

LSSSystem Training Course

A Practical Lean Six Sigma System for Continuous Improvement in Manufacturing

Implement LSSSystem. Learn Lean Six Sigma. Deliver measurable results.

Structure of This Training Course

PART I

Implementing LSSSystem

Learn how to establish a repeatable management system that turns business objectives into continuous improvement.

**Set Goals • Assign Ownership •
Manage Projects • Review Results •
Recognize Success • Repeat**

PART II

Lean Six Sigma Fundamentals

Learn the principles, problem-solving methods, and practical tools needed to execute improvement projects.

**Lean • Six Sigma • DMAIC • Statistical
Analysis • Improvement Tools**

Start with the management system. Then develop the skills needed to execute it.

**Lean Six Sigma provides the methods. LSSSystem provides the system for
continuous improvement.**

Part I: Why Continuous Improvement Programs Struggle

Many Lean Six Sigma programs are aligned with business goals and supported by trained improvement specialists. However, results can still be disappointing when responsibility for improvement rests primarily with the CI specialist rather than operational management.

BUSINESS GOALS



BLACK BELT / CI SPECIALIST

Find projects • Lead projects • Drive execution • Deliver results



DEPARTMENTS

Participate and support

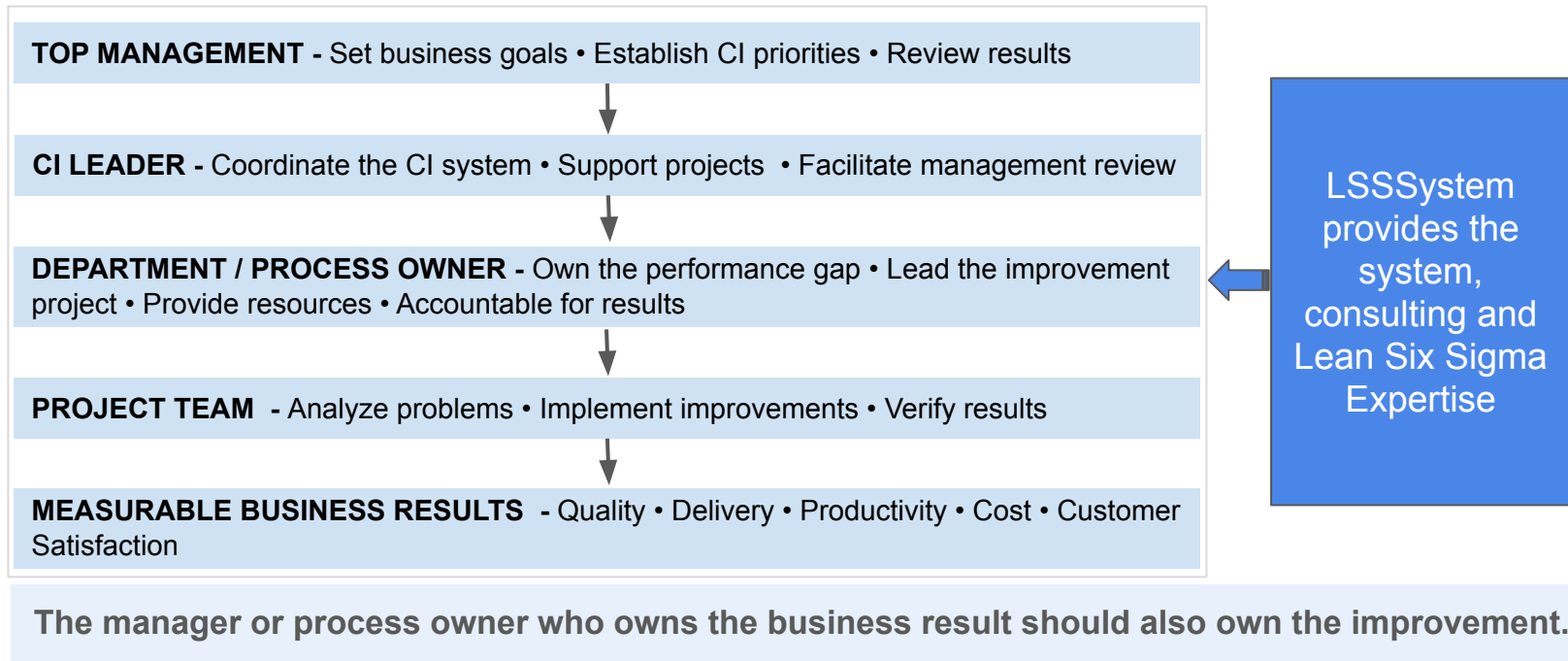
THE CHALLENGE

When the department head does not own the improvement project, the CI specialist may be responsible for results without having full authority over the process, resources, and priorities. Management involvement may be limited, making improvements difficult to implement and sustain.

Continuous improvement cannot be delegated entirely to the CI organization.

