Lansing Community College

Course Cover Sheet

M-CAM Training Area:
☐CNC/Machining ☐Multi-Skilled Mechatronics ☒Production Operation ☐Welding/Fabrications

Program(s): Certified Production Technician

Course: Simulated Production Environment - Instructor Guide

Course Description:

The Simulated Production Environment consists of a tabletop conveyor system that is made up of five roller conveyor sections and two 90-degree corner conveyors. There are 11 active stations in the system where operators can work and there is one material delivery operator. The "product" being built on the line is a wooden car.

The Simulated Production Environment is an eight-hour course designed to simulate a vehicle assembly process and illustrates many of the lean manufacturing principles in action. Through this simulation, participants will understand how the principles of lean manufacturing work together.

Since learning takes place through several hands-on activities, participants must be able to stand for minimum periods of 45 – 60 minutes, perform repetitive hand motions for periods of 30 minutes or more, lift and carry 10 lb objects, lift and use hand powered tools.

This simulation requires a minimum of 7 participants and maximum of 12 participants.

Date Created: March, 2017

Employer/Industry Partner: various manufacturing companies in Mid-Michigan served by Lansing Community College.

Faculty Developer(s)/Instructional Designers(s): Jim Caplis/Ann Lapo

College Contact: Jill Doederlein
Phone: 517.483.9665
Email: doederj@lcc.edu

Additional Information/Comments: Developed to prepare potential workers more quickly to take on the work of manufacturing. Examples: assembly line design and workmanship, lean manufacturing measures, and continuous improvement. LCC partnered with a General Motors SME for direct input into course content.

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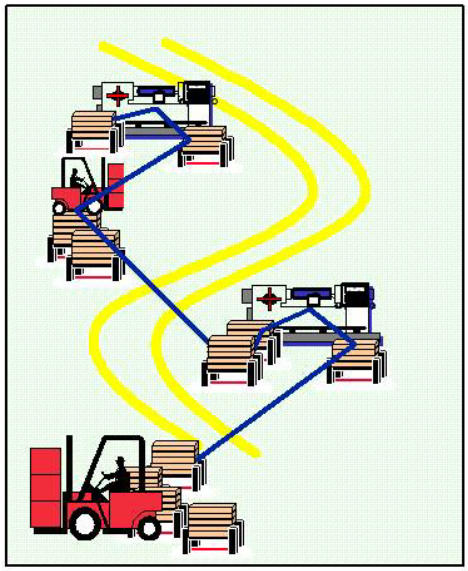
Seven Types of Waste

Transport

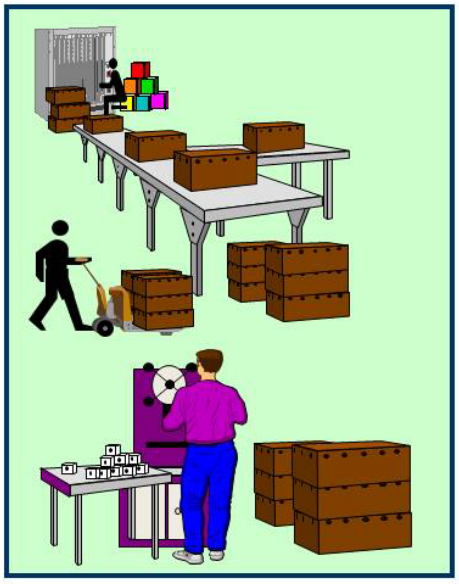
- Transport waste is material movement that is not directly associated with a value adding process
- Processes should be as close together as possible and material flow directly from process to process without any significant delays in between
- Excess transportation may be caused by :
  - Poor layouts
    - Large distance between operations
  - Lengthy, or complex material handling systems
  - Large batch sizes
  - Working to faster rate than customer demand (overproduction)
  - Multiple storage locations



Poor layout exacerbates transportation wastes

Inventory

- Inventory waste is stock and work in process in excess of the requirements necessary to produce goods or services 'just in time'
- Unnecessary inventory that accumulates before or after a process is an indication that continuous flow is not being achieved
- Excess inventory can be caused by;
  - Lack of balance in work flow, forcing inventory build-up between processes
  - Large batch sizes
  - Failure to observe first in first out – stagnant materials
  - Incapable processes
  - Long changeover time



Stock wastes space and effort

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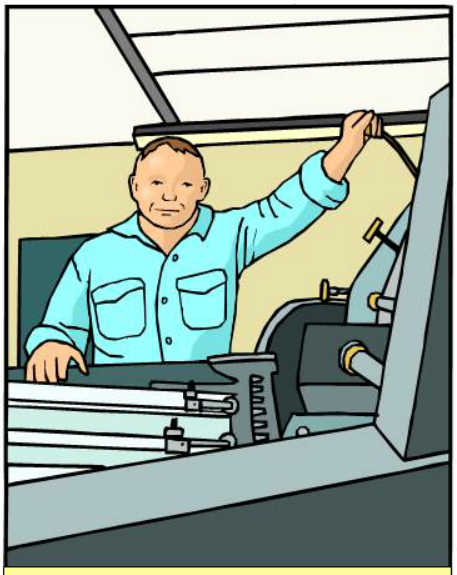
Motion

- Waste of motion is any motion of man and / or Equipment that does not add value to the product or service

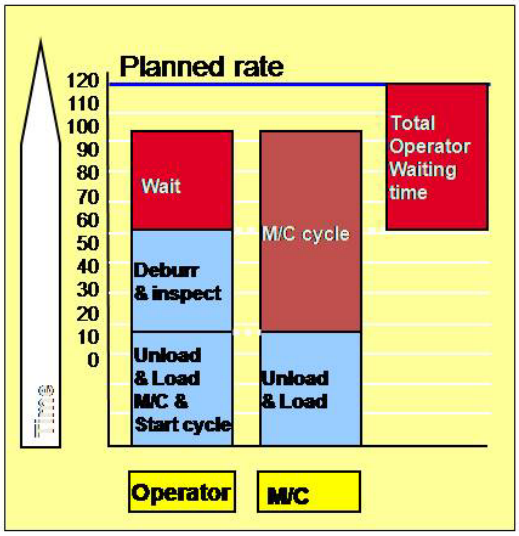
- Wasteful motion is caused by:
  - Poor workstation layout – excessive walking, bending reaching
  - Poor method design – transferring parts from one hand to another
  - Poor workplace organisation
  - Large batch sizes
  - Reorientation of materials



Work smarter not harder

Waiting

- Waste of waiting is any idle time produced when two interdependent processes are not completely synchronised
- Operators are kept waiting, or simply work slowly whilst the machining cycles
- Waiting results from:
  - Poor man / machine coordination
  - Long changeovers
  - Unreliable processes / quality
  - Batch completion, not single piece transfer between operations
  - Time required to perform rework



Waiting time results from failure to synchronise activities

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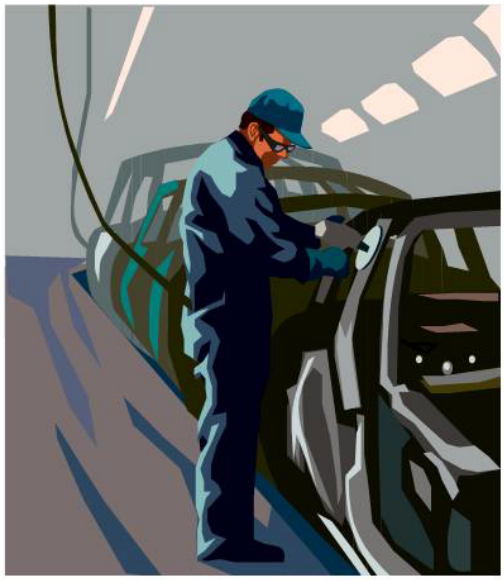
Overproduction

- Overproduction is the worst kind of waste because it causes other wastes and obscures the need for improvement
- Overproduction waste results from producing more (or faster) than required
- Overproduction is caused by
  - Large batch sizes
  - Unreliable processes
  - Unstable schedules
  - Unbalanced cells or departments
  - Working to forecast / inaccurate information not actual demand

Avoid overproduction by balancing supply to demand

Overprocessing

- Over processing is putting more into the product than is valued by the customer,
  - painting of unseen areas
  - unnecessarily tight tolerances
  - cleaning and polishing beyond the level required
- The goal is to do only the level of processing to match that which is useful and necessary
- Over-processing is caused by:
  - No standardisation of best techniques
  - Unclear specification / quality acceptance standards



Clear, standardised instructions avoid over-processing

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Defects

- Waste of correction includes additional work performed on a product or service
- Caused by no, or unclear operating procedure / specifications
- Defects are caused by
  - Inadequate training
  - Skills shortage
  - Incapable processes
  - Incapable suppliers
  - Operator error
  - Excessive stock
  - Transportation

Right first time avoids scrap & rework

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Simulated Production Environment

Facilitator: Jim Caplis

Lansing Community College

Business & Community Institute

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Agenda

1: Manufacturing processes throughout history and the effect of change
2: Lean manufacturing Leadership
3: Effective Job Training
4: Standardized Work
5: Practical Problem Solving
6: Workplace Organization and Visual Management
7: Process or Value Stream Mapping

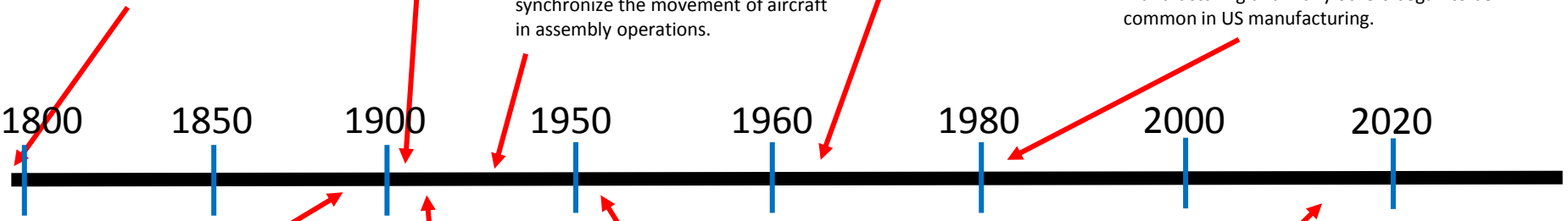
NOTE: There will be two 15-minute breaks and a 30-minute lunch during this 8-hour training.

The use of simulation equipment during a progression of four activities throughout the training helps to drive the concepts home to participants.

Craft, Mass, Lean Production

Category	Craft Production	Mass Production	Lean Production
System	One of	Push	Pull
Orders Management	Make to Order	Make to Assembly	Make to Order
Lots	One at a time	Two batches	Small lot
Takt Time	Very slow pace	Slow pace	Smooth pace
Technologies & Tools	Little Use of Technology	Heavy Use of Technology	Smart Use of Technology
Quality	Questionable quality	Poor quality	High quality
Inventory	No inventory	Large inventory	No inventory
Waste	Limited waste	Wasted resources	No waste
Rework	Necessary rework	Necessary rework	Continual Improvement
Productivity	Low productivity	Low productivity	High productivity
Leadership	Self-Leadership Style	Authoritarian Style	Collaborative Style
Motivation	Some Motivation	Poor Motivation	High Motivation
Group Dynamics	Individualistic Behavior	Individualistic Behavior	Team work

The Evolution of Lean Manufacturing



1799

Automatic Production of Simple Parts: Eli Whitney, inventor of the cotton gin was the first to use the concept of interchangeable parts.

1890s

Scientific Management
Frederick Taylor analyzes work in search of the one best way to do every job.

1902

Jidoka - Sakichi Toyoda invents a device to detect broken threads in looms.

1908

Truly Interchangeable Parts
Henry Ford introduces a standard gauging system used throughout his plant and by every supplier.

1930s

Takt Time German aircraft-industry pioneers use takt time as a way to synchronize the movement of aircraft in assembly operations.

1950s

Kanban and Supermarkets Taichi Ohno develops practical methods to implement Kiichiro Toyoda's concept for just-in-time delivery of parts.

1965

Mass Production Management
Alfred Sloan introduces the manage-by-metrics system he developed at General Motors

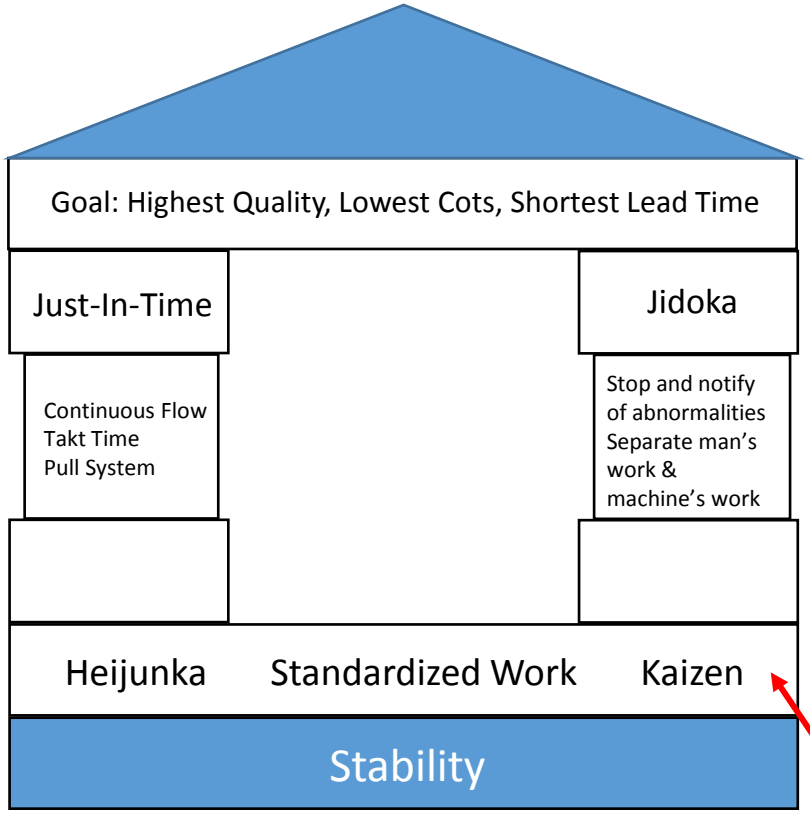
1980's

New terms such as World Class Manufacturing, Stockless Production, Continuous Flow Manufacturing and many others began to be common in US manufacturing.

2010's – 2020's

How does Lean evolve?

Toyota Production System "House"



JIDOKA
Synonym(s): *Autonomation*
Providing machines and operators the ability to detect when an abnormal condition has occurred and immediately stop work

HEIJUNKA
Leveling the type and quantity of production over a fixed period of time.

KAIZEN
Kaizen is the practice of continuous improvement.

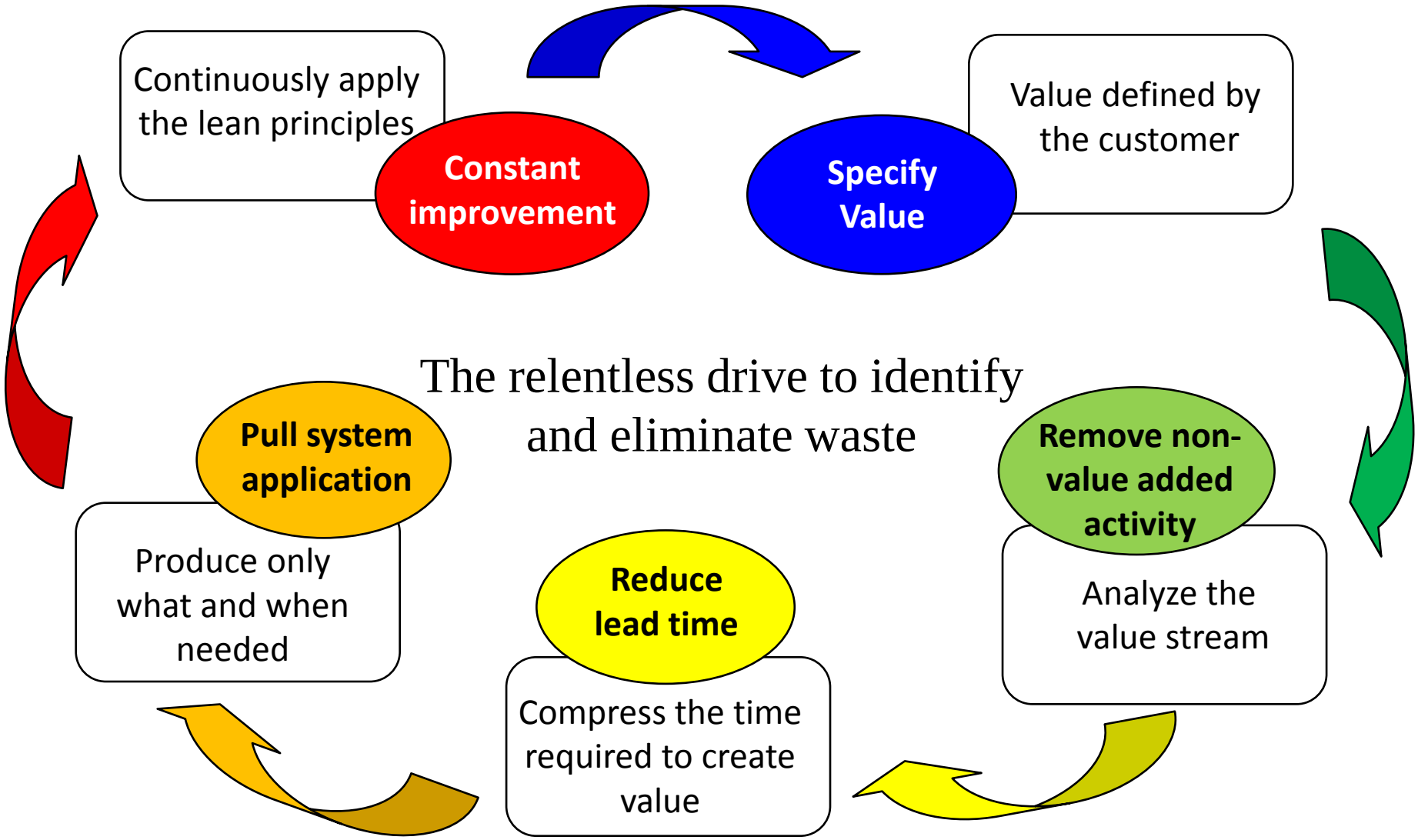
Lean Manufacturing Definition

Lean manufacturing, Lean production, "**lean**“:

is a systematic method for the elimination of waste ("Muda") within a **manufacturing** system.

Lean also takes into account waste created through overburden ("Muri") and waste created through unevenness in work loads ("Mura").

Lean Manufacturing Process

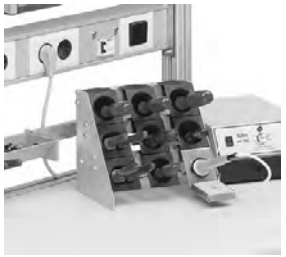


Lean Manufacturing Principles

Continuous Flow

Lean Machines / Simplicity

Workplace Organization



Parts Presentation

Reconfigurability

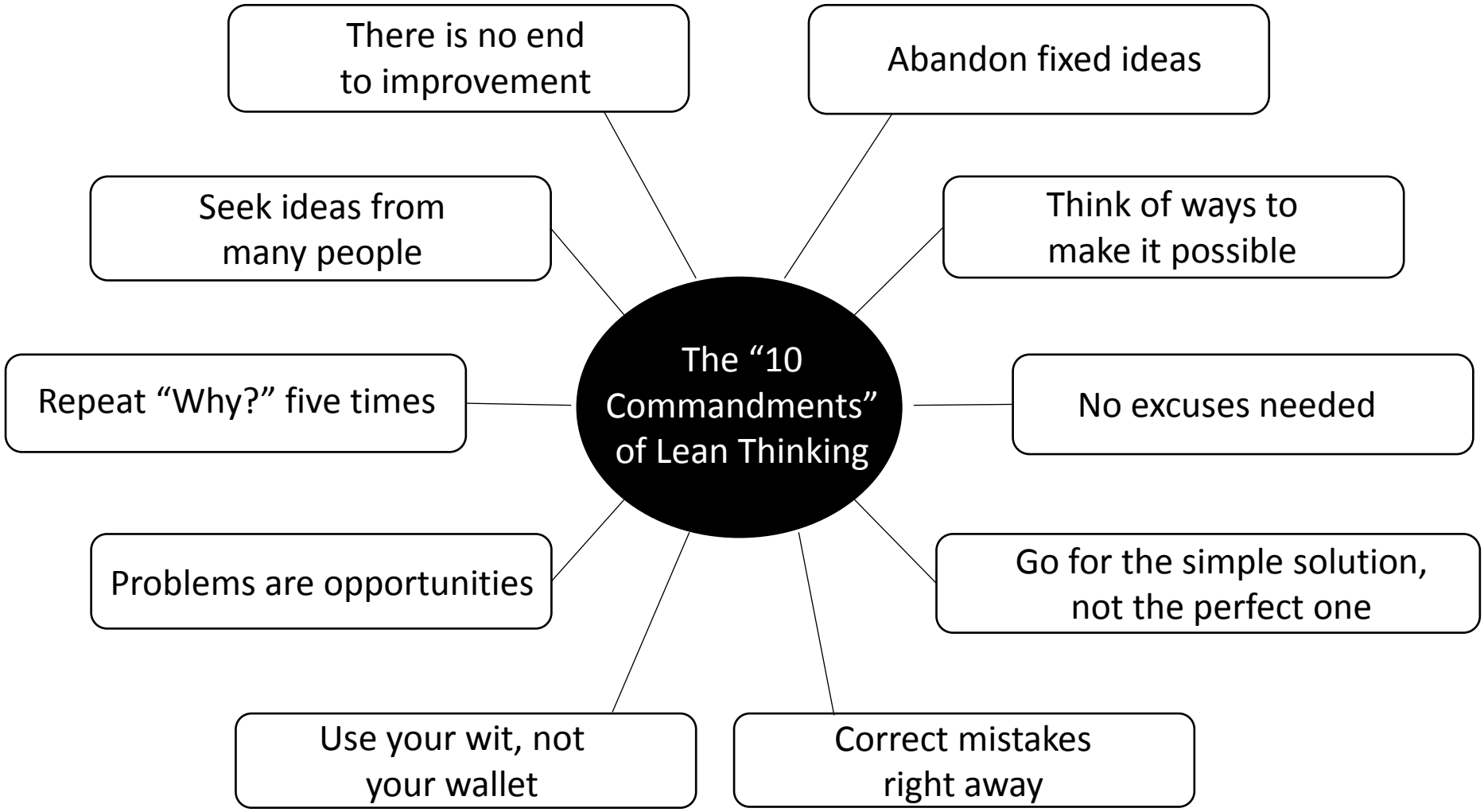
Product Quality

Maintainability

Ease of Access

Ergonomics

The Lean Thinking Commandments



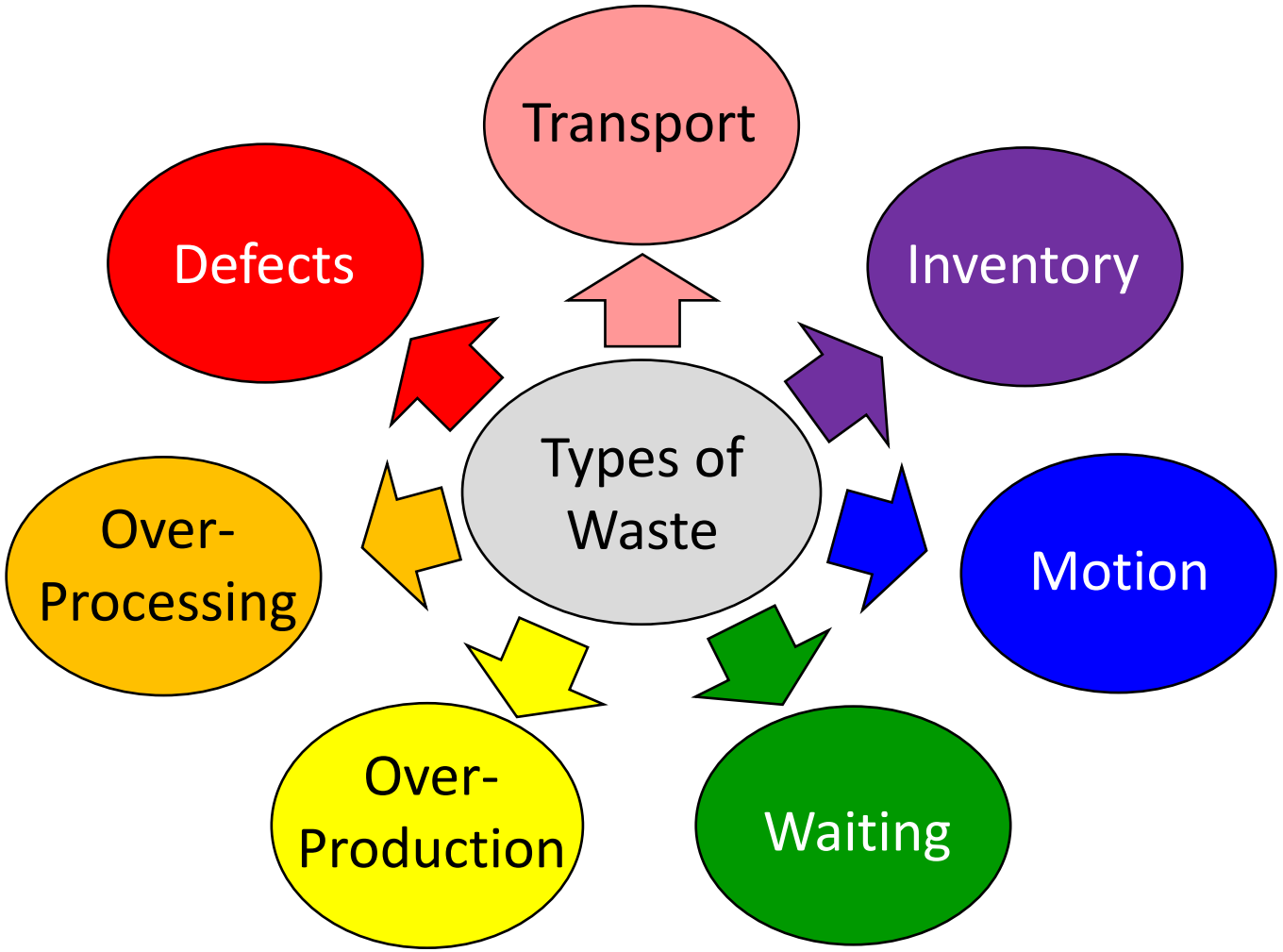
Definition of Waste

"Anything other than the minimum amount of equipment, materials, parts, and working time absolutely essential to production."

