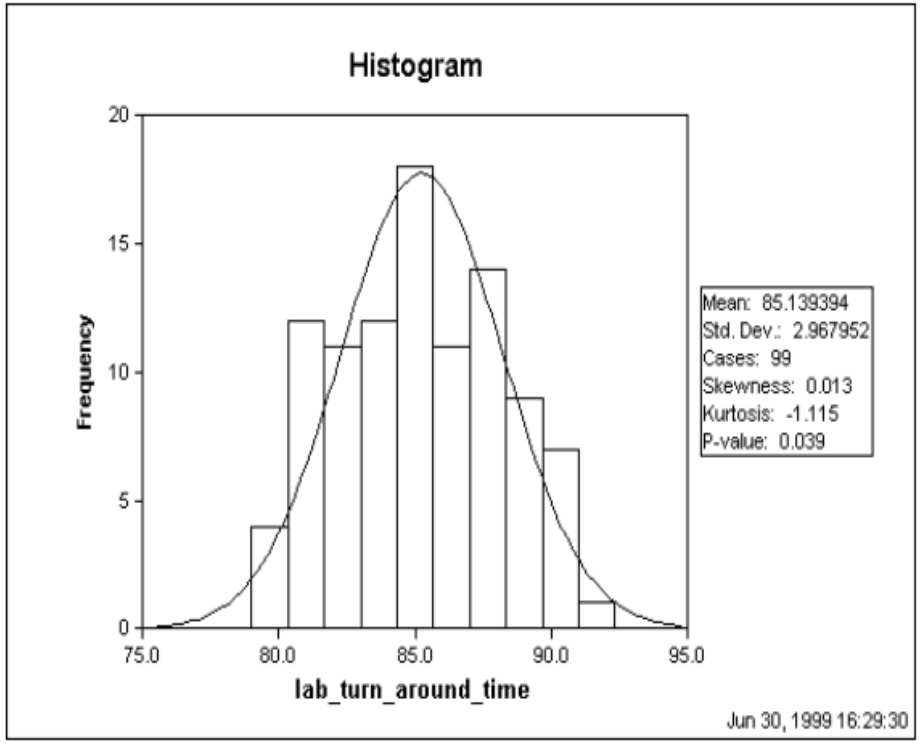
A histogram can show characteristics of the process being measured, such as:

- Do the results show a normal distribution, a bell curve? If not, why not?
- Does the range of the data indicate that the process is capable if producing what is required by the customer or the specifications?
- How much improvement is necessary to meet the specifications? Is this level of improvement is possible in the current process?

Lean Manufacturing principles

Lean Management Tools

Histogram Diagram



Lean Manufacturing principles

Lean Management Tools

Pareto Diagram

The Pareto chart can be used to display categories of problems graphically so they can be properly prioritized. The Pareto chart is named by Juran for a 19th century Italian economist who postulated that a small minority (20%) of the people owned a great proportion (80%) of the wealth in the land. There are often many different aspects of a process or system that can be improved, such as the number of defective products, time allocation or cost saving. Each aspect usually contains many smaller problems, making it difficult to determine how to approach the issue. A Pareto chart or diagram indicates which problem to tackle first by showing the proportion of the total problem that each of the smaller problems comprise. This is based on the Pareto principle: 20% of the sources cause 80% of the problem. The Statit Count Pareto chart is a vertical bar graph displaying rank in descending order of importance for the categories of problems, defects or opportunities. Generally, you gain more by working on the problem identified by the tallest bar than trying to deal with the smaller bars. However, you should ask yourself what item on the chart has the greatest impact on the goals of your business, because sometimes the most frequent problem as shown by the Pareto chart is not always the most important.

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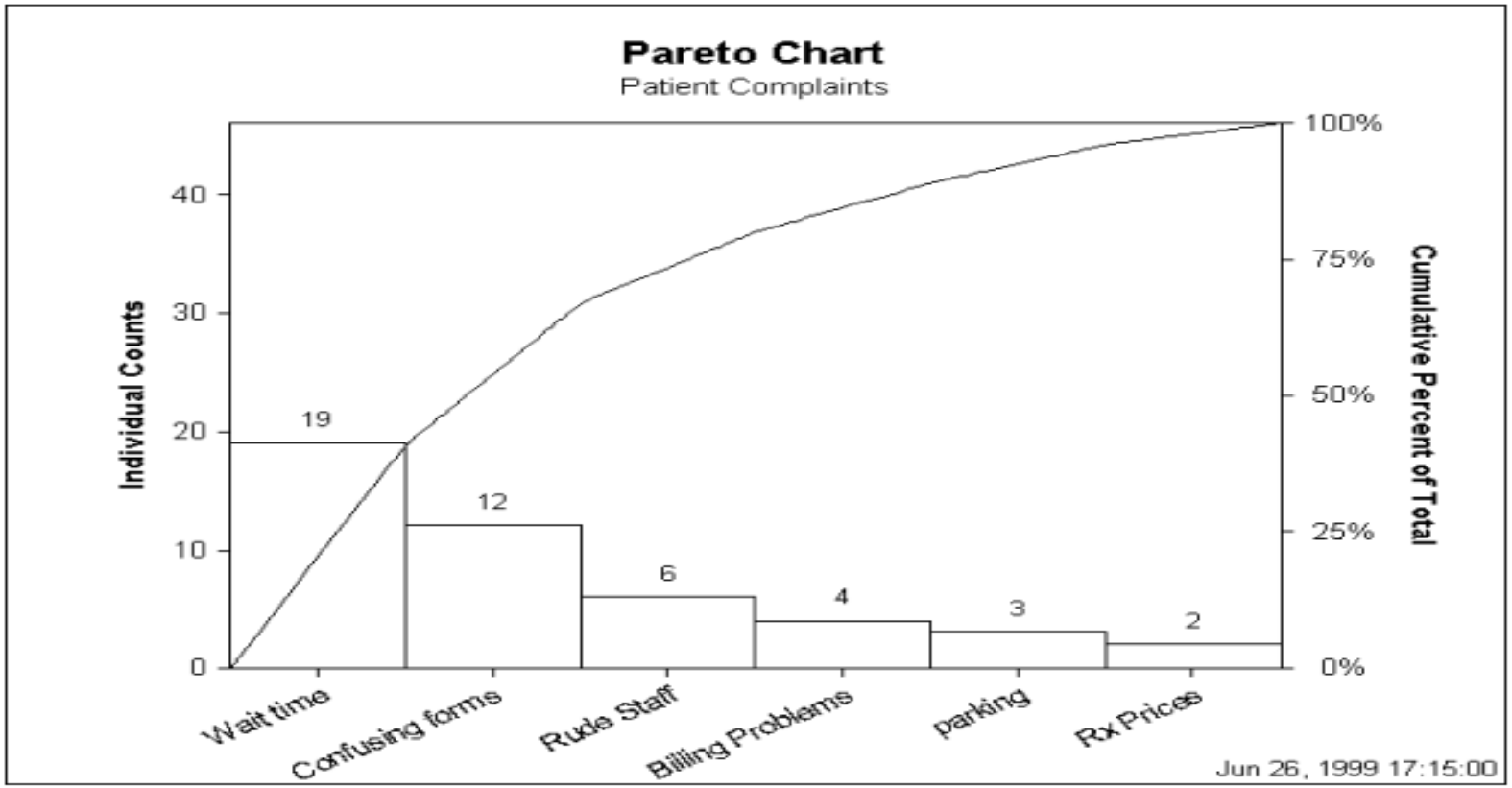
Lean Management Tools

