Lean Sigma (BIO08025)

Lecture 2

Dr. Stephen Daly

Lecture Overview

- Overview of Lean and the 7 Industry Wastes
- 5S

Why do we need to know this?

Important to know basics of lean, and awareness of the 7 industry wastes. 5S is a basic but the first and most important lean tool.

What is Lean?

- A continuous flow of work with **minimal inventories** at each stage of the production process.

- Production capability that is **synchronised** to customer demand.

- **Defect prevention** rather than inspection and rework by building quality in the process and implementing real time quality feedback procedures.

- Manufacturing execution that is driven by customer demand or **“pull”,** not on forecasts or “push”.

- Close **integration of the whole value stream** from raw material to finished product through partnership oriented relations with suppliers and distributors.

- Team based work organisations with multi-skilled operators empowered to make decisions and improve operations.

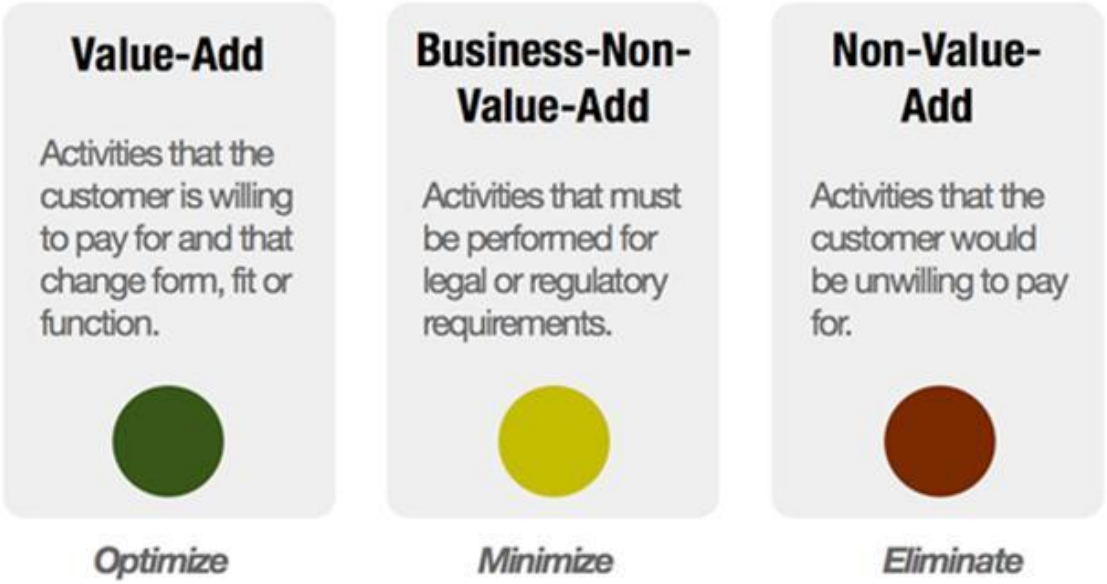
- Active involvement by workers in trouble shooting and problem solving to improve quality and eliminate waste.

Value Added Activity

Value is added to a product when it changes the fundamental nature of the product.

Examples:

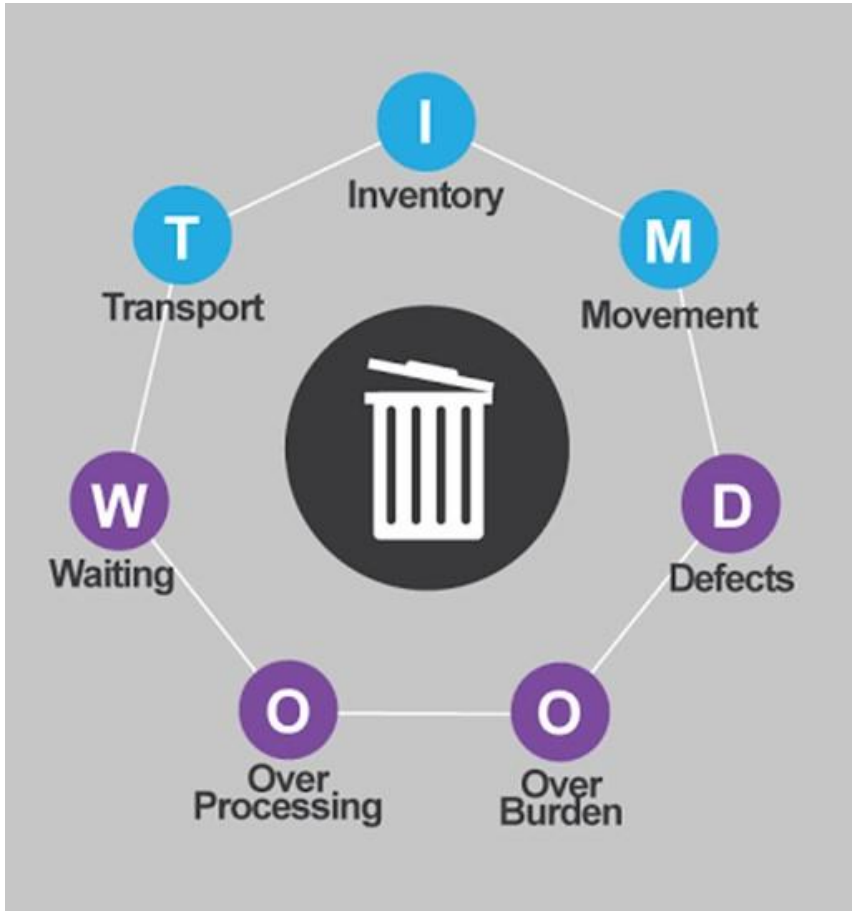
•Stamping a bracket out of a coil of steel. All other activities are non-value added or waste



Eight Service Industry Wastes

1. Errors in documents
2. Transport of documents
3. Doing unnecessary work not requested
4. Waiting for the next process step
5. Process of getting approvals
6. Unnecessary motions
7. Backlog in work queues
8. Underutilized employees

TIMWOOD



Transportation

Transportation waste is moving the product more than is necessary

Examples:

