AQS 200
ROOT CAUSE INVESTIGATION

This material is based upon work supported by the National Science Foundation under Grant No. 1304474
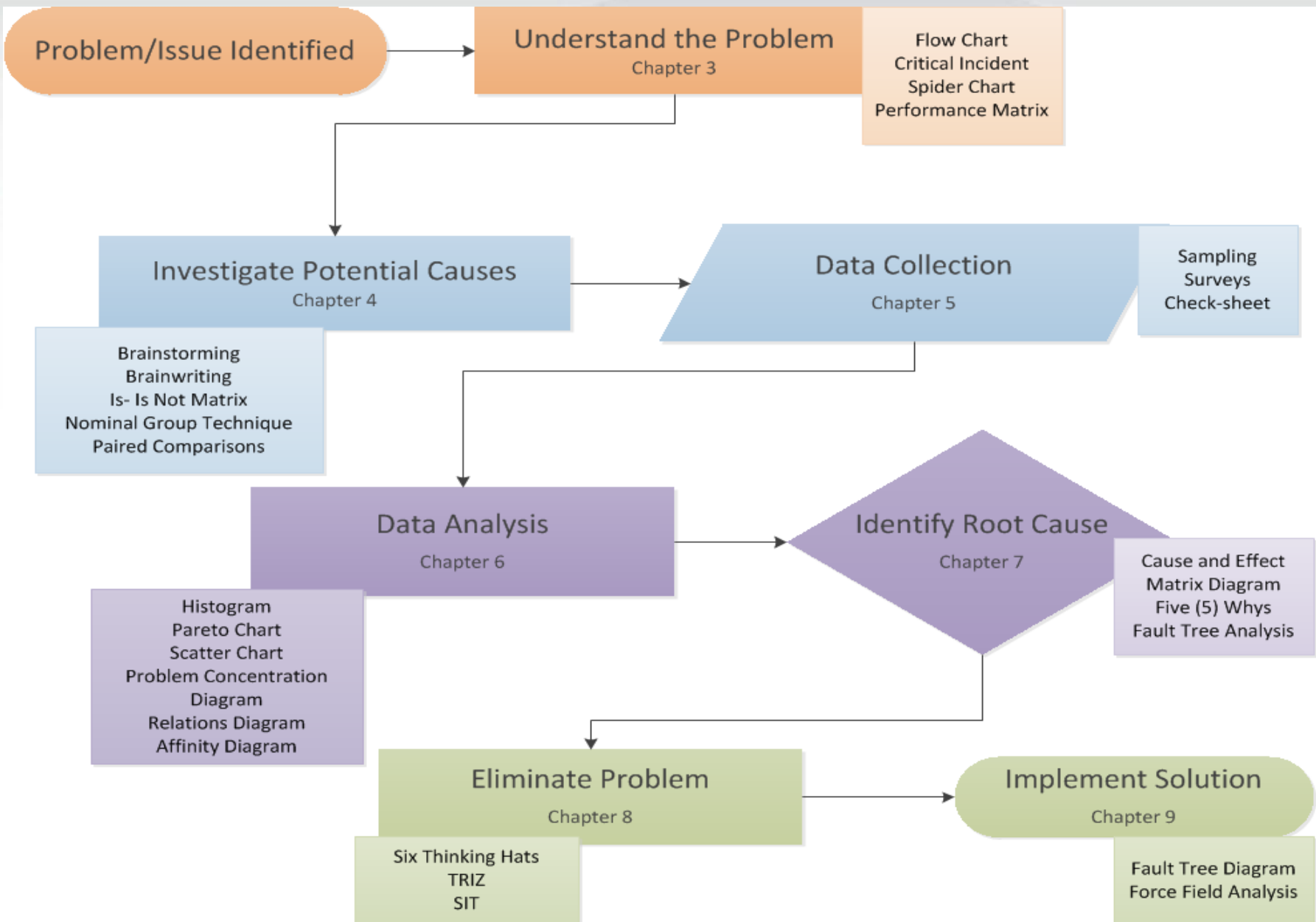
LECTURE 13
CURRENT METHODS
(MANUFACTURING OR SERVICE SECTORS)

- PDCA
- Six Sigma DMAIC
- Lean 7-Step (R-DMAIC-S)
- 8D (8 Disciplines)

PROBLEM ? ? ? ? ? → ROOT CAUSE

Problem/Issue Identified

Understand the Problem
Chapter 3

Flow Chart
Critical Incident
Spider Chart
Performance Matrix

Investigate Potential Causes
Chapter 4

Brainstorming
Brainwriting
Is- Is Not Matrix
Nominal Group Technique
Paired Comparisons

Data Collection
Chapter 5

Sampling
Surveys
Check-sheet

Data Analysis
Chapter 6

Histogram
Pareto Chart
Scatter Chart
Problem Concentration
Diagram
Relations Diagram
Affinity Diagram

