

Lean Tools

**Continuous
Improvement**

Batch Reduction

Layout

**Set Up
Reduction**

Mistake Proofing

Visual Controls



Pull/Kanban

5S + 1

**Value Stream
Mapping**

**Standard
Work**

Cellular Flow

**Point of Use
Systems**



5S: A Tool to Achieve the Future State

- **5S** is a process and method for creating and maintaining an organized, clean, and high-performance workplace.
- **5S** is the **foundation** for continuous improvement, zero defects, and cost reduction.
- **5S** is a **systematic** way to make a more productive work space through employee involvement.
- **5S** enables anyone to **distinguish** between normal and abnormal conditions at a glance.



5S + 1

Each step of 5S
builds upon the next.

+ Safety

Step 5: Sustain

Step 4: Standardize

Step 3: Shine

Step 2: Simplify (Set)

Step 1: Sort



Office Space without 5S



Sort (Seiri)

Establish criteria for determining what is and is not needed in the area based on:

- Usefulness of the item / equipment.
- Frequency of use.
- Quantity needed.

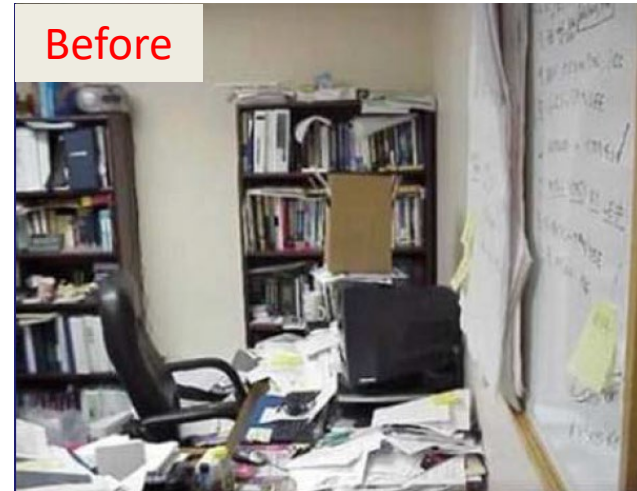
Red Tag Evaluation

- Keep in existing area.
- Move to different spot within area.
- Hold in red tag area.

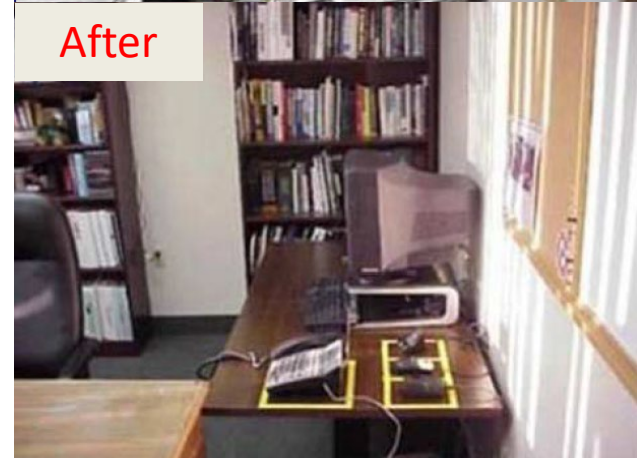
When in Doubt, MOVE IT OUT!

Ask the people who use the material / equipment for help –
We don't want to throw anything out that we actually need!

Before



After



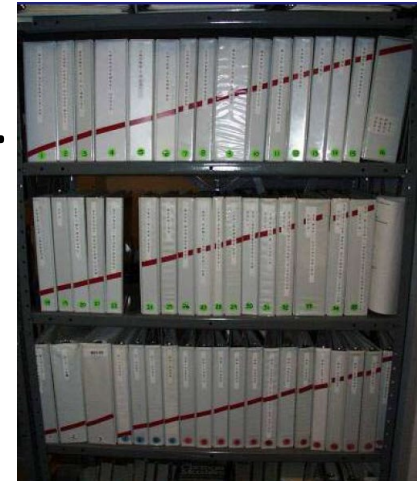
Simplify or Set (Seiton)

Determine the location for needed items and how they should be kept.

- Consider how to store tools and templates.
- Consider principles of motion waste.

Identify best locations.

- Labels, signboards, maps, shadow board.
- 5S Map: shows location of equipment in the area.
- Color-Code Strategy: distinguish use of tools / parts by color.
- Outlining work areas and locations.



**Creating a place for everything and everything in its place!
Make it obvious at a glance!**

Shine (Seiso)

- **Determine Target** *What needs to be cleaned?*
- **Determine Assignments** *Who is responsible?*
- **Determine Methods** *How will it be done?*
- **Determine Tools** *What is needed?*
- **Implement Shine** *Everyone's responsibility.*

Create and maintain a neat and clean environment.
Make it a habit!
To be Lean, you must be clean!



Standardize (Seiketsu)

- Establish guidelines for sort, straighten, and shine conditions.
- Bring the condition of the area up to those standards.
- Make the standard guidelines visible.
- Maintain and monitor first 3S's.
- Assign responsibilities and monitor through self audit and evaluation.



Create a consistent way to carry out tasks and procedures.



Sustain (Shitsuke)

- Development of new awareness and skills.
- Support from management.
- Ongoing, company wide communication.
- Making 5S standards part of daily work.
- Total employee involvement.
- Implement Sustainment Checklist.

Managers Committed



Training



"Buy-in" from all workers



Sustain to maintain success!

Five Levels of Excellence

	Sort	Simplify	Shine	Standardize	Sustain
Level 5 Focus on Prevention	Employees are continually seeking improvement opportunities.	A dependable, documented method has been developed to provide continual evaluation, and a process is in place to implement improvements.	Area employees have devised a dependable, documented method of preventive cleaning and maintenance.	Everyone is continually seeking the elimination of waste with changes documented and information shared.	There is a general appearance of a confident understanding of, and adherence to the 5S principles.
Level 4 Focus on Consistency	A dependable, documented method has been established to keep the work area free of unnecessary items.	A dependable, documented method has been established to recognize in a visual sweep if items are out of place or exceed quantity limits.	5S agreements are understood and practiced continually.	Substantial process documentation is available and followed.	Follow-through with 5S agreements and safety practices is evident.
Level 3 Make it visual	Unnecessary items have been removed from the workplace.	Designated locations are marked to make organization more visible.	Work and break areas and machinery are cleaned on a daily basis. Visual controls have been established and marked.	Working environment changes are being documented. Visual control agreements for labeling and quantity levels have been established.	5S agreements and safety practices have been developed and are utilized.
Level 2 Focus on Basics	Necessary and unnecessary items are separated.	A designated location has been established for items.	Work and break areas are cleaned on a regular, scheduled basis. Key items to check have been identified.	Methods are being improved but changes haven't been documented.	A recognizable effort has been made to improve the condition of the workplace.
Level 1 Just Beginning	Needed and not needed items are mixed throughout the work place.	Items are randomly located throughout the workplace.	Work place areas are dirty, disorganized and key items not marked or identified.	Work place methods are not consistently followed and are undocumented.	Work place checks are randomly performed and there is no visual measurement of 5S performance.