- Having three storage locations for the same material

- Moving raw materials to an offsite warehouse

Inventory

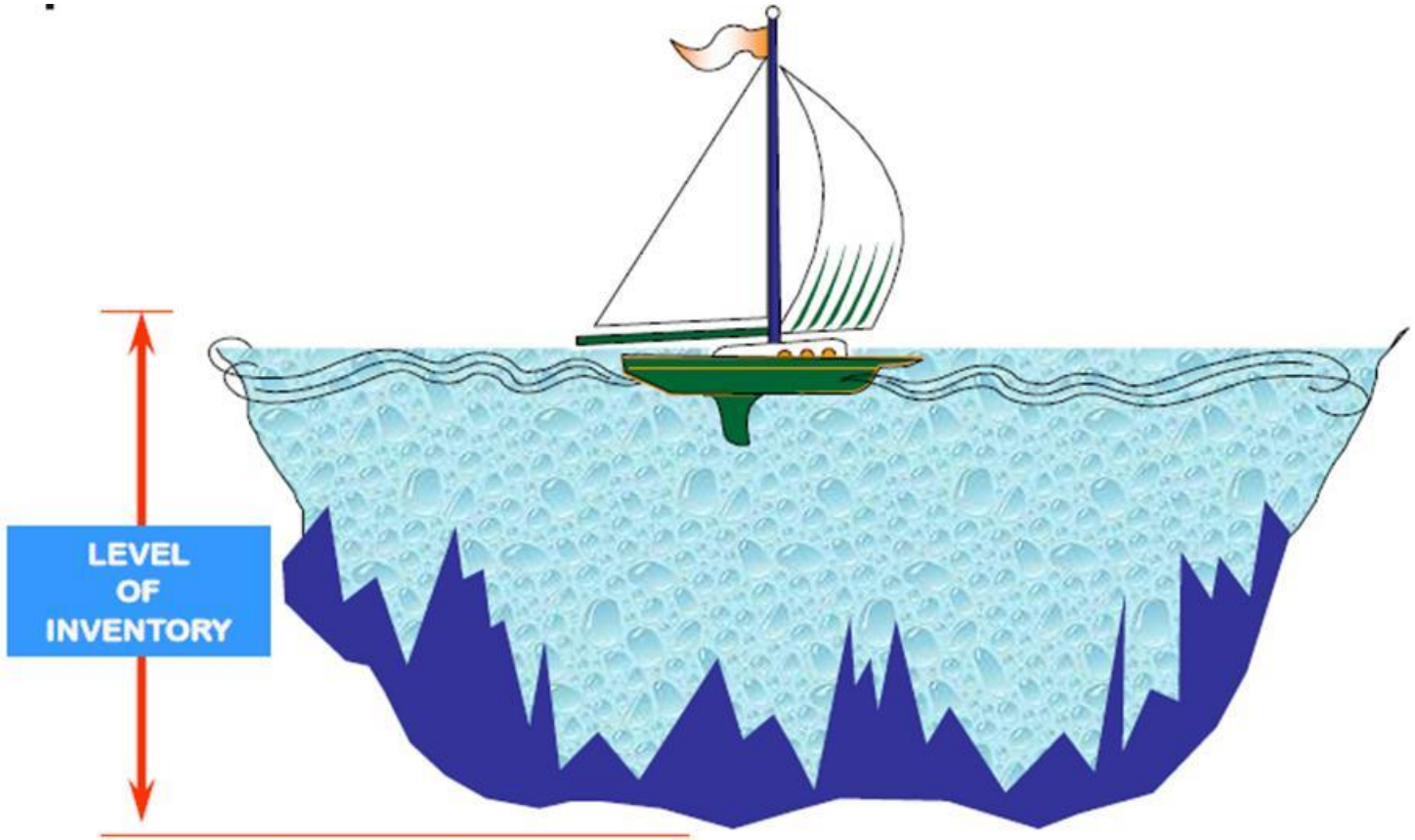
- Inventory waste occurs when there is more product on hand than the customer requested.

Examples:

- More raw material than needed for smooth production (e.g. use of plasmas in biopharmacteuticals-use may be based on potency)

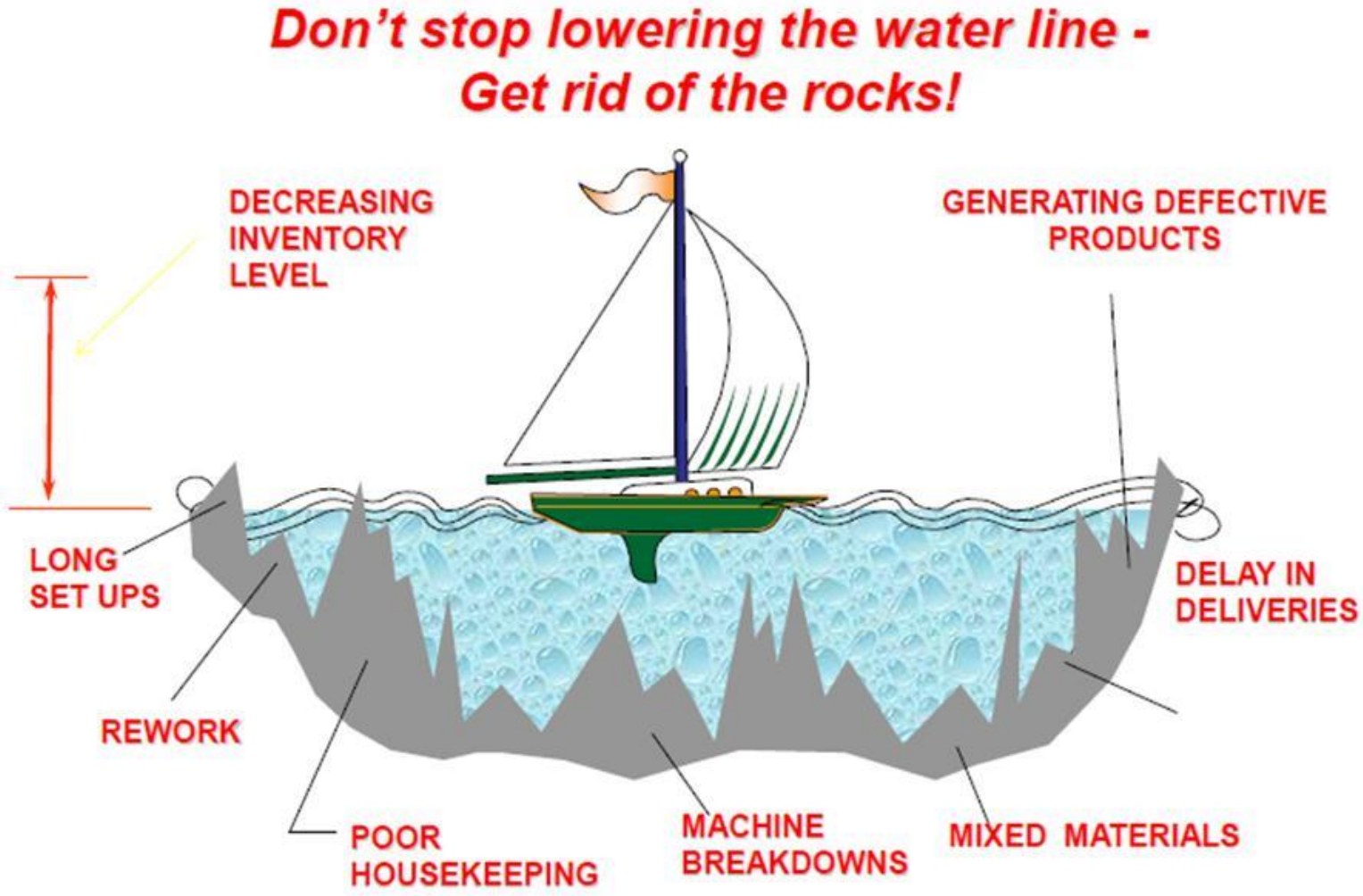
- More work-in-process (any work item in the process that is not yet completed)

