USMC Lean Six Sigma Yellow Belt Training

Course Agenda

- Introduction
- Lean Six Sigma Module
  - ✓Define
  - ✓Measure
  - ✓Analyze
  - ✓Improve
  - ✓Control
- Wrap-Up

Introductions

1. What is your name?
2. Where do you work?
3. Briefly explain one of the questions from the "What Can Lean Six Sigma Do for Me?" sheet.

What Can Lean Six Sigma Do for Me?

At the end of this course you will be able to:

- ✓ Recognize areas for tremendous improvement in your workplace setting.
- ✓ Identify and begin to eliminate waste in your job.

Course Goals

At the end of this course you will be able to:

1. Advance the culture of Continuous Process Improvement (CPI).

2. Understand CPI tools.

3. Be an effective Team Member on CPI Events.

Learning Objectives

At the end of this lesson you will be able to:

- Be familiar with the objectives, tasks and deliverables for each phase of the Define, Measure, Analyze, Improve and Control (DMAIC) framework.
- Understand how the DMAIC framework is used to address process improvements.
- Understand the basic principles of Lean Thinking.
- Be familiar with some of the most commonly used Lean Six Sigma tools.
- Be prepared to apply some of the most commonly used DMAIC tools as a team member on a Rapid Improvement Event (RIE) or project.

Journey to Effective Learning

"Fear makes the wolf bigger than he is."
– German Proverb

- ✓ Function as a team.
- ✓ Everyone participates with equal voice.
- ✓ High level of participation needed for success.
- ✓ Single discussions (respect the speaker).
- ✓ *All* ideas welcome. Ask Questions.
- ✓ Continuous process of learning and development.
- ✓ Relate concepts to your processes.
- ✓ Take notes. You are 7 times more likely to remember something when you write it down.
- ✓ **Have fun!**

Change Management

"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change." – Charles Darwin

Change Management Purpose

Improve the effectiveness and efficiency of the organization.

- Process Improvement Culture Development.
- Continuous quest for excellence.

Change Principles

- **Change is continuously occurring.**
- Process required to manage change.
- Ongoing process - not a stand alone project

What is Lean?

Tools and Methodology to:

Eliminate Waste

WAR ON WASTE!

Improve Flow

By using:

Just-in-Time

Batch Reduction

Pull/Kanban

Standard Work

Value Stream Mapping

Lean Toolbox

Set Up Reduction

Visual Controls

5S + 1

Poka-Yoke

Cellular Flow

What is Six Sigma?

Tools and Methodology to:

Eliminate Defects

WAR ON VARIATION!

Reduce Variation

By using:

Measurement Systems Analysis

Pareto Charts

DMAIC

Statistical Process Control

Value Stream Mapping

Six Sigma Toolbox

Analysis of Variance

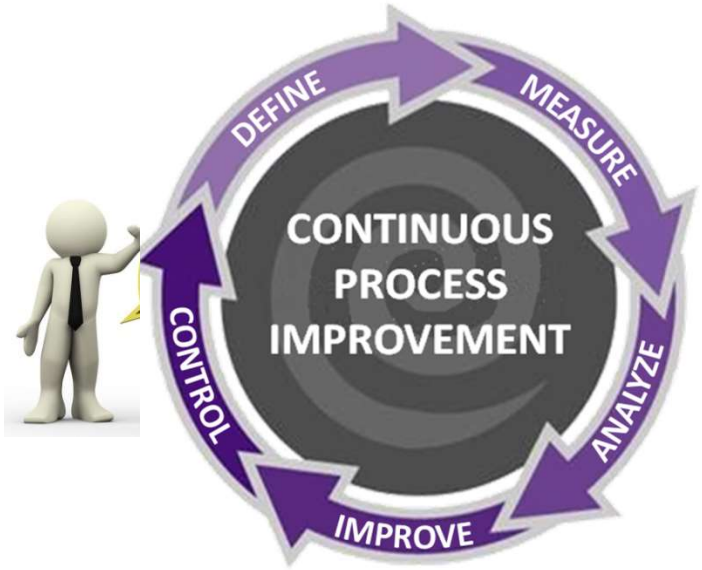
Control Charts

Voice of the Customer

Histograms

Cause and Effect Diagrams

Lean Six Sigma Defined



Lean

Eliminate Waste

Improve Flow

Six Sigma

Reduce Variation

Eliminate Defects

Lean Six Sigma

Together providing the customer with the best possible Value in Quality, Cost and Time

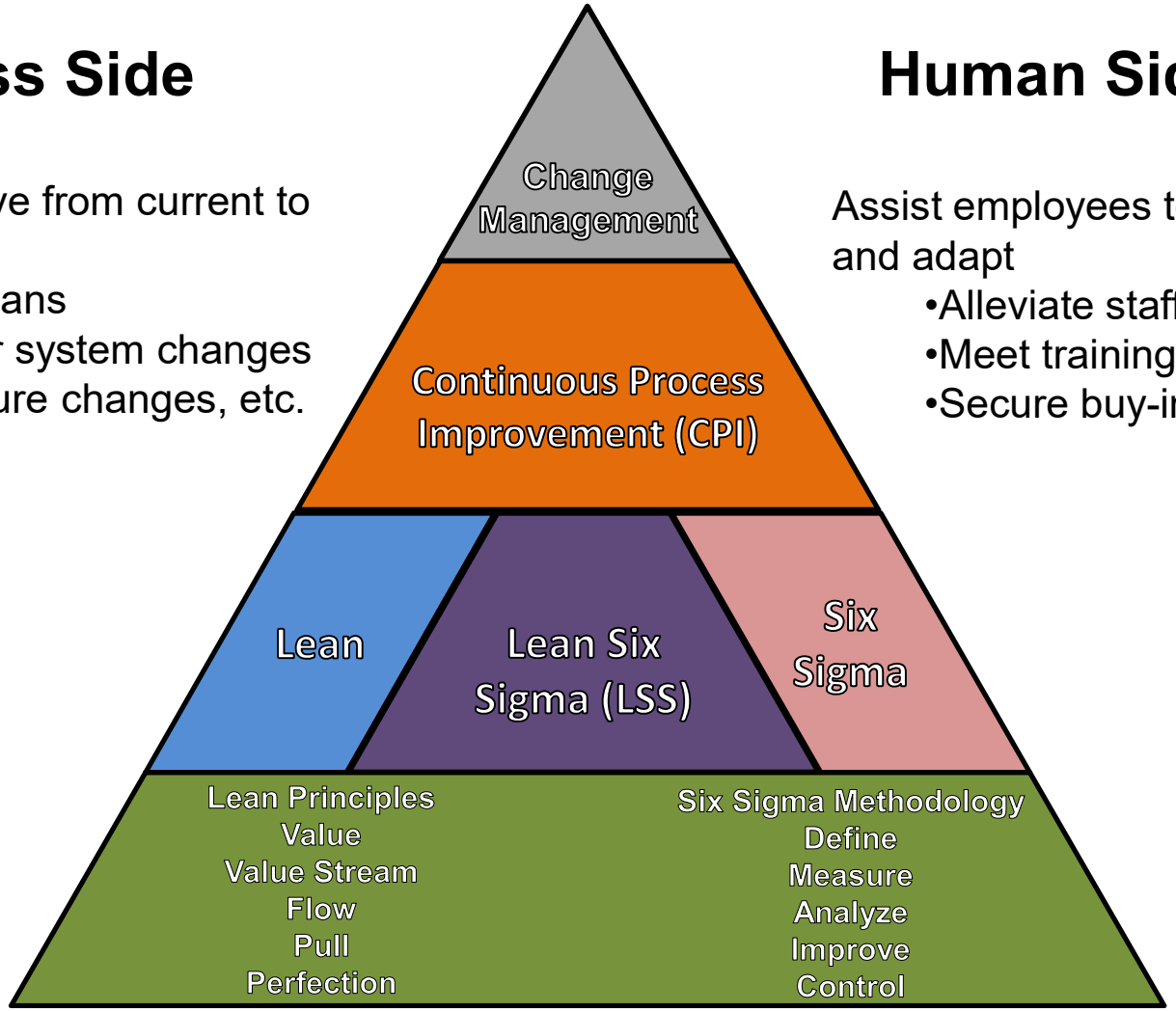
Change Management & CPI / LSS

For successful organizational change, attention should be given to both:

Process Side

Activities to move from current to future state

- Develop plans
- Process or system changes
- Infrastructure changes, etc.



Human Side

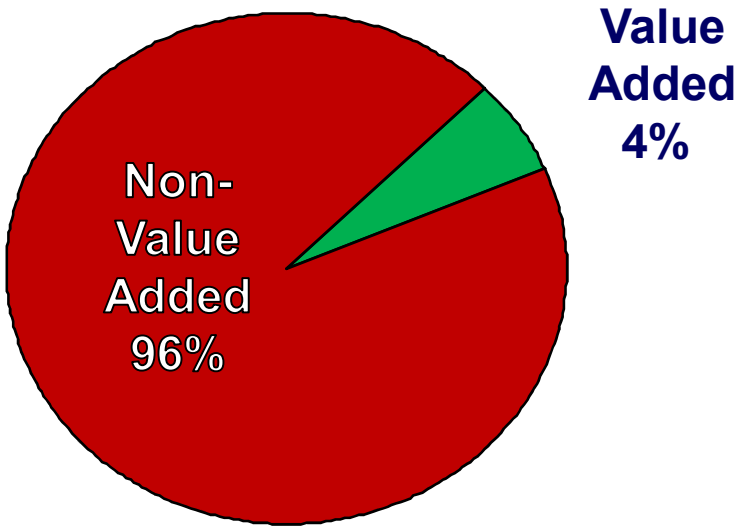
Assist employees to understand and adapt

- Alleviate staff resistance
- Meet training needs (GB)
- Secure buy-in

Change in Focus

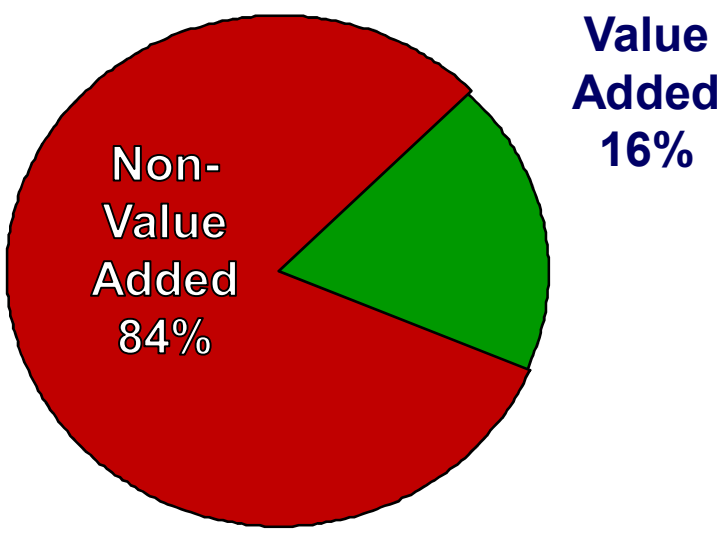
"It is not necessary to change. Survival is not mandatory." - Edward Deming

80's



Before CPI

Today



After CPI

History of Lean and Six Sigma

- **Henry Ford:** Continuous Improvement; reduce waste; improve flow; and improve value.
- **Toyota Production System (TPS):** Developed Lean by focusing on People, Quality, and Efficiency; Mistake proofing, reduced set-ups.
- **Mikel Harry:** Took Six Sigma from Motorola to Allied Signal and GE.
- **Jack Welch:** Utilized Six Sigma to eliminate variation from lean business operations to drive gains in productivity and financial performance for GE.
- **Maytag:** Lean & Six Sigma integrated. Quality so good, the repairman has nothing to do.

DMAIC Methodology

Define

- ***IDENTIFY OPPORTUNITY***

Tollgate Review

Measure

- ***DESCRIBE AS-IS CONDITION***

Tollgate Review

Analyze

- ***IDENTIFY KEY CAUSES***

Tollgate Review

Improve

- ***PROPOSE & IMPLEMENT SOLUTIONS***

Validate & Replicate Changes

Tollgate Review

Control

- ***SUSTAIN THE GAIN***

Tollgate Review

Lean Six Sigma Delivers Results

Performance & Innovation Support Agreements

Agreement Managers | **Agreements/Year**

Before Lean Six Sigma

Finalized → **10**

With Lean Six Sigma

Finalized → **37**

Difference Between 3 and 6 Sigma

Most U.S. companies operate @ 3-4 Sigma

97.7% performance (or up to 25% total revenue in defects).

THREE SIGMA	SIX SIGMA
More than 40,500 newborn babies dropped in hospitals each year.	Three newborn babies dropped in hospitals in 100 years.
Unsafe drinking water about two hours each month.	Unsafe drinking water one second every six years.
Nearly 1,350 incorrect surgical operations per week.	One incorrect surgical operation in 20 years.
Five short or long landings at O'Hare each day.	One short or long landing in 10 years in all the airports in the United States.
2.3 Defects per *hundred* opportunities.	**3.4 Defects per *million* opportunities.**

Why Use CPI?

"There are four purposes for continuous process improvement: easier, better, faster, cheaper – and they appear in that order of priority." – Shigeo Shingo

1. **Easier** – Reduce frustrations for employees, work smarter; not harder.
2. **Better** – Make a process more efficient / effective, improve quality.
3. **Faster** – Reduce lead time to fulfill customer demand.
4. **Cheaper** – Reduce cost to customer.

Project Management Constraints

Triple Constraints of Projects

- Quality (Better)
  - Clear and Specific
- Time (Faster)
  - Amount of time to complete process tasks
- Cost (Cheaper)
  - Money and Effort
- Prioritizing Constraints
  - Should be based on the view of the customer.

Critical Elements for CPI Implementation

- **Leadership commitment.**
- CPI improvement events aligned with the organizational strategy, objectives and customer requirements.
- **A can do attitude!**
- Program training & support.
- Sharing information and knowledge.
- **Learn by doing, with use comes comfort.**

Team Member Responsibilities

As a Yellow Belt you're expected to:

- ✓ Act as an change agent for the organization you're a member of and not yourself.
- ✓ Ensure communication is maintained with the groups you represent.
- ✓ Participate in CPI events.
- ✓ Become familiar with the basic CPI tools, LEAN and Six Sigma.
- ✓ Assist in project reviews.
- ✓ Function in teams between 2 and 8 members

MCINCR-MCBQ Command Level Infrastructure

Leaders

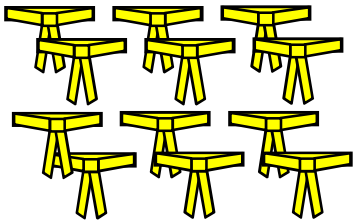
- Owns vision, direction, integration, business results.
- **Leads change, provide strategic direction.**
- **Coordinates implementation of CPI efforts.**
- Communicates standards and guidelines.
- Develops supporting implementation plans.
- Coordinate / oversee Toll Gate Review Meetings, go/no go.
- Provide support & help remove barriers to success.
- Implement improvement solutions & sustain results.
- 1 Day of Training.

Black Belts (BB)
Master Black Belts (MBB)

- **Lead Complex projects.**
- "Go To" subject matter experts.
- Transition results ownership and improvement solution to Sponsor.
- Mentors lower level belts.
- 5 Weeks of Training.

Green Belts

- **Focus on Rapid Improvement Events.**
- May participate on Black Belt teams.
- Close to business process.
- May assist Project Sponsor in implementing improvement solution.
- 1 Week of Training.



Yellow Belts

- **Team members who assist in executing projects/RIEs**
- Collect data.
- Sustain results.
- Leverage/replicate opportunities.
- 1 day of Training.

DMAIC Improvement Process Road Map

Activities

Define	Measure	Analyze	Improve	Control
• Review Project Charter • Validate Problem Statement and Goals • Validate Voice of the Customer and Voice of the Business • Validate Financial Benefits • Validate High-Level Value Stream Map and Scope • Create Communication Plan • Select and Launch Team • Develop Project Schedule • Complete Define Gate	• Value Stream Map for Deeper Understanding and Focus • Identify Key Input, Process and Output Metrics • Develop Operational Definitions • Develop Data Collection Plan • Validate Measurement System • Collect Baseline Data • Determine Process Capability • Complete Measure Gate	• Identify Potential Root Causes • Reduce List of Potential Root Causes • Confirm Root Cause to Output Relationship • Estimate Impact of Root Causes on Key Outputs • Prioritize Root Causes • Complete Analyze Gate	• Develop Potential Solutions • Evaluate, Select, and Optimize Best Solutions • Develop 'To-Be' Value Stream Map(s) • Develop and Implement Pilot Solution • Confirm Attainment of Project Goals • Develop Full Scale Implementation Plan • Complete Improve Gate	• Implement Mistake Proofing • Develop SOP's, Training Plan and Process Controls • Implement Solution and Ongoing Process Measurements • Identify Project Replication Opportunities • Complete Control Gate • Transition Project to Process Owner

Identify and Implement Quick Improvements

RIE/Kaizen, 5S, Value Analysis, Generic Pull Systems, Four Step Rapid Setup Method

Tools

Define	Measure	Analyze	Improve	Control
• Project Charter • Voice of the Customer and Kano Analysis • SIPOC Map • Project Valuation / ROIC Analysis Tools • RACI and Quad Charts • Stakeholder Analysis • Communication Plan • Effective Meeting Tools • Inquiry and Advocacy Skills • Time Lines, Milestones, and Gantt Charting • Pareto Analysis • Belbin Analysis	• Value Stream Mapping • Value of Speed (Process Cycle Efficiency / Little's Law) • Operational Definitions • Data Collection Plan • Statistical Sampling • Measurement System Analysis (MSA) • Gage R&R • Kappa Studies • Control Charts • Histograms • Normality Test • Process Capability Analysis	• Process Constraint ID and Takt Time Analysis • Cause and Effect Analysis • FMEA • Hypothesis Tests/Conf. Intervals • Simple and Multiple Regression • ANOVA • Components of Variation • Conquering Product and Process Complexity • Queuing Theory	• Replenishment Pull/Kanban • Stocking Strategy • Process Flow Improvement • Process Balancing • Analytical Batch Sizing • Total Productive Maintenance • Design of Experiments (DOE) • Solution Selection Matrix • Piloting and Simulation	• Mistake-Proofing/ Zero Defects • Standard Operating Procedures (SOP's) • Process Control Plans • Visual Process Control Tools • Statistical Process Controls (SPC) • Solution Replication • Project Transition Model • Team Feedback Session

Knowledge Check: DMAIC

What does DMAIC stand for?