Every activity should be considered as waste, unless it:

- Meets an explicit customer requirement
- Cannot be shown to be performed more economically

Seven Types of Waste – "TIM WOOD"



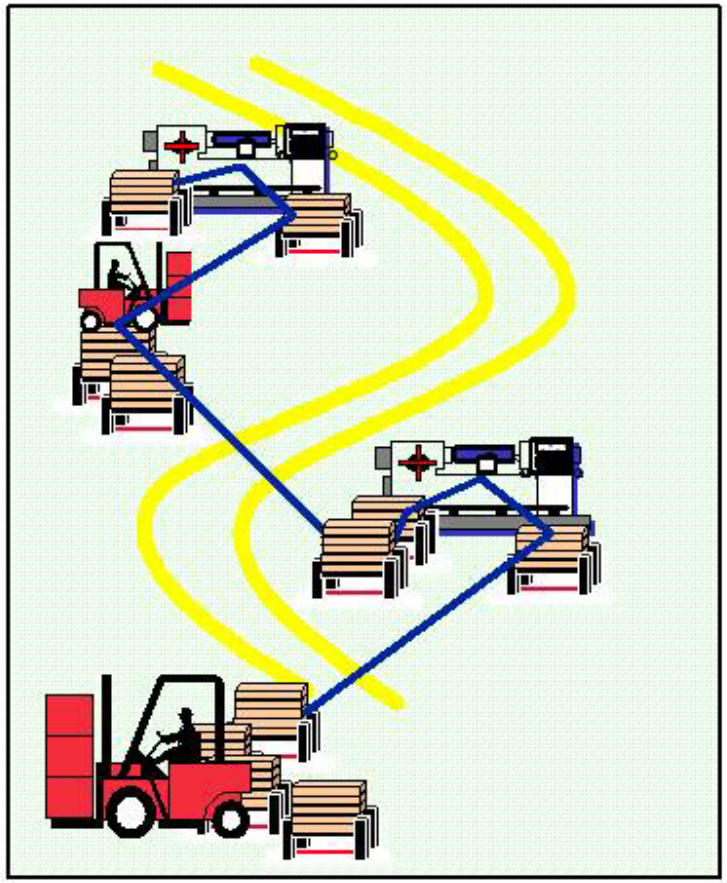
Additional Wastes

- Creativity

- Resources

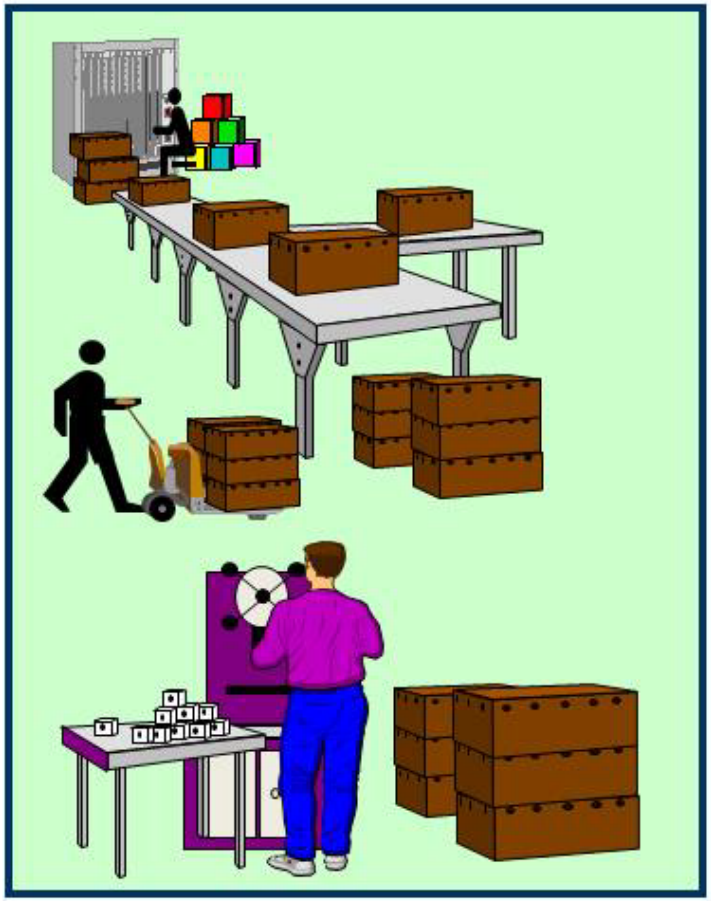
- By products

Transport



Poor layout exacerbates transportation wastes

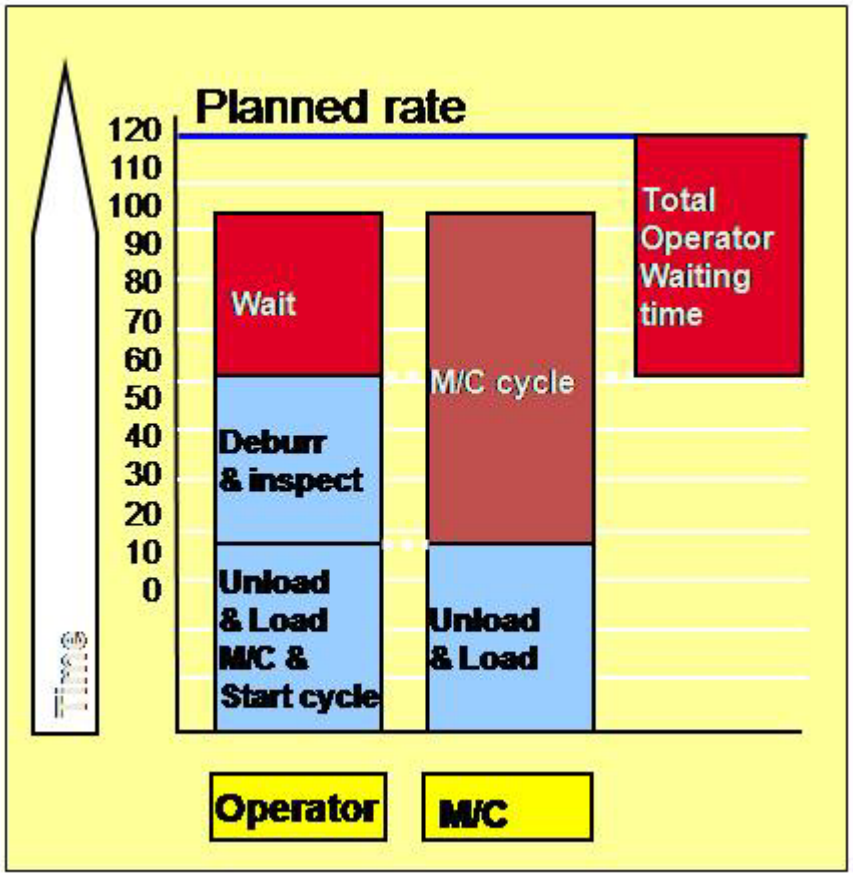
Inventory



Stock wastes space and effort

Motion

Waiting

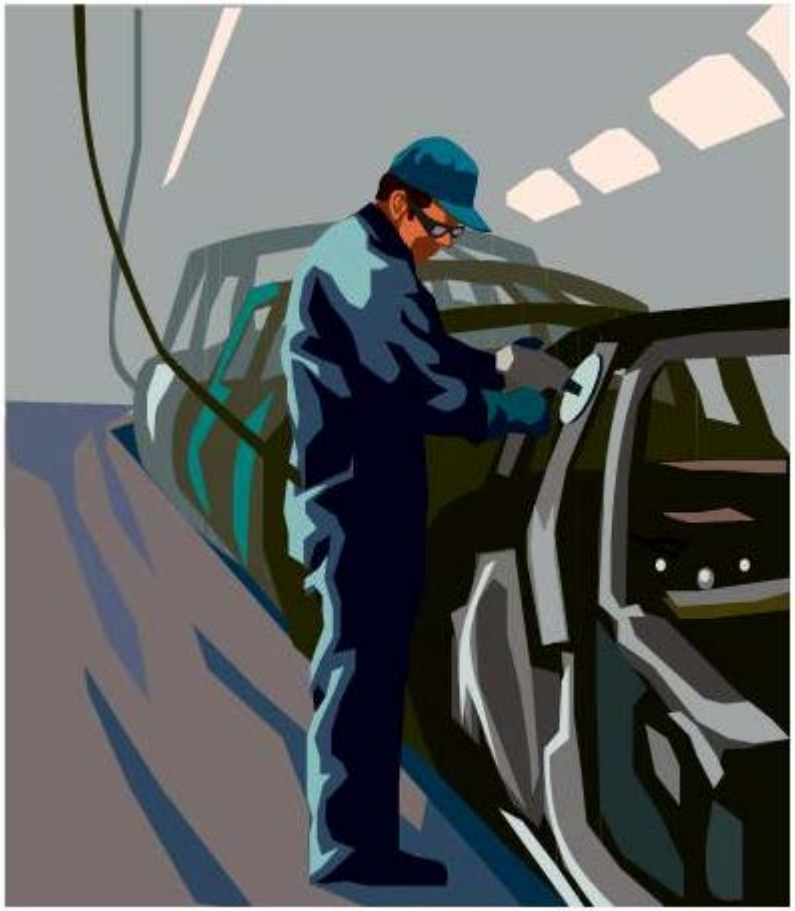


Waiting time results from failure to synchronize activities.

Overproduction

Avoid overproduction by balancing supply to demand

Overprocessing



Clear, standardized instructions avoid over-processing.

Defects

Right first time avoids scrap & rework

Why Change to Lean?

- Will lead any company to greater cost reductions and efficiencies improvements.
- Implemented correctly, companies can realize double-digit cost improvements
- Material Handling/Scheduling/Production Control areas can expect:
  - Significant reduction of inventory levels
  - Elimination of down time due to parts shortages
  - Quicker response times to Customer requirements
  - Achievement 100% on time deliveries
  - Reduction of storage space
  - Better Material and Information Flow
- Manufacturing / Operations areas can expect:
  - Higher production output and increased equipment uptime
  - Improved quality, less scrap
  - Better utilization of floor space and improved work cell efficiency
  - Reduced downtime due to changeovers and machine set ups
  - Safer work environment

Resistance to Lean Change

- Change is a major component of any type of improvement effort, and it is also one of the biggest obstacles.
- There is a strong resistance to change for many people, and it can make them fight hard to keep the status quo.
- Even when the change is going to benefit those who are most effected, they will often be hesitant to embrace it.

<u>Efforts to minimize resistance</u>

- Give plenty of notice
- Announce changes individually
- Understand the emotions
- Solicit feedback
- Don't deny the problems

- Change is going to be hard and no matter what you do, there will be some resistance to the change.
- When implementing a lean strategy for a facility, there is a need to put in the effort required to help everyone get on board with the important changes that need to happen for the improvement of the facility.

Job Instruction Training Form Example

Job Instruction Training (JIT) & Certification

Date Started: _____ Team Member (T/M): _____

Date Completed: _____ Team: _____ Shift: _____

Job: _____ _____ _____ _____ _____ _____

Step 1 - Preparation

A. Review the SOS

-Explain scope of work by reading the SOS elements so the new T/M has an understanding of the major elements (not key points or CVIS) for 2-5 cycles.

B. Review Workstation Board Documentation and Other Information

-Ensure appropriate personal protective equipment is worn by the T/M

-Review procedures and importance of PMP Daily Check Log tasks, Job Rotation Log requirements, and 1 Takt Quality Check Sheet requirements.

-Review the Operator Readiness Document(s).

***** -Review Material Flow process, Error Proofing, Andon, FPS and defect docs.

Step 2 - Observation

C. Review the Job Element Sheets

-Explain the JESs so the new T/M has an understanding of the standardized work with key points and CVISs for 2 to 5 cycles.

***** -Allow for in-depth observation of the JESs so the new T/M has an understanding of the standardized work sequence (including key points,CVIS and CQEP) for ½ to 1 hour.

-Review all Safety Key points and Safety/Quality history on back of JES

-Review all Options. Explain to TM that they might not see all options during training and instruct them to pull the andon for assistance.

D. Demonstrate the job

-Communicate, demonstrate, and explain One Major Step at a time. 1 cycle

-Stress each Key Point. 1 cycle

-Explain the Reasons why. 1 cycle

*****-Have T/M communicate, demonstrate, and explain major steps, key points, reasons why ("song and dance"). 2 cycles

Team Member

Sign _____ _____ _____ _____ _____ _____ ← ***Team Member signature required for each job certified***

Date _____ _____ _____ _____ _____ _____ *(T/M signoff that these steps were used by trainer to certify)*

Trainer

Sign _____ _____ _____ _____ _____ _____ ← ***Trainer signature required for each job certified***

(Trainer signoff that these steps were fully completed by team member)

Step 3 - Try-out

E. Start performing job elements

-Select the 1st set of elements that the T/M will perform (should not exceed 50% of the total cycle time). Initial elements could be the first few JESs of the job or they could be the difficult elements to master that require a learned technique

F. Continue performing job elements

-Select new elements (25% increases). Repeat until all elements are understood and performed in the proper sequence.

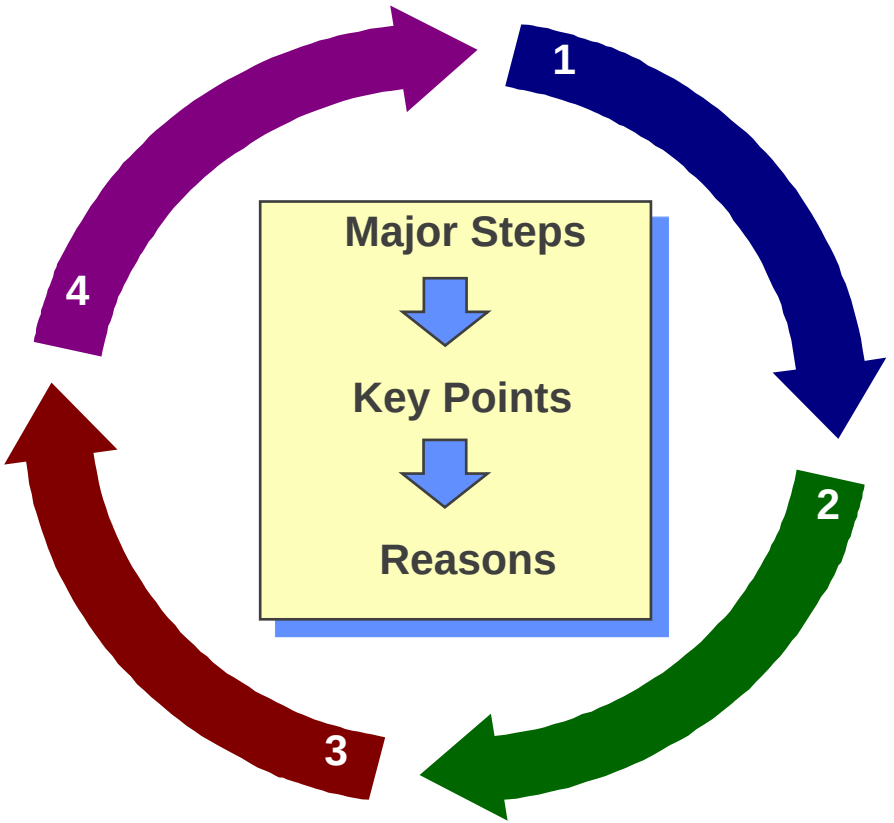
G. Explain Steps

-Have trainee explain each Major Step as they do the job

-Have trainee explain each Key Point as they do the job

-Have trainee explain each Reason Why as they do the job

Job Training



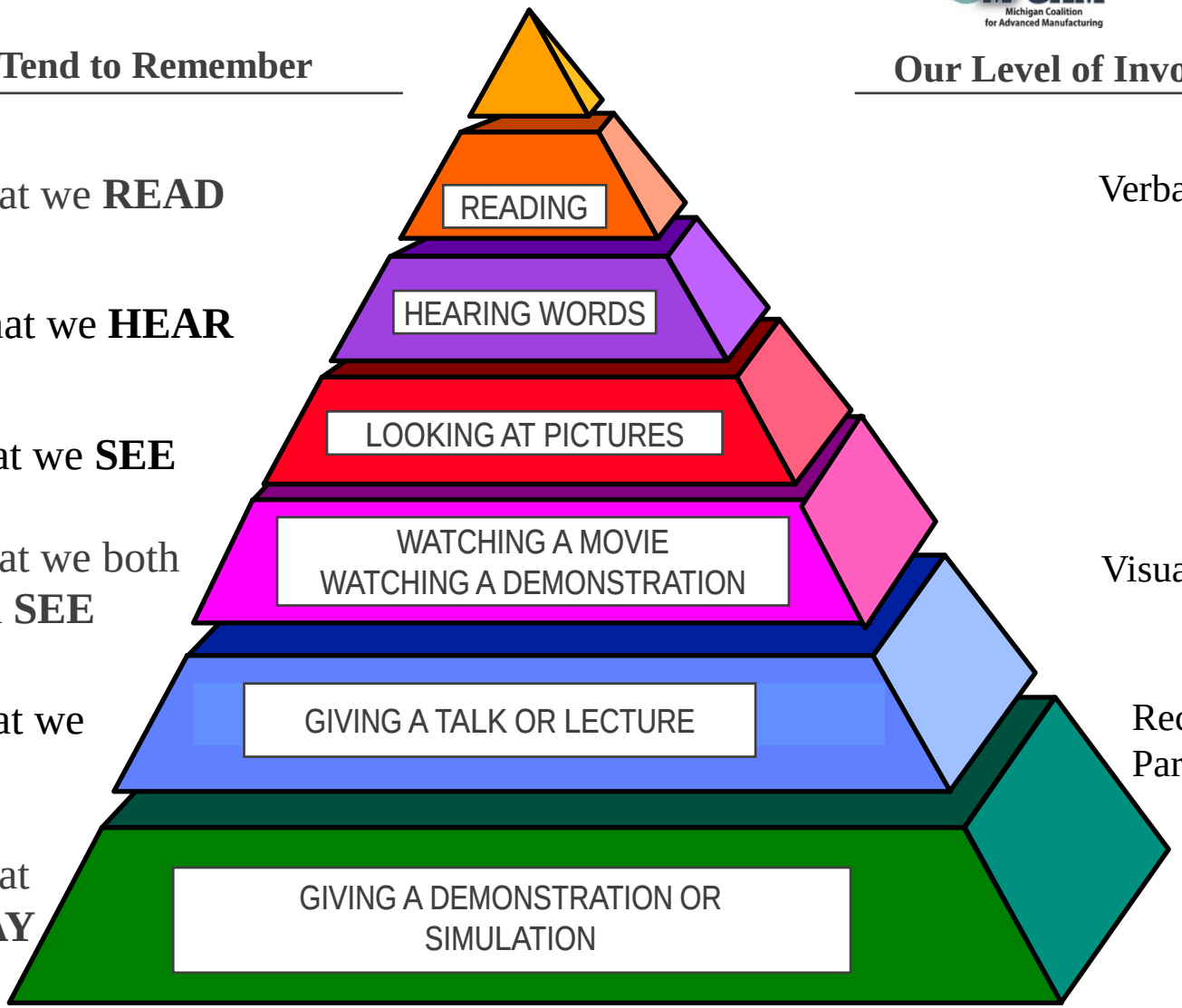
Purpose

To ensure that Team Members are adequately trained to work safely, follow standardized work, meet all quality and productivity requirements

How We Learn

How Much We Tend to Remember

- 10% of what we **READ**
- 20 % of what we **HEAR**
- 30% of what we **SEE**
- 50% of what we both **HEAR** and **SEE**
- 70% of what we **SAY**
- 90% of what we both **SAY** and **DO**



Our Level of Involvement

Verbal receiving

PASSIVE

Visual receiving

Receiving and Participating

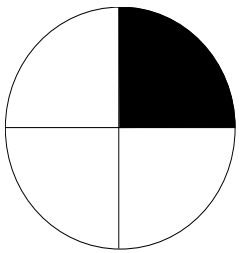
ACTIVE

Doing

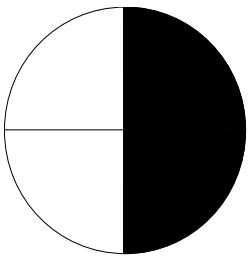
Goals of Job Training

- Formalize the method of job training
- Have the trainers and team members speak or vocalize their actions and movements as they are doing or demonstrating the job.
- Insure understanding and give two-way feedback to the trainer and the team members that the entire message is received.

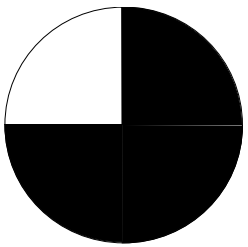
Explanation of Legend (Harvey Ball)



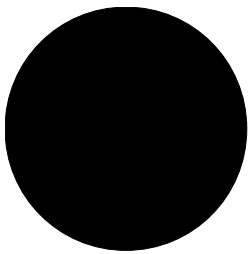
= Knows Steps (in Training)



= Can Perform Job to Quality and Safety but not in Takt Time



= Can Perform Job to Quality, Safety and Takt Time Without Supervision



= Can Train to Job Instruction Standard

When documenting the training process, use the circle legend as a guide to accomplish that task.
The circle is read clockwise, starting in the upper right quadrant.
This slide gives you standard definitions of the quadrants.

Job Training Form Example

Job Instruction Training (JIT) & Certification

Date Started: _____ Team Member (T/M): _____

Date Completed: _____ Team: _____ Shift: _____

Job: _____

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Step 2 - Observation

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-Stress each Key Point. 1 cycle

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	A.	B.	C.	D.	E.	F.	G.
Team Member							
Sign							
Date							
Trainer							
Sign							

← *Team Member signature required for each job certified*

(T/M signoff that these steps were used by trainer to certify)

← *Trainer signature required for each job certified*

(Trainer signoff that these steps were fully completed by team member)

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G. Explain Steps

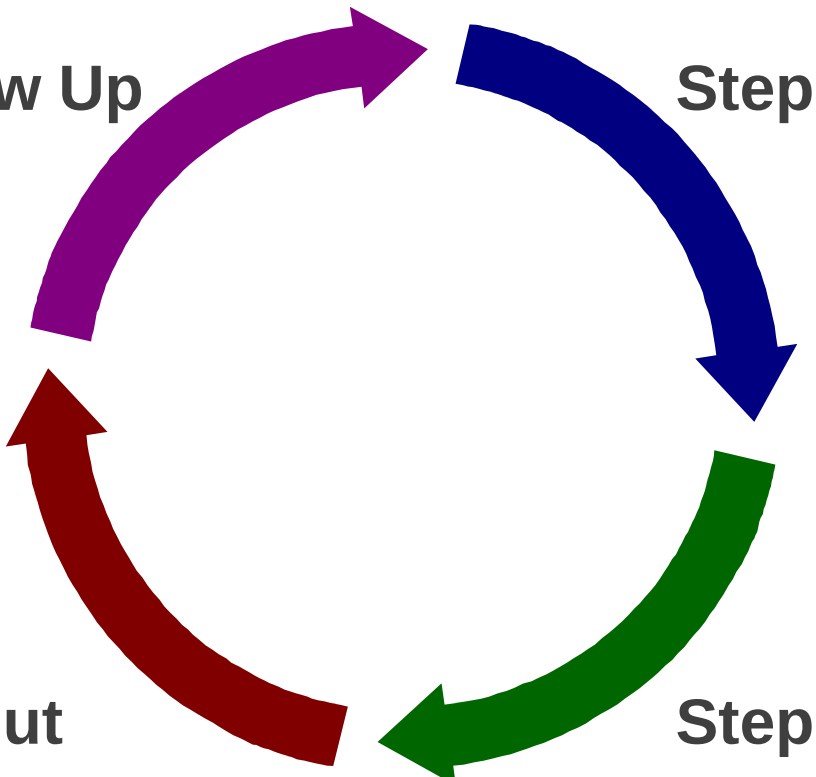
-Have trainee explain each Major Step as they do the job

-Have trainee explain each Key Point as they do the job

-Have trainee explain each Reason Why as they do the job

←

4 Steps of Job Training



Step 1: Prepare Team Member

Step 2: Present Operation

Step 3: Try Out Performance

Step 4: Follow Up

1st Step of Job Training

(Non-Cyclical Notes in red)

Step 1 - Prepare Team Member

- Put the team member at ease
- What does the team member already knows about the job
- State the job – Verbalize/Review the job summary if applicable
- Review base Knowledge/Training information
- Review Safety documentation / information
- Review workstation documentation
- Get the team member interested in learning the job

2nd Step of Job Training

Step 2 – Observation

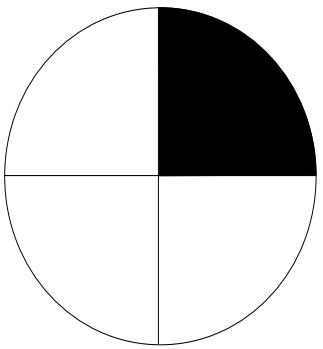
- Review the Work Instruction Sheets (WIS); (Task Information Sheets)
- Perform the job while explaining the major steps, key points and reasons.
- Allow for in-depth observation of the WIS / TIS's so the new Team member has an understanding of the standardized work sequence. (½ to 1 hour).
- Emphasis any safety or quality or engineering standards
- Instruct Clearly, Completely, and Be Patient

2nd Step of Job Training

Step 2 – Observation (Cont.)

- Do not teach more than the team member can master
- Communicate, demonstrate, and explain One Major Step at a time.
- Stress each Key Point
- Explain the Reasons Why
- Have the team member communicate, demonstrate, and explain major steps, Key Points, and Reasons Why back to the trainer

Explanation of Legend (Harvey Ball)



= Knows Steps (in Training)

After Step 1 and Step 2 are completed with the T/M , the trainer should complete one quadrant for the team member indicating that this team member knows the steps and has just started to learn the job.

The team member should also initial the box that corresponds with this particular training and job number.

3rd Step of Job Training

Step 3 - Try Out Performance

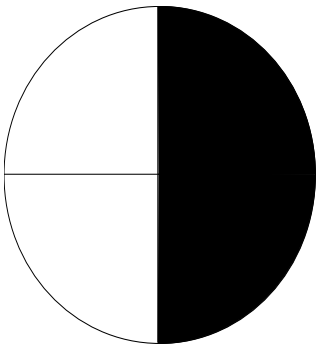
- Team member should start performing the job elements
- Select 1st set of elements (should not exceed ~30% of the total cycle time); Select appropriate amount of STS tasks
- Have team member do the job while the trainer reads the Major Steps
- Have team member explain each work element, any key points and reasons why as they perform the job
- Add more elements / tasks and repeat job for understanding & correct performance

3rd Step of Job Training

Step 3 - Try Out Performance (Cont.)

- Continue performing job until you know the team member knows the job completely
- Some non-cyclical tasks may be done infrequently; Trainer may go through steps in practice then follow-up when task is actually done
- Allow new Team member time to practice by building every other job. If a trainer is not available, another ¾ pie team member can be used to help in the process but the trainer is ultimately responsible for the trainee's quality.
- For non-cyclical tasks, may need observer present for a period of time until team member / trainer feel confident with task

Explanation of Legend (Harvey Ball)



= Can Perform Job to Quality and Safety but not in Takt Time

Step 3 The trainer should complete two quadrants for the team member indicating that this team member can perform the job to quality but not in takt time.

The team member should also initial the box that corresponds with this particular training and job number.

4th Step of Job Training

Step 4 - Follow Up

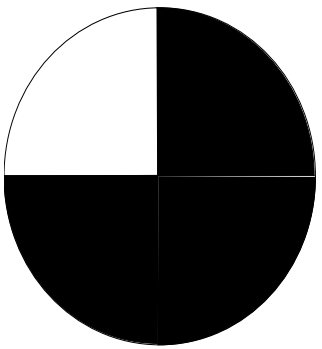
- Leave team member to work on his / her own.
- Designate who the team member goes to for help.
- Remind team member to use the Andon System (or equivalent) for help.
- Check Frequently and encourage questions

4th Step of Job Training

Step 4 - Follow Up (Continued)

- Give any necessary additional training needed to verify team member job competency (e.g. meeting Quality standards in actual Takt time)
- Have team member demonstrate understanding and capability of:
  - Safety requirements, Standardized work, Quality Requirements
- Trainer completes Quality checks
- Trainer checks and documents a number of work cycles. For non-cyclical activities, varying amounts of task repetitions may be required.

Explanation of Legend (Harvey Ball)

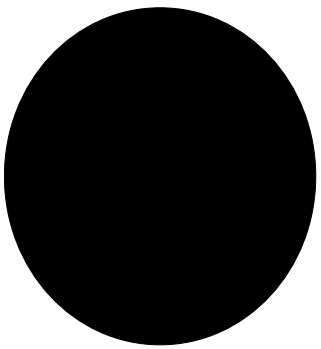


= Can Perform Job to Quality, Safety and in Takt Time Without Supervision

Trainer for Job Training

- Consensus of leadership that the team member can train others.
- Team member has performed the job a minimum number of cycles.
- Team member can verbalize the major steps, key points, and the reasons why, while performing the job.
- Team member is willing to take accountability for the trainee's quality.
- Team member is able to identify and react to problems.
- Leadership has observed the potential trainer follow standardized work.
- Team member demonstrates a working knowledge of the entire Job Instruction Training process.

Explanation of Legend (Harvey Ball)



= Can Train to Job Instruction Standard

Conclusion

- Remember, good training and safety are the keys to success!
- Take time to prepare and train right the first time.

Standardization

Standardization

Definition: Standardization is a *Dynamic Process* by which set standards of terminology, principles, methods, and processes are developed within the organization.

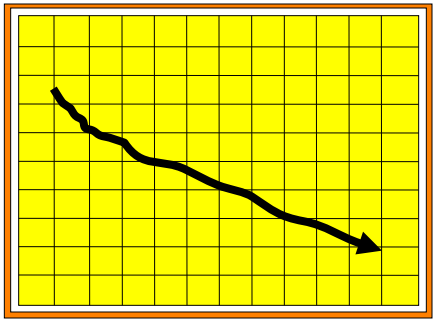
Purpose: The purpose of standardization is to stabilize, so as to achieve a base from which to grow and improve.

Standardization

Why Is Standardization Important?