Inventory Hides True Production Problems



What are the 'rocks' in your company ?

Inventory Hides True Production Problems



Motion

The waste of motion refers to any extra movement of the operator when they are performing the work sequence (excessive or repetitive motion also increases ergonomic issues)

Examples:

- Walking 10 feet to retrieve a part or tool
- Twisting around to grab a part in the back of the workstation

Waiting

Anytime value cannot be added because of a delay is defined as the waste of waiting

Examples:

- Waiting for a raw material
- Waiting for a machine to be fixed/cleaned (Bioreactor)
- Unbalanced assembly/kitpack sequence

Overprocessing

Over processing is doing more to the product than the customer requested

Examples:

- Pegylating a protein for 4 hours when there is characterisation data to support 2
- Testing a product three times when the specification calls for one test.
- Repeating COA testing for incoming material

Overproduction

Overproduction is making more of something than the customer requested

Examples:

- Running a machine for 16 hours when only 10 are required

- Making 2 day's worth of product when only 1 day's worth is required

Defects Correction/Rework

Anything that is not “done right the first time” and requires rework inspection or touchup

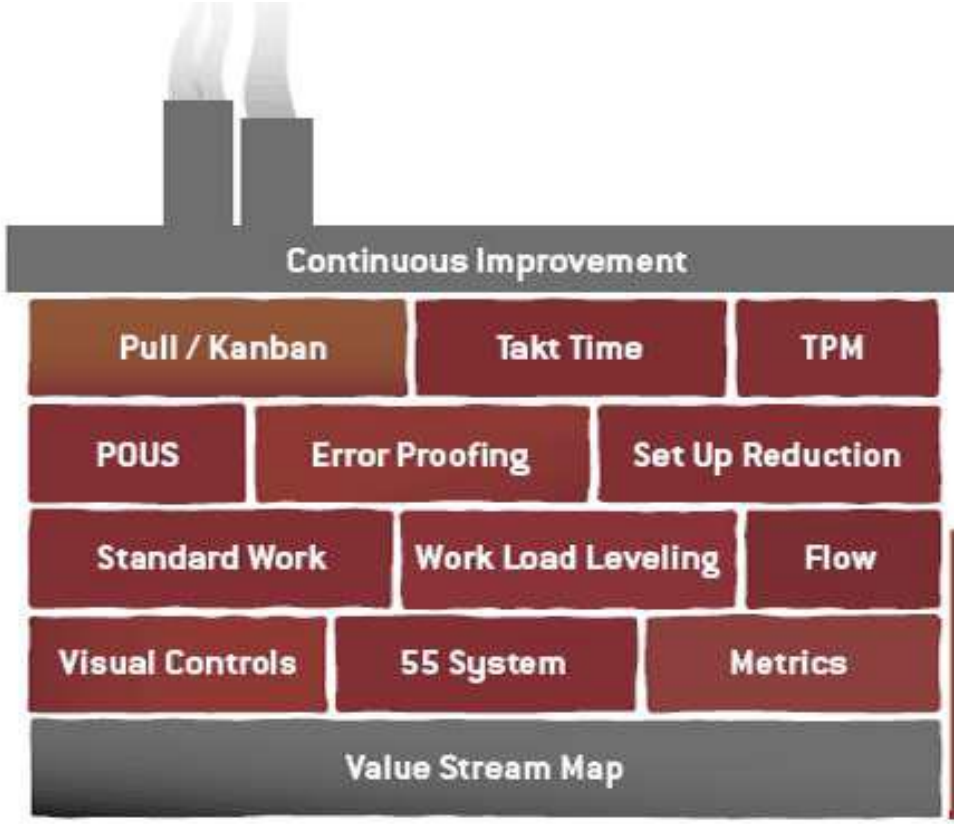
(Also includes scrap and appearance issues)
Examples:

- Re-torquing a bottle/vial
- Sorting incoming materials
- Checking a key dimension
- Trimming thread or flash from a component
- De-Label/Re-label material
- Re-counting vials for accountability

Lean is not just about manufacturing….
Its about the WHOLE Supply Chain

Lean 5S

Lean Building Blocks



What is 5S?