5S Scorecard - Examples

P&I 5S Audit Form

Purpose: To audit administrative supply areas ensuring workplace organization and standards are being met.

Who should fill it out: LSS Specialist or P&I Leader

Directions: The best way to use this tool is to follow these steps:

1. For each statement, circle the appropriate score.
2. Total the score, review with the process worker and/or departmental manager.

Area: P&I	Audit Date:	Auditor:			
Sort		Very Poor	Poor	Good	Very Good/Excellent
1. Are supply areas clear of excess supplies?		1	2	3	4 5
2. Are supply areas clear of out-of-date forms, lists, maps or checklists?		1	2	3	4 5
3. Are supply areas clear of excess personal items?		1	2	3	4 5
4. Are records file cabinets clear of out-dated records?		1	2	3	4 5
5. Is the LSS supply area free of unused items?		1	2	3	4 5
Total Sort:					
Set					
1. Are supplies located in correct location?		1	2	3	4 5
2. Are supplies properly identified and labeled?		1	2	3	4 5
3. Are Records properly stored?		1	2	3	4 5
4. Are all LSS training cases properly labeled and stored (if not in use)?		1	2	3	4 5
5. Are all supply items provided a completed Supply Reorder Cards?		1	2	3	4 5
Total Set:					
Shine					
1. Are supply areas clean and neat, free from clutter?		1	2	3	4 5
2. Is the LSS training case area clean and neat, free from clutter?		1	2	3	4 5
3. Are easels stored neatly in the conference room?		1	2	3	4 5
4. Is printer paper staging area stocked? (At least one ream present?)		1	2	3	4 5
5. Are all Records properly labeled with a information provided?		1	2	3	4 5
Total Shine:					
Standardize					
1. Is the Paper Records Index up-to-date? (Within one month of audit)		1	2	3	4 5
2. Are blank 5S Audit Sheets and Supply Reorder Cards available?		1	2	3	4 5
3. Are supply cabinet maps up-to-date?		1	2	3	4 5
4. Are supply, records, and LSS SOPs reviewed regularly? (Check 1)		1	2	3	4 5
5. Are 5S Rules posted and clearly visible?		1	2	3	4 5
Total Standardize:					
Sustain					
1. Are 5S audits being conducted on a regular basis? (Monthly)		1	2	3	4 5
2. Is the Records Management SOP being followed?		1	2	3	4 5
3. Is the Office Supply Procurement SOP being followed?		1	2	3	4 5
4. Are supplies with no current inventory in process of being reordered?		1	2	3	4 5
5. Can each employee explain the value of 5S? (Ask 1)		1	2	3	4 5
Total Sustain:					
Total of all 5 categories:					
100 - 125: Great. Doing Well. 75 - 99: Caution. Could Do Better <75: Concern: Minimal Effort Shown					
Last Update: 11/17/2016					

Item No.	Description	Rating Scale: 0-5 (0 = No 5S Evident, 5 = Out of the Box)	Score (0-5)
1	Unnecessary items are not stored in the area	5 - No unnecessary items are in the work area 1 - Personal items are mixed with and may interfere with accomplishment of required work	
2	Storage of cleaning material	5 - All required cleaning material is stored, visually marked, readily available 1 - Cleaning material is shared between multiple work areas	
3	General tidiness of work area	5 - Work area is kept clean at all times 1 - Work area is cleaned once a shift	
4	Bulletin Boards	5 - Bulletin Boards are current and have no outdated material on them 1 - Bulletin Boards have outdated or torn or soiled material on them	
5	Emergency Exits	5 - Emergency Exits marked and exit plans posted 1 - Emergency Exits not clearly marked or exit plans outdated, missing or soiled	
6	Process layout	5 - General items carts, movable fixtures, etc required to perform work are labeled, have assigned places and are stored in those places when not in actual work 1 - No apparent storage location for movable items	
7	Aisle marked	5 - Aisle clearly marked 1 - Aisle are not marked or markings are worn-out	
8	Aisle maintained	5 - Aisle are kept clean and free of clutter, use for transportation of material or personnel and not as a storage place 1 - Aisle are not kept clean or used as extended work area	
9	Storage of tools	5 - All tools have clearly marked locations with positive control 1 - Not all tools have clearly marked locations limited control over access	
10	Storage of technical manuals	5 - Technical manual or publications are stored close to normal point of use and in a manner that quickly allows for inventory at anytime 1 - Technical manuals or publications are not stored close to point of use and/or required more than 30 seconds to verify all are present	
11	Equipment / Tooling cleanliness	5 - Equipment / Tooling are kept clean at all times 1 - Equipment / Tooling are not cleaned after each use or maintenance cycle	
12	Equipment / Tooling maintenance	5 - Periodic maintenance requirements are clearly understood, and a means of recording maintenance actions is utilized 1 - Periodic maintenance requirements are not know by the user	
13	Equipment / Tooling Controls ID	5 - Operating restrictions or instructions if required are clearly marked all operators are licensed 1 - Operating restrictions are not posted unlicensed operators are using items	
14	Shelves, Benches, Desks Arrangement	5 - Work area is organized in a manner that allows for flow and are clearly marked as to work performed in the area 1 - Work area is not organized in a manner that promotes flow	
15	Shelves, Benches, Desks Control	5 - Kept clear of unnecessary materials 1 - Work surfaces are clutter or have items not required for maintenance	
16	5S Control and Sustainment Plan	5 - Visual controls are in place to facilitate maintaining organization Check sheets are available and utilizes to maintain 5S process 1 - Visual controls or check sheets are not available or used or maintained	