Pareto Diagram



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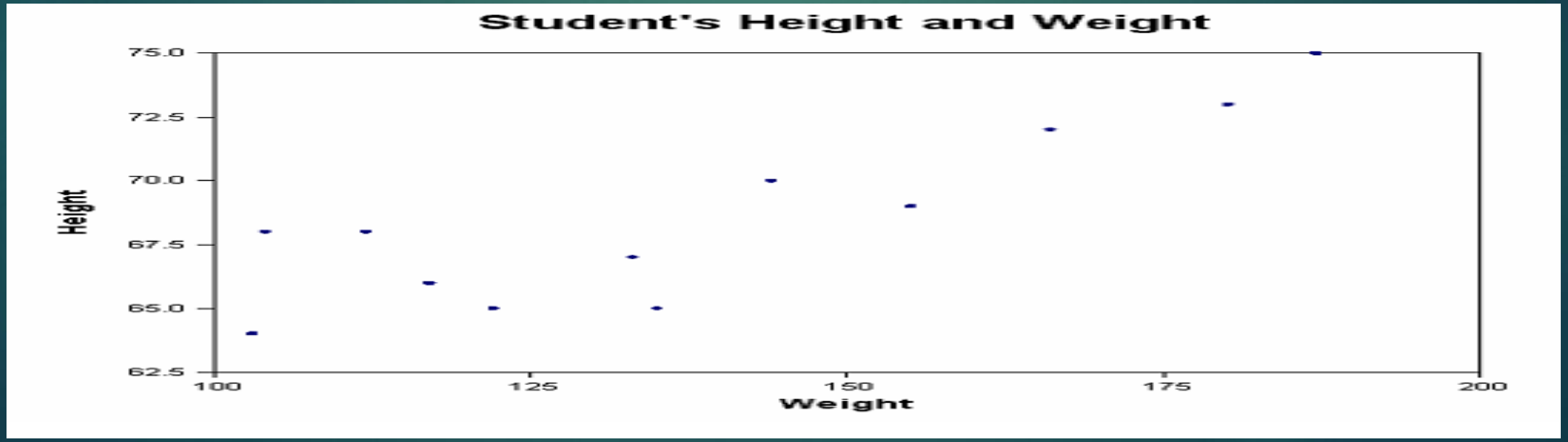
Lean Management Tools

Scatter Diagram

The Sclatter Plot is another problem analysis tool. Scatter Plot are also called correlation chart.

A Scatter Plot is used to uncover possible cause and effect relationships. It is constructed by plotting two variables against one another on a pair of axes. A Scatter Plot cannot prove that one variable causes another, but it does show how a pair of variables is related and the strenght of that relationship. Statistical test quantify the degree of correlation between the variables.



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Lean Management Tools

Brainstoming techniques

This is a conclusive process where certain employees are given the responsibilities of finding solution on getting new ideas.This group meets regularly to compare ideas and getting solution to measuring problems.Brainstoming technique is also consider as powerful technique

Advantages of Brainstoming techniques:

- Brainstorming creates new ideas, solves problems, motivates and develops teams.
- Brainstorming motivates because it involves members of a team in bigger management issues, and it gets a team working together.

Lean Manufacturing principles

Lean Management Tools

Brainstoming techniques contd

Brainstoming techniques process:

- Define and agree the objective.
- Brainstorm ideas and suggestions having agreed a time limit.
- Categorise/condense/combine/refine.
- Assess/analyse effects or results.
- Prioritise options/rank list as appropriate.
- Agree action and timescale.
- Control and monitor follow-up.

Lean Manufacturing principles

Lean Management Tools

Brainstoming techniques contd

Types of Brainstoming techniques:

1.PERSONAL BRAINSTOMING e.g this techniques activities is done just by yourself

2.COLLECTIVE / GROUP BRAINSTOMING e.g this techniques activities is done collectively or in groups. secondly collective brainstorming **helps to make study / findings more productive, motivational and successful. ., team building is one of the antidotes methods or factor applicable**

Lean Manufacturing principles

Lean Management Tools

Brainstoming techniques contd

How to carry out Brainstoming study:

- 1.defining the task,
- stating clear timings,
- organising participants and materials, and
- managing the review and
- 5.follow-up.

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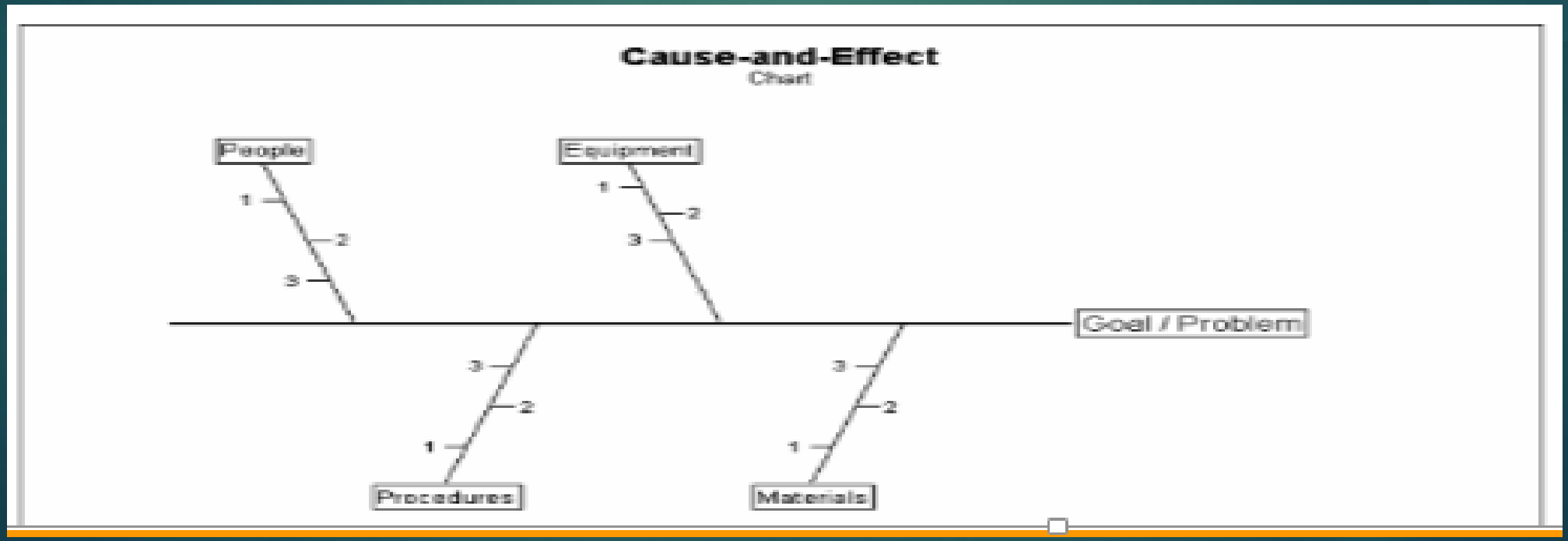
Lean Management Tools

CAUSE & EFFECT DIAGRAM

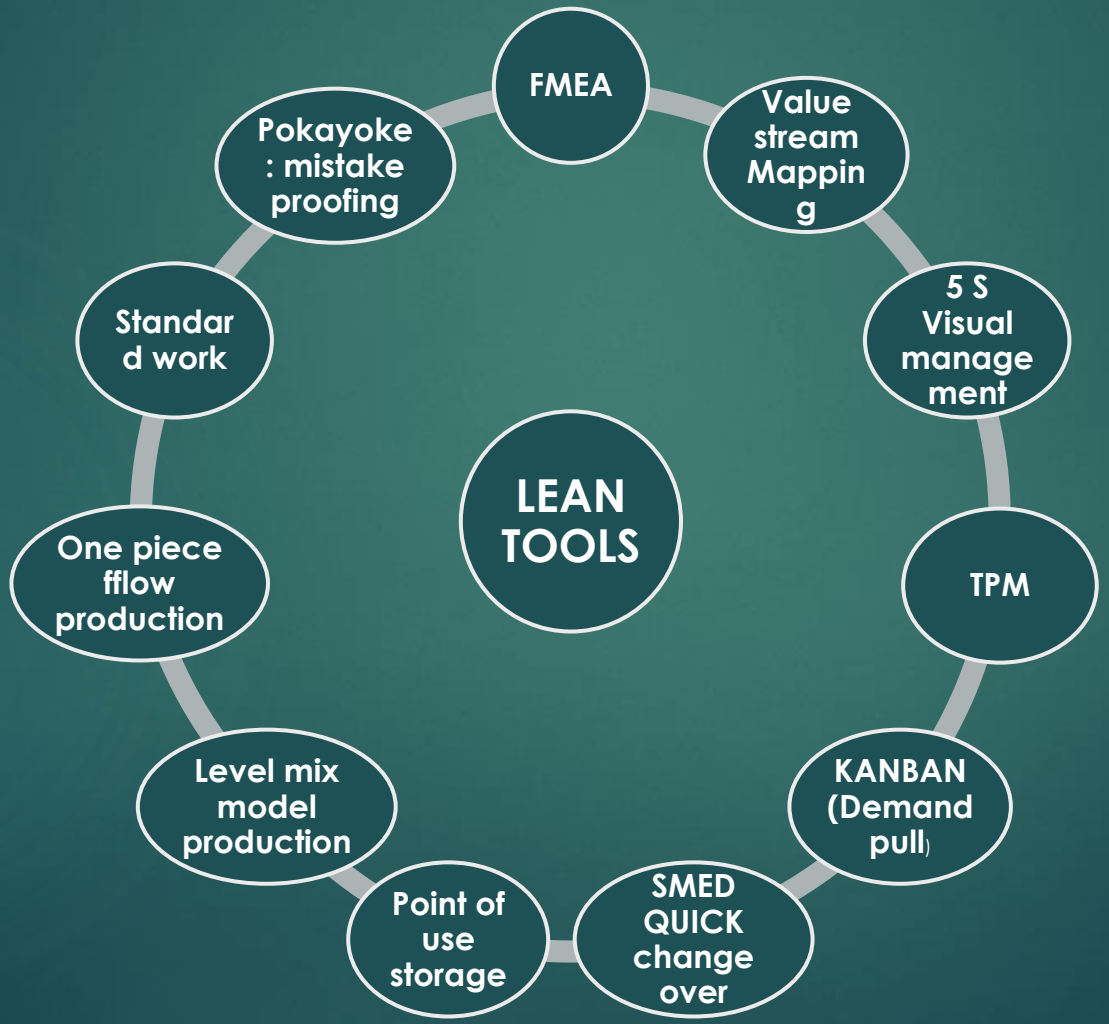
Alternatively ,we can use brainstoming techniques to generate a list a of causes,How ? ,write each possible causes on a horizontal line and determined the 5y for each of the possible root caused identified.