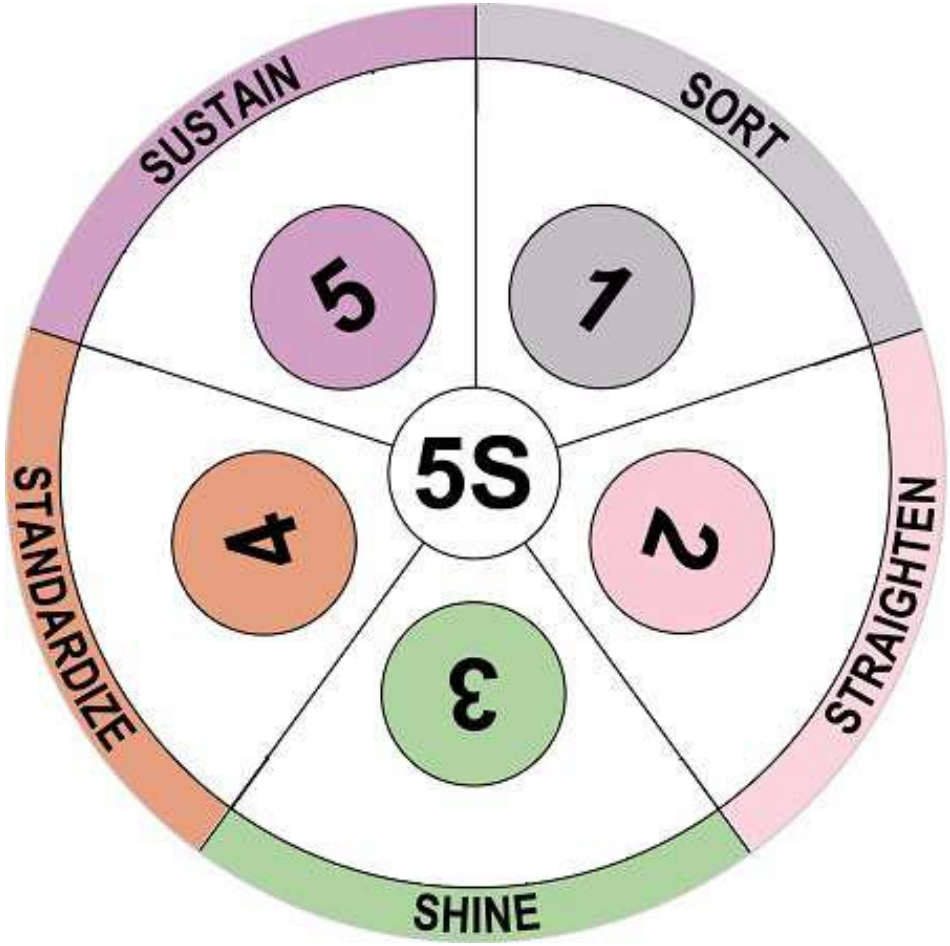
A systematic way of creating a safe, efficient, and highly visible workspace for employees.

5S is one of the pillars of Lean Manufacturing, and provides a starting point for continuous improvement.

Objective of 5S

- To identify opportunities to eliminate waste resulting from day-to-day shop floor Operation
- To establish and institute a process of waste elimination and continuous improvement
- To eliminate the wastes that result from “uncontrolled” processes.
- To gain control on equipment, material & inventory placement and position.
- Apply Control Techniques to Eliminate Erosion of Improvements.
- Standardize Improvements for Maintenance of Critical Process Parameters.

5S Visual Road Map



Steps of 5S

SORT is the removal of items which have not been used in a while or are obsolete

STRAIGHTEN is as the saying goes, “A place for everything and every thing in its place”

SHINE involves cleaning the targeted workplace area and using this process to inspect the workplace and equipment for defects and safety hazards

STANDARDISE is creating visual controls and guidelines for keeping the workplace organised, orderly, and clean

SUSTAIN involves training and instructing employees to follow the guidelines created in the standardise step. This step requires management reinforcing the importance of an organised workplace.

Before 5S-Safety Risks!

After 5S

Maintenance Shop

After 5S

Shop Floor Mangement-Results

Implementation of 5S program resulted in large employee ownership/pride, visual and colour-coded management and a space savings (from 348 sq. feet to 114 sq. feet)

After 5S

Ordered drawers with labels

Why Use 5S?

- Ensures employee safety
- Reduces the chance for error
- Reduces the wasted motion and time of looking for tooling, parts, paper, or Information
- Empowers employees to take control of their own work areas
- Provides a pillar for other lean initiatives
- ***"If you can't master 5S, forget all of the rest"***

  Taichi Ohno, Father of the Toyota Production System

Where is 5S Used?

- Everywhere
- The office
- Shop floor
- Your computer
- Where is it needed today?
- Cluttered work areas
- High traffic work areas
- Shared work areas

Project Scope and Workplace Observation

- Clearly define target area
- Identify purpose and function of target area
- Develop area map
- Show material, people, equipment flow
- Perform scan diagnostic
- Photograph problem areas
- Develop a project display board (area)

5S Roadmap

SORT	STRAIGHTEN	SHINE	STANDARDIZE	SUSTAIN
Criteria for disposal of not-needed items have been established.	Decide and organize ***where*** to keep necessary items	Clean work area.	Established work groups to develop and document standardized work methods.	Area inspections are random and completed by work groups and/or shop floor leaders.
Tag and identify not-needed items.	Decide and organize ***how*** to keep necessary items.	Develop cleaning assignments and checklist.	Work methods established for S's one through three.	5S level is established and posted in the area.
Establish a safe and secure holding area for not-needed items.	Make it easy.	Inspection during cleaning.	Documented and standardized controls for S's one through three.	Work area 5S is maintained.
Evaluate and remove unneces-sary items from the site.	Make it obvious.	Cleaning is an everyday part of the job.	Develop standardized work procedures for all work areas.	Internal inspection process is standard.
Identify problem areas and document prevention actions.	Identify problem areas and document prevention actions.	Identify problem areas and document prevention actions.	Share best practices with internal and external work groups.	Root cause problem solving process in place.

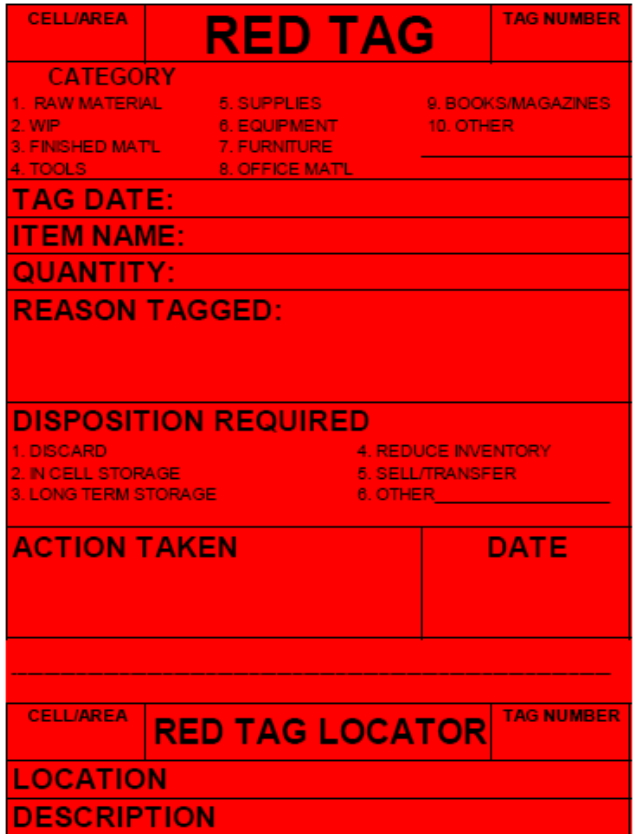
Sort

Red tag process

- Key idea: “When in doubt, move it out”
- Prepare tags
- Attach red tags to unneeded items
- Remove red tagged items to “Dinosaur
- Burial Ground”
- Evaluate (disposition) red-tagged items