SAFETY

QUALITY



COST

COMMON DIRECTION

Standardization Examples

Signage (Stop, Yield, One Way, Speed Limit)

Traffic Lights (Red, Yellow, Green)

Sirens response (Police, Ambulance, Fire Trucks)

Call for Help (911)

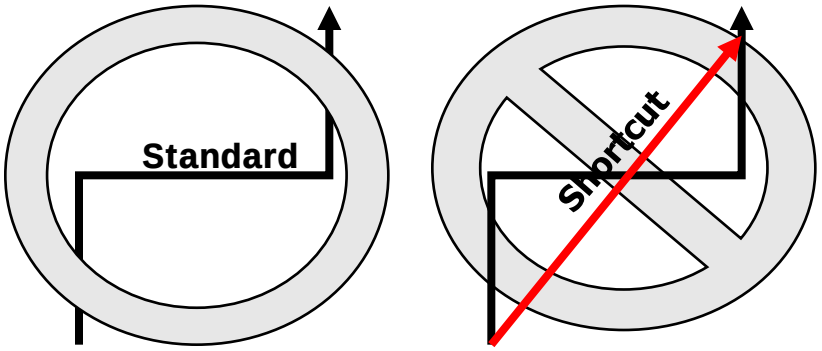
Keys on a keyboard

Calendar

Standardization

A Standard Is the best current practice based on many people's experiences and lessons learned, so…

DON'T SHORTCUT THE STANDARD!!!



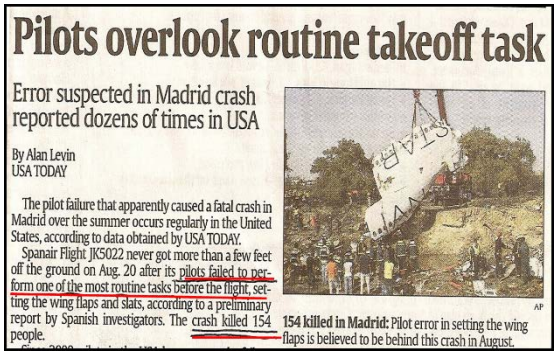
BAD THINGS COULD HAPPEN, ESPECIALLY SAFETY AND QUALITY PROBLEMS

IF YOU DON'T LIKE THE STANDARD, TRY TO CHANGE IT, BUT NEVER SHORTCUT IT.

What Happens When We Don't Follow Standards???

Every year people die from not following safety procedures:

- Fall hazards
- Lockout
- Confined Space



Pilots overlook routine takeoff task

Error suspected in Madrid crash reported dozens of times in USA

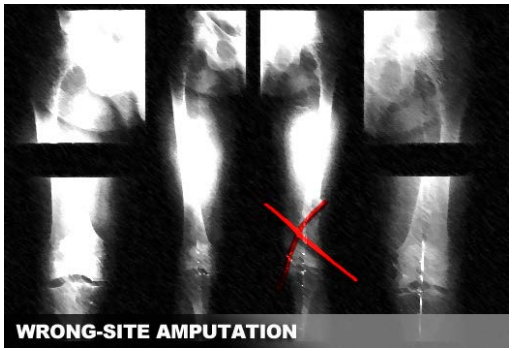
By Alan Levin
USA TODAY

The pilot failure that apparently caused a fatal crash in Madrid over the summer occurs regularly in the United States, according to data obtained by USA TODAY.

Spanair Flight JK5022 never got more than a few feet off the ground on Aug. 20 after its pilots failed to perform one of the most routine tasks before the flight, setting the wing flaps and slats, according to a preliminary report by Spanish investigators. The crash killed 154 people.

154 killed in Madrid: Pilot error in setting the wing flaps is believed to be behind this crash in August.

This pilot and co-pilot failed to perform their standardized checklist process before taking off from the airport.



Car driver had a seizure and crashed car into a tree, crushing both legs.

Arteriography revealed the right leg was salvageable but the left leg was not.

Unfortunately, the x-ray technician mislabeled the films, mixing left for right, and the surgeon first amputated the patient's right leg.

MAKE RULE

TEACH RULE

KEEP RULE

BE A ROLE MODEL!!

LEAD BY EXAMPLE!

It is easy to make standards, but we do not always do a good job communicating them and are even worse at sustaining them.

If you do not have a process to sustain a standard – why even introduce it in the first place?

Standardized Work

Big Picture Benefits of SW

- Improves safety and quality
- Prevents overproduction
- Makes problem solving easier
- Baseline for continuous improvement
- Highlights waste
- Improves ergonomics
- Reduces wasted effort

Definition

The documented current best method to safely and efficiently perform work, that meets the necessary level of quality.

Purpose

To establish a repeatable, predictable baseline for Continuous Improvement and to involve the team member in both the initial and ongoing improvements to achieve the highest levels of Safety, Quality, and Productivity.

Key Components of SW

1. Work Sequence
2. Takt Time
3. Standard In-Process Stock

Work Sequence

Definition:

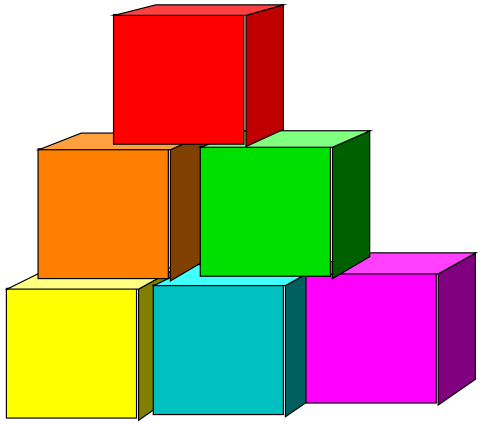
The agreed upon order of the job elements a team member follows in order to maximize safety, quality and efficiency.

Create good flow within the job!

Element Definition

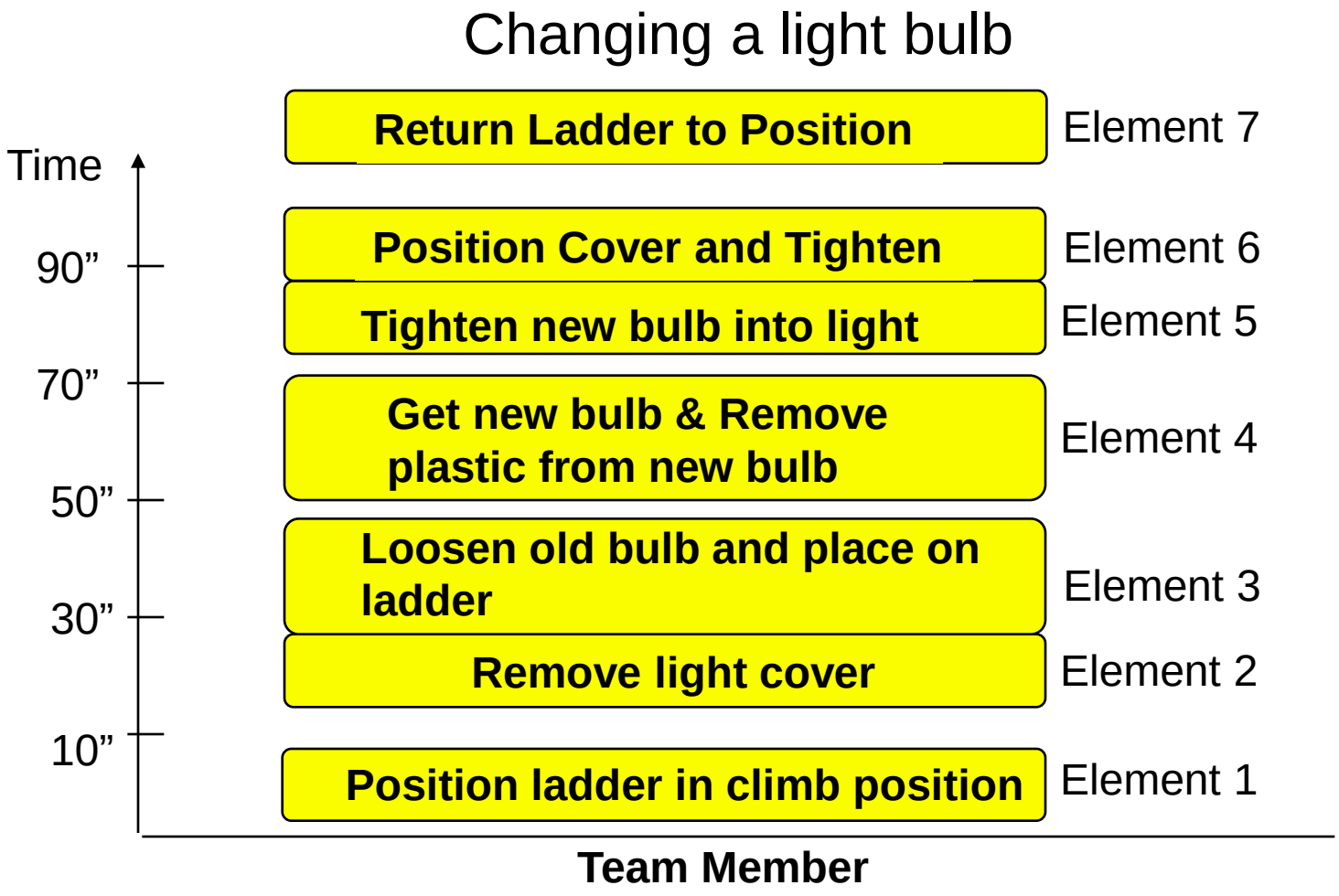
A job element is a logical grouping of actions that advances work to its successful completion

Elements are the basic building blocks of SW. They are used during training to teach the job in manageable chunks.



Job Elements

Any Job can be broken down into job elements. . .



Building Job Elements

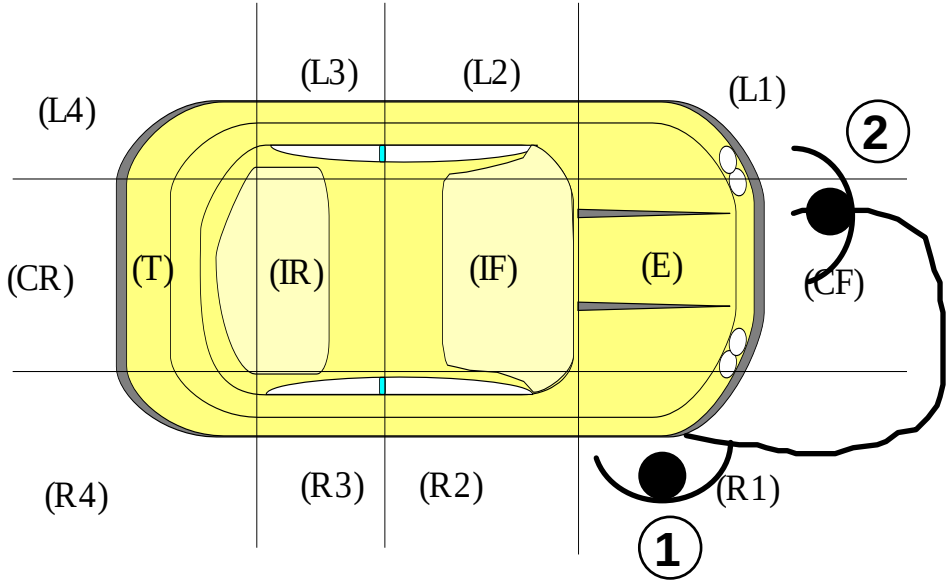
Factors to consider:

- Geographic build location
- Product grouping
- Time required to complete the element
- Walking is not an element, and usually not included in element sheets.
- The first element in any job can be, “read manifest and get parts”.
- Don’t automatically use the groupings as described in your current engineering Standardized Work. Use common sense to break the job down the way you think of it every day.

Recognizing Elements

Geographic Location

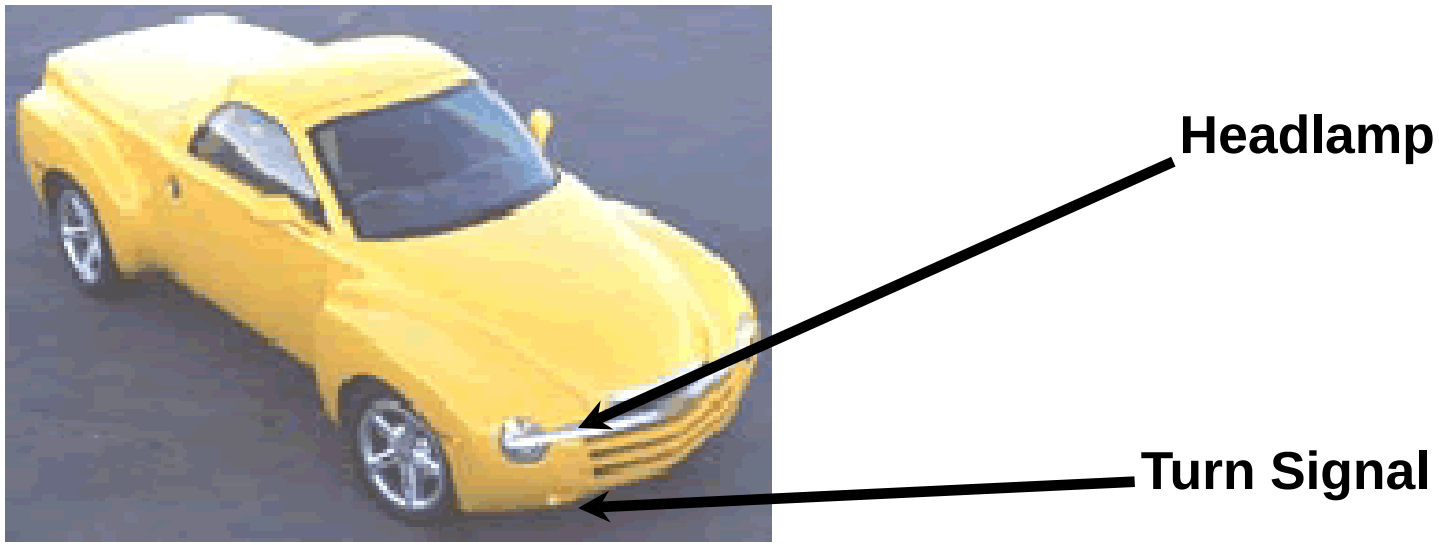
- Elements are usually separated by walking
- An element usually only takes place at one location



Recognizing Elements

Product Grouping

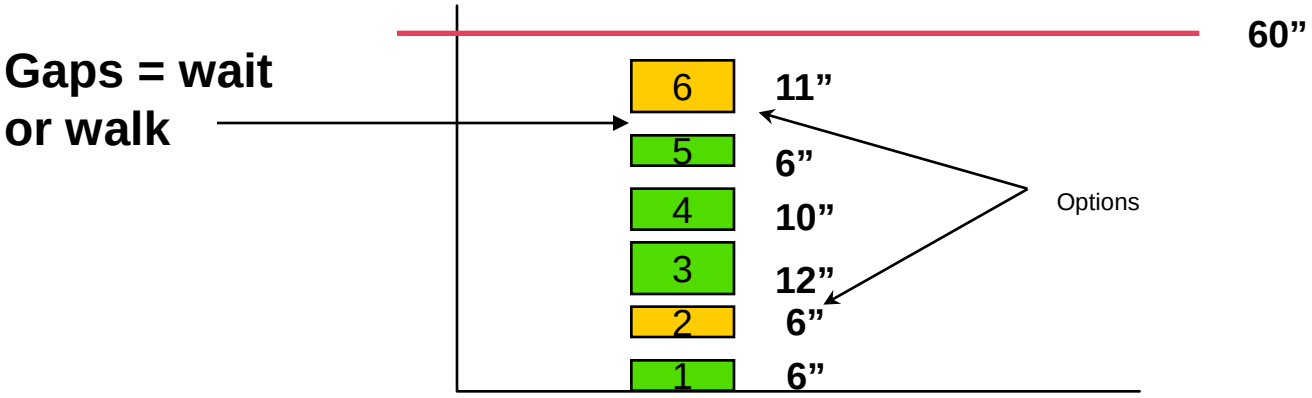
If possible, an element should not combine operations on two distinct product groupings (example of product groupings: headlamp and turn signal.)



Element Time

Time Required to Complete the Element:

- A rough guideline could be to set element size to about 10% of the job (ATT).
- Typically this is 6-7 seconds on a 60 sec takt time.



Key Components of SW

1. Work Sequence
2. Takt Time
3. Standard In-Process Stock

Takt Time

Definition:

The maximum time available to produce a product or service based on customer demand**.**

Formula:

$$TT = \frac{\text{Production Time Available Per Period}}{\text{Customer Demand Per Period}}$$

Takt Time

Formula:

$$TT = \frac{\text{Production Time Available Per Period}}{\text{Customer Demand Per Period}}$$

For this example:

1. **There are 480 minutes in a shift**
2. **Customer demand is 400 cars**

$$\textbf{TAKT} = \frac{\textbf{(480min) x 60sec}}{\textbf{400 units}} = \frac{\textbf{28,800 sec}}{\textbf{400 units}}$$

OR **72 seconds**

Actual Takt Time

Definition:

The planned time available to produce a product or service after accounting for system losses, lunch and scheduled breaks.

Formula:

$$ATT = \frac{(\text{Available time} - \textbf{Non-scheduled downtime} - \text{System Losses \%})}{\textbf{Customer Demand Per Period}}$$

Actual Takt Time

Formula:

$$ATT = \frac{(\text{Available time} - \textbf{Non-scheduled time} - \text{System Losses \%})}{\textbf{Customer Demand Per Period}}$$

For this example:

1. **Available time is 480 min.**
2. **Minus 20 min lunch and two 15 min breaks**
3. **Andon and equipment downtime estimated at 6.5%**

$$\textbf{ATT} = \frac{\textbf{28,800 sec – 3,000 sec – 1,872 sec}}{\textbf{400 units}} = \frac{\textbf{23,928 sec}}{\textbf{400 units}}$$

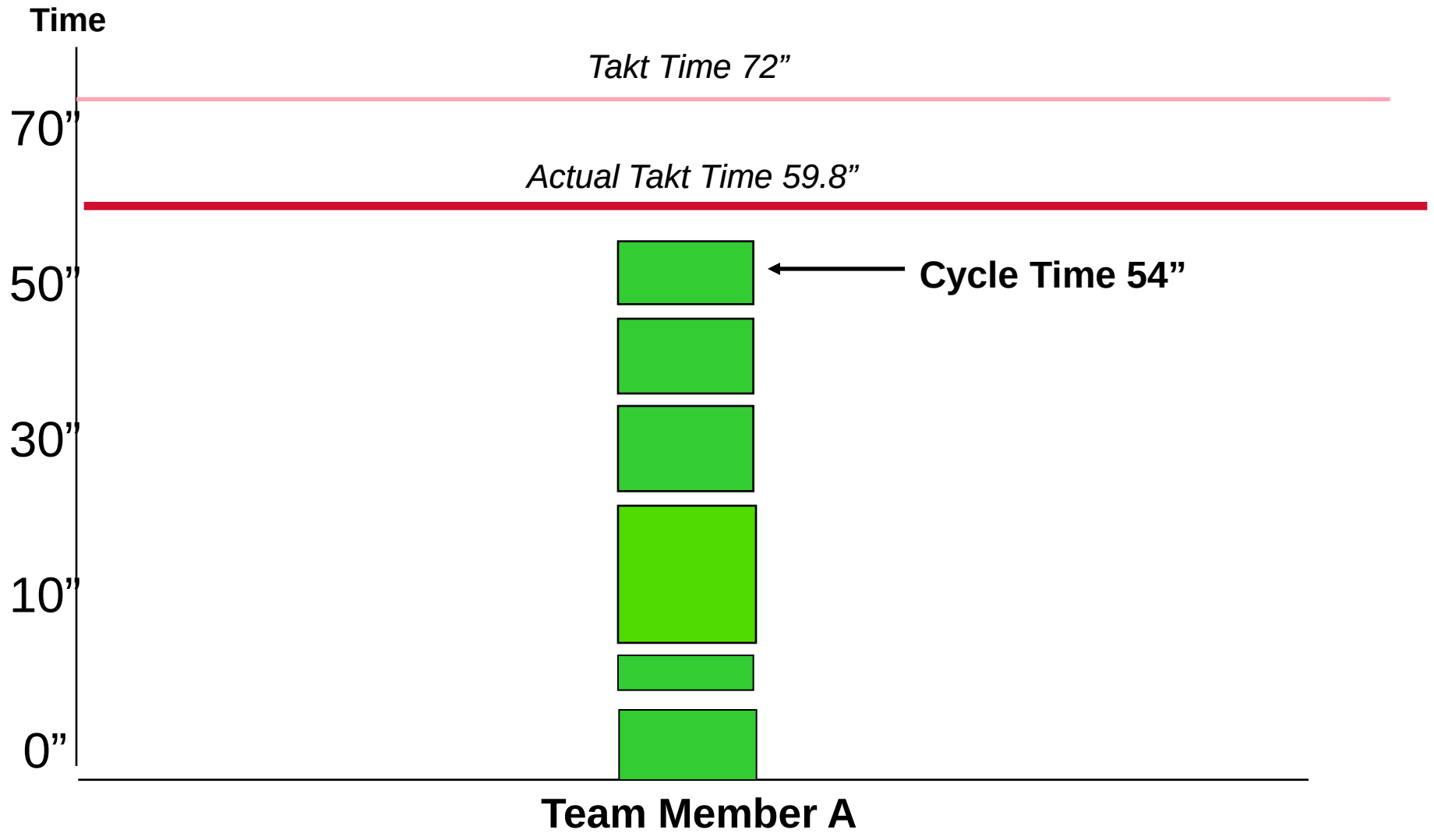
OR 59.8 sec.

Cycle Time

Definition:

The actual time it takes a team member to complete his or her work sequence.

Time Relationship



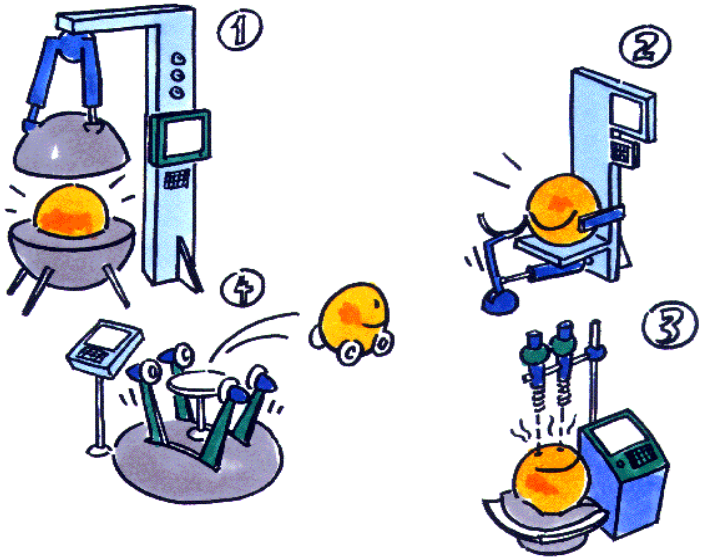
Key Components of SW

1. Work Sequence
2. Takt Time
3. Standard In-Process Stock

Standard In-Process Stock

Definition

The minimum quantity of parts at each operation necessary to efficiently complete the steps of one process in the agreed upon working sequence



Symbol

Standard In-Process Stock

Standardized Work is interrupted when parts are not present.

When do we need Standard In-Process Stock?

- When work sequence and process flow are in opposite directions.
- When automatic machines are present.
- When multiple team members are required to “hand off” to one another.
- When a significant gap exists between operations.

Buffer

Definition:

- The number of stock needed to cover inefficiencies in the system
- Inefficiencies Include:
  - Scrap / defects
  - Breakdowns
  - Andon pulls
  - Blocked / starved
  - Tool breakage

Visual Line Balance Wall

Definition:

A visual time representation of work sequences of several Team Members.

It shows the elements of each Team Member’s work sequence, the cycle time versus the Actual Takt Time and visualizes the standard work vs. option work and walk/wait time.

Visual Line Balance Wall

Purpose:

- Identifies motion improvement opportunities
- Allows work balancing activities, preventing:
  - Overburden
  - Waiting
  - Unevenness
- Enables team members and team leaders to visualize all operations.

Work Instruction Sheet

Definition:

A user friendly document that provides detailed information on a specific element of work to ensure the successful execution of that element.

Purpose:

- To provide detailed training information for new team members.
- To bridge the gap between engineering information and shop floor knowledge.
- To provide a written history of that element.
- To provide a baseline for auditing, problem solving, continuous improvement, rebalancing of work and documentation transfer.

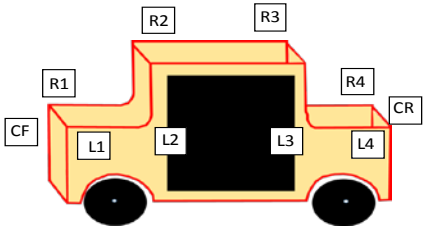
Work Instruction Sheet

Work Instruction Sheet	Job	Operation #	Time
	LCC CPT MFG SIMULATION	#001 - L	

Element Name #3: Position front bumper

Safety ◇ Quality ○ Manditory Seq.

Sym	Ref	Major Step (What)	Key Point (How)	Reason (Why)
BASE				
	1	Position front bumper to (2) studs	Push front bumper straight onto studs	Ensures the front bumper is properly positioned before securing
	2	Finger start (2) nuts onto studs	Position nut with flange toward vehicle	Allows nut to be secured. Nut put on backward wil not allow gun to secure
	3	Step #2 continued	Rotate nuts clockwise and spin	Verifies propler alignment to prevent cross-threaded nuts
	4			
	5			
	6			
	7			
	8			
	9			
	10			

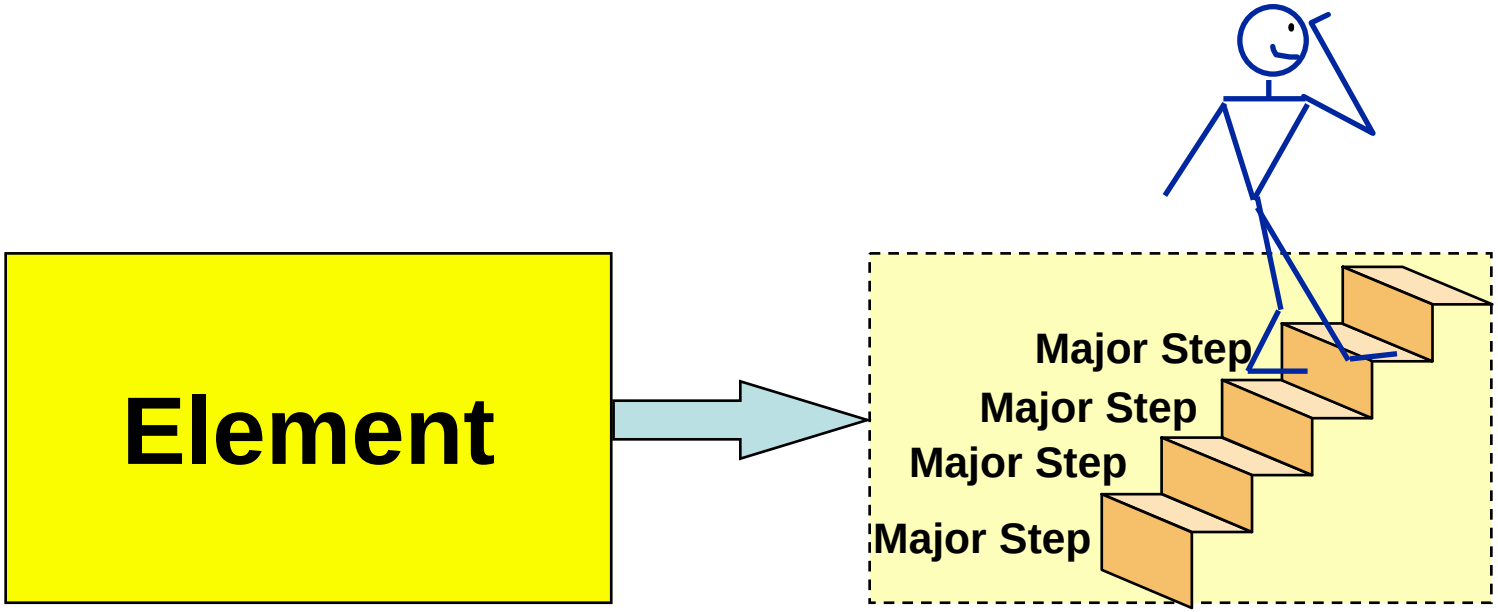


Date	Operation		Time	Change Description				

Major Steps (WHAT)

A major step within an element is:

- An action necessary for advancing the element to its successful completion



Guidelines for Writing Major Steps

When Writing Major Steps You Should:

- Be brief
- Describe a single action
- Avoid use of abbreviations, acronyms and jargon

Examples:

- Place part in fixture.
- Rotate jog switch to the Run position.
- Press Start Cycle button
- Apply sealer to gusset

Key Points (HOW)

Key Points describe how to perform a Step (not all Steps require Key Points).

