LEAN SOLUTIONS ACADEMY

Lean & Six Sigma Training

Green Belt Certification

brought to you by:

PATRICK ADAMS CONSULTING

Meet Your Instructor

- Background
- Lean Solutions "Train-The-Trainer" Course
- Internationally Certified Trainer

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CLASS SCHEDULE

Day 1

- Yellow Belt Class Refresh
- Introduction to DMAIC
- Project Management
  - Charters
  - SIPOC
  - Gantt Charts
- Structured Problem Solving (Steps 1-4)

DEFINE

MEASURE

ANALYZE

IMPROVE

Day 2

- Green Belt Project Review
  - Problem Statement
  - Measures of Success
  - Timeline
  - Help Needed?
- Structured Problem Solving (Steps 5-10)
- Value Stream Mapping
- Facilitating a Kaizen Event
- Impact/Effort Matrix (Affinity Diagram)

Day 3

- Green Belt Project Review
- Strategy Execution
- Hoshin Kanri
- Change Management
- Control and Sustainment

CONTROL

Day 4 (Six Sigma Green Belt Only)

- Six Sigma Statistics
- Measurement Systems Analysis
- Process Capability
- Correlation and Regression
- Introduction to DOE
- Hypothesis Testing

MEASURE

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BODY OF KNOWLEDGE

Yellow Belt

- The Fundamentals of Lean Six Sigma
- History / Process / Cause & Effect
- Principles of Lean / Six Sigma
- Process Mapping / DMAIC
- PDCA / Kaizen & Kaizen Events
- Kano Analysis
- Voice of Customer, & Business
- Defining a Process / CTQ
- The 8 Elements of Waste / Belt Roles
- 5S / Lean Tools / Visual Management / SMED
- Kanban / Poka-Yoke / Standardized Work
- Lean & Six Sigma Belt Roles
- Total Productive Maintenance
- Value Add & Non Value Add Work

Lean Green Belt

- Project Management
- Project Charter
- SIPOC
- 7-Quality Tools / Pareto Analysis
- Control Charts
- Control Plans
- Gantt Chart
- Structured Problem Solving
- Fishbone Diagrams / Graphical Analysis
- Lean Metrics & Projects
- FMEA
- Facilitating a Kaizen Event
- Strategy Execution
- Hoshin Kanri
- Change Management

Six Sigma Geen Belt

- Six Sigma Statistics
- Measurement Systems Analysis
- Process Capability
- Correlation and Regression
- Introduction to DOE
- Hypothesis Testing

Black Belt

- Mann-Whitney / Kruskal-Wallis
- Friedman Mood's Median / Simple Linear Regression
- 1 Sample Sign / 1 Sample Wilcoxon
- One and Two Sample Proportion
- Chi-Squared (Contingency Tables)
- Correlation / Regression Equations
- Regression Equations / Residuals Analysis
- Non- Linear Regression
- Multiple Linear Regression
- Confidence & Prediction Intervals
- Designed Experiments / OFAT
- Experiment Objectives
- Experimental Methods
- Experiment Design Considerations
- Linear & Quadratic Mathematical Models
- Orthogonal Designs
- Full Factorial Experiments & Designs
- Fit, Diagnose Model and Center Points
- Taguchi Designs Control Phase
- Statistical Process Control (SPC)
- Data Collection for SPC / I-MR Chart
- Xbar-R Chart / U Chart / P Chart
- NP Chart / X-S chart
- CumSum Chart / EWMA Chart
- Binomial Distribution and Calculations
- Poisson Distribution and Calculations
- Design for Six Sigma (DFSS) / Hoshin Kanri
- Cost Benefit Analysis / ROI, Payback Period

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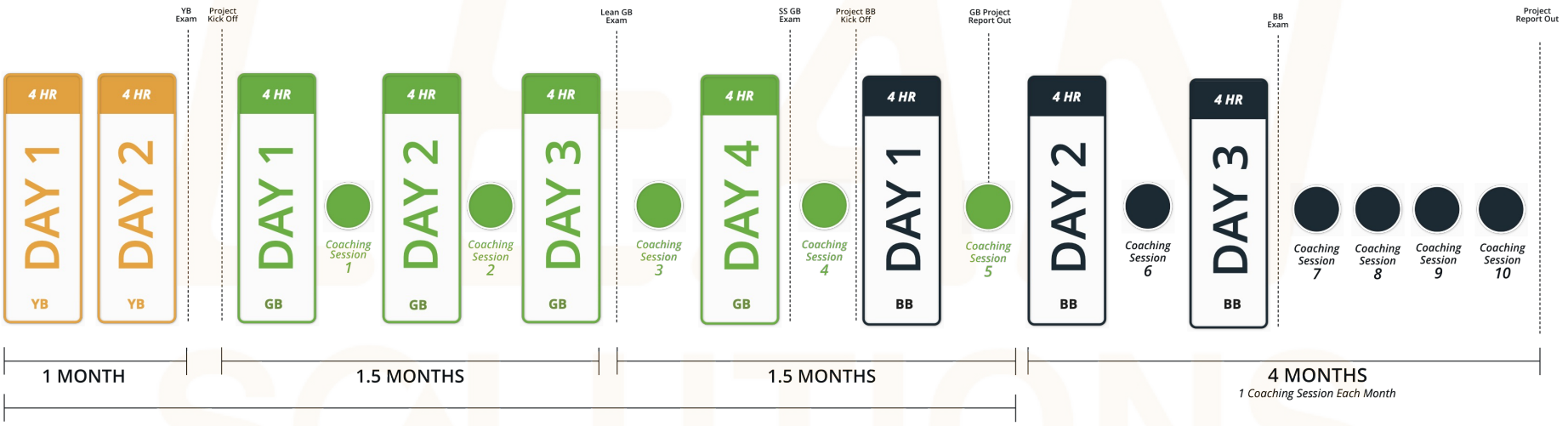

4 MONTHS

Classes Every Other Week

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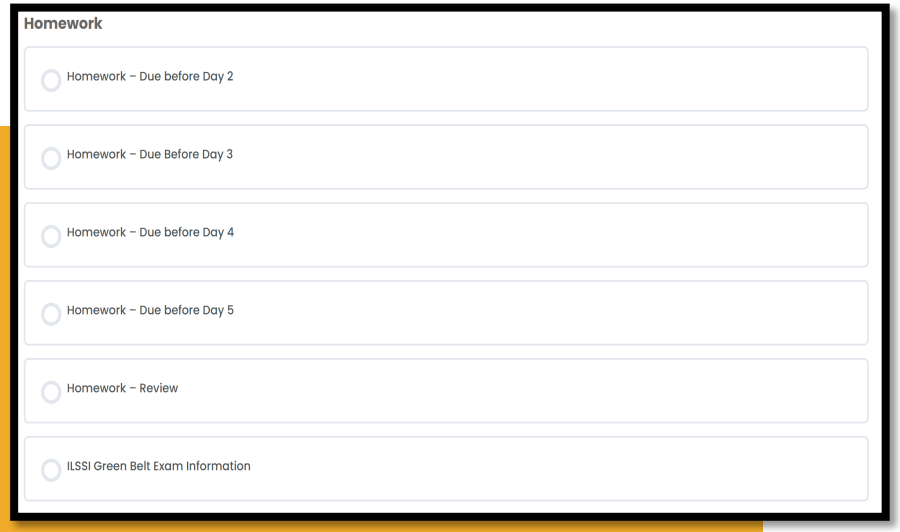

HOMEWORK

As a Green Belt student, you are expected to review and complete the homework for each lesson.

Homework items include information specific to the classroom instruction as well as your project work.

The assignments can be accessed on the student dashboard.

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GREEN BELT
CERTIFICATION EXAM

- Lifetime certification
- Done online on your student dashboard after training is finished
- Open Book
- 100 Multiple Choice Questions
- Pass mark is 70%
- Result issued immediately
- Retake is available

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GREEN BELT
CERTIFICATION EXAM

Find information on how to access the exam on the student dashboard

Download the class PowerPoint slides (as a searchable pdf) to help while studying for and taking the exam

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Yellow Belt Review

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YB Review:

1. What was the name of the first company to use the name 'SIX SIGMA' to describe its Quality Management System?
   - **MOTOROLA**

2. What is the First Principle of Lean production ? What is the most important thing that a Lean process must produce?
   - **VALUE** (for the customer of the process)

3. Which Japanese company is considered as being the first to use true 'Lean Production "effectively and successfully"?
   - **TOYOTA**

4. A basic principle of Six Sigma is to always find the true original source of a defect or problem. This is called _____?
   - **ROOT CAUSE ANALYSIS**

5. A "Six Sigma Process" is often described one that produces no more than 3.4 DPMO What does DPMO stand for?
   - **DEFECTS PER MILLION OPPORTUNITES FOR DEFECTS**

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YB Review:

1. What is the role of a Yellow Belt on a Lean Six Sigma project?
   - A YELLOW BELT IS A TEAM MEMBER WHO ASSISTS A GREEN OR BLACK BELT, USING THEIR KNOWLEDGE OF THE PROCESS THAT THEY CURRENTLY ARE WORKING WITHIN.

2. What is the role of a Green Belt in an organisation ?
   - A GREEN BELT IS A PROJECT TEAM LEADER FOR SMALL AND MEDIUM SIZED PROCESS IMPROVEMENT PROJECTS.

3. What is the role of a Black Belt in an organisation ?
   - A BLACK BELT IS A PROJECT TEAM LEADER FOR LARGE PROBLEM SOLVING / IMPROVEMENT PROJECTS or OVERSEES THE WORK OF GREEN BELTS FOR MULTIPLE PROJECTS. A BLACK BELT IS A FULL TIME PROBLEM SOLVER FOR THE ORGANISATION.

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YB Review:

1. All work shall be highly specified as to content, sequence, timing and _____.
   - OUTCOME

2. True or False? Standard work provides a routine for consistency of an operation.
   - TRUE

3. True or False? Standard work helps to hide problems.
   - FALSE

4. Discussion: Why is it so important to audit standard work?

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YB Review:

1. Which of the traditional 8-Wastes of 'DOWNTIME is concerned with reducing the complexity of processes and taking out unnecessary steps or activities ?
   - **NON-ESSENTIAL PROCESSING / OVER PROCESSING**

2. What is the name of the Waste of producing more that the customer demand can absorb ?
   - **OVER-PRODUCTION**

3. What is Waste called when an activity or step in process needs to be repeated because it was not done 'Right-First-Time' ?
   - **REWORK / DEFECTS**

4. What Waste results in Queues or Backlogs of materials or work ?
   - **WAITING (DUE TO A BOTTLE-NECK IN THE PROCESS)**

5. What is the Japanese word for 'Waste' ?
   - **MUDA**

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YB Review:

1. Which stage of the 5S method is used to ensure that the workers have the good habits and discipline to continue the other 4S tasks?
   - **SUSTAIN**

2. In 5S the action of removing unnecessary tools, equipment and materials from the workspace is called _____.
   - **SORT**

3. Cleaning the workplace of dirt, dust and litter is called what in 5S ?
   - **SHINE**

4. Give one example of a 5S method used for **SET IN ORDER / STRAIGHTEN**
   - **SHADOW BOARDS**
   - **RACKS**
   - **COLORED LABELS**
   - **FLOOR MARKING etc**

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YB Review:

1. What Tool is used to understand what is Critical to Quality (CTQ) by Forming 3 categories: *threshold, performance,* and *excitement*?
   - **KANO ANALYSIS**

2. Splitting Customers into groups according to different needs or behaviours is called _____.
   - **SEGMENTING**

3. CTQs are also sometimes called CTCs or CTSs. What does CTS stand for?
   - **CRITICAL TO SATISFACTION**

4. Give one example of a method used to understand the **Voice of the Customer**?
   - **SURVEYS**
   - **FEEDBACK**
   - **FOCUS GROUPS**
   - **REPEAT SALE METRICS, etc**

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YB Review:

1. What does kaizen stand for?
   - SMALL CHANGE FOR THE BETTER / CONTINUOUS IMPROVEMENT

2. What are the three criteria of kaizen?
   - DOES THE IDEA REDUCE WASTE, IMPROVE QUALITY, AND/OR INCREASE SAFETY?
   - DOES THE IDEA ADDRESS THE ROOT CAUSE?
   - IS IT STANDARDIZED?

3. What are the different types of Gemba walks?
   - SAFETY, 5S, WASTE, VALUE STREAM WALK

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YB Review:

1. What is a ‘Gemba Walk’ ?
   - GOING TO SEE FOR YOURSELF WHAT IS HAPPENING WHERE THE REAL WORK IS DONE

2. What is the benefit of having a Visual Work Place ?
   - ALL TEAM MEMBERS CAN SEE THE STATUS OF WORK AND OPERATIONS EASILY AND AT THE SAME TIME.

3. Give one example of a Visual Management tool or technique ?
   - COLOR CODING, NOTICE BOARDS, GRAPHS AND CHARTS, GOOD LABELLING

4. What are the key components to a good SOP (Standard Operating Procedure)?
   - WHAT
   - HOW
   - WHY
   - USE A PICTURE OR VIDEO

5. A fundamental concept of any Lean Process is that it has well defined and repeatable actions by workers. This concept is call _____work
   - STANDARDIZED

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PROJECT CHECK-IN'S

- What is your Problem Statement?
- Give some background on your Project
- What are your goals?

- Do you foresee any roadblocks?
- Do you need help with anything?
- What are your next steps?

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DMAIC

The Six Sigma Framework for Problem Solving

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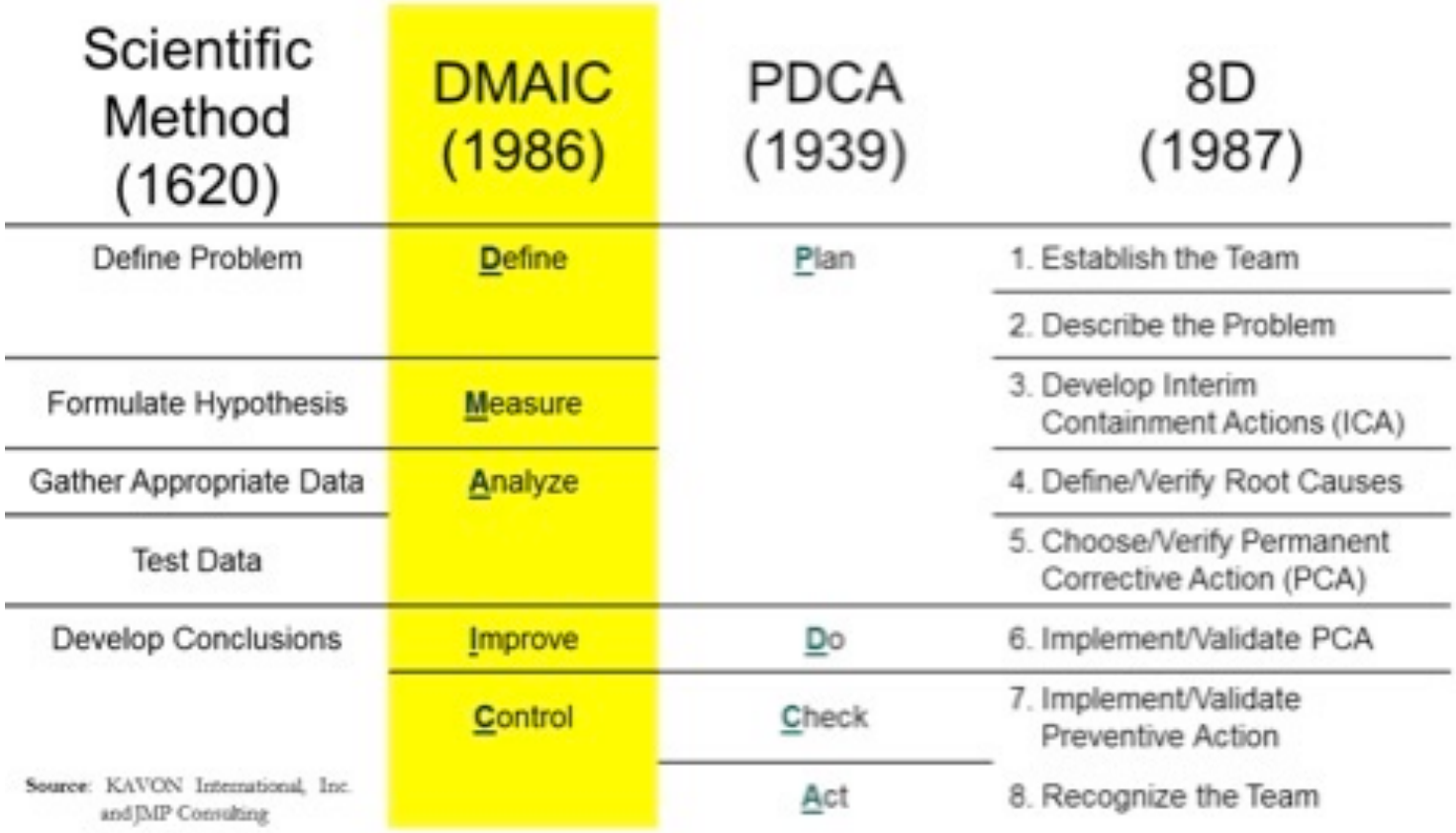

Figure 1: *Roadmap Comparisons to the Scientific Method*

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Define - The business problem (or opportunity), Team and Scope

Measure - The process current state (as-is) of the problem area

Analyze - Determine Root Cause of the problem

Improve - Identify and Choose Best Solution then implement the solution

Control - Ensure your solution is working. Monitor and Control.

