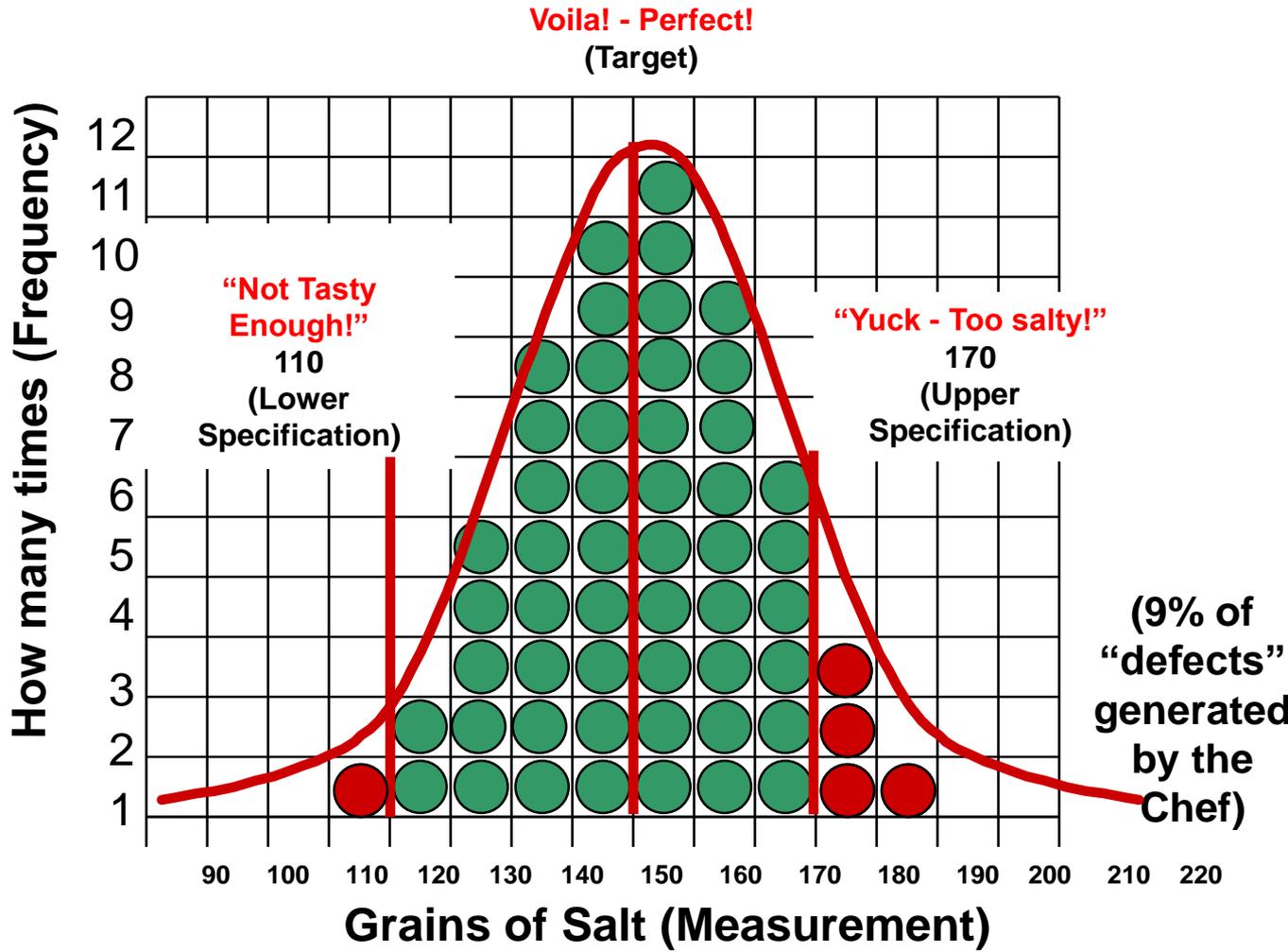


SIGMA LEVEL - CONCEPT |

The Need for Data



How do you make sure your soup tastes good, every time

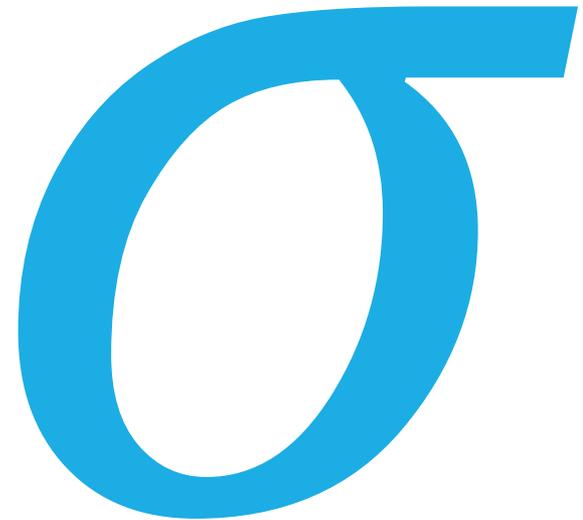
Remember the Chef adding salt...



We need data in order to make informed, effective decisions!

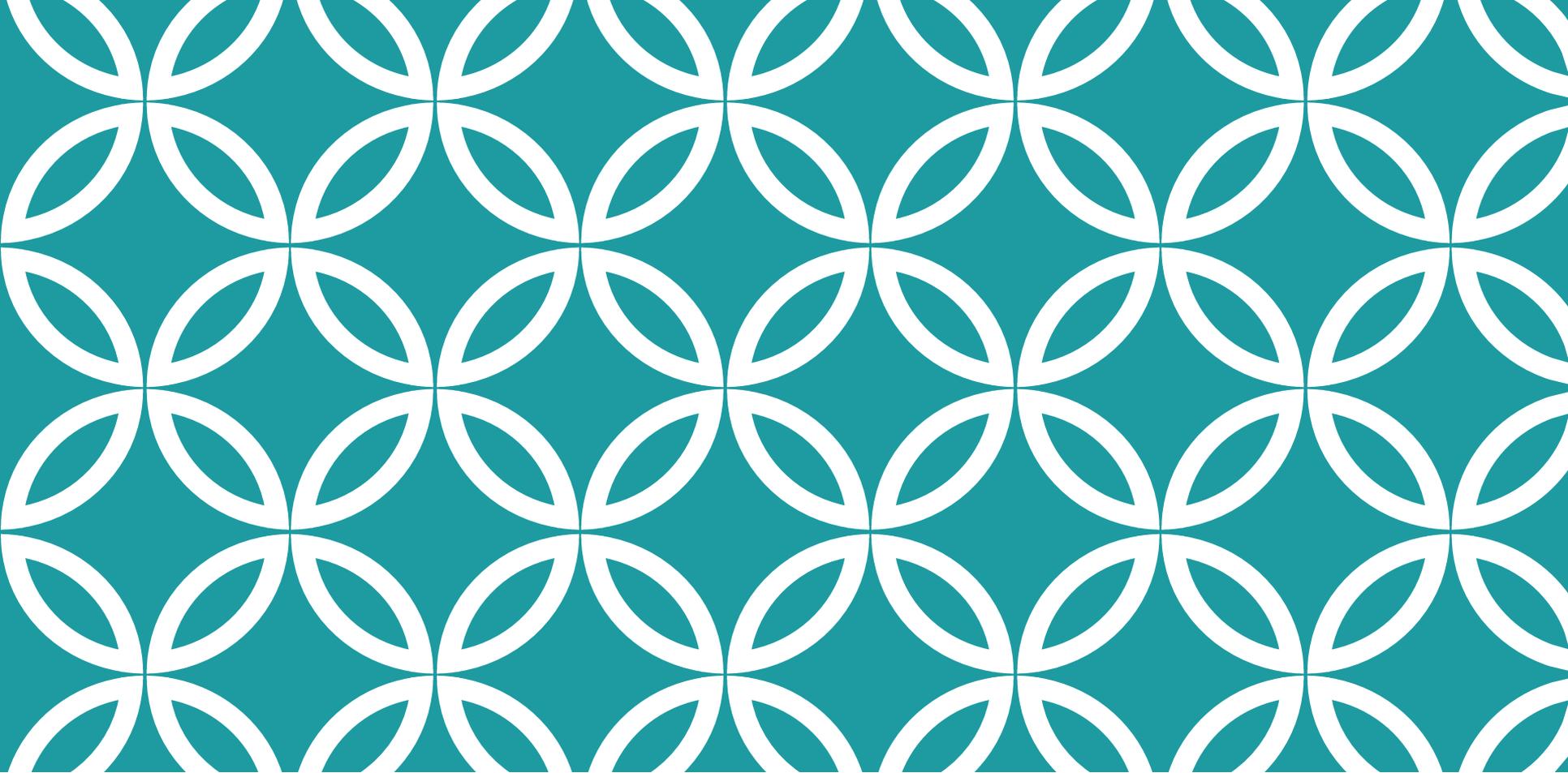
SIGMA LEVEL

- Average alone is not a good measure
- Standard deviation alone tells nothing about the process performance from customers point of view
- Sigma level is a process matrix that incorporates customer requirement, average and standard deviation to tell process performance



SIX SIGMA SCALE

Sigma Level	DPMO	Percent Defects	Percent Success	Capability
1	691,462	69	31	0.33
2	308,538	31	69	0.67
3	66,807	6.7	93.3	1.00
4	6,210	0.62	99.38	1.33
5	233	0.023	99.977	1.67
6	3.4	0.00034	99.99966	2.00



PROCESS IMPROVEMENT USING 6 SIGMA FRAMEWORK

SIX SIGMA PROJECT MANAGEMENT (DMAIC)