Identify Root Cause
Chapter 7

Cause and Effect
Matrix Diagram
Five (5) Whys
Fault Tree Analysis

Eliminate Problem
Chapter 8

Six Thinking Hats
TRIZ
SIT

Implement Solution
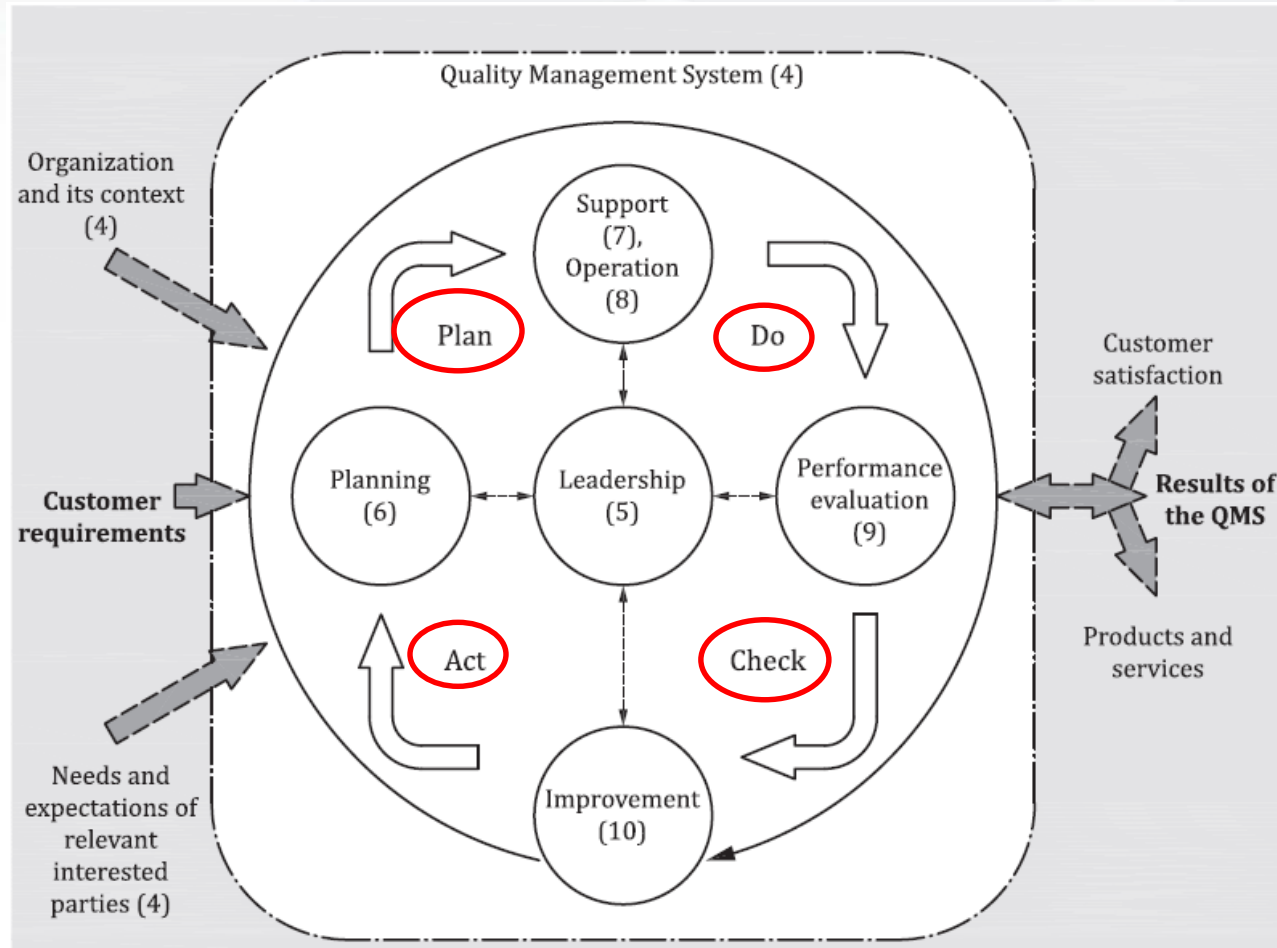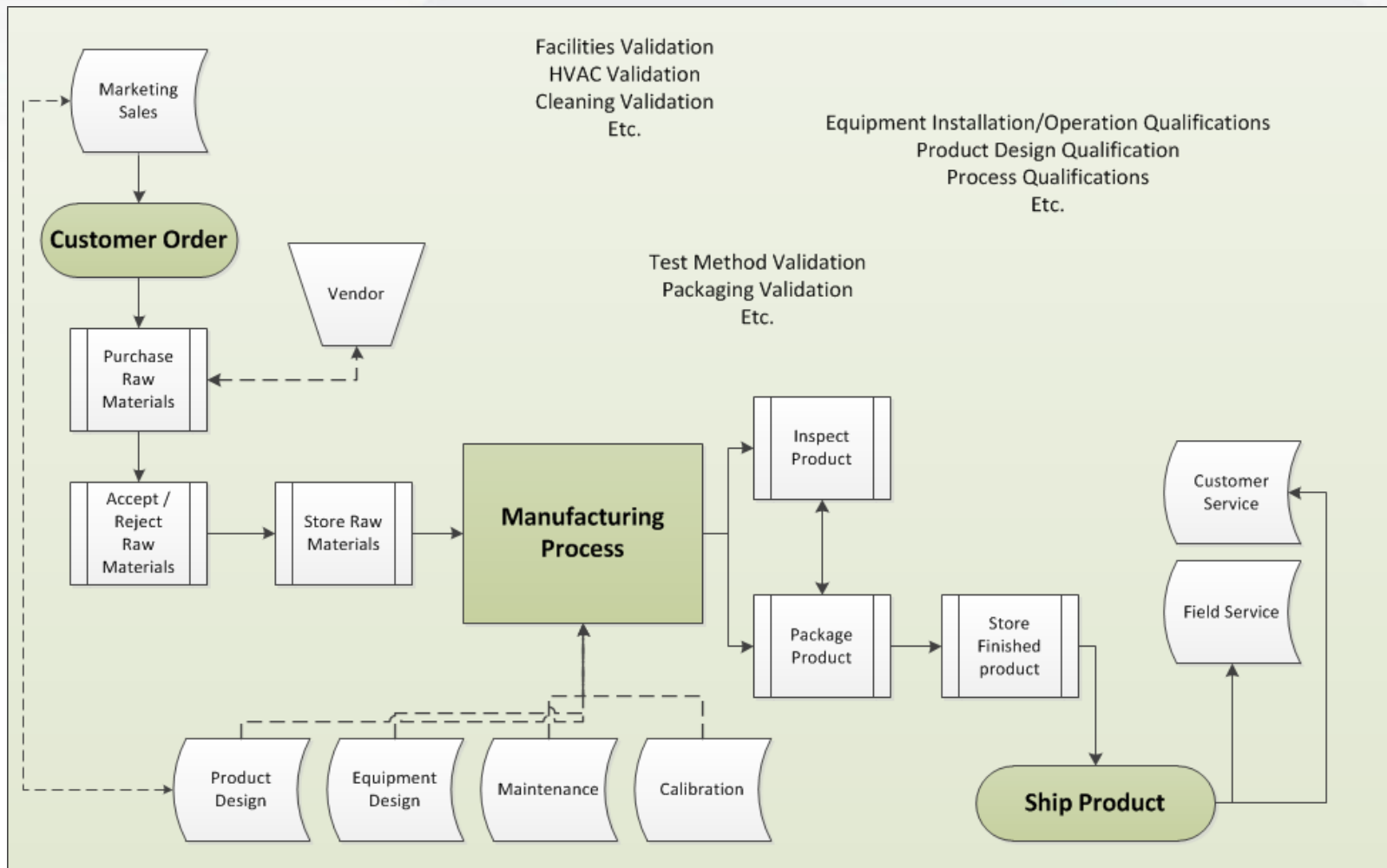Chapter 9

Fault Tree Diagram
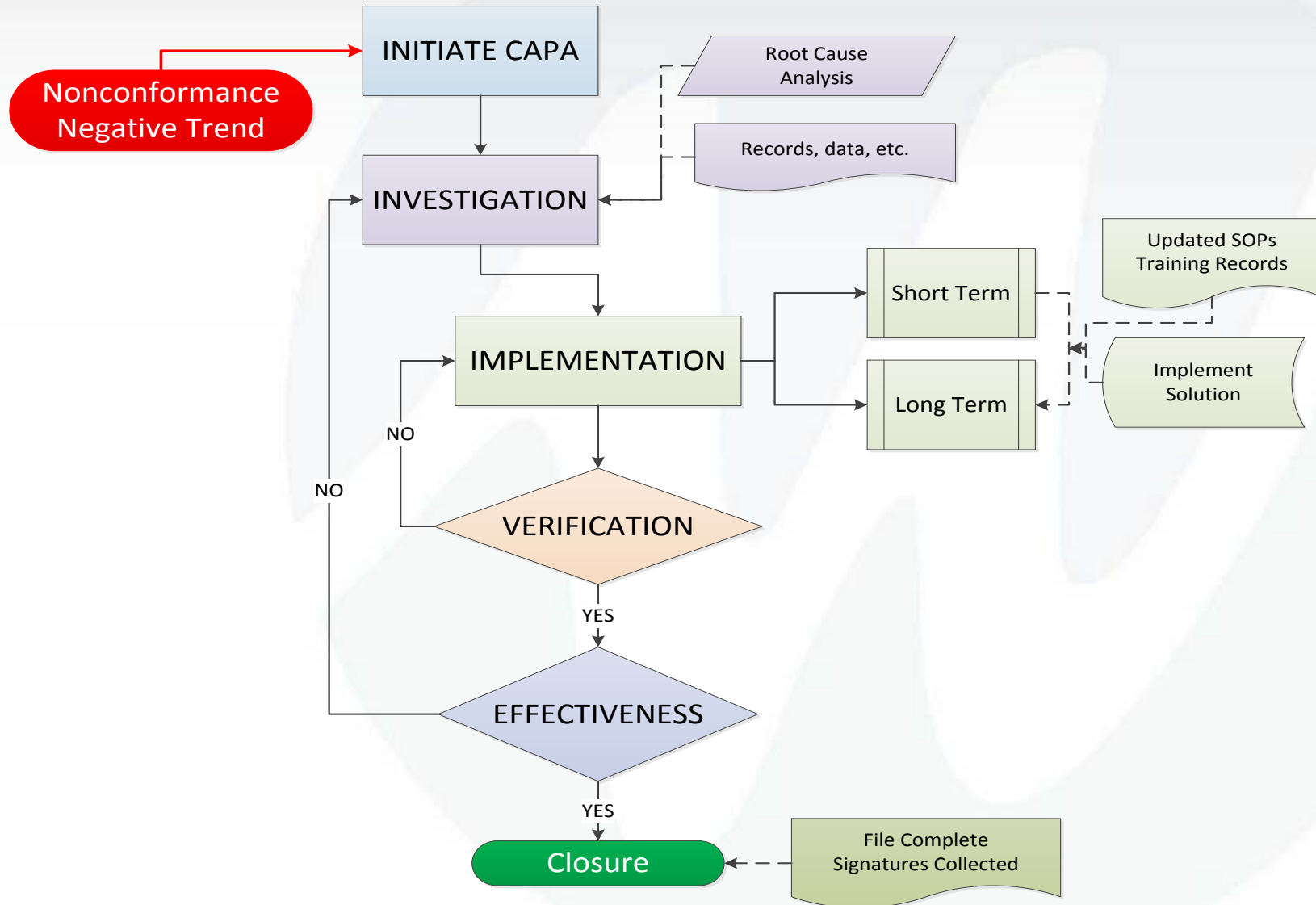Force Field Analysis

REVIEW - QMS

ISO 9001:2015

REVIEW- VALIDATED STATE

REVIEW - CAPA SYSTEM

INDUSTRY - CURRENT

- Method described here is generic
- Manufacturing/Service Sector "Programs"
  - PDCA
  - Six Sigma DMAIC
  - Lean 7-Step (R-DMAIC-S)
  - 8D (8 Disciplines)