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DMAIC Project Checklist

DMAIC Project Checklist		Highlighted Tools are Mandatory			PROJECT	
DEFINE	**Steps**	**Tools**				**X**
1.	Which pain point(s) resulted in project identification	Problem Statement – Project Charter				
2	Define Customer / Supplier & Customer relationship	SIPOC				
3	Voice of Customer gathered	Surveys & Interviews				
4	Specific requirements identified	Kano	Benchmarking			
5	Identify core business process to improve	SIPOC or	Pareto	Process Map/ VSM		
		Affinity	Brainstorm	Weighted Voting		
6	Complete Charter with Sponsor	Charter				
7	Pre-Planning with Sponsor	SIPOC/Charter	FMEA			
8	Financial Discussion with Sponsor	ROI Worksheet				
9	Project Plan	GANTT Chart				
MEASURE	**Steps**	**Tools**				**X**
10	Define Current State	Gemba Walk & Process Map				
11	Data Collection Plan	Pull reports	Time studies	Stop-Keep-Start		
		Kata	SMED			
12	Documentation	SOP's				
13	Now that we have data, does project continue	DMAIC – Management				
ANALYZE	**Steps**	**Tools**				**X**
14	Process Time, Lead Time, and Takt Time calculated.	Lead Time	Process Time	Takt Time		
15	Calculate steps, rework, hand-offs, delays/waits, backlog, productivity.					
16	"Value" identification		Down Time	Brainstorming		
17	Identify problem areas of the process to focus on	FMEA	Check Sheet	Control Chart		
		Brainstorming	Weighted-vote	5-whys		
		Spaghetti Diagram	Fishbone	Pareto		
18	List of items out of scope but that need addressed.	Parking lot				
19	Document Update	Update Charter, Risk Register, Comm Plan, Stakeholder Analysis				
IMPROVE	**Steps**	**Tools**				**X**
20	Identify potential solutions.	Brain storm	SIPOC	Force Field Analysis		
		Fishbone	Guiding Principles	Kanban		
21	Determine best solution to implement.	Daily Kaizen	Voting	Impact Matrix		
		Affinity	Pareto			
		Kaizen Event				
22	Create Future State Map.			Fundamentals of Future State Mapping		
23	Further considerations	Poka- Yoke	5S	SQCD board	Update Standard Work	
24	Pilot executed	Action/task list				
25	Using data from Pilot, decision made to tweak pilot and re-pilot or go wide scale implementation					
26	Wide Scale project plan	Action/task list				
27	Execute Implementation.	ADKAR				
CONTROL	**Steps**	**Tools**				**X**
28	Game plan to return process to owner	Action/task list				
29	Collect and analyze data from wide scale implementation	Control Chart				
30	Training and communication on new process to area	RACI Chart	Tier Meetings	Escalation Plan		
31	System for monitoring new system	Audits	Gemba	SOP		
32	Lessons Learned	Project Team				
33	Initial Report Out (RO)	Report Out Template				
34	Celebrate Completion	Key Stakeholders & Project Team				
35	Project closure documents updated	Control Plan				
36	30, 60, and 90 -day RO - action plans if needed (update ROI).	Report Out Template		Leader Standard Work		
37	6 & 12 month RO - action plans if needed (update ROI).	Report Out Template				

LEAN SOLUTIONS

We do NOT need to use all the possible tools on every project.

Be 'LEAN' in selecting correct tools according to:

- The type of problem
- The scale/size of problem
- How much money and time you have
- The skills /experience of your project team

LEAN SOLUTIONS

DEFINE PHASE

Defining the PROBLEM

Defining the PROJECT

DEFINE

Problem & Project Definition

- The most important Phase of any DMAIC Project
- Choose the right problem to tackle
- Define the PROBLEM
- Identify the key TEAM members and STAKEHOLDERS
- Understand the SCOPE
- Present a good BUSINESS CASE
- Develop a PROJECT CHARTER

3 DOCUMENT

OUTPUTS OF DEFINE

1. Business Case (including Problem Statement)
2. Project Charter
3. High Level Process Map or SIPOC

PROJECT SELECTION – CORE COMPONENTS

Business Case – The Business Case defines the Problem and the Business motivation for considering the project. The Problem is defined with a 'Problem Statement'.

Project Charter – The Project Charter is a more detailed version of the Business Case. This document further focuses the improvement effort. It can be characterized by two primary sections; one, basic project information and two, simple project performance metrics.

High Level Process Map – Used to show a high level understanding of the scope of the process that is to be measured, analyzed, improved and controlled. The SIPOC tool can also be used.

WHAT IS A BUSINESS CASE?

A Business case has 3 main parts :

1. What is the problem that the business or the customer is experiencing? This part is called the 'Problem Statement'

2. What is the target or goal we are trying to reach ?

3. What are the consequences for the business if the problem is not solved, or business benefits if it is solved ? In other words, what is the business motivation for a project to solve the problem ?

The Business Case is constructed with the help of the Process Owner / Manager or the Business Owner / Manager.

THE PROBLEM STATEMENT

Must include:

1. What is the problem?
2. When/Where are we seeing the problem?
3. What requirement is affected?
4. Who does it affect?

Should not:

1. Be more than one problem
2. Suggest a solution
3. Make assumptions

THE PROBLEM STATEMENT

Poor:
The widget is too long (1)

Better:
The widget exceeds the requirement (1) of 38cm (3)

Best:
The last 10 production runs (2) show the widget measured an average of 41cm (1), which exceeds the customer (4) requirement of 38cm +/- 2cm.(3)

1. What is the problem?
2. When / Where are we seeing the problem?
3. What requirement is affected?
4. Who does it affect?

BUSINESS CASE EXAMPLE

Problem Statement

- Customer complaints have increased by 50% in 2019. The 2017 average was 20 complaints per month with a total of 240 over the full year. 2018 average was 21 per month with a total of 252 over the year, The average for the first 5 months of 2019 is 30 complaints with a total of 150 in 5 months.

Target

- We need to reduce complaints back down to the 2017 level of an average of 20 per month.

Consequences

- We will see a drop in new customers and also customers leaving if we do not reduce the complaints and increase customer satisfaction.

WHAT IS
A PROJECT CHARTER?

The *Project Charter* expands on the Business Case, it clarifies the project's focus and the measures of project performance. The Project Charter completed by the Six Sigma Belt (Green or Black).

PROJECT CHARTER DEFINITIONS

- *Problem Statement* - Articulates the pain of the defect or error in the process.
- *Objective Statement* – States how much of an improvement is desired from the project.
- *Project Scope* – Articulates the boundaries of the project. (Use SIPOC diagram)
- *Primary Metric* – The actual measure of the defect or error in the process.
- *Secondary Metric(s)* – Measures of potential consequences (+ / -) as a result of changes in the process.
- **Project Black Belt & Process Owner names**
- **Start date & desired End date**
- **Division or Business Unit name**
- **Team Members**
- **Stakeholder names**

TEAM/PROJECT CHARTER

Project Name:	A better cup of coffee
Date (Last Revision):	xx-xx-xxxx
Prepared By:	Craig T.
Approved By:	Patrick A.

Business Case:

The coffee in the main break room is not very tasty. Employees are leaving the property at break times to visit either the Starbucks next door, or gas station across the street to get their coffee. There have been some close calls with traffic and associates that are crossing the road. Some associates are having trouble getting back to work on time.

Opportunity Statement (High Level Problem Statement):

Poor tasting coffee in the main breakroom is causing associates from all three shifts to go to an off-site location to get a quality cup of coffee.

Defect Definition: Poor tasting coffee

Goal Statement:

Provide coffee that tastes so good associates will not want to leave the site for the duration of their breaks.

Expected Savings/Benefits: Remove time lost due to injuries inflicted due to carelessness and rushing when leaving the site. Equipment and department start up time at the end of breaks to be less than 2 minutes.

Project Scope:

Process Start Point: Easy, fast, and efficient process to access a great tasting cup of coffee in the main break room.

Process End Point: Associates leave the break room on time to return to their work area.

In Scope: Address the break and coffee experience in the main break room.

Out of Scope: The three small break areas located on the plant floor, and the office break room.

Project Plan:

Task/Phase	Start Date	End Date	Actual End
Brief all shifts on project	xx-xx-xx	xx-xx-xx	xx-xx-xx
Brainstorming Session	xx-xx-xx	xx-xx-xx	
Identify Countermeasures	xx-xx-xx	xx-xx-xx	
Create Action Plan	xx-xx-xx	xx-xx-xx	

Team:

Name:	Role:	Commitment (%):
Craig T.	Project Champion	100
Patrick A.	Project Owner	50
Liz H.	Project Manager	75
Taylor K.	Core Member	25
Daniell S.	Core Member	25

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DEFINE MEASURE ANALYZE IMPROVE CONTROL

SMART METRIC

When choosing the best METRIC to use as the main measure of success of your project, consider the SMART method of choosing metrics

Specific - Is the metric well defined?

Measurable - How will we measure it easily?

Attainable - Can we achieve the target?

Relevant - Is the metric related to the problem?

Time Bound - When are we going to measure it?

SIPOC FOR THE DEFINE PHASE

Suppliers
All internal and external suppliers to the process

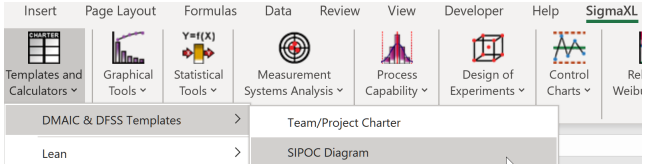
Inputs
All inputs to the process i.e. material, forms, information, etc.

Process
One block representing the entire process with its name

Outputs
All outputs for both internal and external customers

Customers
All internal and external customers to the process

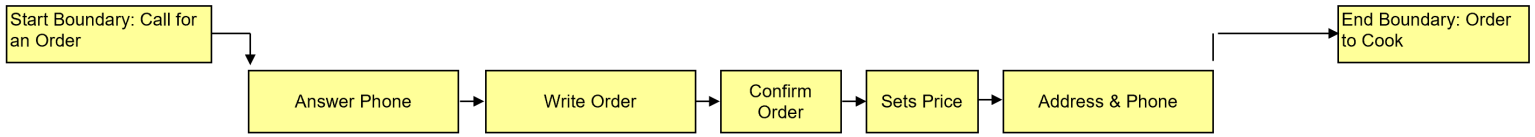
SIPOC



SIPOC DIAGRAM for Customer-Order Process

Process/Project Name:	**Customer Order Process**
Date:	
Prepared By:	
Notes:	

Suppliers	Inputs		Process	Outputs		Customers
Provider	Input Description	Input Requirements (optional)		Output Description	Output Requirements (optional)	Recipient of Output
ATT Phones	Pizza Type		See High Level Process Steps Below	Price		Cook
Office Depot	Size			ConfirmOrder		Accounting
TI Calculators	Quantity			Bake Order		
NEC Cash Regiser	Extra Toppings			Data on Cycle Time		
Customer	Special Orders			Order Rate Data		
	Drink Types/Quantities			Order Transaction		
	Other Products			Delivery Info		
	Phone Number					
	Address					
	Name					
	Time/Day/Date					
	Volume					



SIPOC FOR THE DEFINE PHASE

Class exercise: Complete this SIPOC for making a package delivery of a product that a customer has purchased through your company website.

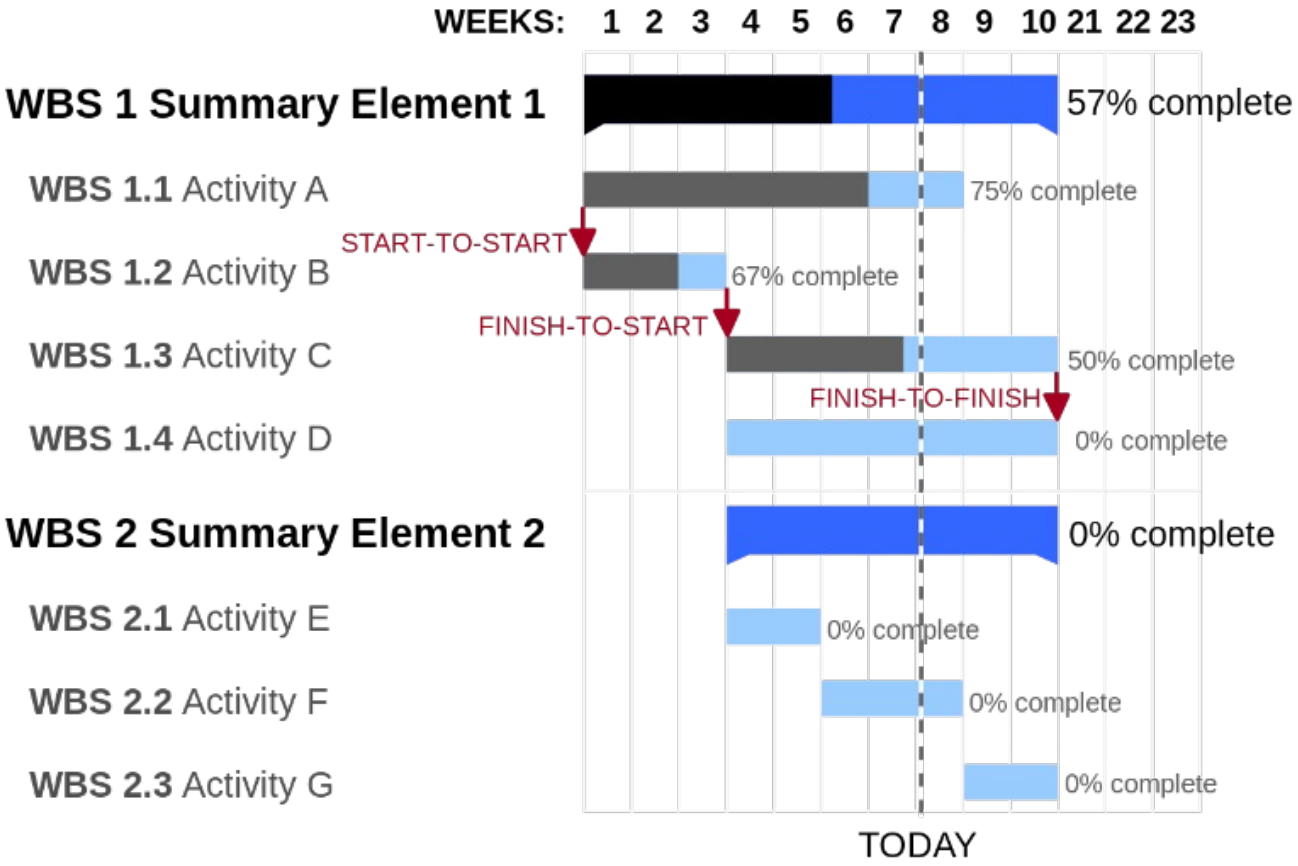
Process name :

_____

Suppliers	Inputs	Process	Outputs	Customers
1._____	1._____	1._____	1._____	1._____
2._____	2._____	2._____	2._____	2._____

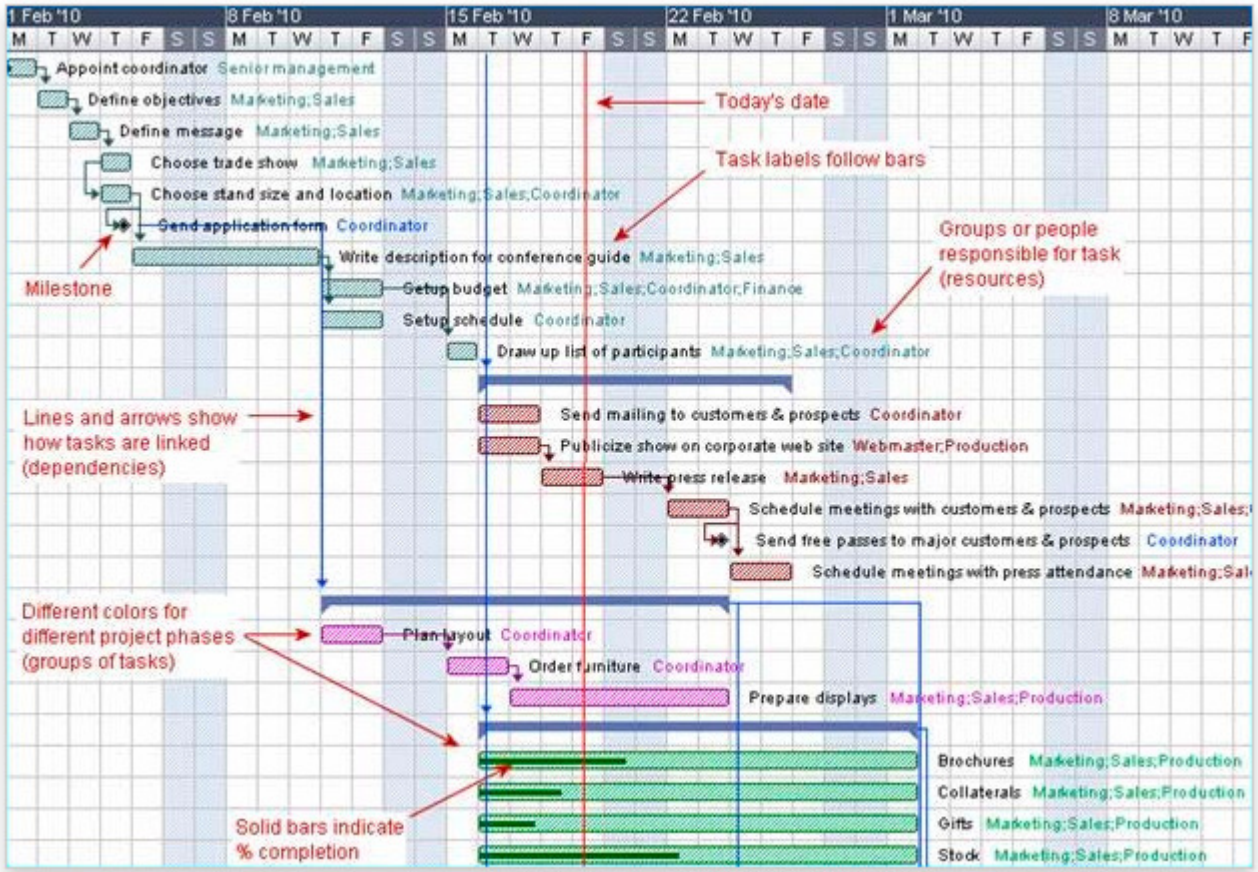
GANTT CHART

CREATE A TIMELINE FOR YOUR PROJECT



GANTT CHART

CREATE A TIMELINE FOR YOUR PROJECT



Karol Adamiecki

Henry Gantt

DEFINE | MEASURE | ANALYZE | IMPROVE | CONTROL

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SUMMARY

At This Point You Should Be Able To…

- Understand the importance for the Define Phase.
- Understand the 3 main output documents of the Define Phase
  - Business Case
  - Project Charter
  - SIPOC of Level 1 Process Map
- Understand SMART Metrics
- Understand Gantt Charts