DEFINE

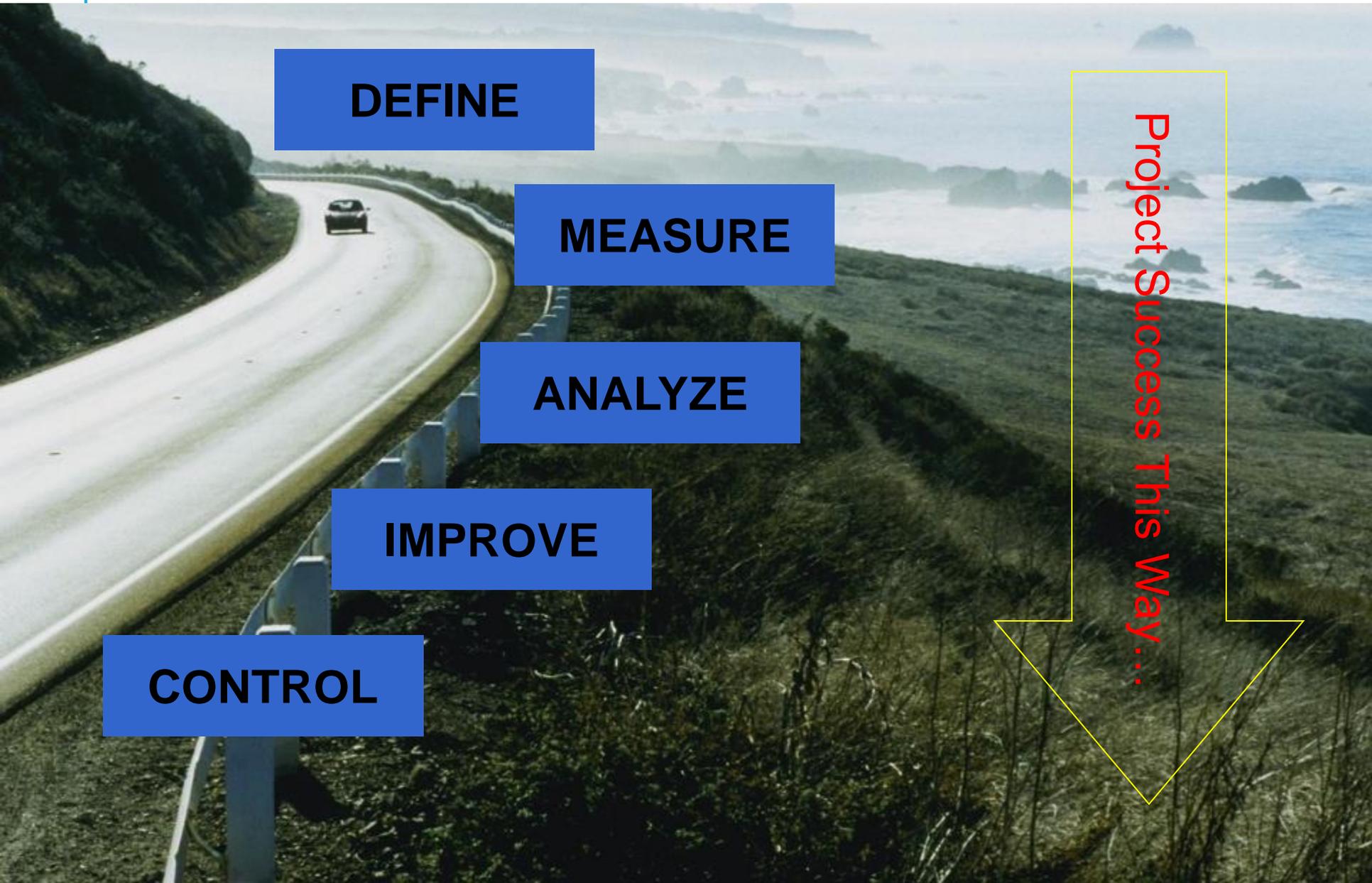
MEASURE

ANALYZE

IMPROVE

CONTROL

Project Success This Way...



MASTANA BURGER

- Mastana, the burger man discovers **dropping sales** in his Islamabad shop
- With a thriving market for bun kebabs and burgers, Mastana is perplexed
- He asks one of his friends at **Bahria University** to help



DEFINE PHASE

Problem Statement

Customers complain that service at Mastana is too slow despite the recent increase in the number of waiters and chefs.

Goal:

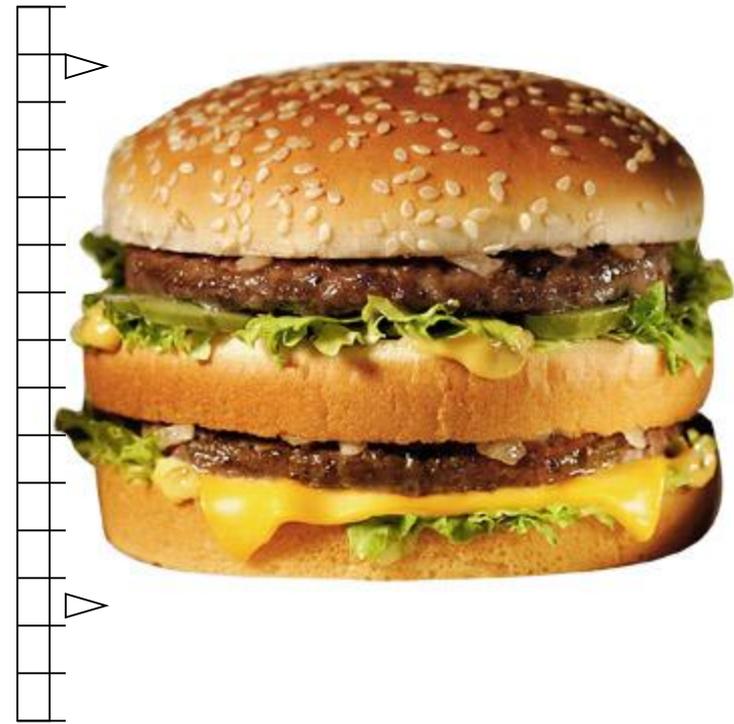
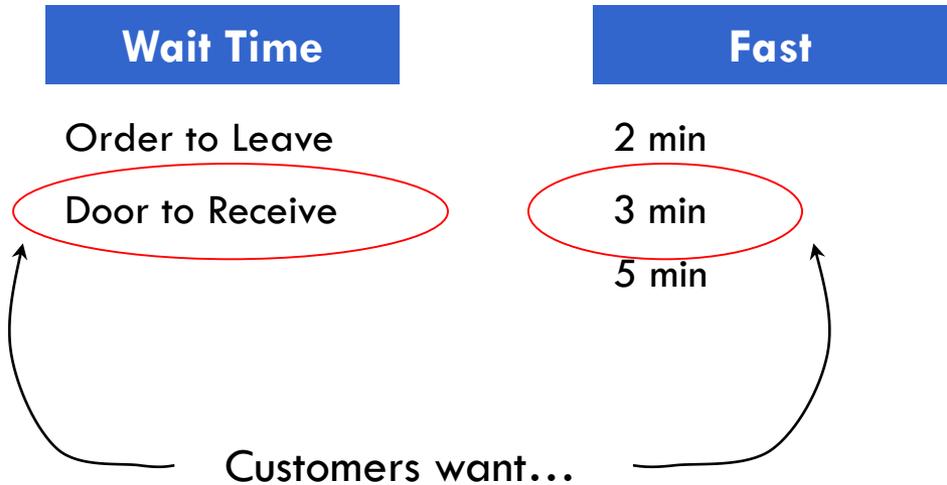
To increase the service speed enough to satisfy the customers, while maintaining burger quality.



MEASURE PHASE

Customer Expectations:

What exactly does “Faster” Service Mean?



ANALYZE PHASE

Process Capability

How well are we doing today?

We are fulfilling Customer orders within 3 minutes only 60-70 % of the time



1.75σ



Identify Variation Sources:

Why can't we be consistent?

Oil Temperature determines how long it takes to cook



And Oil Temperature varies wildly!!

IMPROVE PHASE

Solution Generation:

How do we fix it?

We must fry the kebabs as fast as possible without burning them

How do we know the right temperature?

DOE revealed the best temperature as 250C-300C

Gas pressure is set at the 4th notch

Tested Successful!

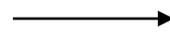


CONTROL PHASE

New Process Capability:

How are we doing NOW?

We are fulfilling Customer orders within 3 minutes only 99 % of the time



4σ!

Solution Control:

Can we ensure our solution is sustainable?

Electric Alarm bell rings every time the temperature falls below 250C or tops 300C



DMAIC MODEL



Define

- A – Identify Project CTQs
- B – Develop Team Charter
- C – High-Level Process Map



Measure

- 1 – Select Project KPI
- 2 – Define Performance Standards
- 3 – Measurement System Analysis

R0 – Review



Analyze

- 4 – Establish Process Capability
- 5- Define Performance Objectives
- 6 – RCA & VAA

R1 – Review



Improve

- 7 – Suggest Solutions
- 8 – Financial Analysis
- 9 – Pilot Test

R2 – Review



Control

- 10 – Sustain Solutions
- 11 – Determine Process Capability
- 12 – Translation

R3 – Review



R4 – Review



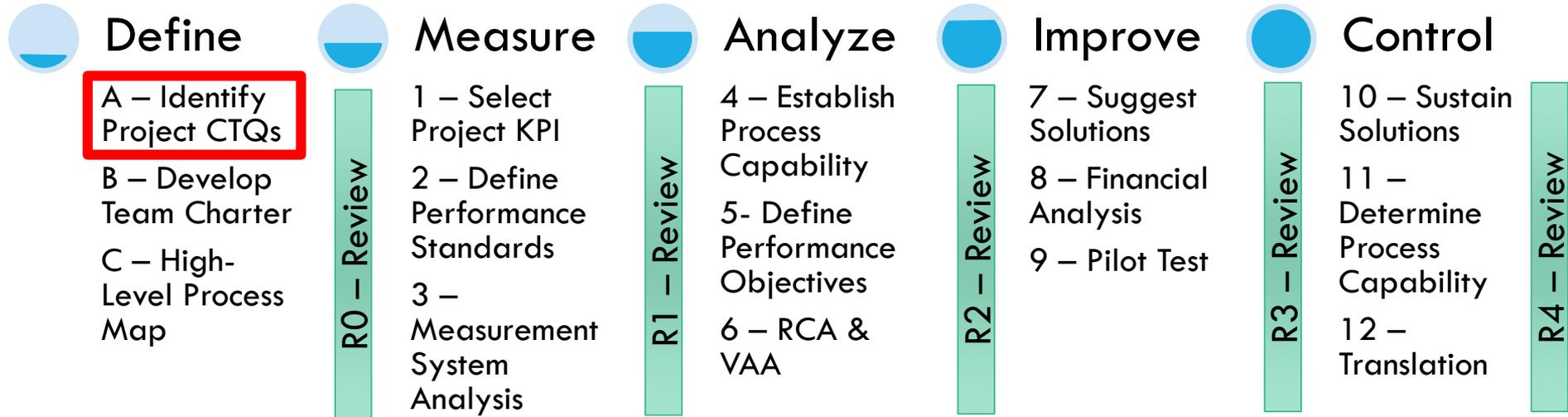
DEFINE PHASE

Use the tools that will help you take a top-down look at the processes from a business perspective. Start with the customer and what is important to the customer.