What questions do you have so far?

Define Phase

Define Phase

Objectives:

- Identify what adds value to the process from both the business and customer perspective (VOB, VOC).
- Develop the business processes, define the critical customer requirements.

Activities:

- Create a project charter.
- Assemble a project team.
- Develop high-level process map (SIPOC).
- Define project goals.
- Communication Plan.
- Leadership approval (Review).

Types of Improvement Opportunities

Name	Duration	Scope of Change	Size of Team	Time to Implement
Just Do It	1 – 2 Days	Solution ready to implement – problem well defined	Project Sponsor	Immediate
Kaizen / Rapid Improvement Event (RIE)	3 – 5 Days	Short term, high intensity effort to address a specific problem	4 – 12 (Full-Time During Event)	Immediate to Short Term
Project	3 – 6 Months	Complex problem, no apparent root cause	3 – 15 (Part-Time)	Mid to Long Term

SIPOC

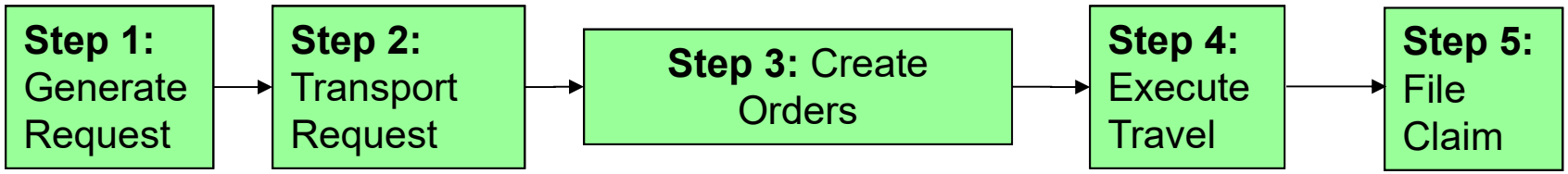
- SIPOC stands for:

Suppliers	Inputs	Process	Outputs	Customers

- A process snapshot that captures information to a project.

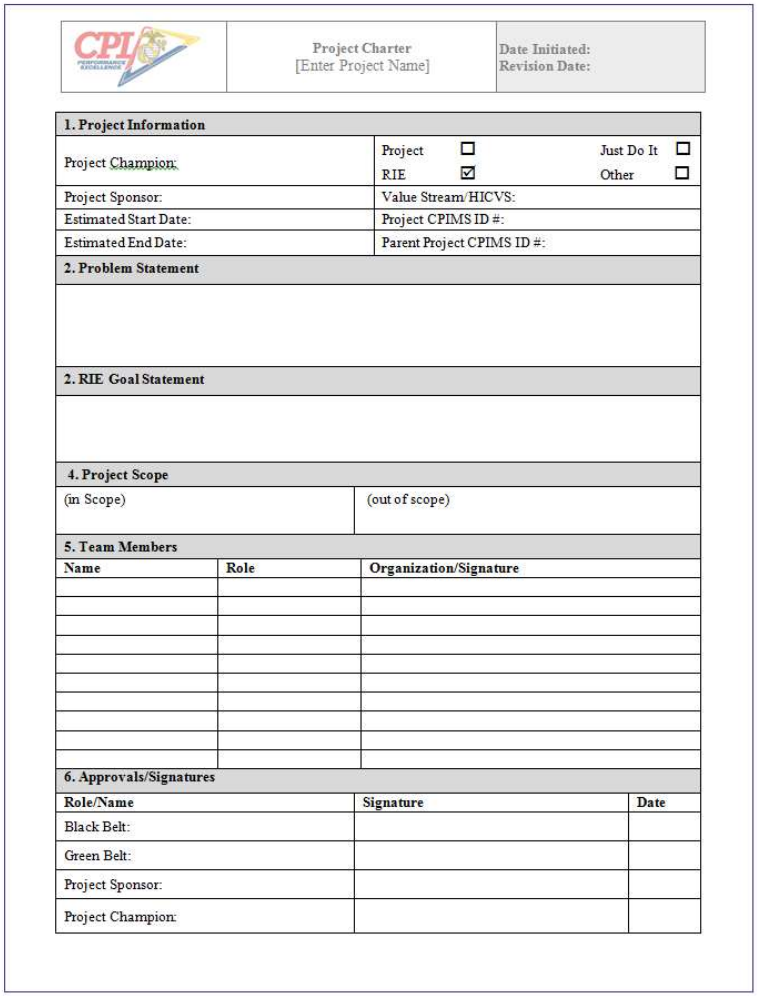
SIPOC Example: Streamlining a Travel Request

Suppliers	Inputs	Process	Outputs	Customers
• SUB • NAVSEA • TYCOMS • OPNAV/CNO • NUWC • NRL • JHU • NSWC	• Destination • Transportation Mode(s) • Job Order Number • Travel Dates	• See Below	• Travel Orders • Advances • E-Tickets • Emails • Itinerary • Claim Forms	• Fleet • NAVSEA • Shipyards • NSWC • TYCOMs • Business Office



Project Charter

- The team's commencement document.
- Defines the team's project plan and mission.
- The charter does not solve the problem.
- Charters are living documents that are subject to change.
- Charters cover 3 critical elements:
  - Problem / Opportunity Statements
  - Goal Statements
  - Scope Statements



CPI	Project Charter [Enter Project Name]	Date Initiated: Revision Date:

1. Project Information		
Project Champion:	Project ☐ RIE ☑	Just Do It ☐ Other ☐
Project Sponsor:	Value Stream/HICVS:	
Estimated Start Date:	Project CPIMS ID #:	
Estimated End Date:	Parent Project CPIMS ID #:	
2. Problem Statement		
2. RIE Goal Statement		
4. Project Scope		
(in Scope)	(out of scope)	

5. Team Members		
Name	**Role**	**Organization/Signature**

6. Approvals/Signatures		
Role/Name	**Signature**	**Date**
Black Belt:		
Green Belt:		
Project Sponsor:		
Project Champion:		

Opportunity / Problem Statements

- Improvement opportunity / problem statements should provide the following information:

WHAT	WHERE	WHEN	EXTENT	IMPACT

- Goal Statements should follow the SMART criteria:

SPECIFIC	MEASURABLE	ACHIEVABLE	REALISTIC	TIME BOUND

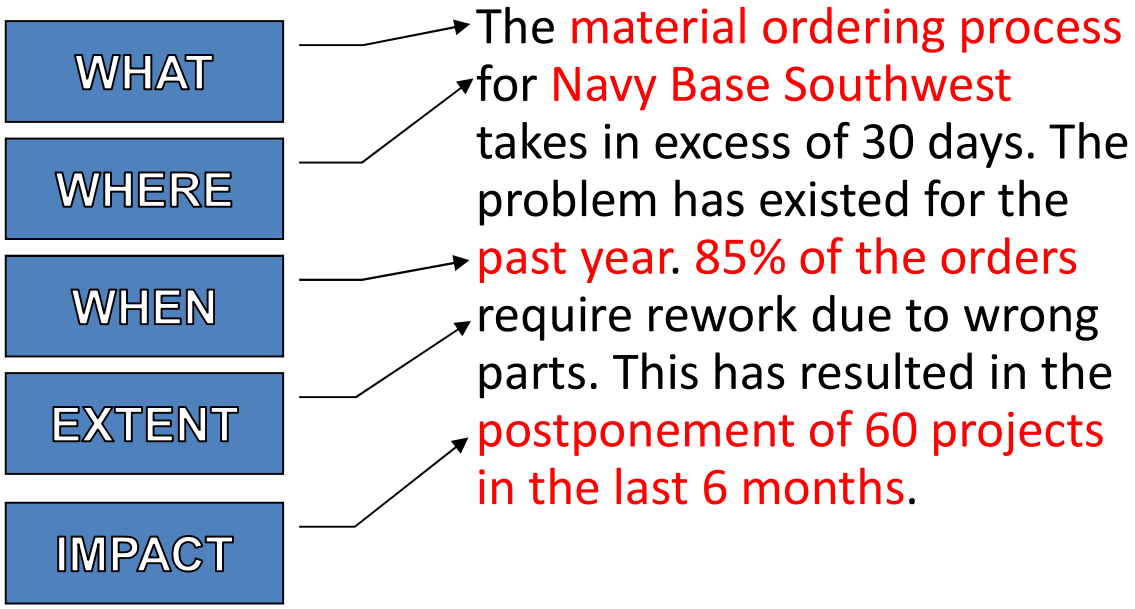
- Scope Statements should provide awareness of specific boundaries of your improvement opportunity.

Examples of Opportunity or Problem Statement

Example of a bad opportunity or problem statement.

It takes too long to process a material order form and wrong parts are ordered.

Example of a better opportunity or problem statement.



Voice of the Customer (VOC)

VOC is obtained as part of the Define and Measure phase.

You must:

- Identify all customers.
- Prioritize customers.
- Gather the Voice of the Customer.
- Translate customer wants into critical customer requirements and prioritize them.

Capturing Voice of Customer is one of the critical elements of the methodology – understanding what requirements must be satisfied

Your Customer defines your success!

Translating VOC into Customer Requirements

Customer requirements must:

- Relate directly to the process of producing a service or product.
- Be measurable and specific.
- Cannot be vague and incomplete.
- Not be biased toward a particular solution or approach.

Example:

- Customer comment:
  - "We are unable to depend on delivery time when we need to get our parts"
- Customers Key Issue:
  - There is too much variation in delivery days, and the delivery must fit within a specific window of time.
- Customer requirement:
  - Delivery products no earlier than three days and no greater than five days from the date of the confirmed order.

Communication Plan

Effective Communications

Must have the following characteristics:

- A consistent formal process.
- **Simple and understood by all.**
- Contain current information.
- Have a feedback loop built into the process.

Will help:

- Build and maintain trust.
- Prevent rumors.
- Enlist and enroll the participation of employees in the pursuit of achieving objectives.
- **Manage expectations**

Knowledge Check: SIPOC

What does SIPOC stand for?

Knowledge Check: Communication Plan

What are the benefits of an effective Communication Plan?

What questions do you have so far?

Measure Phase

Measure Phase

Objectives:

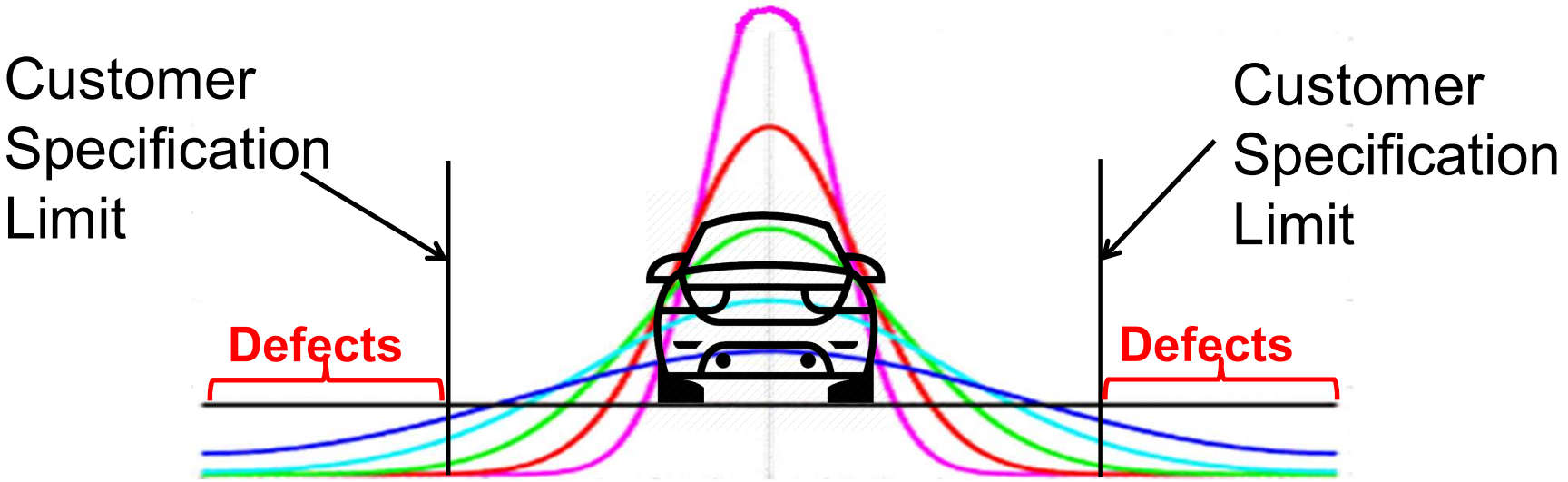
- Identify critical measurements.
- Understand the data calculations.

Activities:

- Map process and identify inputs and Outputs.
- Establish Measurement plan.
- Collect baseline performance data.
- Validate measurement system.
- Leadership approval (Review).

Understanding Variation

- **Common cause** (inherent) **variation** is always present in a process.
  - A process that exhibits only common cause variation is a **stable** process.
  - A stable process is **predictable**.
- **Special cause** (assignable) **variation** is some unusual, uncommon event.
  - A process that exhibits special cause variation is an **unstable** process.
  - An unstable process is **unpredictable**.



Data Types

Da•ta (Da' tä, Dä'tä) *pl n.(singular or plural in number)* – Information, usually organized for analysis.

Variable Data

- Data that could be **measured** on an infinitely divisible scale or continuum. There are no gaps between possible values.
- Examples:
  - Tire pressure (lbs/sq.in.)
  - Cycle Time (minutes)
  - Speed (mph)
  - Length (inches)
  - Response time (milliseconds)

Attribute Data

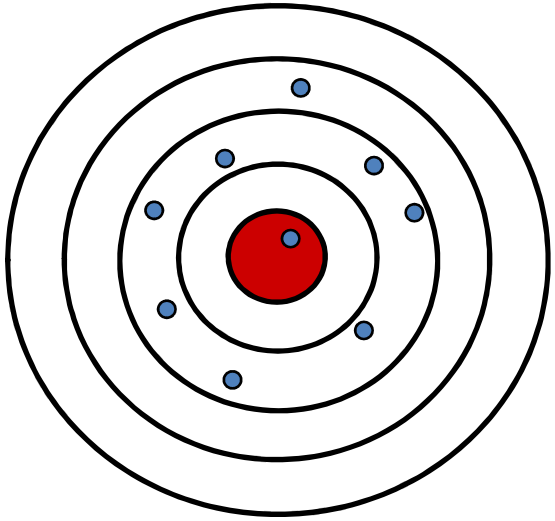
- Discrete data measures attributes, qualitative conditions, and counts. There are gaps between possible values.
- **Examples:**
  - # defects per unit
  - PO's placed per day
  - Number of calls on hold per hour
  - Shoe Size
  - Number of employees

Data Types Quiz

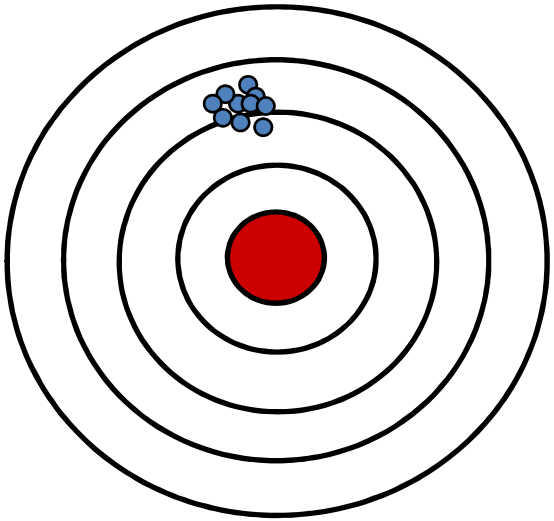
Beside the following examples, determine if: Variable" (continuous) or "Attribute" (discrete).

- Average Labor Hours
- Data input accuracy
- Responsible organization
- Hole diameter using a "go/no-go" gage
- Hole diameter
- Order turnaround time
- Weight of refrigeration charge (grams)
- Cycle Time
- Certification Defects

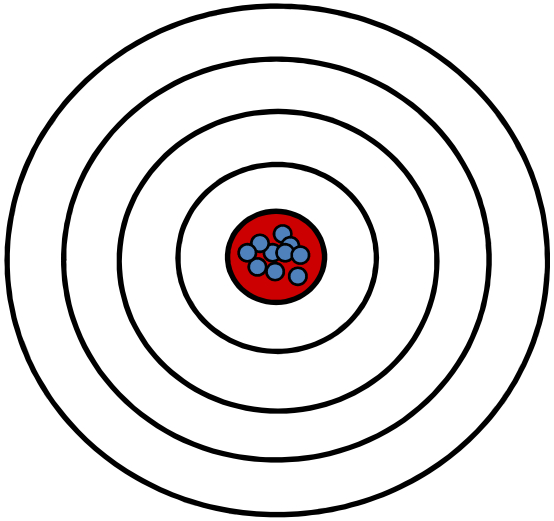
Measurement Properties



Accuracy without Precision



Precision without Accuracy



Accuracy and Precision

Data Collection Plan

Key questions to consider:

- *Why* are we measuring
- *What are we measuring?*
- *How will we gather the data?*
- *Where will gather the data?*
- *When / how often will the data be gathered?*
- *Who needs to see the data?*

Objective **(Why)**	Measures/ Data **(What)**	Data Collection Method **(How)**	Data Sources **(Where)**	Timing **(When)**	Responsible Party **(Who)**

Walk The Gemba

- Gemba means “real place” or “go see.”
- The work place is where value is created.
- Management has a responsibility to “get the facts” from the work space.