QUIZ 1:

1. What is the framework used in Lean Six Sigma for running Lean Six Sigma projects where we are unsure of the root cause or solution ?
   - **DMAIC Define – Measure – Analyse – Improve – Control**

2. What are the names of the 3 document deliverables in the DEFINE Phase ?
   - **Business Case (including Problem Statement)**
   - **Project Charter**
   - **Scope Statement or SIPOC**

3. What does the acronym SIPOC mean ?
   - **SUPPLIERS, INPUTS, PROCESS, OUTPUTS, CUSTOMERS**

4. What do we call a 1-page summary of your timeline with milestones?
   - **Gantt Chart**

STRUCTURED
PROBLEM SOLVING

DEFINE | MEASURE | ANALYZE | IMPROVE | CONTROL

LEAN SOLUTIONS

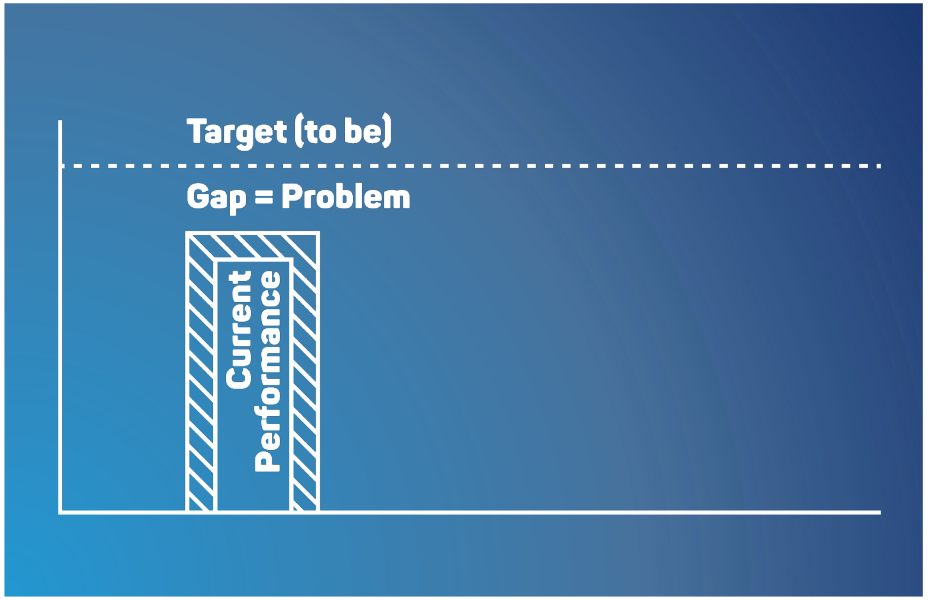
INTRODUCTION

- What types of problem solving are in use throughout your Organization?
- How effective is the problem solving in your facility at determining the TRUE root cause?

WHY

BASIC PROBLEM SOLVING?

It's a general rule of life that we will try anything easy that doesn't work before we will embrace anything harder that does.



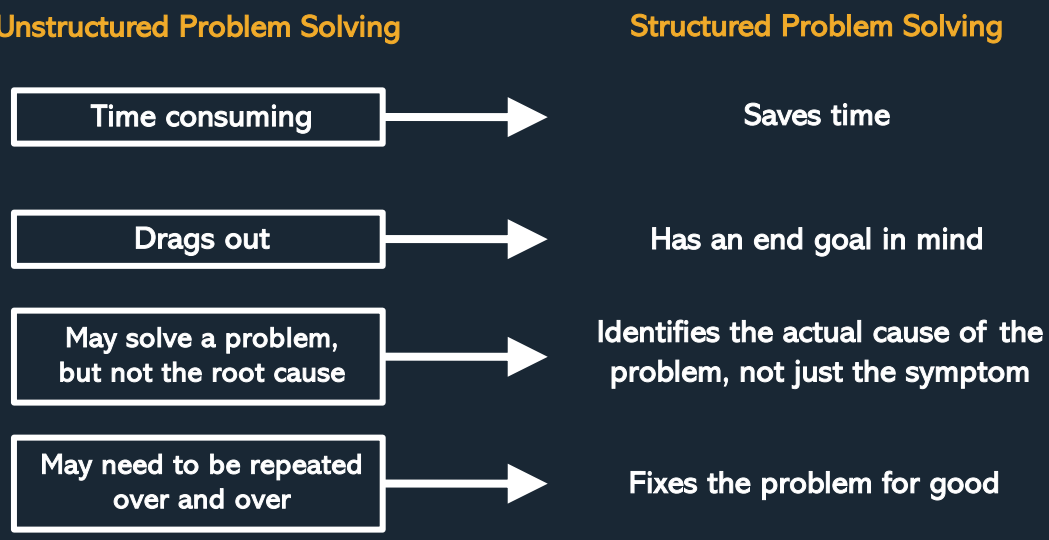
WHAT IS
A PROBLEM?

A problem is a “gap” - between:

Current condition – **what is actually happening**
Target or ideal condition – **what should be happening, what is needed**

WE NEED

STRUCTURED PROBLEM SOLVING



WHO SHOULD BE INVOLVED
IN SOLVING PROBLEMS?

- Members (40-400)
- Leads (3-9)
- Middle Management (2-4)
- Upper Management (1-2)

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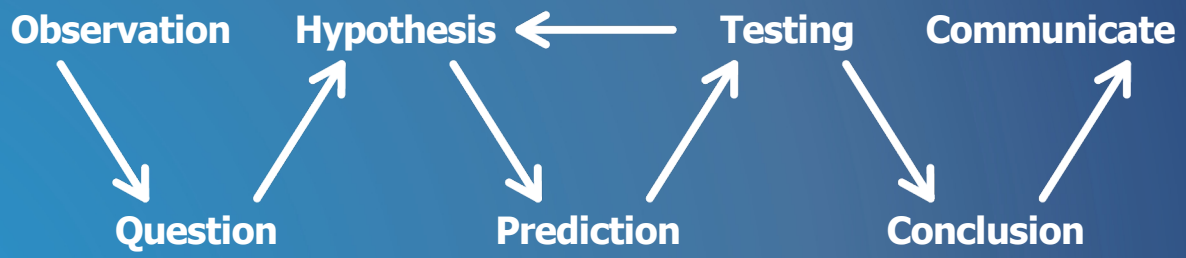
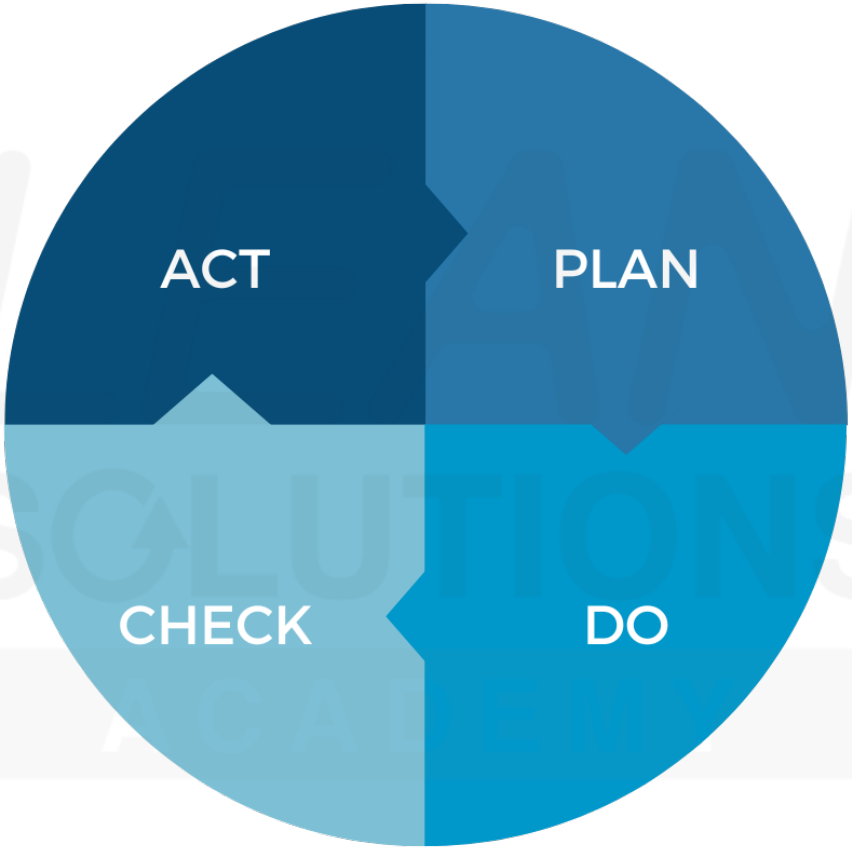
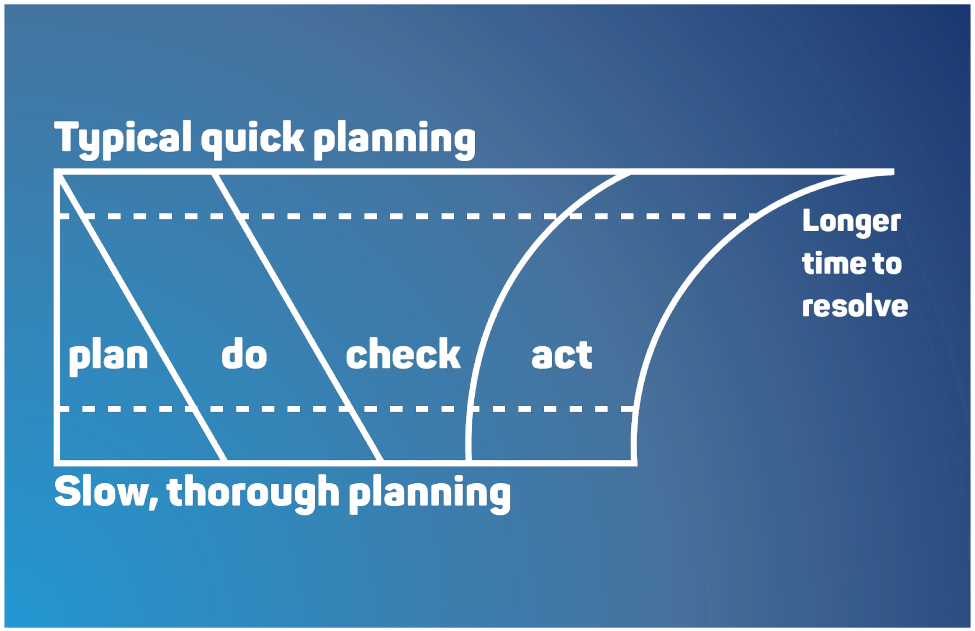
SCIENTIFIC METHOD



THE ENGINE OF EXECUTION



BALL TOSS EXERCISE



PRACTICAL
PROBLEM SOLVING

10 STEP PROBLEM SOLVING METHOD

PLAN the product or process improvement:

1. Describe the problem
2. Understand needs & requirements
3. Use a team approach
4. Identify potential causes
5. Collect & analyze data (to verify root cause)
6. Identify alternatives & select solution
7. Prepare a plan of action
8. Get leadership approval & support

DO the improvement:

9. Implement the solution

CHECK the results:

10. Measure, monitor & control your results

ACT on the results: Review and recognition

TAKE INTERM STEPS

- If the customer or next operation is at risk, take immediate interim action to contain the problem and prevent it from spreading.
- This step should be considered a band-aid only and not the cure.
- Examples of containment action:
  - Purge stock
  - Inspect work in process
  - Rework and fix errors
  - Alert customers
  - Apply temporary verifications

STEP 1

DESCRIBE THE PROBLEM

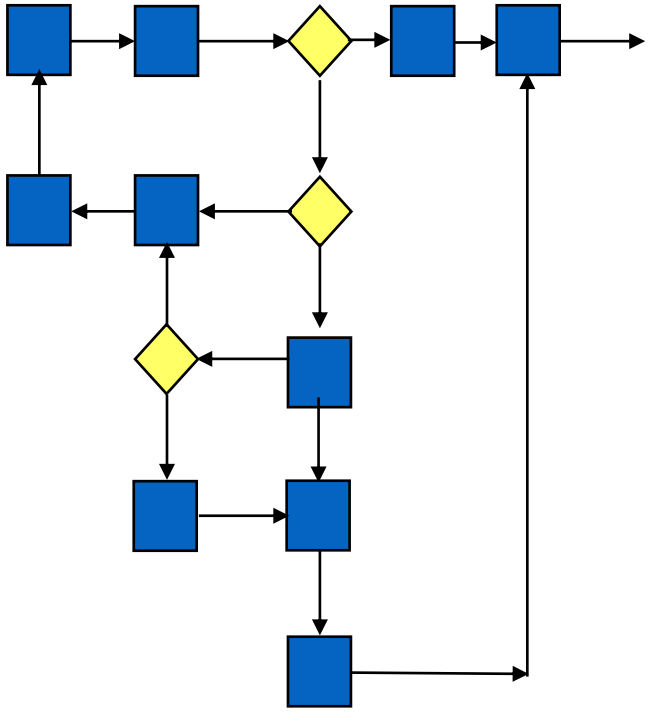
THE PROBLEM


Evidence
Incident
Fact
Problem
Reject
Error
Look for systemic issues
Issue
Incidents
Rejects
Errors
Facts
Facts
Evidence
Problems
Issues
Facts
Fact
Problem
Group observations
(i.e., facts, errors)
into problem categories
Problem 1
Problem 2
Problem 3

> YOU CAN'T MANAGE WHAT YOU DON'T MEASURE.
>
> - W. Edward Deming

UNDERSTANDING THE PROCESS

We must first understand the Process Flow
before Process Problems can be understood.

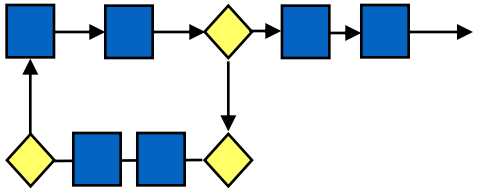


PROCESS MAPPING

There are usually 3 view of a process:

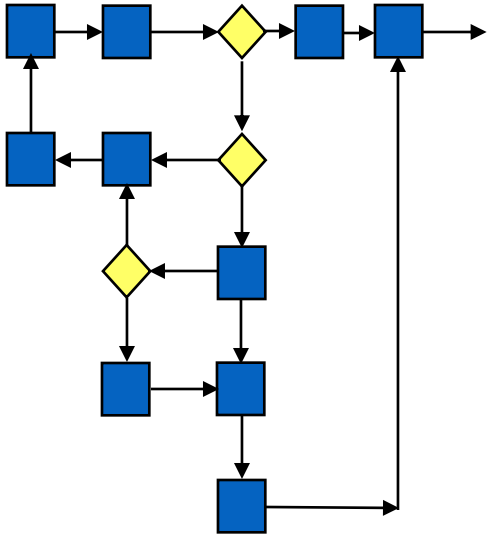
1

What people *THINK* it is..



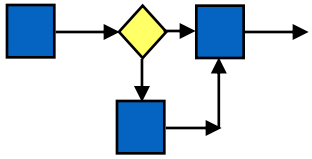
2

What it *ACTUALLY* is..



3

What it *SHOULD* be..