Examples of things to consider when writing Key Points:

- Could the team member get injured if they failed to follow a certain method or technique? If so, describe that method or technique.
- Does the success or failure depend on performing the work a certain way? If so, describe how to perform that task successfully.
- Have you learned an easier way to perform the Step? If so, describe that easier method.

Reasons (WHY?)

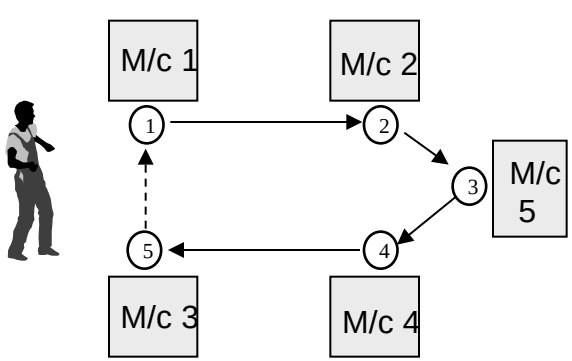
- What happens if the key point is ignored?
- Why is it done this way? What is the reason?
- Every Key Point must have a reason.

"The reason this key point is so important is. . . "

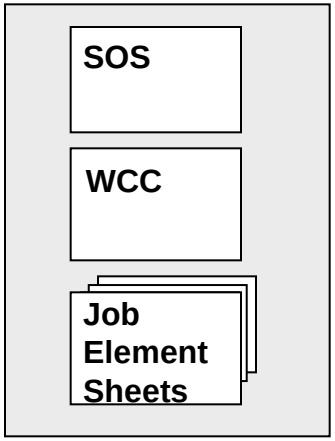
Definition of Cyclic Work

Work consisting of a sequence of job elements that are performed repeatedly within Actual Takt Time throughout the course of a work day.

Cyclic

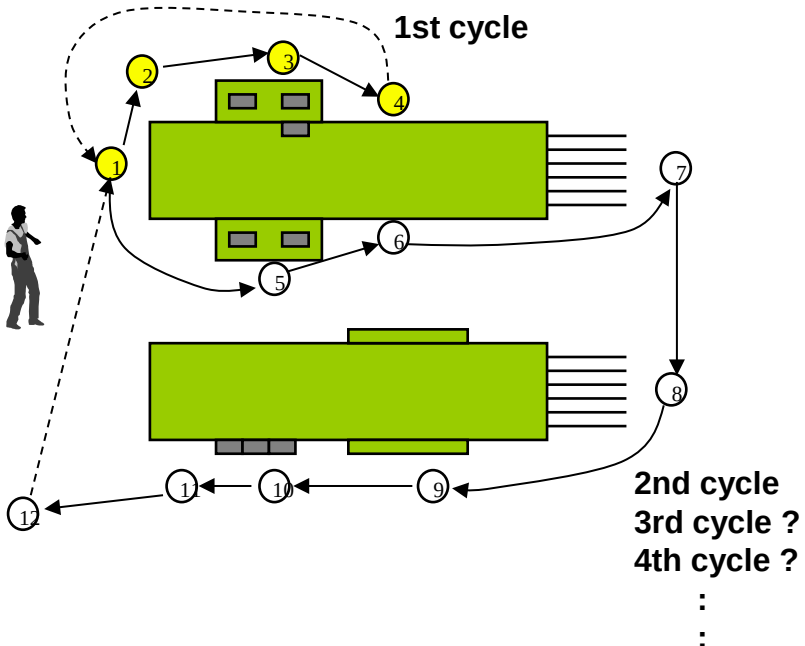


Cycle time </= ATT



Definition of Non-Cyclic Work

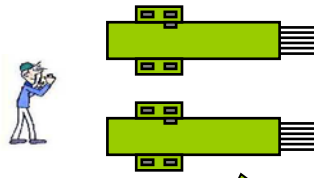
- Work consisting of tasks which, when completed, are performed according to a prescribed sequence of job elements. The sequence in which the tasks are performed may not be repeatable, but the job elements that make up the task are repeatable.
- This type of work can also occur within a cyclic process.



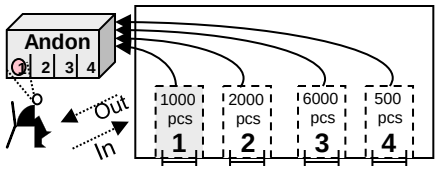
Examples of Non-Cyclic Work:

Non-Cyclic Work

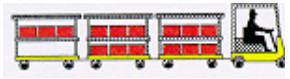
1 Multiple Machining Work



2 Tool change

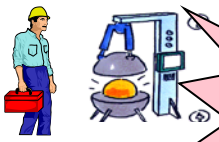


3 Material Delivery



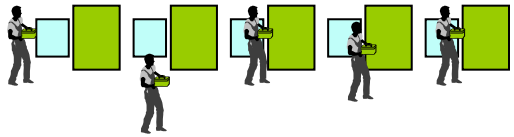
4 Quality Repair or Check

5 Maintenance



Planned or Breakdown

6 Changeover



7 Administrative

Change Sequence

Core Requirements:

A stable process must be in place to continuously improve Standardized Work.

All elements and details of Standardized Work must be agreed to across all shifts.

Change Sequence

Process steps should include:

- Agreement of all shifts on what will be changed and when it will happen.
- Generation of a work order (if required) to initiate the change.
- Evaluation of potential impacts (Ergonomics, material flow, packaging/containers, mandatory sequences, etc.) by experts in these areas where required.
- Updating of all SW documentation, including the labor database (e.g., STDS, Business Pro, Work Combination Chart, Visual Line Balance Wall, etc.).
- Training of team members in the revised process.

Roles and Responsibilities

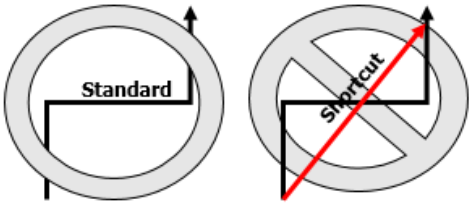
- Team Member
- Team Leader
- Supervisor
- Industrial Engineering
- Joint Plant Leadership

3 – LCC SPE Standardized Work Revised 4-26-2017
Slide 5:

Standardization

A Standard Is the best current practice based on many people's experiences and lessons learned, so…

DON'T SHORTCUT THE STANDARD!!!



BAD THINGS COULD HAPPEN, ESPECIALLY SAFETY AND QUALITY PROBLEMS

IF YOU DON'T LIKE THE STANDARD, TRY TO CHANGE IT, BUT NEVER SHORTCUT IT.

Slide 6:

What Happens When We Don't Follow Standards???

Every year people die from not following safety procedures:

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- Lockout
- Confined Space


Pilots overlook routine takeoff task

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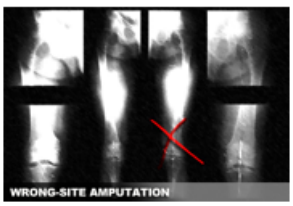
This pilot and co-pilot failed to perform their standardized checklist process before taking off from the airport.



Car driver had a seizure and crashed car into a tree, crushing both legs.

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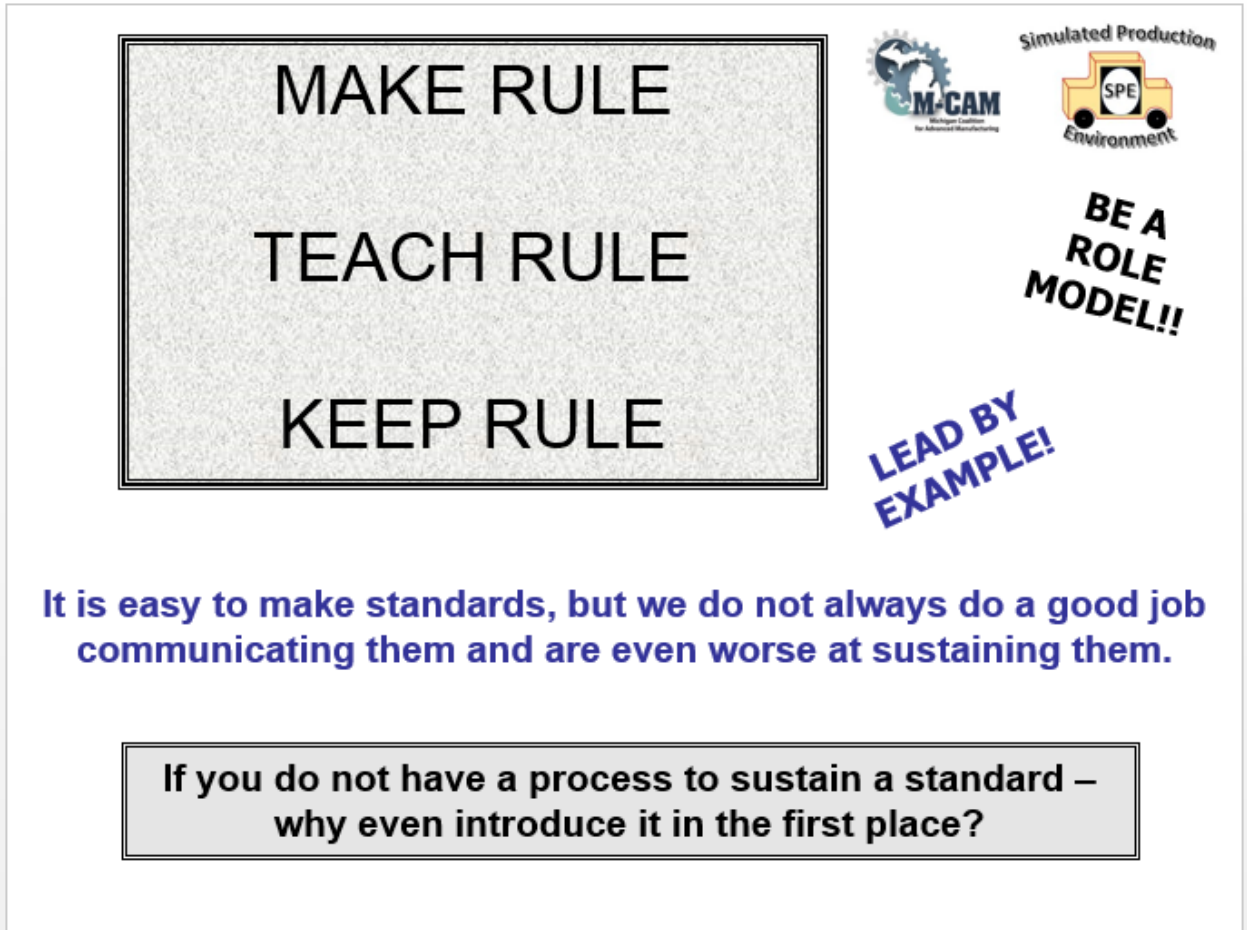
Slide 7:



Read through the slide.

Here, it is important to say:
“Why make a rule if you don’t teach it and follow it.”

Example of Countermeasure Sheet

COUNTERMEASURE SHEET - MONTHLY OR DAILY (circle one)

Shift	B.P.D or LA Category	Date Found	Problem Description	Root Cause	Action (Short/Long Term Countermeasure)	Target Date	Resp.	Support	Status	Comments
1	Q	11/11/13	8 fails for paint defects at Q2 - (3) dirt on left rear door; (3) craters on right front door; (2) poor metal finish repairs	Feathers found to be damaged; Seal line operator used lotion on hand at break; New operator in body repair at Elpo Sand booth	Contacted maintenance to replace broken feathers; re-instructed the operator on seal line about approved products to use; Contacted body shop GL to retrain new operator.	########	Joe P.; Tom L. & Sam W.		1	Group #4 example
2	P	11/15/13	Team leaders on line for the whole day	(4) team members absent. (2) absent due to illness; (2) not called in with reason.	Interview (2) team members that didn't call in to determine reasons for absence. Appropriate action to be determined.	########	Jim C.		2	Group #4 example
2	R	11/21/13	18 minutes of downtime at Q2 due to high volume of dirt calls on left side front and rear doors	New Q2 inspection operator at Q2. Question whether operator truly knew the standards.	Contacted the Quality Group Leader to re-instruct operator as to the correct standards for dirt calls.	########	Steve W.		2	Group #4 example
3	LA	11/22/13	Operator observed not following standardized work as described in the documentation.	Operator performed multiple repairs on vehicle prior to being observed, therefore in trying to catch up failed to do next car as desceribed.	Counseled operator that in cases where this issue takes place to use the Andon cord to call for help or stop the line long enough to catch up doing the proper process.	########	Jim C.		3	All area example
1	P	11/10/13	Missing sign ins on PMP check log for dates 11/9/13 and 11/10/13	Operator stated that checks were performed but forgot to mark the log	Re-instructed operator as to the importance of performing PMP checks	########	Jim C.		3	Group #3 example
2	C	11/16/13	Approximately 50 lbs. of powder spilled on the floor in the powder storage area	Operator did not properly latch hoist connections on bag before transferring bag for use.	Check standardized work (TIS) to ensure that the correct procedure was documented, re-instructed and observed operator to ensure proper process was followed.	########	Jim C. Tom.M		2	Group #3 example
3	Q	11/21/13	8 Sand mark defects found on liftgates (lower left side) at TCR	Observed operator using wrong grit of sand paper to perform repairs.	Instructed Team Leader to make sure correct paper was available and ensure operator performed repairs correctly.	########	Tom. M.		2	Group #3 example
1	Q	11/28/13	Water leak found in GCA at L/S windshield "U" channel seam	Sealer was not applied properly to cover the entire seam surface area.	Reinstructed operator that proper sealer coverage was critical to eliminate leaks and instructed team leader to monitor seams at end of deck.	########	Jim C.		3	Group #1 Example
2	R									Group #1 Example
3	LA									Group #1 Example

Status Legend: Action Identified (PLAN) Action Being Implemented (DO) Action Being Evaluated (CK) Action Closed (ACT)

Business Planning

Learning Objectives

- Definition and purpose of Business Planning.
- How business plans align the organization.
- Who is involved.
- Why Business Plan Deployment (BPD) is important.
- Plan, Do, Check, Act (PDCA).
- Benefits of BPD.

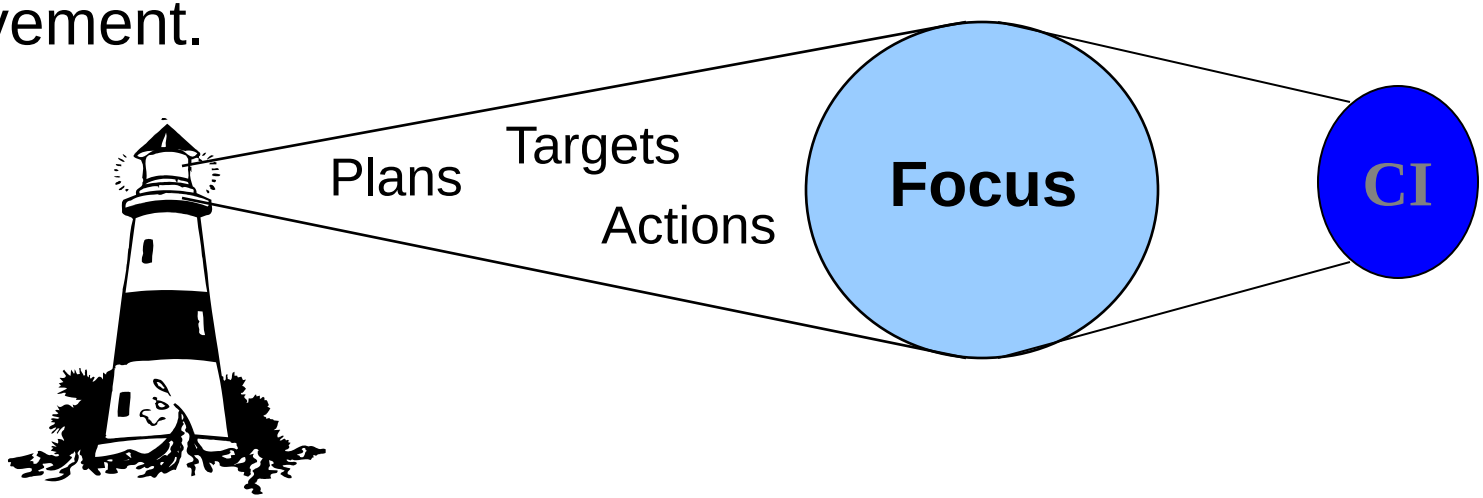
Business Planning

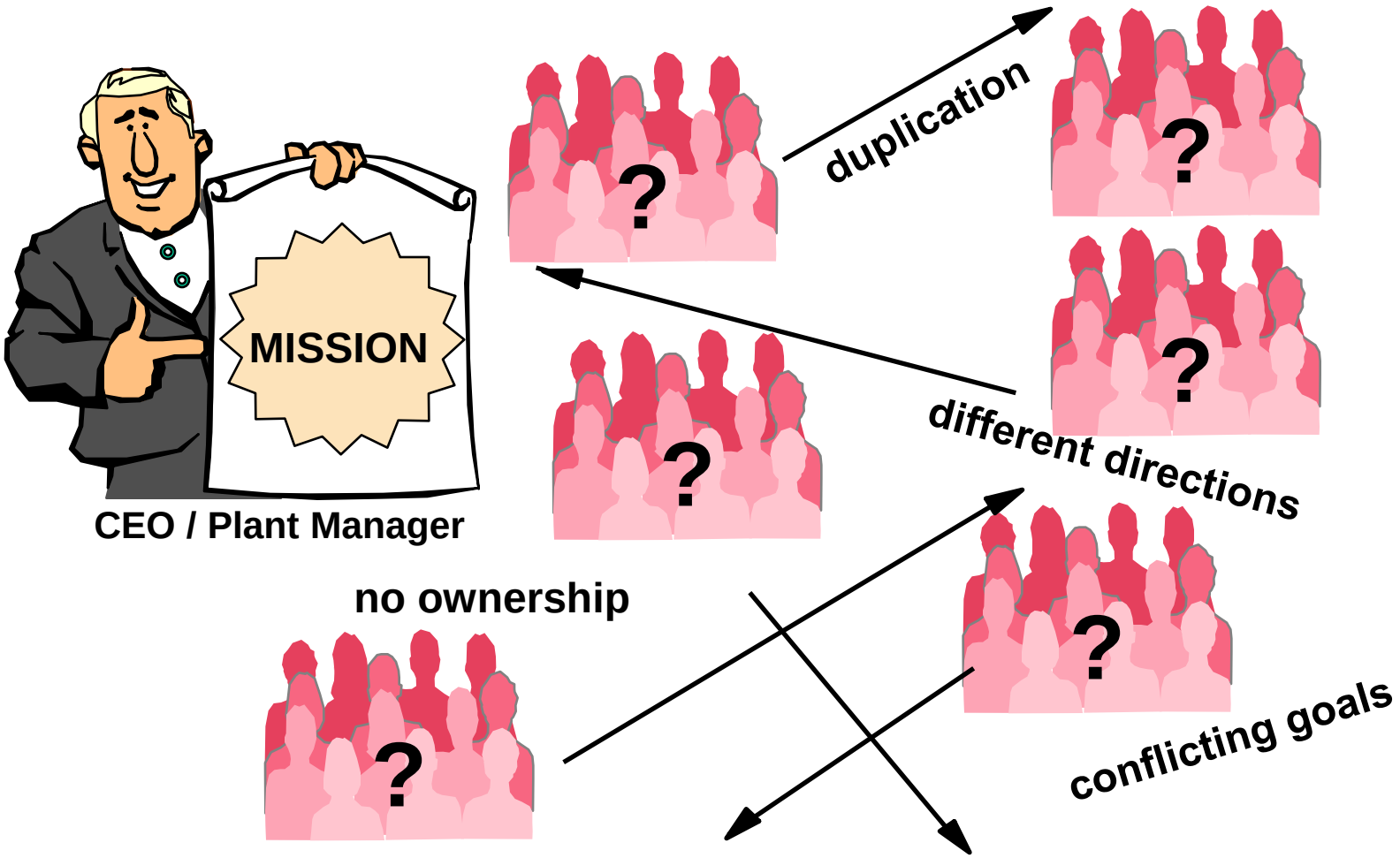
Definition:

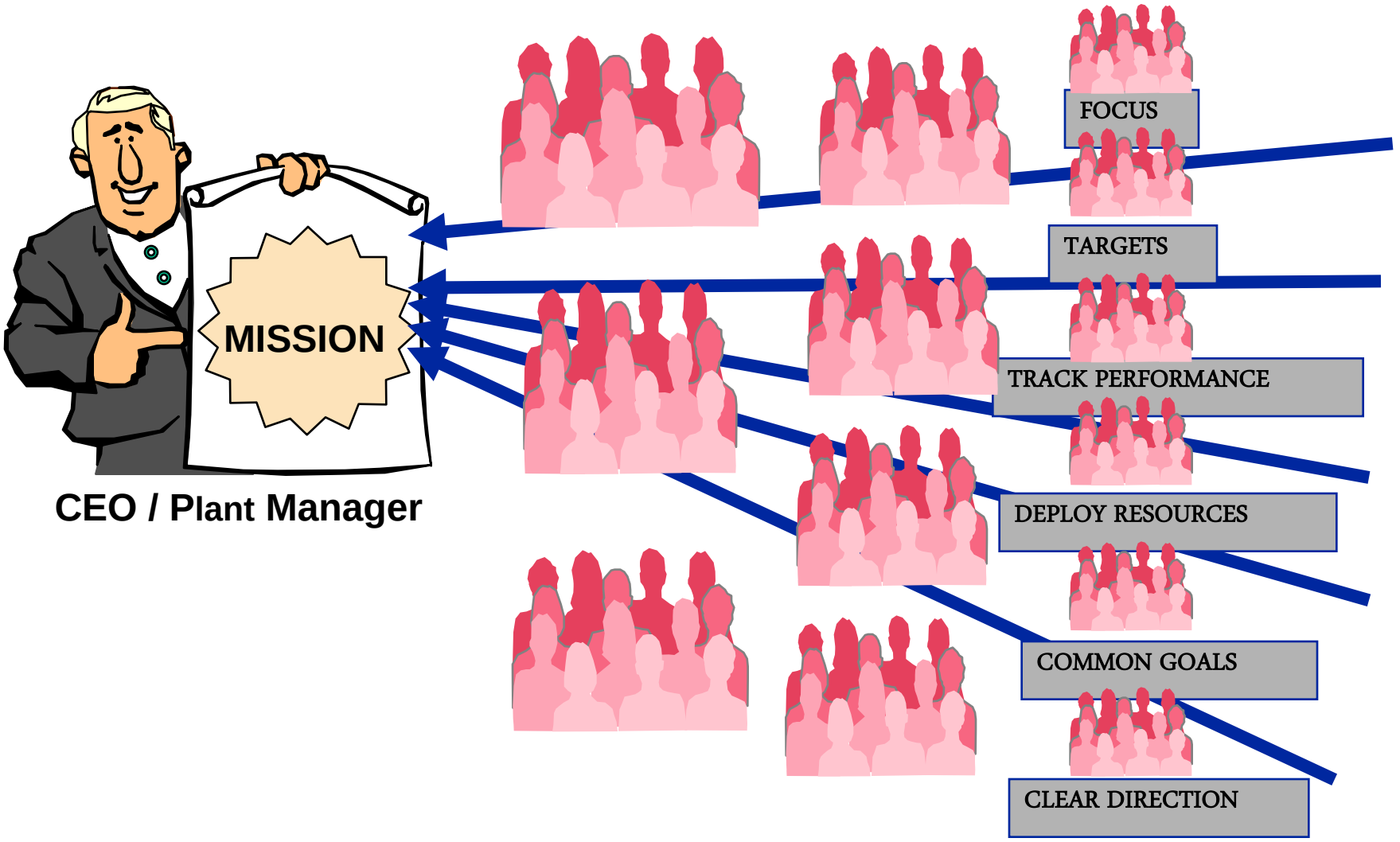
A process that enables the total organization to cascade targets, develop actions, integrate plans and remain focused to achieve plant-wide goals and manage change.

Purpose:

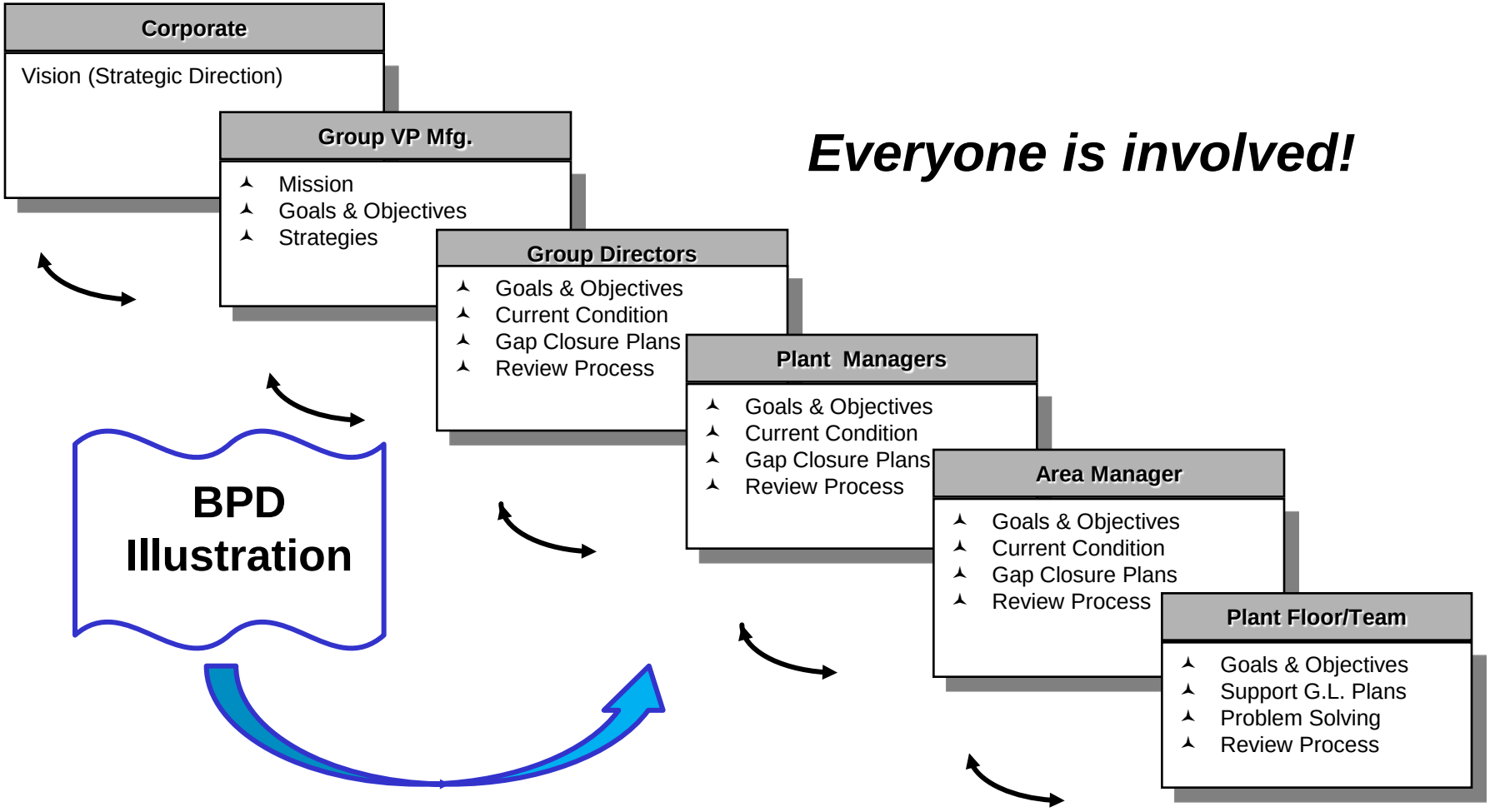
To align and integrate all employees to work together, to take action and to develop a culture of continuous improvement.