Lean Manufacturing principles

General Lean Management Tools

General Lean Management tools that we can come accross in the area of production are listed below:



Lean Manufacturing principles

Lean Methods

a) Lean managements and KAIZEN what are the requirements for realizing KAIZEN within a company.

HENSE1.

- Necessity of self reflection
- Continuous questioning of the current state
- Regards mistakes as possibility to improve, not as failure

GENCHI GENBUTSU

- Regards as japanes philosophy which meand „Go and see it yourself".
- Observe and compare the events on the spots with our open eyes to know the extent of its spread.

Lean Manufacturing principles

Lean Method cont.

HOSHIN KANRI

- Policy deployment
- Targets are differented vertically and horizontally
- Integration of lond, medium and short term targets into the corporate strategy.

b) Lean Management and TPM

- Involvements of employee
- 5S principles
- Plant effectiveness and maintenance

Lean Manufacturing principles

Lean Method cont.

c) Lean Management and the Pull principles (Demand-oriented f.)

- Milk run i.e. Rotation truck, drives to several suppliers everyday on the same route.
- Supermarket i.e. Raw material storage, minimum and maximum stock visualized.
- Small train i.e. Hail transport system, that shuttles between supermarket, cell WIP, shop stock and TPA.
- Cell wip i.e. work in progres
- Shop stock i.e storage of the output of production unit.
- Kanban i.e. Realization of the demand orienta. Fabrication (Pull principles)
- HEITUNKA i.e. Heitunka board schedules t. of the small train.
- TPA i.e. Truck preparation are TPA dock station where delivery of pallets to customer is prepared.

Lean Manufacturing principles

Lean Method cont.

d) Lean Management and Visual Management

- Value stream mapping VSM
- Key performance indicator KPI
- Zoning /ANDON
- JIDOKA / First defect stop.

e) Lean Management Pokayoke

- Zero defects
- K. cause human
- Detect and Avoid
- Quality Intensification

Summary of the topics in LEAN:

Introduction to LEAN world

- Lead development
- Five principles of LEAN
- Concept of value added & loss
- Seven kinds of WASTE (MUDA)
- Elimination of Seven kind of waste

Some practical LEAN foundation tools

- KAIZEN,PDCA ,JIDOKA,POKAYOKE,standardized work,KANBAN,GENCHI GENBUTSU
- 5S prinicples
- OEE measurement & development

Summary of the topics in LEAN:

Development of machine effiiciency in LEAN management

- Total productive maintenance TPM
- SMED principles
- OEE measurement and development

Material flow development & design of manufacturing cells

- Just in time JIT
- Cell based production
- Push system

Some Practical LEAN foundation tools:

LEAN foundation tools

- KAIZEN,PDCA ,JIDOKA,POKAYOKE,standardized work,KANBAN,GENCHI GENBUTSU
- 5S prinicples
- OEE measurement & development

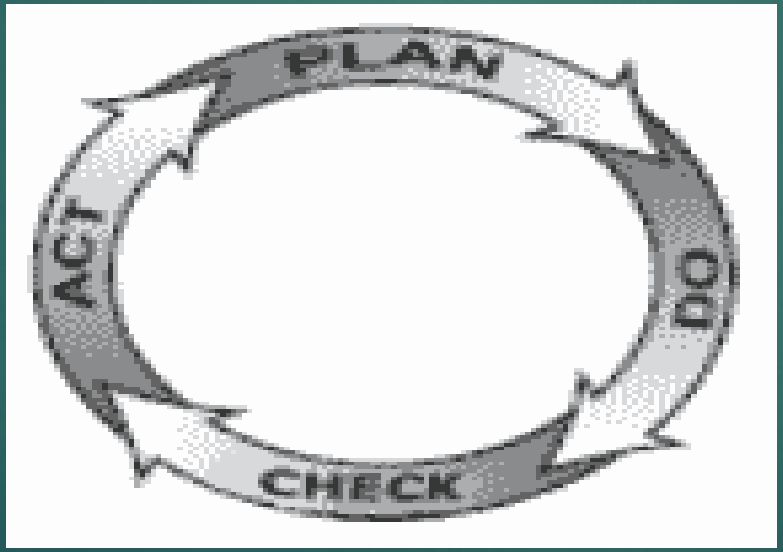
KAIZEN principles

KAIZEN is a system of continuous improvement in which instances of waste qre eliminated one by one at a minimal cost.The principles of KAIZEN involves Every employees beginning from CEO to the lowest worker in the organization. The main aim of KAIZEN is to elimate waste thereby improve quality at a reduce cost.

Some Practical LEAN foundation tools:

PDCA principles

The plan–do–check–act cycle is a four–step model for carrying out change. Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement.



Some Practical LEAN foundation tools:

PDCA principles

When to Use Plan–Do–Check–Act

•As a model for continuous improvement.
•When starting a new improvement project.
•When developing a new or improved design of a process, product or service.
•When defining a repetitive work process.
•When planning data collection and analysis in order to verify and prioritize problems or root causes.
•When implementing any change.

Plan–Do–Check–Act Procedure

- Plan. Recognize an opportunity and plan a change.
- Do. Test the change. Carry out a small-scale study.
- Check. Review the test, analyze the results and identify what you've learned.
- Act. Take action based on what you learned in the study step: If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.

Some Practical LEAN foundation tools:

JIDOKA device

JIDOKA is one of the two main pillar of **TPS**. it refers to the ability to stop production lines,by man or machine ,in the event of problems such as equipment malfunction,quality issues or late work.Jidoka helps prevent the passing round of defects,helps identify and correct problem areas using lacalization and isolation,and makes it possible to build quality at the production process.

POKAYOKE device

A Japanese term meaning "mistake proofing." An example of pokayoke would be a machine designed so that parts can be fixtured only in the correct position.

Low cost highly reliable devices used in the JIDOKA system that will stop processess in order to prevent the production of defective parts

Some Practical LEAN foundation tools:

STANDARDIZED WORK

The achieve Japanese system organizes all jobs around human motion and creates an efficient production sequence without any MUDA .Work organized in such a way is called Standardized work.it consists of three elements:Takt time,Working Sequence and Standard in process stock.

KANBAN

A Japanese word meaning "card signal." It represents any visual method used to show the need for parts or products to be moved or produced.

Kanban also refer to A small sign that is key control for Just-in-time production.it serves as: 1.Instruction for production & converyance 2.Visual control tool to check for over production and detect irregular processing speed. 3.Tool to perform KAIZEN.

Some Practical LEAN foundation tools:

THE PRODUCTION KANBAN

A kanban that contains all of the basic information about a batch, such as number and weight, plus details about what type of work should be accomplished within the cell.