STANDARD PROCESS MAPPING SYMBOLS

Standard symbols for Process Mapping:

(available in Microsoft Office™, Visio™, iGrafx™ , SigmaFlow™ and other products)

A RECTANGLE *indicates an activity. Statements within the rectangle should begin with a verb*

A PARALLELAGRAM *shows that there are data*

A DIAMOND *signifies a decision point. Only two paths emerge from a decision point: No and Yes*

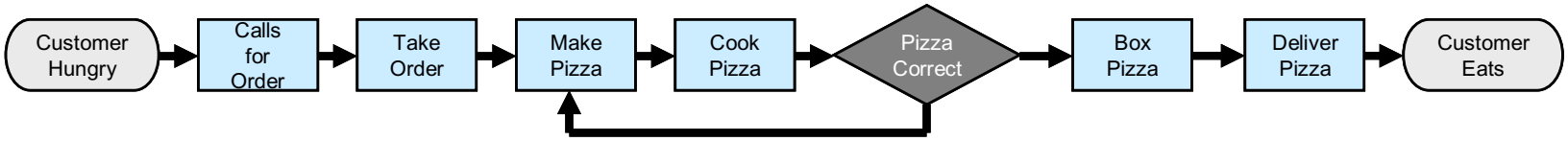
An ELLIPSE *shows the start and end of the process*

An ARROW *shows the connection and direction of flow*

A CIRCLE WITH A LETTER OR NUMBER INSIDE *symbolizes the continuation of a flowchart to another page*

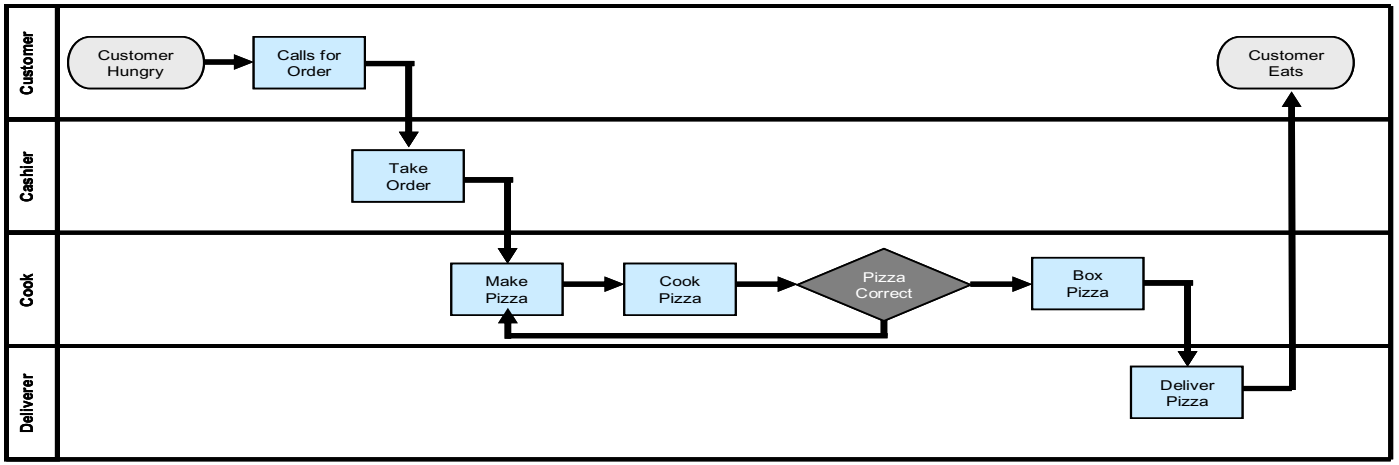
TYPES OF PROCESS MAPS

The Linear Flow Process Map



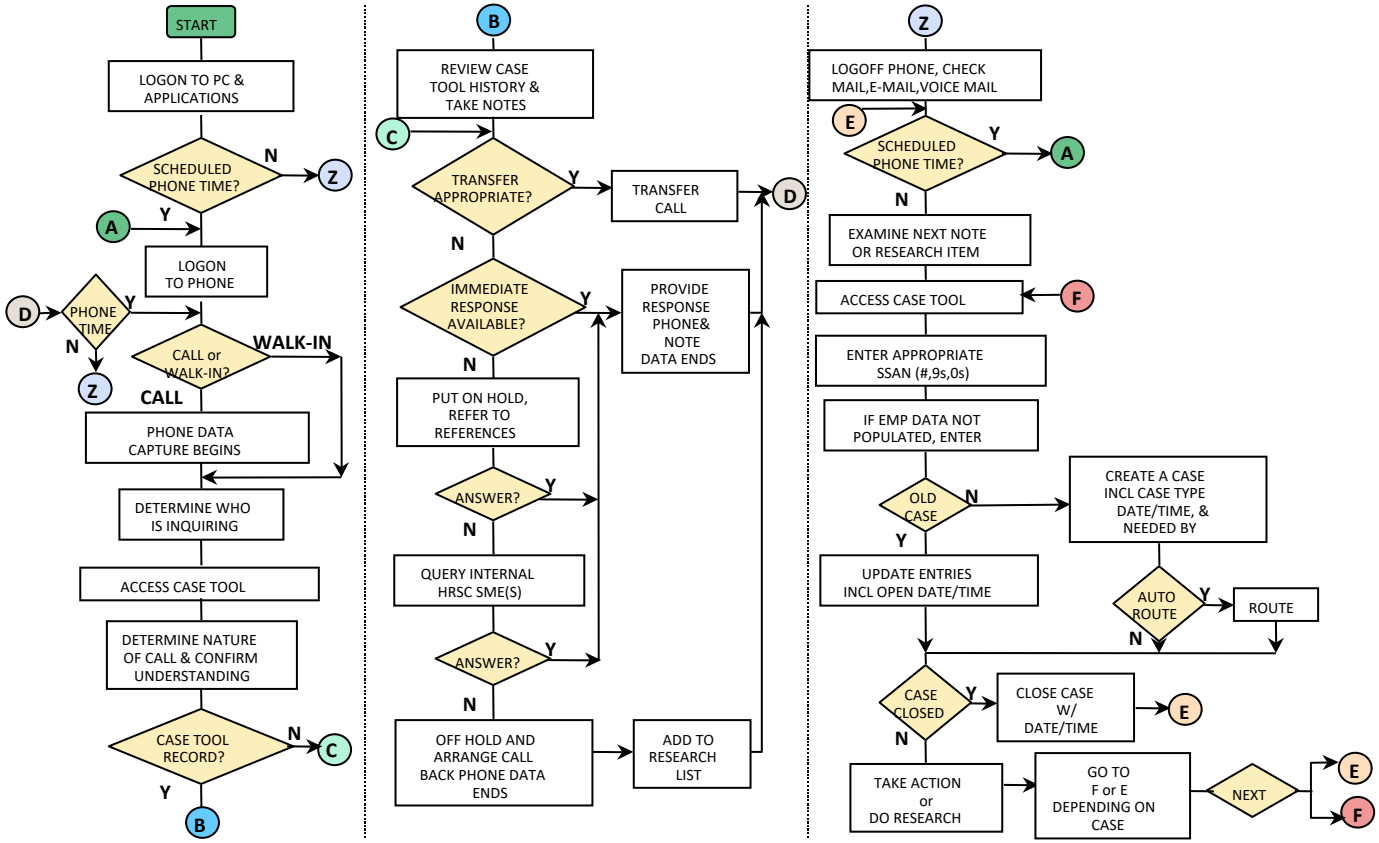
As the name states this diagram shows the process steps in a sequential flow, generally ordered from an upper left corner of the map towards the right side.

The Deployment-Flow or Swim Lane Process Map



The value of the Swim Lane Map is that is shows you who or which department is responsible for the steps in a process. A timeline can be added to show how long it takes each group to perform their work. Also each time work moves across a Swim Lane there is a "Supplier – Customer" interaction. This is usually where bottlenecks and queues form.

PROCESS MAP EXAMPLE



LEAN SOLUTIONS

PERFORMACE MEASURES

- Performance measures are the indicators used to see the difference between what is, and what should (or could) be.
- Established at each level of the organization.
- Often used to describe a problem condition.

MONITORING WITH SPC

Statistical Process Control (SPC):

- SPC is used for monitoring of a process to make sure it is ‘ in control’
- The most common method of SPC is a Control Chart
- SPC was first introduced in the 1930 by **Walter Shewhart** and then popularized in the 1960 and 1970 by **Joseph Juran** and was the basis of the Motorola ‘**Six Sigma**’ Quality program.

Control Charts

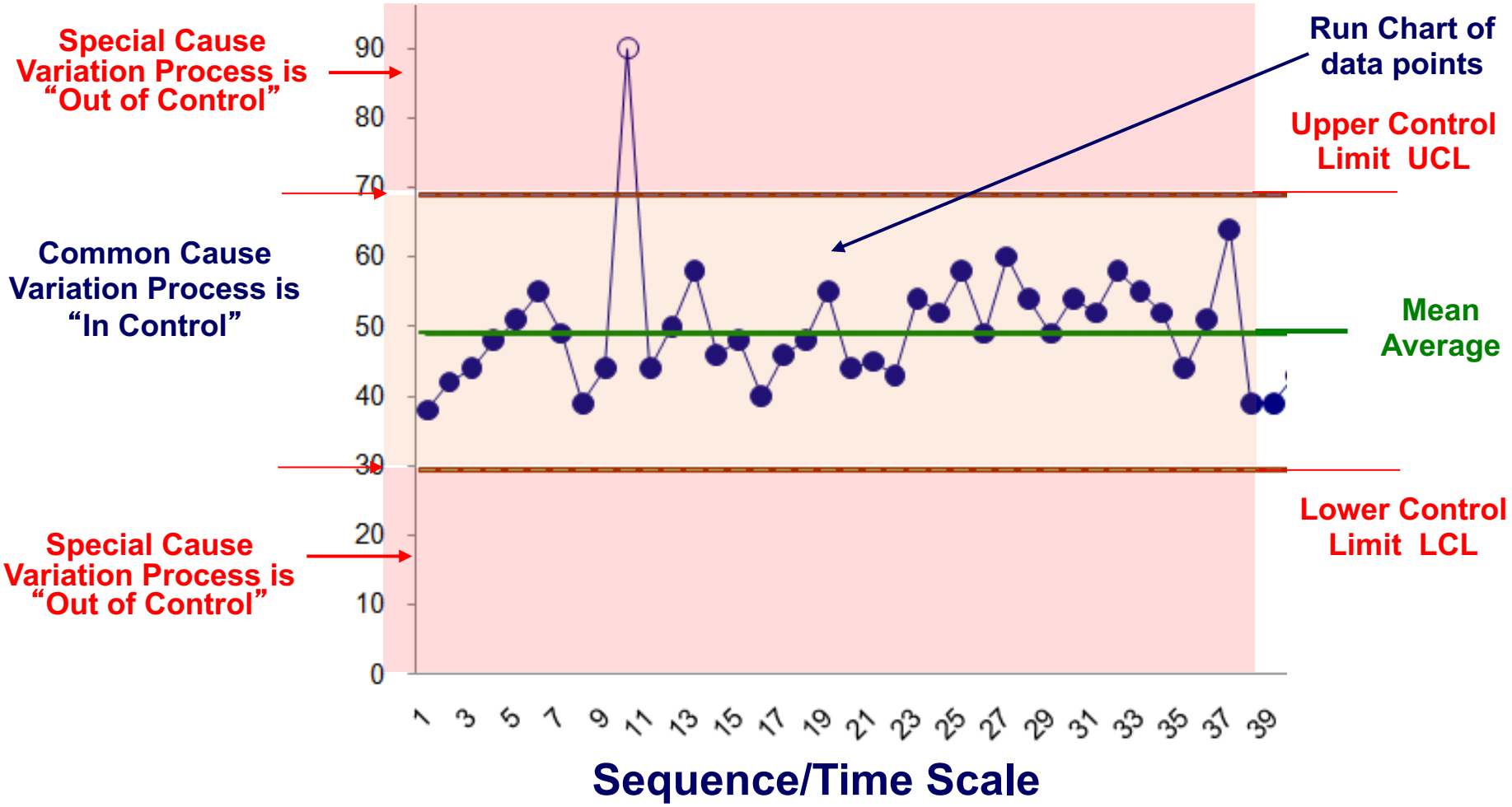
- **Control Charts indicate when a process is "out of control" or exhibiting Special Cause variation.**

- **Control Charts incorporate upper and lower Control Limits.**
  - **The limits are typically +/- 3 σ from the Center Line.**
  - **These limits represent 99.73% of natural variability for Normal Distributions.**

- **Use of Control Charts can be applied to all processes.**
  - **Services, manufacturing and retail are just a few industries with SPC applications.**

- **Control Limits are used to define the limits that the business is setting for the process.**
  - **Ideally Control Limits should be narrower than customer specs.**

CONTROL CHART



2 types of Variation shown on Control Chart

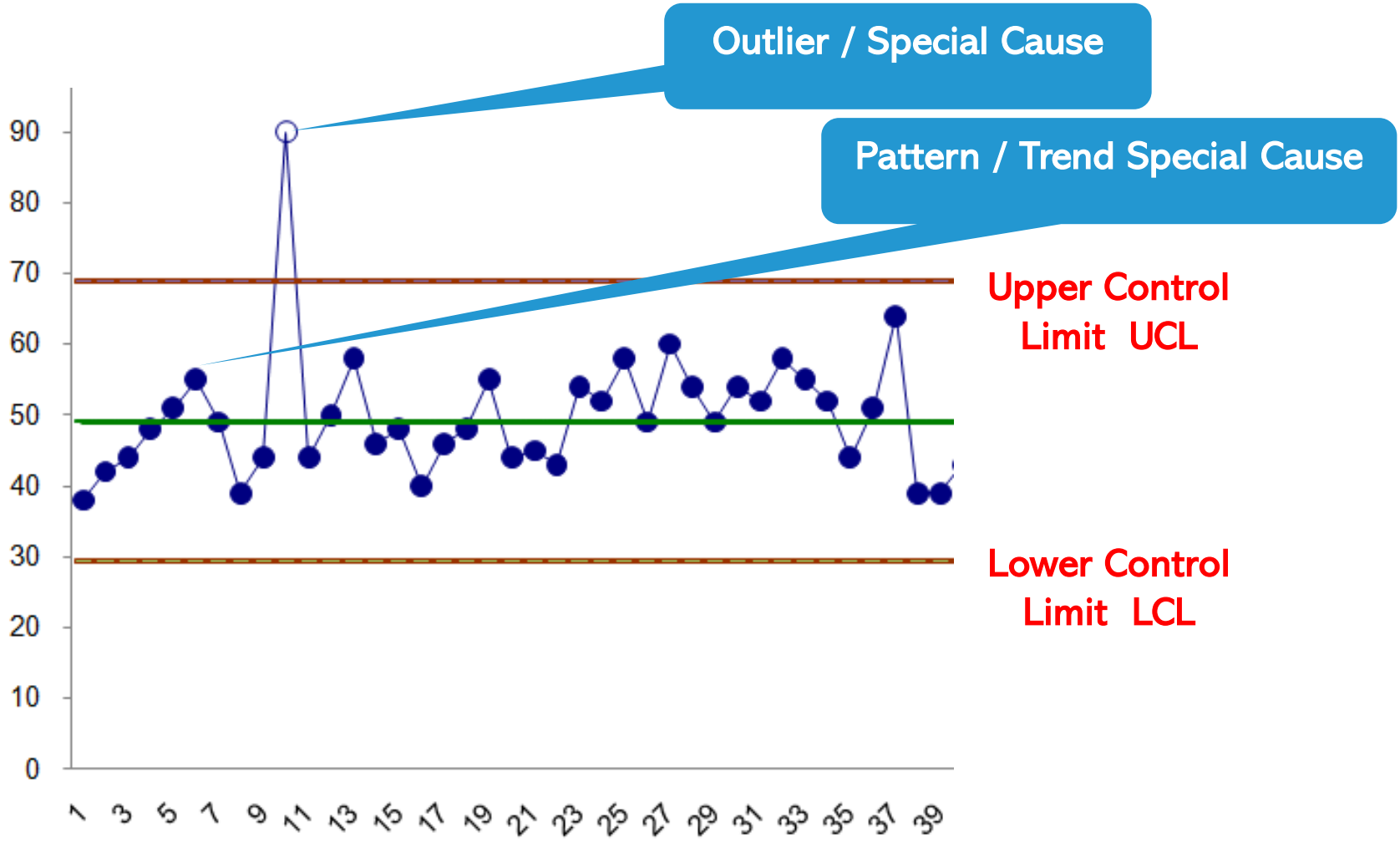
1. Common Cause Variation

Expected, natural and inherent in every process. Due to random small changes in the process inputs. Small changes in temperature, vibration, wait time or worker energy level are examples. 'Chronic' variation