METHOD COMPARISON

Andersen & Fagerhaug	PD\CSA	Six Sigma	7-Step	8-Disciplines (8D)
			Recognize	
Understand the Problem	Plan	Define	Define	Plan
				Select Team
Identify Potential Solutions				Define
				Interim Containment & Actions
Data Collection	Do	Measure	Measure	Determine/ ID / Verify Root Cause & Escape Points
Data Analysis	Check	Analyze	Analyze	
Identify Root Cause		Improve	Improve	Choose / Verify Permanent Corrections
Root Cause Elimination	Act	Control	Control	Validate Corrective Actions
			Sustain	Preventive Actions
Acknowledge Success				Congratulate Team

PDCA

- Plan – Do – Check – Act
  - Deming Cycle / Shewhart Cycle
  - Continuous Improvement

PDCA

- Use when
  - model for continuous improvement.
  - starting a new improvement project.
  - developing a new or improved design
  - defining a repetitive work process.
  - planning data collection and analysis in order to verify and prioritize problems or root causes.
  - implementing any change

PDCA

1. Plan
   – Recognize an opportunity
   – Plan a change

2. Do
   – Test the change
   – Carry out a small-scale study

3. Check
   – Review the test
   – Analyze the result
   – Identify what you've learned

4. Act
   – Take action based on data
     • Successful results - incorporate
     • Unsuccessful results – repeat cycle
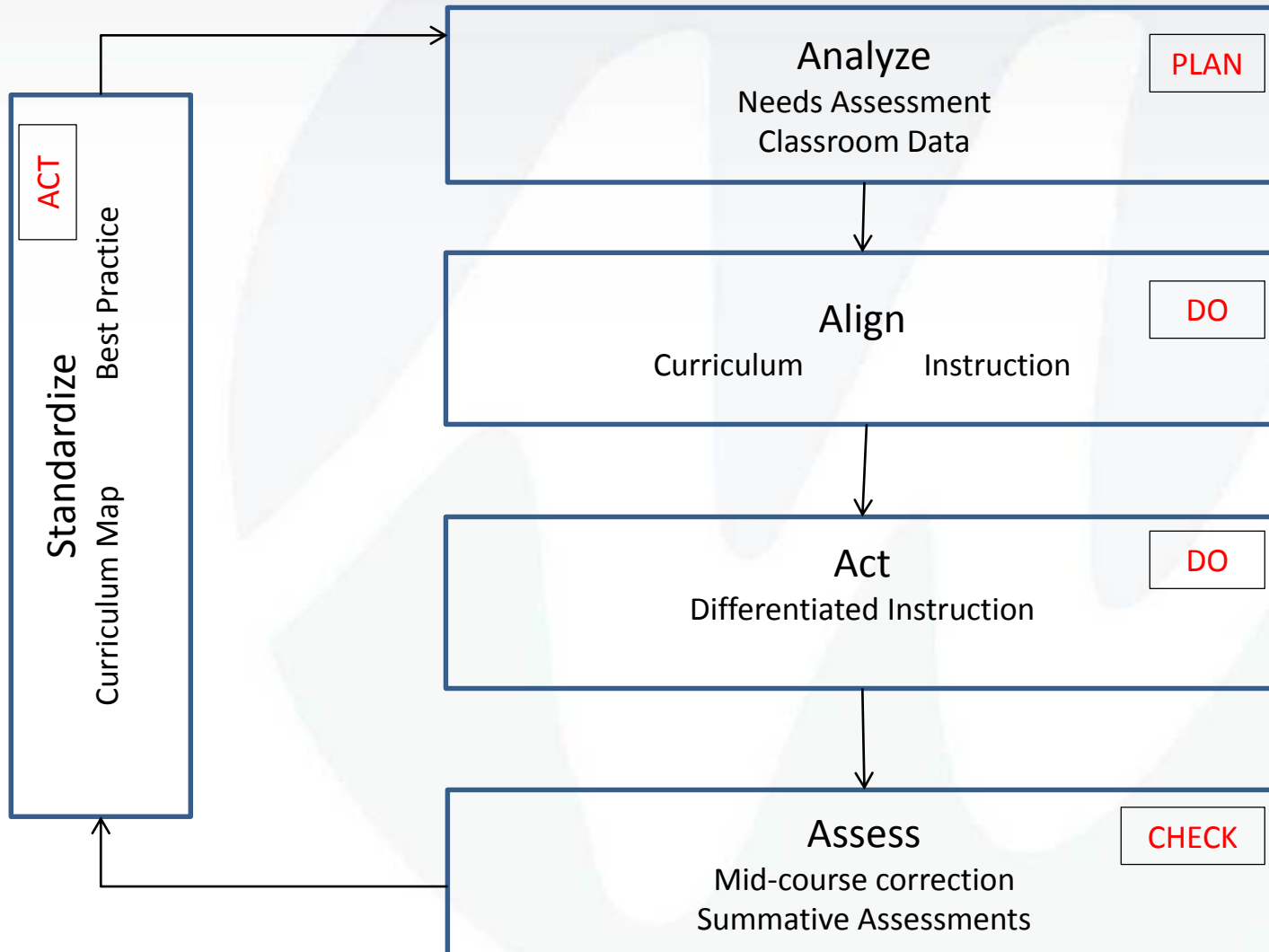   – Use data to plan new improvements and begin cycle again

Example

PDCA - *Example*

The Pearl River, NY School District

- 2001 Malcolm Baldrige National Quality Award
- uses the PDCA cycle to define work processes
- Structure for strategic planning
  - Needs analysis
  - Curriculum design/delivery
  - Staff goals/evaluation
  - Providing student/support services
  - Classroom instruction

PDCA - Example

Analyze — PLAN
Needs Assessment
Classroom Data

Align — DO
Curriculum   Instruction

Act — DO
Differentiated Instruction

Assess — CHECK
Mid-course correction
Summative Assessments

Standardize — ACT
Best Practice
Curriculum Map

SIX SIGMA

- Business Management Strategy

- Process Improvements

- Works with lean – source of improvement project

- Developed by Motorola 1986
  - 1995 Jack Welch made business strategy at General Electric

- Utilizes quality tools and statistical methods

SIX SIGMA

- Continued effort to achieve stable and predictable process results

- Manufacturing (business) processes have characteristics that can be
  - Measured
  - Analyzed
  - Controlled
  - Improved

- Achieving sustained quality improvement requires total organizational commitment (Top Management)
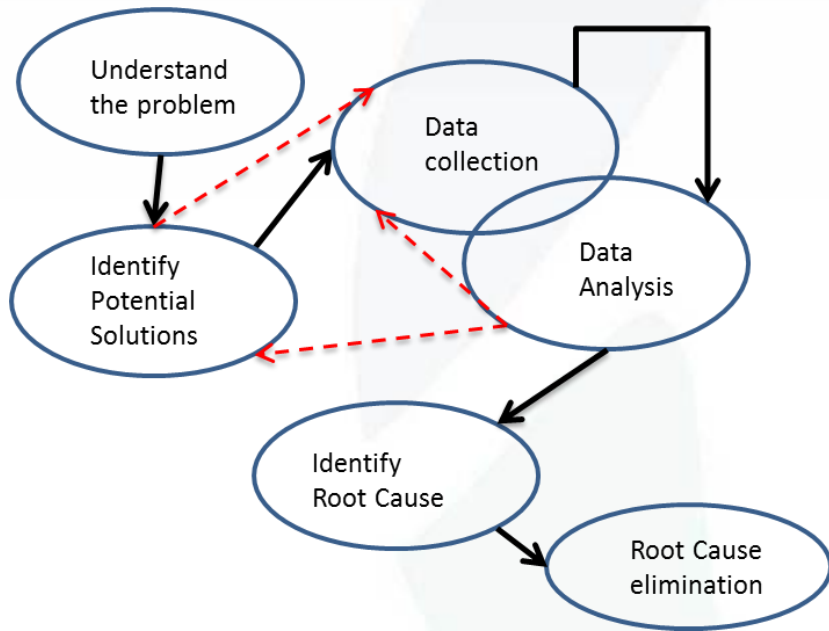
SIX SIGMA

- Why successful
  - Clear focus on financial returns
  - Increased emphasis on top-level support
  - Clear commitment making decisions based on data
    - Verifiable; statistical
- Structured (formal) investigation process
  - Improve quality by identifying (removing) defects and minimizing process variability
  - Utilize quality management and statistical methods
  - Practitioners with defined roles and methods expertise
    - Champions
    - Master Black Belt
    - Black Belt
    - Green Belt
    - Yellow Belt

SIX SIGMA

- Practitioners: defined roles and methods expertise

  - **Champions** – responsible for implementation across the organization in an integrated manner

  - **Master Black Belt** – project coaches, 100% of their time on projects, guide black and green belts; ensure consistent application across various functions/departments

  - **Black Belt** - apply methodology to specific projects; focus on project execution

  - **Green Belt** - work on projects/implementation along with other job duties, data collection, some analysis

  - **Yellow Belt** - basic training and participate in projects

SIX SIGMA

- ## Root Cause Analysis
  - – Investigation process

Andersen & Fagerhaug	Six Sigma
Understand the Problem	Define
Identify Potential Solutions	
Data Collection	Measure
Data Analysis	Analyze
Identify Root Cause	Improve
Root Cause Elimination	Control

Six Sigma - DMAIC

- Define
  - clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline.