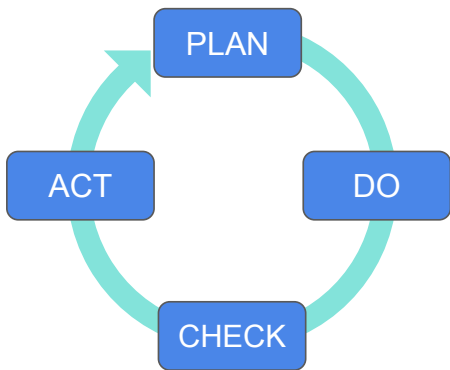
LSSSystem: Make Improvement a Management Responsibility

LSSSystem treats continuous improvement as a management responsibility. The CI Leader coordinates the improvement system; department and process owners remain accountable for their improvement projects and business results, while LSSSystem provides the system, consulting, and Lean Six Sigma expertise.



The LSSSystem Continuous Improvement Cycle

LSSSystem turns continuous improvement into a repeatable management cycle that connects business priorities, improvement projects, management review, and organizational learning.



PLAN: Top management works with department heads to establish measurable improvement goals, assign ownership, and prioritize projects.

DO: Department heads lead improvement projects with their teams using the Lean Six Sigma DMAIC framework, supported by LSSSystem.

CHECK: Top management reviews progress and results, removes barriers, reinforces accountability, and verifies business impact.

ACT: Standardize successful improvements, capture lessons learned, identify what should be improved next, and begin the next PLAN cycle. .

LSSSystem brings Lean Six Sigma expertise to every department throughout the improvement cycle—without requiring every department head to be an expert.

PLAN: Translate Business Goals into Improvement Goals

PLAN begins with the priorities of the business. Top management works with department heads to translate business objectives into measurable improvement goals and identify where improvement is needed.

BUSINESS OBJECTIVES

Improve Quality • Delivery • Productivity • Cost

**PERFORMANCE GAPS**

Where are we falling short?

**IMPROVEMENT GOALS**

What measurable result do we need to achieve?

Example: OTD = 82% → **Goal:** Improve OTD to $\geq 95\%$

PLAN Question: What must improve to achieve our business goals?

DO: Execute Improvement Through DMAIC

Department heads own and lead improvement projects with their teams. Each project follows the DMAIC framework, with LSSSystem providing guidance and Lean Six Sigma expertise throughout the project.

DEPARTMENT HEAD

Owens the goal and project

**PROJECT TEAM**

Works on the problem

**DMAIC**

DEFINE → MEASURE → ANALYZE → IMPROVE → CONTROL

LSSSystem supports the team with methodology, tools, data analysis, and problem-solving guidance.

Example: Production Manager owns OTD improvement → Team executes DMAIC project → OTD
82% → ≥95%

DO Question: Are we executing the right improvement projects with clear ownership?

CHECK: Review Progress & Verify Results

Top management conducts quarterly and annual management reviews to evaluate improvement performance, reinforce accountability, remove barriers, and verify measurable business results.

QUARTERLY REVIEW

Are we on track?

- Review project progress and KPIs
- Address overdue projects and barriers
- Confirm resources and priorities
- Hold project owners accountable

ANNUAL REVIEW

What did we accomplish?

- Review completed projects and results
- Verify total business benefits
- Evaluate overall CI performance
- Identify priorities for the next year

Example:

OTD: **82% Baseline** → **≥95% Target** → **96% Actual**

Management reviews results—not just project activity.

CHECK Question: Are our improvement projects delivering the expected business results?

ACT: Standardize, Learn & Continue Improving

ACT turns management review into action. Standardize successful improvements, capture lessons learned, recognize contributions, and use the results to establish the next improvement priorities.

STANDARDIZE

Integrate successful improvements into normal operations.

→

LEARN

Capture lessons learned and share successful practices.

→

RECOGNIZE

Recognize department heads and teams for measurable improvement results.

→

NEXT CYCLE

Identify the next improvement priorities and return to PLAN.

ACT closes one improvement cycle and provides the learning and priorities for the next.

ACT Question: What should we standardize, what did we learn, and what should we improve next?

Part II: Lean Six Sigma Fundamentals

Why does continuous improvement matter? Continuous improvement is the ongoing effort to improve how work is performed. In manufacturing, the goal is to continuously improve quality, delivery, productivity, and cost to strengthen customer satisfaction and business performance.

QUALITY	DELIVERY	PRODUCTIVITY	COST
Fewer defects	Shorter lead time	More output	Less waste
Fewer complaints	Better On-Time Delivery	Less downtime	Lower operating cost

Continuous Improvement = Better Business Performance

What Is Lean Six Sigma?

Lean Six Sigma is a practical approach to improving business performance by combining two powerful improvement methods: Lean and Six Sigma.

LEAN

Improve Speed & Flow

Lean focuses on identifying and eliminating waste—activities that consume time, effort, or resources without adding value to the customer.



SIX SIGMA

Improve Quality & Consistency

Six Sigma focuses on reducing variation and defects so processes produce more consistent and predictable results.

Lean Six Sigma = Better Quality • Faster Processes • Lower Cost

Lean: Eliminate Waste

Lean focuses on maximizing customer value while minimizing waste. Waste is any activity that consumes time, effort, space, or resources without adding value from the customer's perspective.

VALUE-ADDED ACTIVITY

An activity that transforms the product or service in a way the customer values.

NON-VALUE-ADDED ACTIVITY (WASTE)

An activity that consumes resources but does not create value for the customer .

Example: Manufacturing a Part

Cutting to specification → Inspection → Waiting → Moving → Rework

Cutting to specification → Value-Added

Inspection / Waiting / Moving / Rework → Non-Value-Added *

The Lean Question: Does this activity add value for the customer?