2. Special Cause Variation / Assignable Cause Variation

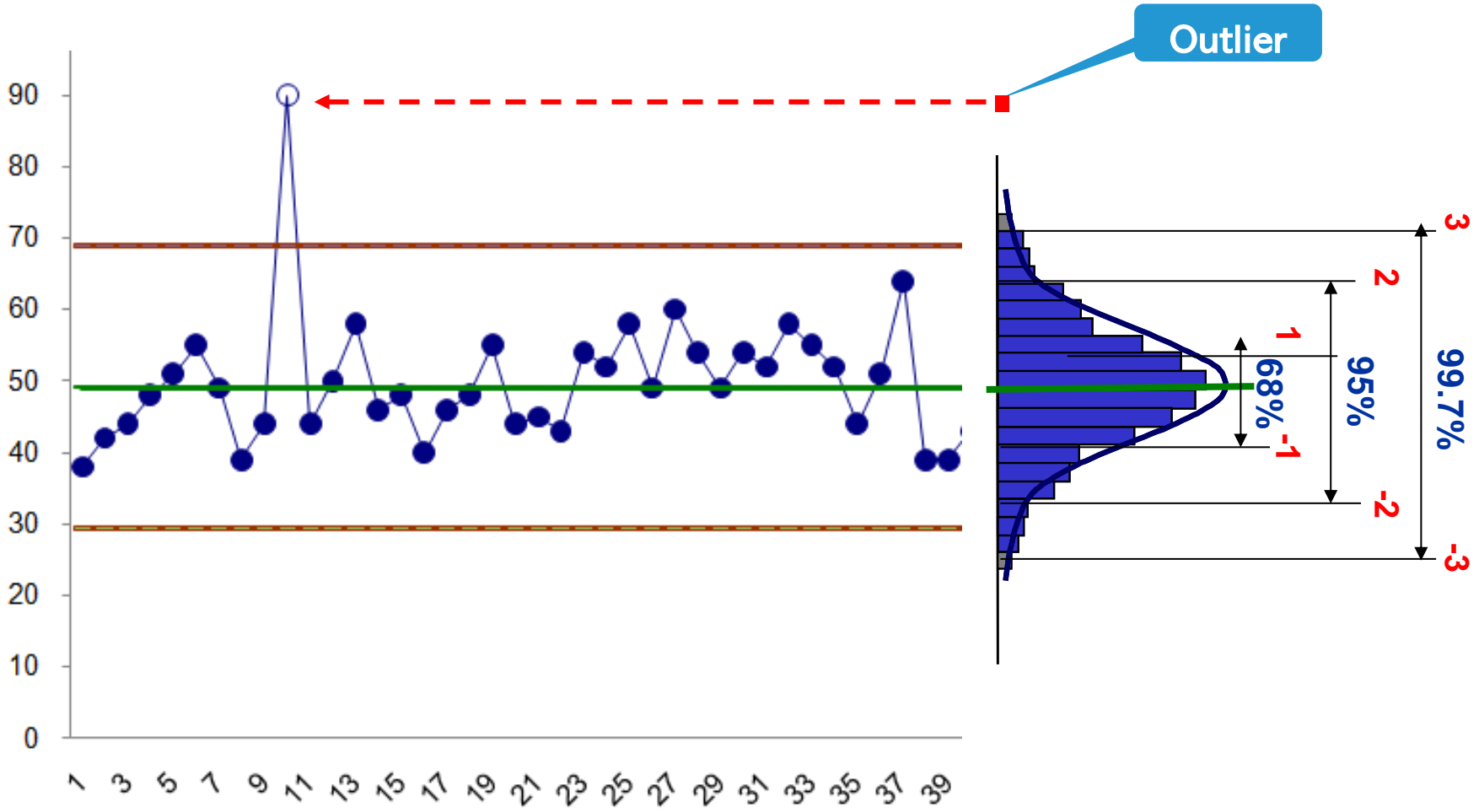
Unexpected, not part of the process. Often due to external influences out of our control such as accidents, mechanical or electrical failures. 'Sporadic' variation. Can be either an **'Outlier'** or an unusual **'Pattern or Trend'** in the data. See the 'Western Electric' tests for Special Causes.

CONTROL & OUT OF CONTROL



LEAN SOLUTIONS

CONTROL & OUT OF CONTROL



LEAN SOLUTIONS

Considerations when selecting a control chart

There are over 10 different types of Control Charts!

Many factors influence the choice of which control chart to use. These include:

1. The type of data being charted (Variable or Attribute)
2. The required sensitivity (size of the change to be detected) of the chart
3. The subgroup size / sample size
4. The ease and cost of sampling
5. Production volumes

Process Capability: Capability Studies

Capability Studies:

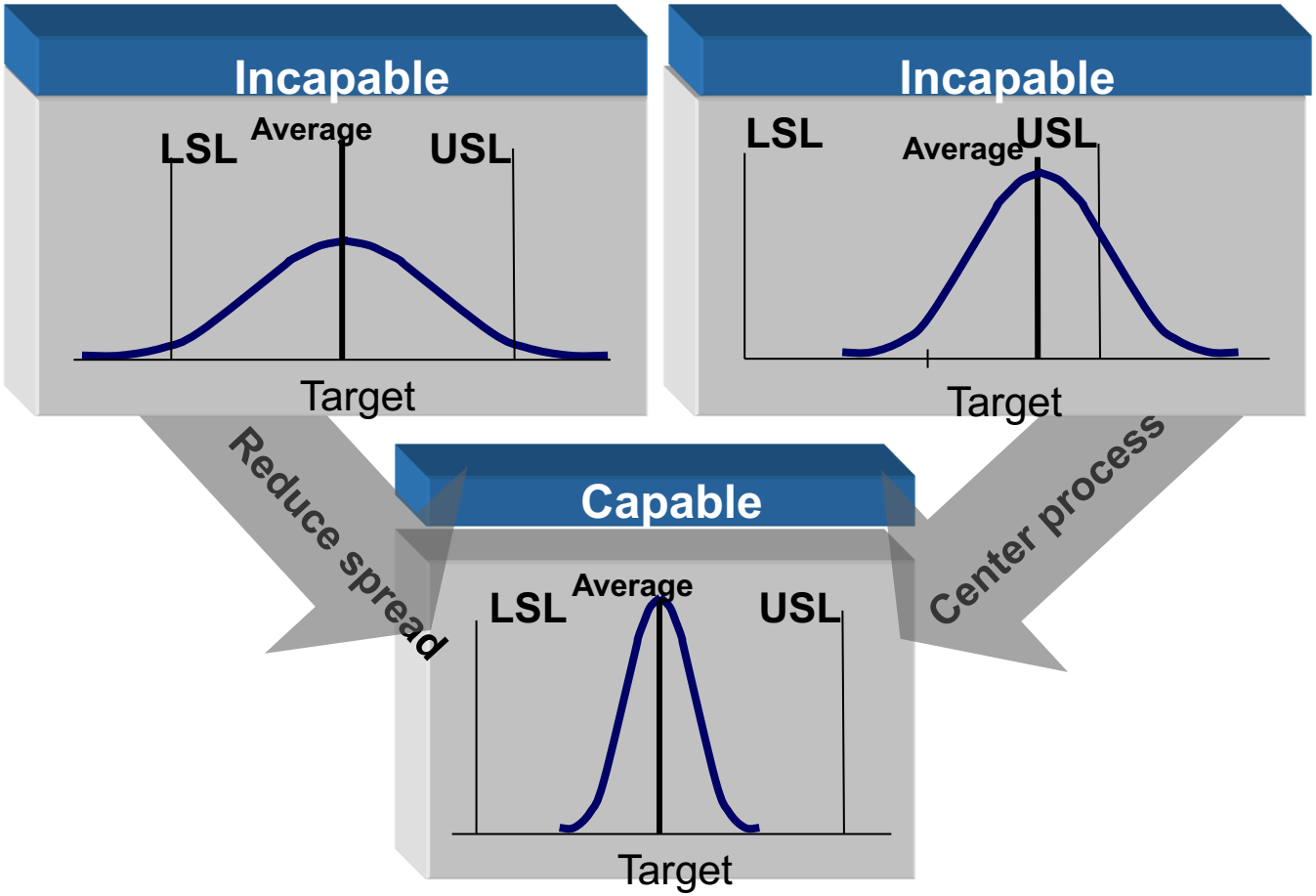
- Are intended to be regular, periodic, estimations of a process's ability to meet customer requirements.
- Can be conducted on both Variable (Quantitative) and Attribute (Yes or No) Data.
- Are most meaningful when conducted on stable, predictable processes.

Understanding Process Capability

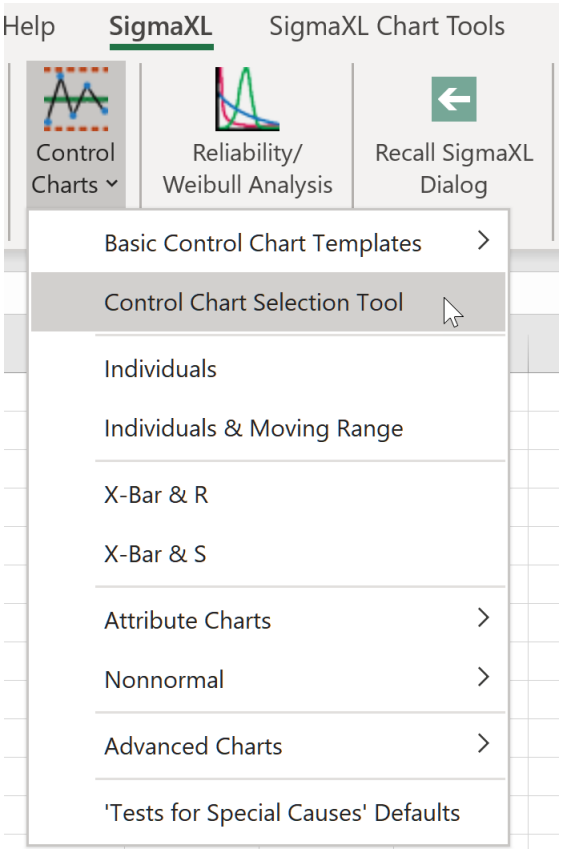
Process Capability / Process Performance :

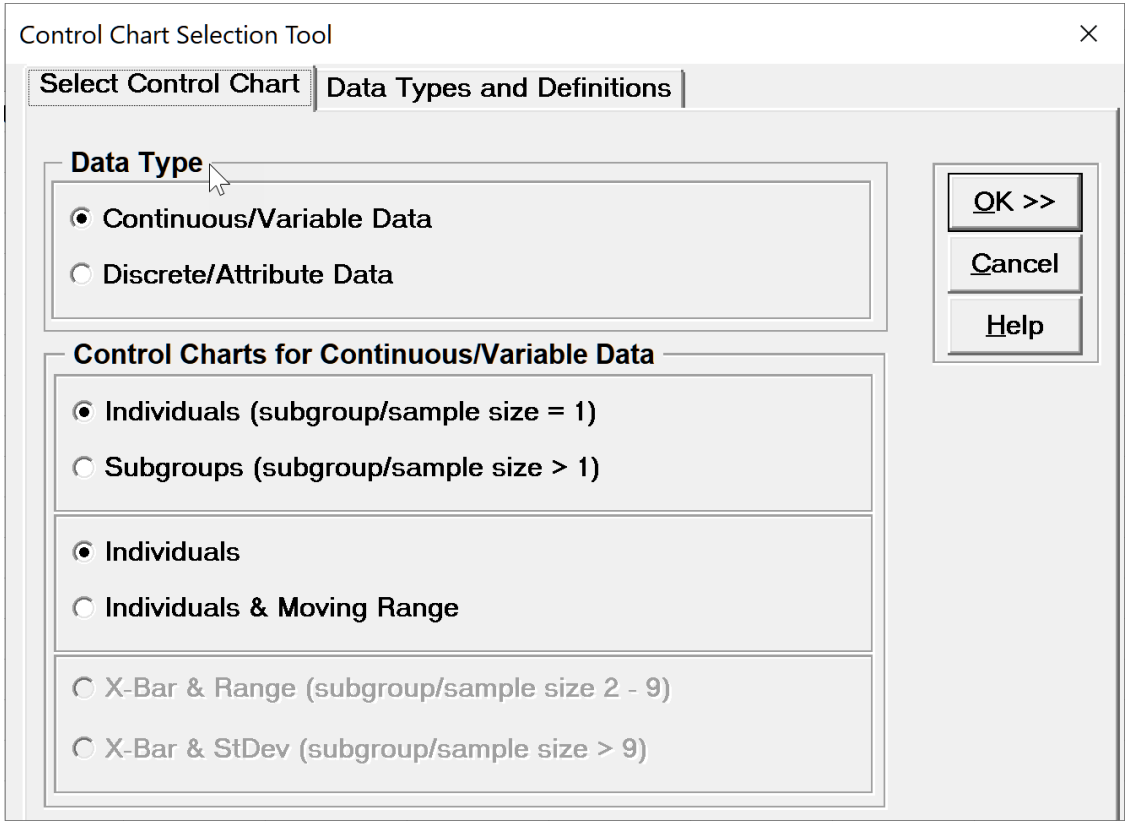
- **The ability of a process to meet the expectations of the customer**
- **Provides insight as to whether the process has a:**
  - **Centering Issue (relative to specification limits)**
  - **Variation Issue**
  - **A combination of Centering and Variation**
  - **Inappropriate specification limits**
- **Provides a baseline metric for improvement.**