Sort - Red Tags

- When do you Red Tag?
  - Obsolete, Unneeded?
  - Stored here used elsewhere?
  - Used infrequently?
  - What is this used for?
- What do you need?
- What do you not need?
- What can you remove?
  - Go to Production Manager to notify Engineer or owner


CELL/AREA | RED TAG | TAG NUMBER

CATEGORY
1. RAW MATERIAL
2. WIP
3. FINISHED MAT'L
4. TOOLS
5. SUPPLIES
6. EQUIPMENT
7. FURNITURE
8. OFFICE MAT'L
9. BOOKS/MAGAZINES
10. OTHER _____

TAG DATE:

ITEM NAME:

QUANTITY:

REASON TAGGED:

DISPOSITION REQUIRED
1. DISCARD
2. IN CELL STORAGE
3. LONG TERM STORAGE
4. REDUCE INVENTORY
5. SELL/TRANSFER
6. OTHER_____

ACTION TAKEN | DATE

_____

CELL/AREA | RED TAG LOCATOR | TAG NUMBER

LOCATION

DESCRIPTION

Red Tag Event

Straighten

Make it obvious where things belong

- Lines
  - Divider lines
  - Outlines
  - Limit lines (height, min-max)
  - Arrows show direction
- Labels
  - Color coding
  - Item location
- Signs
  - Equipment related information
  - Show location, type, quantity, etc.

Shine

- Clean everything, inside and out
- Inspect through cleaning
- Prevent dirt and contamination from reoccurring

Results in

- Fewer breakdowns
- Greater safety
- Product quality
- More satisfying work environment

Standardize

- Establish guidelines for the team–5-S conditions
- Make the standards and 5-S guidelines visual
- Maintain and monitor those conditions

Sustain

Determine the methods your team will use to maintain adherence to the standards

- 5-S concept training
- 5-S communication board
- Before and after photos
- One point lesson
- Visual standards and procedures
- Daily 5-minute 5-S activities
- Weekly 5-S application

Example

5 S Project for Gas Syringes

First Step-Define the Problem

- Gas tight syringes are frequently used and in demand by the In Process Lab group.
- Currently all IPC syringes are stored in the same plastic box.
- This is a safety concern and also increases the risk of damaging the syringes.
- Syringe blockage is another common issue.

Use Lean Tools and Methodology to Solve the Problem

VOICE OF THE CUSTOMER

Informal meetings were held with the IPC group to establish any current issues.

5S:

The principles of 5S were applied to the HPLC consumables area.

5S was used as it is proven tool for the organisation of workspaces.

Each of the 5S stages were followed;

Sorting/Shine:

An analysis of what syringes were required was carried out and syringes no longer needed and taking up space were removed.

Set In Order:

Each syringe was given a specific location and identified by its volume with a label.

Standardise:

A dedicated housing was sourced for each syringe and clearly labelled.