The Five Actuals

1. Go to the actual workplace.
2. Engage the people who do the actual work.
3. Observe the actual process.
4. Collect the actual data.
5. Understand the actual value stream.

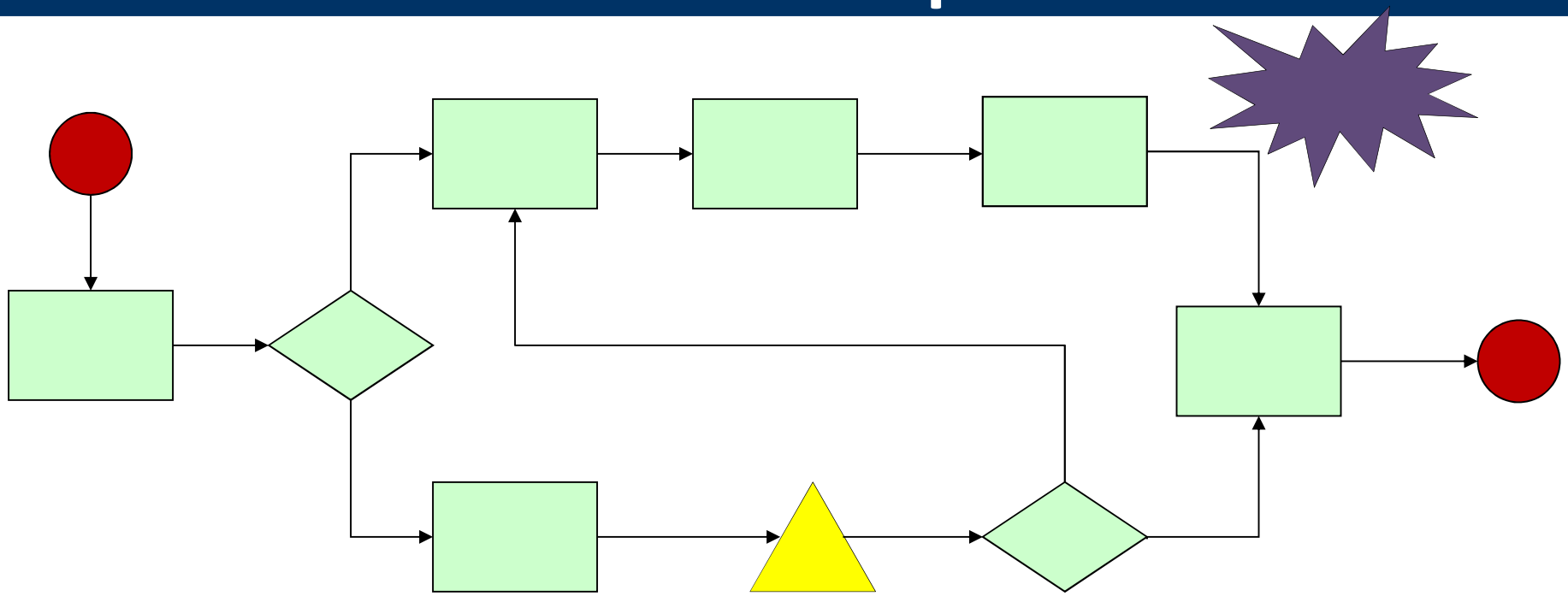
Ohno’s Circle

Direct Observation Leads to Better Understanding.

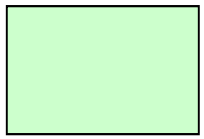
Process Maps

- Used for visualizing a system or process (sequence of events, tasks, activities, steps).
  - Can be used to identify opportunities for improvement such as streamlining or combining operations.
- Drawn with standard symbols representing different types of activities or operations.
- Several Types: Linear, Top-Down, Swim Lane, Value Stream

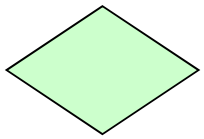
Process Maps



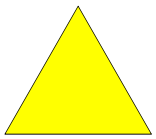
Standard Process Map Symbols:



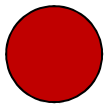
Process Step



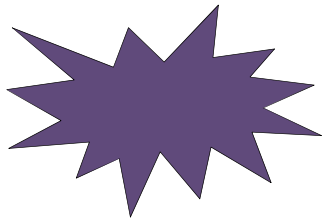
Decision Point



Wait (Inventory)

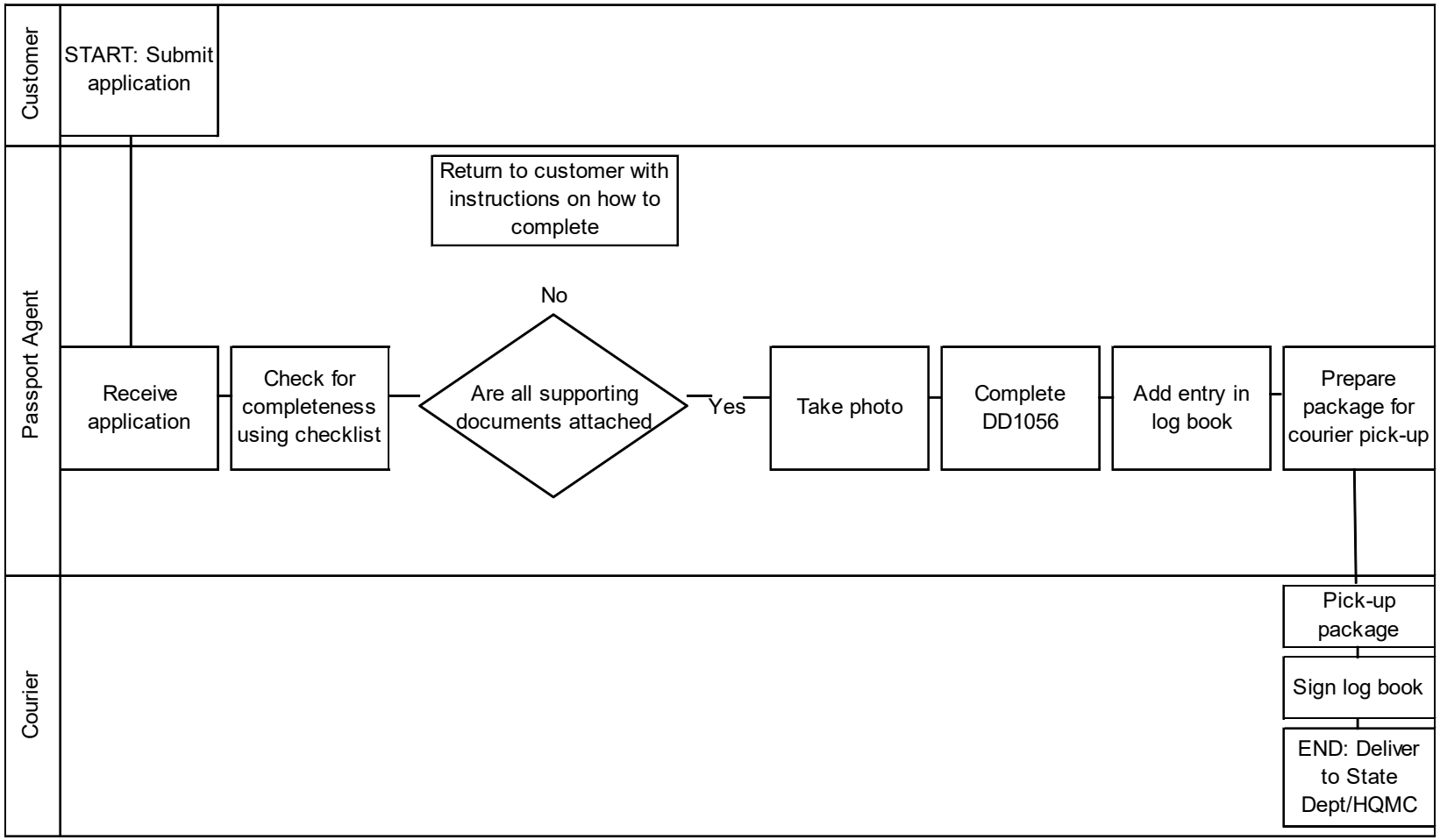


Start/Stop
Redirect



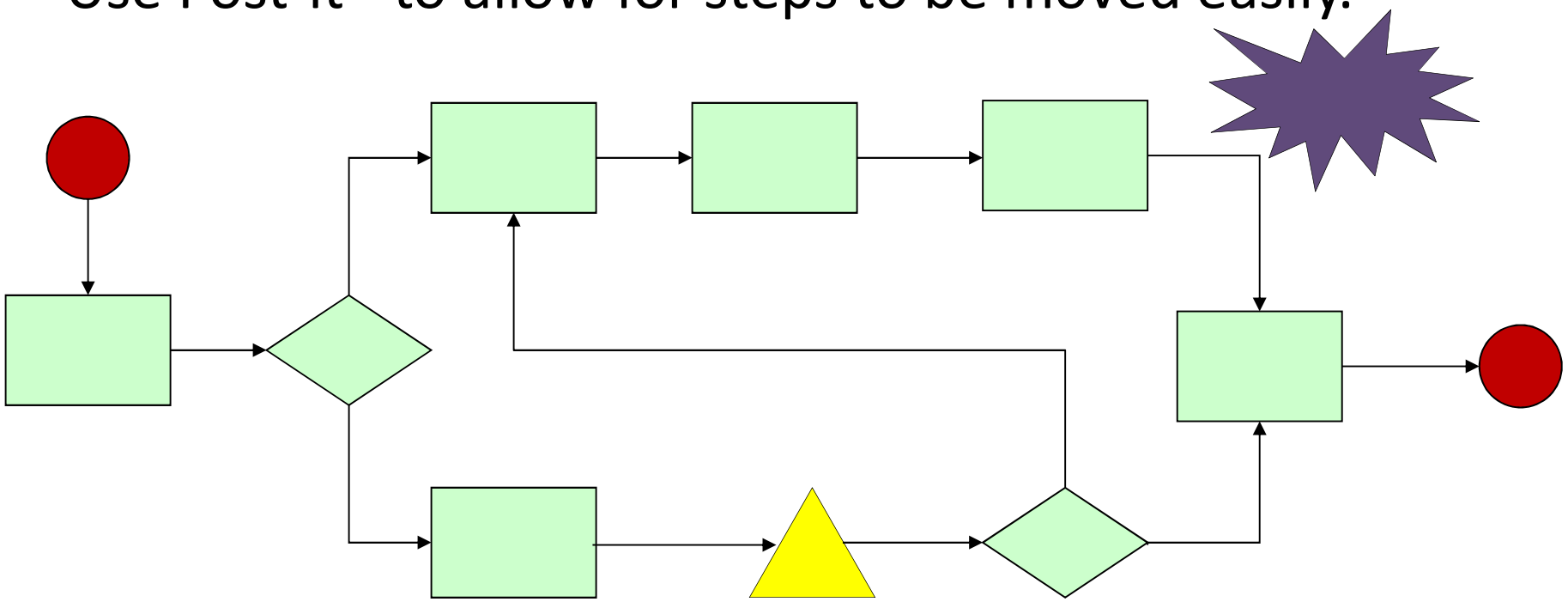
Project Burst

Process Map Example



How to Build a Process Map

- Walk the Gemba (workplace/process), noting process steps, decision points and inventory (wait points).
- Keep track of forms/documents used, and obvious improvement areas with project bursts.
- Use Post-it® to allow for steps to be moved easily.

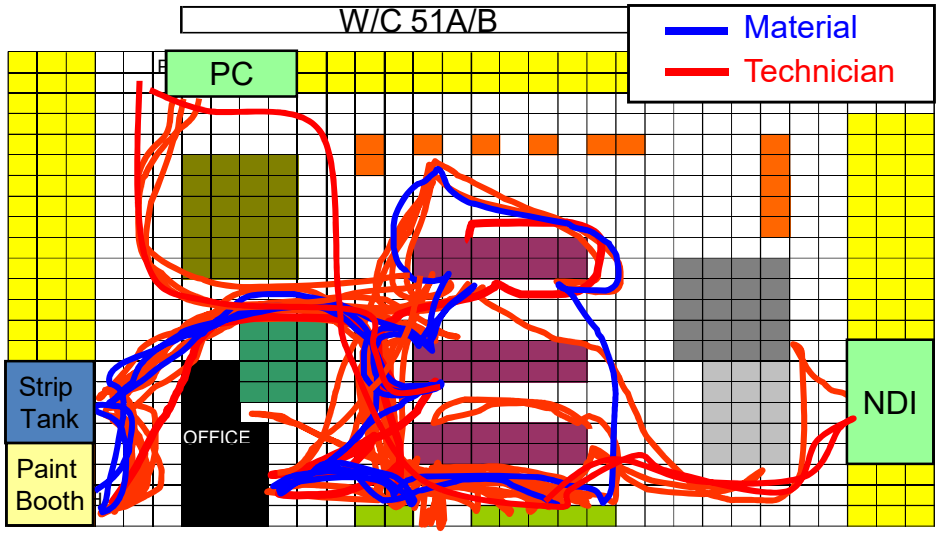


Spaghetti Diagrams

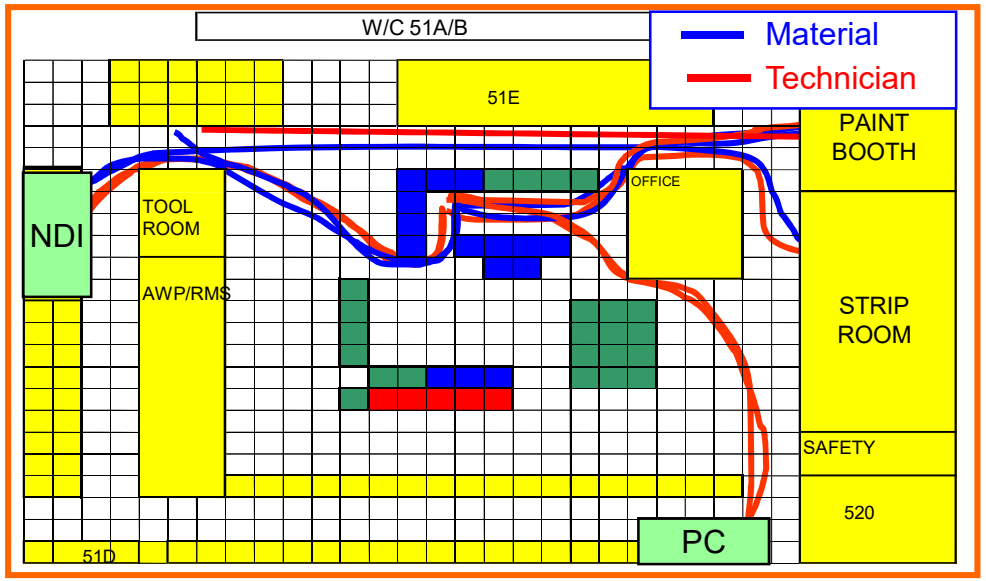
- Graphically describes the production layout, standard in-process inventory, and other factors in standard operations.
- Used to depict where there is wasted product, travel, people movement, queues, etc.
- Shows the physical area layout, flow of product through a series of process steps, or maps where a person walks to complete their process.

Before/After Spaghetti Diagram

BEFORE



AFTER



Knowledge Check: Gemba

Why is it critical to walk the process (go to Gemba)?

Knowledge Check: Process Maps

What kind of map would we use if we were concerned with process layout?

What kind of map visually shows how work flows from function to function?

What questions do you have so far?

Analyze Phase

Analyze Phase

Objectives:

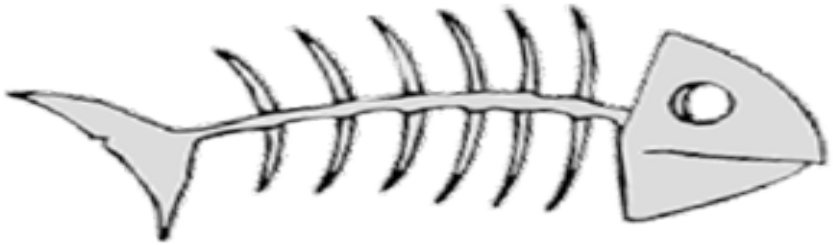
- Data Analysis
- Determine Root Cause

Activities:

- Identify and validate Root Causes.
- Determine impact of root causes to process output.
- Prioritize root causes.
- Leadership approval (Review).

Root Cause Analysis

"It's not that I'm so smart, it's just that I stay with problems longer. – Albert Einstein



- Root cause analysis is where the *real* cause of the problem is uncovered.
- A root cause is one that, if corrected would prevent a recurrence of the problem.
- A technique used is asking **"<u>Why</u>" <u>5 times</u>**

Analysis – Determining Root Cause

Problem: Lincoln memorial deteriorating at a high rate.

1. Why: We wash this memorial more than the others.
2. Why: Bird droppings make it unsanitary for tourists.
3. Why: Birds eat the Spiders that gather in masse.
4. Why: Spiders gather to eat the flying midges that swarm.
5. Why: Midges swarm around the bright, warm lights that are turned on at dusk.