Capability Defined



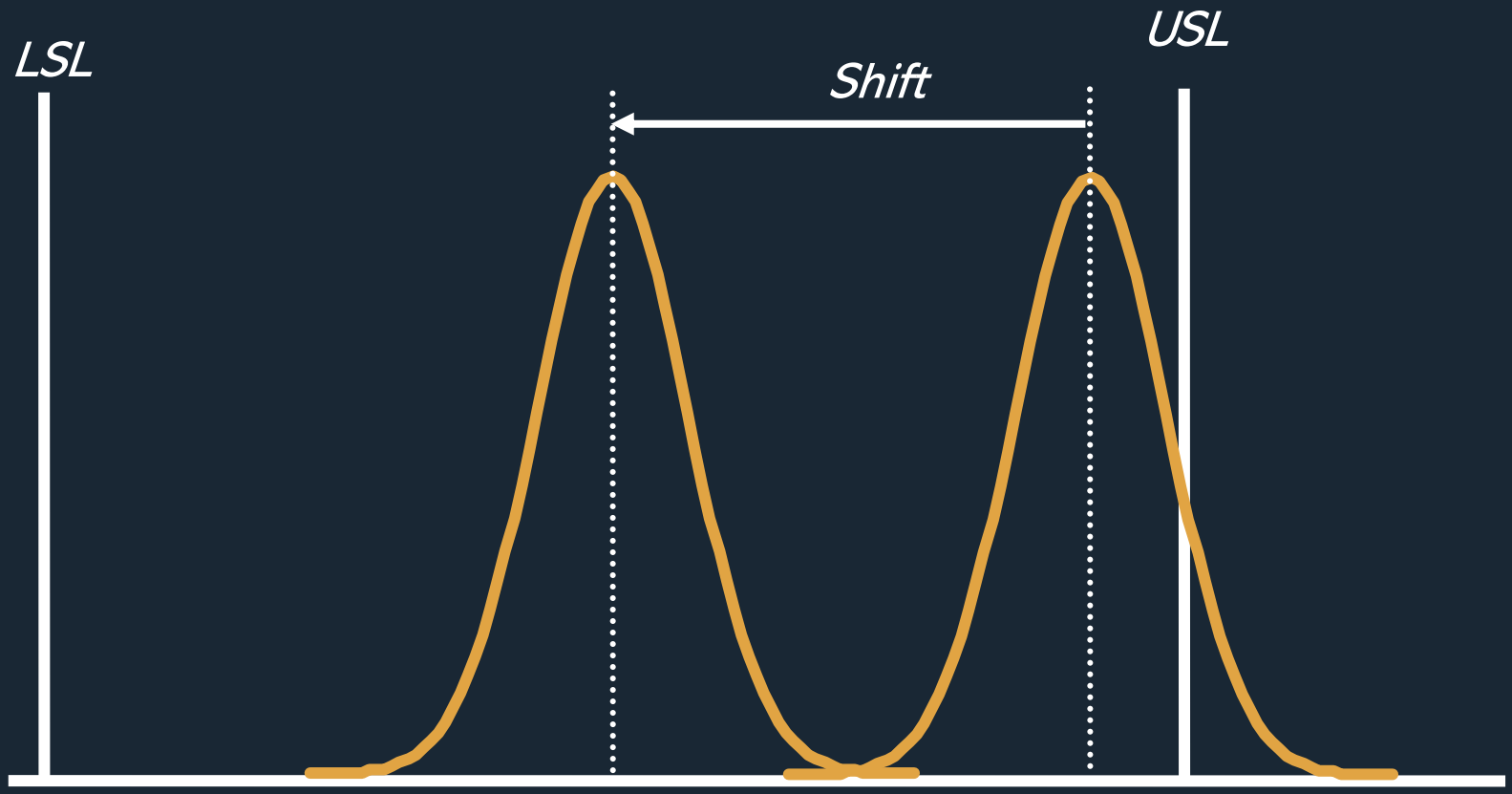
SIGMAXL CONTROL CHART
SELECTION TOOL





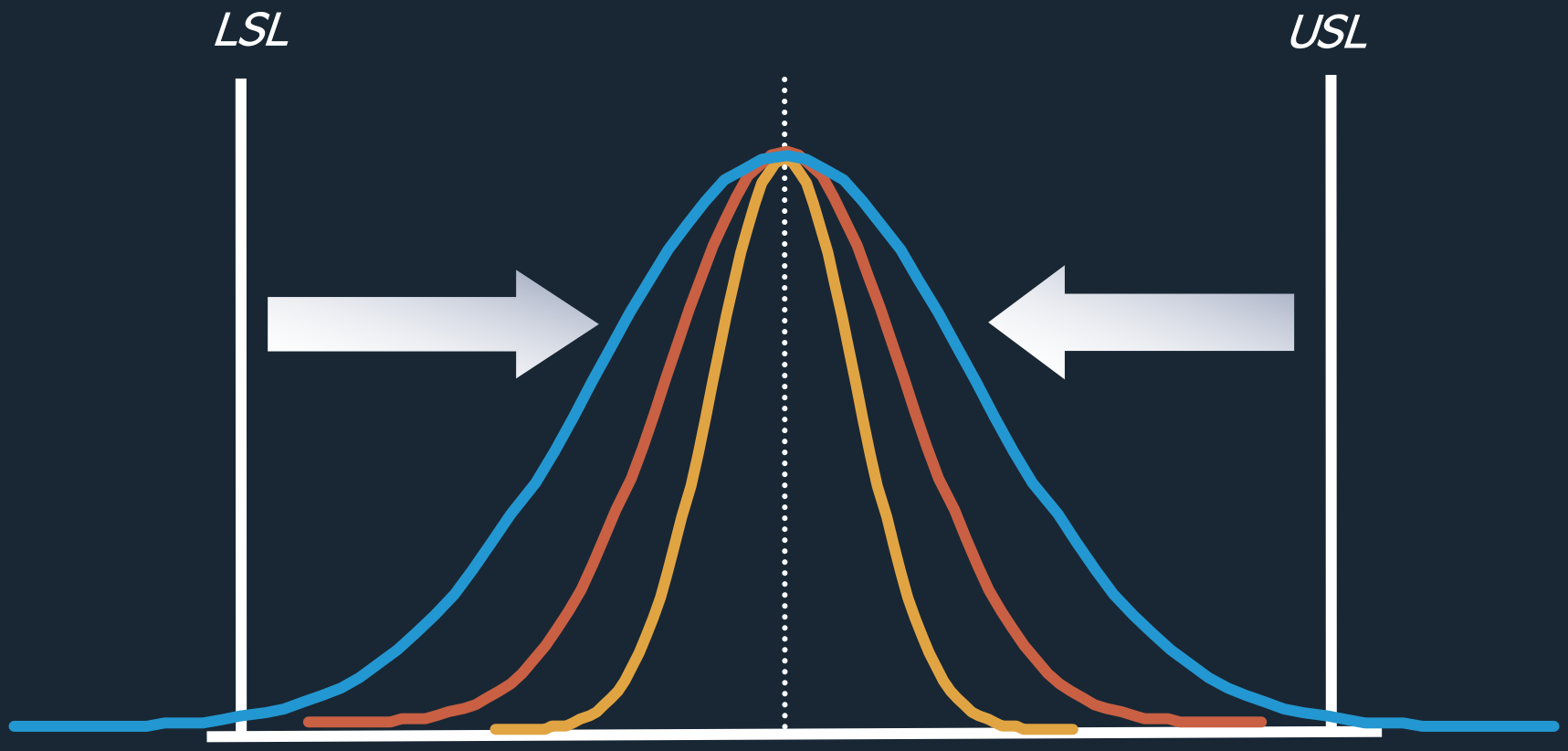
STEP 1 – SHIFT THE MEAN

This involves finding the variables that will shift the process to the target. This is what is done first.



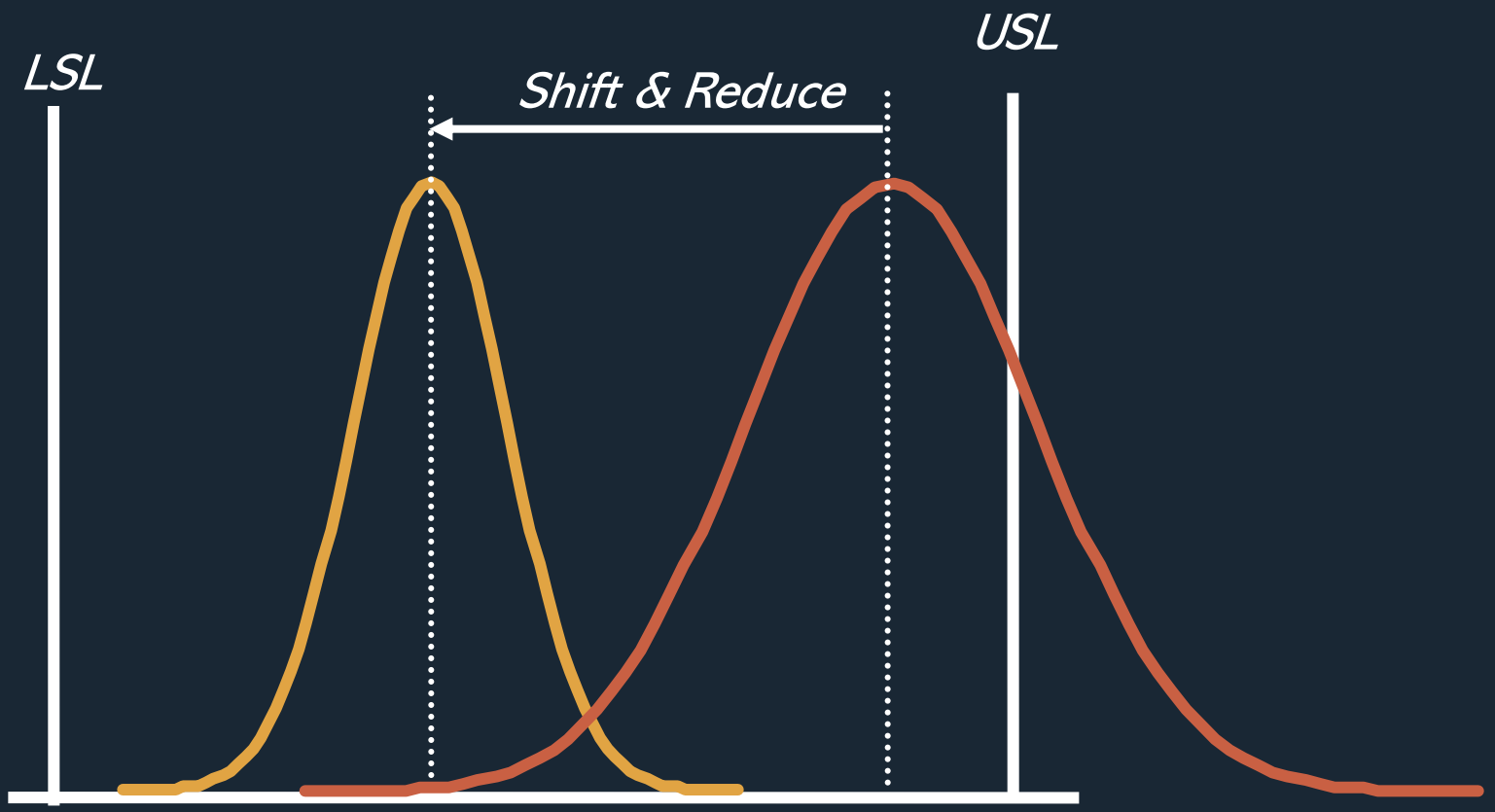
STEP 2 – REDUCE VARIATION

Reducing Variation is typically not so easy to accomplish and is a main focus of Six Sigma projects.



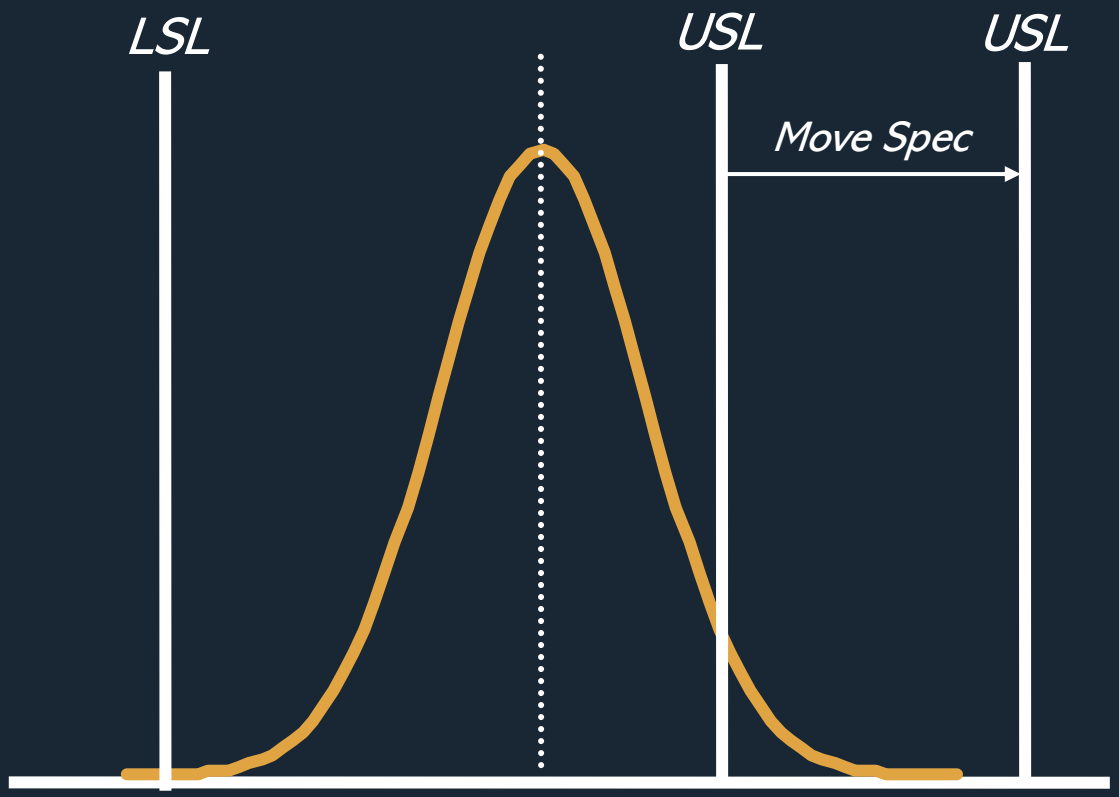
SHIFT MEAN & REDUCE VARIATION

This is the aim of most Six Sigma projects



MOVING CUSTOMER SPECIFICATION LIMITS

Customers usually do not go for this option but if they do…it is the easiest way to increase capability !



Remember, the Goal of the Measure Phase was to:

Evaluate the "As-Is" Capability of the Process.

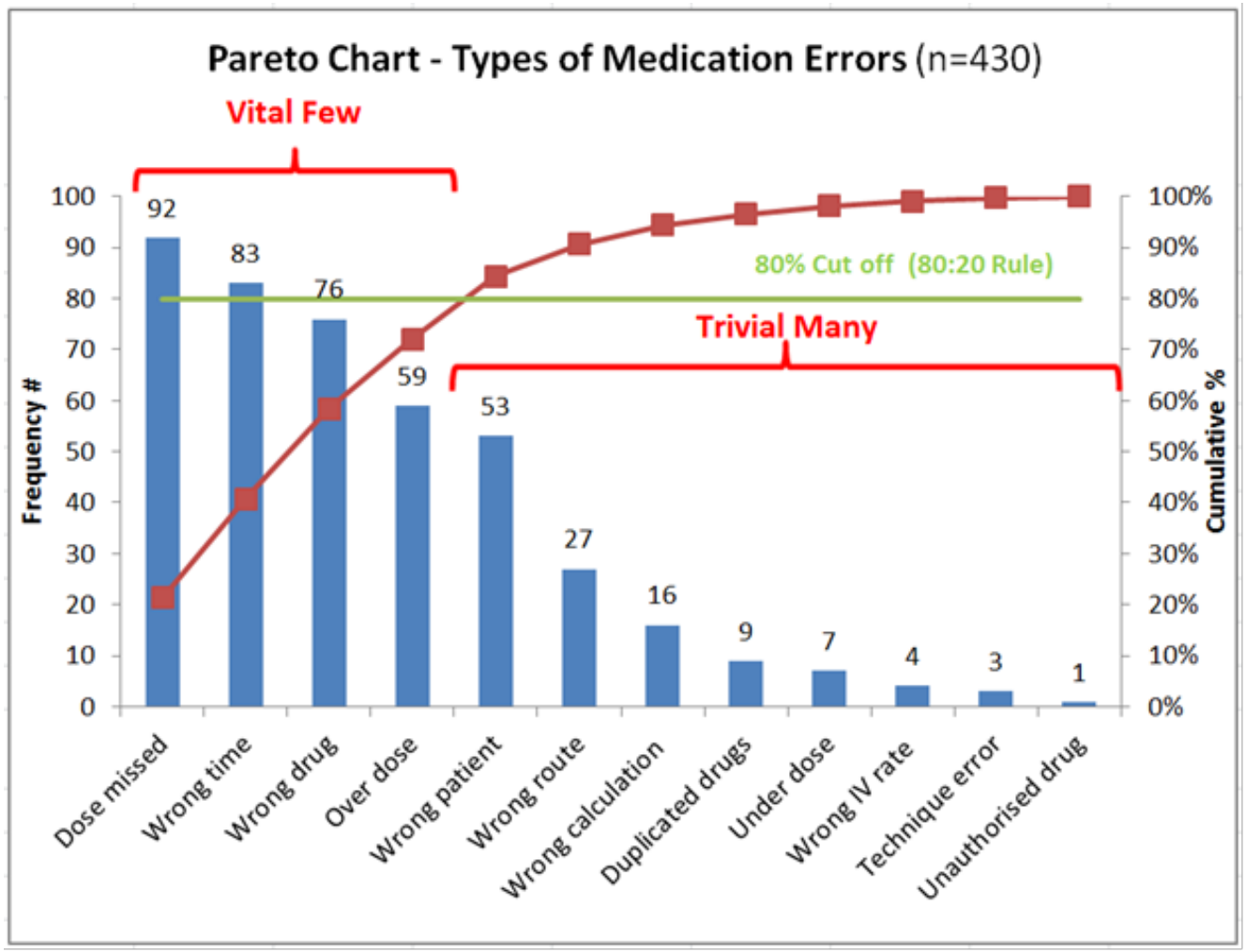
ANALYZE PHASE

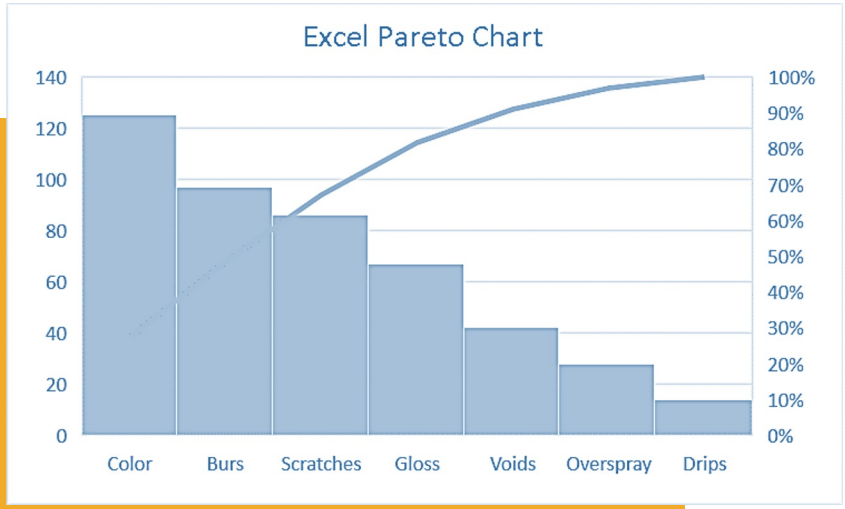
The Analyze Phase is

The Analyze Phase is for determining the ROOT CAUSE of the problem that we are trying to solve.

THE PARENTO PRINCIPLE

- The Pareto Principle was first developed in 1906 by Italian economist, Vilfredo Pareto, who observed that 20% of the population owned 80% of the wealth.
  - Also called the 80 : 20 rule.
- Joseph M. Juran adapted Pareto's economic observations to business applications.
- Juran stated that “80% of Defects in Process Outputs are as a result of 20% of the total Defective Process Inputs



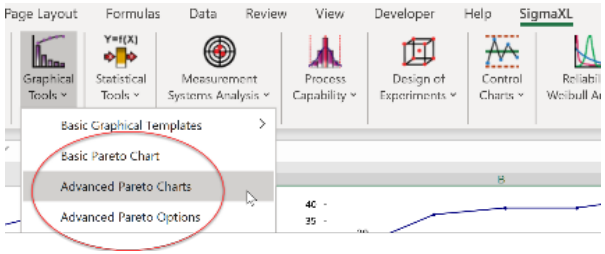


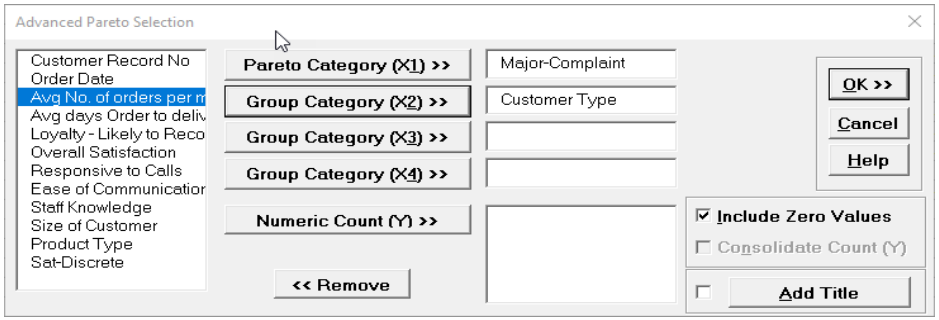
PARETO
CHART

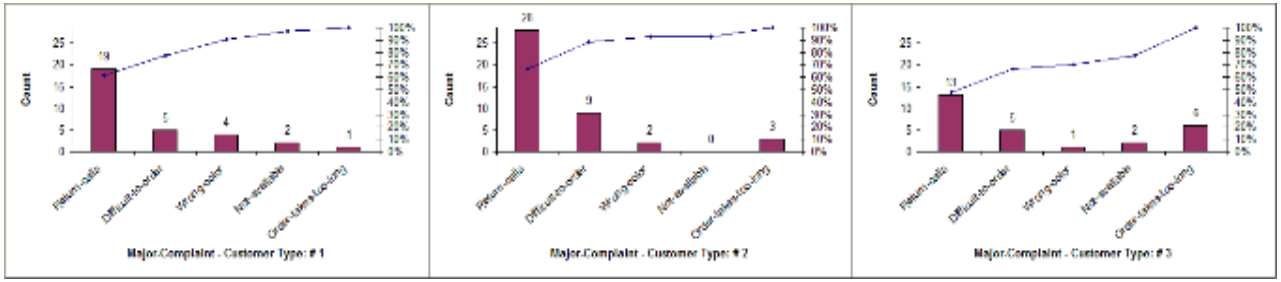
A Pareto Chart is a vertical bar graph in which values are plotted in descending order of frequency from left to right. This classifies problems and defects by type in the order of quantities and illustrates the cumulative percent total as a line graph.