** Some non-value-added activities, such as required inspection, may currently be necessary even though they do not directly add customer value.*

The 7 Wastes

Lean identifies seven common types of waste that consume resources without adding value to the customer.



TRANSPORATION

Unnecessary movement
of materials or products



INVENTORY

More materials, WIP, or
finished goods than needed



MOTION

Unnecessary movement
by people



WAITING

People, machines, or
materials waiting



OVER PRODUCTION

Producing earlier or
more than needed



OVER PROCESSING

Doing more work than
the customer requires



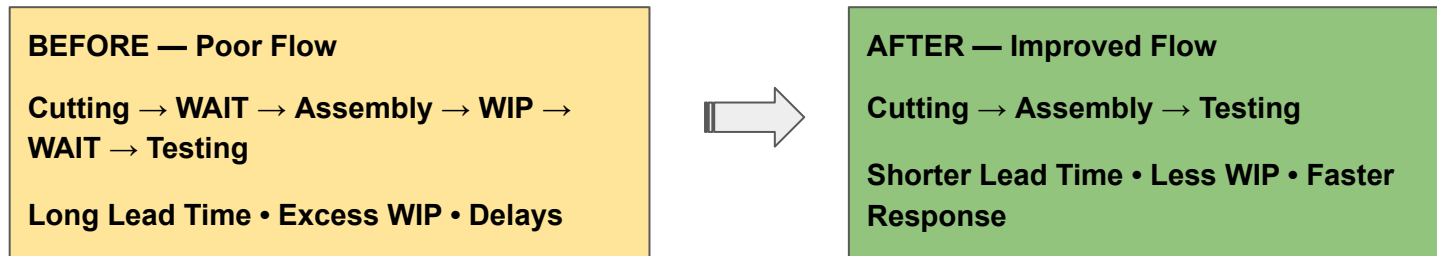
DEFECTS

Scrap, rework, errors, or
corrections

Learn to see waste before trying to eliminate it.

Lean: Improve Process Flow

Lean improves the flow of materials and information through the process. By reducing waiting, excess inventory, unnecessary movement, and bottlenecks, products can move through the process faster with less delay.



CYCLE TIME - Time required to complete a process step.

LEAD TIME - Total elapsed time from beginning to end.

WIP - Work-in-process that has started but is not yet finished.

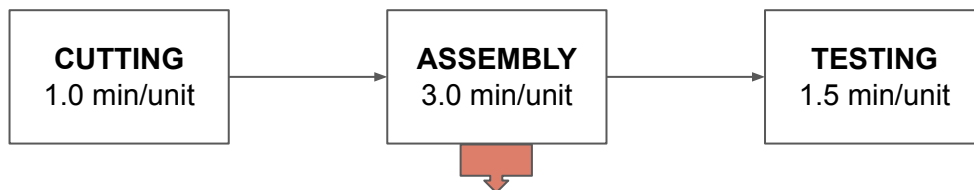
Lean improves speed by improving flow—not by making people work faster.

Lean: Match Process Flow to Customer Demand

Takt Time defines the production pace required to meet customer demand. Compare Takt Time with the cycle time of each process step to determine whether the process can keep pace with demand.

Customer demand: Available Production Time = 420 min/day, Customer Demand = 210 units/day

Takt Time: $420 \div 210 = 2 \text{ min/unit}$, Required Pace = 1 unit every 2 minutes



Assembly is the bottleneck: 3.0 min/unit > 2.0 min Takt

Customer requires: 1 unit every 2 min

Process can produce: about 1 unit every 3 min

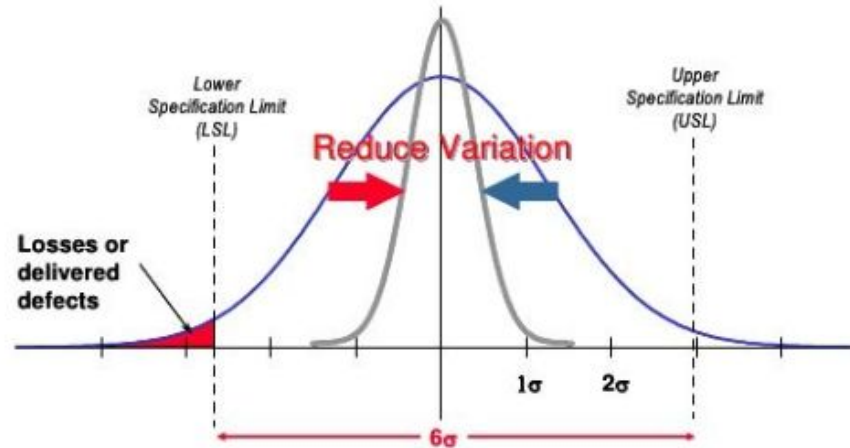
The process cannot meet customer demand.

Making Cutting faster will not increase total output while Assembly remains the bottleneck.

Takt Time sets the required pace. The bottleneck limits the actual pace.

Six Sigma: Reduce Variation

Six Sigma focuses on reducing variation and defects so processes produce consistent and predictable results. Every process has variation, but excessive variation can cause defects, poor quality, and unpredictable performance.