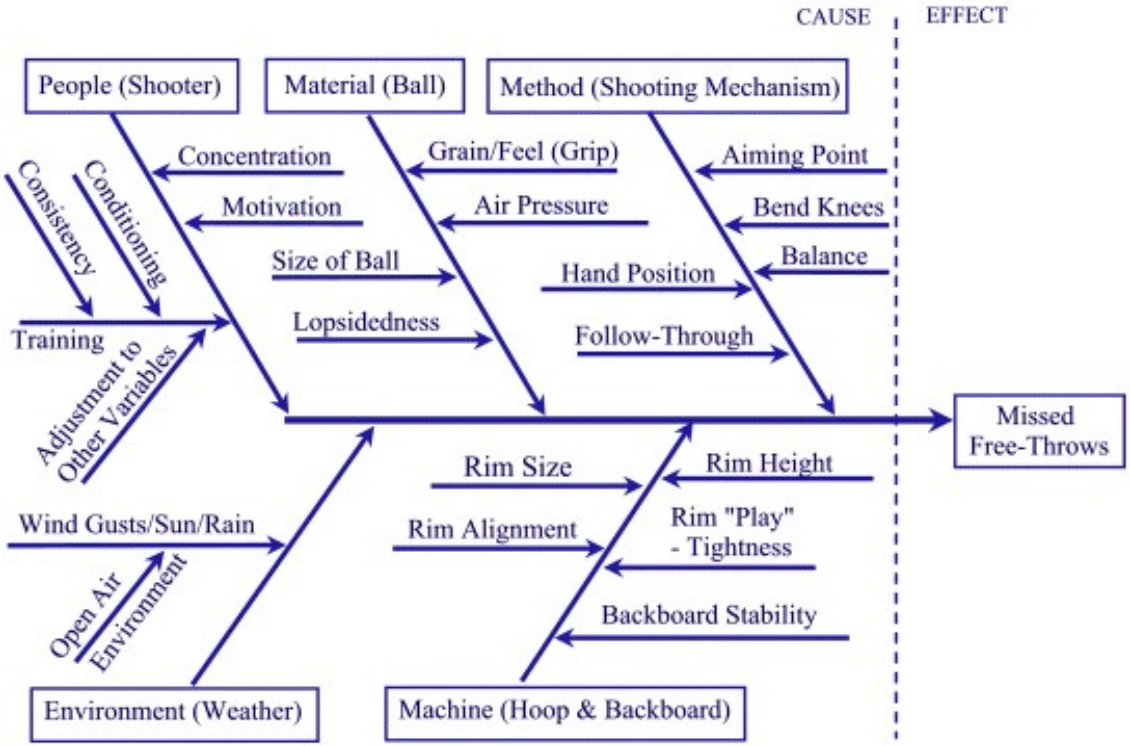
Answer: Delay turning on the lights for one hour

Fishbone Diagram

- Breaks problems down into bite-sized pieces.
- Displays many possible causes in a graphic manner.
- Shows how causes interact.

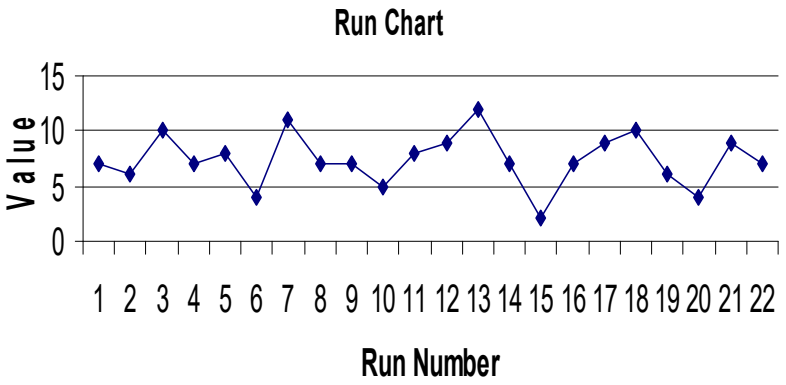
Suggested Causes:

- Man
- Method
- Machine
- Material
- Measurement
- Mother Nature

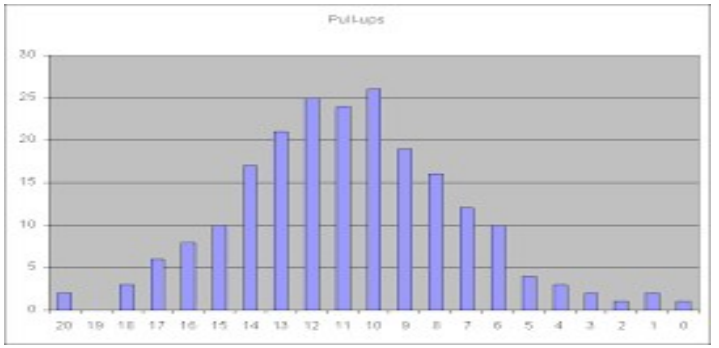


Examples of Data Tools

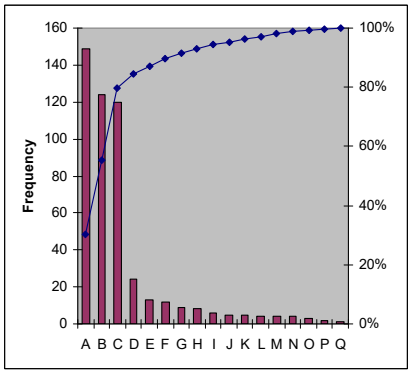
Control/Run/Trend Chart:
Shows change over time.



Frequency Plot/Histogram:
Shows distribution of variation and range.



Pareto Chart:
Helps focus on key problems.



Pareto Charts

Similar to histograms but used to prioritize problems

- Aligns categories in descending order.

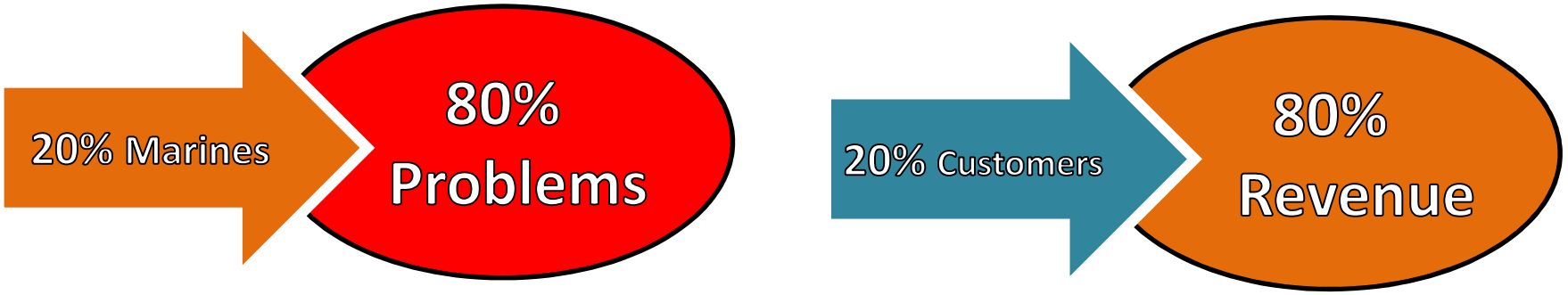
The "80/20" Rule:

Pareto charts illustrate the concept that, for any given distribution of the results:

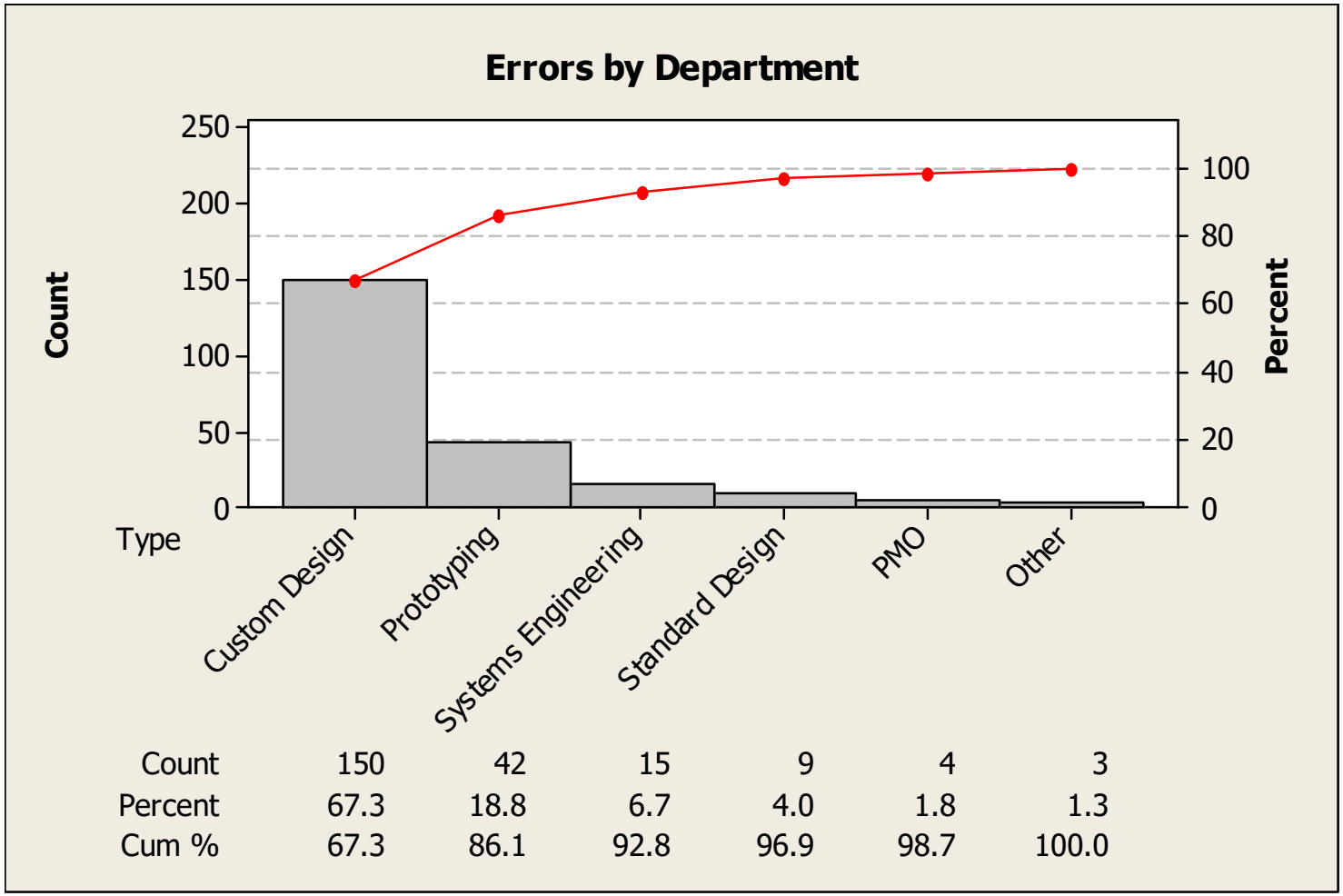
The majority of the distribution (80%)

is determined by

a small part (20%) of the potential contributors or causes.



Pareto Charts - Example

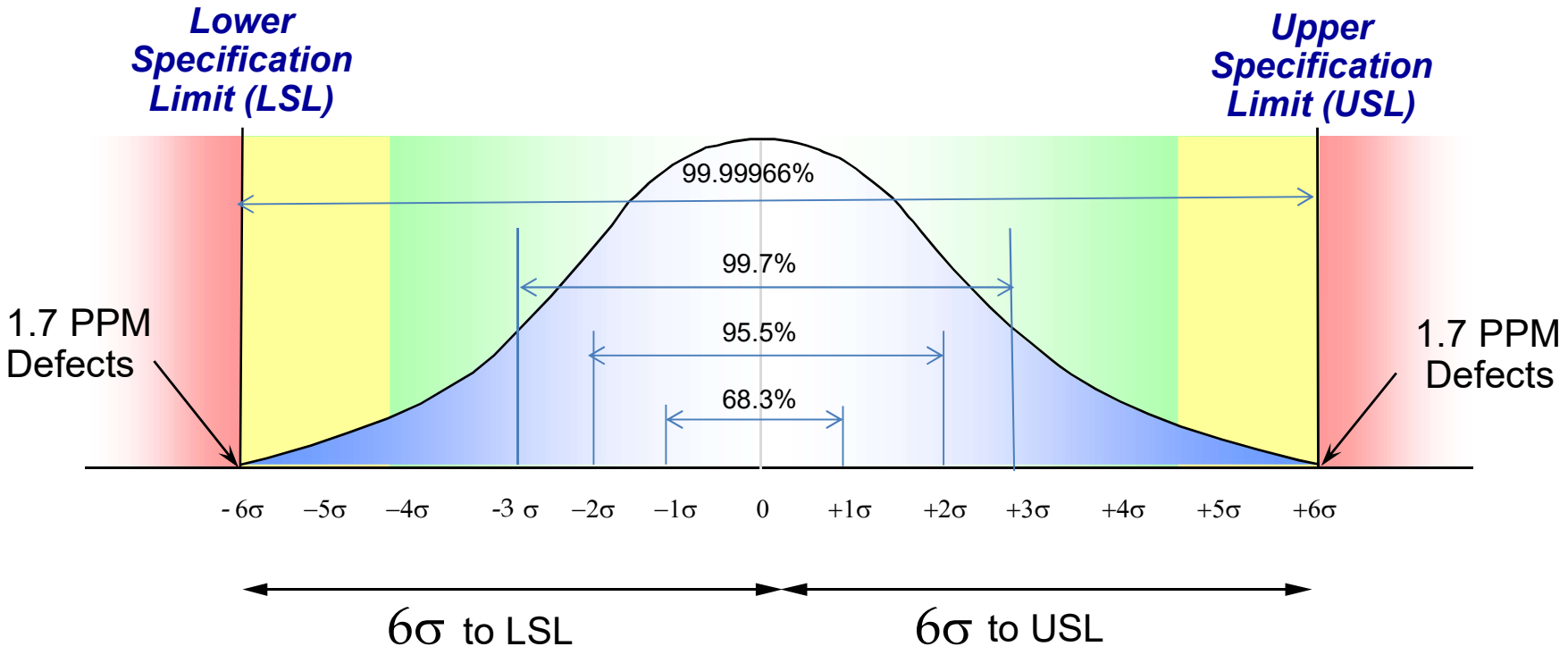


Cumulative % line

% against this axis

Categories

Six Sigma



Six Sigma is focused on the **reduction of variation** using process improvement tools, with the ultimate idea of removing defects (i.e. rework, waste).

Sigma Level	Defects per Million	Yield
6	3.4	99.99966%
5	230	99.977%
4	6,210	99.38%
3	66,800	93.32%
2	308,000	69.15%
1	690,000	30.85%

Statistical Terminology

- **Population** - a complete set; all items of interest
  - The number of elements in a population is denoted by ***N.***
- **Sample** - a subset of elements from the population
  - The number of elements in the sample is denoted by ***n.***
- We can characterize a population or sample in 3 ways:
  1. Measure of central tendency (location of center or middle).
  2. Measure of variation (spread or width).
  3. Measure of distribution (what does the set look like when viewed graphically (shape)).

Data Characteristics

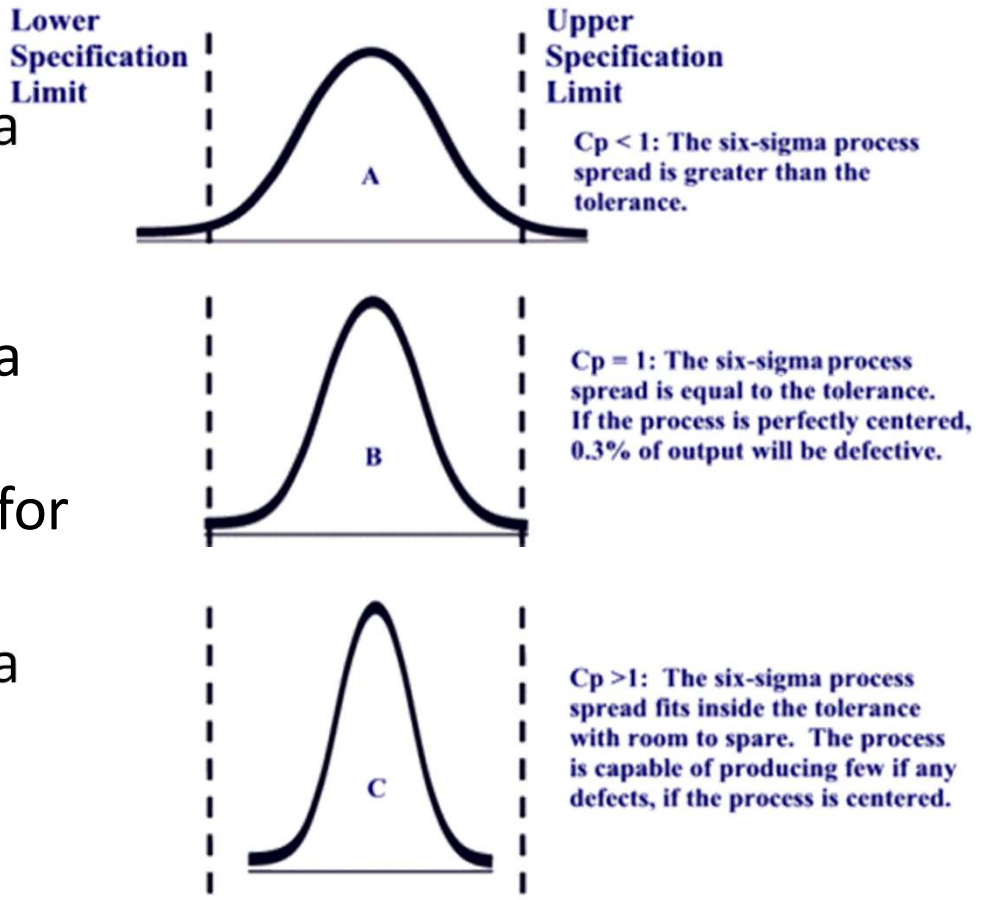
- **Central Tendency (location)** – defines the location or center or middle of data.
  - Examples: Mean, Median and Mode
- **Variation** – defines the width of the data.
  - Examples: Range, Variance, Standard Deviation
- **Distribution** – defines the shape of the data, and a visual that can be more descriptive than just numbers.
  - Examples: Histogram, Stem & Leaf plots, Boxplots

Process Capability

A measure of how close a process is running to its specification limits.