Safety

Common Sense is Good Sense



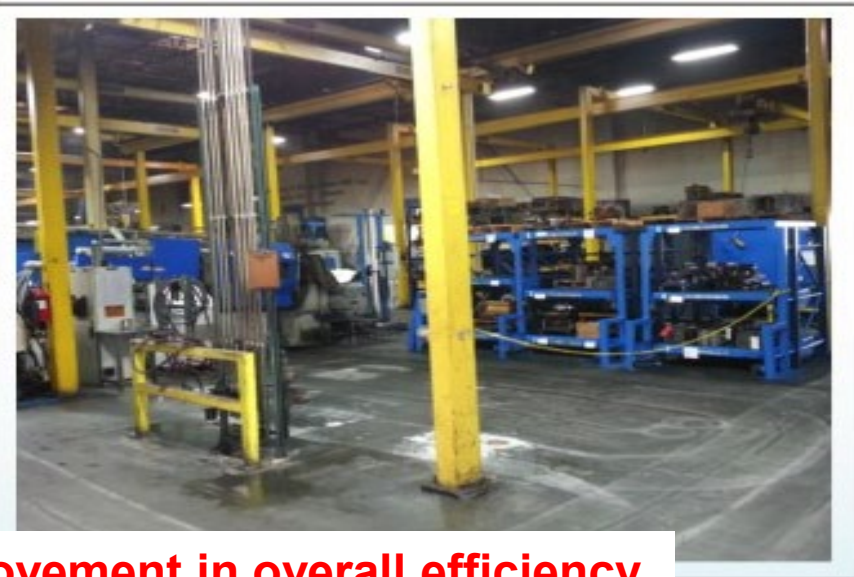
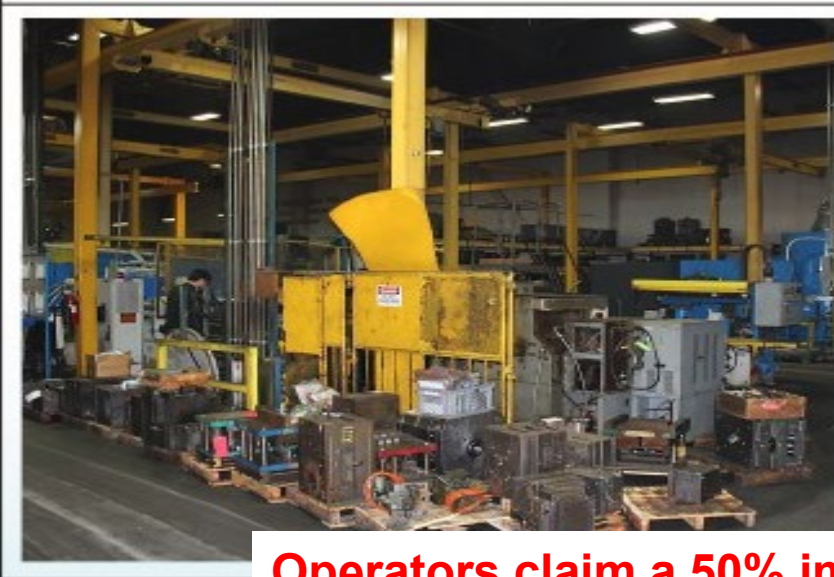
Safety

- Include Safety in all your Improvement Projects.

Can you identify the safety issues?



5S Example



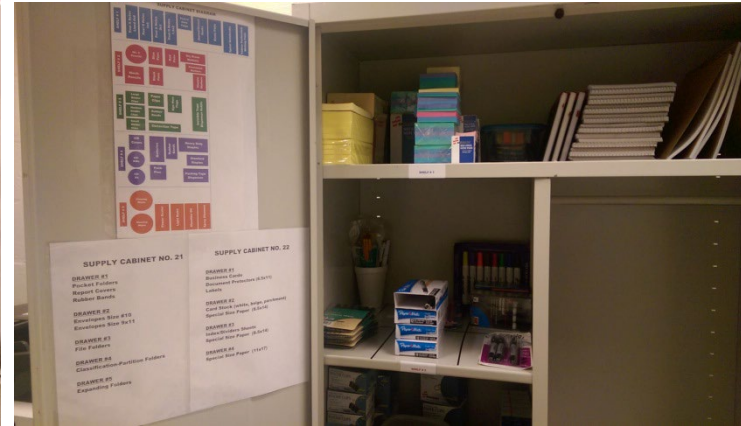
Operators claim a 50% improvement in overall efficiency



5S Example – G-7 Supply Cabinet



BEFORE



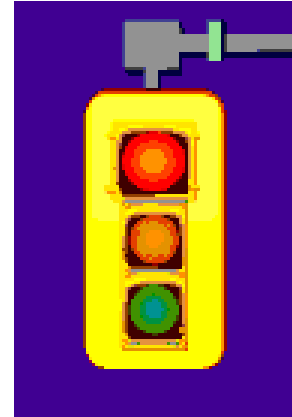
AFTER



What is a Visual Workplace?

When anyone can walk into a workplace and visually understand:

- The current situation.
- The work process.
- Ahead, behind or on schedule.
- When there is an abnormality.



Use signals, lights, diagrams, charts and signs to:

- Clearly **define** the **normal** condition or a **required action**.
- **Expose** the **abnormal** undesired condition in real time.