WITHDRAWER KANBAN

A kanban used to signal the movement of parts between cells. It contains just the basic information about the batch such as the number of pieces and weight.

GENCHI GENBUTSU

Go see the problem.This is the belief that practical experience is valued over the theorectical knowledge.You must see the problem to know the extent of its spread.

Some Practical LEAN foundation tools:

5S PRINCIPLES

The 5 'S' Process: Seiri, Seiton, Seiso, Seiketsu, Shitsuke

The **5S Process**, or simply "**5S**", is a structured program to systematically achieve total organization, cleanliness, and standardization in the workplace. A well-organized workplace results in a safer, more efficient, and more productive operation. It boosts the morale of the workers, promoting a sense of pride in their work and ownership of their responsibilities.

"**5S**" was invented in Japan, and stands for five (**5**) Japanese words that start with the letter '**S**': Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. Table 1 shows what these individual words mean. An equivalent set of five 'S' words in English have likewise been adopted by many, to preserve the "5S" acronym in English usage. These are: Sort, Set (in place), Shine, Standardize, and Sustain. Some purists do not agree with these English words -

they argue that these words have lost the essence of the original 5 Japanese words.

Some Practical LEAN foundation tools:

The 5 'S' Process: Seiri, Seiton, Seiso, Seiketsu, Shitsuke

Seiri	Tidiness	Throw away all rubbish and unrelated materials in the workplace
Seiton	Orderliness	Set everything in proper place for quick retrieval and storage
Seiso	Cleanliness	Clean the workplace; everyone should be a janitor
Seiketsu	Standardization	Standardize the way of maintaining cleanliness
Shitsuke	Discipline	Practice 'Five S' daily - make it a way of life; this also means 'commitment'

Some Practical LEAN foundation tools:

OEE PRINICIPLES

***OEE* assigns numerical value to improvement opportunity.** It factors in the availability, performance and quality of output of a given piece of equipment and tells you this:

*How much **right-first-time** product did this machine produce compared to what it should have produced in the allocated time?*

How OEE Works

The OEE calculation rolls the "6 big losses" of TPM into one number that represents the effective operating rate for a piece of equipment or synchronized line—in other words, the percent of time the equipment or line is operating effectively, or its *valuable operating time*. That translates to the percentage of product produced compared to what could have been produced in the scheduled time.

Some Practical LEAN foundation tools:

How OEE Works

Availability (downtime)	1. Equipment failure (breakdowns) 2. Setup and adjustment
Performance (speed)	3. Idling and minor stoppages 4. Reduced speed of operation
Quality (defects)	5. Process defects (scrap, repairs) 6. Reduced yield (from startup to stable production)

It's calculated like this:
OEE (%) = Availability rate × Performance rate × Quality rate
•**Availability rate** (percentage of time the machine is ready to produce, working properly, and not in the midst of changeovers or adjustments) ***= Available time (scheduled operating time − downtime) ÷ Scheduled operating time.***

Some Practical LEAN foundation tools:

How OEE Works

•**Performance rate** (ratio of output produced compared to a standard) **= *Actual output ÷ Standard output.***

- **TIP:** The rule of thumb for standard output is to use the best output rate known to be produced on the machine, regardless of whether that is above or below design speed. If a machine consistently outperforms its design spec, your performance rate will exceed 100% and potentially mask availability problems. On the other hand, if the machine has never been able to achieve its design spec, it's usually not helpful to use that as the standard.
- **TIP:** Any losses due to minor stoppages, idling, or slowdowns show up in the performance rate.

•**Quality rate** (ratio of good output compared to actual output)**= *Right-first-time output ÷ Actual output.***

- **TIP:** Any defective output, including output that needs rework or repair or is scrapped during adjustment, is not counted as quality output.

Development of Machine efficiency in LEAN management:

Total Productive maintenance TPM

TPM. A manufacturing improvement method that increases production and reduces waste through continuous attention to the condition of machines and processes. .

SET UP REDUCTION.

A lean effort that uses standardization to reduce the time it takes to perform retooling.

SMED PRINICIPLES.

Single-Minute Exchange of Die (**SMED**) is one of the many lean production methods for reducing waste in a manufacturing process. It provides a rapid and efficient way of converting a manufacturing process from running the current product to running the next product. This rapid changeover is key to reducing production lot sizes and thereby improving flow (Mura).

Development of machine efficiency in LEAN mangement:

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Material flow development and design of manufacturing cell:

JUST IN TIME JIT.

An inventory strategy companies employ to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs.

This method requires that producers are able to accurately forecast demand.

1. The pull system and 2. Talk time

Describes production system in terms of supermarket system.each production line arraed its deverse output for the following line to choose from like merchandise on supermarket shelves.Each line became the customer for the preceeding line. i.e and each line became a suppermarket for the following line.the following line would come and choose the items it needed from the shelves and only those items choose are replace.The preceding line would produce only the replacement items for the one that the following line had selected-This is PULL SYSTEM PROCESS

Material flow development and design of manufacturing cell:

JUST IN TIME JIT contd.

The pull system

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Material flow development and design of manufacturing cell:

JUST IN TIME JIT contd.

The talk time

Takt-time is time which should be taken to produce a component on one vehicle.This timing mechannism is based on the monthly production schedule.Daily total operating time is figured on the basis of all machinery oparating at 100% efficiency during regular working hours.The takt-time allows us to produce many parts of many different types for use in vehicles on the production schedule and to supply those parts to each process on the assembly line at the proper time.This keeps production on schedule and permits flexible response to change in sale:

$$\text{Takt-Time} = \frac{\text{Straight work time(in seconds)}}{\text{Required Number of Production based on demand}}$$

Material flow development and design of manufacturing cell:

CELL BASED PRODUCTION:.

INTERNAL CUSTOMER.

A department or individual within the company that relies on others to satisfy the external customer. For any cell, the next cell in a process is always the internal customer.

CELL.

A specialized grouping of people, machines, tooling, and materials. The purpose of a cell is to efficiently produce small batches of parts.

CELLULAR MANUFACTURING.

A lean manufacturing method that uses specialized groupings of machines, people, and materials.

Material flow development and design of manufacturing cell:

MATERIAL FLOW DEVELOPMENT.

ASSEMBLY LINE.

A linear method of manufacturing in which the object being produced passes through different work stations until it is complete.

JOB FLOOR.

A manufacturing facility that produces several different products in smaller batches. A machine shop is a type of job shop.

WITHDRAWER KANBAN.

A kanban used to signal the movement of parts between cells. It contains just the basic information about the batch such as the number of pieces and weight.

Material flow development and design of manufacturing cell:

MATERIAL FLOW DEVELOPMENT.

FLOW SHOP.

A manufacturing facility that produces one or two similar products using high-volume specialized equipment. An assembly line is an example of a flow shop.

EXTERNAL CUSTOMER.

An outside organization or individual that receives a product or service from the company. .

IN PROCESS INSPECTION.

The inspection of a part during production to detect errors. Errors that are detected early may allow the part to be reworked or prevented from continuing through the manufacturing process.

Material flow development and design of manufacturing cell:

MATERIAL FLOW DEVELOPMENT.

PUSH SYSTEM.

In a push system, the producers control the pace of product development. Design changes are made infrequently, only when the current design becomes completely obsolete. But this system promotes the producer's control over the product and risks dissatisfying consumers.