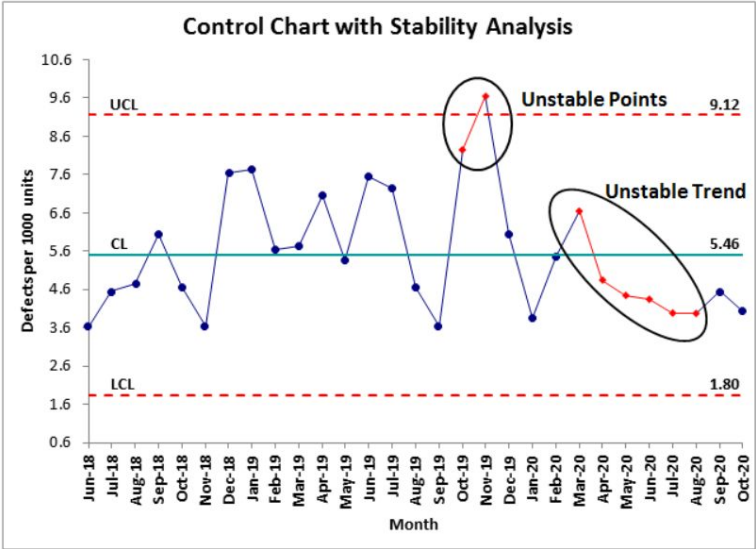


Less variation means more output stays within customer specification limits, resulting in fewer defects.

Six Sigma Question: How can we reduce variation and consistently meet customer requirements?

Six Sigma: Control the Process with SPC

Statistical Process Control (SPC) uses process data over time to identify unusual variation and determine whether a process is stable and predictable.



UCL — Upper Control Limit

CL — Center Line

LCL — Lower Control Limit

COMMON-CAUSE VARIATION

Natural variation that is part of the process.

SPECIAL-CAUSE VARIATION

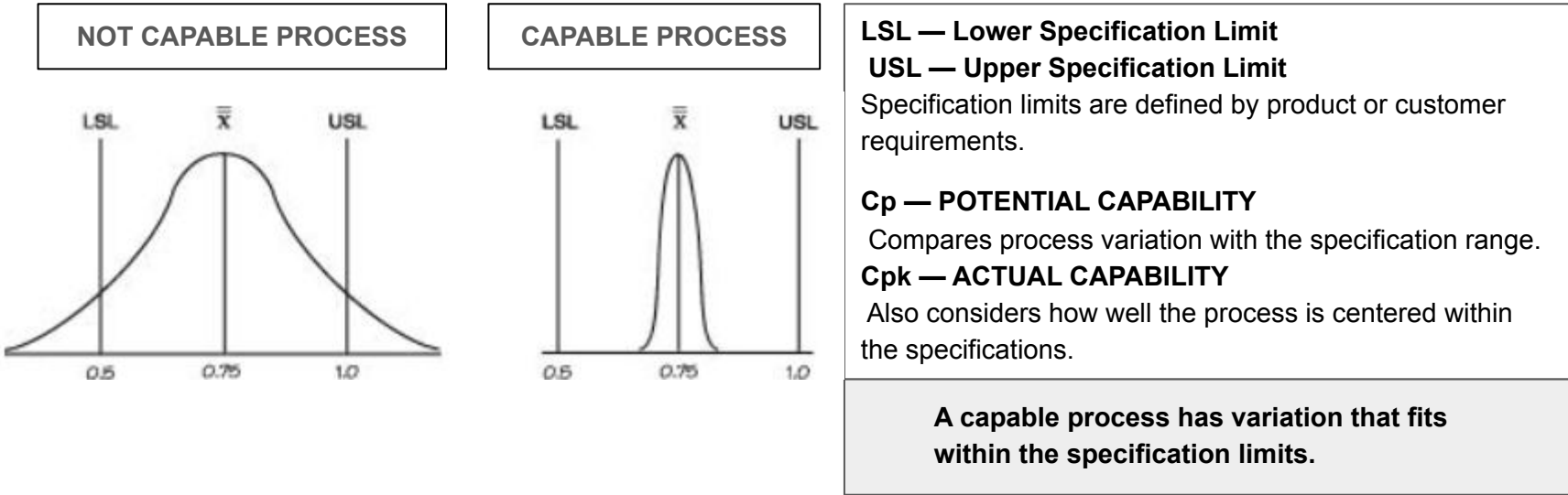
Unusual variation indicating that something in the process may have changed.

When SPC identifies a special-cause signal, investigate what changed in the process.

SPC Question: Is the process stable and predictable over time?

Six Sigma: Understand Process Capability

Once a process is stable, process capability evaluates whether its variation fits within the specification limits and whether it can consistently meet requirements.



Capability Question: Can the process consistently meet specification requirements?

Six Sigma: Use Statistical Analysis

Six Sigma uses data and statistical analysis to understand process performance, identify causes of variation, and make better improvement decisions.