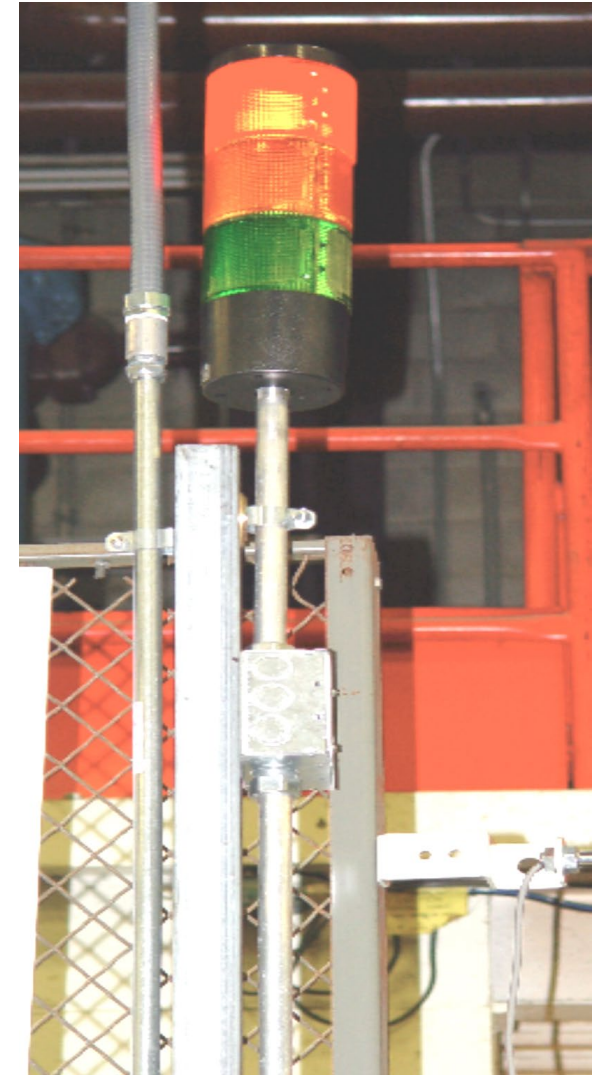


Examples of Visual Controls

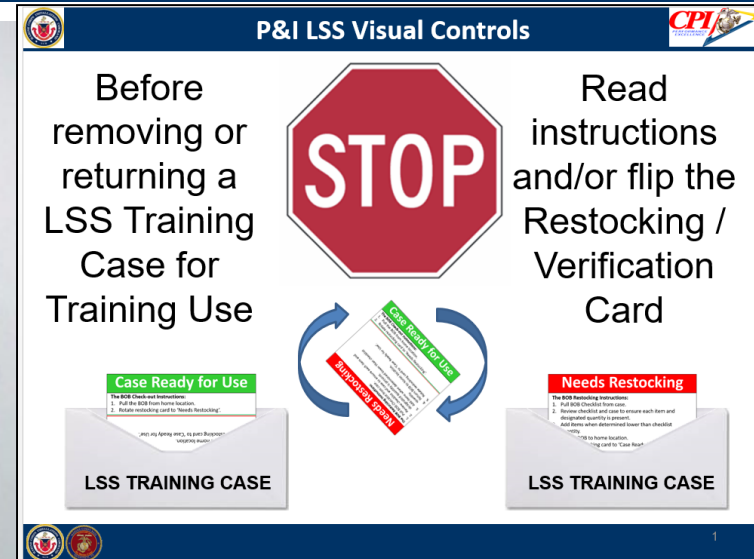
- Shadow boards for tools, supplies and safety equipment.
- Color coding such as Green / Yellow / Red.
- Lines on the floor that outline storage areas, walk ways, work areas, etc.
- Marks to indicate correct machine settings.
- Standard work instructions, standard operating procedures (SOPs).
- Kanbans to control production.



Visual Controls



Visual Controls - Example



Needs Restocking

The BOB Restocking Instructions:

1. Pull BOB Checklist from case.
2. Review checklist and case to ensure each item and designated quantity is present.
3. Add items when determined lower than checklist quantity.
4. Return BOB to home location.
5. Rotate restocking card to 'Case Ready for Use'.

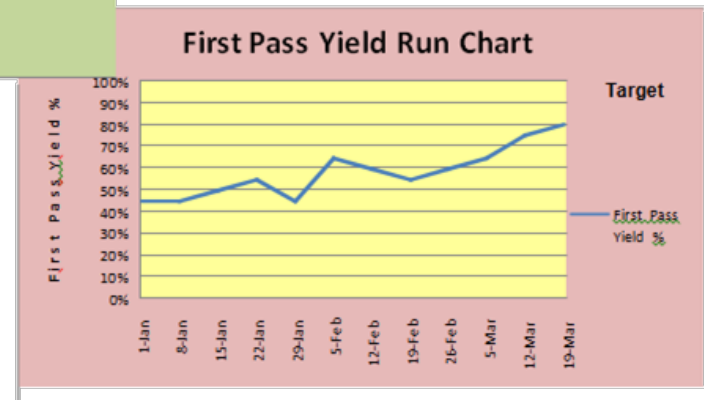
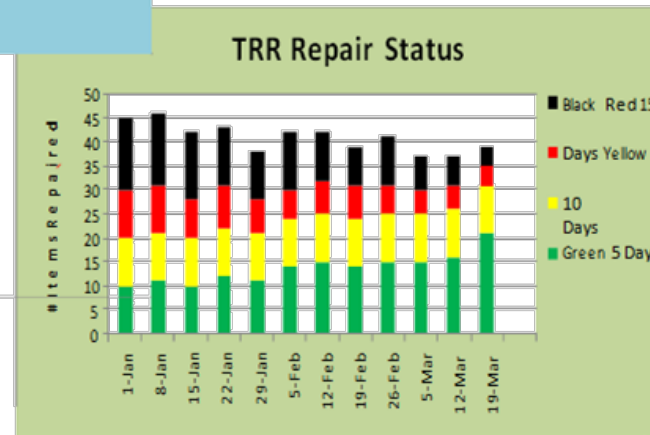
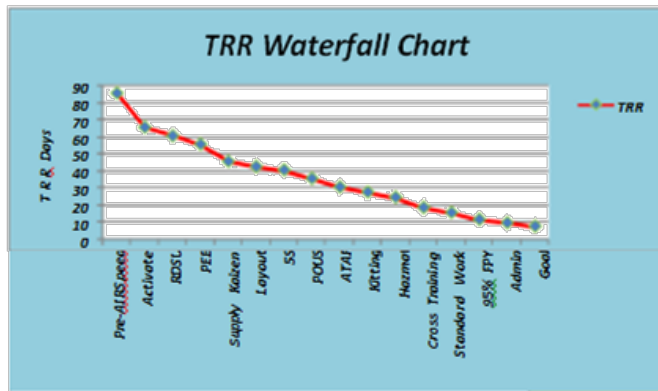
The BOB Check-out Instructions:

1. Pull the BOB from home location.
2. Rotate restocking card to 'Needs Restocking'.

Case Ready for Use

5 seconds or less – what is out of place and missing?

Examples of Visual Controls – Management Reports



Visual Controls – Final Thoughts

A signal that does not come on is meaningless.



- Must come on to identify & expose waste or a required action.

The number of times that a signal goes on is not important, but how long it takes for the signal to go off, is!

Standard Work

- To choose out of the best method and use it.
- Today's standardization, instead of being a barricade against improvement, is the **necessary foundation** on which tomorrow's improvement will be based.
- Standard Work **eliminates the possibility** to do anything but follow established best practices.

“If you think of ‘standardization’ as the best that you know today, but which is to be improved tomorrow, you get somewhere. But if you think of standards as confining, then progress stops.”

– Henry Ford



What is meant by “Standard Work”?

The principles, tools, and techniques used to ensure process standardization in a JIT environment.

- Developed by the people who do the work.
- Focused on efficient use of resources through waste elimination.
- Establishes the foundation for CPI.

**“Where there is no Standard, there can be no Kaizen.”
– Taiichi Ohno**



Why Standard Work Is Important?

➤ Lowens Process Time

Reduces variation - Work is performed the same way every time.

Decreases learning curve for rotating workforce.

Reduces waste (More time is spent performing)

Supply knows what to Supply and when.

➤ Critical in guaranteeing success every day.

➤ Increases quality and first-pass yield.

➤ Critical for effective Point of Use System (POUS) & 5S.