MISSION
CEO / Plant Manager
duplication
different directions
no ownership
conflicting goals

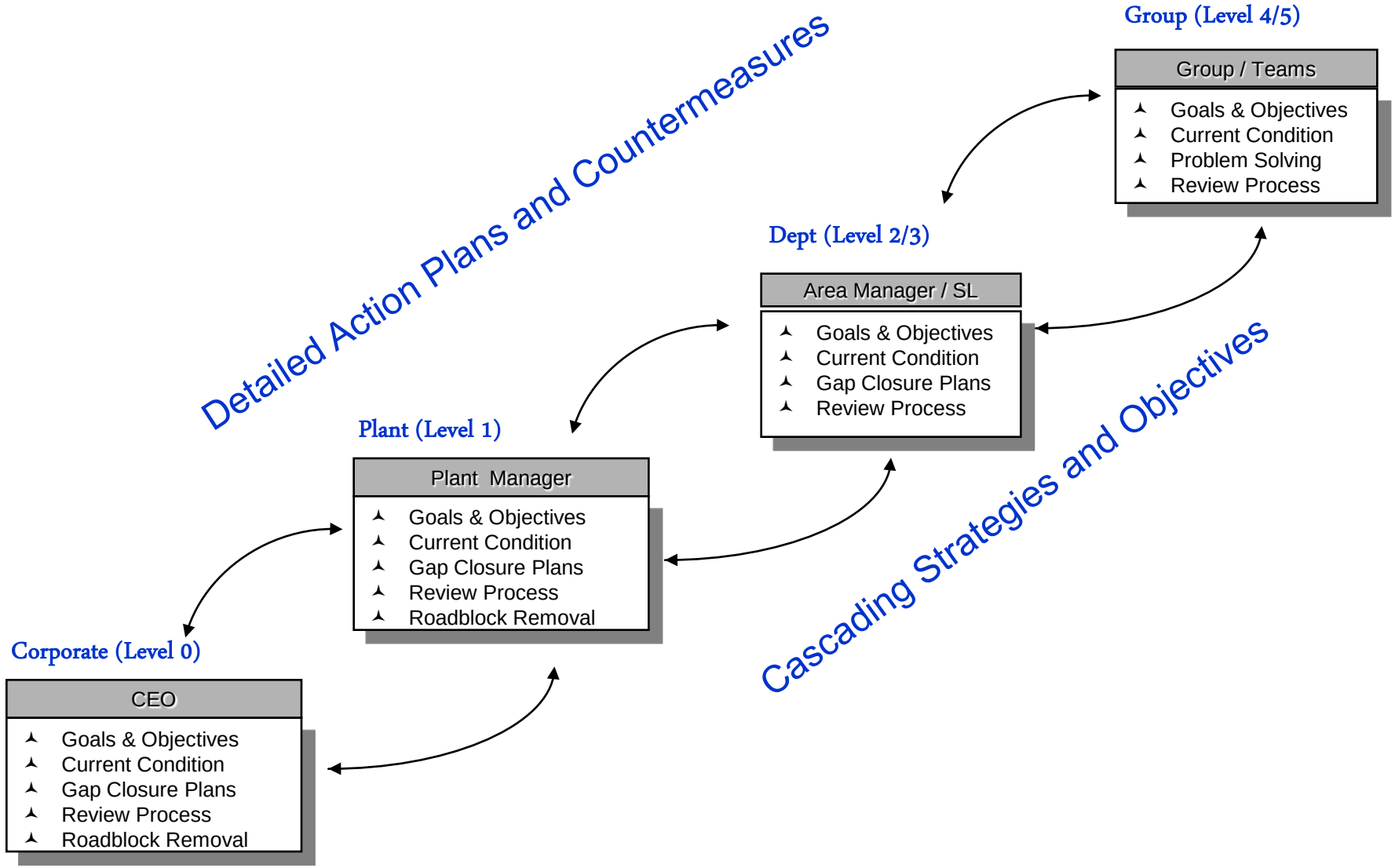

MISSION
CEO / Plant Manager
FOCUS
TARGETS
TRACK PERFORMANCE
DEPLOY RESOURCES
COMMON GOALS
CLEAR DIRECTION

Who is involved?



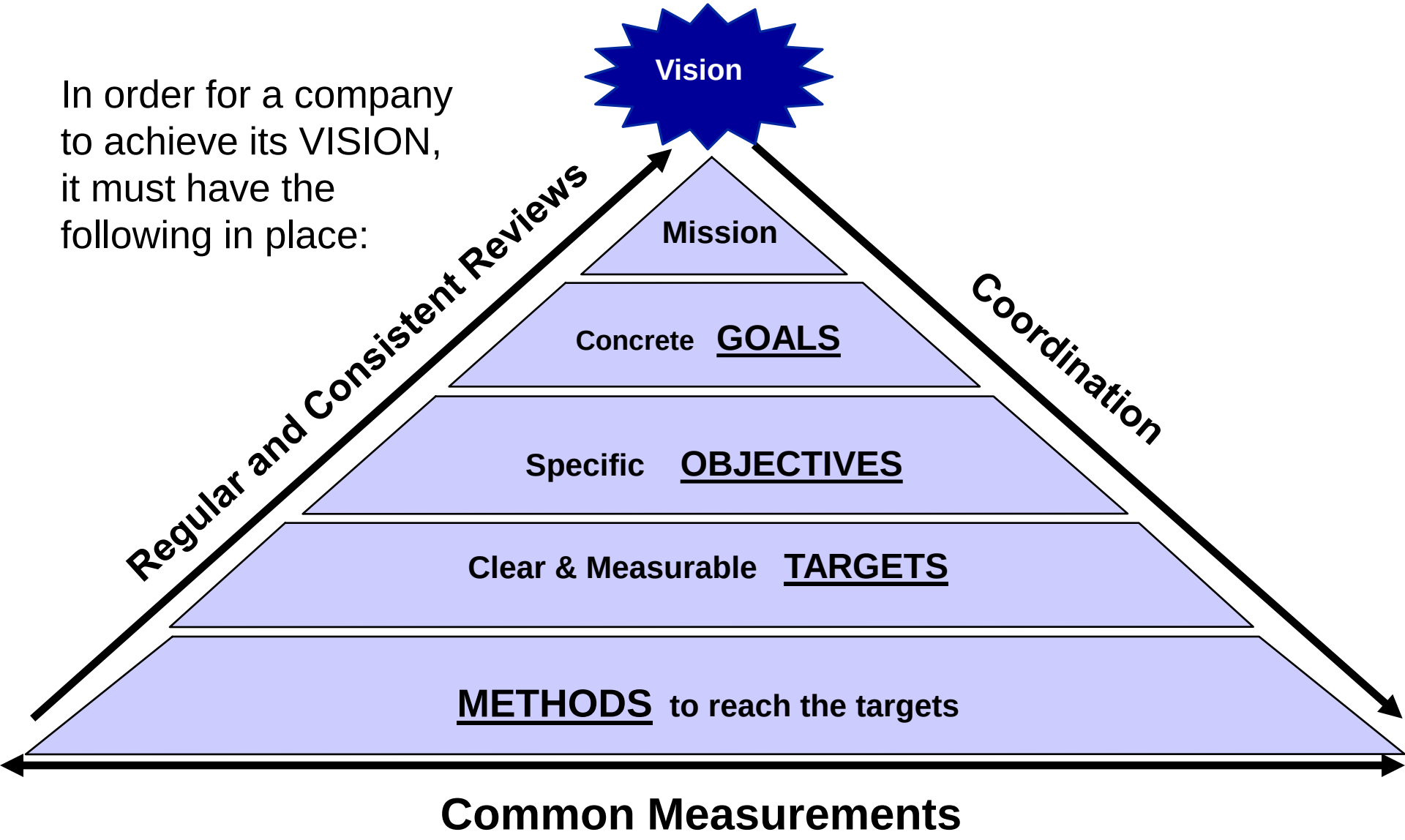
Everyone is involved!

Consolidation of BP Levels

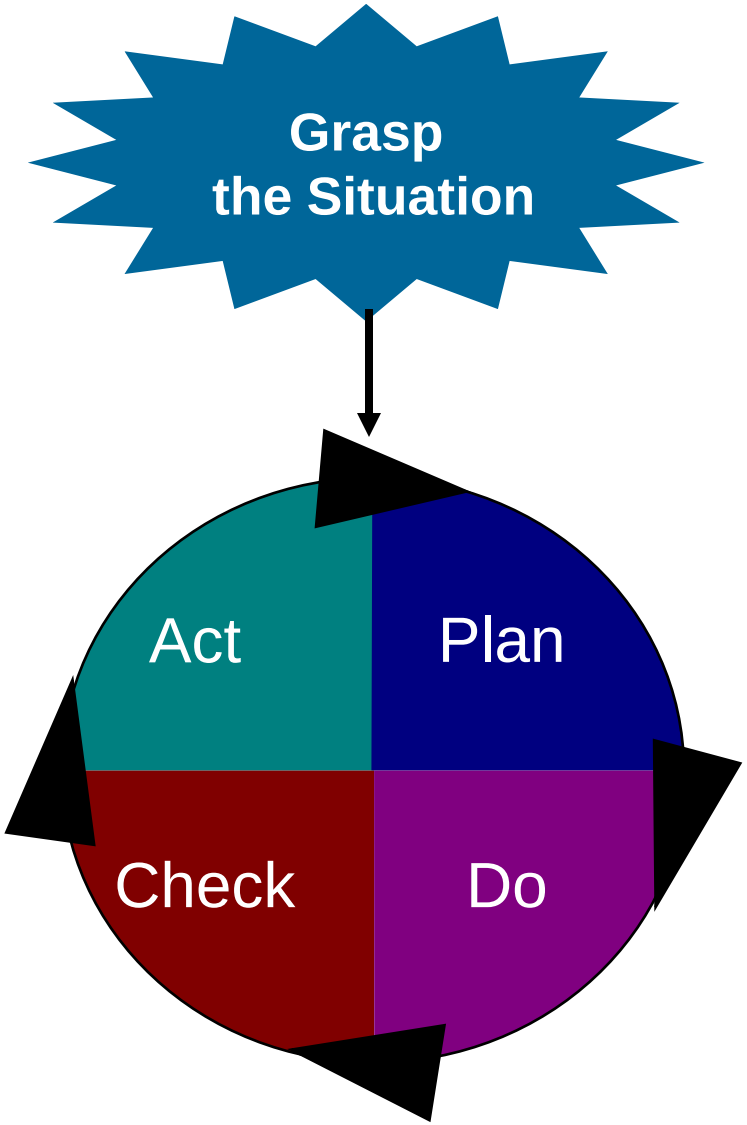


Business Planning Elements

In order for a company to achieve its VISION, it must have the following in place:



Business Planning (PDCA)



PLAN

When we truly grasp the situation, we can make a good Plan.

DO

We then implement the plan on time as planned.

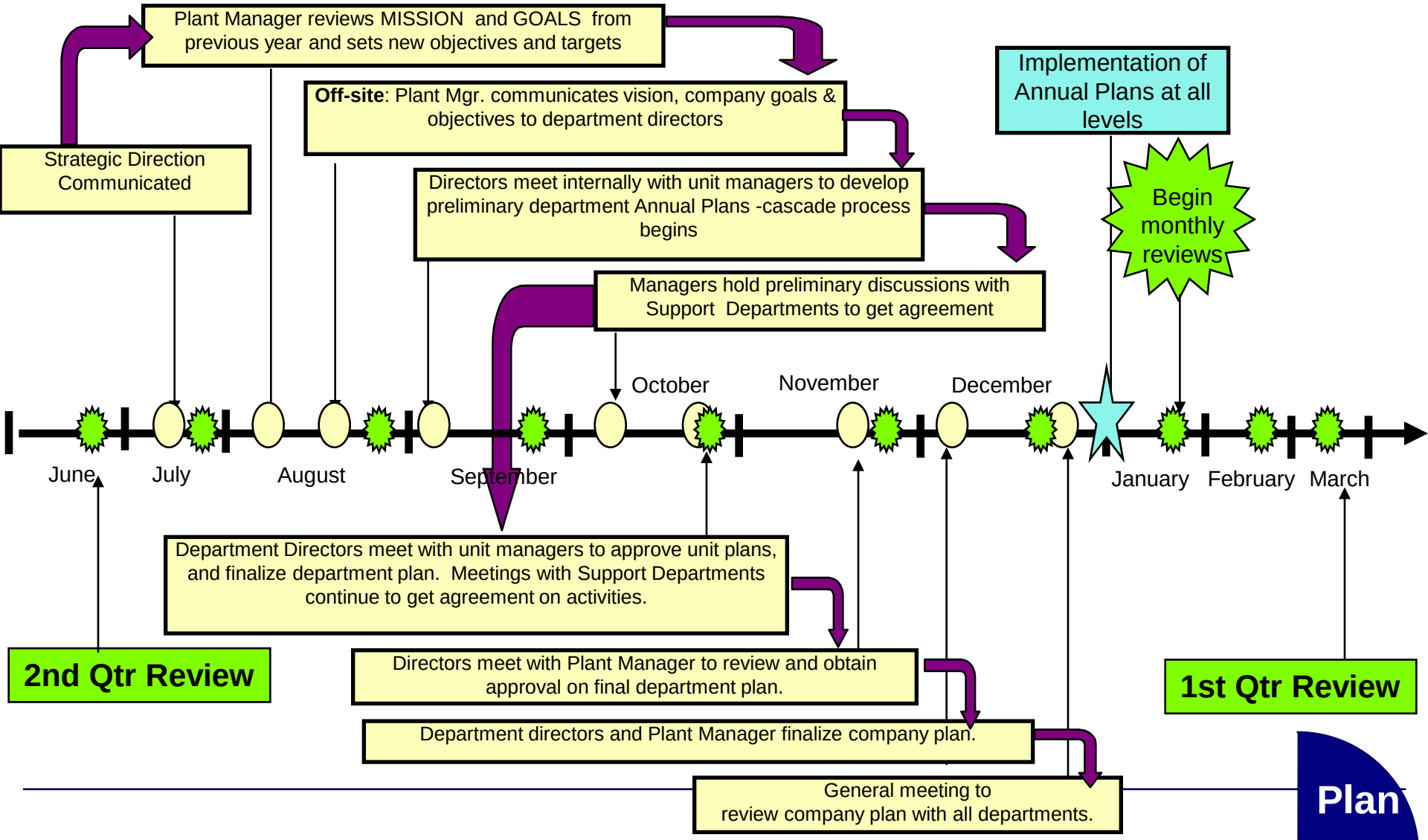
CHECK

We evaluate ourselves regularly to make sure we are achieving the desired results and to Check the plan.

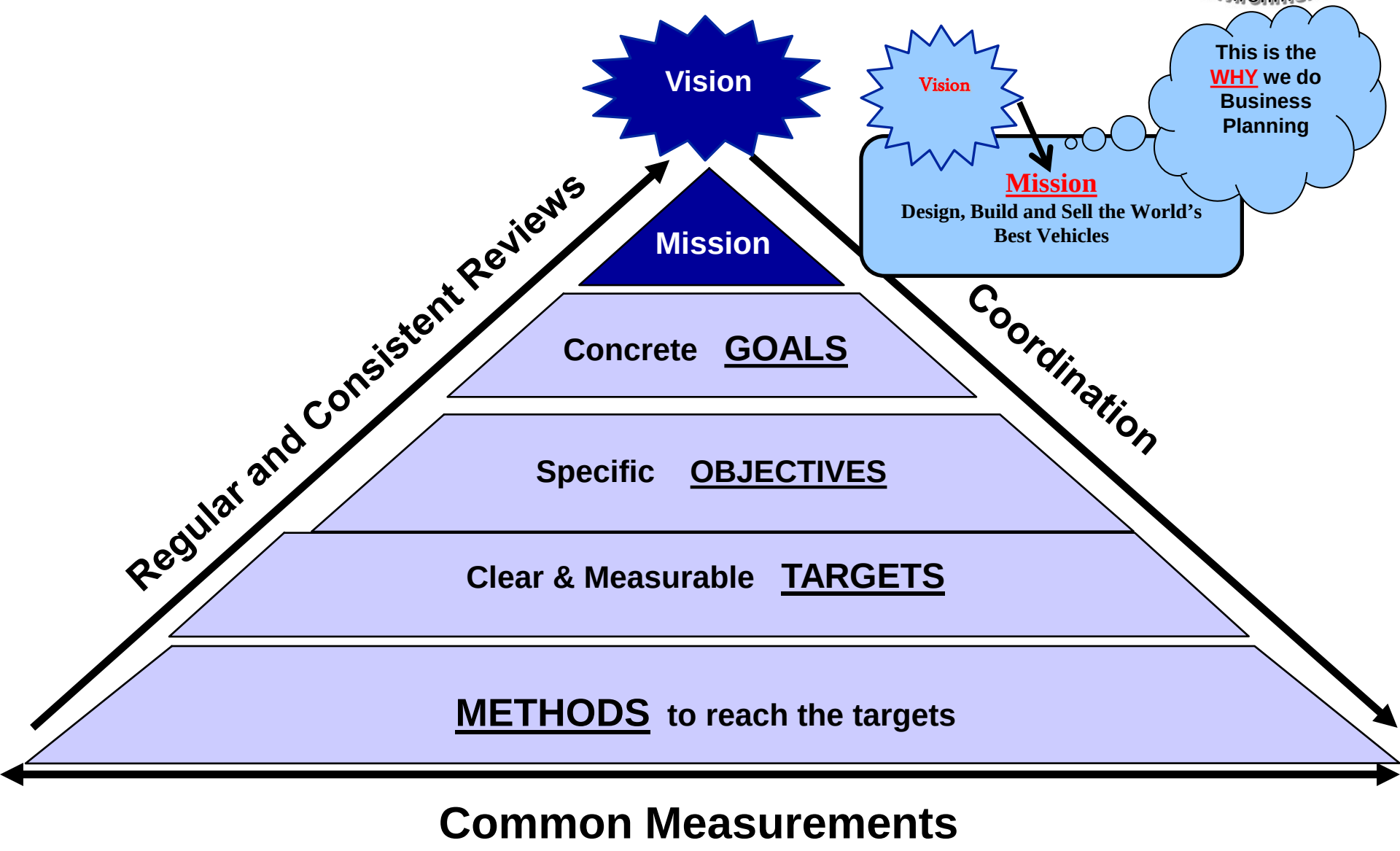
ACT

We then take Action to change the plan or get back on track in order to achieve our targets.

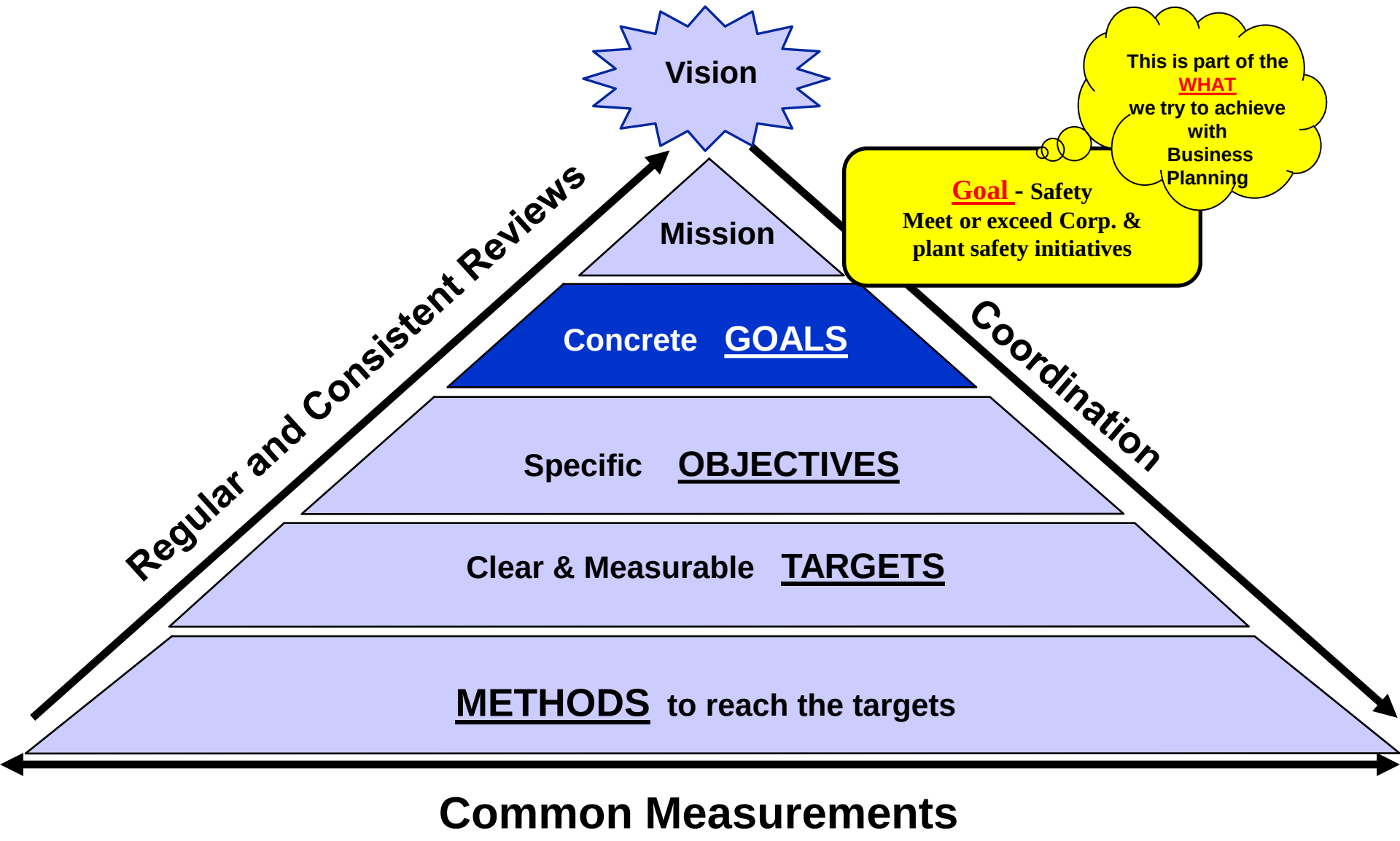
Annual Planning Cycle (Plant Example)



Business Planning Elements



Business Planning Elements

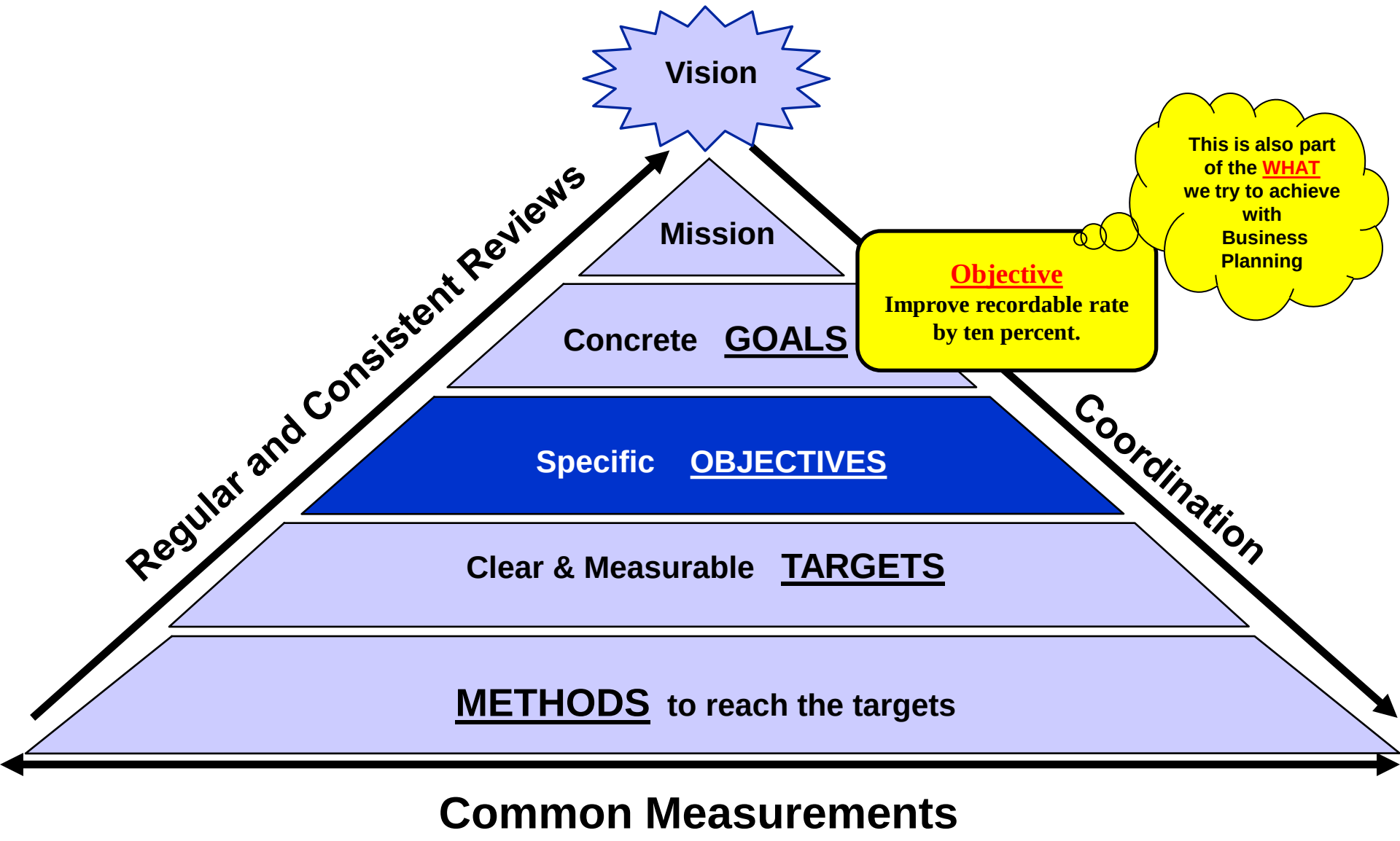


Goals

- directly support the Vision and Mission.
- are defined and supported by managers and directors.
- provide areas of focus so that specific objectives can be defined.
- fall into the BPD categories (e.g. Safety, Quality, Cost, etc.).
- may change from year to year, but do not change dramatically.

(Think of the Goal as the mission statement for each BPD category.)

Business Planning Elements

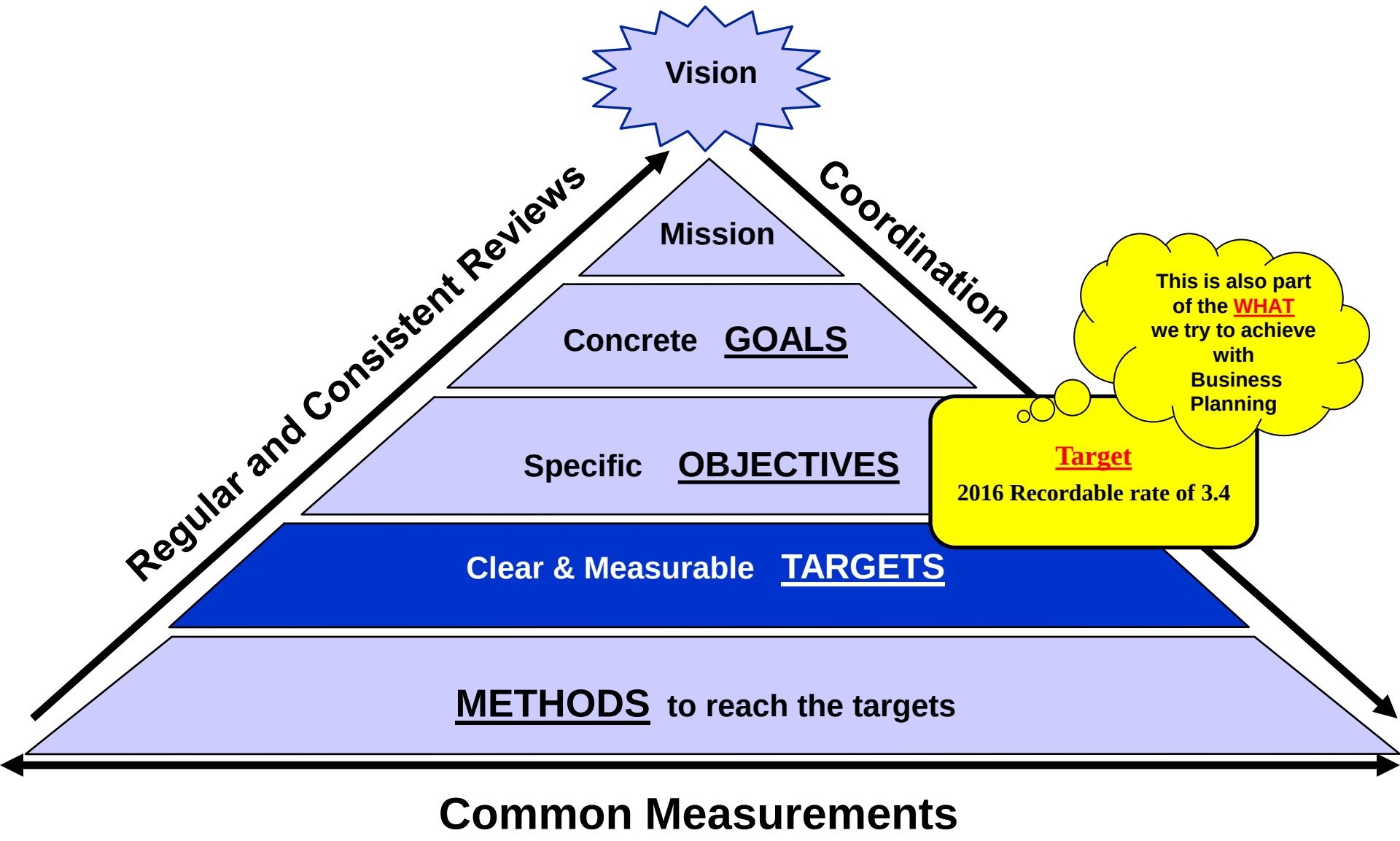


Objectives

- directly support goals and are agreed to by all levels of the organization.
- are more specific than goals.
- are documented on the annual plan.
- are followed up and reviewed monthly.