DEFINE PHASE STEPS

- A. Identify Project CTQs
- B. Develop Project Charter
- C. High-Level Process Map

DMAIC MODEL



A - IDENTIFY PROJECT CTQS

Focus Customer

Identify Customer Needs

Sample Tools:

- VOC
- CTQ
- Problem Re-statement

HOW TO IDENTIFY CTQs

Identify
Your
Customers

Compile &
Evaluate
VOC

Translate
VOC into
CTQs

Prioritize
CTQs



VOICE OF CUSTOMER

Surveys

Focus Groups

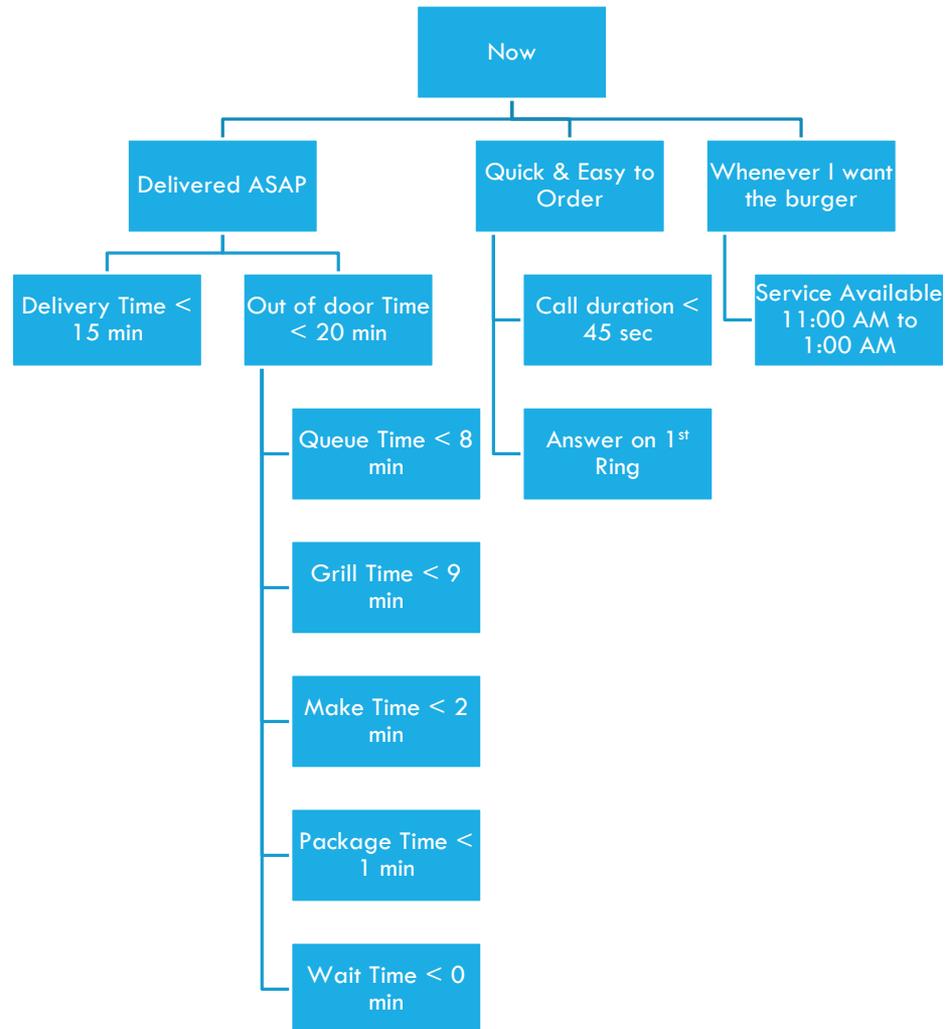
Interviews

Customer Complaints

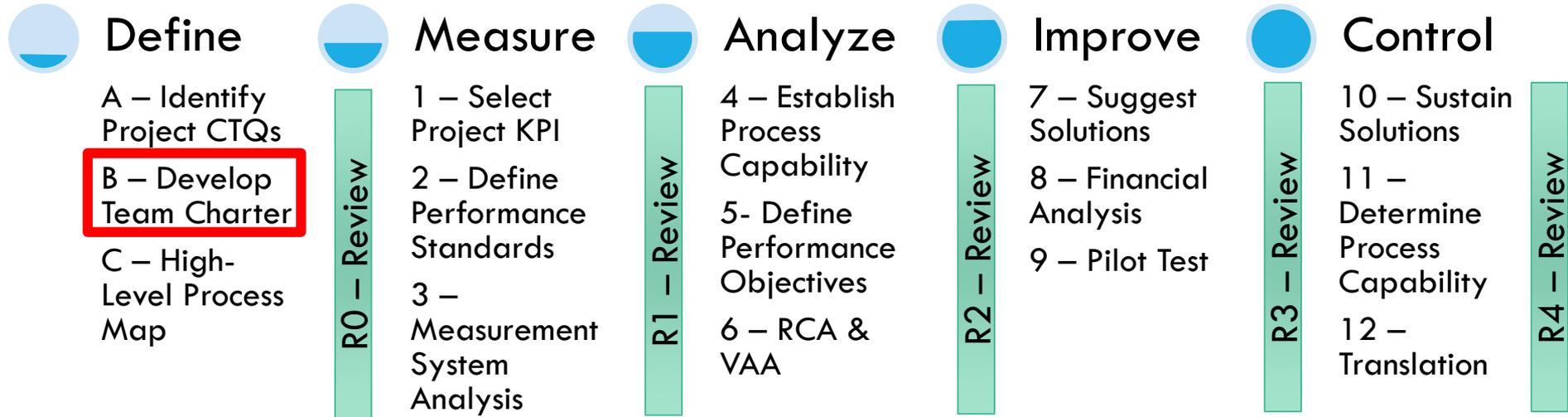
CTQ DRILL-DOWN TREE

1. List customer requirements (1st Tier of CTQ)
2. Address every requirement:
 - I. What does this really mean to customer
 - II. What does this mean for each sub-system or step in the process
 - III. How could we measure this?
3. Don't get too specific too fast. Keep the answers only one step more detailed than the first tier. Write answers in a second tier of the tree diagram.
4. Do a "necessary and sufficient" check of the answers
5. Which characteristic is required or not required for a requirement?
6. Continue creating tiers until you have reached characteristics at a level of detail that are meaningful to the organization and can be measured
7. Repeat till each customer requirement is identified. Every branch of the tree can be of different lengths.
8. Check that all characteristics at the end of any branch are measurable. Use operational definitions to clarify them. These are Critical-to-Quality (CTQ) characteristics.

CTQ EXAMPLE: BURGER HOME DELIVERY



DMAIC MODEL



B - DEVELOP PROJECT CHARTER

Focus Customer

Problem Statement

Goal

Project Scope

Business Case

Sample Tools:

- SMART Goals
- Includes/Excludes
- Soft Vs Hard Cost/Savings

PROBLEM RESTATEMENT

What makes a good problem statement?

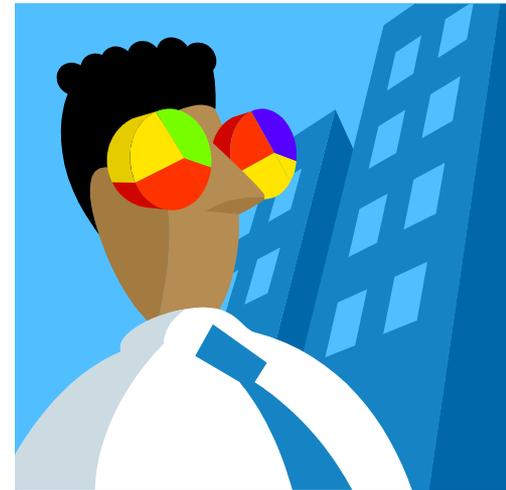
- Keep it brief – 2 or 3 short sentence at most
- Avoid technical language
- Quantify the problem – Use any data you have available
- Explain the cost of problem
- Define the Scope

PROBLEM AND GOAL STATEMENTS

The purpose of the **Problem Statement** is to describe what is wrong.

The **Goal Statement** then defines the team's improvement objective.

Together they provide focus and purpose for the team.



PROBLEM STATEMENT EXAMPLE

Vague Problem Statement:

Our customers are angry with us and late in paying their bills.

Improved Example:

In the last 6 months (when), 20% of our repeat customers-not first-timers-are over 60 days late (what) paying our invoices. The current rate of late payments is up from 10% in 1990 and represents 30% of our outstanding receivables (magnitude). This negatively affects our operating cash flow (impact or consequence).