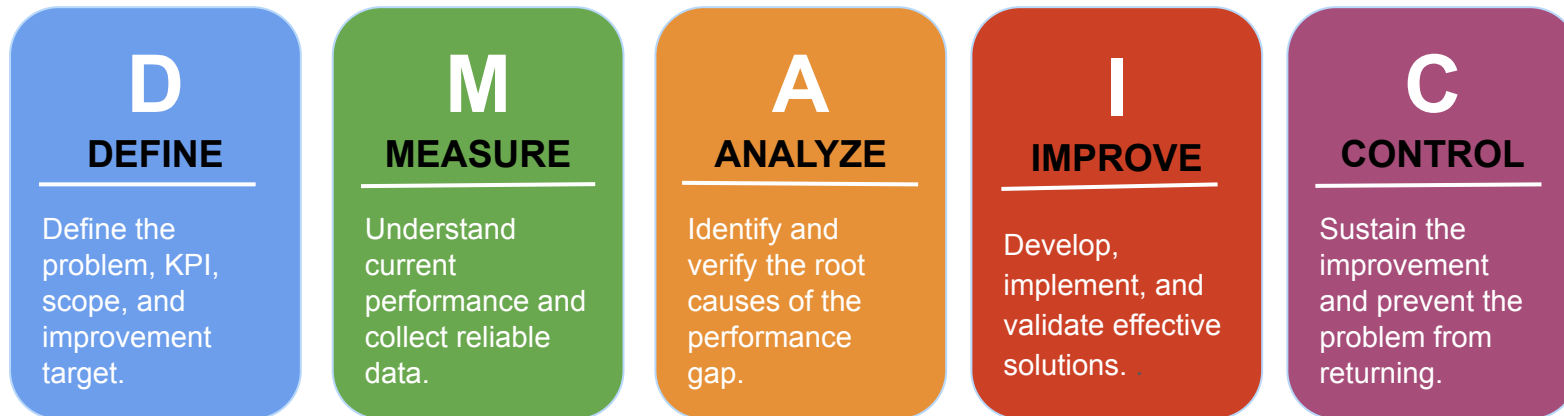
QUESTION	POSSIBLE TOOL
Is our measurement system reliable?	MSA
Are two processes or suppliers different?	Hypothesis Testing
What factors affect the output?	Regression / ANOVA
What process settings work best?	DOE

You don't need to master every statistical tool. Understand the problem first, then use the right tool when needed.

Start with the question—not the statistical tool.

DMAIC: A Structured Improvement Method

DMAIC is a structured five-phase method for improving existing processes. It helps teams move from understanding the problem to implementing and sustaining measurable improvement.



Every improvement project starts with a measurable performance gap and ends with a verified result.

Define Phase: Describe the Problem Clearly

Improvement starts by clearly describing the problem. A good problem statement describes what is wrong, where or when it occurs, and the business impact—without assuming the cause or prescribing the solution.

WEAK PROBLEM STATEMENT

Our production operators are causing too many defects and need more training.

Why weak: assumes both the **cause** (operators) and **solution** (training).

BETTER PROBLEM STATEMENT

The assembly line defect rate increased to 8% during the past three months, increasing scrap and rework costs and affecting on-time delivery.

Describe the problem clearly. Don't assume the cause or solution.

Define Phase: Write a Good Objective Statement

Once the problem is clearly described, define how performance will be measured. Establish the KPI, current performance (baseline), and desired performance (target).

KPI — The measure used to track performance.

Baseline — Current performance before improvement.

Target — The desired level of performance.

WEAK OBJECTIVE STATEMENT

Reduce defects.

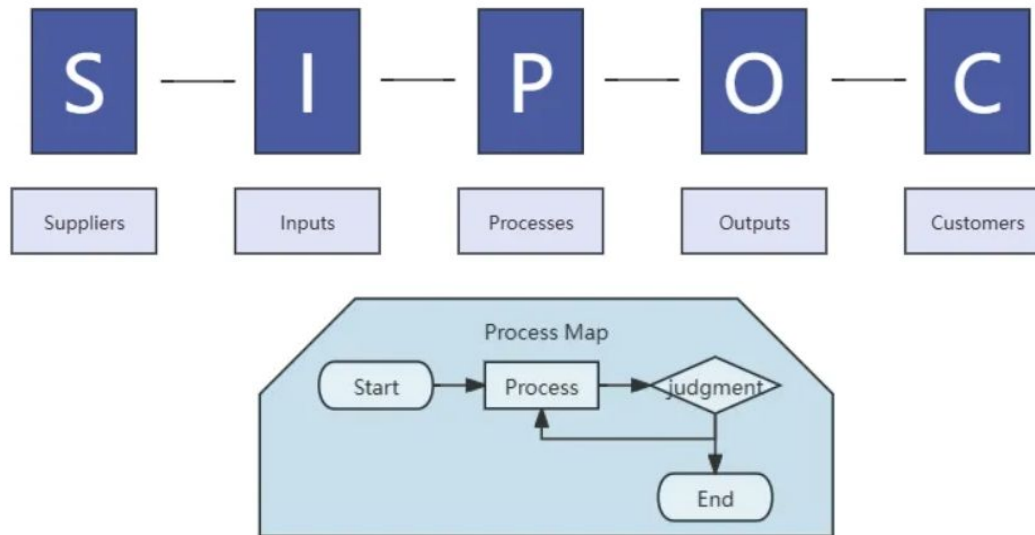
BETTER OBJECTIVE STATEMENT

Reduce the assembly line defect rate (KPI) from 8% (baseline) to 2% (target) within six months.

A good objective defines the KPI, baseline, target, and timeframe.

Define Phase: Understand the Process with SIPOC

Before improving a process, first understand how it works at a high level. SIPOC helps the team define the process boundaries and identify the key suppliers, inputs, process steps, outputs, and customers.