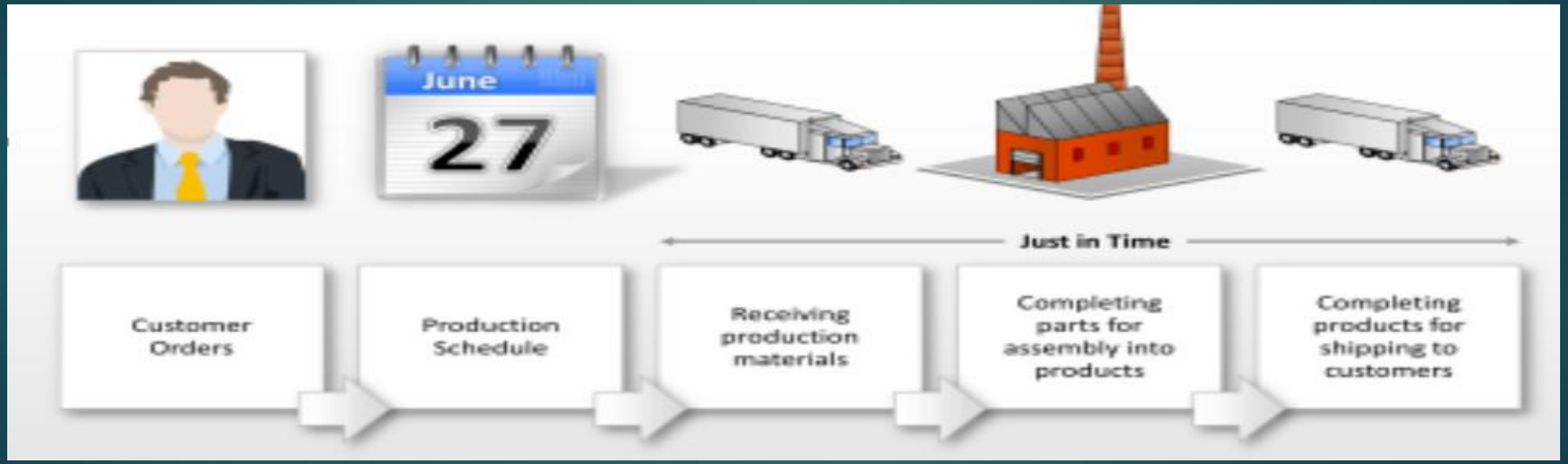
DEFINITION OF PUSH SYSTEM.
A production method based on keeping up with preset inventory levels or with due dates for customer orders rather than customer demand

PULL SYSTEM.

A material management system in which parts are not delivered to machines until they are needed. Pull systems are based on actual demand for parts.

Just in time – JIT –Production System

An inventory strategy which companies employ to increase efficiency and decrease waste by receiving goods only as they needed in the production process, thereby reducing inventory cost.



Just in time – JIT –Production System

Pull system:

In the " PULL SYSTEM" individual items are replenished as each item begins to run low in the shelf. i.e the first step in the process is not completed untill the second step uses materials or supplies from first step.At most of the Japanese company every steps of the manufacturing process uses KANBAN to signal the previous step when its part needs to be replenished.

DEFINITION OF PULL SYSTEM.

A material management system in which parts are not delivered to machines until they are needed. Pull systems are based on actual demand for parts.

Just in time – JIT –Production System

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$$\text{Takt-Time} = \frac{\text{Straight work time (in seconds)}}{\text{Required Number of Production based on demand}}$$

5 Why Analysis

Meaning:

Regarded as a simple tools which helps the organizations in the problem solving methodology. The problem solving methodology should include the following summary:

a) Problem definition
b) Contain action
c) How these techniques identify all root causes
d) Demonstrate all action were actually deployed and that show actions were realistic to capture the problems.
e) Verify action were successful in preventing the problems from reoccuring.

5 Why Analysis

Cause investigation steps using 5 Why analysis:

Step one: Make sure you confirm the direct cause of the abnormality, by verifying it if its visible, and if not visible, consider potential causes mistead and check the most likely causes. Confirm the direct cause base on fact, and ask the following:

a) Why is the problem occuring?
b) Can I see the direct cause of the problem?
c) If not, what do I suspect as potential cause?
d) How can I check the most likely potential cause?
e) How can I confirm the direct cause?

5 Why Analysis

Cause investigation steps using 5 Why analysis:

Step two: Use 5 Why investigation to build fish bone diagram that lead to the root cause and ask the followings:

a) Will addressing the direct cause prevent recurrence?
b) If not, can I see the next level of cause?
c) If not, what do I suspect as the neyt level of cause?
d) How can I check and confirm the next level of cause?
e) Will addressing this level of cause prevent recurrence?

5 Why Analysis

Cause investigation steps using 5 Why analysis:

If not, continue to asking why? Until you find the root cause stop at the cause that must be addressed to prevent recurrence and ask

a) Have I found the root cause of this problem?

b) Can I prevent recurrence by addressing this cause?

c) Is this cause linked to the problem by Ishikawa principle that is based on fact?

d) Does the process pass the „therefore test"

e) If I ask why again, will I be into another problem?

5 Why Analysis

Cause investigation steps using 5 Why analysis:

Conclusion

Be sure you have use 5 Why investigation to answer the below questions:

a) Why did we have non conformance?
b) Why sis the problem escape to the next level /customer?
c) Why did the system allow it to occure?

5 Why Practical Problem solving Method

There are four major parts of the process:

- Grasp the Situation
- Cause Investigation
- Problem Correction
- Prevention through Errorproofing

- Grasp the Situation

During the first part of the process, you:

- Identify the Problem
- Clarify the Problem
- Locate the Point of Cause (PoC)

5 Why Practical Problemsolving Method

- Cause Investigation

In the second part of the process, you:

- Conduct a 5-Why investigation to identify the root cause for the specific problem, for why the problem was not detected, for the ‚system' allowed the problem to occur.

- Problem Correction

In the third part of the process, you:

- Take specific action to correct the problem. At a minimum, short-term temporary measures are required to protect the customer.

- Prevention Thrue Errorproofing

In the fourth part of the process, you:

- Take specific action to make sure the problem cannot recure, typically through errorproofing
- Capture Lessons Learned.

Check sheet

Tools for generating information:

What it is?

- A form for recording data

When to use it?

- When you are gathering new data from original sources.

How to use it?

- Decide what data you collect.
- Design a form for recording data as it is collected
- Test the form you may need to revise it based on your experience.
- Make up a „total" check-sheet to marge the data collected by different data gatherers at different times e.t.c

Check sheet contd.
Tools for generating information:

CHECK SHEET
DEFECT DATA FOR 2002–2003 YTD

Part No.: TAX-41
Location: Bellevue
Study Date: 6/5/03
Analyst: TCB

	2002												2003					
Defect	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	Total
Parts damaged		1		3	1	2		1		10	3		2	2	7	2		34
Machining problems			3	3				1	8		3		8	3				29
Supplied parts rusted			1	1		2	9											13
Masking insufficient		3	6	4	3	1												17
Misaligned weld	2																	2
Processing out of order	2															2		4
Wrong part issued		1						2										3
Unfinished fairing			3															3
Adhesive failure				1							1		2			1	1	6
Powdery alodine					1													1
Paint out of limits						1								1				2
Paint damaged by etching			1															1
Film on parts						3		1	1									5
Primer cans damaged								1										1
Voids in casting									1	1								2
Delaminated composite										2								2
Incorrect dimensions											13	7	13	1		1	1	36
Improper test procedure										1								1
Salt-spray failure													4			2		4
TOTAL	4	5	14	12	5	9	9	6	10	14	20	7	29	7	7	6	2	166

Flow charts
Tools for generating information:

What is it?

- A diagram that shows the phases in a process, in sequense.