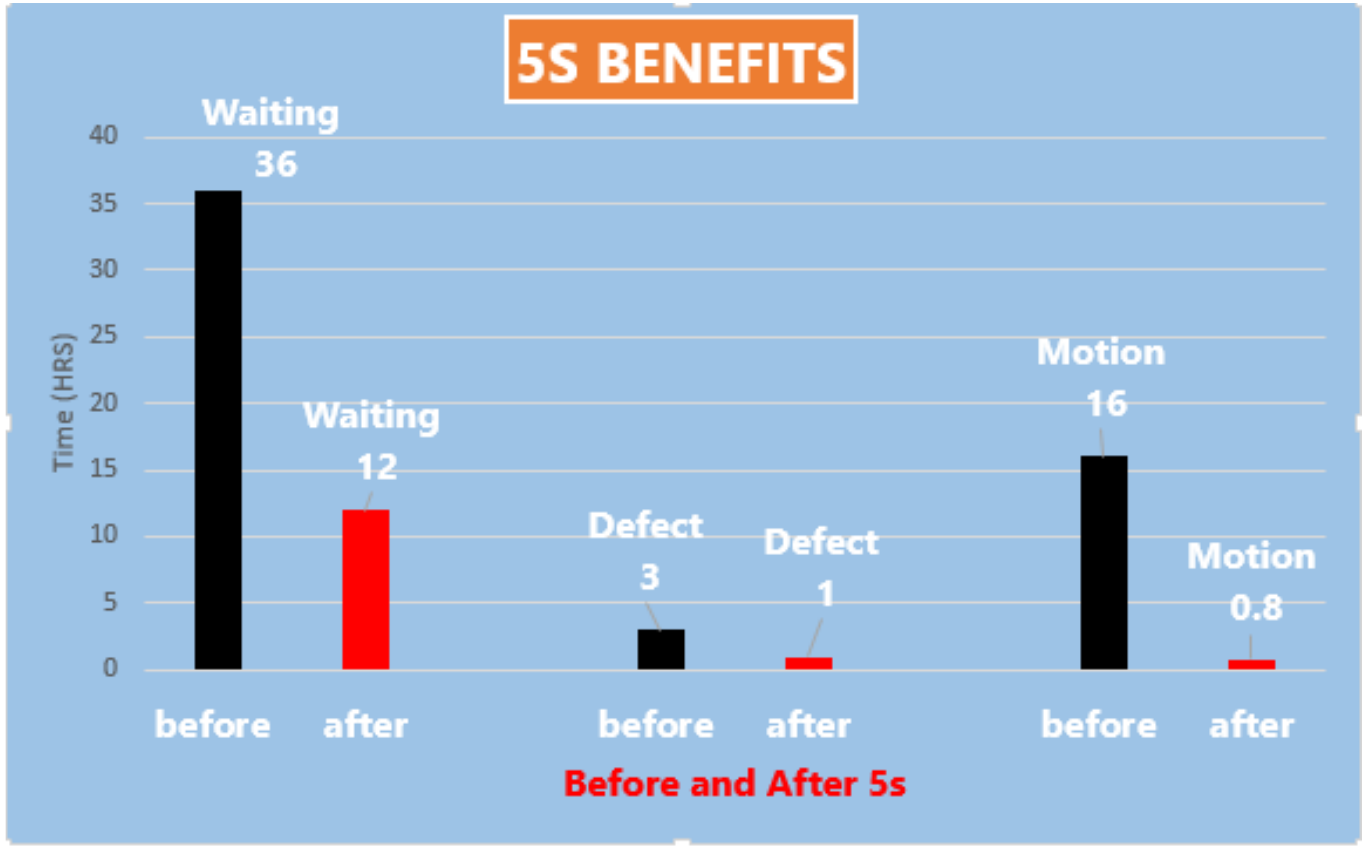
TIMWOOD

Used to determine associated wastes

Waste	Description	Before	After	Benefit
Safety	Syringes kept in unsafe manner.	High risk of needle prick.	Risk prevented.	Safety concern eliminated.
Defect	High usage can result in blocks.	Up to 3 syringes per week found with blocks.	<1 blocked syringe a week, when syringes rinsed with MeOH after use.	MeOH rinse aid prevents syringe blocks.
Waiting	Blocked syringes had to be dismantled and sonicated for ten mins the reassembled and flushed. Total time = 15mins.	15mins per syringe x 3 syringes/week = 45mins/week = 3hrs/month = 36hrs/year spent unblocking syringes.	15mins per syringe x <1syringe/week = 15mins/week = 1hr/month = 12hrs/year spent unblocking syringes.	Saving over 24hrs per year.
Motion	Unnecessary searching for correct syringe	Up to 20mins/week= 80mins/month= 16hrs/year spent looking for correct syringe	< 1min/week = 4mins/month 48mins/year spent looking for correct syringe	Saving over 15hours per year

After 5S Implementation

Metrics of before & after implementation



Workplace 5S Checklist

	BEFORE	AFTER	
Sort	☐	☐	**Distinguish between what is needed and not needed**
	☐	☐	Unneeded equipment, tools, furniture, etc. are present
	☐	☐	Unneeded items are on walls, bulletin boards, etc.
	☐	☐	Items are in aisles, stairways, corners, etc.
	☐	☐	Unneeded inventory, supplies, parts, or materials are present
	☐	☐	Safety hazards (water, oil, chemical, machines) exist
Straighten	☐	☐	**A place for everything and everything in its place**
	☐	☐	Correct places for items are not obvious
	☐	☐	Items are not in their correct places
	☐	☐	Aisles, workstations, equipment locations are not identified
	☐	☐	Items are not put away immediately after use
	☐	☐	Height and quantity limits are not obvious
Shine	☐	☐	**Cleaning, and looking for ways to keep it clean and organized**
	☐	☐	Floors, walls, stairs, and surfaces are not free of dirt, oil, and grease
	☐	☐	Equipment is not kept clean and free of dirt, oil, and grease
	☐	☐	Cleaning materials are not easily accessible
	☐	☐	Lines, labels, signs, etc. are not clean and unbroken
	☐	☐	Other cleaning problems of any kind exist
Standardise	☐	☐	**Maintain and monitor the first three S's**
	☐	☐	Necessary information is not visible
	☐	☐	All standards are not known and visible
	☐	☐	Standard Work doesn't exists for all cleaning and maintenance jobs
	☐	☐	All quantities and limits are not easily recognizable
	☐	☐	Items cannot be located in 5 seconds
Sustain	☐	☐	**Stick to the rules**
	☐	☐	Area workers have not had 5-S training
	☐	☐	5-S is not performed routinely
	☐	☐	Personal belongings are not stored neatly
	☐	☐	Standard Work is not available or up to date
	☐	☐	Daily 5-S audits are not performed

Note: Check all that apply, plan countermeasures.

Example 2-Media Prep Area in Lab

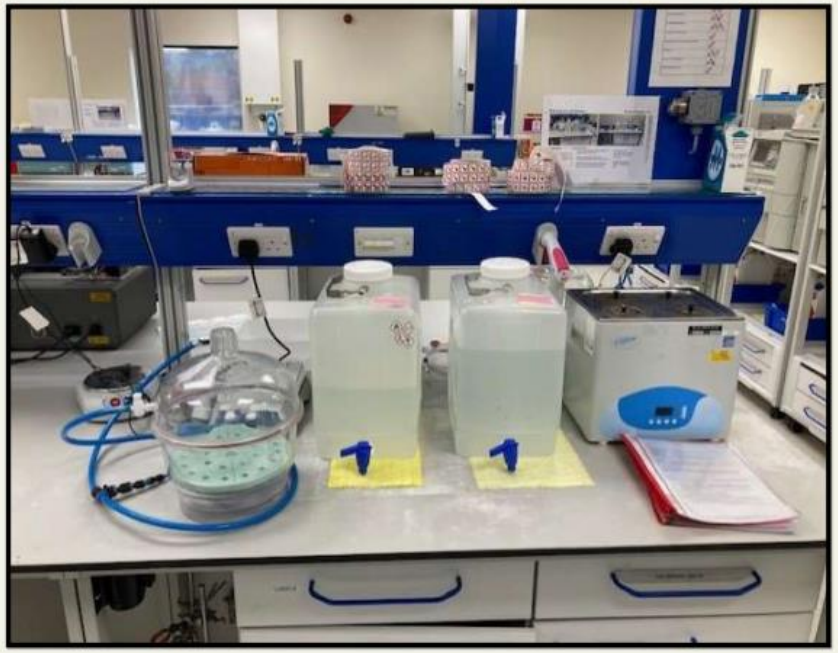
Media Preparation Area Before

- Area cluttered and untidy
- SOPs left on the bench
- Equipment not in use, blocking other equipment
- Hazard labels stored incorrectly