Process Capability Values

- Process Capability < 1 indicates a process that is unable to meet specifications.
- Process Capability = 1 indicates a process that is able to meet specifications, but has no room for variation.
- Process Capability > 1 indicates a process that is able to meet specifications, and can allow for additional variation.

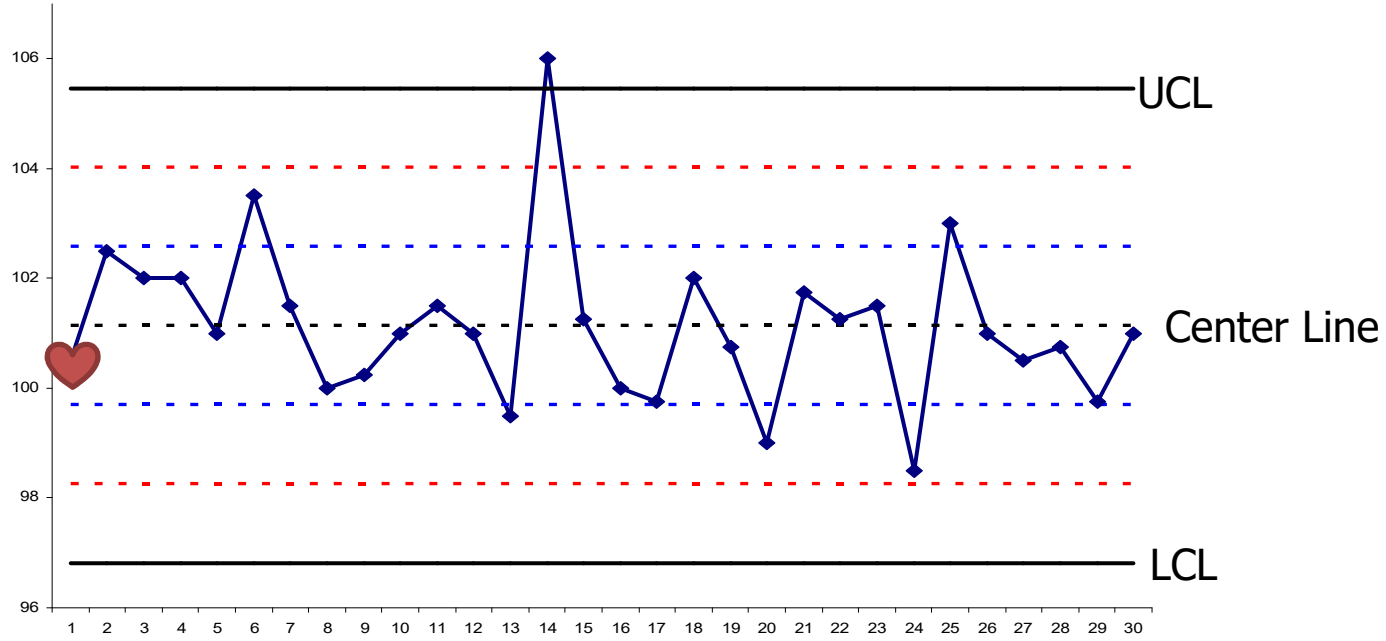


Control Charts

- Control charts are vary similar to Run Charts, but have additional information.
  - Centerline (mean)
  - Control Limits
- Used to analyze variation in a process.
  - Attribute (count) based
  - Variable (measurement) based
- Data types determines control chart.
- Used to determine if variation is inherent to the system (common cause) or caused by an assignable event (special cause).

In Control & Out of Control Conditions

- In control processes demonstrate common cause variation.
- Out of control demonstrate special cause variation conditions including:
  - Extreme Points, Trends & Shifts, Oscillation.



Knowledge Check: Fishbone

What is the purpose of the Cause and Effect Diagram (Fishbone/Ishikawa)?

Knowledge Check: Variation

Name the two types of variation?

Knowledge Check: Pareto Chart

What is the underlying principle of the Pareto Chart?

What questions do you have so far?

Improve Phase

Improve Phase

Objectives:

- Identify Potential solutions.
- Map out “TO BE” process.
- Develop an implementation Plan.
- Pilot solution.

Activities:

- Brainstorm potential solutions.
- Evaluate and select best solution.
- Identify solution impacts.
- Produce “to be” process maps and present implementation plan.
- Communicate solutions to all stakeholders.
- Leadership approval (Review).

Lean Overview

- Lean Principles
- Types of waste within processes.
  - TIMWOOD and U
- Basic lean methods of process improvement.
  - Value Stream Mapping
  - Little's law
  - Mistake proofing
  - 5S + 1
  - Visual controls
  - Right Sizing
  - Standard Work
  - TAKT Time

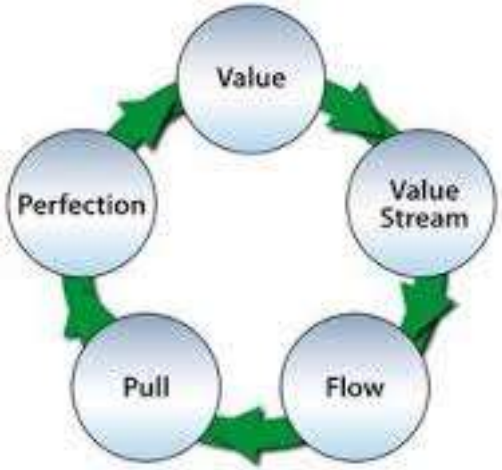
Lean Defined

"Becoming 'lean' is a process of eliminating **waste** with a goal of creating **value**."

Source: *Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative* by Earl Murman, Thomas Allen, Kirkor Bozdogan, Joel Cutcher-Gershenfed, Hugh McManus, Deborah Nightingale, Eric Rebentisch, Tom Shields, Fred Stahl, Myles Walton, Joyce Warmkessel, Stanley Weiss, Shela Wdnall, (Pagrave, 2002)

Lean Principles – Womack & Jones 1996

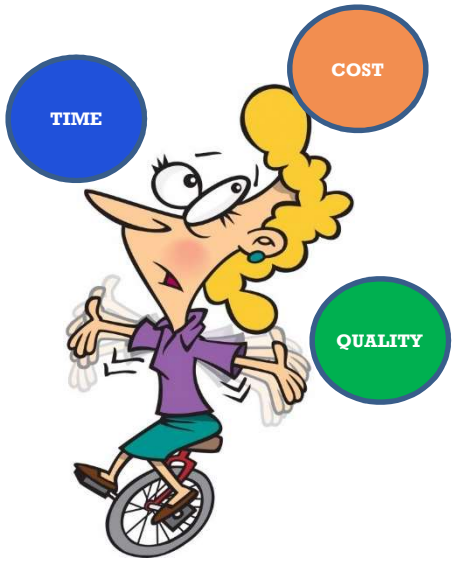
- **Value** specified from the customer's perspective.
- The **Value Stream** has been identified for each service.
- The product / service **Flows** without interruptions.
- The customer can **Pull** value through the process.
- Continuous pursuit of **Perfection**.



Lean Principles – Value

- Critical starting point for Lean.
- **Can only ultimately be defined by the customer**.
  - NO two customers define Value identically.
- Critical questions we must ask ourselves.
  - Do we truly understand Value from our customer's perspective?
  - Are we truly focused on providing that Value?
  - What are the barriers & obstacles preventing us from focusing on and providing that Value?

$$Value = \frac{Features \ x \ Performance \ x \ Quality}{Cost \ x \ Time}$$



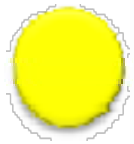
Value Added, Business Value, Non Value Added

Value Added

The customer wants it (and is willing to pay for it) and,

It changes form, fit, or function of a product or service and,

It is done right the first time.



Business Value

No value is created but customer is willing to pay for it.

Required by Law / Statute / Unchangeable Policy.

Non-Value Added - Waste

Consumes resources but creates no value in the eyes of the customer.

If you can't get rid of the activity, reduce it.

Definitions of Waste (Muda)

Those Elements of a process that **Do Not Increase the Value** of a Product ***as Perceived by the Customer***, but **increases Cost and Process times.**

Anything other than the **minimum** amount of **equipment, materials, parts, space, and worker's time** which are absolutely essential to **add value** to the product.

8 Types of Waste

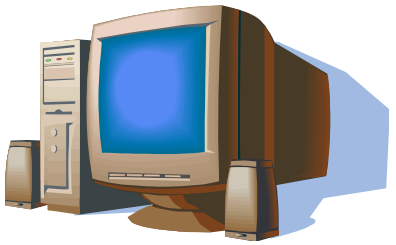
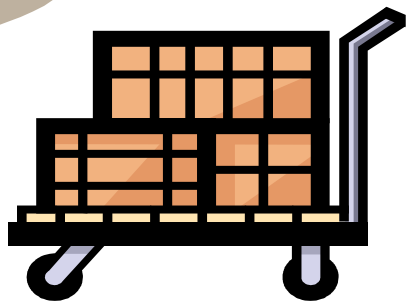
Identify and **Eliminate** these Wastes:

Types of Waste:

T	Transportation
I	Inventory (Excess)
M	Motion
W	Waiting
O	Over-Production
O	Over-Processing
D	Defects
&	
U	Under Utilization of people

Transportation




Waste caused by **<u>unnecessary</u>** movement of material or product.

Primary Causes:

- Inefficient Facility Layout
- Process Islands vs. Continuous Flow
- Batch (Push) Mentality
- Lack of Right-Sizing
- Long Setup Times
- Lack of Multi-Skilled Workers

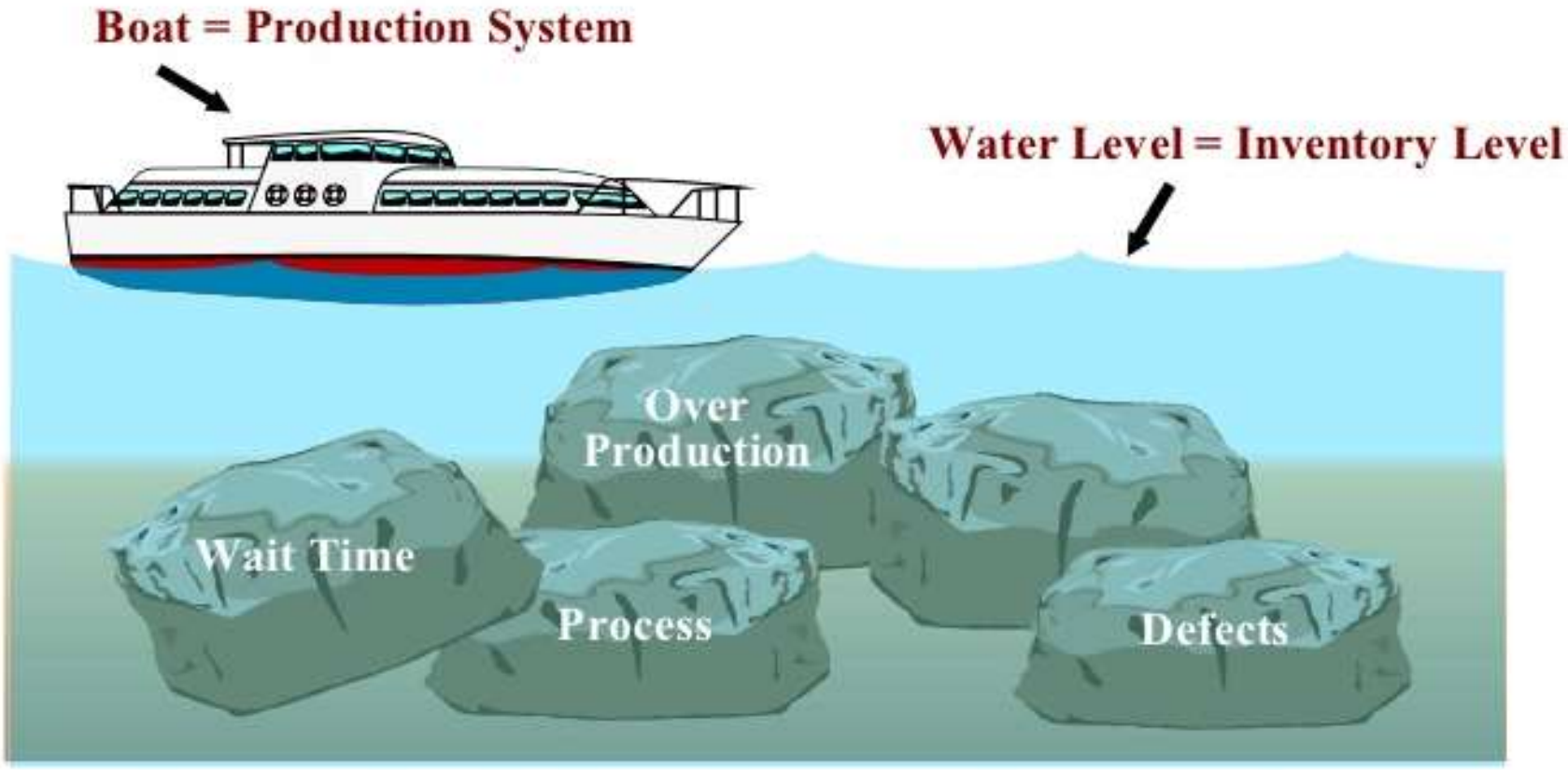
Inventory (Excess)

Waste of materials, parts and assembled goods, when purchased or produced **in advance** of customer requirements.

Increases Cycle Time & Process Lead Time

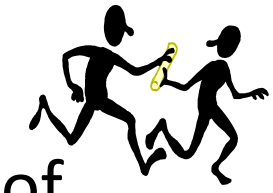
8 Wastes – Inventory (Excess)

Inventory Hides Problems!



Rocks = Hidden Problems (Uncovered as Inventory is Reduced)

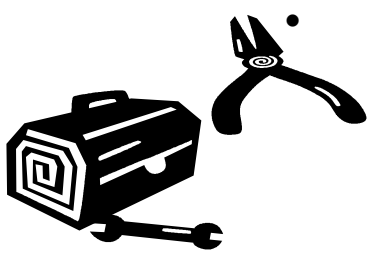
Motion

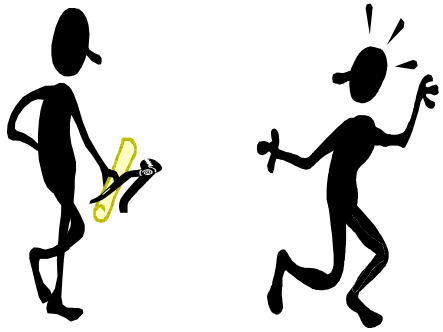


Waste caused by **non-value added movement** of workers and / or production machines.

Primary Causes:

- Inefficient workplace layouts.
- Inefficient tools and / or fixtures.
- Lack of Standard Work causing inconsistency.
- Batch movement of product.





Waiting & Over Production

Waiting

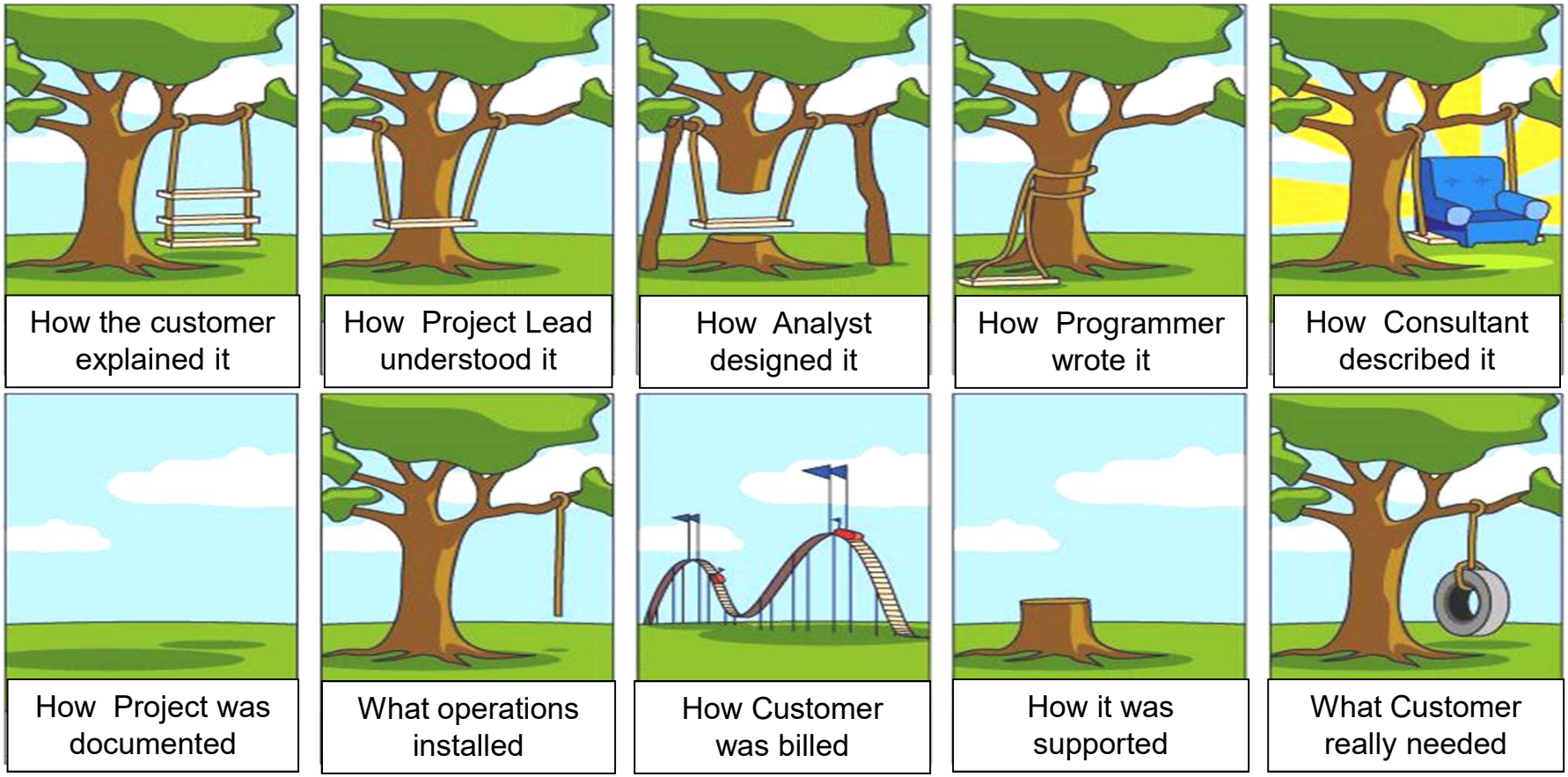
The Waste of waiting occurs whenever the hands of an employee are idle.