It is best to limit the number of objectives per goal, so that the team can remain focused on top priority items.

Business Planning Elements

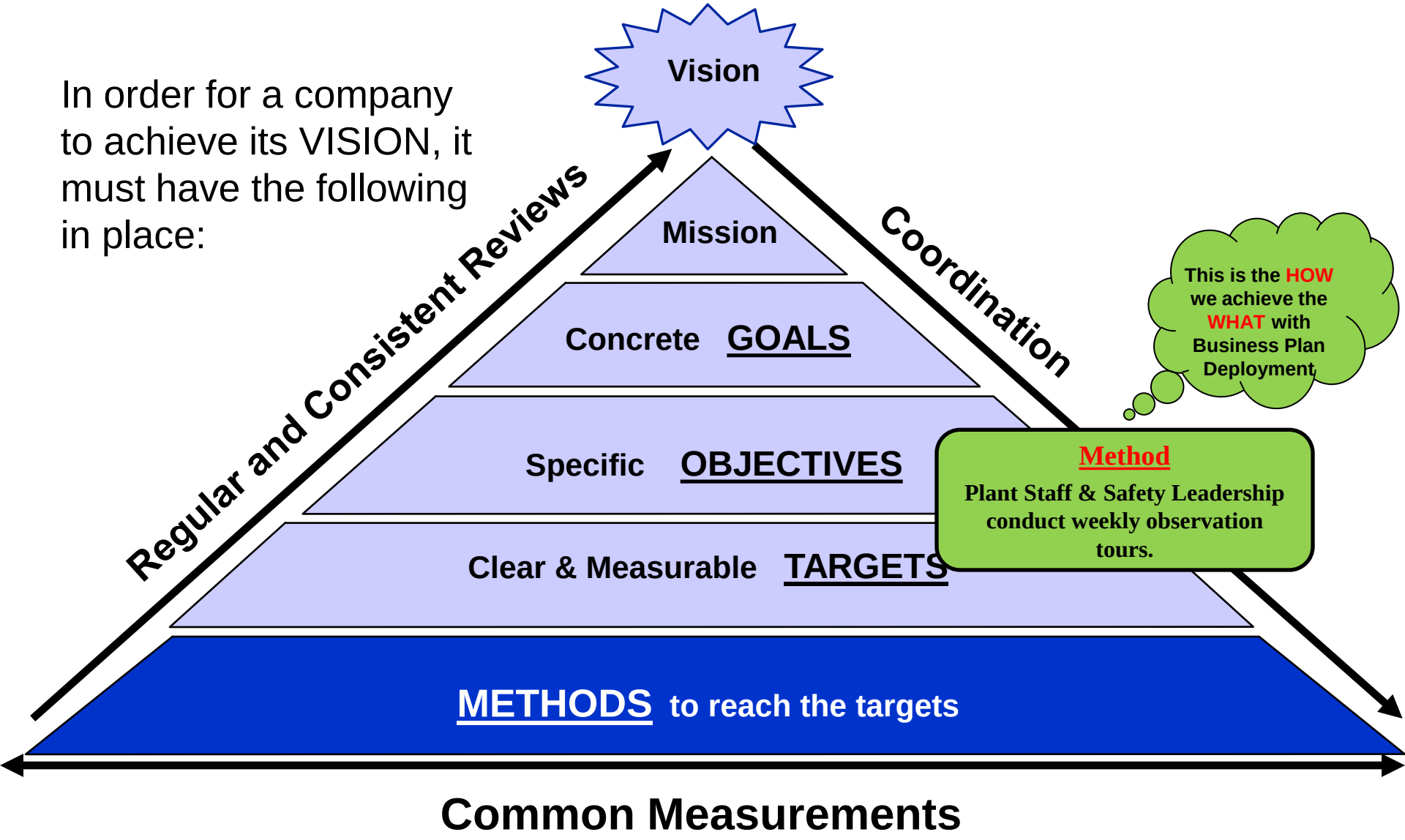


Targets

- Achievable - If targets are too high, team members will be disillusioned, and not motivated to work towards something they believe is unachievable.
- Challenging - If targets are too low, problems can remain hidden. Targets should be aggressive so that problems are uncovered, providing us with opportunities to improve.
- Based on reliable statistics and tracked regularly. Without a reliable statistics tracking system, we will be unable to measure the achievement of our objective.
- SMART (Specific, Measured, Agreed, Realistic, Timed).

Business Planning Elements

In order for a company to achieve its VISION, it must have the following in place:



Methods

- The “ *HOW* “ of the annual plan.
- Specific.
- Timed and scheduled.
- Assigned to individuals responsible for carrying them out.
- Supported by detailed action plans.

Cascading the Plan

- Vision
- Goals

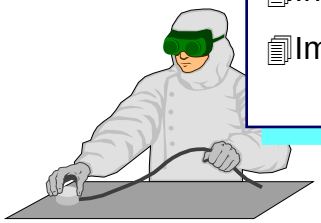
Plant Manager

- Objective
- Objective
- Objective
- Targets
- Methods

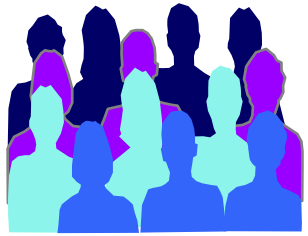
Department Directors

Feedback Loop

- Support
- Input
- Implementation



Team Leaders/ Team Members



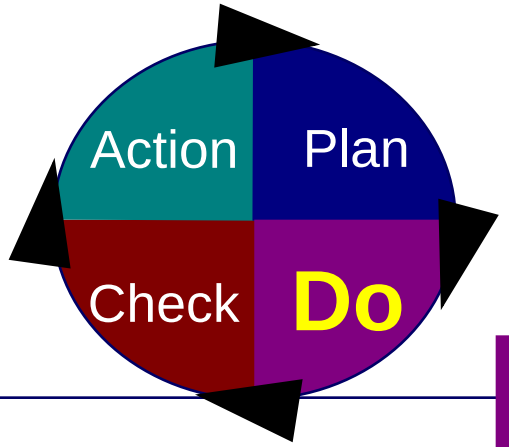
- Objective
- Objective
- Objective
- Targets
- Methods

Unit Managers/Section Leaders

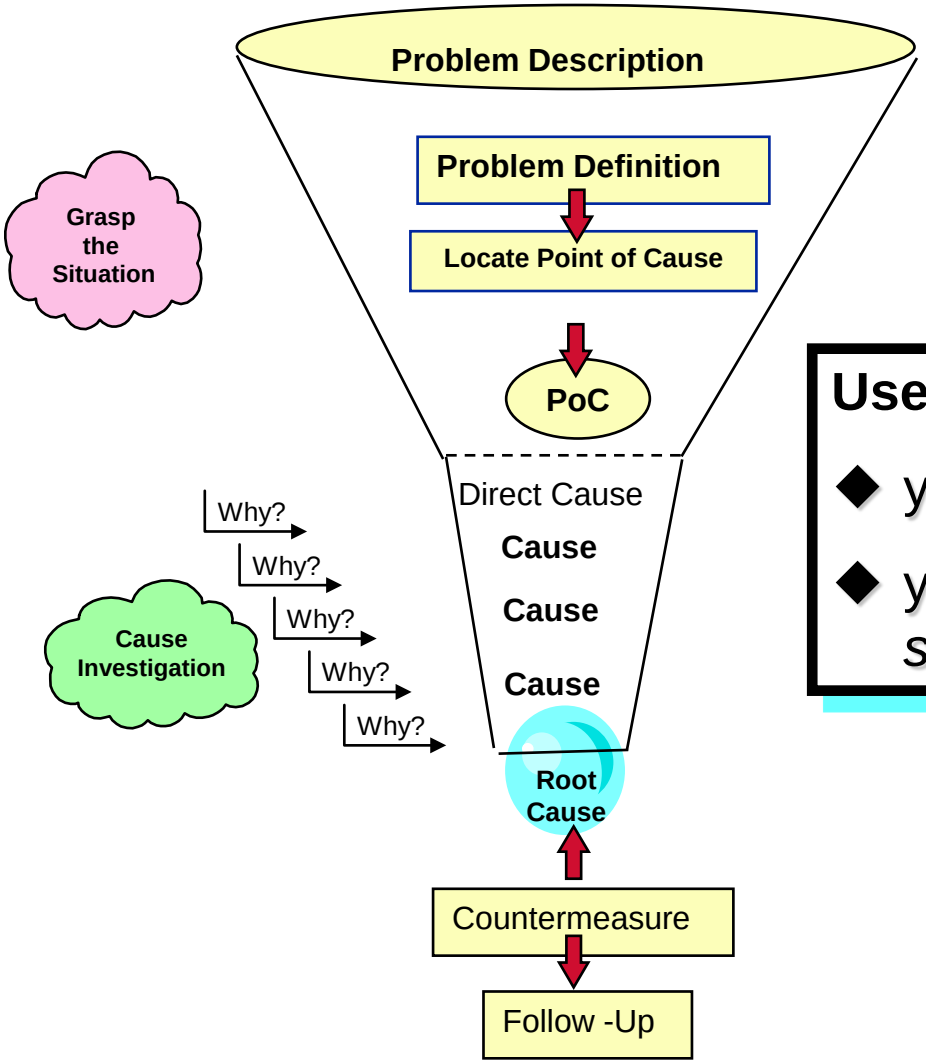
Business Planning: Do

Main Points

- Communicate and confirm the plan:
- Execute the plan as planned, on schedule
- Monitor the results and progress of the plan
- Adjust as needed to stay on plan and target
- Visualize progress to the plan:



Problem Solving



Use Problem Solving when:

- you are **not** following the plan.
- you **are** following the plan, but you are *still* not achieving desired results.

Do

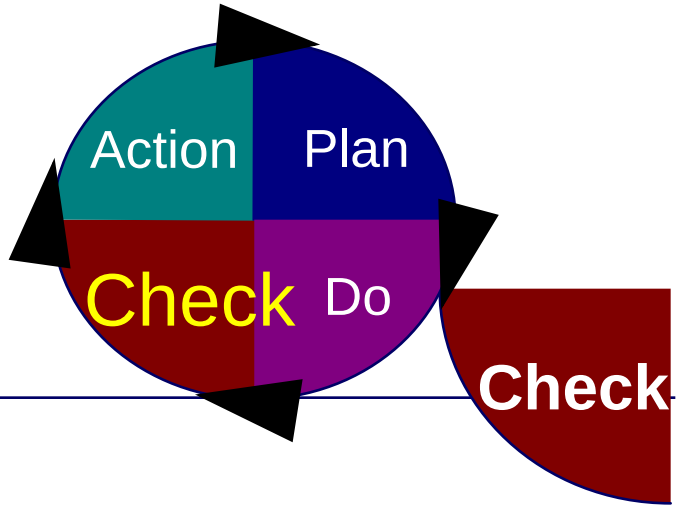
Pitfalls in the “Do” Phase

- People initiating activities that weren’t on the plan.
- People not referring to the plan for timing.
- Problems implementing planned activities due to unforeseen circumstances.
- Implementing the plan, but still not reaching the desired results.
- People wanting to make changes to the plan and implement corrective actions, without going through problem solving steps.

Business Planning: Check

Main Points

- Hold Scheduled Reviews.
- Confirm the Progress of Current Activities to Expectations.
- Confirm Results to Our Targets.
- Evaluate the Plan and Results.



Review Process

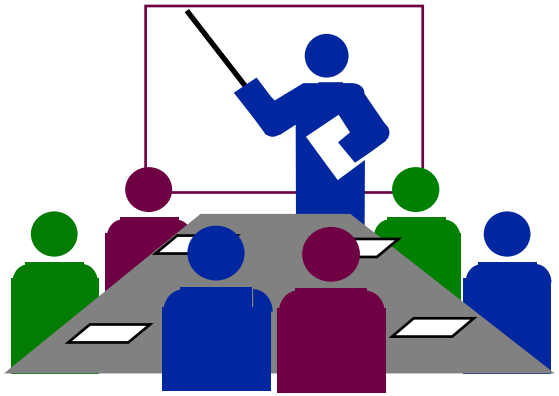
- Reviews must take place at each level with a meeting schedule that is set for the year and strictly followed to:
  - Check the process
  - Assure the plan is being followed and is on time
- A meeting schedule needs to be set for the year and strictly followed (example below). Use a visual sign-in sheet on the board to track when a review took place and who participated.

WHO	FREQUENCY
Internal Dept. Measure Reviews	Monthly
Manufacturing Unit Managers to Plant Managers and Staff	Monthly
Plant Managers to Director/Manufacturing Manager	Monthly/Quarterly
Director/Manufacturing Manager to Vice President	Monthly/Quarterly

Check

Purpose of Reviews

- A check to assure we are doing what we said we would do.
- An opportunity to review problem solving results.
- A forum to agree on new methods/countermeasures to address root cause.
- A forum to agree on new objectives and targets.
- A forum to facilitate coordination of activities and resources.
- Coach/Teach/Mentor.
- Recognize achievements.
- Share Lessons Learned.



Review Process

- Reviews should be held at the BPD boards.
- Presentations should be limited to the information on the BPD boards.
- Managers coach and asks question about Problem Solving to assure Root Cause has been found.
- Problem Solving analysis and Action Plans should be available to view or present if necessary.
- Countermeasures and activities implemented from the previous cycle are analyzed for effectiveness.

Check

Review Process

Benefits of Regular Reviews

- Achievement of the Business Plan objectives.
- Consensus on methods to achieve objectives.
- Clear Action Plans for countermeasures.
- Defined roles and responsibilities.
- Efficient distribution of resources, coordination of activities.
- Sharing of experiences.
- Assignment of activities to cross-functional departments.
- Status at a glance on Business performance to plan.

Updating The Plan

- Check the plan regularly (at least once a month)
- Make notations to the plan regarding delays, additions, or changes. Note delays or problems right on the annual plan, with an explanation.
- Can use a string, or line, or another method, to show the current month on the schedule. Immediately shows where you are on the plan.
- Fill in start/end date circles, and control points as activities are completed.
- Never delete or erase items on the plan. The plan tells a story and the story will help us in problem solving, and also in planning for next year.

Updating The Plan

- Monthly status to plan objectives and methods are best communicated by using a combination of symbols and colors for the rating system.
- Green circles show the target is being met or exceeded; and a red X represents the target was missed.

- Meets or exceeds targets

X

Targets missed

- Overall status is determined by making an assessment of planned objectives; accounting for performance to targets, trends, priorities and or relative importance.
- Overall status provides a high level “Status At a Glance” look at how the group is performing in each of the business categories.
- Visual tool supports the “Go and See” philosophy and quickly directs where follow-up support is needed.

Countermeasures

Countermeasure Sheet

COUNTERMEASURE SHEET - MONTHLY OR DAILY (circle one)

Shift	B.P.D or LA Category	Date Found	Problem Description	Root Cause	Action (Short/Long Term Countermeasure)	Target Date	Resp.	Support	Status	Comments
1	Q	11/11/13	8 fails for paint defects at Q2 - (3) dirt on left rear door; (3) craters on right front door; (2) poor metal finish repairs	Feathers found to be damaged; Seal line operator used lotion on hand at break; New operator in body repair at Elpo Sand booth	Contacted maintenance to replace broken feathers; re-instructed the operator on seal line about approved products to use; Contacted body shop GL to retrain new operator.	########	Joe P.; Tom L. & Sam W.		1	Group #4 example
2	P	11/15/13	Team leaders on line for the whole day	(4) team members absent. (2) absent due to illness; (2) not called in with reason.	Interview (2) team members that didn't call in to determine reasons for absence. Appropriate action to be determined.	########	Jim C.		2	Group #4 example
2	R	11/21/13	18 minutes of downtime at Q2 due to high volume of dirt calls on left side front and rear doors	New Q2 inspection operator at Q2. Question whether operator truly knew the standards.	Contacted the Quality Group Leader to re-instruct operator as to the correct standards for dirt calls.	########	Steve W.		2	Group #4 example
3	LA	11/22/13	Operator observed not following standardized work as described in the documentation.	Operator performed multiple repairs on vehicle prior to being observed, therefore in trying to catch up failed to do next car as desceribed.	Counseled operator that in cases where this issue takes place to use the Andon cord to call for help or stop the line long enough to catch up doing the proper process.	########	Jim C.		3	All area example
1	P	11/10/13	Missing sign ins on PMP check log for dates 11/9/13 and 11/10/13	Operator stated that checks were performed but forgot to mark the log	Re-instructed operator as to the importance of performing PMP checks	########	Jim C.		3	Group #3 example
2	C	11/16/13	Approximately 50 lbs. of powder spilled on the floor in the powder storage area	Operator did not properly latch hoist connections on bag before transferring bag for use.	Check standardized work (TIS) to ensure that the correct procedure was documented, re-instructed and observed operator to ensure proper process was followed.	########	Jim C. Tom.M		2	Group #3 example
3	Q	11/21/13	8 Sand mark defects found on liftgates (lower left side) at TCR	Observed operator using wrong grit of sand paper to perform repairs.	Instructed Team Leader to make sure correct paper was available and ensure operator performed repairs correctly.	########	Tom. M.		2	Group #3 example
										Group #1 Example

Status Legend: Action Identified (PLAN) | Action Being Implemented (DO) | Action Being Evaluated (CK) | Action Closed (ACT)

Countermeasures – Defining the Problem

Is the Countermeasure Effective? – BPD, Layered Audit, Alarms

Is the problem clearly defined?
Supports identification of Root Cause.

- Goal was not met - What happened (actual vs should)
- Define the situation - When, How Many, Where?

Problem	
Door window doesn't work	Poorly written problem description
Left front door window doesn't go up or down	Better written problem description

Problem descriptions, root causes and actions should answer **all** the following questions to provide the best information:

	What happened - part defect, machine malfunction, near miss, target, task not complete
	When - date, time, shift
	How Many - qualtity, %
	Where - could be station #, location on a part

Countermeasures – Determining Root Cause

Is the reason Why the problem occurred clear? Ensures C/M focused on the cause.

- Ask Why until clear.

To write an effective Countermeasure the root cause of a problem must be clearly identified. If…

Root cause identified
Effective countermeasure
Problem does not recur

Root cause not identified
Poor countermeasure
Problem recurs

Root Cause	
Harness not plugged in	Vaguely written root cause
Electrical connection to window regulator not completely plugged in	Better written root cause

	Why did the problem occur
	Keep asking (5 Why's) until originating cause (Root) is identified
	Perform Therefore test Say "Root Cause" therefore each cause and the answers connect back to the problem
	If outside the area of control then assign to responsible person

Countermeasures – Documenting Actions

If this action is implemented will the problem re-occur? Effective C/M prevents a repeat of same problem.

- Look for timing and single owner

Action Countermeasure	Timing	Resp.
Changed JES	TBD	
Changed key point on JES to do push click pull test on connection	10/07/13	JMC

Poor attempt at an action description

Better attempt at an action description

	Short Term - Will the implementation of this action contain the problem, action taken to minimize impact
	Long Term - Will the implementation of this action prevent a repeat
	Is more formal problem solving required- see problem solve criteria
	Timing is aggressive but realistic completion date
	Responsible person owns the problem and can fix it

Countermeasures – Status

Where is this issue in the PDCA cycle? Inspect what you Expect.

- Follow up until closed.

Status	Support / Comments
●	I think it's fixed
●	JES re-written and TM's trained to new task

Poorly written comment

Better written comment

	Plan is sound
	C/M implemented
	Evaluation supported by data
	Data shows problem closed

Notes on Countermeasures

- Recognize the difference between “soft” & “hard” countermeasures (both of which may be required).
- Soft countermeasures
  - do not involve error proofing.
  - are often people focused instead of process focused.
  - frequently involve “counseling or retraining the Team Member.”
- Hard countermeasures
  - limit risk or error proof the process altogether.

Management's Role in the Team Problem Solving Process

- Establish, maintain, and continuously improve the system.
- Refrain from tampering/overriding the priority system.
- Provide the "right" resources (people, facilities, etc.) in sufficient quantity and quality to complete the task in a timely manner.
- Respect resource commitments.
- Provide clear expectations - before the fact.
- Share significance (impact) of problem with team.
- Live up to commitments - People, time, resources.
- Understand the process and support the team.
- Give authority to team members.
- Provide constructive/supportive interest in team and process.
- Review progress and ask constructive coaching questions.
- Require adherence to proper process and appropriate documentation.
- Be patient.

  Demanding "instant solutions" to problems forces teams to shortcut the process which often results in failure to identify root cause or otherwise fatally flaws the process.

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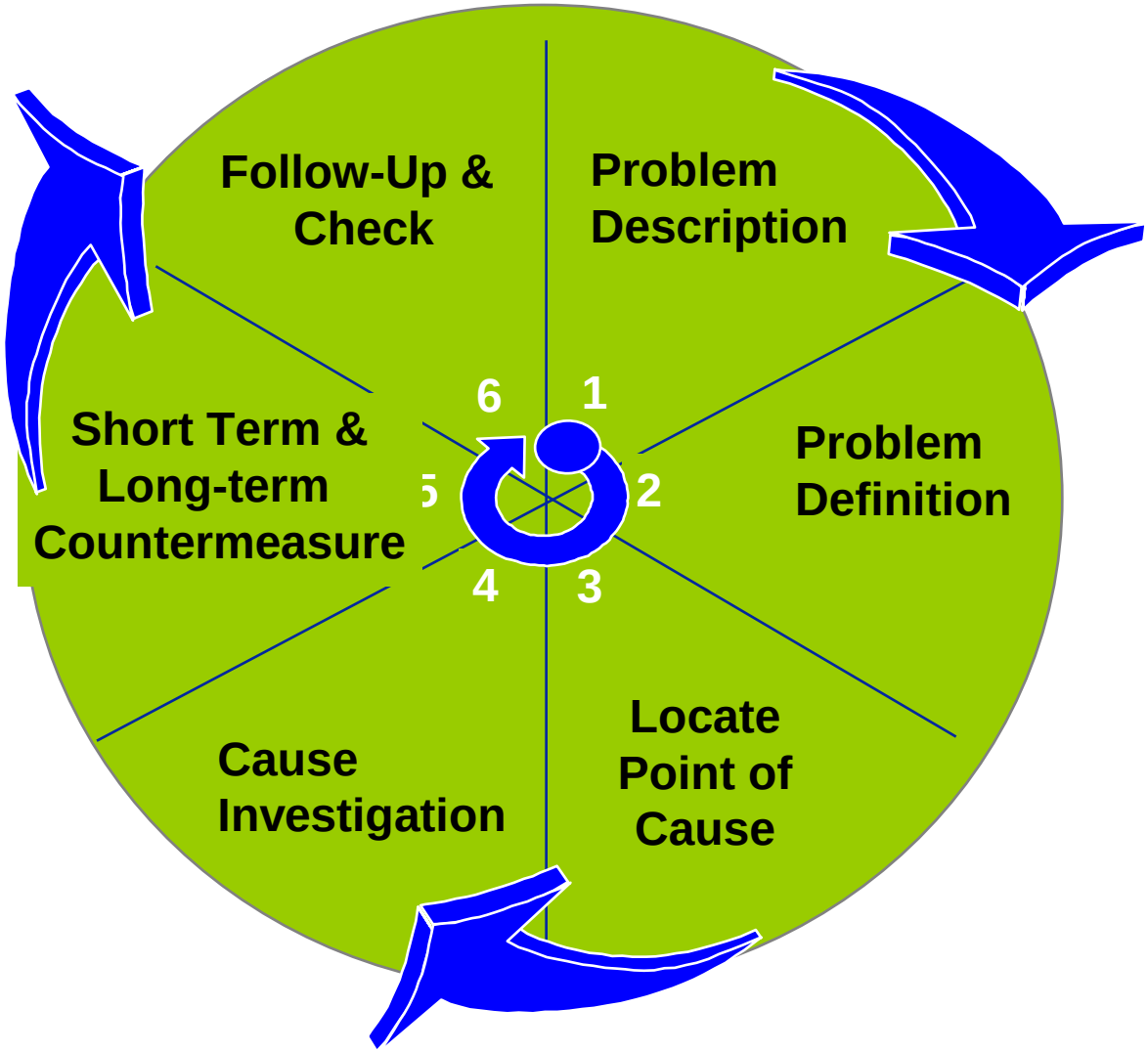
Practical Problem Solving

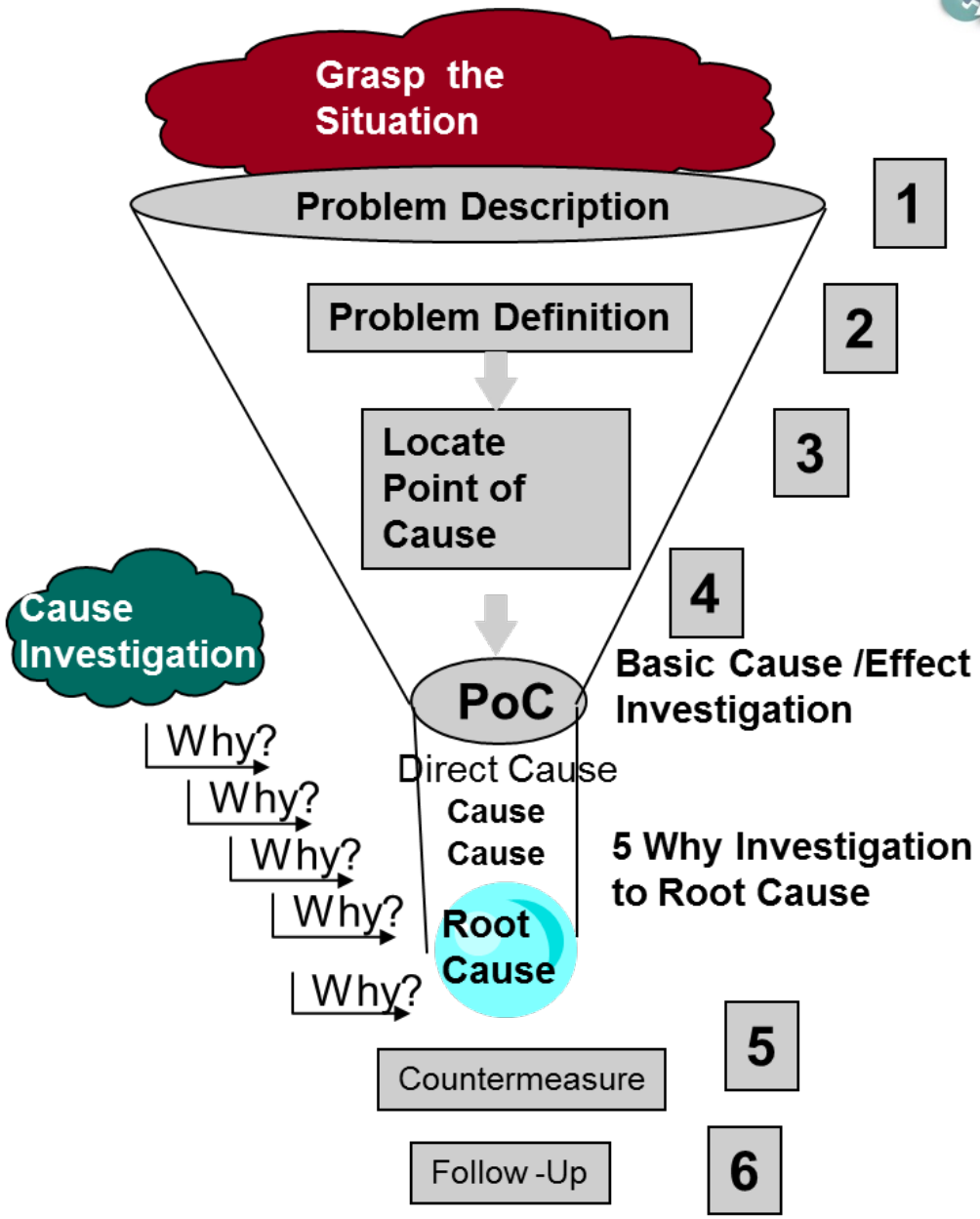
Many forms of problem solving exist:

- Ford typically uses the 8-D process
- GM typically uses the 6-Step PPS process
- Chrysler typically uses the 7-D process
- Many companies use a 4-Step process

6-Step Problem Solving



PPS Funnel


Grasp the Situation
Problem Description
1
Problem Definition
2
Locate Point of Cause
3
4
Cause Investigation
PoC
Basic Cause /Effect Investigation
Why?
Why?
Why?
Why?
Why?
Direct Cause
Cause
Cause
Root Cause
5 Why Investigation to Root Cause
Countermeasure
5
Follow -Up
6

Problem solving problems

- Problem is described incorrectly or inadequately.
- Some of the 8-D steps are skipped or ‘sluffed off.’
- Poor team make up or poor participation.
- Lack of team technical expertise and skills.
- Incorrect or incomplete root cause was identified.
- Preconceived notions clouding the problem-solving process.