The Pareto principle is also call the 80/20 rule because roughly 80% of the problems come from 20% of the causes.

SIGMAXL ADVANCED PARETO CHART EXAMPLE







SIGMAXL

Open SigmaXL on your computer…

- Open Excel and Click on SigmaXL
- Go to the ‘Help’ dropdown and click on sample data (choose ‘customer data’)
- Under SigmaXL, hover over Graphical Tools dropdown and click on Basic Pareto Chart
- Check the box for use entire data set, click next. Place ‘major complaint’ into pareto category.
- Finish.

PERFORMACE MEASURES

LEAN SOLUTIONS

DEFINE | MEASURE | ANALYZE | IMPROVE | CONTROL

Remember…
THE PROBLEM STATEMENT

Must include:

1. What is the problem?
2. When/Where are we seeing the problem?
3. What requirement is affected?
4. Who does it affect?

Should not:

1. Be more than one problem
2. Suggest a solution
3. Make assumptions

STEP 2

UNDERSTAND NEEDS & REQUIREMENTS

UNDERSTAND NEEDS & REQUIREMENTS

- Determine customer needs, requirements and expectations.
- Product and process requirements must be understood prior to efforts to improve or change them.
- Understand technical requirements.
- Determine mandatory criteria.
- Assess any potential risk.

FMEA (RISK ANALYSIS)

WHY CREATE A FMEA?

Failure Modes and Effects Analysis (FMEA)
is a methodology to manage…

RISK!!!

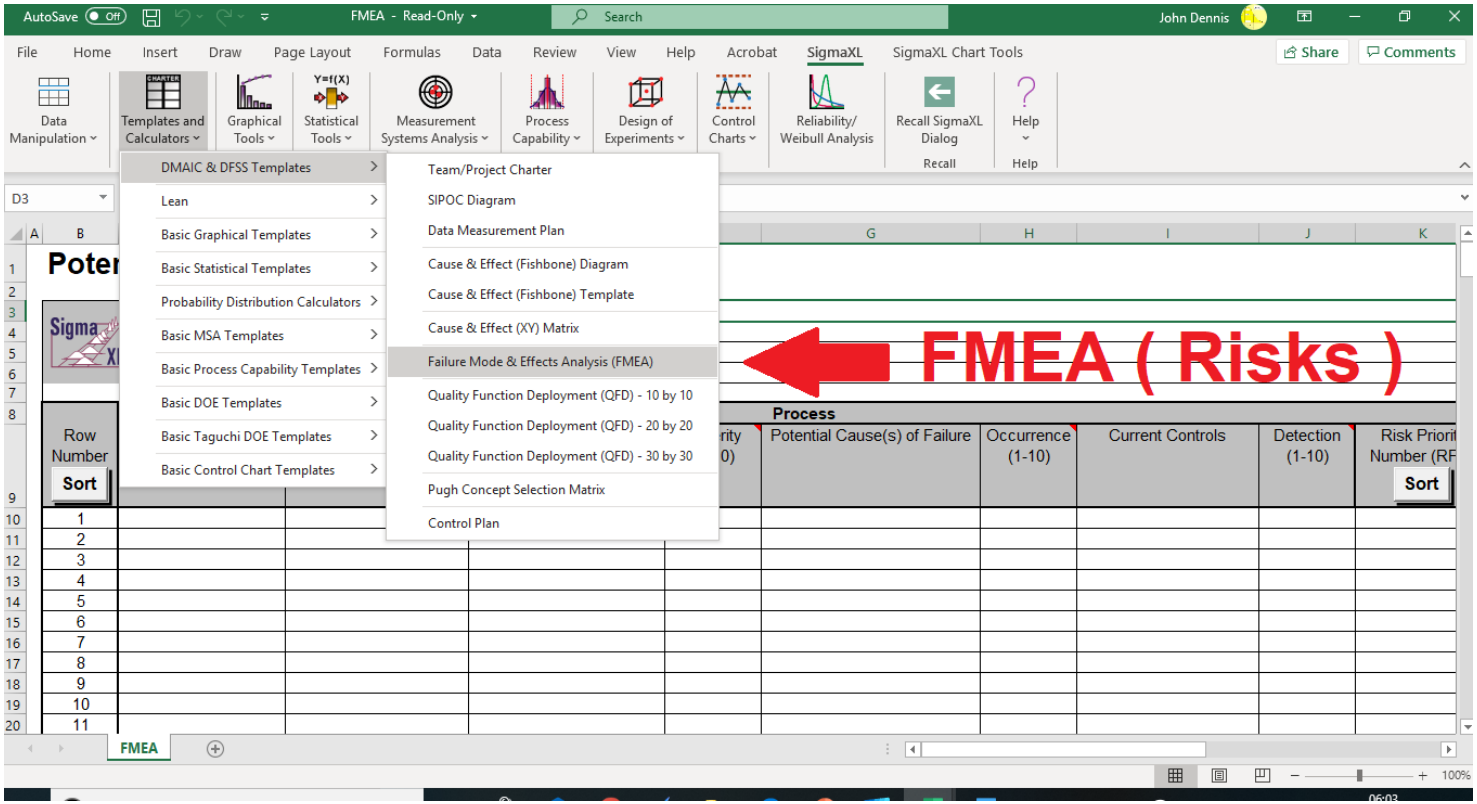
THE FMEA MATRIX

For a Process FMEA:

#	Process Function (Step)	Potential Failure Modes (process defects)	Potential Failure Effects (Y's)	SEV	Potential Causes of Failure (X's)	OCC	Current Process Controls	DET	RPN	Recommend Actions	Responsible Person & Target Date	Taken Actions	SEV	OCC	DET	RPN
1																
2																
3																
4																
5																
6																
7																
8																
9																

RPN = Risk Prioritization Number
SEV = Severity of the Failure
OCC = Probability of Occurrence of the Failure
DET = Difficulty to detect the Failure

Calculate RPN for your Business Risk if there was a new Lockdown in next 3 months for Covid19 that lasts more than 3 months ! Compare to RPN risk of a Financial Crash in Stock Market of more than 40% in next 3 months.



DEFINE | MEASURE | ANALYZE | IMPROVE | CONTROL

LEAN SOLUTIONS

STEP 3

USE A TEAM APPROACH

USING A TEAM APPROACH

Collaborate with cross-functional team members from various levels that have a vested interest in solving the problem.

Philosophy

- Problem-solving efforts should be fact-based
- The person doing the job is the probably the most knowledgeable about it.
- People want to be involved and want to do their jobs well.
- More is accomplished together.
- Greater success comes with a structured approach.
- Are there employees with undiscovered talents.

1

THE MARSHMALLOW CHALLENGE

PETER SKILLMAN

THE CHALLENGE

Build the Tallest Free-Standing Structure

20 Sticks of spaghetti

1 yard tape

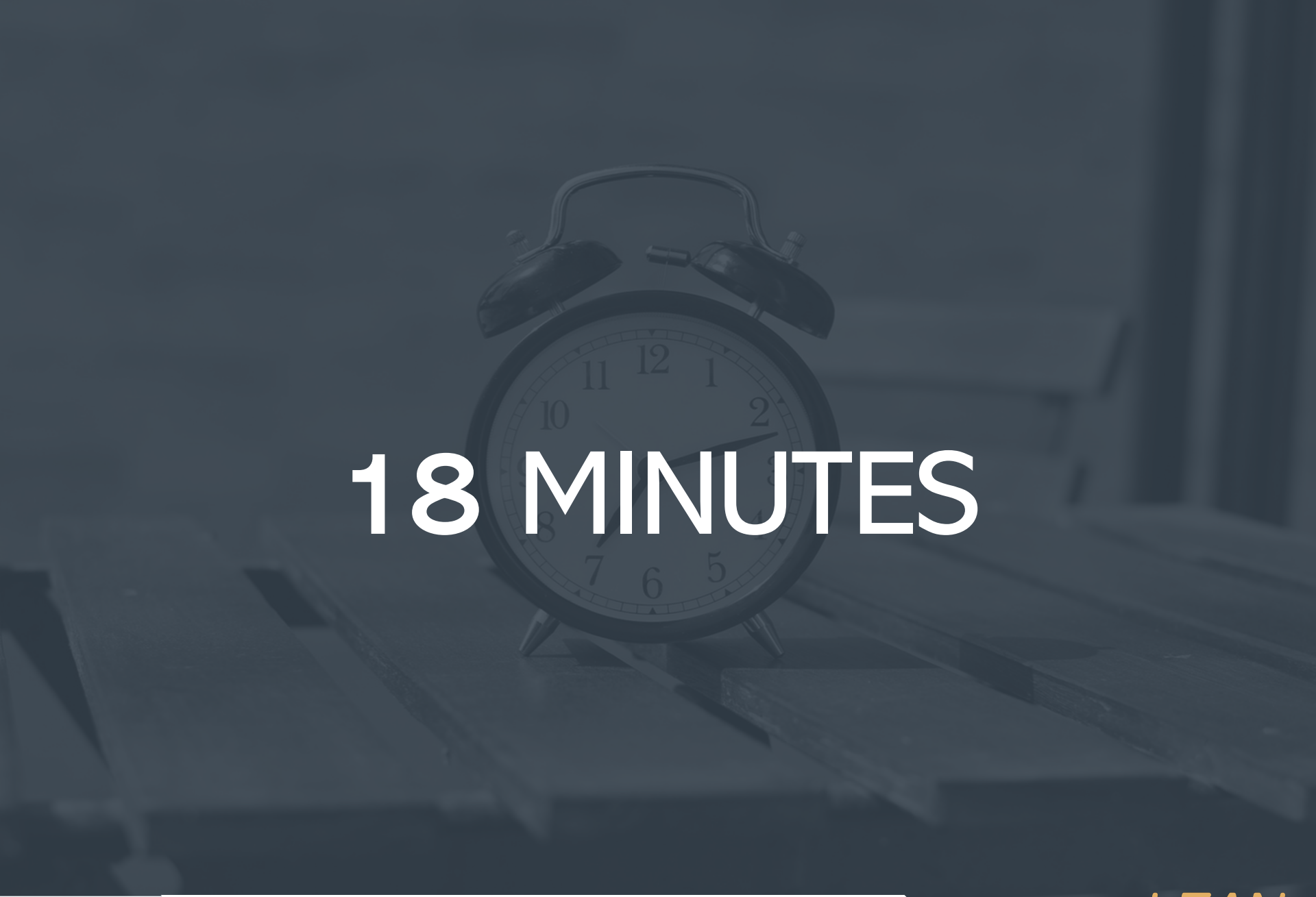
1 yard string

One marshmallow

THE KIT

THE RULES

1. Build The Tallest Freestanding Structure
2. The Entire Marshmallow Must Be On Top
3. Use As Much Or Little Of Kit As You Want
4. Break Spaghetti, Cut Yarn As You Wish
5. May Not Hold Structure Up


18 MINUTES

Was Your Team

SUCCESSFUL

In Building A Free-standing Structure?

WHY OR WHY NOT?

Would you do anything

DIFFERENTLY

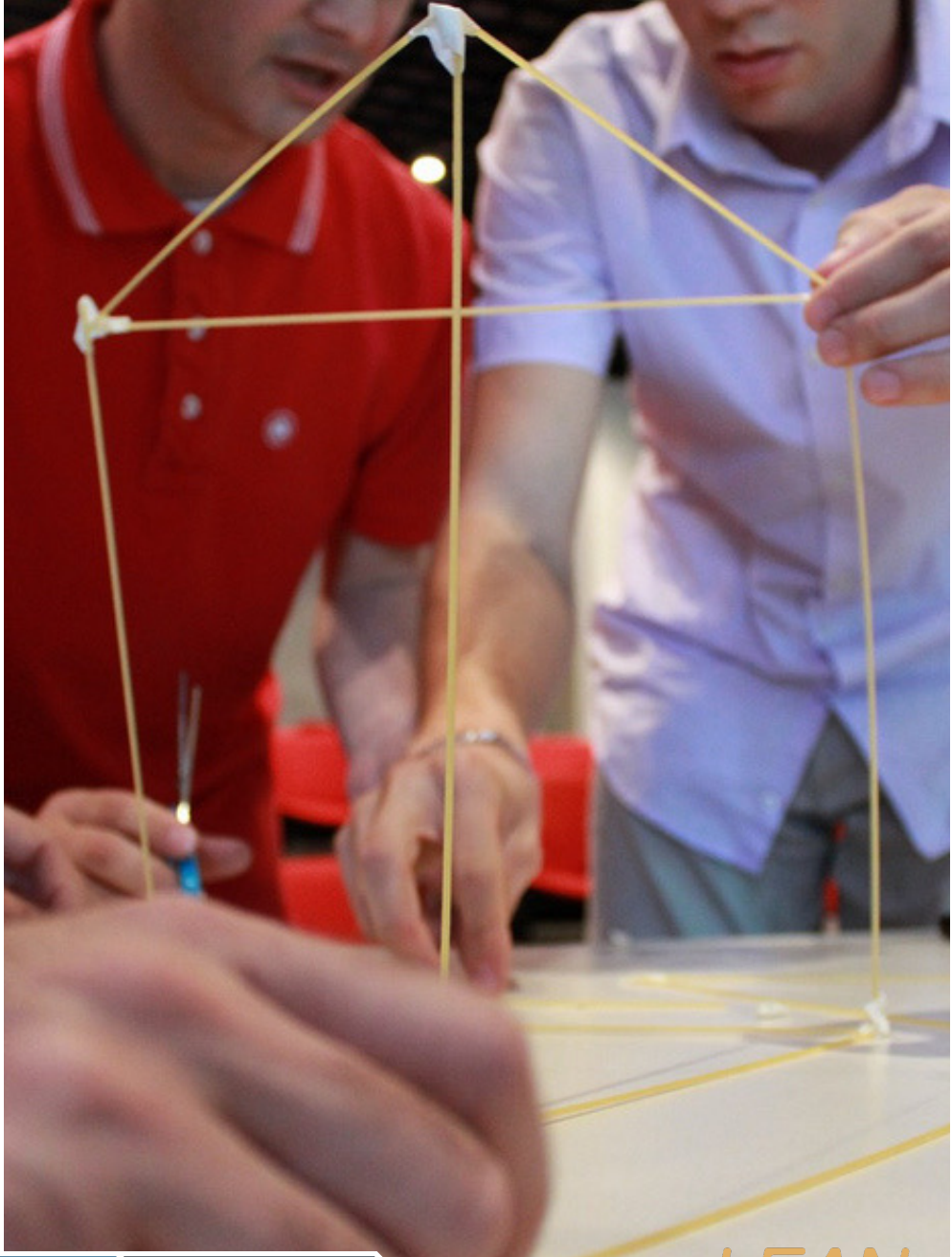
If you could do it over again?

DEFINE | MEASURE | ANALYZE | IMPROVE | CONTROL

LEAN SOLUTIONS

Be honest…How well did You work as a

TEAM?