Over production

Waste caused by producing more than the customer needs (Push). This type of waste leads to **excessive inventories**.

Over Processing

The Waste of **Unnecessary** or Non-Optimized Processes and/or Operations.



"There is nothing so useless as doing efficiently that which should not be done at all." ***Peter Drucker***

Defects / Rework

Waste that occurs when a process, product, or data **does not conform** to proper specifications. The result could cause product rework, scrap, or the escape of a defect to the customer.

What Causes Defects?

- Poor procedures or standards.
- Non-conforming materials.
- Worn or out of tolerance tooling.
- Human mistakes.

Under utilization of employees

ULTIMATE WASTE

Waste of a person's time

8 Wastes - Examples

Type of Waste	Physical Process	Transactional Example
Transporting	Parts Moving to Warehouse and Back	Data Handoffs
Inventory (Excess)	Excessive Work-in-Process	Backlog of Design or Tooling Changes
Motion	Retrieving Parts, Tools, Information	Poor Office Lay-Out
Waiting	Out of supplies, Lack of Information	Meetings, Approval, System Down Time
Over-Processing	Performing Unneeded Operations	Approvals (Too Many Sign-offs)
Over-Production	Working Ahead of Schedule	Printing Paper Too Soon
Defects	Scrap or Rework	Drawing or Planning Errors, Rework
Under utilization of employees	More people involved than required to perform physical or transactional tasks.	

Exercise


Overproduction
Transportation
Waiting
Inventory
Movement
Eight Wastes
Overprocessing
Scrap & Efforts
Under-utilized People

8 Types of Wastes Exercise

- Break into teams.
- Identify the 8 Types of Wastes.
- Brainstorm 3 examples of waste in your work areas.
- Be prepared to share your examples with the class.

Lean Principles – Value Stream

- **Value** specified from the customer's perspective.
- The **Value Stream** has been identified for each service.
- The product / service **Flows** without interruptions.
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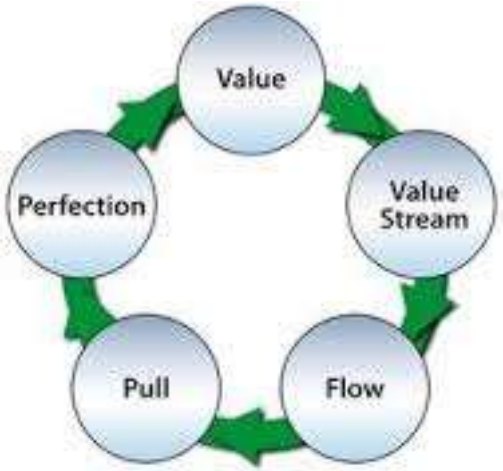
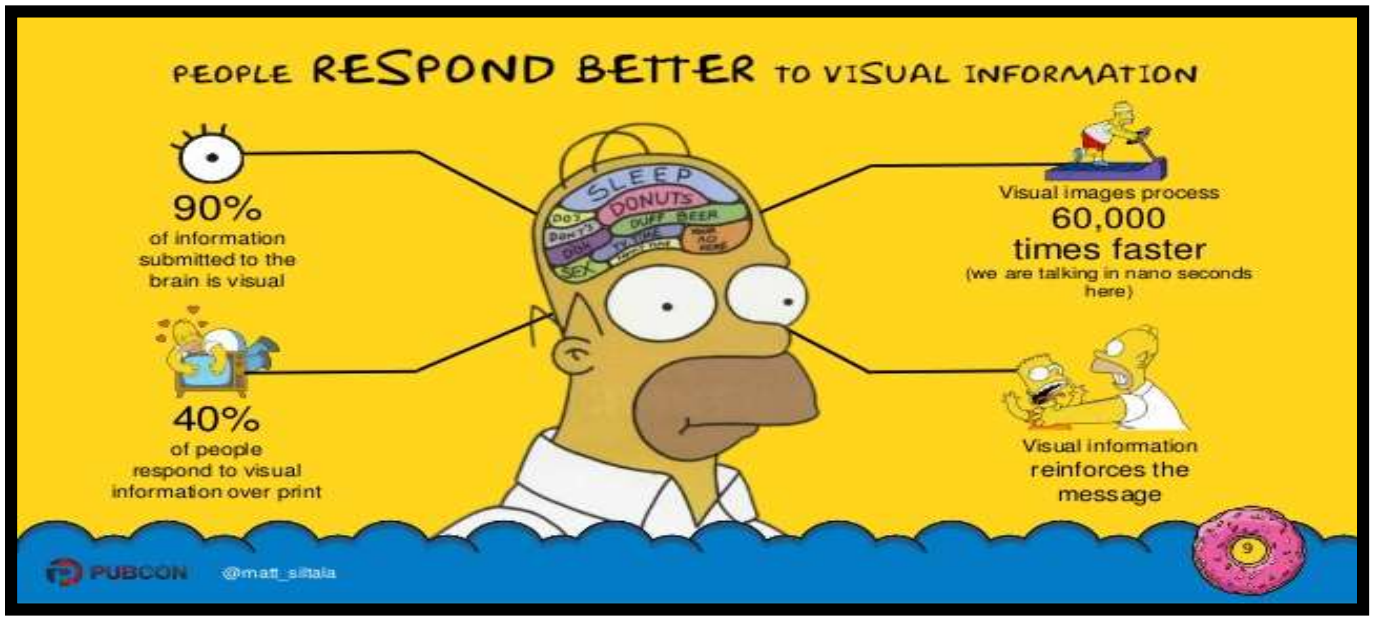
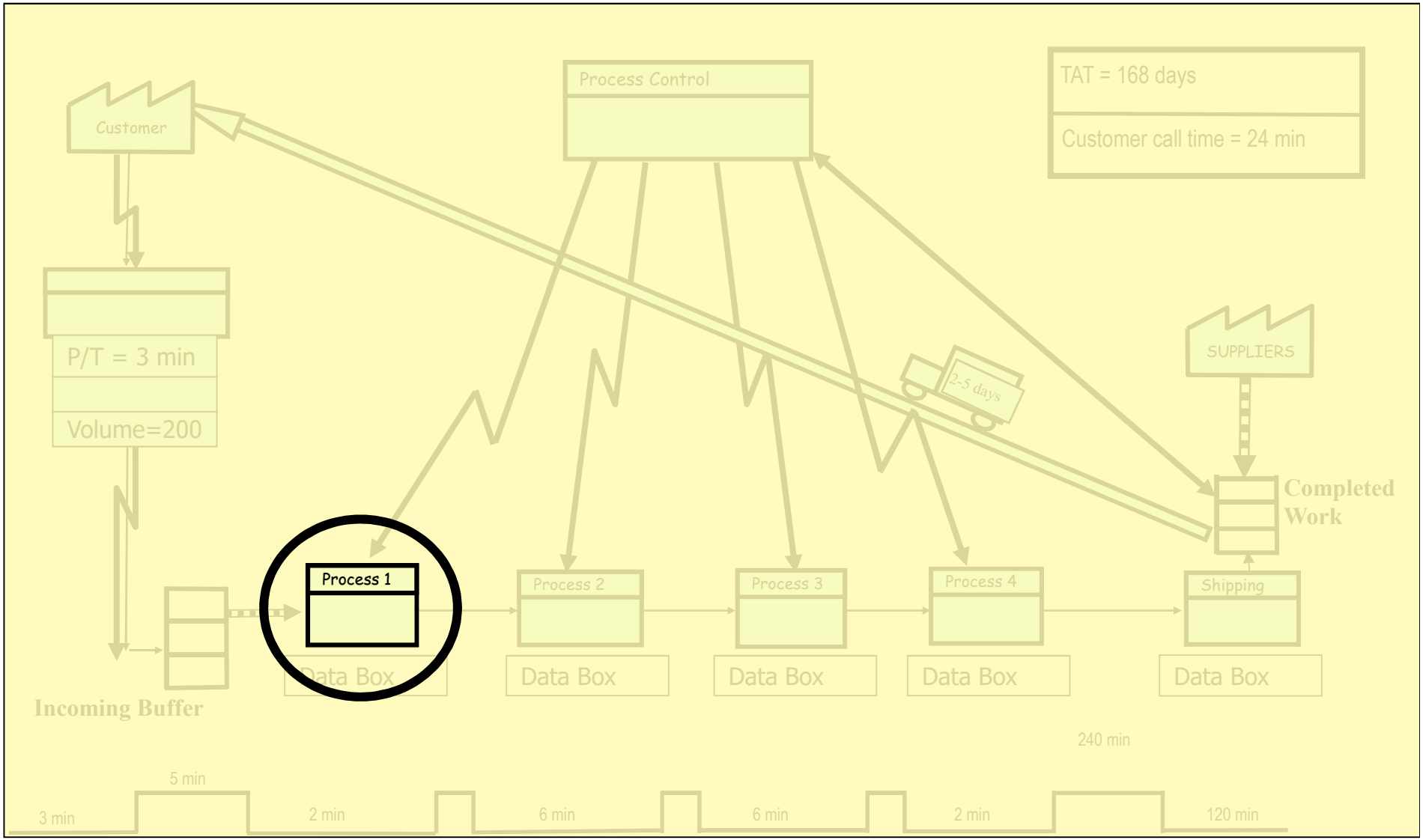


Value Stream Analysis

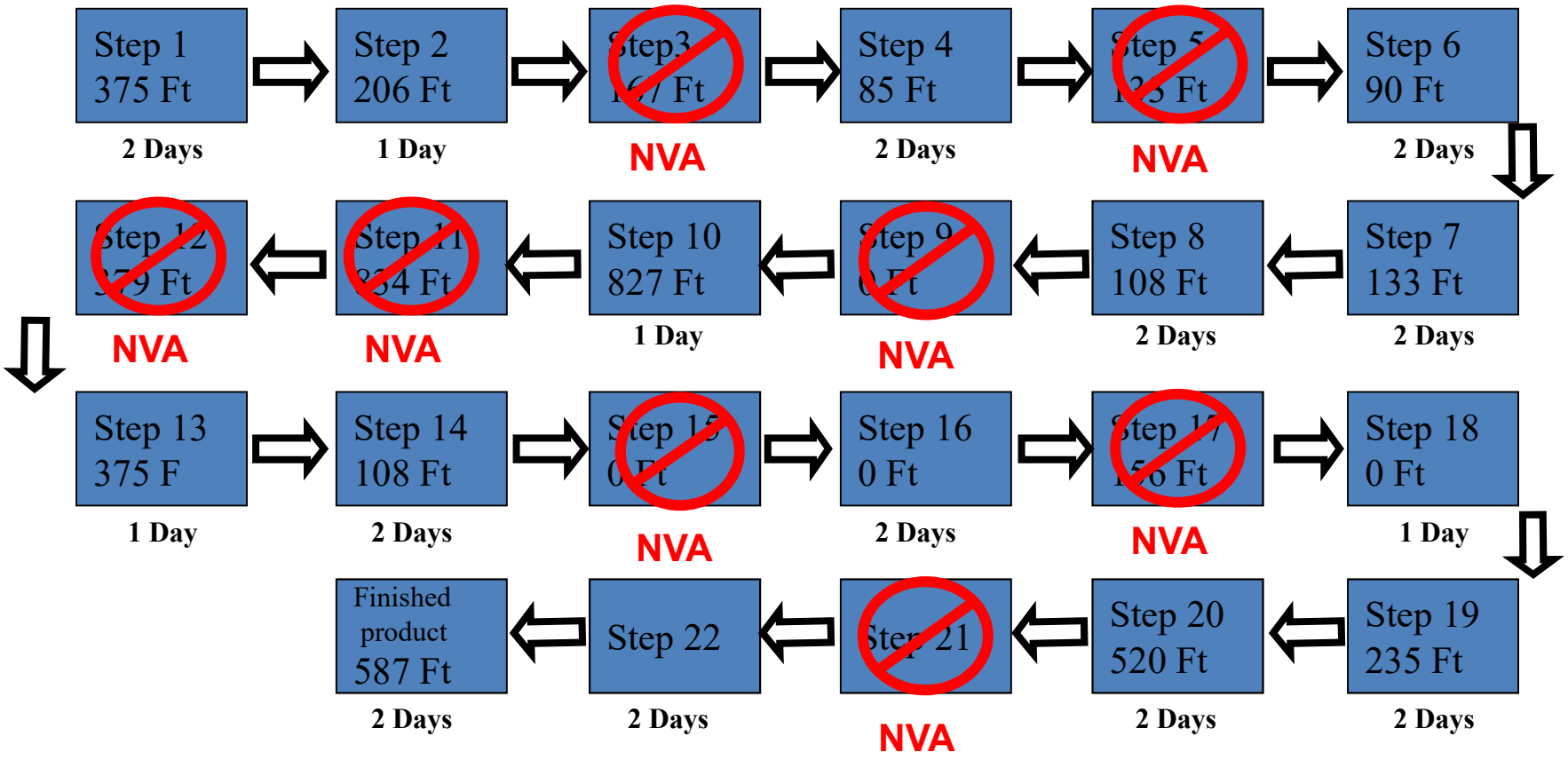
- A “VISUAL” planning tool used to identify non-value added activity (NVA) and develop plans to eliminate the waste.
- Value Stream Analysis is the key to all improvement activities.
- Includes the entire set of activities running from requirement to finished product for a specific product or service.
- Seeks to optimize the whole from the standpoint of the final customer.



Value Stream Map (VSM)



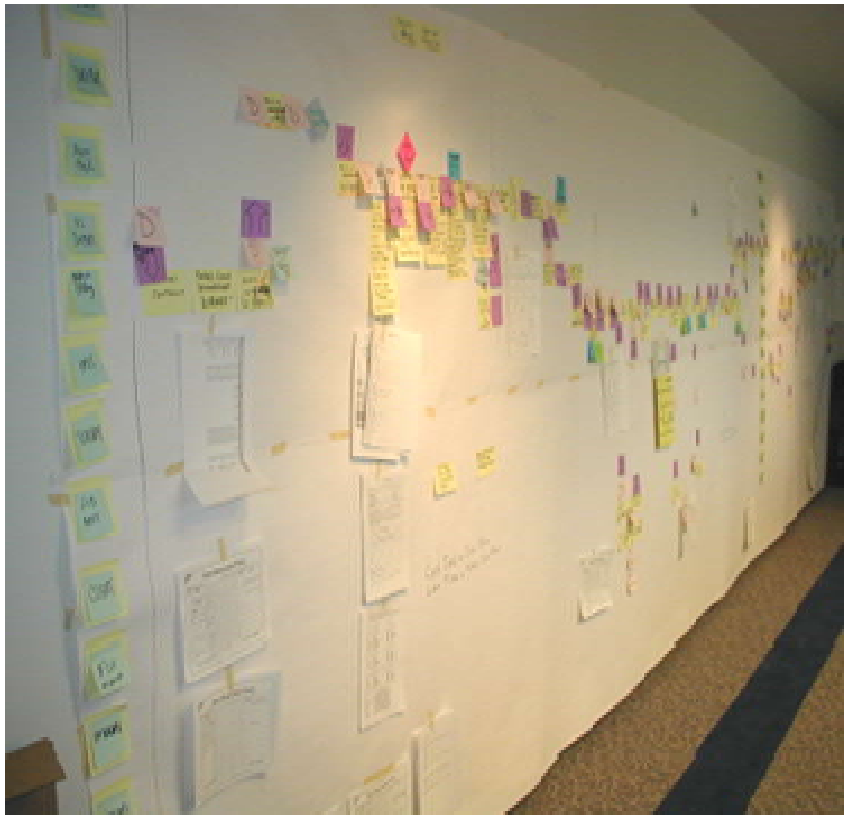
VSM for Process 1 (Process Flow Map)