Standard Work Instructions

EXAMPLE:

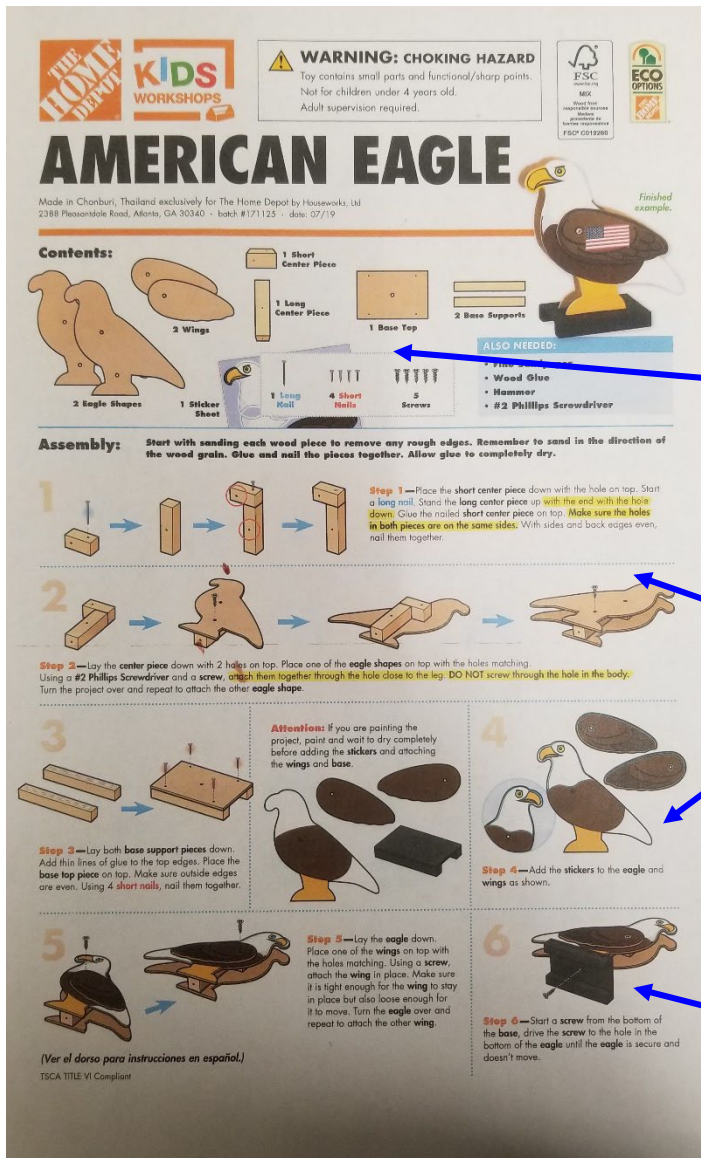
American Eagle Kit Instructions

Kits Include:

Parts needed to complete the build

Step by Step Instructions on how to assemble with visual aids

A final picture with it assembled



Standard Work Example

LSS Green Belt Training Set-Up – Standard Work

Preparation

- Review Checklists
- Collect & Stage Supplies / Equip.
- Load & Transport to Training Site

Set-up (Daily)

- Furniture Layout
- Hook-up Computer & Projector (Cable & Exercise Bag) – First Day Only
- Layout Name Tents & Terminology Sheets
- Tape (Painters) signs on entry doors

Set-up (Cont)

- Tape Door Lock (VEC)
- Create (or Rehang) Training Sign
- Prep Training Roster

Set-up (Future)

- Exercise Prep

Lean Six Sigma Green Belt Training Exercises - Standard Work Instructions

WHAT IS GOOD POSTURE?

UC DAVIS OCCUPATIONAL HEALTH SERVICES

Head upright and over your shoulders
Eyes looking slight downward without bending from the neck
Backrest should support the natural curve of the lower back
Elbows bent at 90°, forearms horizontal
Shoulders should be relaxed, not raised
Thighs horizontal with a 90°-110° angle at the hip
Feet supported and flat on the floor
If this isn't possible, then feet should be fully supported by a foot rest

Statapult Simulation Round 1 – Standard Work

Preparation

- Determine Number of Groups.
- Stage Training Aides (Statapult & Handout Case).
- Rearrange training space (tables).

Preparation (Continued)

- Layout Supplies.
- Prepare Handouts (Round 1).

Execution

- Review Slides.
- Conduct Baseline Shoot (10 Minutes).
- Review Example Process Layout.
- Distribute Round 1 Handouts.
- Allow 5 Minutes to Learn Roles.
- Start Simulation (Approx. 30 Minutes).
- Record Data on Data Collection Sheets.
- Clean-up.
- Input Data into Statapult Excel Spreadsheet.
- Review Summary Data.

Lean Six Sigma Green Belt Training Exercises - Standard Work Instructions

Standard Work Combination Table

Systems2win

Process	Process Name or Part #	Version	Effective Date	Expiration Date	Comments & Ideas
1	A. Can Load cutting machine	1	1	4	
2	A. Can Load cutting machine to finish	1	1	4	
3	A. Can Load	1	1	4	
4	A. Mirror Unload last cycle & load next	1	1	4	
5	B. Bend tube Unload last cycle, load	1	1	4	
6	B. Bend tube	1	1	4	
7	C. Paint & dry	1	1	4	
8	E. Assemble	1	1	4	
9	F. Package	1	1	4	
10	Walk back to start over	1	1	4	
11	Operator Grand Total	1	1	4	

Work Instruction Comments

Step 1. Although you can use word wrap, you might not want to - because when you paste this data to the Standard Work Combination Chart (B-C), your next work step up with the row on the chart and you won't have word wrap.

Options for how to handle long Work Elements or Comments

Option 1) Use word wrap for printing instructions without the chart, and then change the cells to not word wrap when printing the chart.

Option 2) Highlight the cells - then select Format > Cells > Alignment tab, and uncheck the box for "Wrap Text". Then highlight the entire rows containing the (too long wrapped) text, and select Format > Rows > AutoFit Rows.

Option 3) Rather than wrapping long text above, refer to long comments in their Work Instructions - Comments section - referencing the appropriate Sequence Number and/or Work Element description.

Tip: Standard Work Instructions should be:

- Concise
- Useful brief reminders for experienced operators

Standard Work Instructions should NOT be:

- A replacement for a Work Standards Sheet - which defines in detail how to build a product according to engineering specifications.
- A replacement for a Job Instruction Sheet - which is used to train new operators. The Job Instruction

Automatically draws time chart!