  - Project Charter
    - Documents reason for project
    - Objectives and constraints
    - Identify main stakeholders
    - Identify overall goals and performance expectations

    SMART Goal

    Specific   **M**easurable **A**ttainable   **R**elevant **T**ime bound

http://en.wikipedia.org/wiki/DMAIC

SMART Goals Guide	
Specific	» What exactly needs to be accomplished? » Who else will be involved? » Where will this take place? » Why do I want to accomplish the goal?
Measurable	» How will I know I've succeeded? » How much change needs to occur? » How many accomplishments or actions will it take?
Attainable	» Do I have, or can I get, the resources needed to achieve the goal? » Is the goal a reasonable stretch for me? (neither out of reach nor too easy) » Are the actions I plan to take likely to bring success?
Relevant	» Is this a worthwhile goal for me right now? » Is it meaningful to me—or just something others think I should do? » Would it delay or prevent me from achieving a more important goal? » Am I willing to commit to achieving this goal?
Time-bound	» What is the deadline for reaching the goal? » When do I need to take action? » What can I do today?

Six Sigma – SMART GOAL

- Define

  SMART Goal

  ***S**pecific **M**easurable **A**ttainable **R**elevant **T**ime bound*

  Example:

  improve customer service by 50%

Six Sigma - DMAIC

- Define

  SMART Goal

  Specific Measurable Attainable Relevant Time bound

  Example:

  improve customer service by 50%

  ???

Six Sigma - DMAIC

- Define

  SMART Goal

  Specific Measurable Attainable Relevant Time bound

  Example:

  ~~improve customer service by 50%~~

  The dropped call rate in Customer Service shall be reduced from the 10% level recorded in fiscal year 2014 to 5% for fiscal year 2015.

Six Sigma - DMAIC

- Define

  SMART Goal

  Specific Measurable Attainable Relevant Time bound

  Example:

  ~~improve customer service by 5%~~

  The dropped call rate in Customer Service shall be reduced from the 10% level recorded in fiscal year 2014 to 5% for fiscal year 2015, by increasing efficiency.

  Specific - reduce dropped calls
  Measurable -   5% rate
  Attainable -   improved efficiency
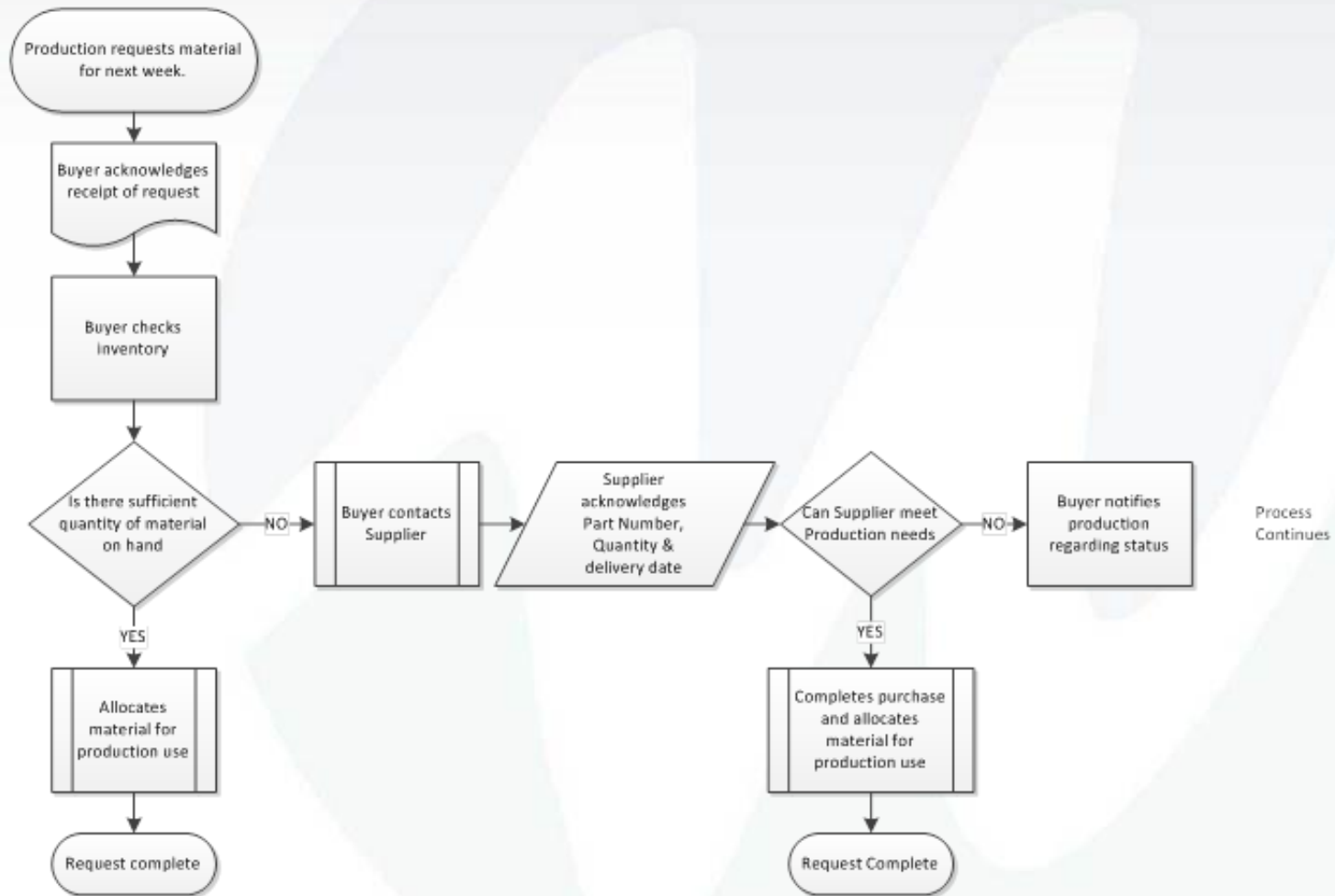 Relevant – Customer Service
  Time Bound – 2015 FY