AS-IS METRICS
- 23 PROCESS STEPS
- 35 Queues
- 8 NVA STEPS
- TAT = 43 DAYS
- TOTAL DISTANCE = 5242 Ft

TO-BE METRICS
- *15 PROCESS STEPS*
- *23 Queues*
- *0 NVA STEPS*
- *TAT= 12 DAYS*
- *TOTAL DISTANCE=1528 Ft*

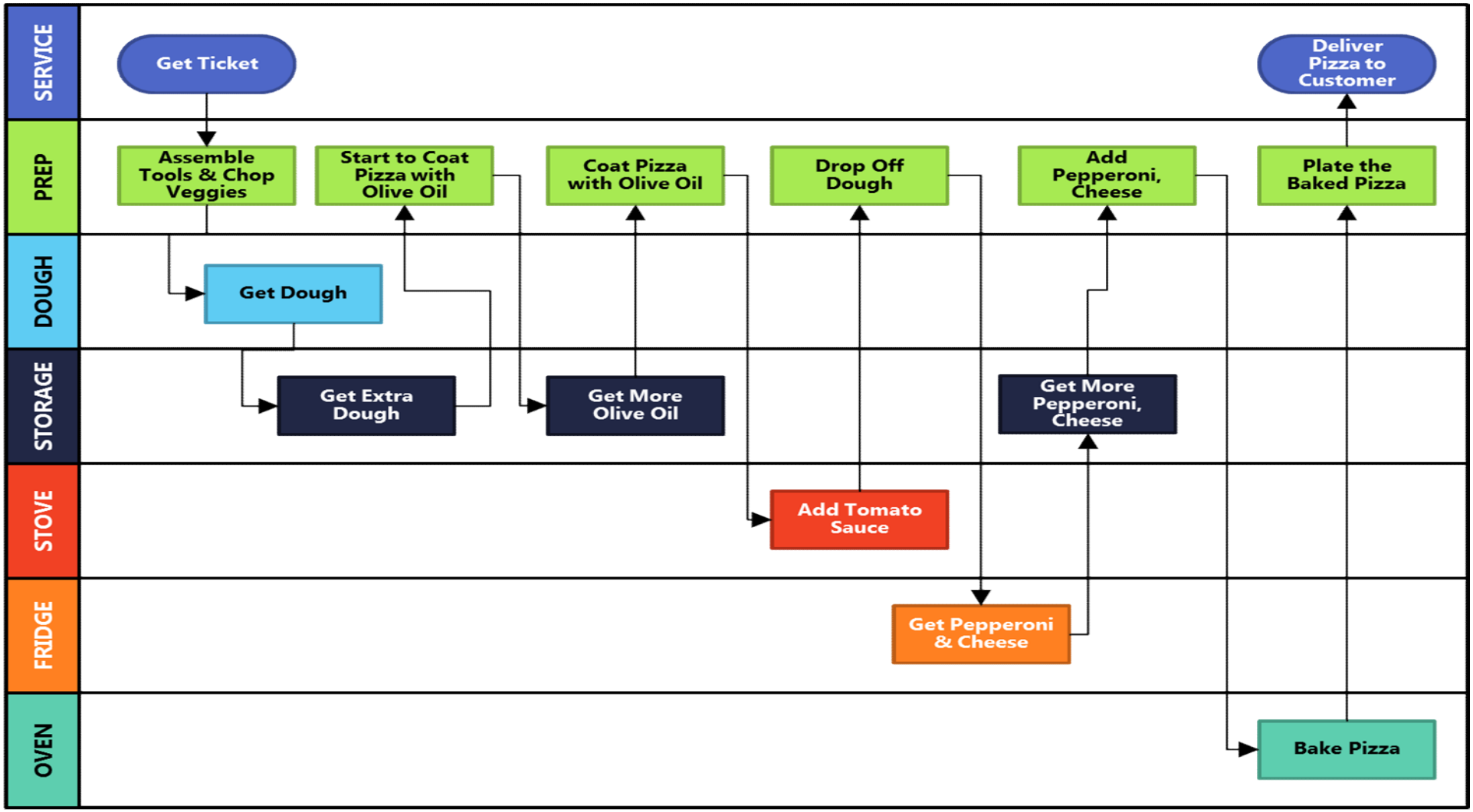
Value Stream Map - Examples



Process Map – Swim Lanes

Current State: The Pizza Place

Source: North Carolina Center for Public Health Quality



Lean Principles – Flow

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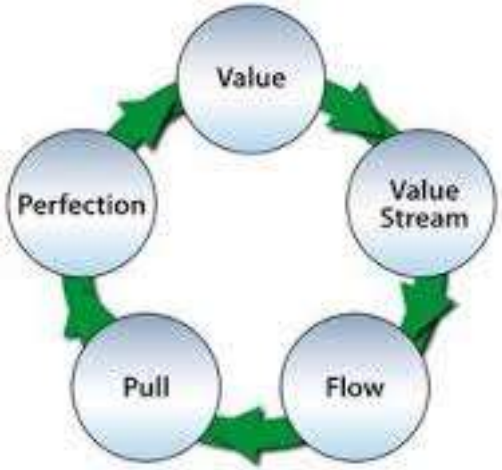


What is Flow?

The continuous, progressive adding of Value in the eyes of the customer.

- Starts at receipt of customer request.
- Ends at delivery to customer.

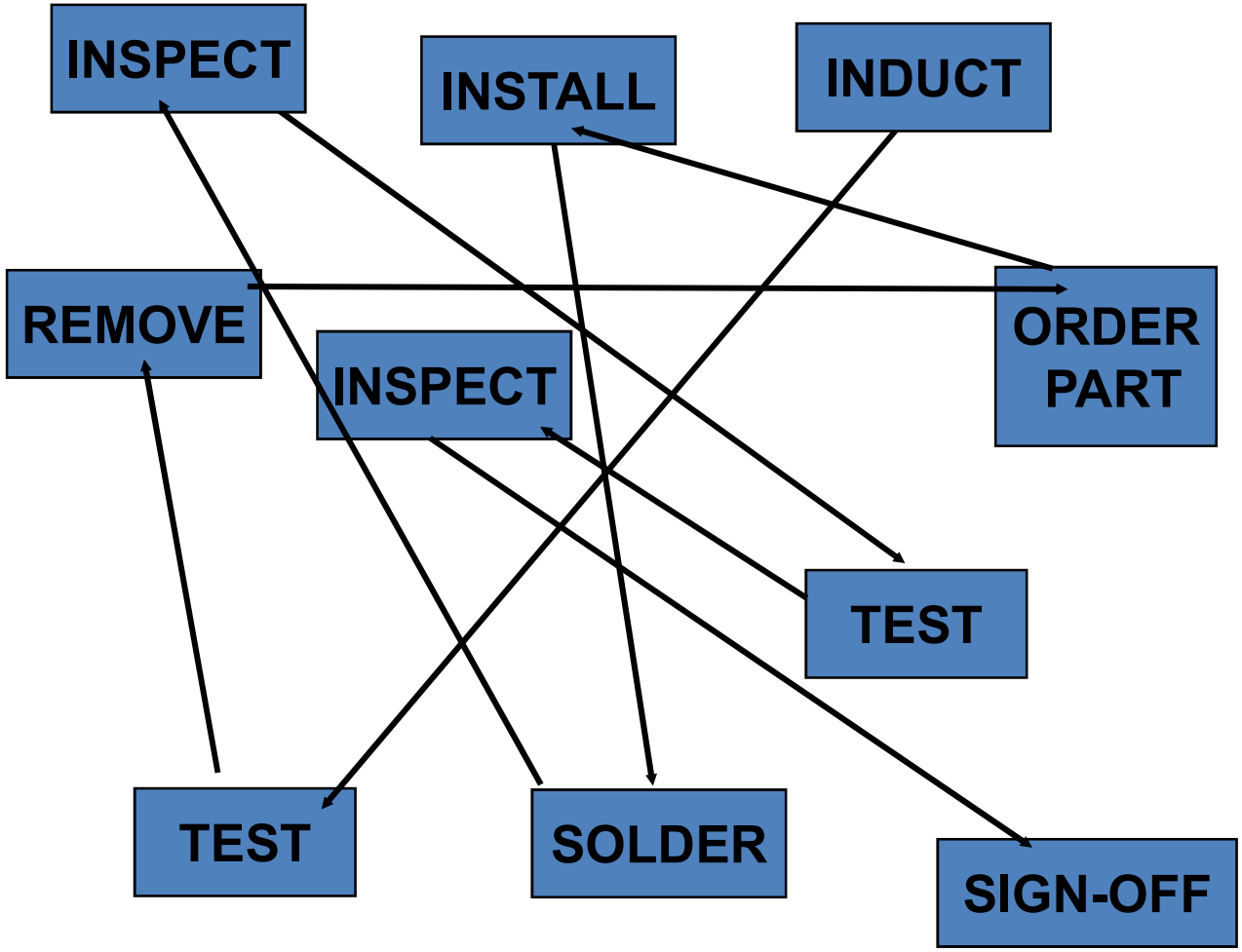
- Flow utilizes the fewest number of steps with **no interruptions**.
- Eliminates waste.

People always working on the product and the product always being worked on.

Typical Flow – Before Improvements

Workplace Layout

- Batch operations
- Isolated processes
- Unknown status



Batch and Queue

- Production of large lots of identical items to meet **anticipated demand**.
  - Production is to schedule, not to demand.
- Makes great efficiencies possible for equipment amortized over large quantities.
- Increases inventory and cycle times.
- Examples of Batching
  - Waiting for a table at a restaurant (Table for 4).
  - Waiting at IPAC to get CAC.
  - On the telephone when on hold.
- Batching may be required in some instances
  - Providing a product / service to a specific group / crowd.
  - Examples: In-class training, Base tours, Award presentations, Carpooling, etc.

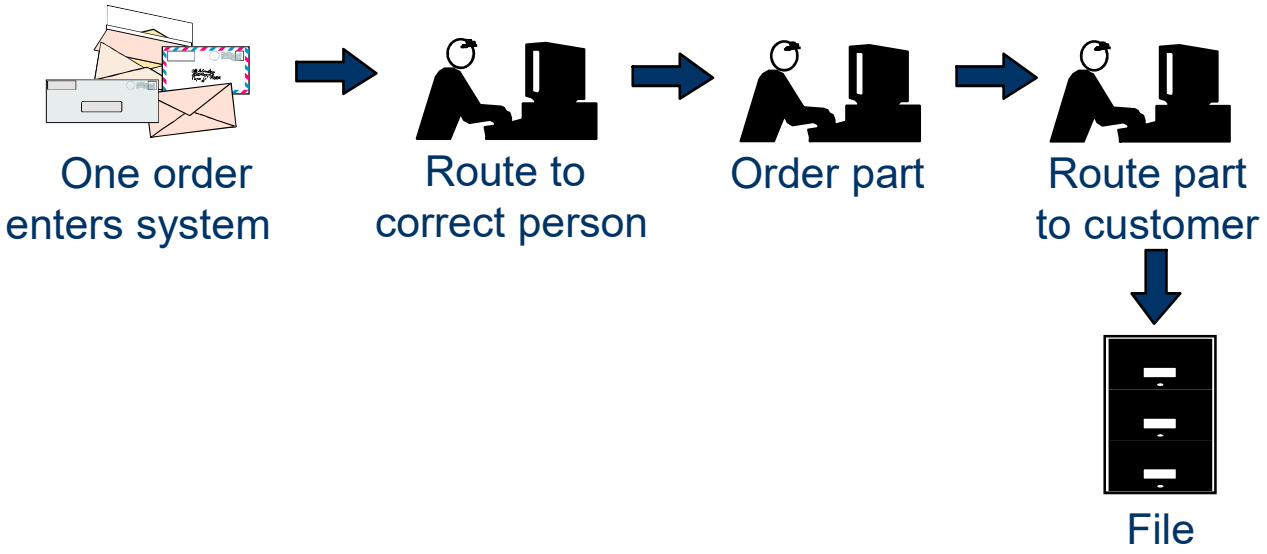
Toyota Production System

- Taiichi Ohno / Shigeo Shingo found the real challenge was to create continuous flow in "small-lot" production.
- Ohno achieved small lot continuous flow by:
  - Aligning equipment & resources to the Value Stream.
  - Physically locating machines close together.
  - **Driving down batch sizes.**
    - Single Minute Exchange of Die (SMED).
    - Splitting and right-sizing of operations.
  - Cross Training.
  - Simple production control processes – Pull / Kanban.
  - Aggressive root cause analysis.
  - Application of Lean tools such as Kitting, Point of Use Systems (POUS), and visual controls.

One Piece Flow

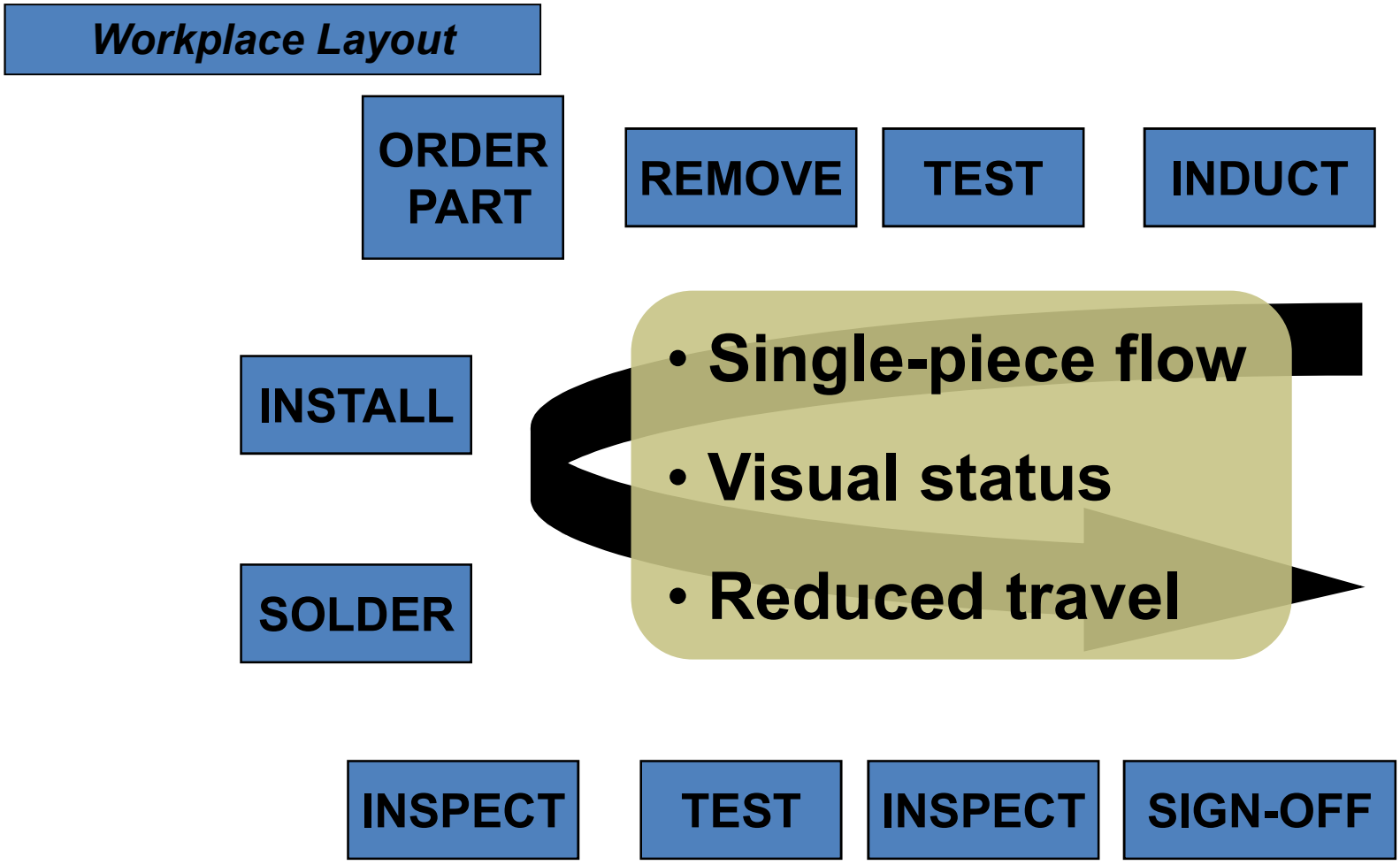
The Ideal State:

Produce and move one piece at a time.

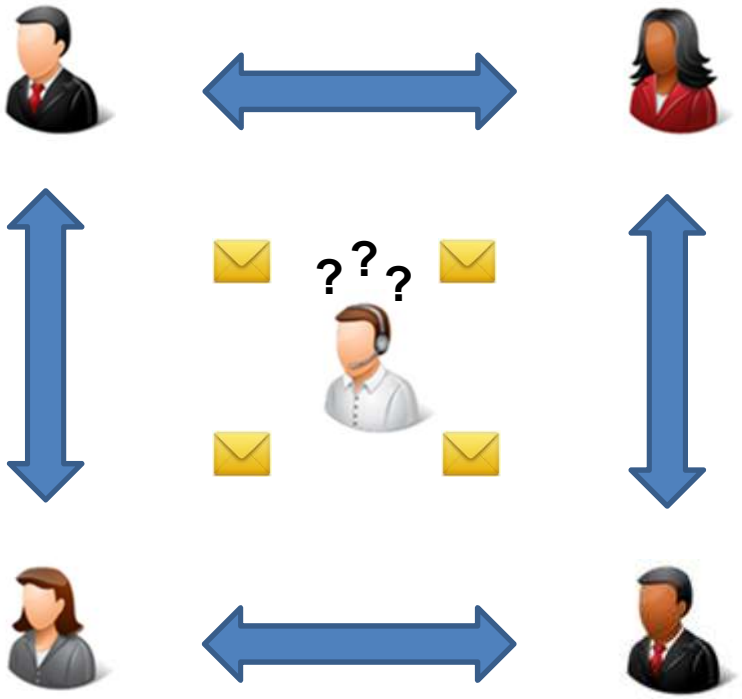


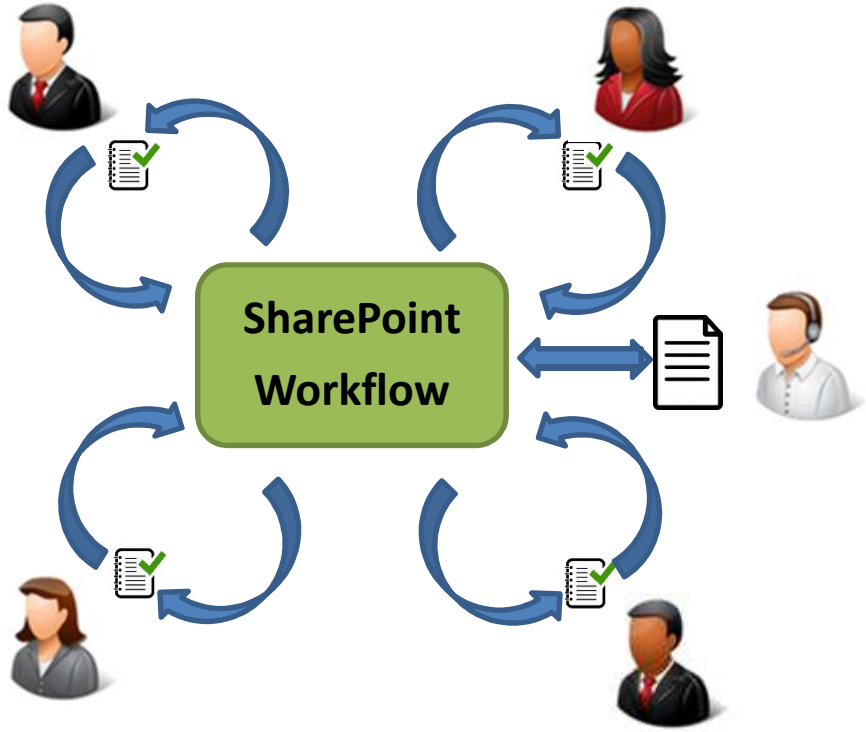
Segregate excess WIP away from the improved process; develop a plan to eliminate it.