SIPOC defines the process at a high level before detailed analysis begins.

Measure Phase: Establish the Baseline

The Measure phase establishes reliable facts about current process performance. Before looking for root causes, collect the right data and verify that the baseline accurately represents the current process.

DATA COLLECTION PLAN

Define:

- What data will be collected
- Where the data comes from
- When/how often it will be collected
- Who will collect it

BASELINE VALIDATION

Confirm:

- The measurement is reliable
- The data represents the current process
- The KPI is calculated consistently
- The baseline can be trusted

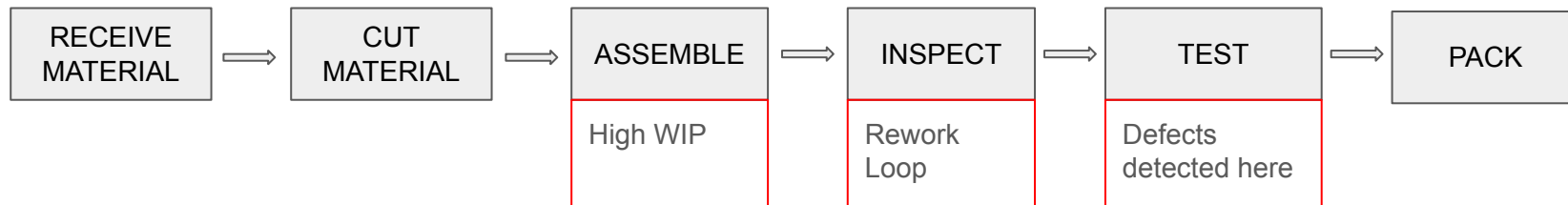
Example

KPI: Defect Rate	Data: 8 weeks of production
Total Units: 10,000	Defects: 800
Baseline Defect Rate: 8%	

Don't analyze causes until you can trust the data.

Measure Phase: Understand the Process with a Process Map

After establishing the baseline, map the actual process in enough detail to understand how work flows and where problems, delays, rework, or variation may occur.



WHAT TO LOOK FOR: Waiting and delays • Excess WIP • Rework loops • Inspection points • Process handoffs

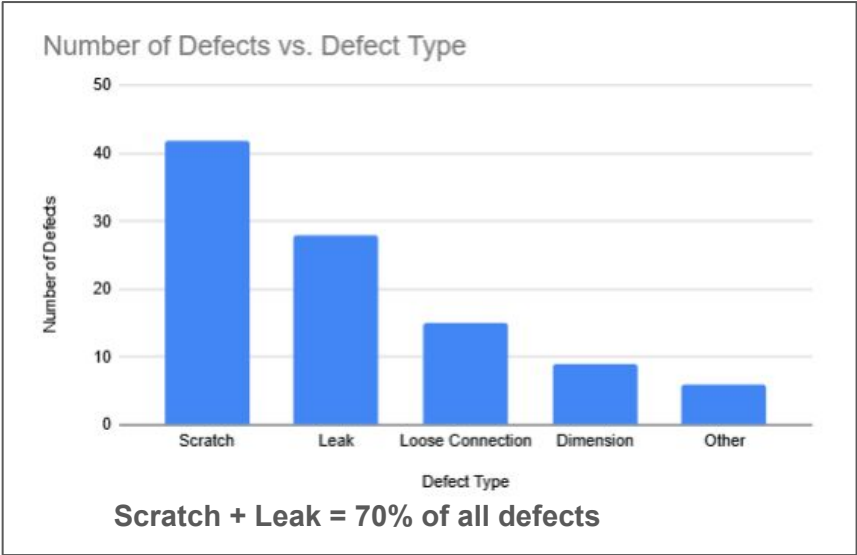
ALSO LOOK FOR: Where defects are created or detected • Differences between the actual and documented process

Map what actually happens—not what the procedure says should happen.

Understand the process before analyzing why it fails.

Measure Phase — Focus Using Pareto Analysis

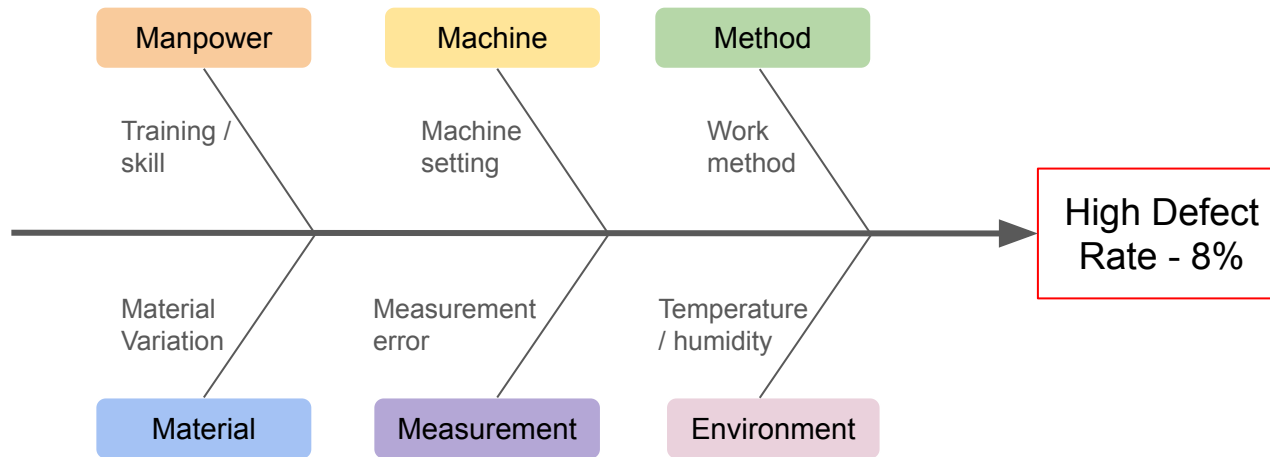
Not all problems contribute equally to poor performance. Pareto analysis ranks problem categories from largest to smallest to help the team identify where most of the problem is concentrated and focus improvement efforts where they can have the greatest impact.