Use A Team Approach

Team members must be:

- Willing to contribute.
- Capable of intelligently diagnosing problems.
- Trainable - willing to learn.
- Team players.
- Trusting team members.
- Able to bring their expertise and skills to bear on the problem.

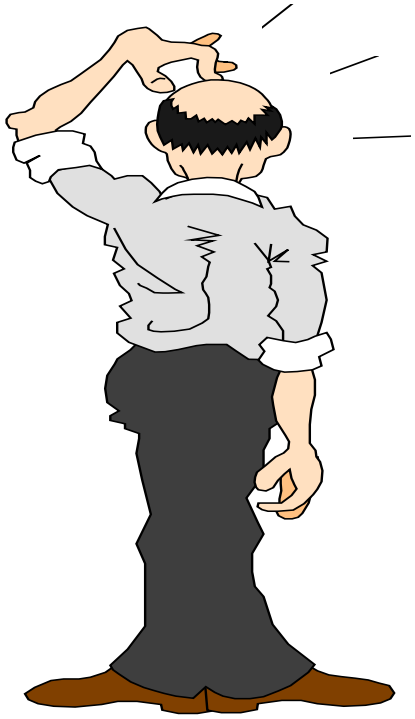
Basic team principles:

- Focus on the situation, issue, or behavior, not other persons.
- Maintain the self-confidence and self-esteem of others.
- Maintain constructive relationships with team members and support personnel.
- Take initiative to make things better.
- Lead by example.

Step #1 – Problem Description

A large, vague description of what you think the problem is. (“Like a Google Search”)

“Misapplied sealer on the quarter panel”

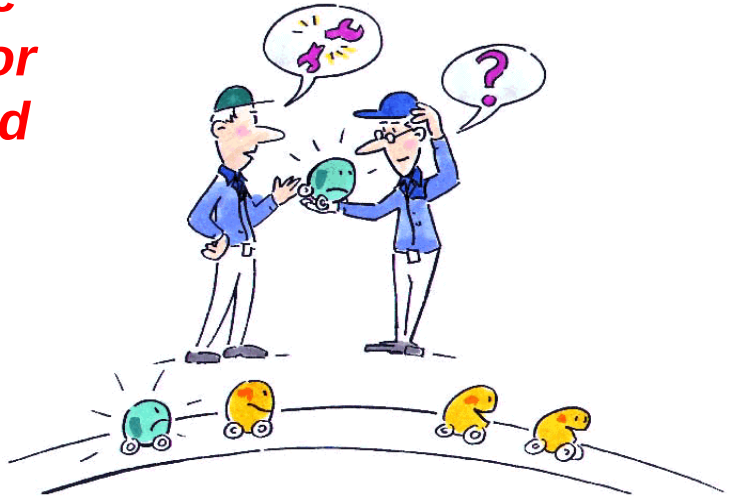


Write a statement that describes in general terms the current situation.

Step #2 – Problem Definition

Completely describe the deviation between the standard or expected results and what is actually happening.

"Misapplied sealer found on left side rear door toward the back of the door above the feature line. No misapplied sealer is allowed on an A-surface."



Question for Clarification

WHO.

- Identify individuals associated with the problem.
- Characterize customers who are complaining.
- Who is having difficulty?

WHAT.

- Describe the problem adequately.
- Does the severity of the problem vary?
- Are operational definitions clear (e.g., defects)?
- Is the measurement system repeatable and accurate?

WHERE.

- If a defect occurs on a part, where is the defect located?
- What is the geographic distribution of customer complaints?
- Where the difficulties being detected?

WHEN.

- Identify the time the problem started and its prevalence in earlier time periods.
- Do all production shifts experience the same frequencies of the problem?
- What time of the year does the problem occur?

WHY.

- Any known explanation contributing to the problem s hould be stated.

HOW.

- In what mode of operation did the problem occur?
- What procedures were used?

HOW MANY.

- What is the extent of the problem?
- Is the process in statistical control? (e.g., P chart)

Problem Solving Documentation

A PROBLEM SOLVING WORKSHEET THAT COMBINES 5W2H AND IS/IS NOT ANALYSIS CAN BE A GOOD TOOL TO ENSURE ALL ASPECTS OF DEFINING THE PROBLEM HAVE BEEN CONSIDERED

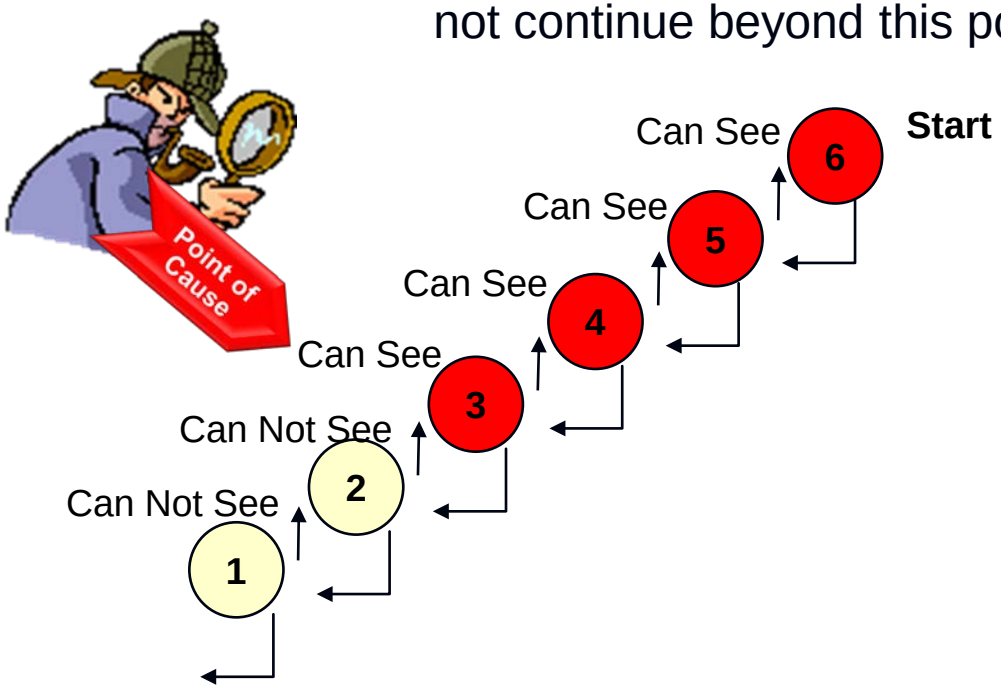
PROBLEM SOLVING WORKSHEET

1. Problem Statement
(What's wrong with what)

2. Description of problem	IS	IS NOT	Deductions About Facts and Other Information			Possible Causes
			Differences	Changes	Date	Speculate – Indicate mechanism
WHAT Object						
Deviation						
WHERE Seen on object						
Seen geographically						
WHEN First seen						
When else seen						
When seen in process (life cycle)						
HOW BIG Number of objects affected						Test causes for probability: Challenge each with "How does it explain (each) is/is not fact?" Note assumptions needed to explain. Note facts which "Shoot Down."
Number of problems						Plan to verify (Root cause):
Size of problem						

Step #3 – Locate Point of Cause

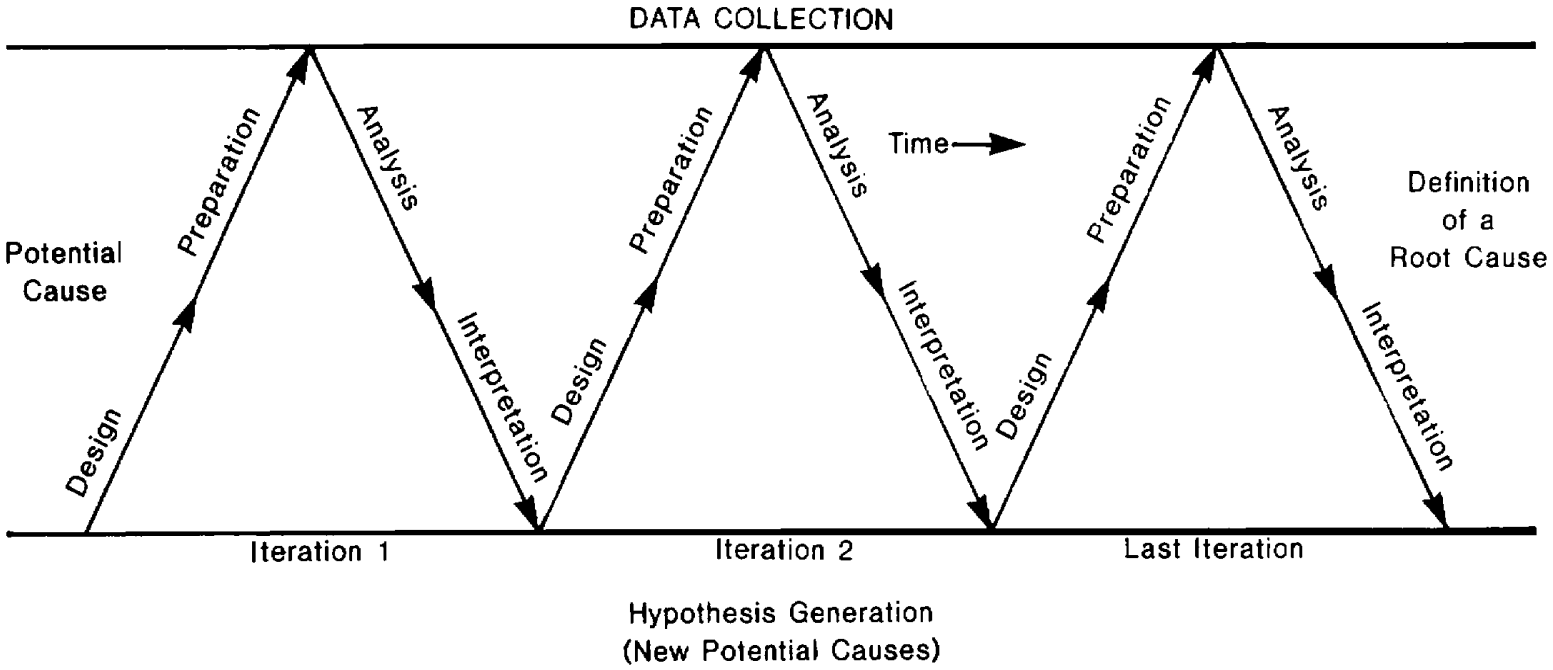
- "Where is the problem occurring?"
- Where is the problem actually caused? (as opposed to where the problem is first observed)
- Walk process back until condition is no longer evident
- Continue for several more stations to be sure the condition does not continue beyond this point



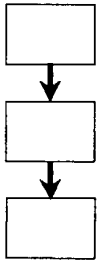
"Team member at operation 004L is reaching inside car to the floor pan getting sealer on right arm sleeve before touching exterior rear door surface."
Point of Cause is 41R

Collect and Analyze Data

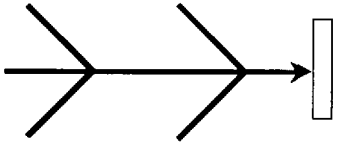
- Collect data to determine importance of potential causes.
- Several potential causes may need to be analyzed through data.
- Six steps in investigating a potential cause:
  1) How could the potential cause have resulted in the problem?
  2) What type of data should be collected to prove it?
  3) Prepare the materials to conduct the study
  4) Collect the data
  5) Analyze statistically
  6) State conclusions



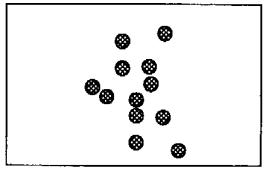
Data Collection Techniques



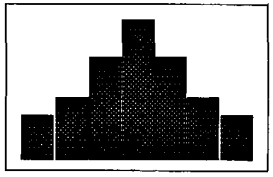
Flow Charting



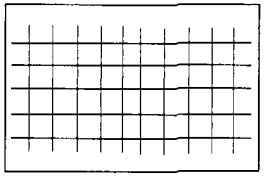
Cause & Effect Diagram



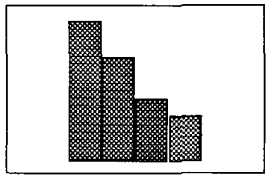
Scatter Diagram



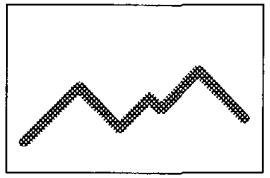
Histogram



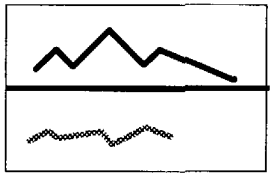
Check Sheets



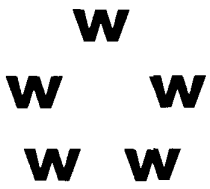
Pareto Chart



Run Chart



Control Chart



Brainstorming

Step #4 – Cause Investigation

5 Why's

- Identify the Problem Statement using data not assumptions.
- Prompt for responses that can be verified with data, no opinions.
- Ask Why until you get to an Actionable root cause
- Be sure you can answer "How the problem occurred", "Why it was not detected".
- It is possible to need more or less than 5 Whys. Continue asking Why until the root cause is found.
- Blame the process, not the people!

Step #4 – Cause Investigation

- **"The internal mail is often late."**
  why is the internal mail often late?
- "The actual delivery starts too late."
  why does the actual delivery start too late?
- "There is too much re-sorting."
  why is there too much re-sorting?
- "There's a significant number of wrong addresses."
  why is there a significant number of wrong addresses?
- When people move we don't update the address list.

Root Cause: **Address list is not updated**.

Can these responses be verified with data?

Direct Cause

The substandard acts or conditions which directly contribute to the occurrence of an accident/incident.

Root Cause

The job and personal factors from which substandard acts and/or conditions originate.

Step #5 – Short/Long Term Countermeasures

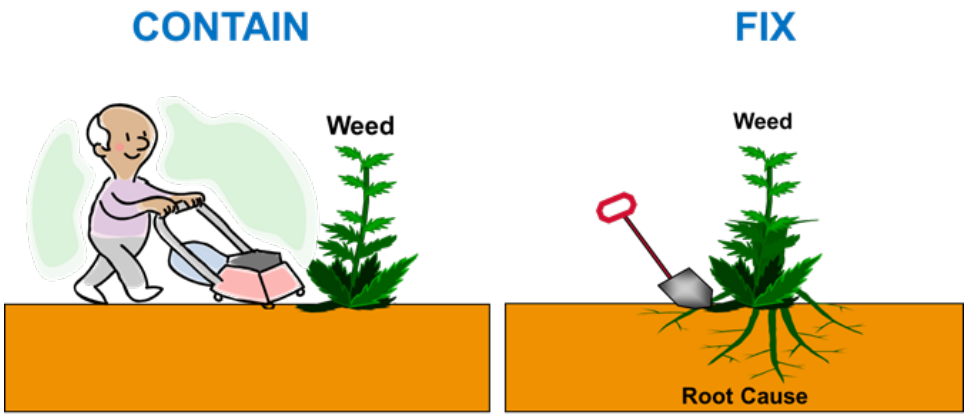
Containment vs. Countermeasure

Containment (Short):

- Protects the Customer
- Stops producing suspect material
- Quarantines all suspect material

Countermeasure (Long-Fix):

- Addresses the root cause of the problem
- Prevents the problem from recurring
- An action that is timed to measure effectiveness



Step #6 – Follow Up and Close Out

Follow ups ensure effectively implemented countermeasures

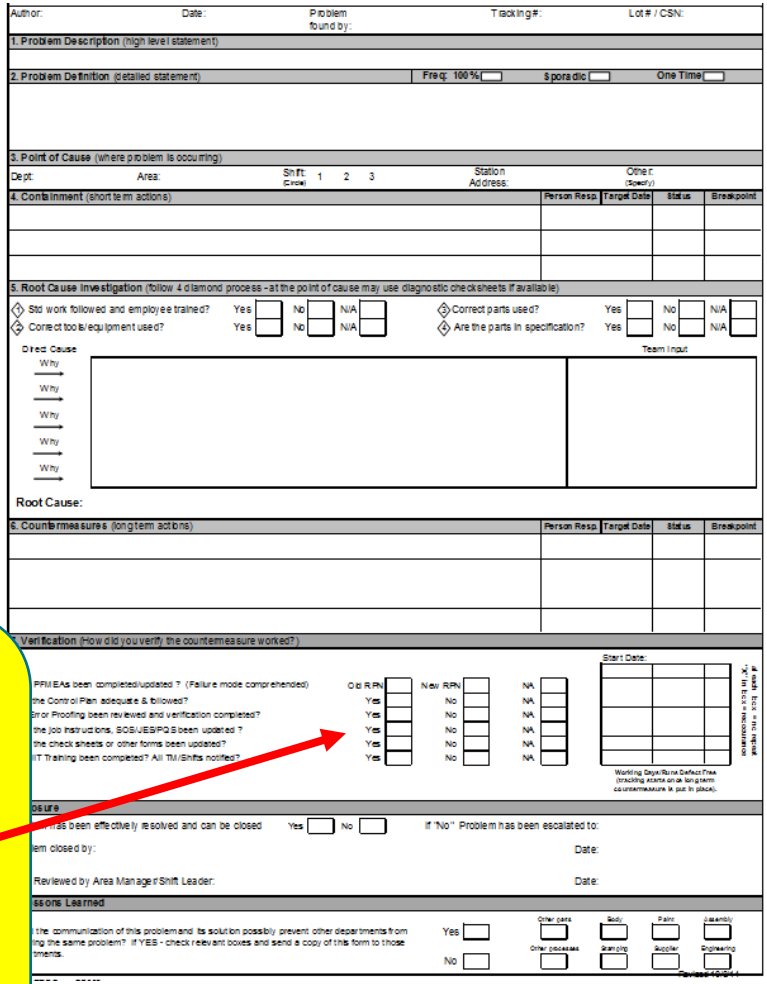
- Answer verification questions
- Run trial
  - Run the trial until assured the problem is dead
  - Initial in box if there was no discrepancy found that day
  - “X” in box if there was a discrepancy found that day

7. Verification (How did you verify the countermeasure worked?)

Start Date:

Have PFMEAs been completed/updated ? (Failure mode comprehended)	Old RPN		New RPN		NA					
Was the Control Plan adequate & followed?	Yes		No		NA					
Has Error Proofing been reviewed and verification completed?	Yes		No		NA					
Have the job instructions, SOS/JES/PQS been updated ?	Yes		No		NA					
Have the check sheets or other forms been updated?	Yes		No							
Has JIT Training been completed? All TM/Shifts notified?	Yes		No							

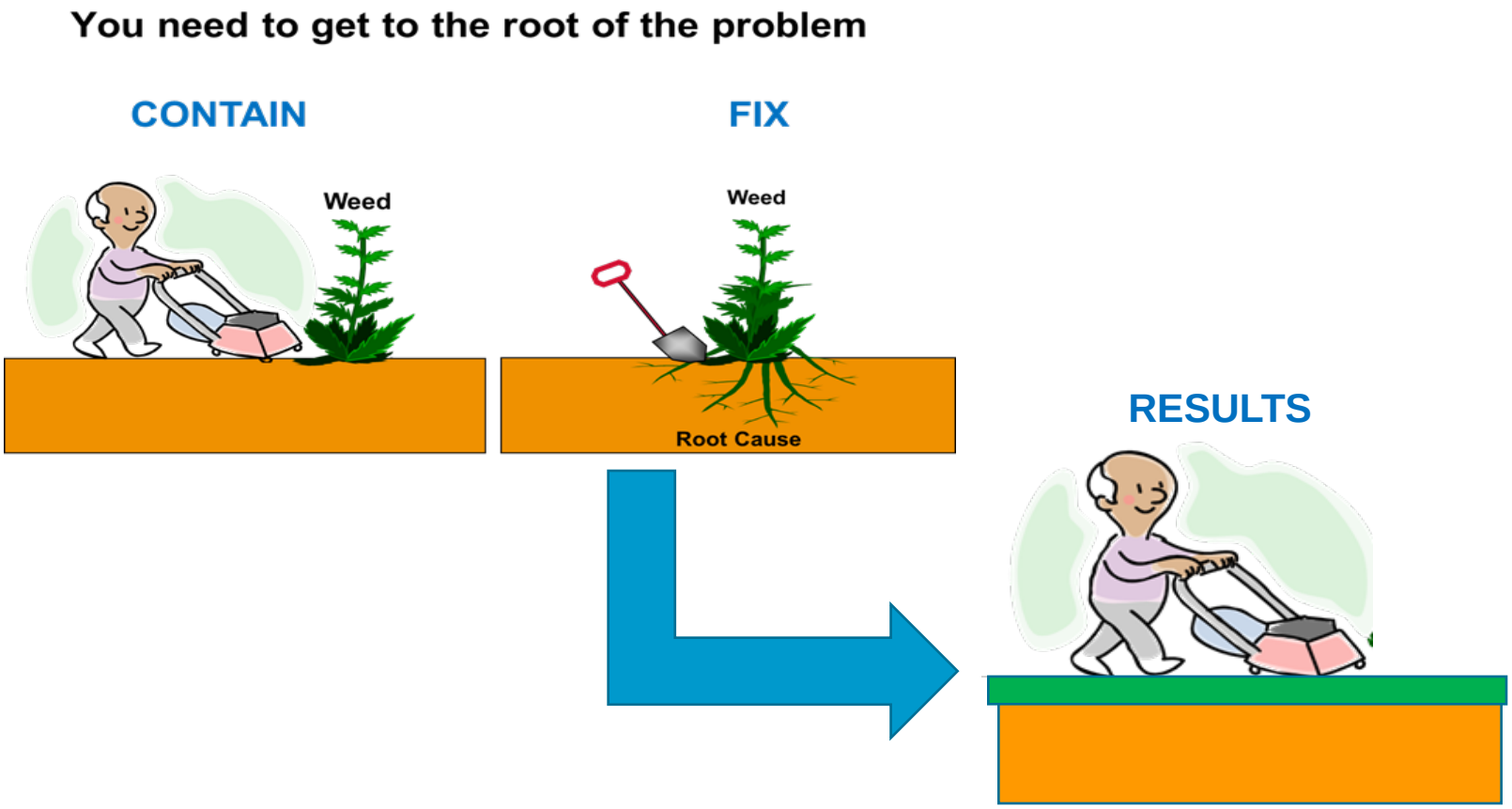
Initial each box = reoc... “X” in box = discrepancy



Verification is done only after Countermeasure has been implemented and break point has been reached

Step #6 – Follow up & Close Out

Close out makes sure the problem is indeed gone.



Congratulate & Reward the team

- Determine the appropriate recognition for all team members
- Document the efforts of the team
  - Videotape the problem and the resolution.
  - Present the case to the operating committee.
  - Publish and distribute a notice or paper about the team’s efforts.

- Investigate any possible larger (Patent) applications that the problem resolution can be applied.

Management's Role in the Team Problem Solving Process

- Establish, maintain, and continuously improve the system.
- Refrain from tampering/overriding the priority system.
- Provide the "right" resources (people, facilities, etc.) in sufficient quantity and quality to complete the task in a timely manner.
- Respect resource commitments.
- Provide clear expectations - before the fact.
- Share significance (impact) of problem with team.

Management's Role in the Team Problem Solving Process

- Live up to commitments - People, time, resources . . .
- Understand the process and support the team.
- Give authority to team members.
- Provide constructive/supportive interest in team and process.
- Review progress and ask constructive coaching questions.
- Require adherence to proper process and appropriate documentation.
- Be patient: Demanding "instant solutions" to problems forces teams to shortcut the process which often results in failure to identify root cause or otherwise fatally flaws the process.


5S
SORT
1
SET IN ORDER
2
SHINE
3
STANDARDIZE
4
SUSTAIN
5

More than just housekeeping

- Organizing your workplace is not just tidying up
- Efficient and Ergonomic not just pretty
- Waste removal means more than just the scrap

  7 types of waste

Transport	Inventory
Motion	Waiting
Over-production	Over-processing
Defects	Talent (Not part of original wastes)

- An environment that promotes continual improvement by exposing waste and abnormalities (out-of-standard conditions)

What is 5S?

5S is a systematic approach to workplace or home organization and housekeeping. Encouraging ownership and self-discipline to sustain and further develop working practices.

5S aims to:

- Improve safety
- Remove waste from the workplace
- Improve quality
- Provide an environment where continuous improvement is embraced
- Makes out-of-standard conditions immediately visible

Origins of 5S

- Started with Japanese initiation of Lean Based on observations of Ford Motor Co. and Piggly Wiggly supermarkets
- Help set the framework for Just In Time (JIT) material delivery
- Help set the framework for waste elimination

Steps of 5S

- Sort (clearing – Seiri)

  Clearly separating the necessary from the unnecessary and removing the unnecessary
- Set in Order (organize – Seiton)

  Visually arrange and identify items for ease of use and retrieval
- Shine & Check (clean/check – Seiso)

  Keeping the workplace or other areas clean (not pretty) to allow out-of-standard conditions to be identified
- Standardize (conform – Seiketsu)

  Continually monitor the level of clearing, organizing, and cleaning
- Sustain (custom/practice – Shitsuke)

  Work toward a shared set of values regarding clearing, organizing, and cleaning

Sort Process

- Definition: Involves the sorting of the contents in an area and removing unnecessary items.

- Why: Problems are reduced and it improves work flow & communication.

- Problems avoided: Clutter in the workplace.

  (i.e. Time wasted searching for tools and/or parts. Un-needed inventory such as parts and/or material.)

The 1st “S” Sort

UN-NEEDED	NEEDED
(Red Tag) means: • Unsafe/ Defective • Obsolete • Hoarded junk • Too many • Rarely used parts & equipment • Unknown	means: • Used for daily work • Used periodically (changeovers) • Used by someone in the area

The 1st “S” Sort

Basic Rules for Red Tagging

- Team will establish a deadline for initial disposition. (Usually 24-48 hrs.)
- Team to define a “Red Tag Area” to hold items awaiting disposition.
- Disposition for all items should be recorded listing the item description, picture if applicable, and final disposition i.e. scrap, return to stores, etc.
- Raw materials are reviewed from a “visual inventory” standpoint.
- Items with an asset number may have to go through a special disposition process.
- Any parts such as motors, gearboxes, bearings, belts, etc. can be referred to Maintenance and Stores for final disposition.
- Chemicals should be referred to Safety Mgr. and Quality Mgr. for disposition directions.

Set in Order Process

- Definition: Involves the arrangement of the necessary items for easy and efficient access and keeping them in that order.

- Why: Eliminates many kinds of waste. (i.e. Scrap, time, lost opportunity.)

- Problems avoided: Waste in motion, searching, human energy, excess inventory, & defective products.

The 2nd “S” Set In Order

- Analyze the situation for the designated area.
- Target issues and areas to improve.
- Decide where things belong, how they should be kept and agree upon the best location and method to address these concerns.
- Make it obvious - “Visual Controls”.
- Labels and color coding (shows ownership, optimal set-points). Signboards (metrics, component names, etc).

Set in Order examples

Shine Process

- Definition: Involves the cleaning of everything in the work area and keeping it clean.

- Why: Use cleaning as a way to ensure that the area & equipment are maintained as they should be “ in like new condition”.

- Problems avoided: Low moral, safety issues, and hidden defects.