Six Sigma - DMAIC

- Define
  - clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline.
  - Project Charter
    - Documents reason for project
    - Objectives and constraints   (beware scope creep)
    - Identify main stakeholders
    - Identify overall goals (SMART) and performance expectations
  - Team formation
    - Black Belt as leader, green belt for support
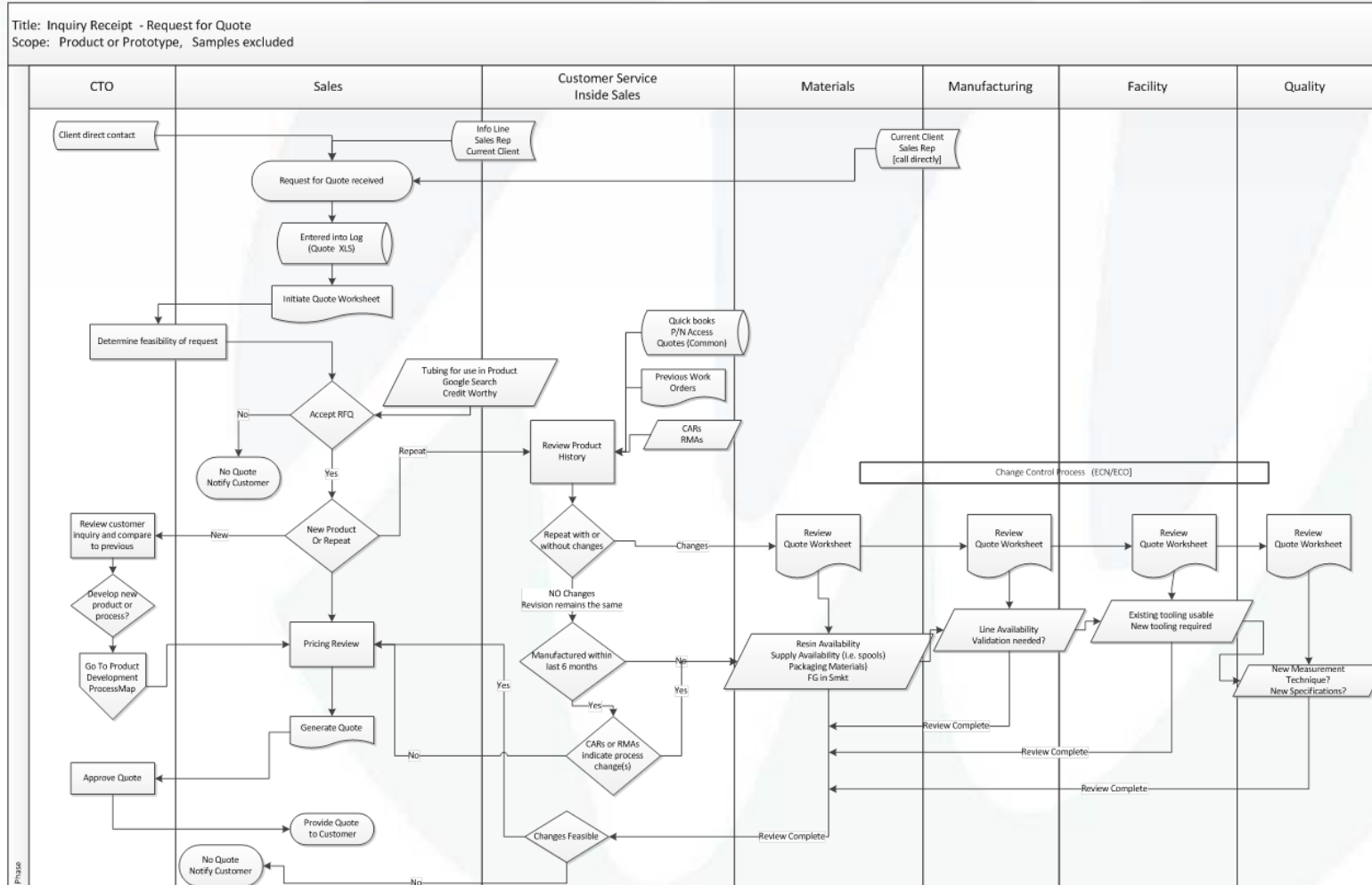   - Subject Matter Experts (i.e. purchasing, production, etc.)

http://en.wikipedia.org/wiki/DMAIC
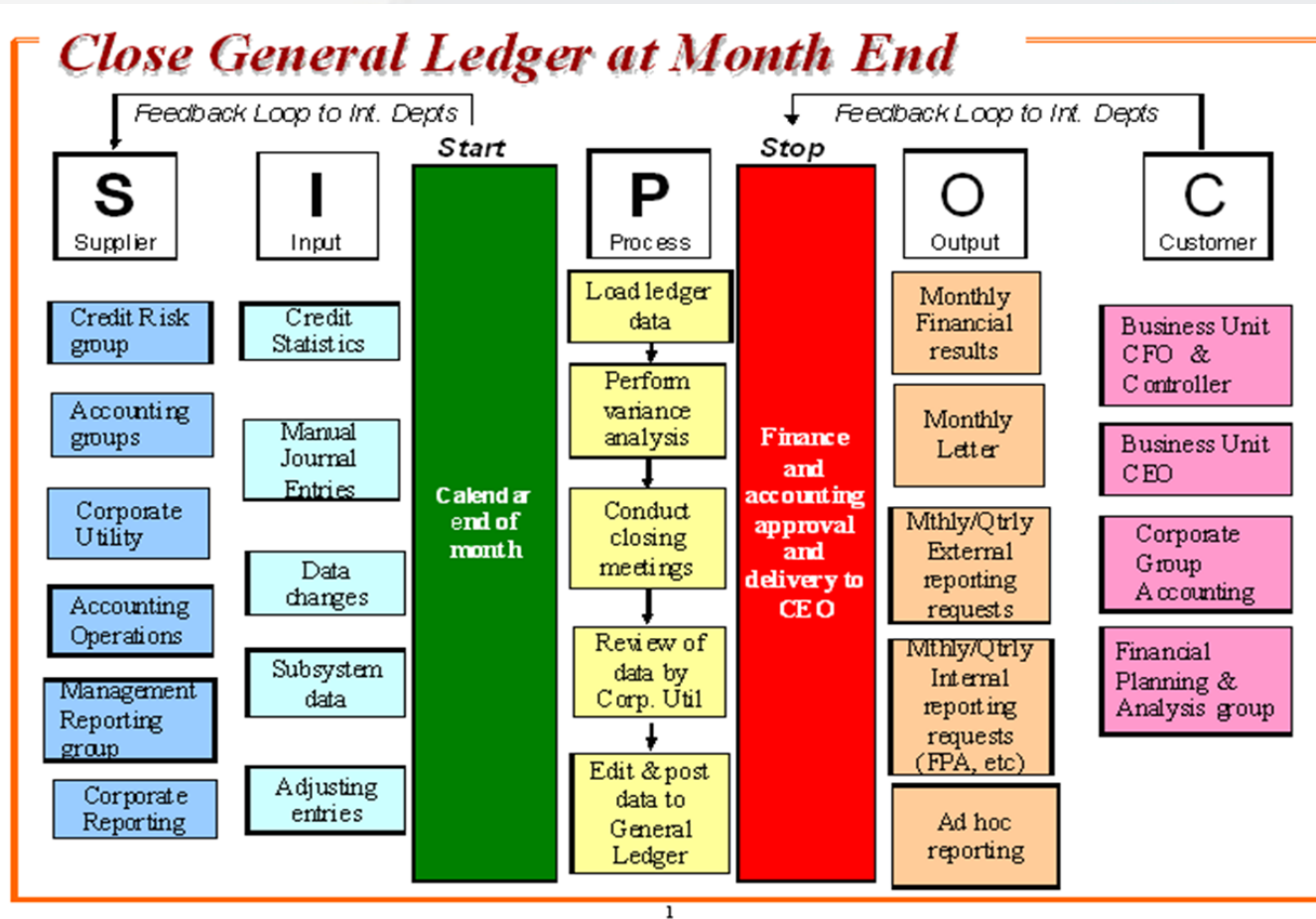
SIX SIGMA - DEFINE TOOLS

- Flowcharts are useful for mapping a process to:
  - Illustrate where problems can occur
  - Provide detailed understanding of the process looking for what can influence the problem

- Different types of flow charts
  - Regular – depicts activities/tasks
  - Cross-Functional – adds person/department that is responsible for activity
  - Multi-Level – Starts at beginning with high level activities, individual tasks are then outlined on a lower level (separate page).

STANDARD FLOW CHART

CROSS FUNCTION FLOW CHART

SIX SIGMA - DEFINE TOOLS

- Flowcharts are useful for mapping a process to:
  - Illustrate where problems can occur
  - Provide detailed understanding of the process looking for what can influence the problem

- SIPOC Diagram
  - Supplier
  - Input
  - Process
  - Output
  - Customer

SIPOC

Supplier	Input	Process	Output	Customer
Person or Organization	Information, materials or service provided	Set of action steps to transform input into output	Final product or service resulting from process	Person, process organization that receives the output
Providing resources to process of concern		Adding customer value		

Additional columns for controls/requirements
or general comments are sometimes also added

SIPOC – Example

Month End Close out for Financial Institution

Six Sigma - DMAIC

- Define: clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline.