Focus improvement efforts where they can have the greatest impact.

Analyze Phase: Identify Potential Causes

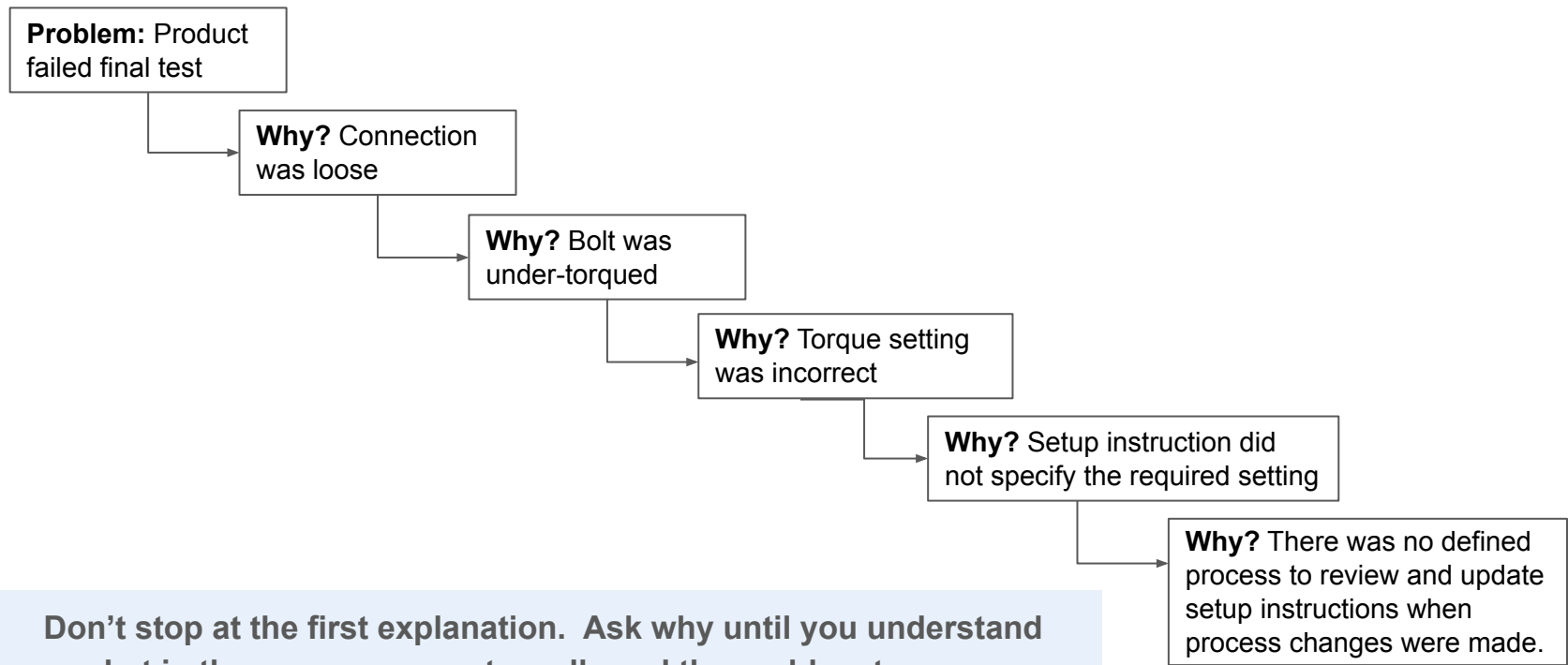
The Analyze phase seeks to understand why the performance gap exists. Start by identifying potential causes, then use data and evidence to determine which causes actually contribute to the problem.



A Fishbone Diagram identifies possible causes. It does not prove the root cause.

Analyze Phase: Dig Deeper with 5 Whys

5 Whys helps move the investigation from the symptom toward an underlying process or system cause. The number of Whys is not fixed—continue until the underlying cause is understood.



Don't stop at the first explanation. Ask why until you understand what in the process or system allowed the problem to occur.

Analyze Phase: Verify Causes with Statistical Analysis

Fishbone and 5 Whys help identify potential causes, but potential causes should be verified with evidence. Statistical analysis helps determine whether observed differences and relationships are meaningful rather than simply random variation.