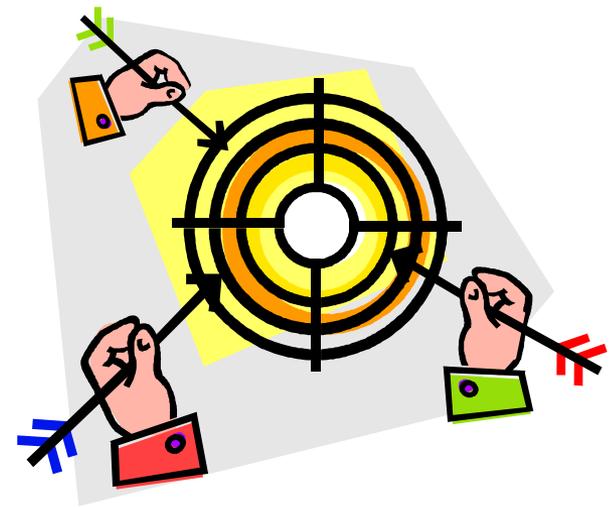
GOAL STATEMENT

Describe, in measurable terms, what success will look like when you've solved the problem

Include a statement of the performance level that will solve your problem

Also include the time frame in which you plan to implement the improvement

Remember SMART Goals

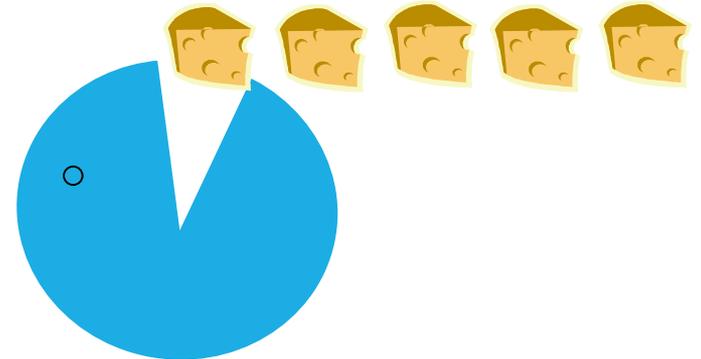
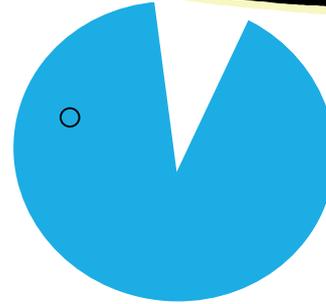
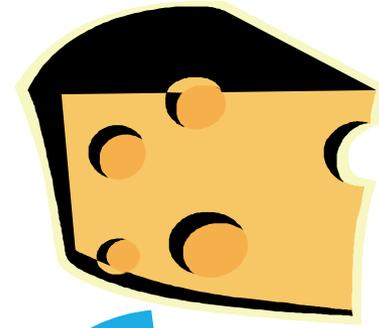


PROJECT SCOPE

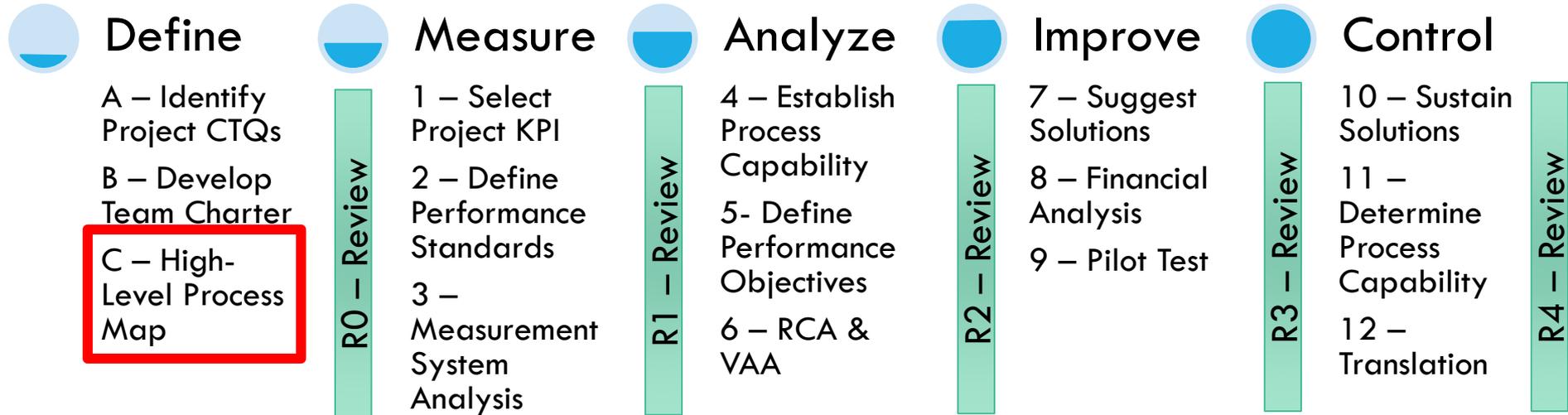
How large a problem are you trying to solve in how short a time?

With your limited resources and time, what aspect of the problem can you solve?

What critical aspect of the issue should you focus on at this time?



DMAIC MODEL



C — HIGH-LEVEL PROCESS MAP

Focus Internal Processes

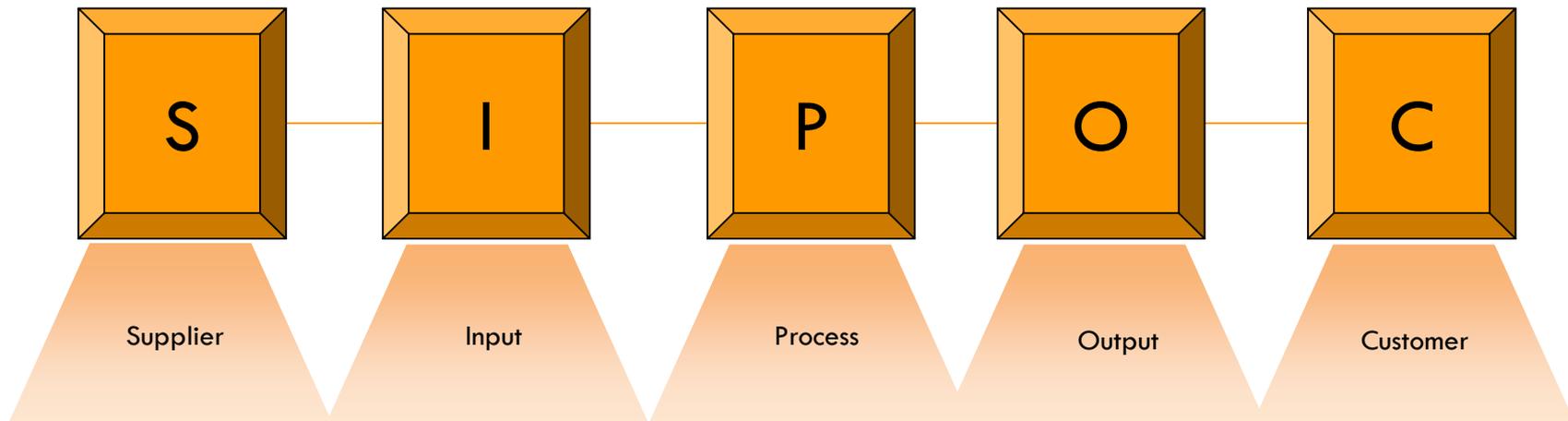
Layout the essential elements

Which processes are affecting the outcome

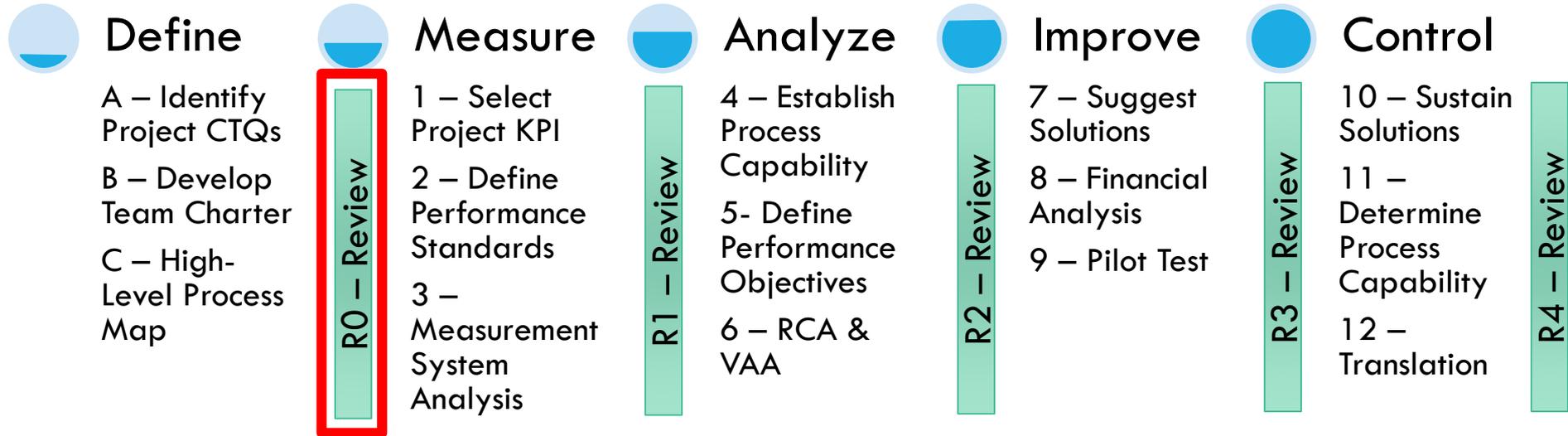
Sample Tools:

- SIPOC
- CTQ

SIPOC



DMAIC MODEL



RO – DESIGN PHASE REVIEW

Problem Statement		Team & Roles:
Project Goal Statement:		
Customers(s):		
CTQ:		Business Case – CoPQ and Projected Benefits:
In Scope:	Out of Scope:	Hard Savings:
		Soft Savings:



MEASURE PHASE

Use the tools to assess current performance. Determine how current process is doing.

MEASURE PHASE STEPS

1. Select Project KPI
2. Define Performance Standards
3. Measurement System Analysis

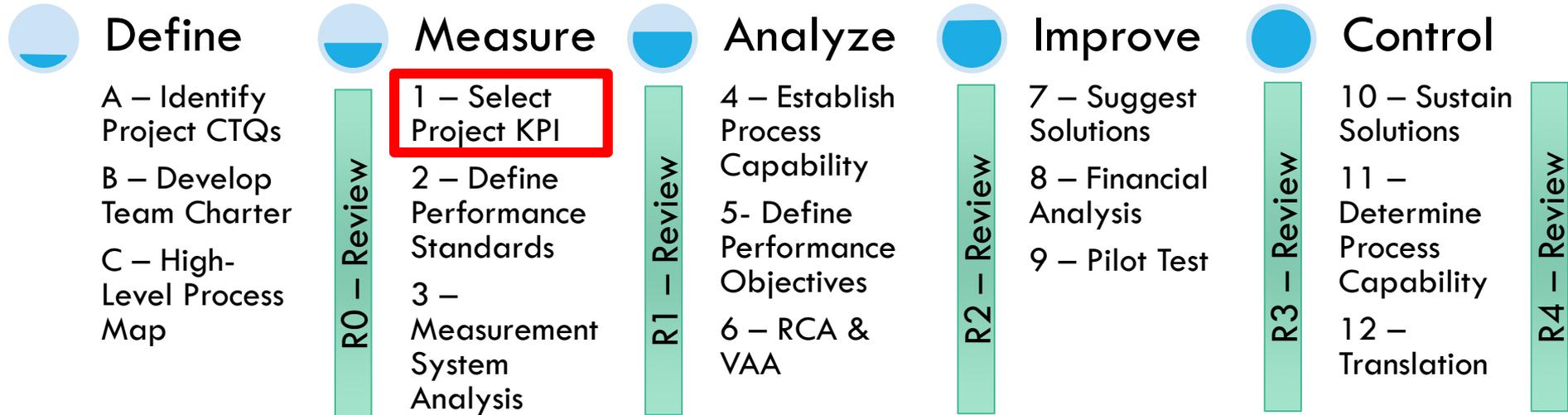
SOURCES OF EXISTING DATA



- ***Customer Surveys***
- ***Complaints***
- ***Benchmarking Data***
- ***Executive Level Discussions***
- ***Job Specific Discussions***
- ***Market Strategies***
- ***Scorecards & Dashboards***
- ***Focus Groups***

Use all your information sources to figure out what your customers need.