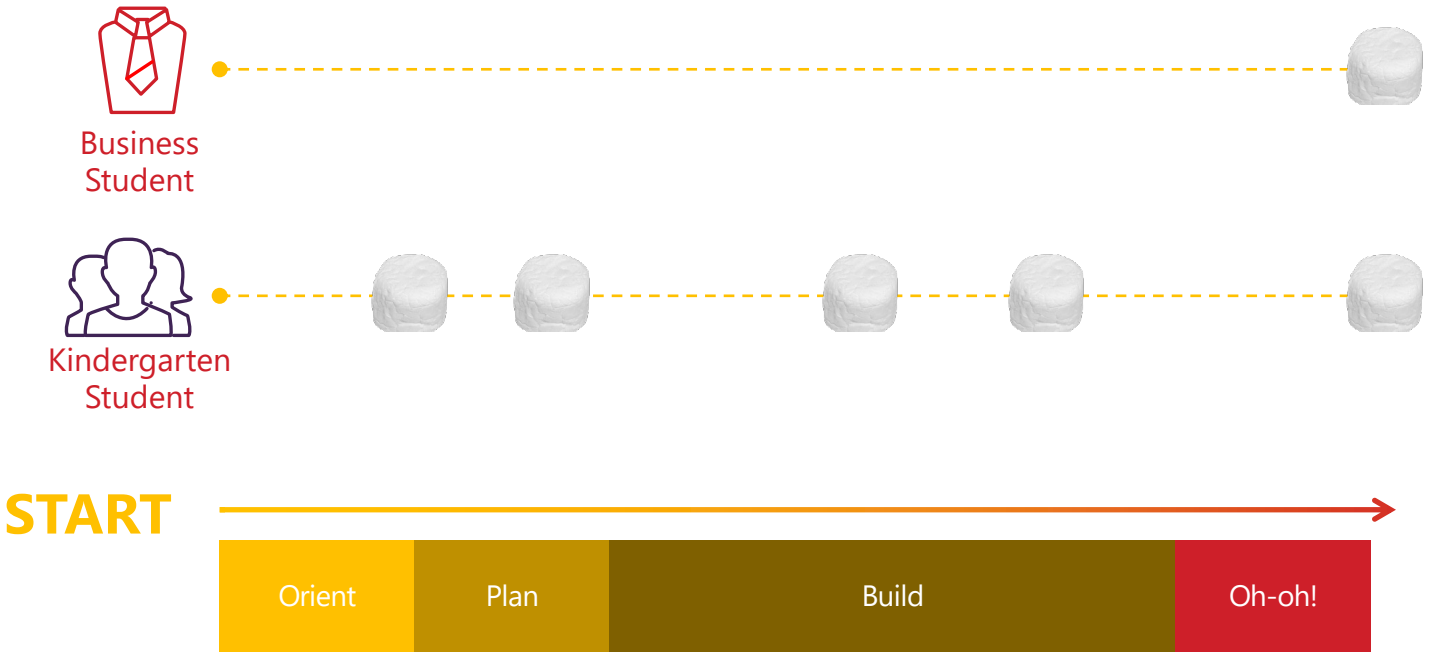
WHO CONSISTENTLY PERFORMS POORLY?

RECENT BUSINESS SCHOOL GRADUATES

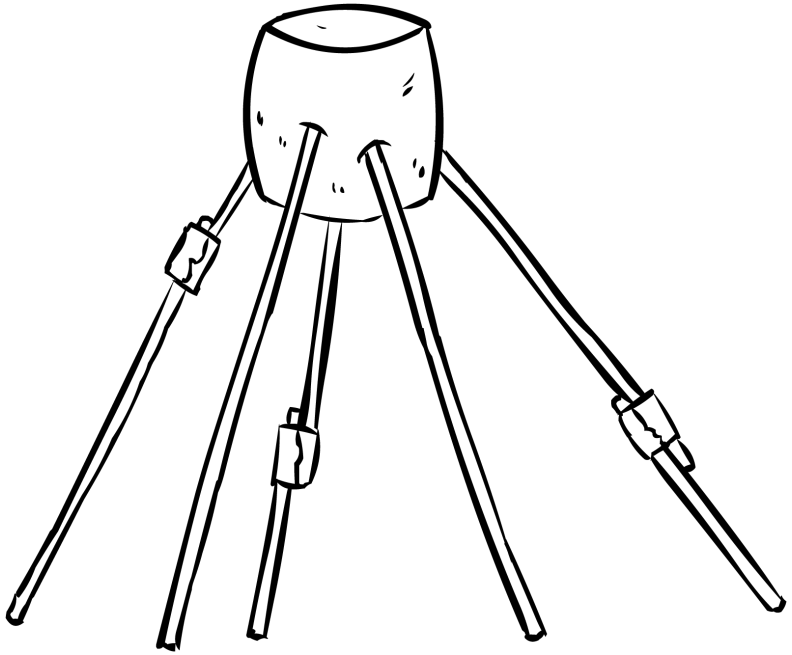
WHO CONSISTENTLY PERFORMS WELL?

RECENT KINDERGARTEN SCHOOL GRADUATES

TYPICAL PROGRESS



SIMPLE ACTIVITY, DEEP LESSON

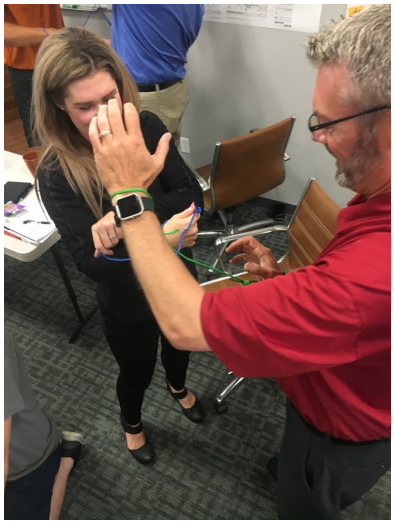


PROBLEM SOLVING LESSONS

- ✓ Use a Team Approach – Collaborate Quickly!
- ✓ Diversified Skills Matter
- ✓ Use Rapid PDCA Cycles (Prototyping Matters)
- ✓ Drive out Hidden Assumptions with PDCA Cycles

PROBLEM SOLVING:
PRODUCT INNOVATION RED CUP CHALLENGE

CONFLICT RESOLUTION:
PAPER RINGS



CREATIVE THINKING:
INFINITE LOOPS

COMMUNICATION:
BACK-TO-BACK

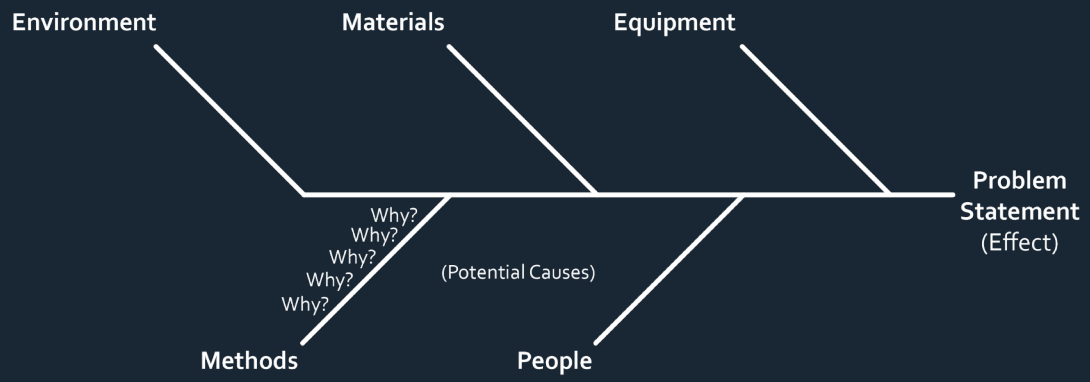
TEAM BUILDING:
PAPER CHALLENGE

STEP 4

IDENTIFY POTENTIAL CAUSES

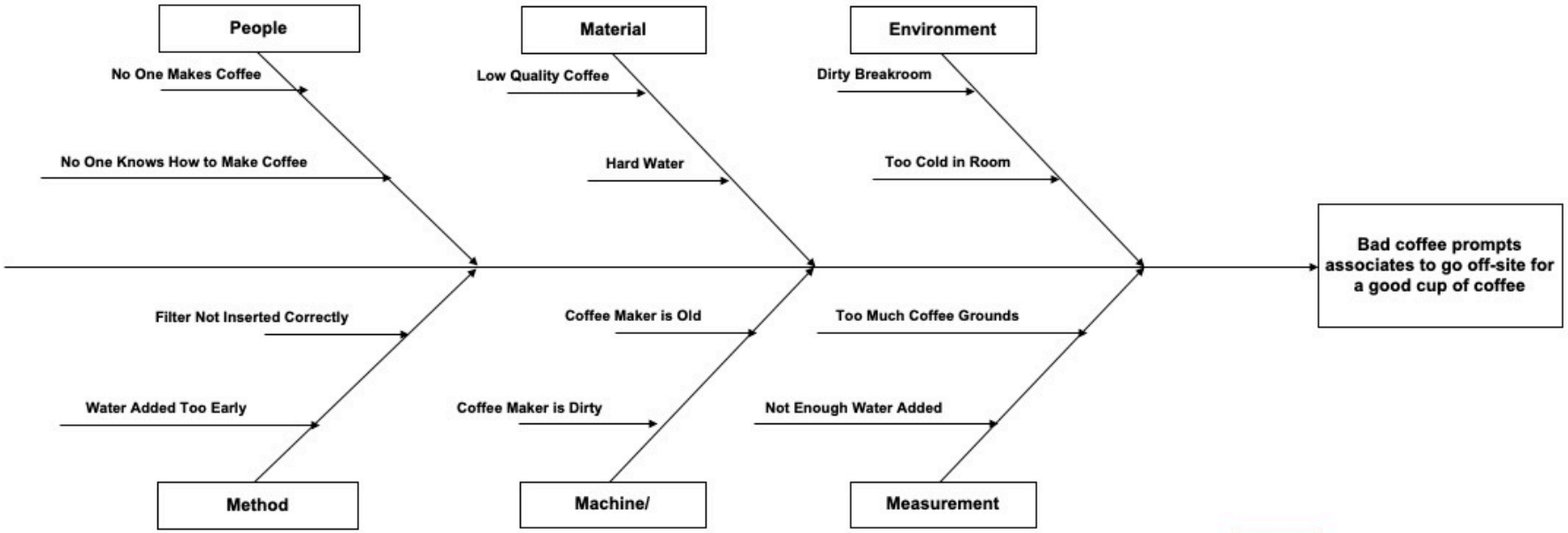
CAUSE & EFFECT DIAGRAM

- Using a Cause & Effect Diagram, consider potential causes in each category.
- Ask "Why?"
- Use branches, stems, and twigs on the diagram to display each response.



CAUSE & EFFECT (FISHBONE) DIAGRAM

Process/Project Name:	A Better Cup Of Coffee
Date:	xx-xx-xx
Prepared By:	Craig T.
Notes:	Brainstorming Session

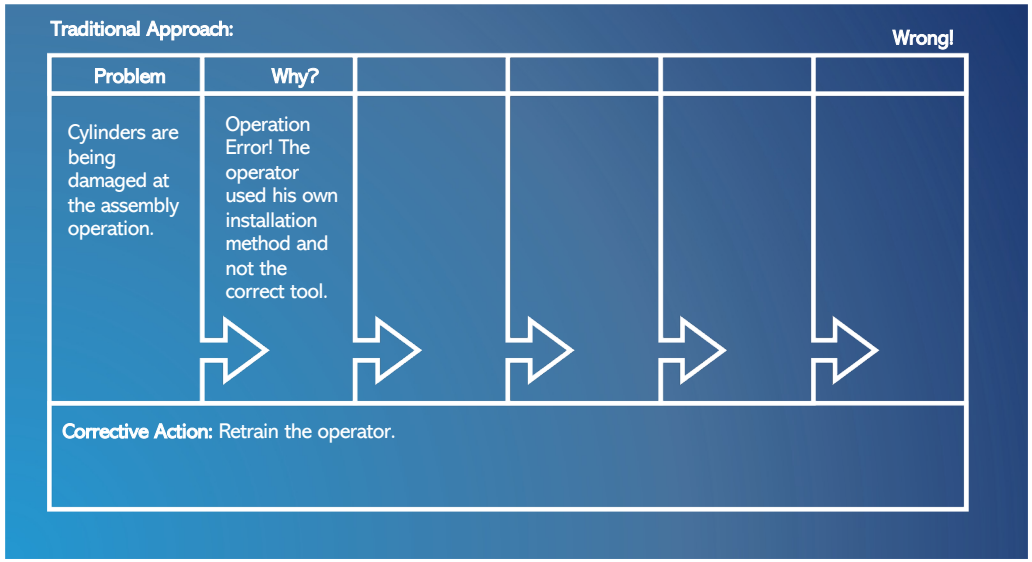


Notes:
1. Overwrite the text in the Cause, Sub-Cause and Problem Statement/Effect as appropriate.
2. Use copy and paste to create additional causes or sub-causes.
3. The arrows with text are grouped. To ungroup use Excel's Draw > Ungroup tool.

In the last 4 days, our coffee maker produced 100% of the coffee with a terrible bitter taste, which my wife and I disliked.

WHERE DO I START

CLUSTERING METHOG + N/3 METHOD

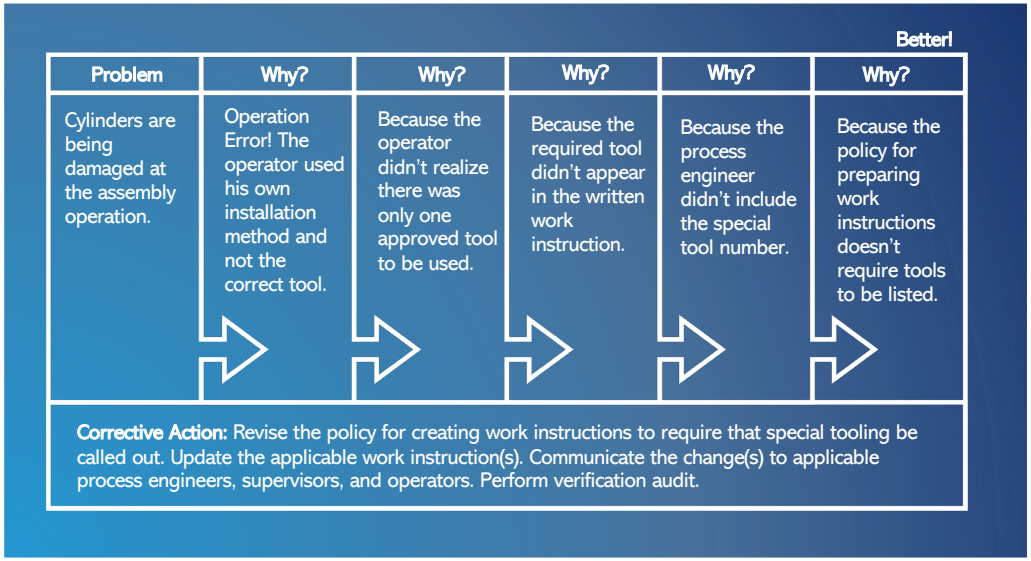


One of the most effective tools in determining root cause is to simply keep asking why something occurs/happened.

The traditional approach usually jumps to a quick conclusion which often results in repeat occurrences of the same or similar kind.

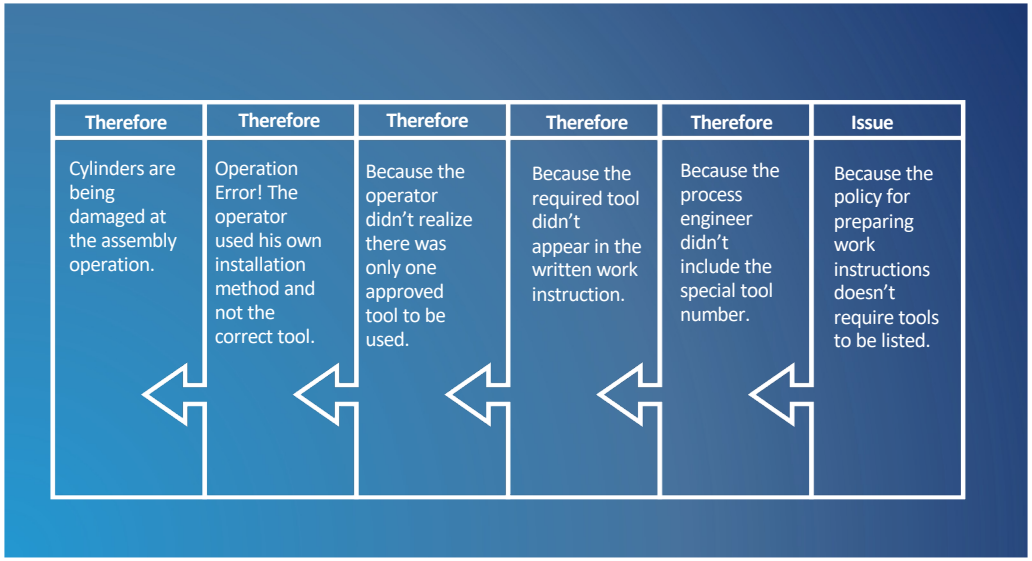
5 WHY ANALYSIS

On the other hand, continually asking ‘why?’ generally gets to the underlying root causes



THEREFORE TEST

After you reach the potential root cause using the “5 why’s”, check the rationale using the “therefore test” to verify the resulting cause/effect relationship. Does it make sense?



5-Why Example

Space for additional "5 Why?" Analysis ***(optional, continuing from front page section 4.D)***:

Cause Idea: ← Why this?	Cause Idea: ← Why this?	Cause Idea: ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Root Cause: ☐ Verified	Root Cause: ☐ Verified	Root Cause: ☐ Verified

Cause Idea: ← Why this?	Cause Idea: ← Why this?	Cause Idea: ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Answer → ← Why this?	Answer → ← Why this?	Answer → ← Why this?
Root Cause: ☐ Verified	Root Cause: ☐ Verified	Root Cause: ☐ Verified

QUIZ 2:

1. How do you calculate Takt Time?
   - **EFFECTIVE WORKING TIME PER TIME PERIOD / CUSTOMER DEMAND PER TIME PERIOD**

2. What is the difference between special cause and common cause variation?
   - **COMMON CAUSE IS EXPECTED WHILE SPECIAL CAUSE IS UNEXPECTED.**

3. What is the goal of the measurement phase?
   - **EVALUATE THE "AS-IS" CAPABILITY OF THE PROCESS**

LEAN SOLUTIONS

HOMEWORK REVIEW

(Open Computers and Log into your Portal)

LEAN SOLUTIONS

END OF DAY 1

LEAN SOLUTIONS