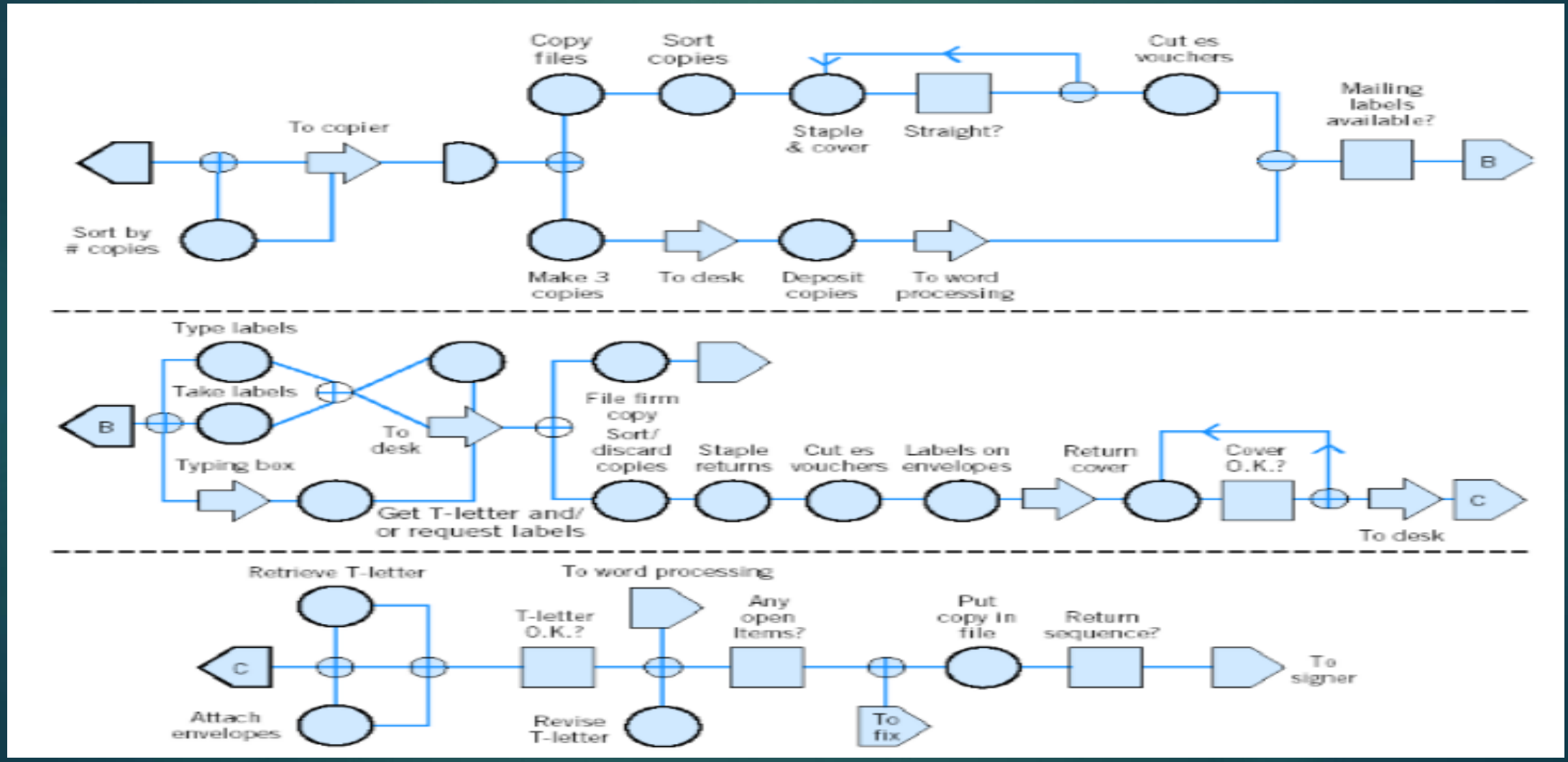
When to use it?

- You need to understand the work process to identify and organize factors contributing to a problem or possible solutions.

How to use it?

- Use these elements to show activities:
- Convene a group representing each part of the work process you want to document
- Identify the process you want to document. Make it clear where the process begin and ends.
- Brainstorm the basic activities and decision points in the process you want to document.
- Make up a chart, showing the activities in order. – link boxes (for activities) and silver (for decision points) with arrows to show the direction the process takes e.t.c

Flow chart
Tools for generating information:



KAIZEN Principles

KAI = Means change

ZEN = Means Good.

KAIZEN is a japanese word that means ‚change for the better'. Kaizen is a combination of maintenance, problem solving and innovation that is generally perfomed by a team.

Kaizen is a system of continuous improvement in which for instance waste are eliminated one by one at minimal cost. These is perfomed by employees rather thanspecialist. The theory of Kaizen philosophy was first introduced by Mosaki Imai in his book called Kaizen: The key to japanese competitive success.

Kaizen principles focus on continous improvement of processses in manufacturing, engineering, supporting business process and management. Kaizen activities continually improves all functions and involves employees from CEO to the assembly line operator worker.

KAIZEN Principles

The Kaizen principles are centered on the followings:

- Customer orientation
- Total Quality Control TQC
- Quality Circles QC
- Automation
- Work discipline
- Total Productive Maintenance TPM
- Kanban
- Quality Improvement
- Zero defect
- Just-in-time
- Small group activities
- Productivity Improvement
- New product development

KAIZEN Objectives

- Reduction of cost, quality increase and shortering of through put time by eliminate waste (MUDA).
- Standardization of work instructions, after proposal of employees involvements in the initiatives.
- Self depend and conscions avoidence of wastage in time, material e.t.c

KAIZEN Benefits

- Waste reduction (time, motion, inventory, transportation e.t.c.)
- Improve productivity, quality and use of capital e.t.c.
- Faster delivery, lower cost and greater customer satisfactions.
- Widely applicable and acceptable.
- Increase employees job satisfaction, sense of responsiblity and moral.
- Highly effective result oriented and transparent.
- Optimization of production facilites and work environment.

KAIZEN Principles

Application of Kaizen Implementation

KAIZEN Principles

Approach for Kaizen Implementation

The following approach for Kaizen implementation are listed below:

a) 5S
b) 8D Methodology
c) Value stream mapping
d) PDCA cycle

Approach for Kaizen Implementation: **5S principles**

"**5S**" was invented in Japan, and stands for five (**5**) Japanese words that start with the letter '**S**': Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. Table 1 shows what these individual words mean. An equivalent set of five 'S' words in English have likewise been adopted by many, to preserve the "5S" acronym in English usage. These are: Sort, Set (in place), Shine, Standardize, and Sustain. Some purists do not agree with these English words - they argue that these words have lost the essence of the original 5 Japanese words.

Approach for Kaizen Implementation

Seiri	Tidiness	Throw away all rubbish and unrelated materials in the workplace
Seiton	Orderliness	Set everything in proper place for quick retrieval and storage
Seiso	Cleanliness	Clean the workplace; everyone should be a janitor
Seiketsu	Standardization	Standardize the way of maintaining cleanliness
Shitsuke	Discipline	Practice 'Five S' daily - make it a way of life; this also means 'commitment'

Approach for Kaizen Implementation: **8D Methodology**

8D is a systematical problem solving tools for finding solutions to the root cause of the problem or failure and it widely used in most of automotive industries e.t.c i.e and this approach is written below accordingly:

- FORMING A TEAM: A cross functional team should be established to analyzed,investigate the problem
- DESCRIBE THE PROBLEM: You choose a problem to work with and,then describe it in writing (fully expression).
- INTERIM CONTAINMENT ACTION IN PLACE: You should implement an interim action how customer will be protected ICA e.t.c
- EVALUATE ROOT CAUSES: You should learn more about what could be the causes of the problem from data gathering,analyzing ,investigating it thorougly
- SELECT A SOLUTION & VERIFY IT: You should select a solution and a plan for implement it. Your solutions must be successful(verify) in preventing the problem from reoccuring.
- IMPLEMENTING AN ACTION & VALIDATE IT: You should implement the plan, monitor the results and adjust the plan as needed
- ACTION TO PREVENT RECCURENCE & LESSON LEARNED: You should fix an action to prevent reoccurence of the problem from the systemic point of view

Approach for Kaizen Implementation: **8D Methodology**

8. CLOSING OF THE 8D: Congratulations to the team for job well done.

Summary: You can think about the process as TEST in form like this when finding a solutions to the problem:

- Team formation
- Description of the problem
- Interim Containment action in place
- Evaluate root causes
- Select a solution & verify it
- Implement an action
- Action to prevent reoccurence & lesson lerned activities
- Closing of the 8D process.

Approach for Kaizen Implementation : **Value stream mapping**

Value stream mapping is a lean manufacturing technique used to analyze the flow of materials and information currently required to bring a product or service. It is a helpful method that can be used in Lean environments to identify opportunities for improvement in lead time. It can be applied to any process needing improvement, and is often used in logistics, supply chain, service-related industries, healthcare, software development, and product development.