- Measure
  - objectively establish current baselines as the basis for improvement.
  - data collection step to establish process performance baselines

  Data Collection
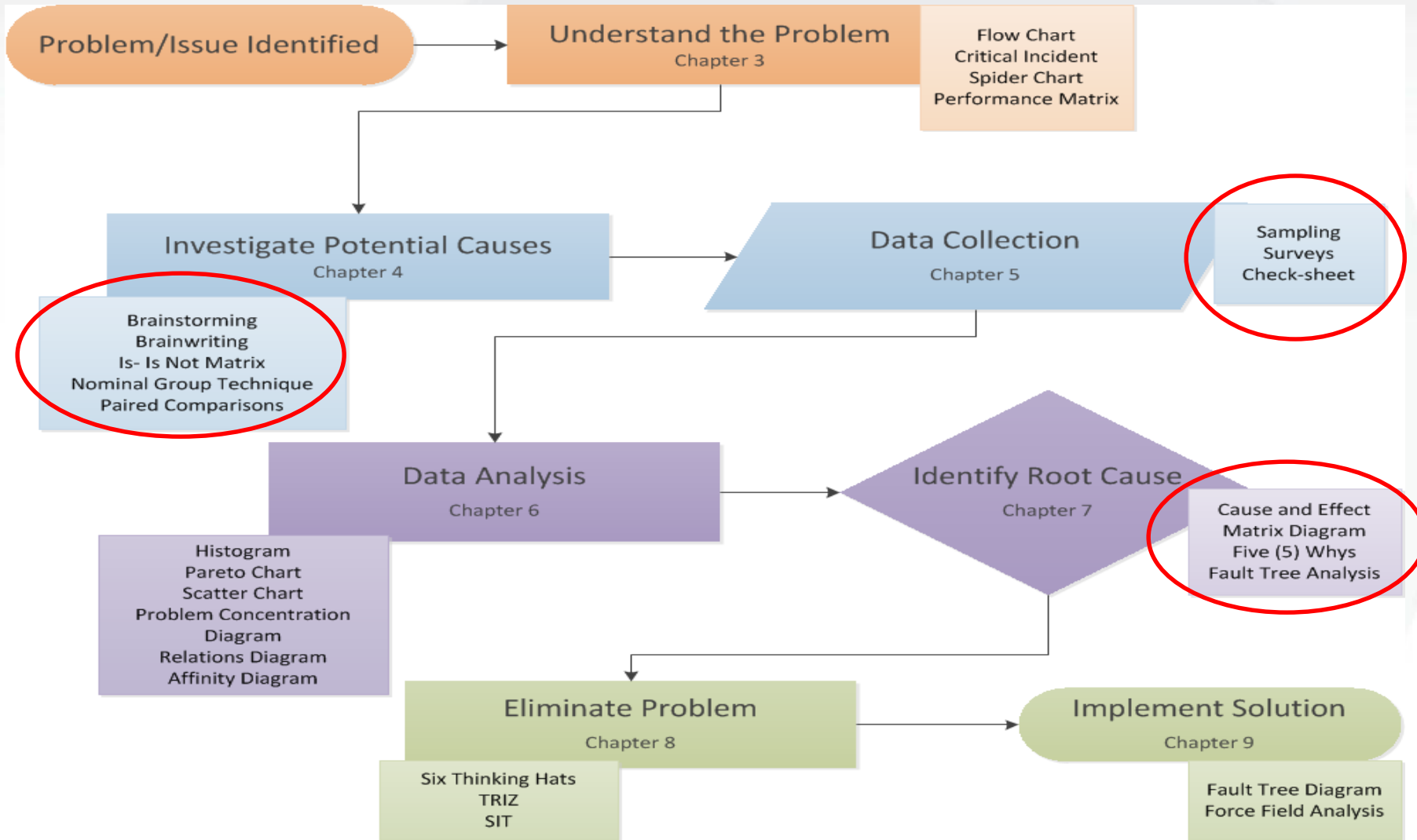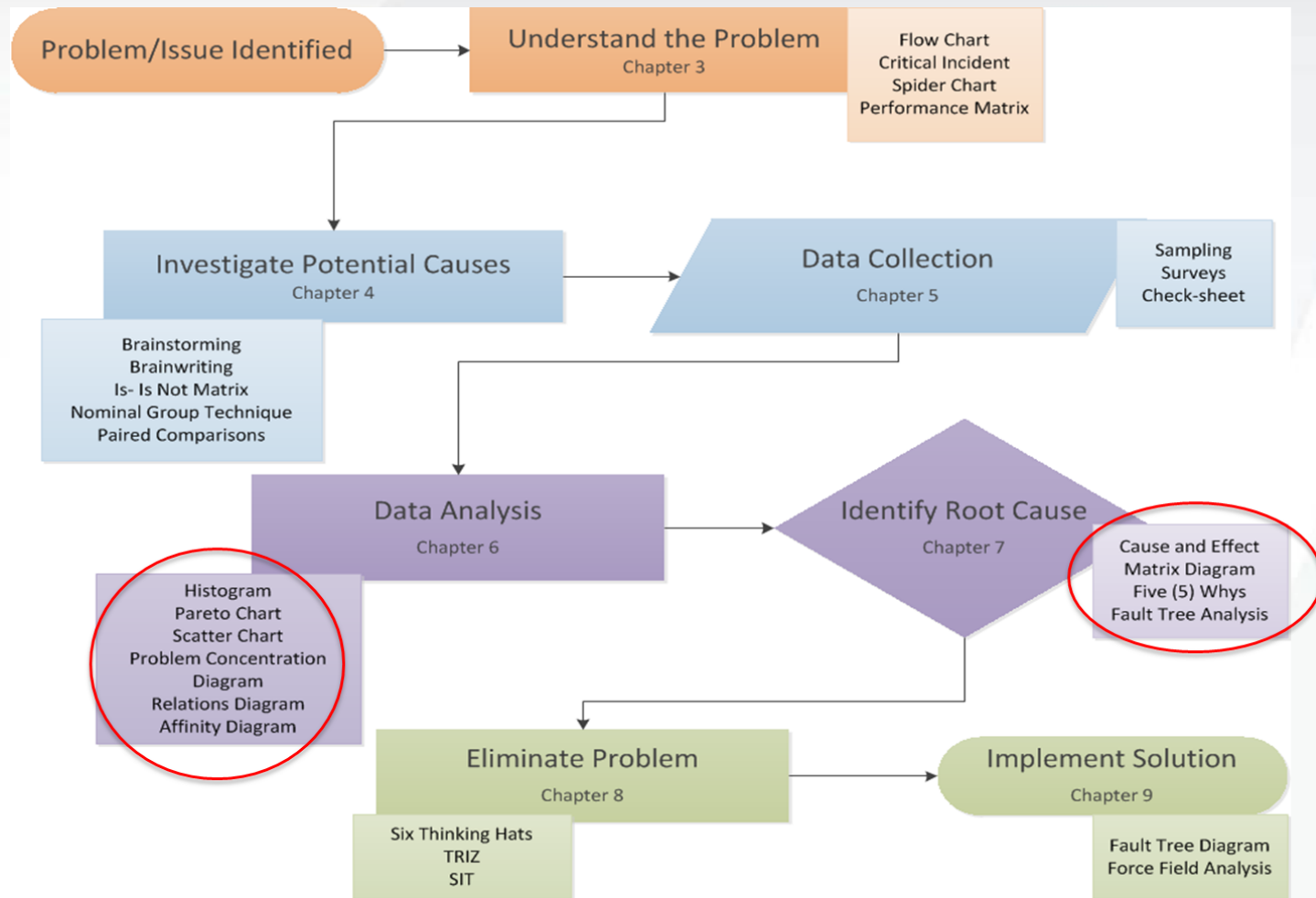   brainstorming, check-sheets
       Is – Is Not
       Surveys
       Paired Comparison

http://en.wikipedia.org/wiki/DMAIC

Six Sigma – MEASURE Tools

Six Sigma - DMAIC

- Define clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline.

- Measure objectively establish current baselines as the basis for improvement. (data collection)

- **Analyze**

  - identify, validate and select root cause for elimination

    Statistical Analysis (comparisons)

    Histograms, Scatter charts

    Root Cause Analysis (Fishbone, 5W'sH)