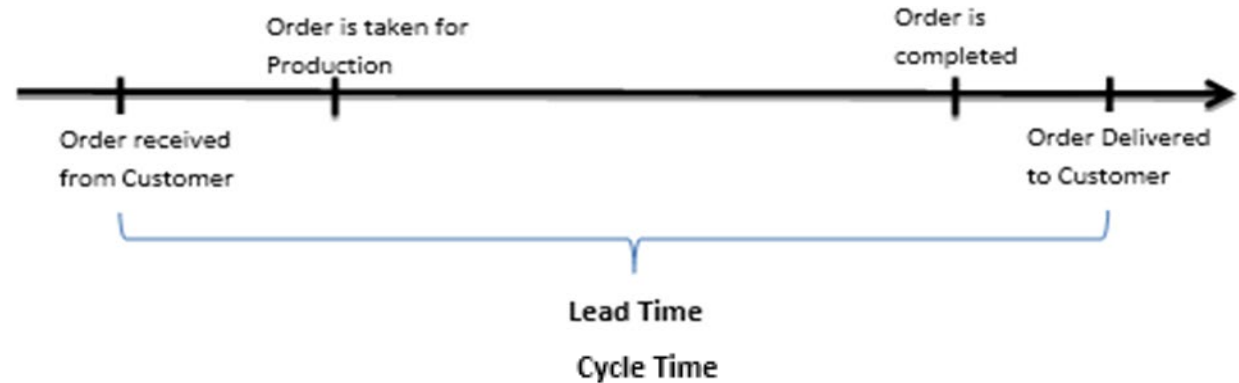
Adjust column width of this column to adjust width of chart (This box doesn't print)

Related documents:

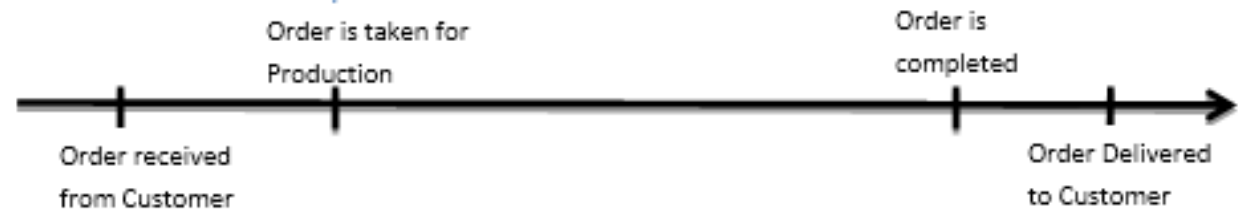
Layout Diagram for Sample Process - After - 3a

Time Components of Standard Work

Lead Time =



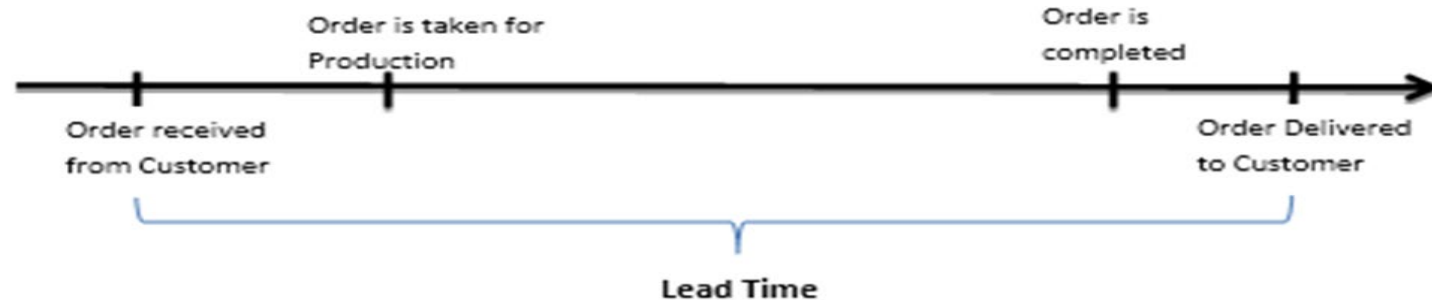
Cycle Time =



Takt Time =



Lead Time



- The time required to complete an entire process (including wait times) from order to delivery.
- Can be measured or estimated.

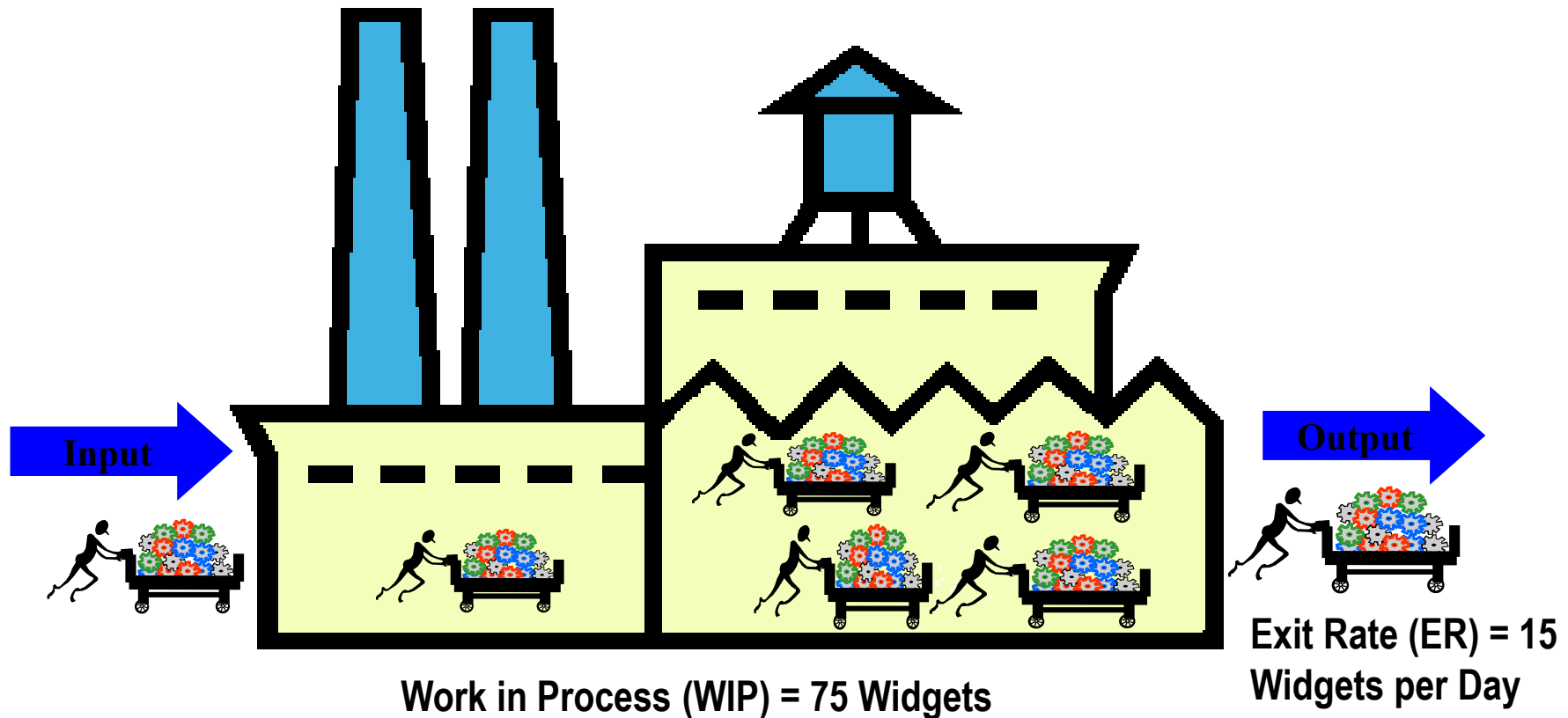
Examples:

- Time to produce an item.
- Time to complete an approval process.
- Time to complete a report.