5S Standards

Media Preparation Area After

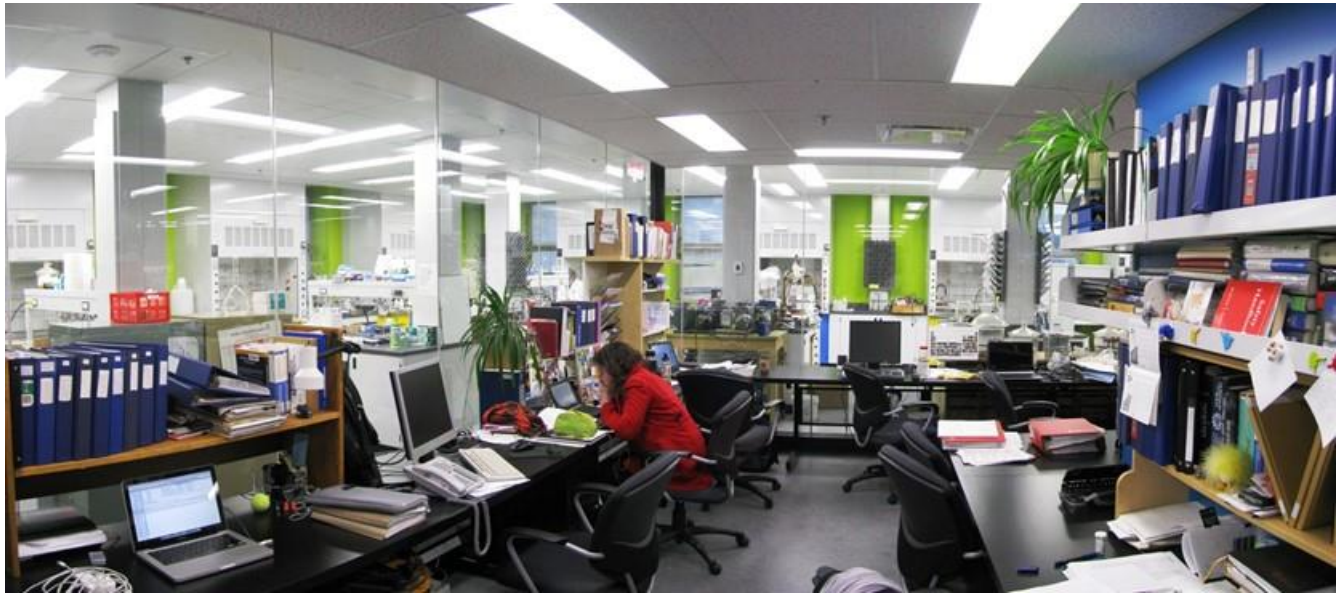
- Area should be kept tidy and free from clutter when not in use
- Solution containers should be labelled with the lid closed
- Magnetic stirrer should be visibly clean after every use



Example 3

Office Optimisation using Lean & 6 Sigma Tools :

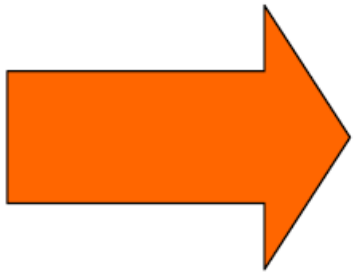
DMAIC, 5S and Kanban



DEFINE

Problem Statement :
Where we are at
Q: What is the issue we're addressing?

A: The stationery room is a high traffic area with multiple customers that is disorganised and cluttered making consumables difficult to locate, re-order and re-stock. Printing facilities are also difficult to use and access.



Goal Statement :
Where we wish to be
Q: What do we wish to achieve?

A: An organised stationery area that is tidy with equipment and consumables in designated areas, making it easy and quick to re-order and re-stock with printing facilities readily accessible

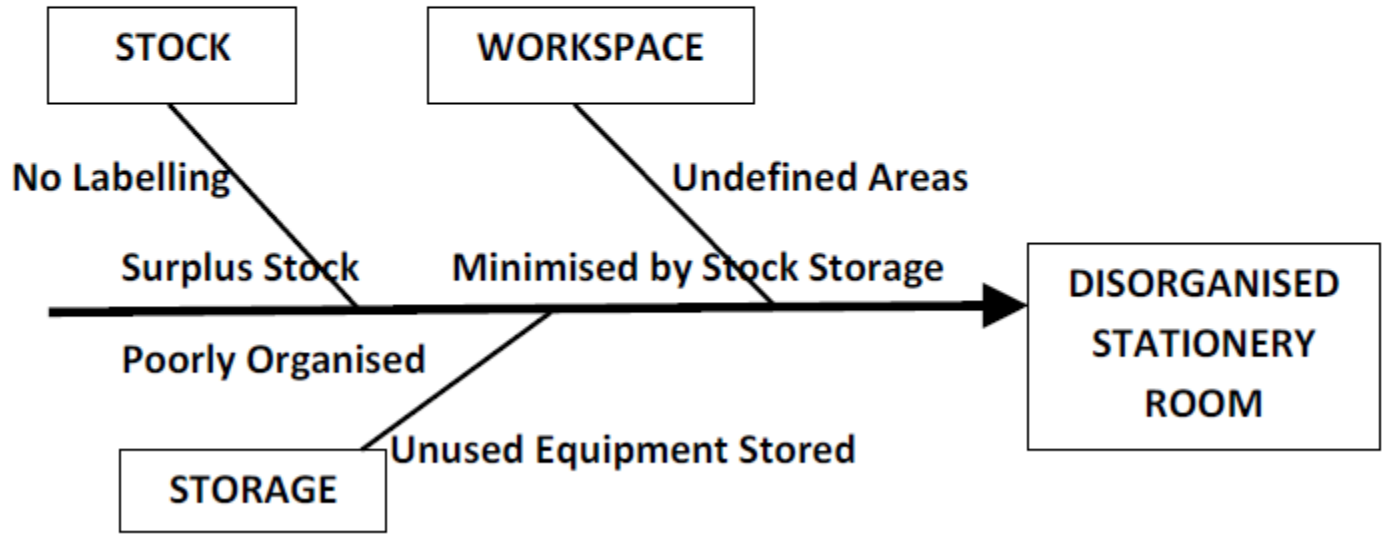
MEASURE

Process Observation was utilised as the primary measurement tool as the room is used for a number of different purposes depending on the client. The following descriptive findings about the existing state of the Stationery Room were obtained.

- **Undefined areas for storage of consumables inventory**
- **Poorly designated locations for essential equipment**
- **Lack of available storage and bench space**
- **Unutilised items in area**
- **No labelling for inventory storage**
- **Surplus inventory = major issue (reducing available storage)**

ANALYSE

Information gleaned via the Measure phase was used to determine which aspects of the current problem(s) to prioritise via fishbone analysis.