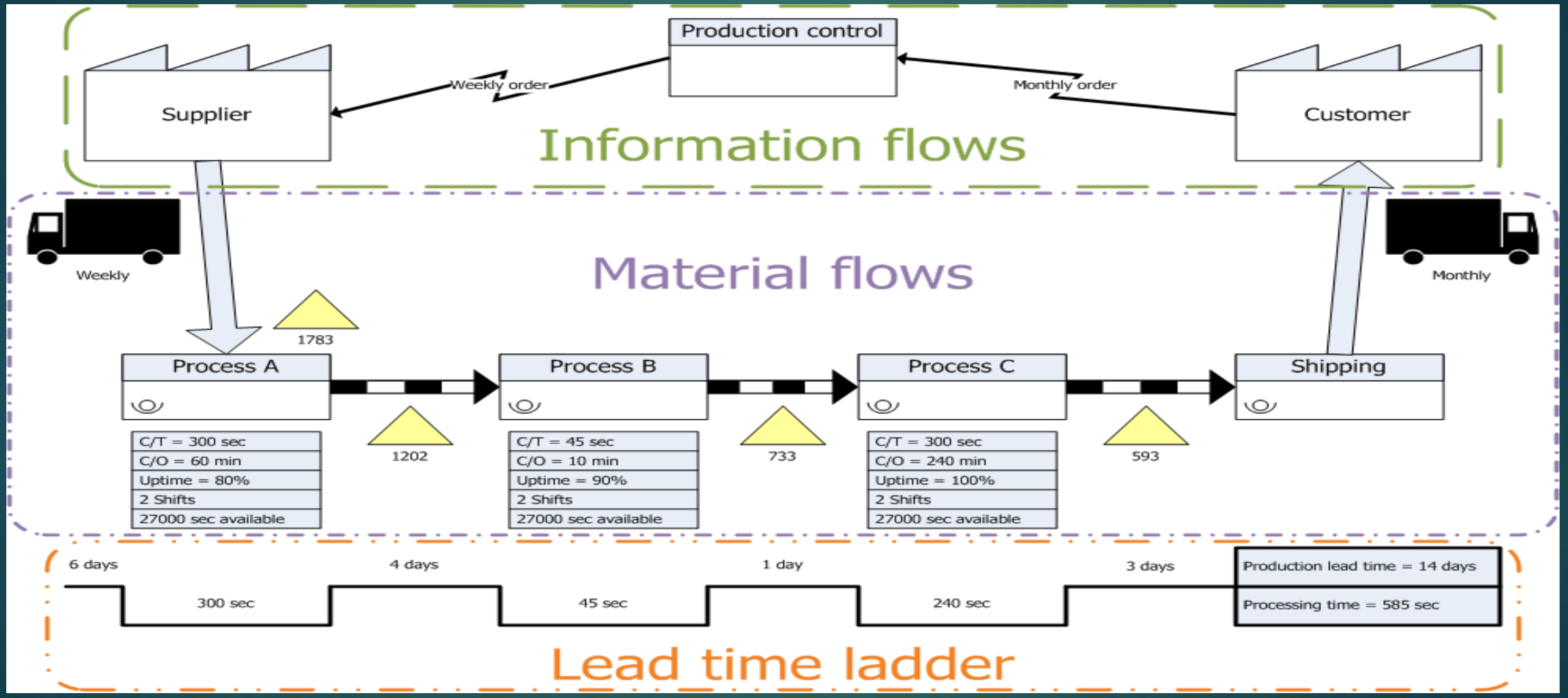
Value Stream Mapping is a tool used to create a material and information flow map of a product or process. Value stream mapping provides visibility into the material and information flow system in terms of both value added & non-value added activities.

Approach for Kaizen Implementation : **Value stream mapping**

BASIC STEPS IN VALUE STREAM MAPPING:

- Identify the target product, product family, or service.
- Draw a current state value stream map, which shows the current steps, delays, and information flows required to deliver the target product or service. This may be a production flow (raw materials to consumer) or a design flow (concept to launch). There are 'standard' symbols for representing supply chain entities.
- Assess the current state value stream map in terms of creating flow by eliminating waste.
- Draw a future state value stream map.
- Work toward the future state condition

Approach for Kaizen Implementation : **Value stream mapping**



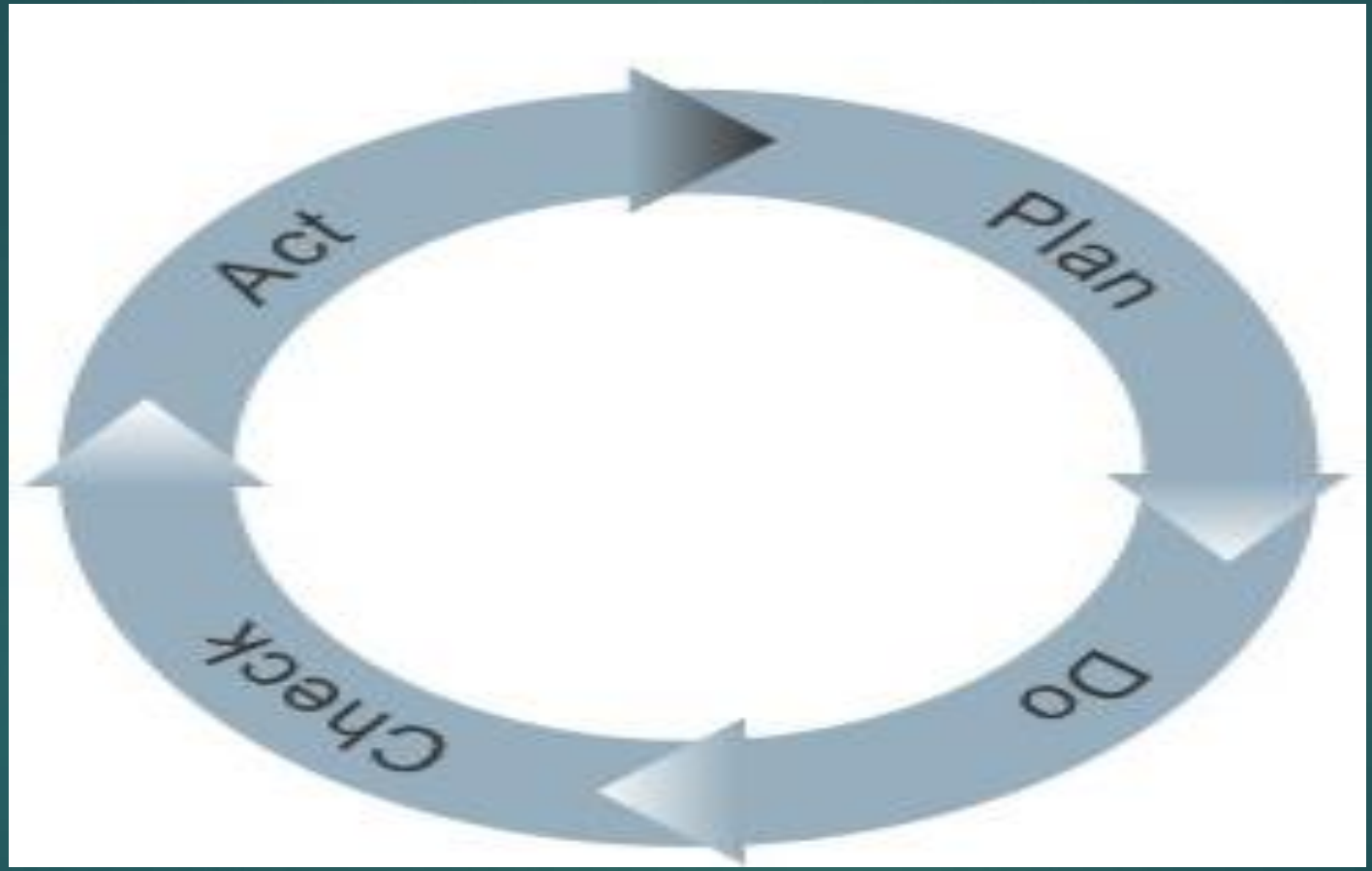
Approach for Kaizen Implementation : **PDCA Cycle**

The plan–do–check–act cycle is a four–step model for carrying out change. Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement.

When to Use Plan–Do–Check–Act

- As a model for continuous improvement.
- When starting a new improvement project.
- When developing a new or improved design of a process, product or service.
- When defining a repetitive work process.
- When planning data collection and analysis in order to verify and prioritize problems or root causes.
- When implementing any change.

Approach for Kaizen Implementation : **PDCA Cycle**



Approach for Kaizen Implementation : PDCA Cycle Explanations

1. **Plan**. Recognize an opportunity and plan a change.
2. **Do**. Test the change. Carry out a small-scale study.
3. **Check**. Review the test, analyze the results and identify what you've learned.
4. **Act**. Take action based on what you learned in the study step: If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again

Poka-yoke : Mistake proofing

A japanese term meaning ‚Mistake proofing'. An example of Poka-yoke would be a machine designed so that parts can be fixtured only in the correct position.

Low cost highly rehable devices used in the JIDOKA system that will stop processes in order to prevent the production of defective parts.