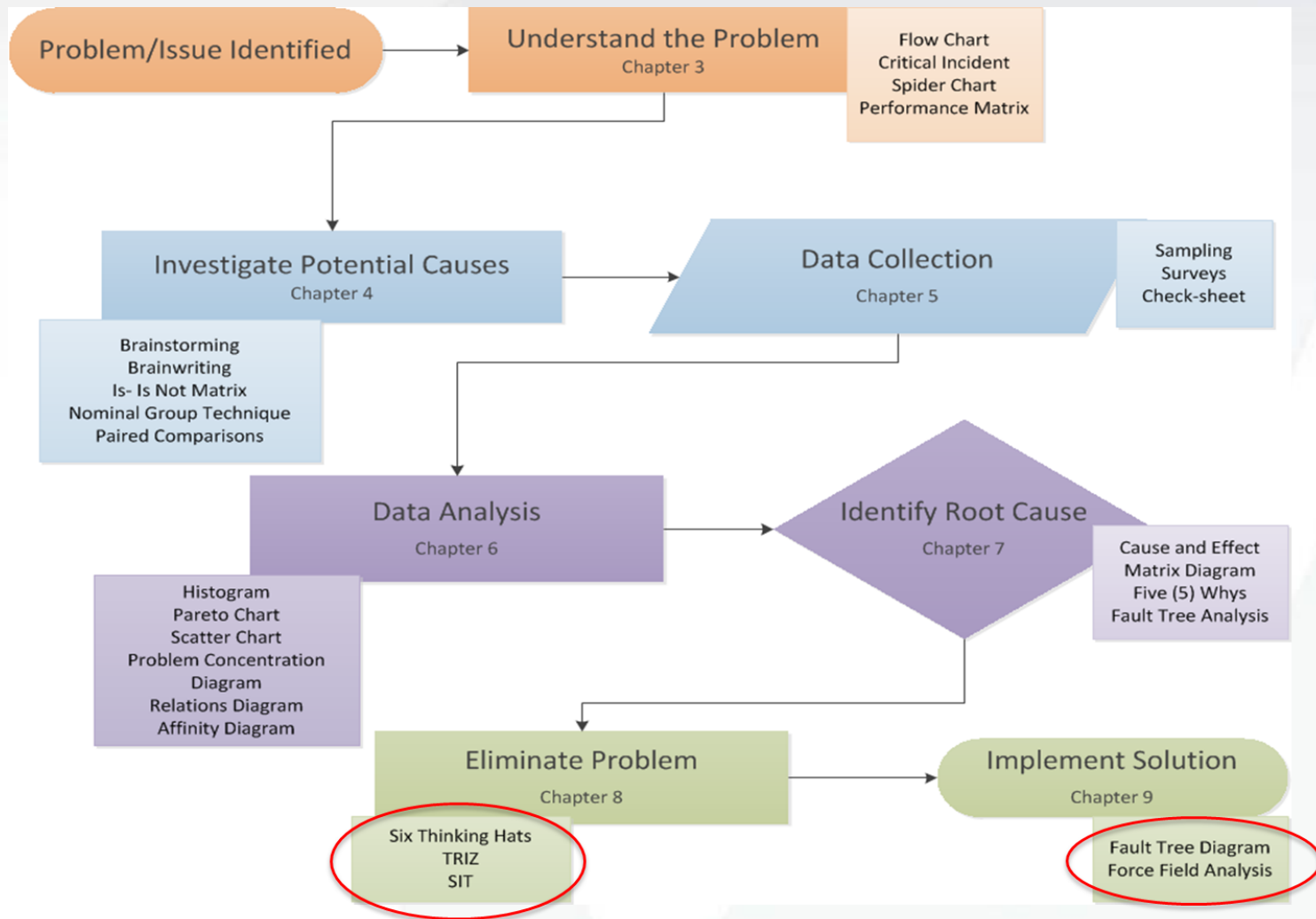# Six Sigma – ANALYZE Tools

Six Sigma - DMAIC

- Define: clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline.

- Measure: objectively establish current baselines as the basis for improvement (data collection).

- Analyze: identify, validate and select root cause for elimination.

- **Improve**
  - identify, test and implement a solution to the problem
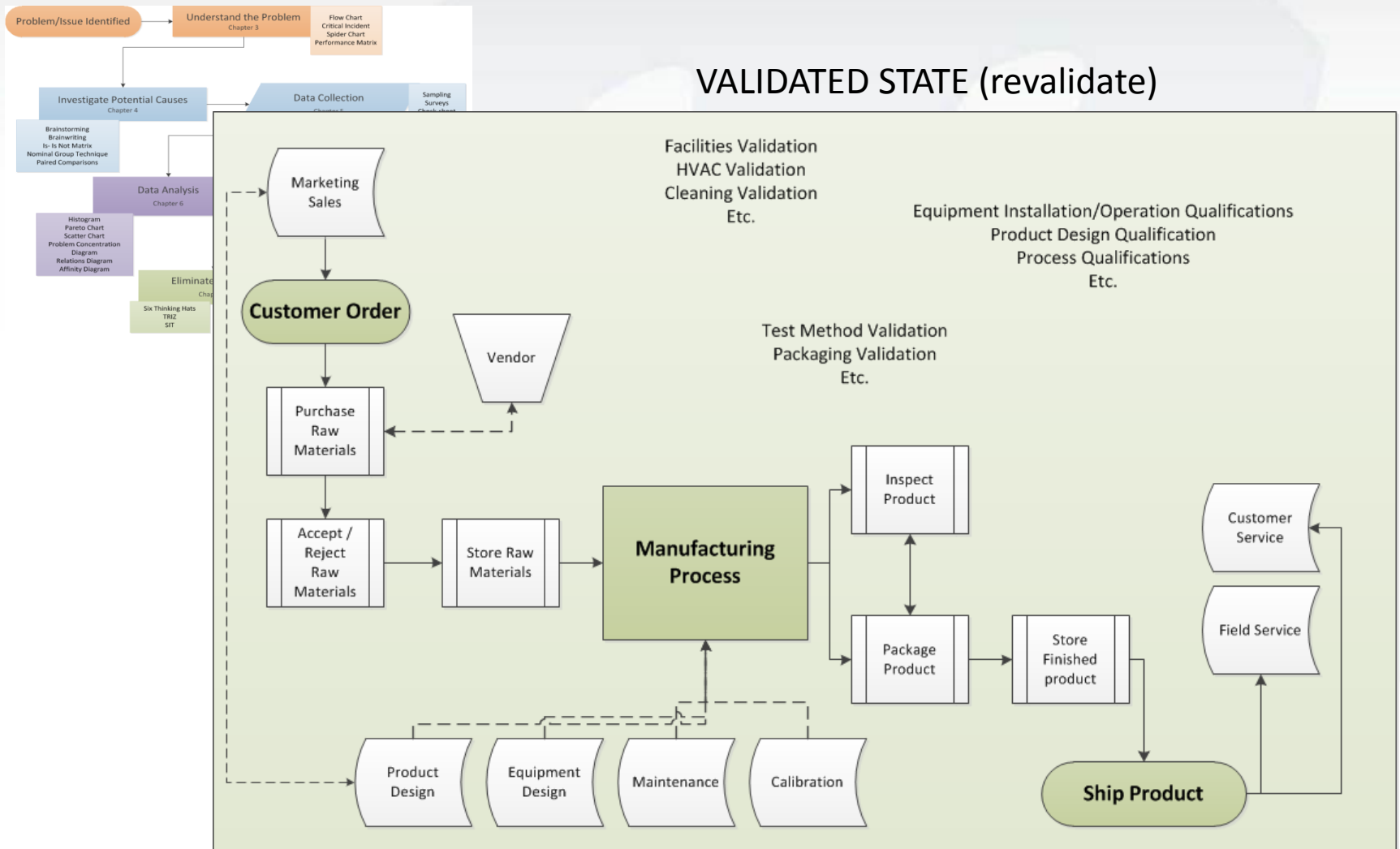 - in part or in whole