Analyse (Contd.)

A summary of the current situation determined root causes of problems to be:

1. Variability in almost all aspects of room utilisation is one major issue.
2. Inconsistency in Inventory Management is another major issue.
3. No systems had been implemented – they had just "evolved" over time.

It was recognised that a systematic approach was needed, so the following solution strategies were proposed:

a) 5S methodology will be implemented.
b) Visual controls will be utilised to create and maintain order and enable ease of inventory management (Kanban Board + Cards).
c) Stationery levels to be standardised.

IMPROVE

To address issues with the stationery room 5S methodology was employed.

Sort All items in the room were evaluated on the basis of relevance to the area. If not relevant to the stationery area then removed and stored elsewhere. Unnecessary items were discarded if not needed/claimed within one week.	

Improve (Contd.)

Straighten Remaining essential items were now re-arranged in the stationery room with the expressed aim of making these items easier and more efficient to access. Visual controls were put in place to make it simple to identify placement of equipment.	
Shine Stationery area was thoroughly cleaned during the sort phase. Any equipment returning during the "straighten" phase was thoroughly cleaned and checked for faults and/or damage and repaired or discarded as relevant.	

Improve (Contd.)

Standardise

Kanban Board and Labelling System implemented resulting in :

- Simplified, streamlined re ordering process
- Inventory levels defined (maximum and re-order trigger levels.
- Cupboard and shelving labelling applied – stock given designated areas.
- Staff trained in use of Kanban system.

Improve (Contd.)

Sustain

Weekly 5S scorecard audits implemented in conjunction with Stationery Room Maintenance roster– staff to complete on a rotating basis (thus everyone is involved).

.CONTROL

Visibility of the project improvements are communicated via the 5S board in the area.
Staff involvement via participation in the Audit and maintenance activities enhances ownership and the ongoing success of the project.

5S Scorecard

Date		Audited by	Score	0 - No evidence of improvement, 1- Little Evidence, 2 - Some Evidence, 3- Meets requirements, 5 - Job well done (nothing more could be done)						
			/95							
		Evaluation Criteria		0	1	2	3	5	Observation/Evidence (what observations were made to indicate the criteria is not being met?)	Actions (What corrective actions need implementing to prevent the issue from happening again?)
Sorting Total = ___ / 25	Keep only what is needed	Are there unutilised items on the shelves and cabinets?								
		Cables and wires not properly organised?								
		Is the document tray / printer left with paper?								
		All excessive documentation and inventory has been eliminated? (e.g. 3 months supply present when only 1 week to obtain stock)								
		Evidence of a regular sorting exists. If a red tag area exists is it clearly marked and has a schedule for disposition period?								
Straighten Total = ___ / 20	Arrange and identify	Equipment and supplies are located at the point of use?								
		All shelves, frequently used items etc are clearly labelled?								
		Storage areas contain clear re-stocking instructions. Clear indication of max and min inventory quantity exists?								
		Stationery materials well organised and are easy to reach and are returned to their original location?								
Shine Total = ___ / 25	Managing at a glance	Areas are clean and kept orderly?								
		No items are unidentified or lying on top of cabinets/shelves.								
		It is easy to distinguish what belongs to the area and what doesn't.								
		No loose papers around?								
		Wastebaskets are emptied regularly?								
Standardise Total = ___ / 20	Eliminate variations	The location of what is inside the cupboard can be seen at a glance?								
		Instructions are available on how to operate equipment in the work area?								
		Visual controls consistent in appearance throughout the work area?								
		Consumables all have an identifying Kanban card?								
Sustain Total = ___ / 25	Maintain and improve	Internal audits performed at scheduled intervals and on time?								
		5S audit scores are displayed in the work area and communicated?								
		Sorting event continues to happen.								
		Items are cleared from red tag area on a regular basis.								
		5 min 5S is carried out on Mon /Wed / Fri ?								

Fig 1 : 5S Audit Scorecard

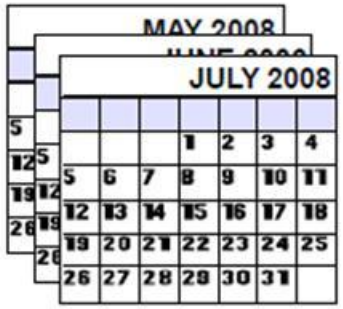
Summary

- Re-ordering/re-stocking events reduced from 3 per week to 1 per week.
- Room is now tidy and more orderly thus easier for all customers to
- access its facilities (i.e. it's more efficient!).
- All staff were empowered to take ownership of ongoing improvement
- activities.
- VOB (Voice Of the Business) has been heard resulting in productivity
- gains and reduced costs of inventory on hand.
- Kanban card system has markedly simplified re-ordering and re-stocking

- Gains were both quantifiable and qualitative :
  - numerically – time,
  - non-numerically – ownership, motivation, pride in achievements
- Both are positive not just for Staff but also the Business

5S - Summary


Red Tag
Category
1. Machine
5. Jigs
6. Raw Materials
7. Notices
Reason For Tagging
1. Not Needed
2. Defective
5. Scrap
6. Used rarely
Action frequency of use)
2. Return (Supplier)
5. Apply
Date Of Red Tagging


MAY 2008
JULY 2008


Reduced wasted time
Lower Cost
Improved Safety
A better way of working
Tour Ready at all times
Removal of waste
Sort
Clearly distinguish needed items from unneeded items and eliminate the latter
Straighten
Keep needed items in the correct place to allow for easy and immediate retrieval
Sustain
Make a habit of maintaining established procedures
Standardise
This is the process you use to maintain the first three S's
Shine
Keeping the area clean and free from contamination

Resistance to Implementing 5S

What's so great about sort and set in order? It will take too much time.

Why clean when it just gets dirty again?

Are sort, set in order, and shine really going to boost productivity?

Why bother?

What are the *reasons for resisting* 5s implementation?

We already implemented sort and set in order.

We're too busy for 5s.

We did 5s years ago.

Benefits of Implementing 5S

Workers have an opportunity to provide creative ideas about how the workplace should be organized.

Higher job satisfaction.

Clear expectations.

Reduced changeover time = higher productivity.

Reduced defects and higher quality.

Elimination of cost causing waste.

Reduced delays mean timely delivery of product.

Maintained machinery and equipment means reduced downtime.

Win customer confidence and trust.

Safer environment.

What are some benefits of implementing 5s?

- End of Lecture