The 3rd “S” Shine

- Inspect the work area and equipment, with an emphasis on health and safety.
- Begin eliminating obvious defects on the shop floor and on equipment.
- Identify areas needing attention such oil leaks, frayed belts, excess grease, peeling paint.
- Itemize required materials such as cleaners, degreasers, paint, etc. All material must be approved for use in a food facility.
- Itemize work required and develop schedule.

Standardize Process

- Definition: Involves creating or updating Standard Operating Procedures for keeping the area organized, orderly, clean and make the workplace more visual and obvious.

- Why: Integrates first 3 S's into a unified structure.

- Problems avoided: helps to prevent regression.

The 4th “S” Standardize

- Review and incorporate organizational practices as required.
- Establish operations SOPs and maintenance work instructions for the visual workplace.
- Create schedules and checklists that define required activities and responsibilities.
- Establish “visual controls” (sign-boarding).

Sustain Process

- Definition: Creating a process to ensure 5S is ingrained into the organizational culture.
- Why: The organization needs to ensure that the gains made are maintained through the first four steps.

  Also used as a basis for continuous improvement.
- Problems avoided: The ability to slip back to not doing 5S.

The 5th “S” Sustain

- Get management commitment.
- Create schedules and checklists that define required activities and responsibilities.
- Establish and promote routine audits to sustain organizational practices.
- Adhere to first 4 S categories.
- Set practical goals and give adequate feedback to all.
- Implement a discipline for culture change to maintain the 5 S concepts.

Examples of 5S

- Silverware organizers
- Library/Bookstores
- Traffic Signs & Maps
- Parking Lots
- Department, Building Supply, and Grocery Stores
- Airports
- Fire Stations & Engines
- Fast food restaurants

Areas In Need Of 5 S

5S Before and After

5-S Work Floors

Review

- 5-S is a systematic organizational approach to manufacturing and other activities
- Developed in its current form by Toyota
- **S**ort, **S**et, **S**hine, **S**tandardize, and **S**ustain
- A method you live EVERY day – NOT a one time occurrence.

Value Stream Mapping

Creating a Value Stream Map:

- A team exercise
- Includes the people most involved in the process.
- Looks at what actually happens vs. what should happen.
- Usually supplier to customer process for a particular product or product family.

Choosing the product or product family

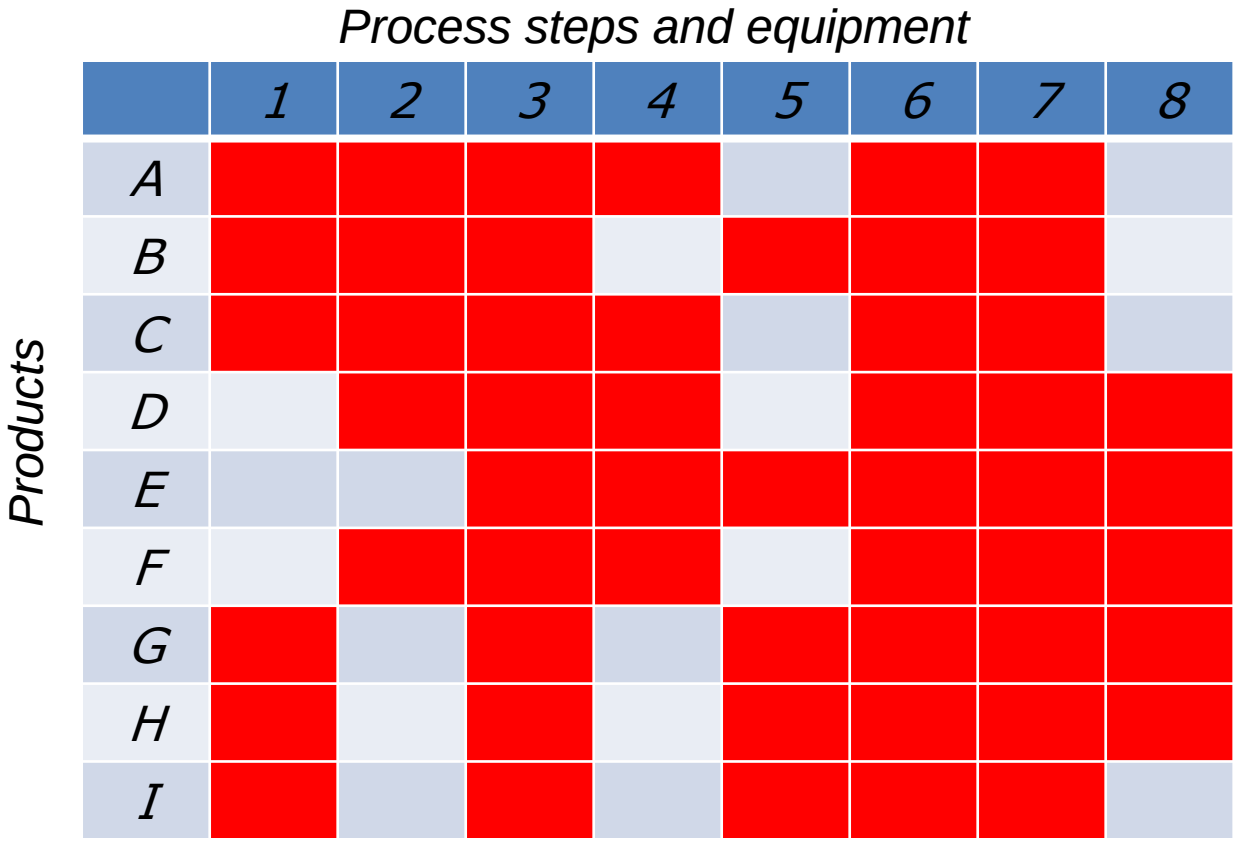
- Choose one product / family of products to map
- Select one to be mapped:
  - Needs improvement
  - Valuable to the company
  - High likelihood of success
  - Can form the basis of improvement of other products / families

Product Family Analysis

- Sometimes a company has many products:
  - can be difficult to decide which to map
  - can be difficult to define families of products
- Product families share common processes and process routes.
- Simple matrix can be used to identify product families.
  - use the highest volume / contributing products

Product Family Analysis Matrix

- Identify suitable Product Family by grouping:

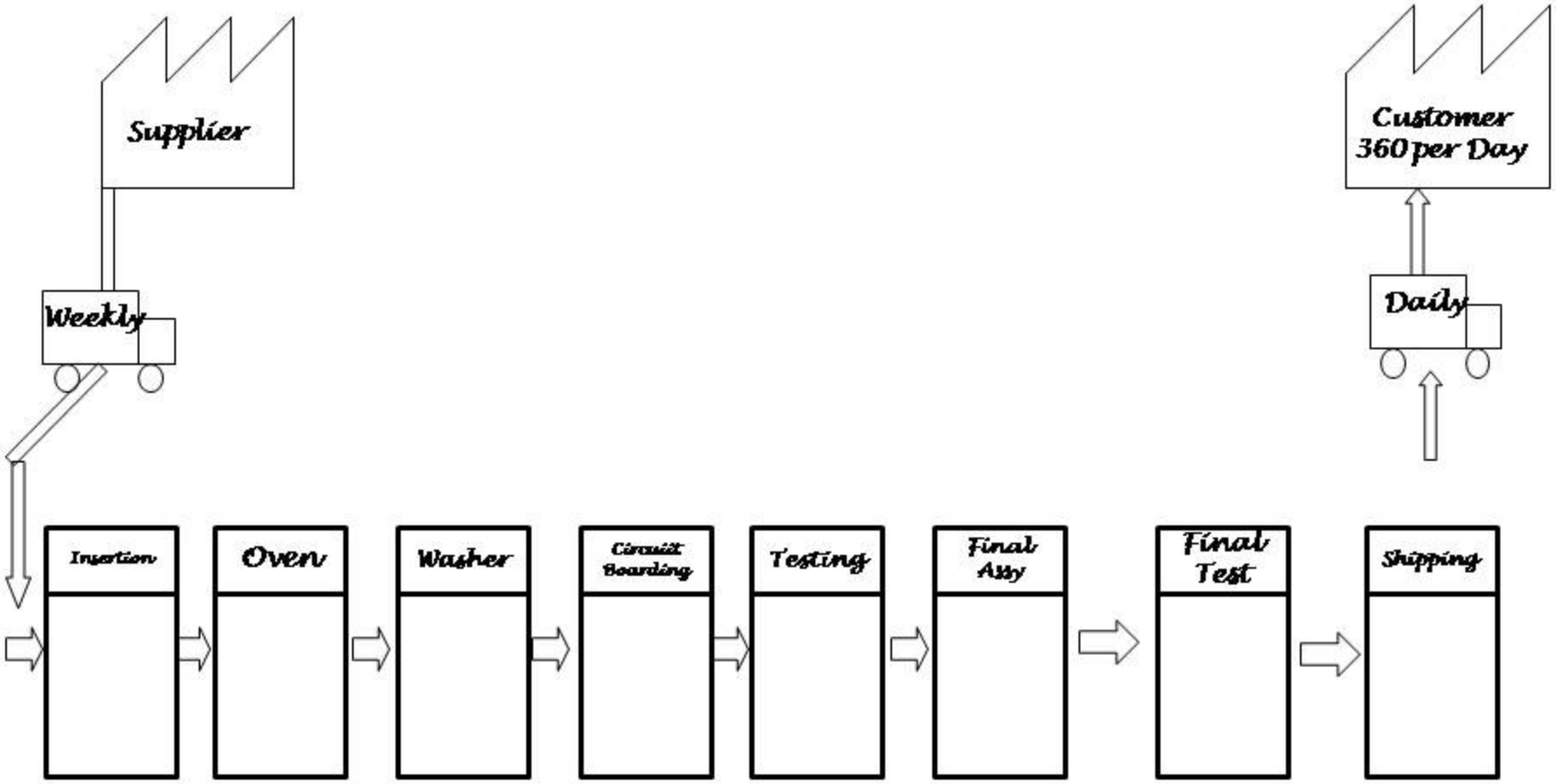


- Group products into families based upon similar downstream process steps

Where do we start?

- A3 paper, pencil, and inquiring set of minds…
- Define the process to be mapped
- Bound the process (supplier – customer)
- Create a box for each process step
- Sometimes entire supply chain is mapped with boxes representing companies

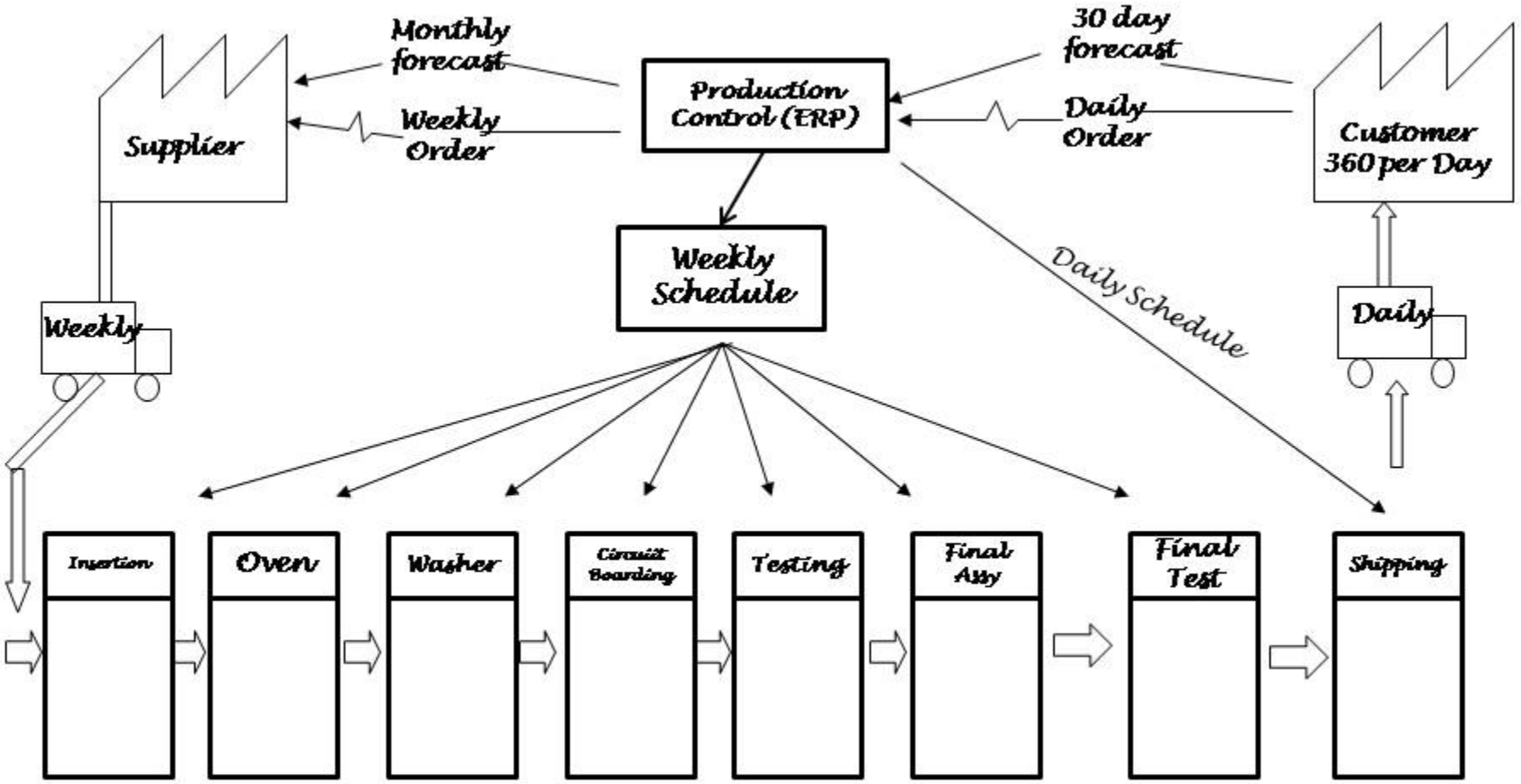
Map the Process Flow



Information Flows

- VSM differentiates from other techniques because the flow of information is added.
- Information flows show how orders are placed and schedules communicated.

Add Information Flows



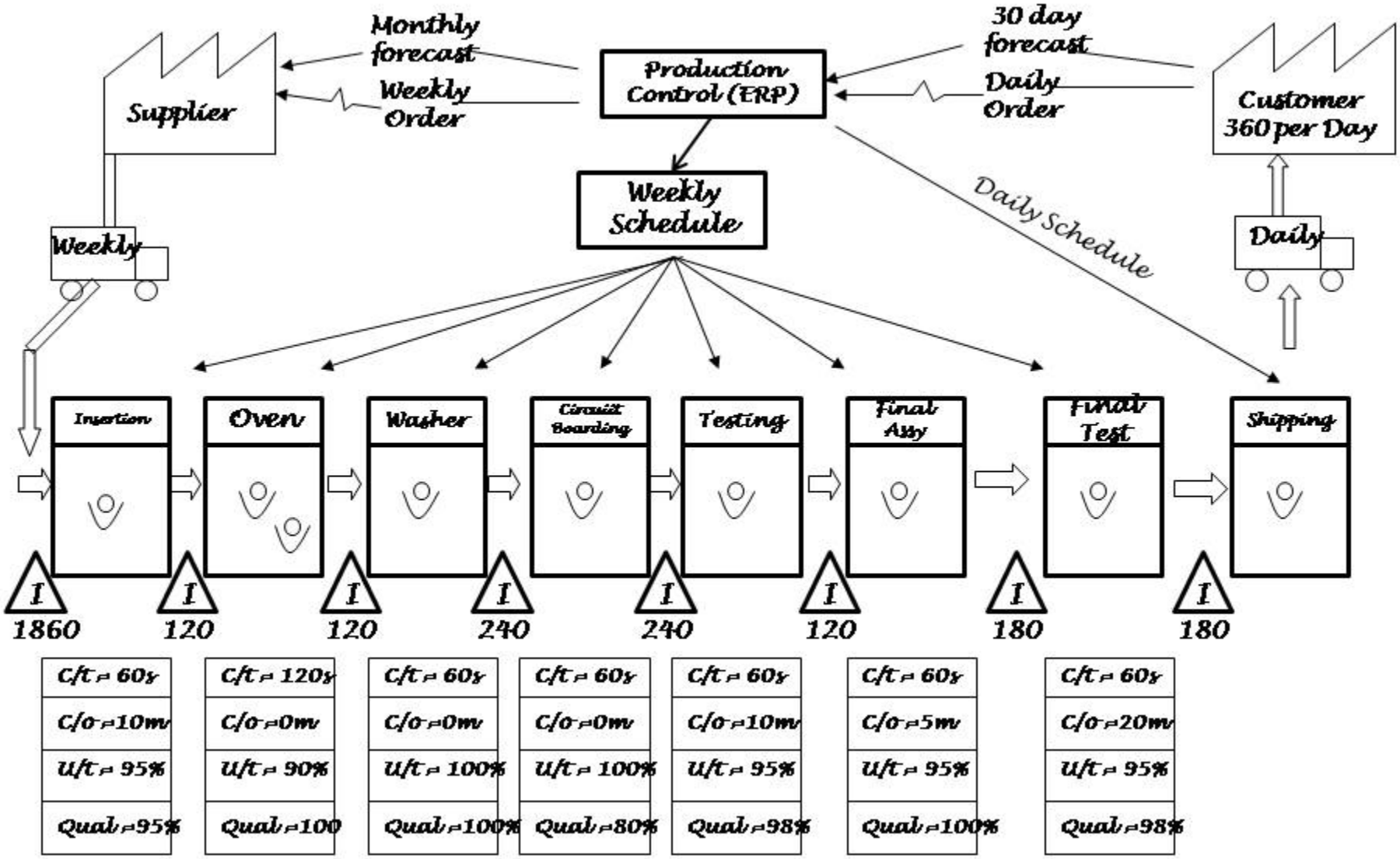
Collect Process Data

Next step is to record the data for the process

Typical data collected is:

- Inventory
- Cycle time (time taken to make one product)
- Change over time (from last good piece to next)
- Uptime (on-demand machine utilization)
- Number of operators
- Net available working time
- Scrap rate
- Pack size – Pallet size

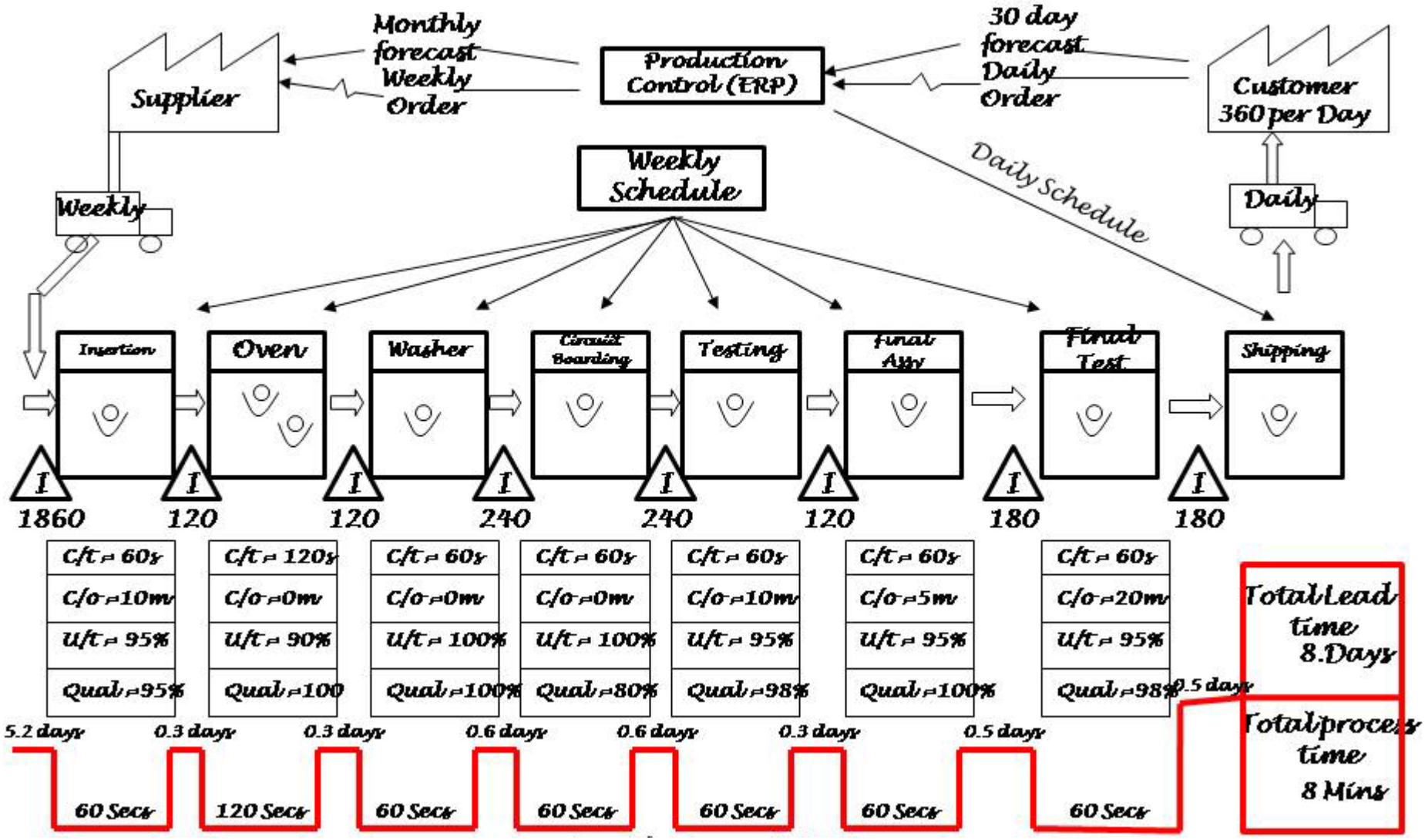
Add the Data


Supplier
Monthly forecast
Weekly Order
Production Control (ERP)
30 day forecast
Daily Order
Customer 360 per Day
Weekly Schedule
Daily Schedule
Weekly
Daily
Insertion
Oven
Washer
Circuit Boarding
Testing
Final Assy
Final Test
Shipping
1860
120
120
240
240
120
180
180
C/t = 60s
C/o = 10m
U/t = 95%
Qual = 95%
C/t = 120s
C/o = 0m
U/t = 90%
Qual = 100
C/t = 60s
C/o = 0m
U/t = 100%
Qual = 100%
C/t = 60s
C/o = 0m
U/t = 100%
Qual = 80%
C/t = 60s
C/o = 10m
U/t = 95%
Qual = 98%
C/t = 60s
C/o = 5m
U/t = 95%
Qual = 100%
C/t = 60s
C/o = 20m
U/t = 95%
Qual = 98%

Creating a Time Line

- Need to show how long inventory remains in the system
- Need to show how long a product is processed
- Processing time is measured for one item, not a batch
- Use inventory and daily demand to calculate total days of inventory on hand

Analyze the Data



What does our VSM tell us?

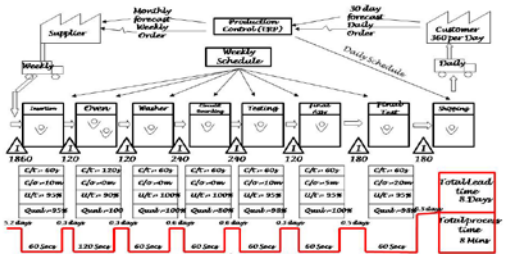
- Timeline shows that a product takes only 8 minutes to process but a single piece of inventory can be in process for over 8 days.

- Data boxes show which processes have long changeovers or poor quality performance and other issues.

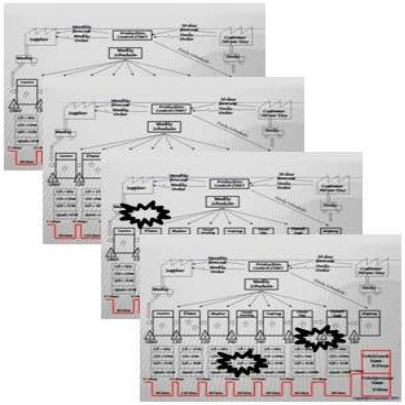
Next Stage for Our VSM

- The next stage is to create the ideal state value stream map.
- Future state maps can then be created to move the organization process toward the ideal using Kaizen improvement bursts.

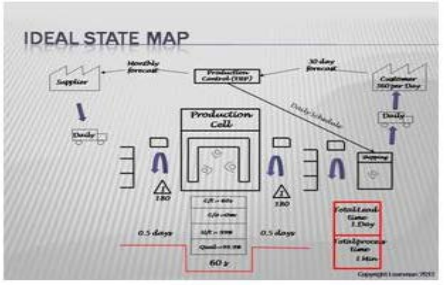
Current State

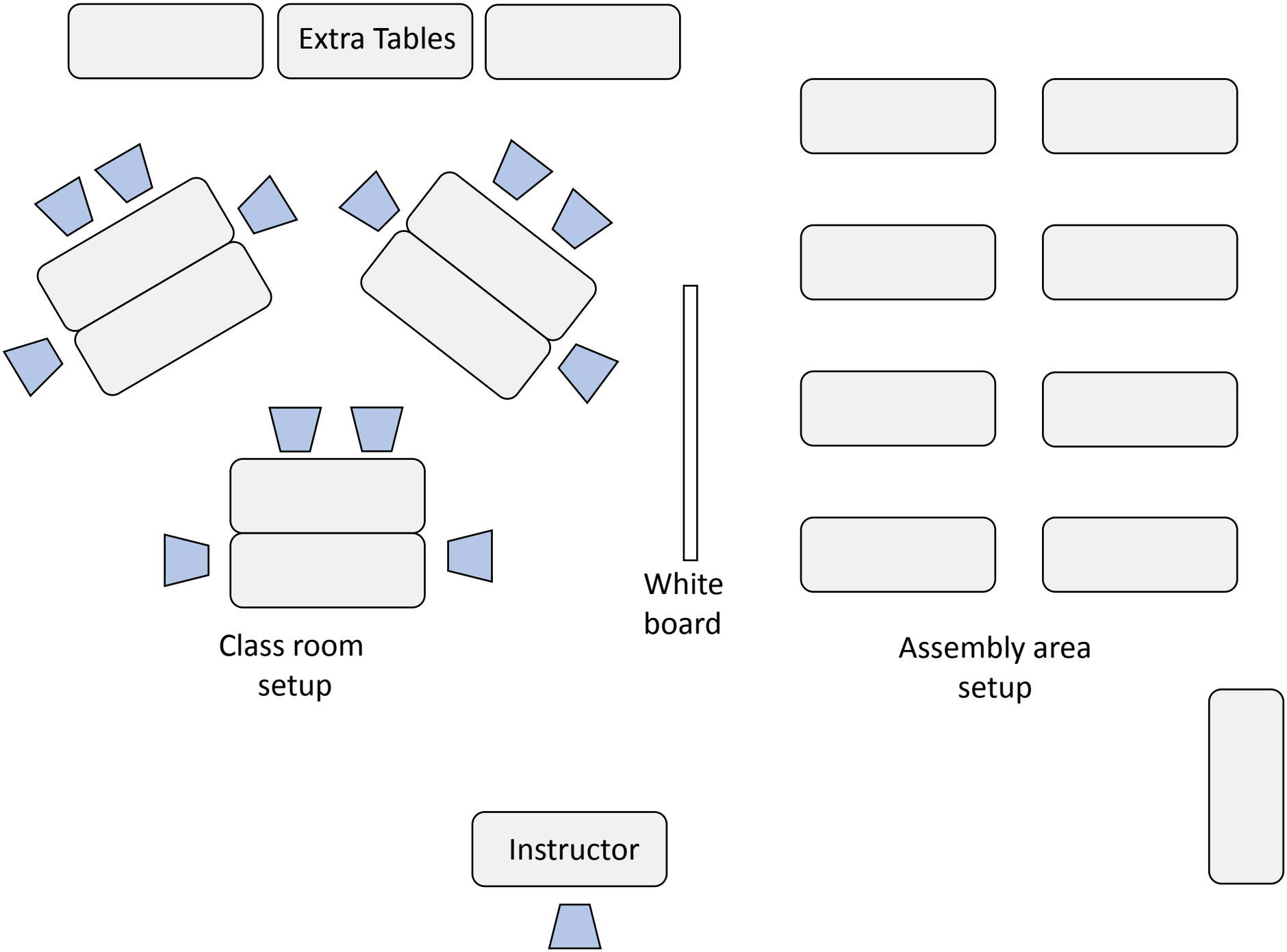


Future State



Ideal State




Extra Tables
White board
Class room setup
Assembly area setup
Instructor