DMAIC MODEL



1 — SELECT PROJECT KPI

Focus Y (KPI)

Continuous Vs Discrete Data

Identify & measure customer CTQs

Sample Tools:

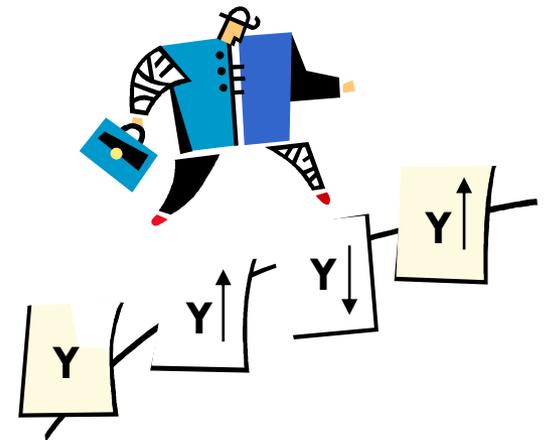
- VOC
- QFD
- FMEA

DEVELOPING A PROJECT “Y”

Y = What you will measure, including units of measure (inches, \$\$, hours, etc..)

It is CRITICAL to have a well defined Y

- Helps the team understand what the project is all about.
- Provides ONE, key measurement to determine the success or failure of the project



PROJECT Y EXAMPLES

- Number of hours from start to finish to refill a generator at a cell site
- The number of Days from prospecting to closure of a corporate deal
- The size of discrepancy between the forecasted and actual sales



OPERATIONAL DEFINITION

Definition:

- An operational definition is a precise description that tells how to get a value for the process Y you are trying to measure. It includes “What Something Is” and “How to Measure It”

Purpose:

- To Remove Ambiguity so that Everyone has the same understanding
- To provide a clear way to measure the characteristic
 - Identifies what to measure
 - Identifies how to measure it
 - Makes sure that no matter who does the measuring, the results are essentially the same
 - Must be useful to both you and the customer

PROCESS MAPPING

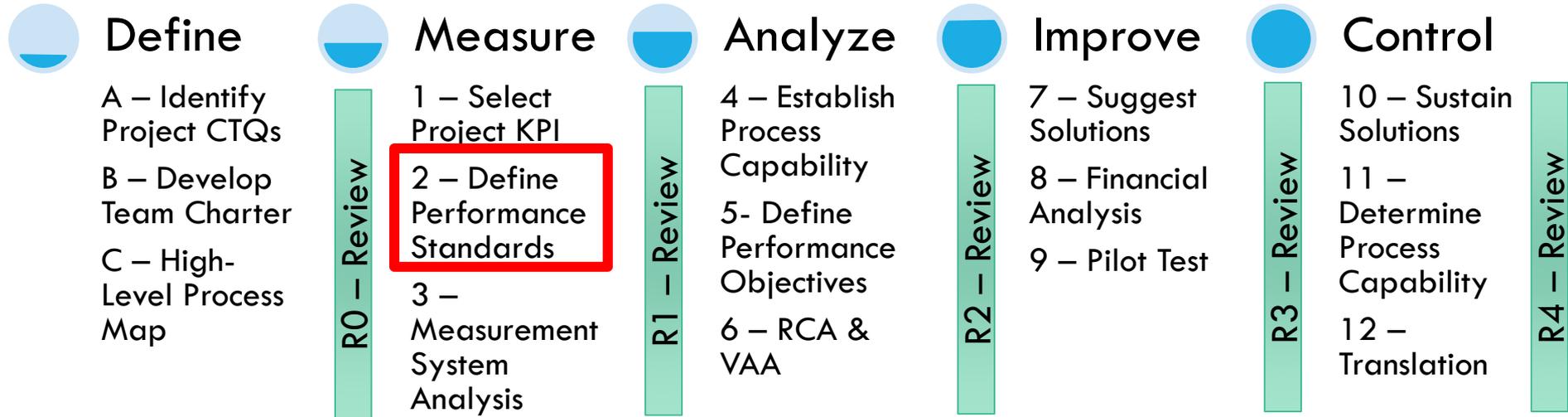
Determine scope

- Required complexity & details
- List steps

Arrange the steps in order

Assign Symbol

DMAIC MODEL



2 — DEFINE PERFORMANCE STANDARDS

Focus Y

Define & Confirm specifications for Y

Sample Tools:

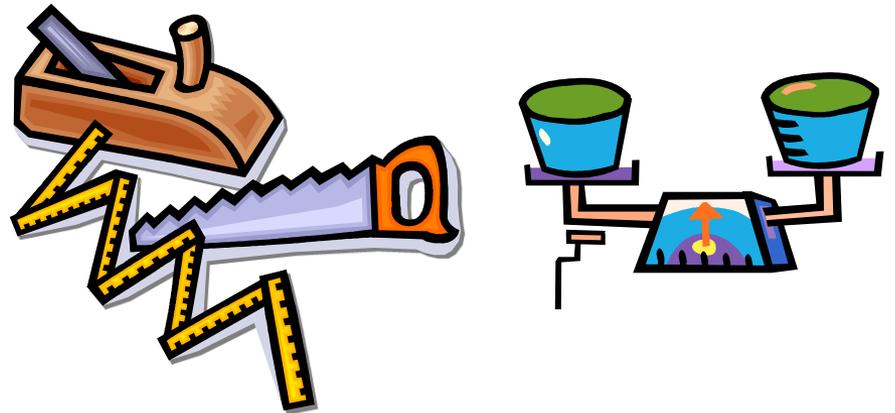
- Kano
- Customer
- blueprints

SPECIFICATION LIMITS — CONTINUOUS DATA

- What are the limits within which customer remains satisfied
- USL — Upper Spec Limit
- LSL — Lower Spec Limit
- Target — Ideal Value

DEVELOPING A DEFECT – DISCRETE DATA

- What is a defect?
 - A defect is any nonconformity in a product or process
 - A defect is an event that fails the criteria for passing.



DEFECT EXAMPLES

USL 55 minutes – Continuous

- Defect (Discrete) = any wait time plus exam time that is greater than 55 minutes;
- Units = patients examined in clinic

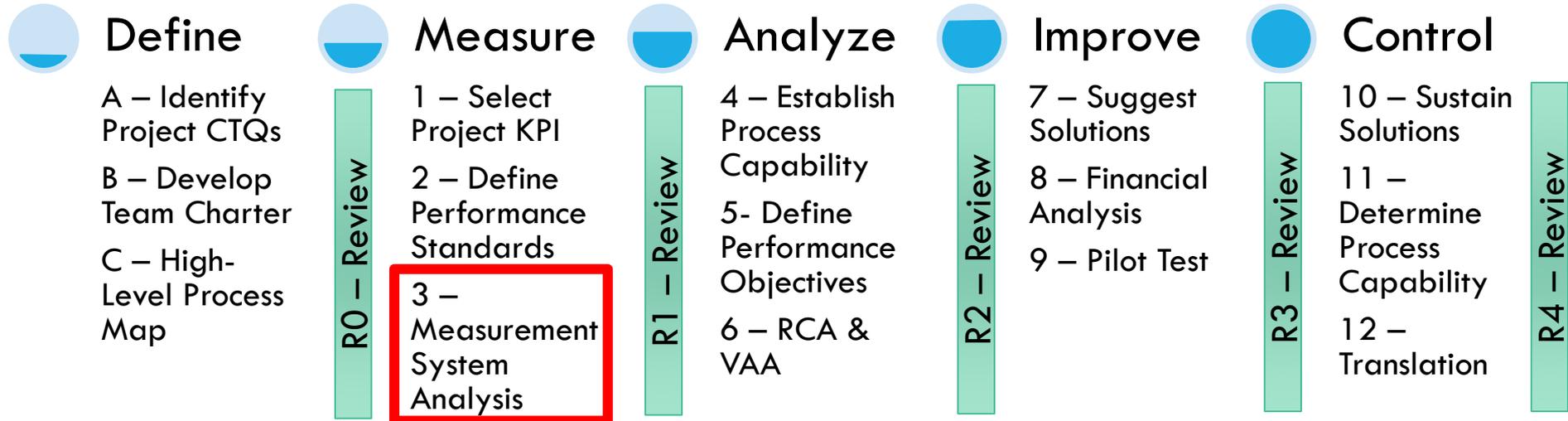


PERFORMANCE STANDARDS

Goal of Performance standard is to translate the customer's expectations into measurable boundaries of acceptance.

	Continuous	Discrete
Y – (Define KPI)		
USL		N/A
LSL		N/A
Unit	N/A	
Opportunity	N/A	

DMAIC MODEL



3 — MEASUREMENT SYSTEM ANALYSIS

Focus Y

Measurement System is adequate to measure Y

Sample Tools:

- Gage R & R

MEASUREMENT SYSTEM ANALYSIS

Precision: Ability to repeatedly measure the same product and service and obtain same results.

Accuracy: Ability to produce average measured value which agrees with the true value or standard being used.