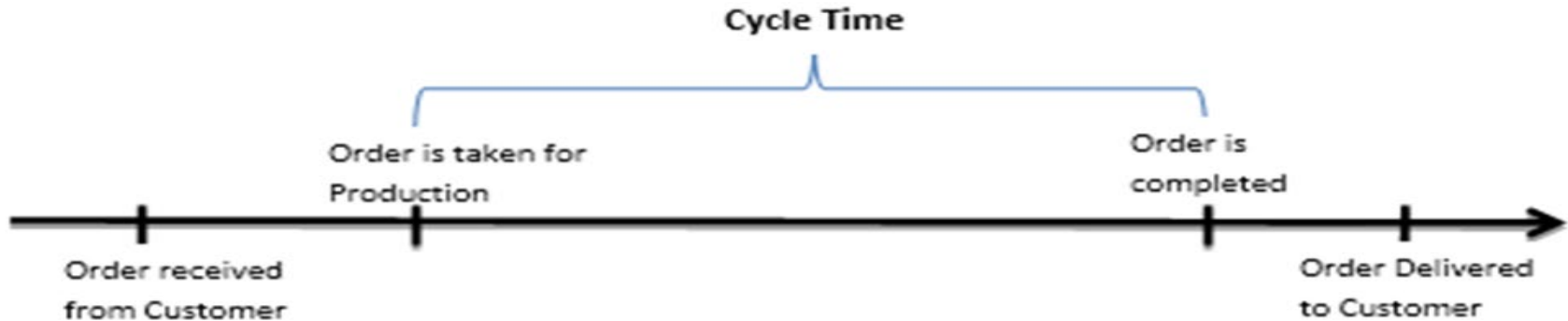
Lead Time Estimation

Little's Law Example



$$\text{LeadTime} = \frac{\text{Work In Process (WIP)}}{\text{Exit Rate (ER)}} = \frac{75}{15} = 5 \text{ days}$$

Cycle Time



- The time it takes a product to move (cycle) through a step or a process, including queue and move times.

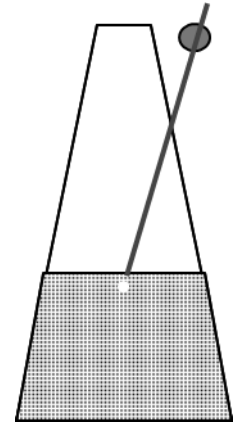
Example

- The time from when the order is taken for production to when the order is completed.

Takt Time

The rate at which a product or service needs to be provided to meet customer demand.

$$\text{Takt Time} = \frac{\text{Time Available}}{\text{Customer Demand}}$$



Takt Time

- 250 Available Workdays per Year.
 - (assuming 5-day work week)
- Customer requires 30 Units per Year.

$$\text{Takt Time} = \frac{(250 \text{ days})}{(30 \text{ Units})}$$

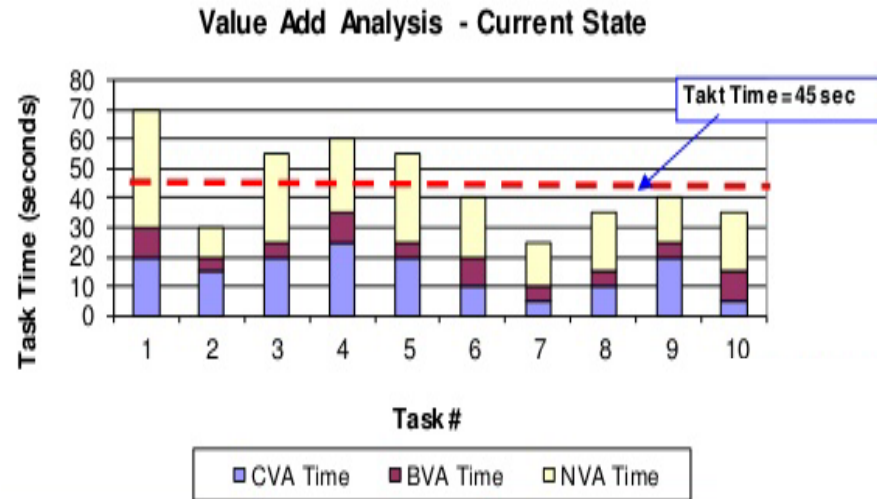
$$\text{Takt Time} = 8.3 \text{ days per Unit}$$

- With a Takt Time of 8.3 days, you must induct and sell a unit every 8.3 workdays in order to meet the Customers annual demands.



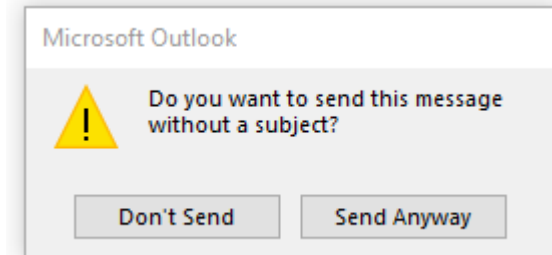
Workload Balancing

- Workload Balancing is the balancing of a process between several staff positions.
- Cycle Time must be less than or equal to Takt Time.
- Wait Time is commonly added to Standard Work to synchronize sub-jobs across staff positions.



Mistake Proofing

Remove before flight



“Anything that can go wrong, will go wrong!”
That is why we need mistake-proofing.

What is Mistake Proofing?

**“You will become clever through your mistakes”
– German Proverb**

- Technique to prevent mistakes before they create defects.
 - Devices which prevent mistakes from happening.
 - Methods to prevent errors and to detect errors quickly if they occur.
- Less expensive than the cost of rework.
- Based on simplicity and ingenuity.



Everyday Examples



Why is Mistake Proofing important?