  Revalidate

  Change control

http://en.wikipedia.org/wiki/DMAIC

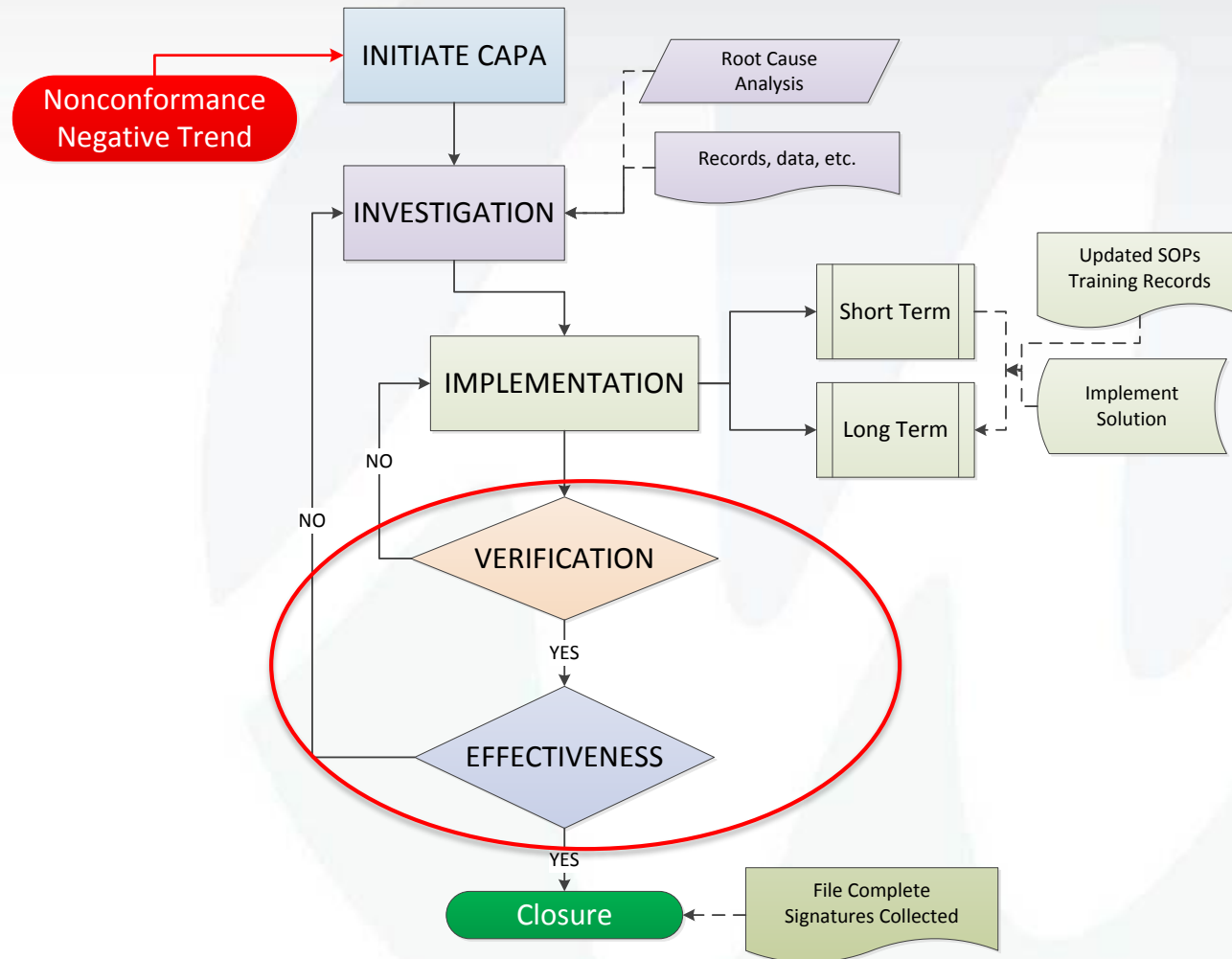# Six Sigma – IMPROVE Tools

Six Sigma – IMPROVE

Six Sigma - DMAIC

- Define: clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline.
- Measure: objectively establish current baselines as the basis for improvement (data collection).
- Analyze: identify, validate and select root cause for elimination.
- Improve: identify, test and implement a solution to the problem.
- **Control**
  - monitor the improvements to ensure continued and sustainable success
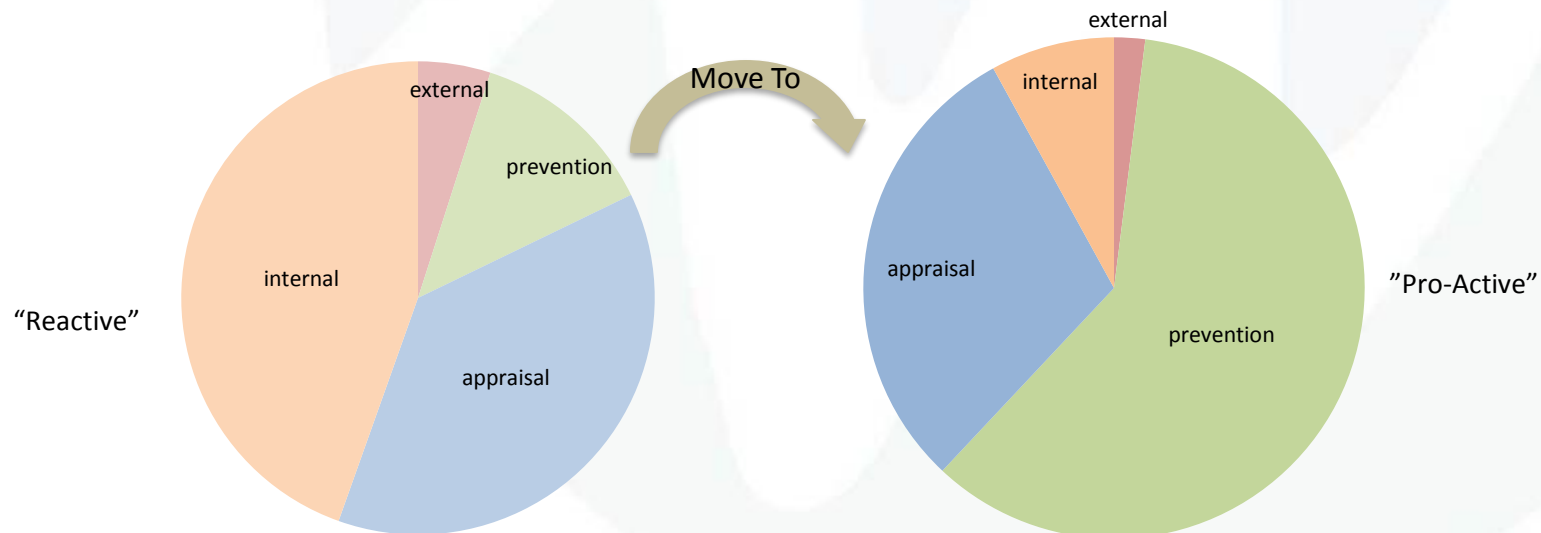
  Evaluate effectiveness

  Update procedures / training

Six Sigma - CONTROL

Six Sigma (DMAIC) - Summary

- ***Define***: clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline

- ***Measure:*** objectively establish current baselines as the basis for improvement (data collection)

- ***Analyze:*** identify, validate and select root cause for elimination.

- ***Improve:*** identify, test and implement a solution

- ***Control:*** Monitor to ensure continued/sustainable success

Lean – 7 Step - RDMAICS

- ***Recognize***

- Define, Measure, Analyze, Improve, Control

- ***Sustain (Standardize)***

Lean – 7 Step - RDMAICS

- Recognize
  - Identify unfavorable variation/problem/ symptom

- *Define, Measure, Analyze, Improve, Control*

- Sustain (Standardize)
  - Share practices through the organization
  - Proceduralize
  - Effectiveness

Eight Disciplines (8D)

- Developed by Ford Motor Company
  - Problem solving method used typically by engineers to resolve issues
  - Originally 8 stages (disciplines), initial planning stage added later
- Used widely by automotive industry and supply chain
  - Expanded to Food manufacturing, healthcare and IT

Eight Disciplines (8D)

D0: plan

D1: Use a team

D2: Describe the problem

D3: Develop interim containment plan

D4: Determine & verify root causes / escape points

D5: Verify permanent corrections for problem will resolve the problem for the customer

D6: Define and implement Corrective Actions

D7: Prevent System Problems

D8: Congratulate your team

Eight Disciplines (8D)

D0: Plan

Determine prerequisites and plan for solving problem

Eight Disciplines (8D)

D0: Plan

Determine prerequisites and plan for solving problem

D1: Use a Team

Establish a team of people with product/process knowledge

Eight Disciplines (8D)

D0: plan
   Determine prerequisites and plan for solving problem

D1: Use a Team
    Establish a team of people with product/process knowledge

D2: Describe the problem
   Specify problem by quantifiably identifying
      who, what, where, when, why, how and how many

Eight Disciplines (8D)

D0: plan

  Determine prerequisites and plan for solving problem

D1: Use a Team

   Establish a team of people with product/process knowledge

D2: Describe the problem

   Specify problem by quantifiably identifying
       who, what, what , where, when, why, how and how many

D3: Develop interim containment plan

    define (and implement) actions to isolate the problem from
    any customer

Eight Disciplines (8D)

D4: Determine & Verify Root Cause and Escape points
 identify all applicable causes that could explain problem
 identify why problem was not noticed at time of occurrence
 Verify and prove causes (data collection)

D5: Verify permanent corrections

 Using pre-production programs, quantitatively confirm selected corrections will resolve the problem

D6: Define & Implement Corrective Actions

Eight Disciplines (8D)

D7: Prevent System Problems
   modify systems/practices/procedure to prevent recurrence
   of issue and all similar problems

D8: Congratulate your team
   Recognize collective efforts of the team
   Formal organizational thank you

INDUSTRY CURRENT

- PDCA – Plan Do Check Act

- Six Sigma (DMAIC)

- Lean 7-Step (R-DMAIC-S)

- 8D (Eight Disciplines)