1. Contact Type	2. Fixed Value Type	3. Motion-Step Type
• Testing shapes, size or physical attributes to detect errors.	• Alerting operator if a certain number of movements are not made.	• Determine whether the prescribed steps of the process have been followed.

Poka-yoke : Mistake proofing

Mistake proofing (Poka-Yoke) is a techniques to eliminate errors often referred to as „fail-safeing”. Mistake proofing should be used as a preventive technique to control repetitive tasks or actions. This techniques is designed to reduce customer concerns.

Statistical Process Control (SPC principles)

Control Charts are used to monitor and improve a process. They focus on sources of variation. There are many types of control charts for both continuous and discreet data. We will focus on the widely used Average and Range charts (X-bar & R).

- When to use X-bar & R Control Charts:
  - When you want to monitor the quality of a process metric
  - When continuous data are readily available for a process
- When adjustments can be made to drive the process metric to nominal

Statistical Process Control (SPC principles) contd.

How do Control Charts help to avoid defects?

How?

- Control charts can be used to drive an output to nominal
- Control charts can provide a time-ordered record of trends
- Control charts can reduce variation in the process
- Control charts can distinguish between common cause and special cause variation.

Statistical Process Control (SPC principles) contd.

Brief history of Control charts.

Shewhart concluded from studying his charts that variation from chance - or **common cause variation** - formed a normal distribution, while the variation from assignable causes - or **special cause variation** - did not.

By developing limits around the normal distribution, he found he was able to detect when assignable causes were present. The charts provided a time-based graphical picture of trends.

This concept of common cause versus special cause is important in understanding control charts.

Statistical Process Control (SPC principles) contd.

Causes of Variation

Common Cause - sources of variation within a process that has a stable, repeatable, and predictable distribution over time. Such a distribution is said to be "in control".

Although variation is undesirable, the predictability of common causes allows them to be identified and removed.

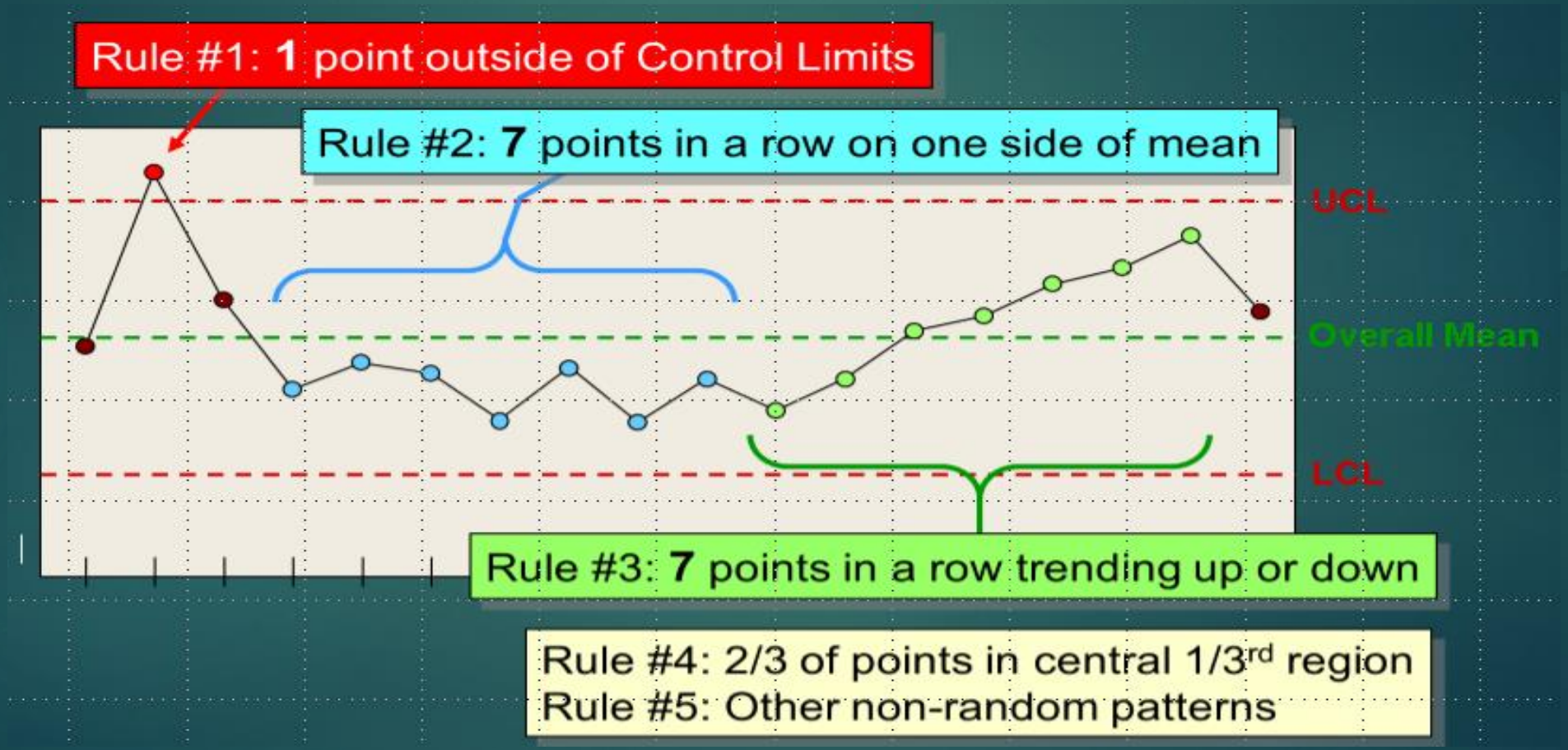
Common causes are removed via **Process Improvement**.

Special Cause - sources of variation that are not always acting on the process. They change the process distribution in unpredictable ways.

1. The unpredictable nature of special causes makes them difficult to identify and prevent.
2. Special causes are often controlled, rather than prevented, through the use of inspection and control charts.
3. Special causes are removed via **Problem Solving**.

Statistical Process Control (SPC principles) contd.

Test Rules



Statistical Process Control (SPC principles) contd.

Steps in Constructing an Average and Range Chart (X-bar and R)

- **Select the process and characteristics to control.**

The characteristic that is chosen for an average and range chart should be quickly and easily measured by trained operators.

The characteristic must be a continuous measurement.

- **Establish the sampling plan and rational subgroup size.**

A **rational subgroup** should provide the maximum chance for the measurements within the subgroup to be alike and the maximum chance for the subgroups to differ from each other. The variation between subgroups will be compared to the variation within subgroups.

It is important that the measurements in any subgroup be produced under the same conditions, i.e, the same operator, same machine, taken consecutively.

Statistical Process Control (SPC principles) contd.

Steps in Constructing an Average and Range Chart (X-bar and R) Contd

This minimizes the variation within each subgroup. Any variation between the subgroups would then signal a change in the process that should be investigated.

large subgroup size makes it easier to detect process shifts. If the expected process shift is small, use larger subgroups. The inspection cost does increase with large subgroups. The increased cost must be balanced with the need for sensitivity.

A subgroup size of five is frequently used for easy computation. Subgroups of four or larger will provide a normal distribution even if the population is non-normal.

Gather data / Enter into Minitab.

Run the process as is and gather data.

Regardless of whether the data is collected manually or automatically, it is important to remember that Minitab prefers stacked data; therefore, it is easiest to transfer data into Minitab if it is recorded vertically (see at right)

Statistical Process Control (SPC principles) contd.

Steps in Constructing an Average and Range Chart (X-bar and R) Contd

- Establish the overall mean and control limits.

Control limits can be calculated manually; however, use Minitab to automate this process.

See the AIAG SPC Reference Manual for the formulas for calculating the control limits for each type of control chart.

Control limits should be calculated from data collected while the process is known to be stable and representative of the desired process.

Once the control limits are determined, they should not be changed unless the process has been modified.

Statistical Process Control (SPC principles) contd.

Steps in Constructing an Average and Range Chart (X-bar and R) Contd

- Analyze for the chart for statistical control.

If the process has no special causes affecting its variation, then it will assume a normal probability distribution with no points exceeding the control limits. A process is said to be stable when no out of control conditions exist.

When a point falls outside the control limits, or other unusual patterns of variation occur, a special cause of variation may be present. Under these conditions the process is said to be **out of control**. Minitab can automatically detect these patterns for you.

When out of control conditions exist, you will want to investigate