Typical Flow – After Improvements



Lean Flow In the Office





Before Lean

Shotgun Email Method

Problems:

- Confusing
- Wasted Time
- Increased Costs

After Lean

SharePoint Workflow

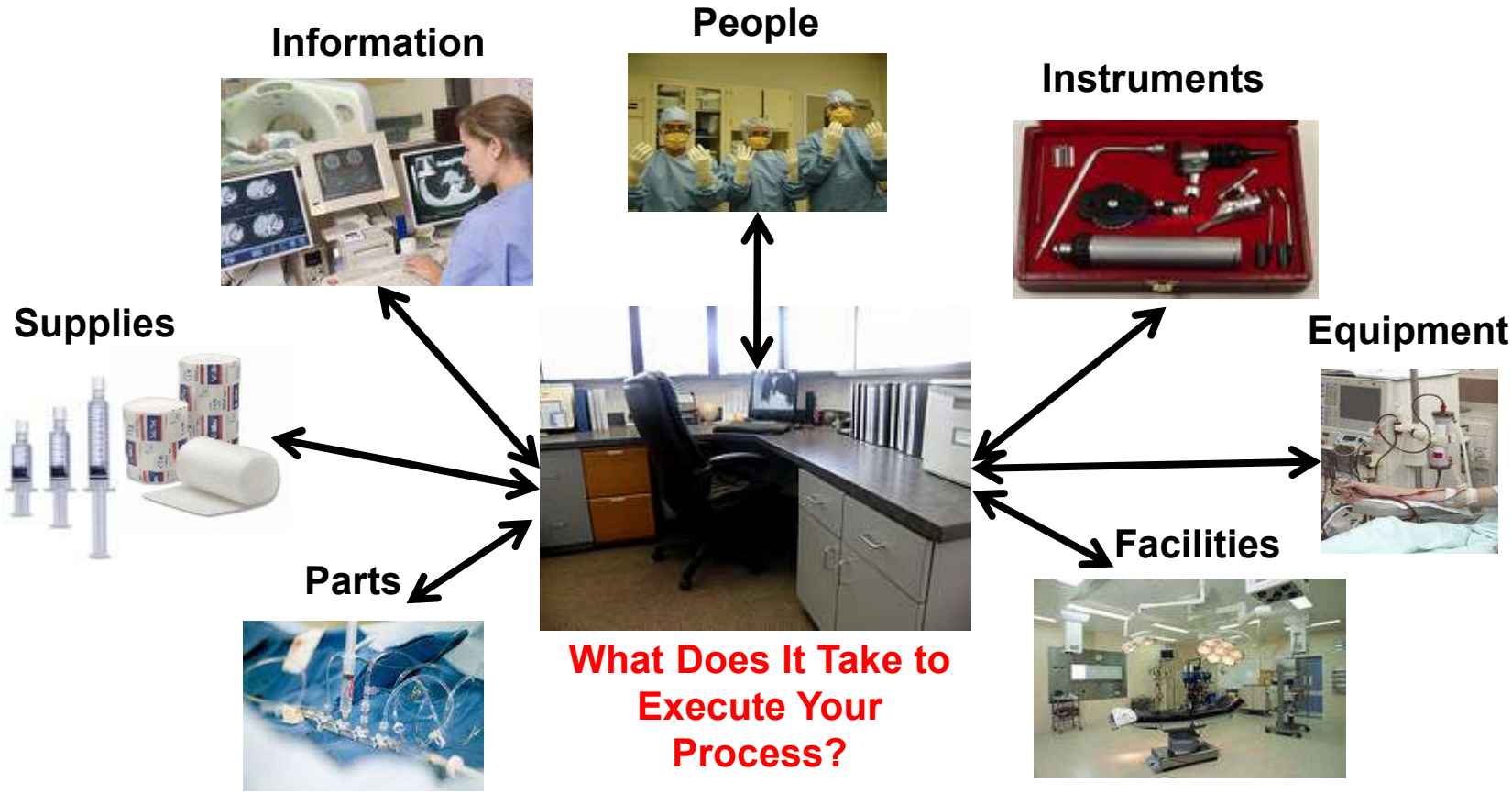
Benefits:

- Reduce Errors
- Improved flow, less confusion
- Decreased Costs

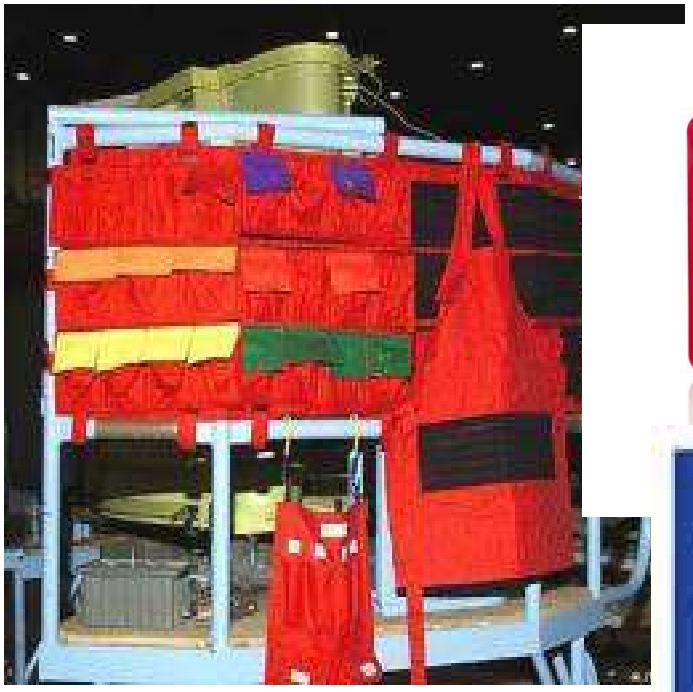
Point of Use Systems (POUS)

POUS is a practice that ensures that the right information, parts, tools, equipment & people are available where & when needed.

Are your workers treated like doctors in an operating room?

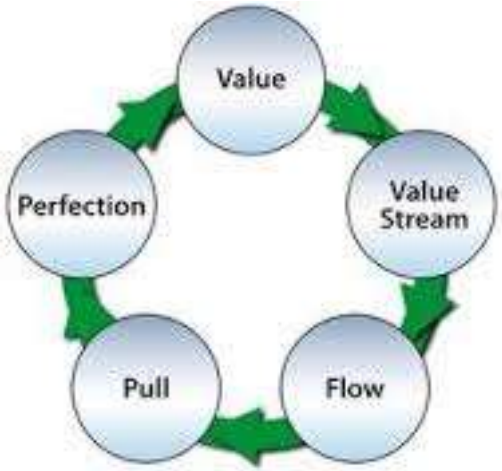


POUS/Kitting Examples



Lean Principles - Pull

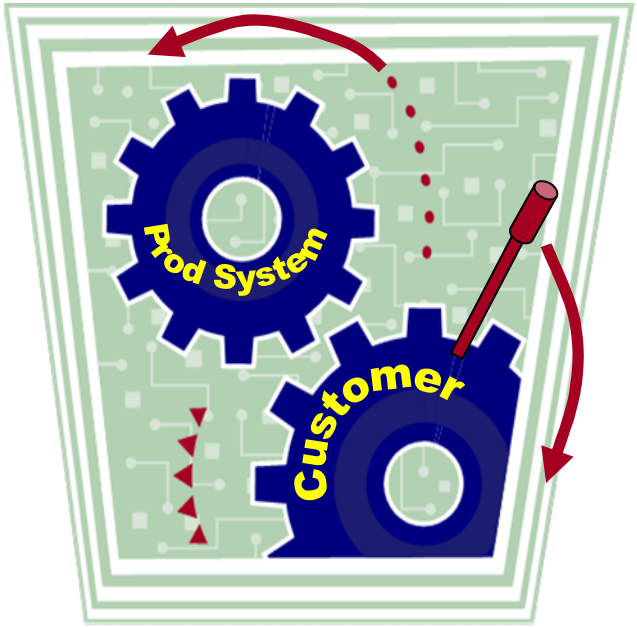
- **Value** specified from the customer's perspective.
- The **Value Stream** has been identified for each service.
- The product / service **Flows** without interruptions.
- The customer can **Pull** value through the process.
- Continuous pursuit of **Perfection**.



Push vs. Pull

Push:

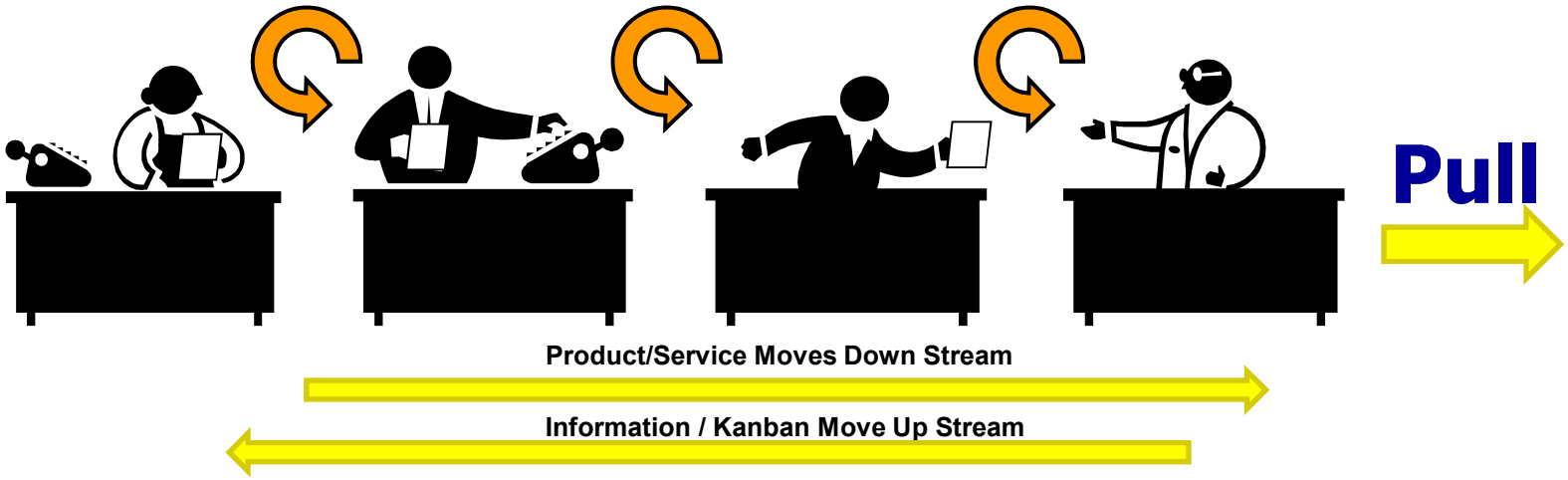
Work is pushed into the system or process based on **forecasts or schedules**.



Pull:

A **customer-driven system** that produces and moves a product/service *only* when the customer needs it.

Pull Systems



Let Customer's Pull Value

- No one upstream produces a good or service until the downstream customer asks for it.
- Replaces *"Ready or not here I come"* with *"OK, Now I'm ready".*

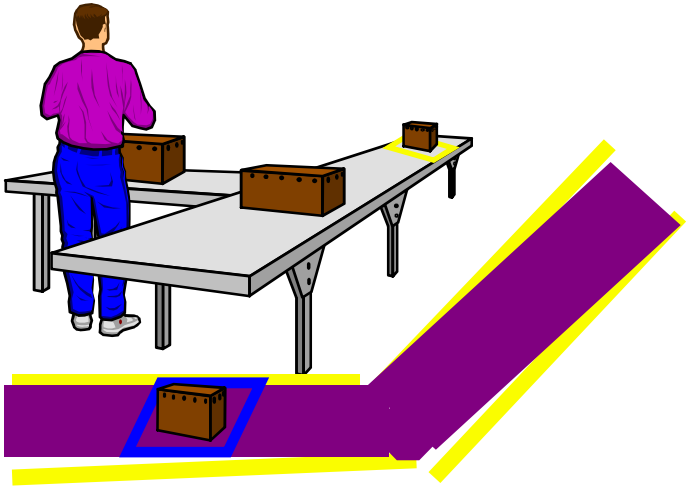
Requirements for Pull System

- **Elements**
  - Upstream Supplier
  - Downstream Customer
  - Visual Trigger (Kanban)

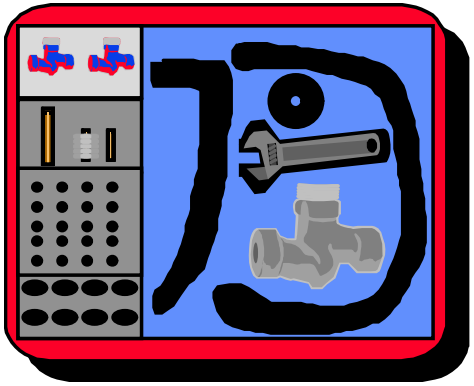
Sequenced - Use First In First Out (FIFO) lanes
Replenished - Create supermarkets

Types of Pull Signals (Kanbans)

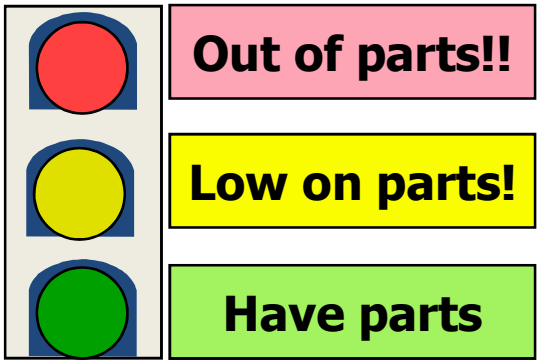
Square on Floor



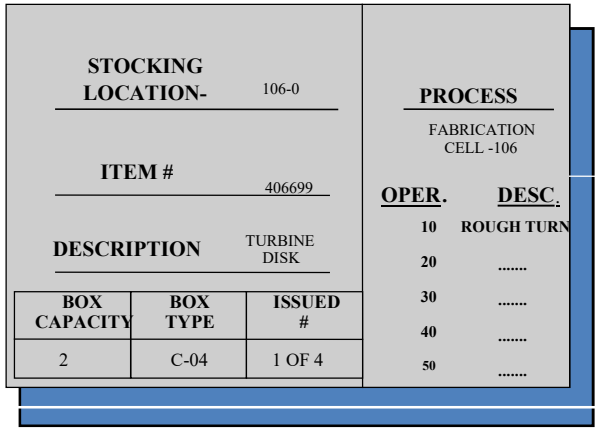
Containers (Kits)



Lights



Cards



Pull System Example

Reordering Office Coffee

Step One: Remove Empty Box

Step Two: Locate New Box

Step Three: Pull Kanban

Step Four: Replace Box

Step Five: Place Kanban in Reorder Pouch

Step Six: Replace Stock

Lean Principles – Perfection

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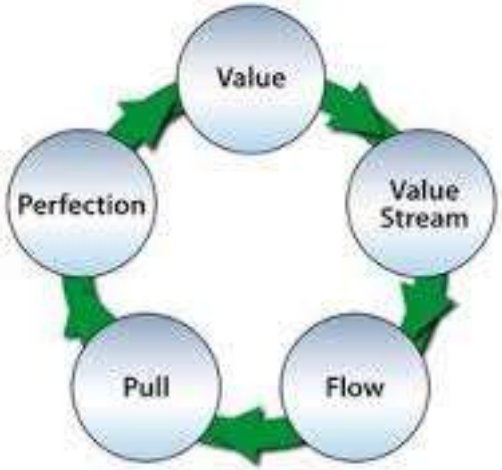

Pursue Perfection

- Begins with understanding Lean Principles & visualizing the “perfect” process at the outset.
- No matter how much you improve a process to make it leaner, there are always ways to continue to remove waste by eliminating effort, time, space and errors.
- Achieving the “Lot Size of 1”.
- **Achieving Continuous Flow.**
- Achieving a CPI Culture.

It's Cultural

You Can't Become Lean without Learning

One Million – That's how many ideas Toyota *implements* *e*ach year. Do the math: 3,000 ideas a day.

But not just any ideas. **Mostly tiny ones** by employees that view their role not to be simply doing the work, but taking it to the next level…every day, in some little way.

When an entire organization thinks like that, it becomes unstoppable.