- Enables continuous work flow & reduces cycle time
- Builds quality into the process, reducing the number of in-process inspection interruptions.
- **Is a critical element of perfecting standard work.**
- Enables quick detection of defects to prevent passing to the next process or customer.
- **Reduces defects which reduces operating expenses.**

Accept no defects, make no defects, pass no defects!



Piloting

- Piloting helps us understand the impacts of changes to the process.
 - Select your improvements and prioritize them.
 - If jobs are re-assigned make sure everyone understands their new role.
 - Use the pilot to ensure you have identified the root cause of the problem(s).

Prove Your
Project with
a Pilot



Benefits of Lean

- ✓ Work Smarter; **not Harder.**
- ✓ Reduces costs by:
 - Reducing delivery time, cycle time, set-up time.
 - Eliminating waste.
 - Seeking continuous improvement.
- ✓ Improves quality.
- ✓ Increases overall customer satisfaction.
- ✓ Improves employee morale and working environment.



What questions do you have so far?



Control Phase



Control Phase

Objectives:

- Establish control plan.
- Verify improvements.
- Transition project to process owner.



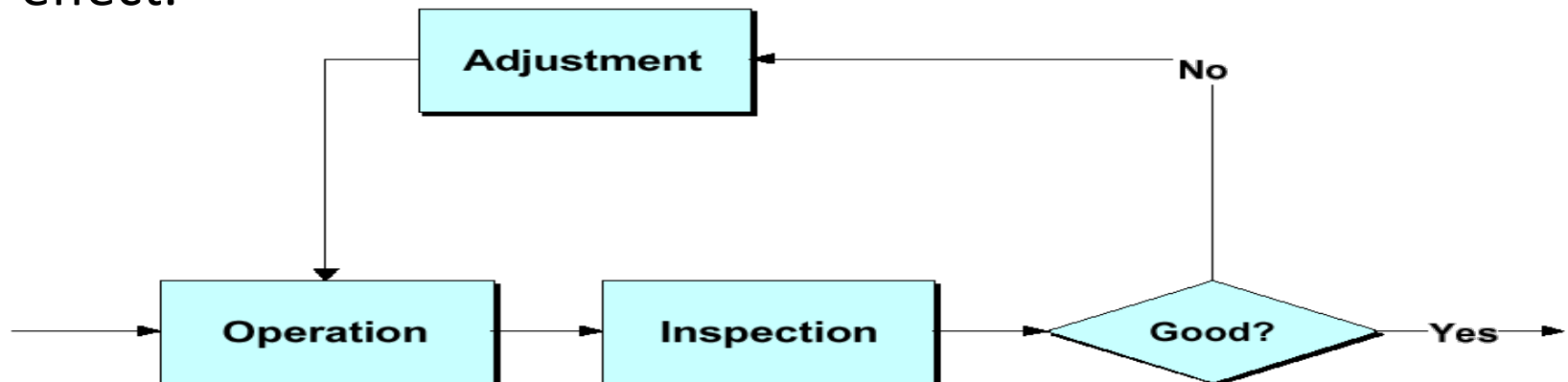
Activities:

- Identify replication opportunities.
- Update Standard Work Instructions.
- Integrate lessons learned.
- Integrate and Manage solutions in daily work processes.
- Prepare a project transition plan and management review.
- Celebrate your success.



Control Plan

- Control Plans create a structured approach for control of process and product characteristics important to the customer.
- **Control Plans assure well thought-out reactions are in place if an out of control condition occurs.**
- They provide a method for documentation and communication of control methods.
- **Control Plans must be living documents.**
- Control Lag is the time from Operation to Adjustment taking effect.



Feedback Sessions & Turnover Plan

Feedback Sessions provide teams with opportunity to reflect on the success of the project/event.

- What Worked?
- What Didn't Work?
- What can be Capitalized?

Project Turnover Plan

- This where you develop and document the turnover of the project.
- The Project will be turned over to the Process Owner.



Complete Report Out

Complete a Project Financial Metrics Worksheet

- Project / Event Savings
 - Labor Saved / Avoided (in \$).
 - Material Saved / Avoided (in \$).
 - Space Saved (in Sq. Ft.).
 - Etc.
- Project / Event Costs and Benefits
 - Cost of Manpower for Project / Event (in \$).
 - Return on Investment (ROI).



What questions do you have so far?



Yellow Belt Training Wrapup



Vision

Use CPI tools to:

- Achieve Cost Wise Readiness.
- Ensure that products are “Ready For Tasking”.
- Improve Quality of your product / service.
- Improve your work environment and increase morale.
- Increase customer satisfaction.

Work Smarter, not Harder!



Keys to Success

- **Employee Involvement**
- Clearly defined Command goals
- Stable deployment Teams
 - Teams have been proven to be most effective in the deployment and sustainment of gains in CPI projects.
- **Identify & Empower Champions**
 - Use and reward motivated people, then follow through.
- **Visual tools**
 - Strive to have visual tools that make it easy to see and understand the process, what the current status is, and any abnormalities.
- **Atmosphere of Experimentation**
 - Tolerate mistakes, demonstrate patience, etc.



Take-Aways

CPI is all about reducing our cost of doing business by increasing Productivity and Quality.

CPI concepts are well-proven, fully demonstrated and exemplify **“World Class”** business concepts.

YOU Can Make a Difference !!!!!



Module Summary

- Reviewed the five phases of the DMAIC framework and the objectives, tasks & deliverables for each phase.
- Reviewed the basic principles of Lean Thinking (Value, Value Stream, Flow, Pull, Perfection).
- Used the DMAIC framework to address process improvements.
- Applied some of the most commonly used Lean Six Sigma tools using DMAIC to improve the products and services.
- Prepared to participate on project and events as needed by their command or organization.



What We Have Covered: Course Goals

Advocated and promoted the need for a CPI culture within the Marine Corps.

Discussed the principles and methodology of Lean Six Sigma (LSS) / Continuous Process Improvement (CPI).

Discussed LSS tools and how they can be applied within a project / event and the workplace.

Defined the roles and responsibilities of being an effective team member.



Recap

- ✓ DMAIC
- ✓ Variation Types
- ✓ Root Cause Analysis
- ✓ Types of Improvement Opportunities
- ✓ 4 Purposes of CPI
- ✓ 8 Types of Waste
- ✓ 5S+1
- ✓ Takt Time



Additional Training Information

Military Students

The below training event codes (Table 77) replaced the Military Service School codes from (Table 02).

LX 3 LEAN SIX SIGMA - BLACK BELT

LE 3 LEAN SIX SIGMA - EXECUTIVE BELT

LG 3 LEAN SIX SIGMA - GREEN BELT

LY 3 LEAN SIX SIGMA - YELLOW BELT