3 RS FOR PRECISION & ACCURACY

Repeatability: Variability between operators/device combination.
Variation obtained for repeated measurements

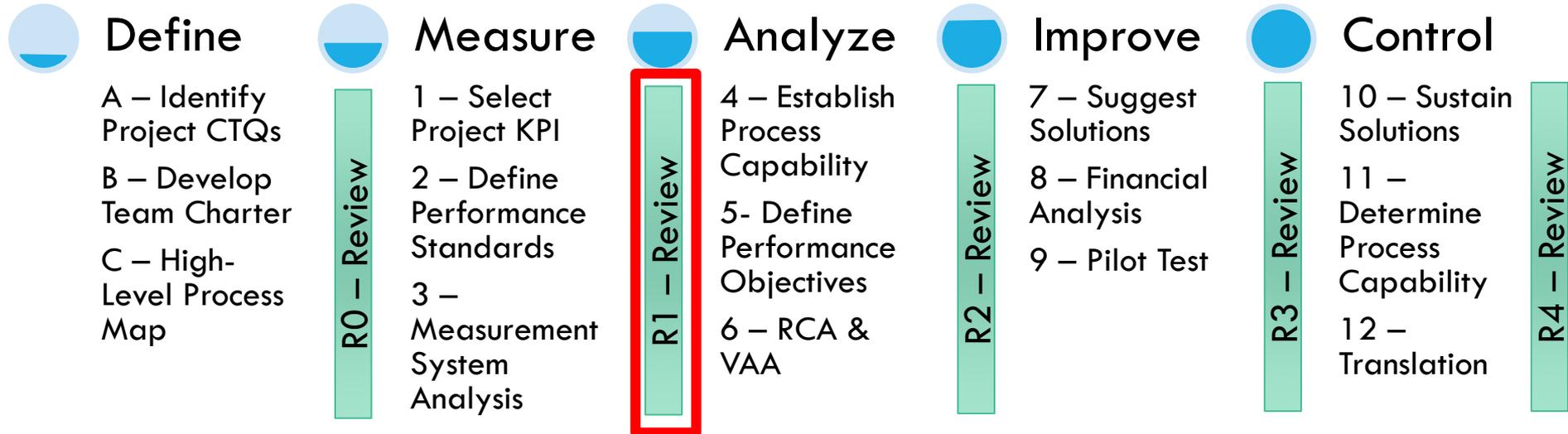
- Data collected by the same person
- Using the same instrument
- On the same product or service
- At different times

Reproducibility: Variability between operators. Variation obtained due to difference in people who are taking measurements

- By different people
- Using the same instrument
- On the same product or service
- At the same time

Resolution: Sensitivity of Scale

DMAIC MODEL



R1 – MEASURE PHASE REVIEW

Project Y (Name of KPI):		Tool Usage:
Explanation for Selecting this KPI:		
Performance Standards:		Notes/Graphs:
(Continuous Data) USL:	(Discrete Data) Unit Definition:	
LSL:	Opportunity Definition:	
Target:	Defect Definition:	
Measurement System Analysis on Y: (How do we know the data is credible?)		



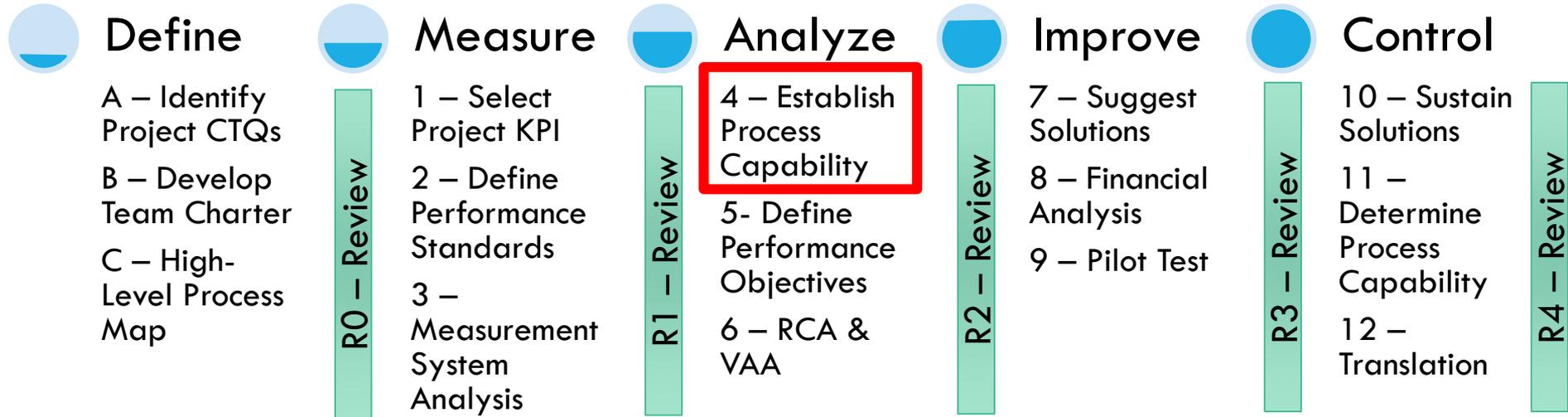
ANALYZE PHASE

Use the tools to determine the root cause(s) of the problem. Try to identify relationships between variables and what some of the key process indicators are.

ANALYZE PHASE STEPS

4. Establish Process Capability
5. Define Performance Objectives
6. Root Cause and Value Added Analysis

DMAIC MODEL



4 — ESTABLISH PROCESS CAPABILITY

Focus Y (KPI)

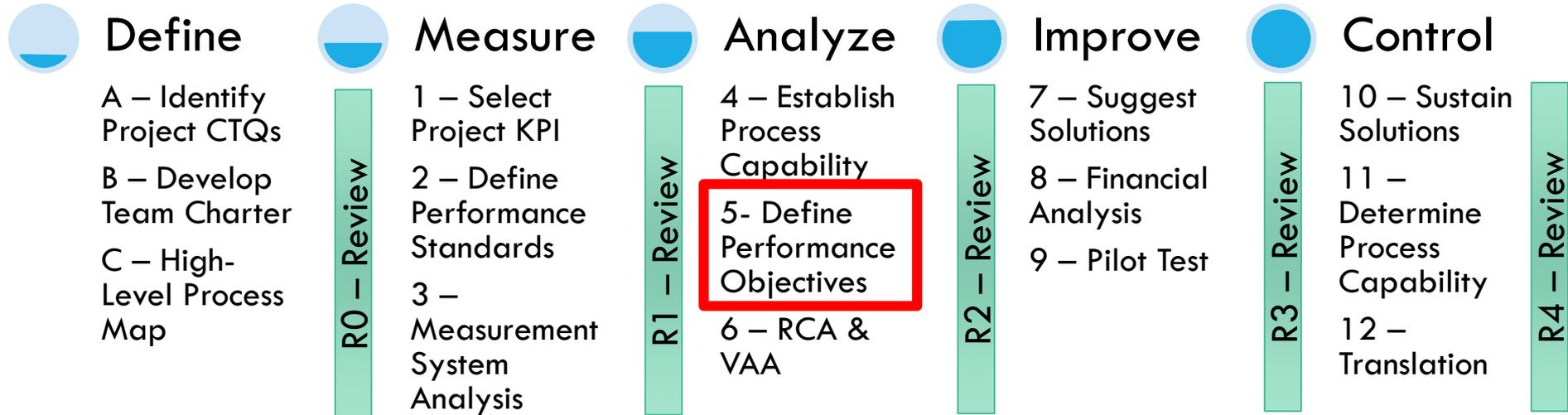
Baseline current process

Normality Test

Sample Tools:

- Capability indices

DMAIC MODEL



5 — DEFINE PERFORMANCE OBJECTIVES

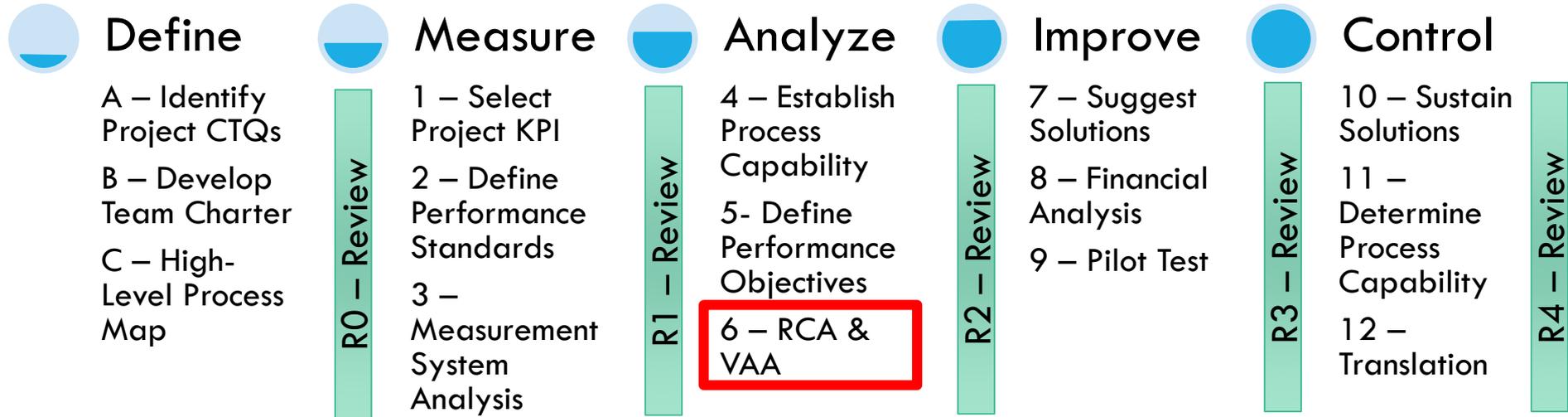
Focus Y (KPI)

Strictly define goal of project

Sample Tools:

- Benchmarking
- Team

DMAIC MODEL



6 – ROOT CAUSE/VALUE ADDED ANALYSIS

Focus X (Root Causes)