INPUT (X)	OUTPUT (Y)	POSSIBLE TOOL	MANUFACTURING EXAMPLE
Discrete — 2 groups	Continuous	2-Sample t-Test	Compare part dimensions from Supplier A vs. Supplier B
Discrete — 3+ groups	Continuous	ANOVA	Compare cycle time across four machines
Continuous	Continuous	Regression Analysis	Determine whether temperature is related to product strength
Discrete	Discrete	Chi-Square Test	Determine whether Pass/Fail is associated with supplier

You don't need to master every statistical tool. The LSSSystem Consultant can help you select and apply the appropriate analysis when needed.

**Finding where the problem occurs is not always the same as finding why it occurs.
Verify the root cause before implementing corrective actions.**

Improve Phase: Apply Practical Improvement Methods

Once root causes are understood, select improvement methods that address the specific problem. Different problems require different solutions—there is no single tool for every situation.

**MISTAKE
PROOFING
(POKA-YOKE)**

Prevent errors from occurring or make them immediately detectable.

KAIZEN

Engage employees in focused, practical improvements to the work process.

SMED

Reduce setup and changeover time to improve flexibility and flow.

TPM

Improve equipment reliability and reduce unplanned downtime.

**STANDARD
WORK**

Define the best-known method to perform work consistently.

**5S / VISUAL
MANAGEMENT**

Organize the workplace and make abnormal conditions easier to see.

Examples:

Defects → Mistake Proofing | Long Changeovers → SMED | Downtime → TPM | Process Variation → Standard Work

Start with the problem. Select the method that helps solve it.

Improve Phase: Test Solutions Before Full Implementation

Before implementing a solution across the entire process, test it on a manageable scale to confirm that it produces the expected improvement.



EXAMPLE

Problem: High defects caused by inconsistent torque

Solution: Standardized torque setting

Pilot: Test on one production line

Measure: Compare defect rate before and after

Decision: Implement broadly if results demonstrate improvement

Implementation does not prove effectiveness. Results do.

Improve Question: Does the solution work under real operating conditions?

Improve Phase: Optimize the Process with DOE

When several process factors may affect the output, Design of Experiments (DOE) provides a structured way to determine which factors matter and identify effective process settings.

ONE-FACTOR-AT-A-TIME can be very time consuming and does not reveal interactions between factors.

Change Temperature → Test → Change Pressure → Test → Change Speed → Test

DOE

Study multiple factors systematically — **including interactions between factors**

Potential Factors (X's)

Temperature • Pressure • Speed



DOE — Design of Experiments

Systematically change factors and measure their effects



Best Combination of Settings



Improved Outputs (Y)

Quality • Yield • Performance

DOE Question: Which process factors and settings produce the best performance?

Control Phase: Verify & Sustain the Improvement

The Control phase verifies that the improvement achieved the target and establishes controls to ensure the improved performance is sustained over time.

VERIFY THE RESULT

BASELINE → TARGET → ACTUAL RESULT

For example: **8% Defects → ≤2% Target → 1.8% Actual**

Compare actual performance with the baseline and project target.

SUSTAIN THE RESULT

STANDARDIZE

Update procedures
and standard work

TRAIN

Ensure employees
understand the
new method

MONITOR

Track the KPI and
process
performance

RESPOND

Define actions when
performance falls outside
acceptable conditions.

An improvement is not complete until the result is verified and the new process is sustained.

Control Question: How will we know the improvement is working—and continues to work?

Control Phase: Establish a Control Plan

A Control Plan defines what must be monitored, how it will be monitored, who is responsible, and what action should be taken when performance is unacceptable.

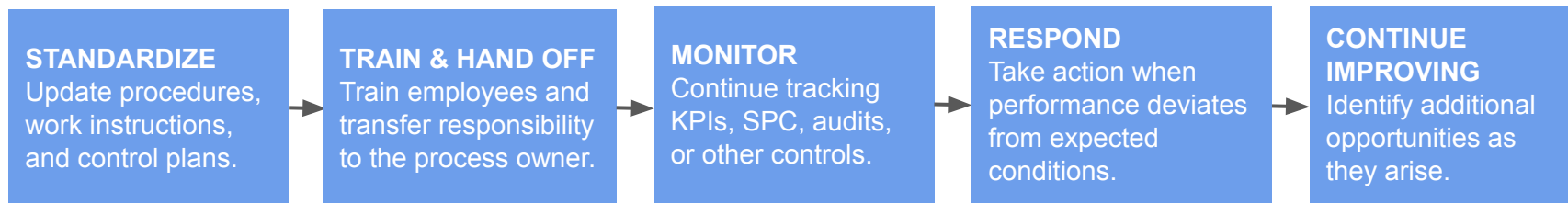
WHAT TO CONTROL	HOW TO MONITOR	FREQUENCY	RESPONSIBLE	REACTION
Critical dimension	SPC / Control Chart	Every 2 hours	Operator	Stop & notify supervisor
Torque setting	Setting verification	Start of shift	Technician	Correct setting & verify product
Defect rate	KPI / Trend Chart	Daily	Supervisor	Investigate abnormal increase

Use SPC when appropriate to detect process changes before they become larger quality problems.

Don't just monitor performance—define what to do when it changes.

Control Phase: Standardize & Transfer Ownership

Once the improvement is verified and controls are established, standardize the new process and transfer responsibility for sustaining performance to the process owner.



The project may end, but process ownership and continuous improvement continue.

Control Question: Who will own the process and ensure the improvement is sustained?