List of statistically significant X's based on analysis of historical data

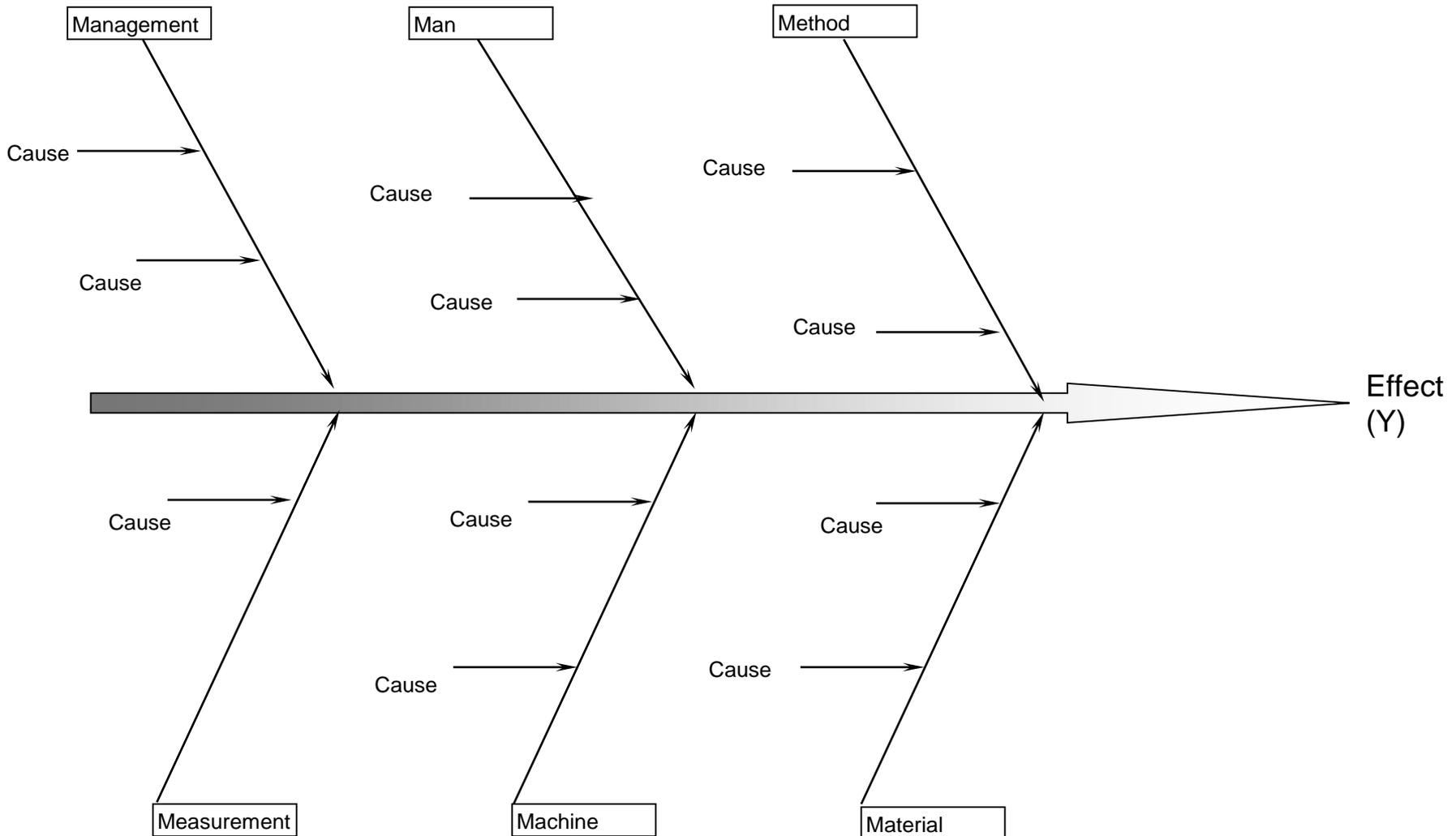
Sample Tools:

- Process Analysis
- Fishbone Analysis
- Hypothesis Testing

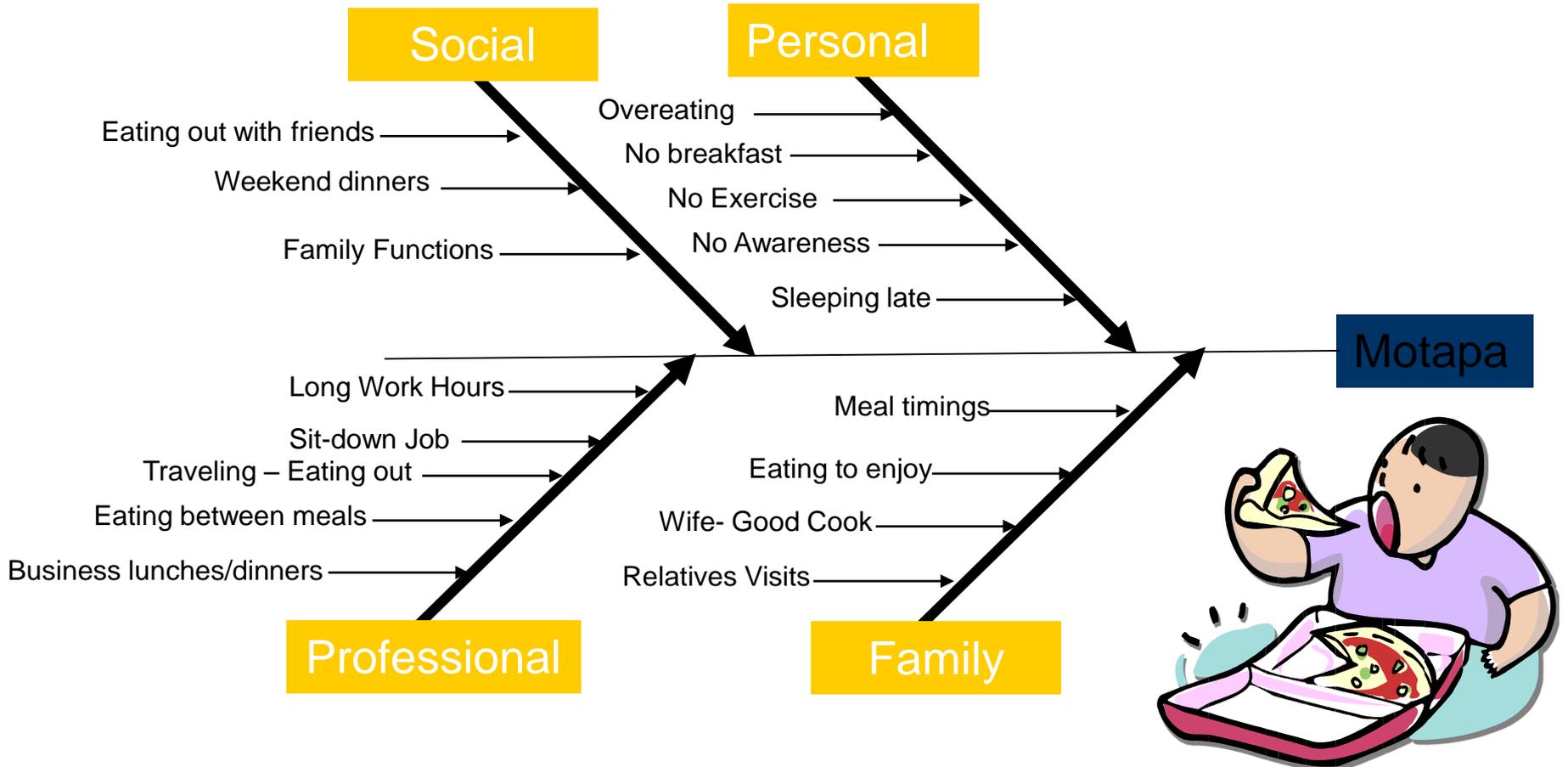
TOOL OVERVIEW: FISHBONE

- Purpose:
 - To determine if you have correctly identified the true problem
 - To provide a visual display of all possible causes of a specific problem
- When:
 - To expand your thinking to consider all possible causes
 - To gain group's input
- Guidelines:
 - Living document; often linked to a process flow diagram.
 - Should be dated and considered a part of process information
 - It is recommended that this diagram be created through multiple brainstorming sessions

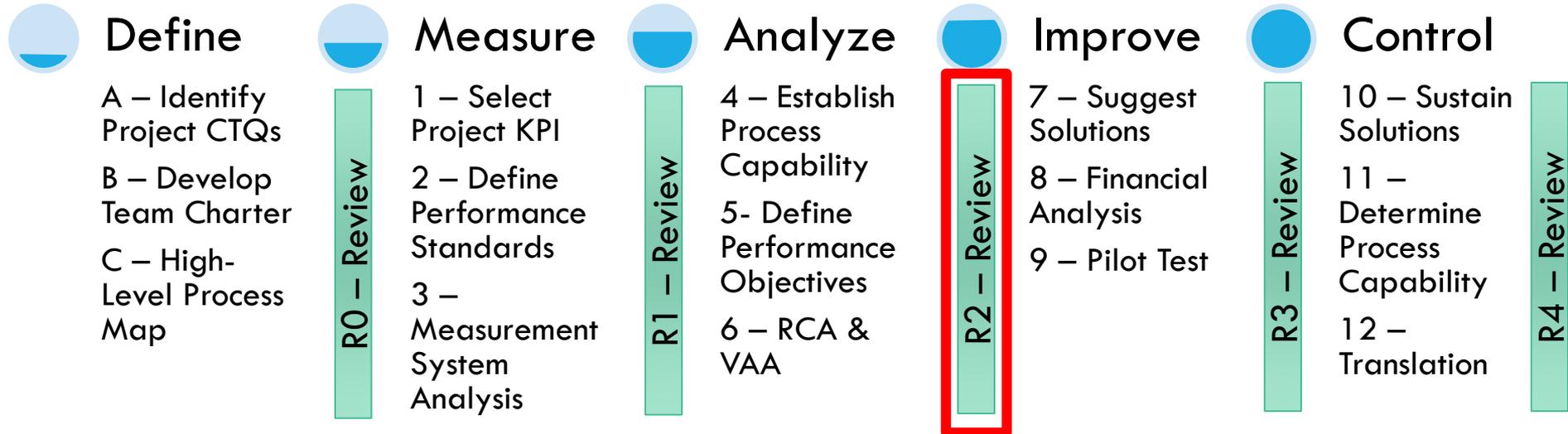
FISHBONE DIAGRAM (CAUSE & EFFECT DIAGRAM)



CAUSE & EFFECT DIAGRAM



DMAIC MODEL



R2 – ANALYZE PHASE REVIEW

Baseline (Current) Sigma Level:

Tool Usage:

Performance Objective:

Benchmark:

Rationale:

Notes/Graphs:

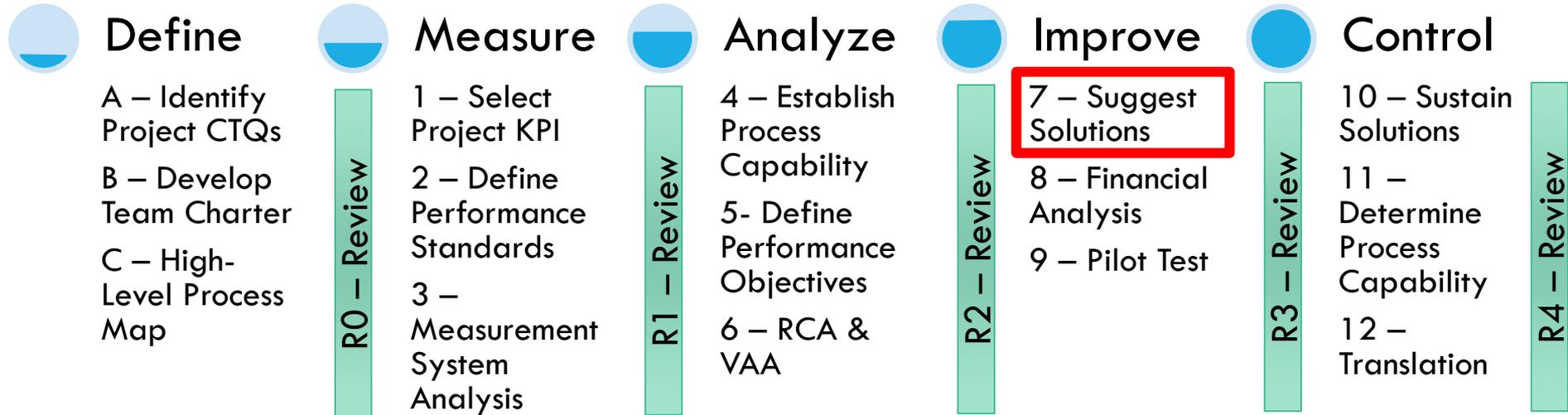
Sources of Variation (Root Cause Analysis):

Non-Value Adding Activities (Value Addition Analysis)

IMPROVE PHASE STEPS

7. Suggest Solutions
8. Financial Analysis
9. Pilot Test

DMAIC MODEL



7 — SUGGEST SOLUTIONS

Focus X (Critical Inputs)

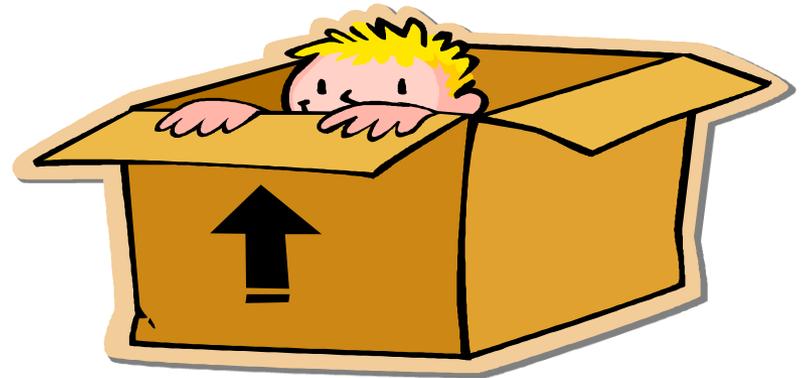
Determine vital few X's that cause changes to your Y

Sample Tools:

- Anti Solution
- Six Thinking Hats
- Work-out

OUT-OF-THE-BOX THINKING

Force yourself and your team to question the “first” solution that comes to mind



ANTI-SOLUTION

- Brainstorm ways to make the problem worse
- Reverse the output to discover creative solutions

ROADBLOCKS FOR CREATIVE SOLUTION

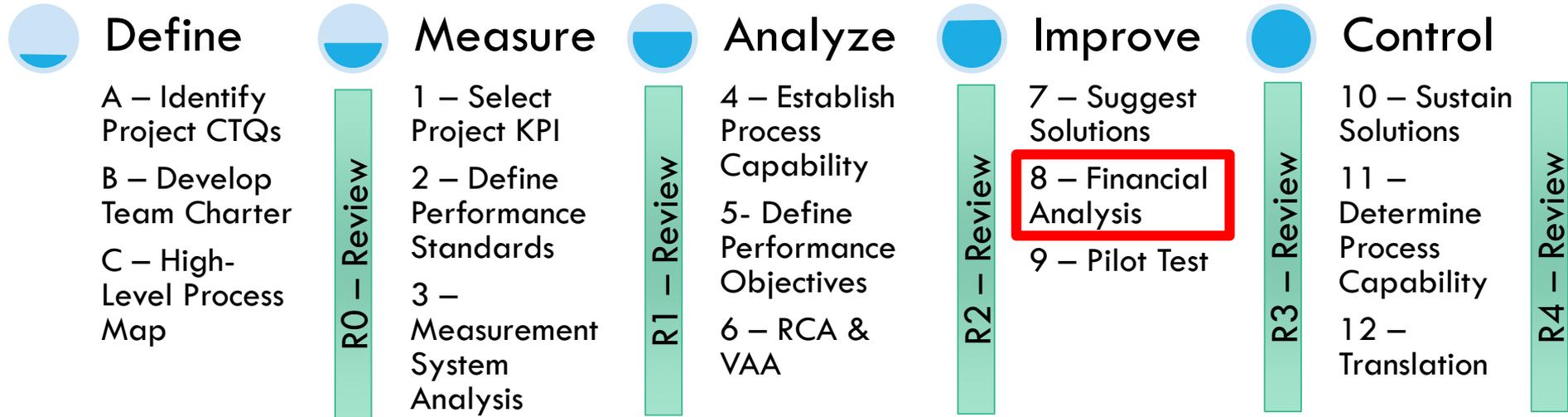
Premature judgment.

Searching for the single answer

Assumption of the fixed pie

Solving their problem is their problem

DMAIC MODEL



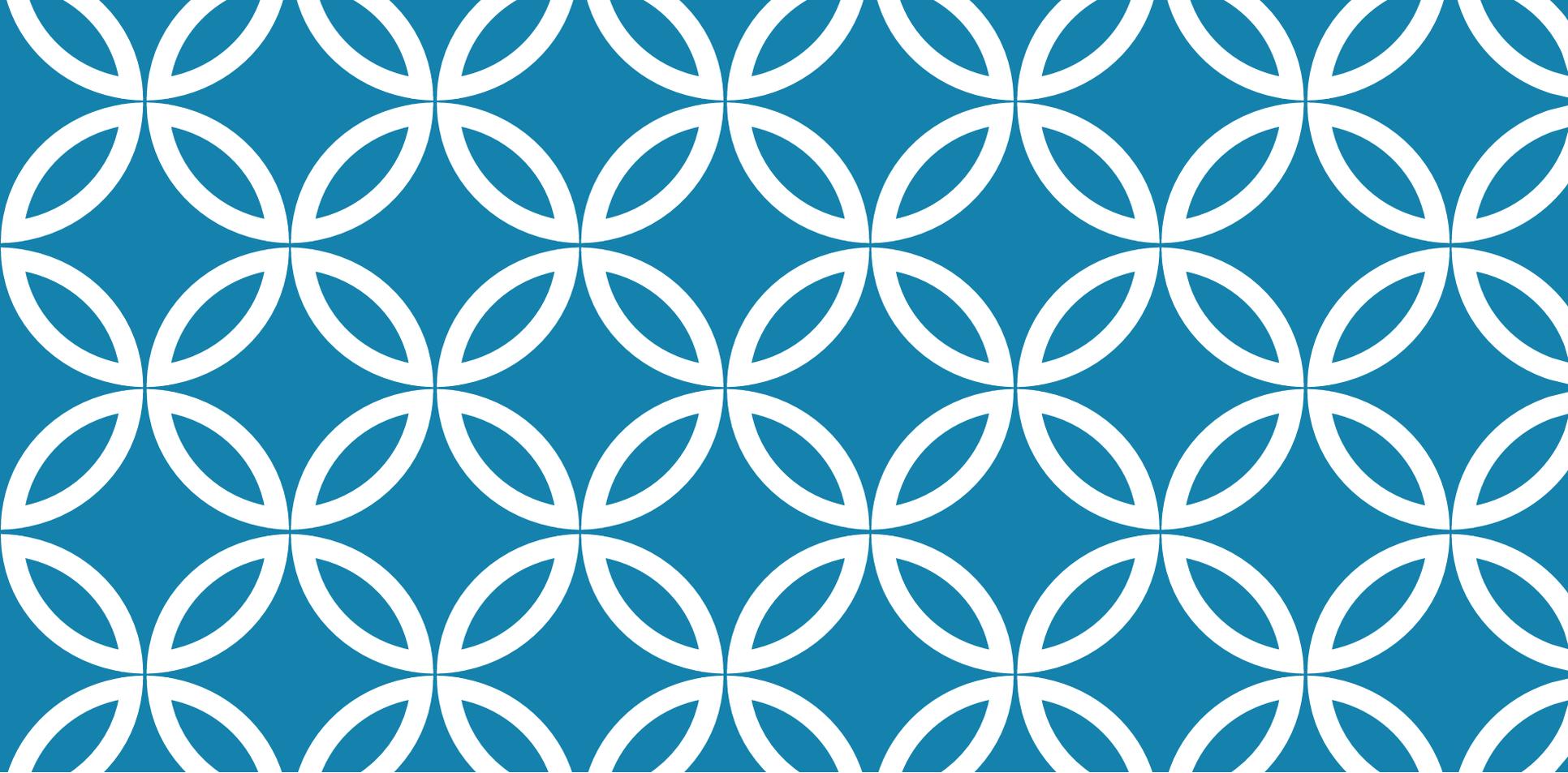
8 — FINANCIAL ANALYSIS

Focus X

Specify tolerance on the vital few X's; suggest solution options that address the problems

Sample Tools:

- Cost Benefit Analysis
- Pay Back Period
- IRR



FINALIZING IMPROVEMENTS



EASE-IMPACT MATRIX



The diagram is a 2x2 matrix. The vertical axis is labeled 'Impact' with 'High' at the top and 'Low' at the bottom. The horizontal axis is labeled 'Ease' with 'Easy' on the left and 'Difficult' on the right. The matrix is divided into four quadrants by a horizontal line and a vertical line.

	Easy	Difficult
High		
Low		



Control diet while eating out with friends

Healthy breakfast

Stop eating while still not full

Regular Exercise

Control diet during travel

Increase obesity Awareness

Stop eating between meals

Sleeping early

Regular meals

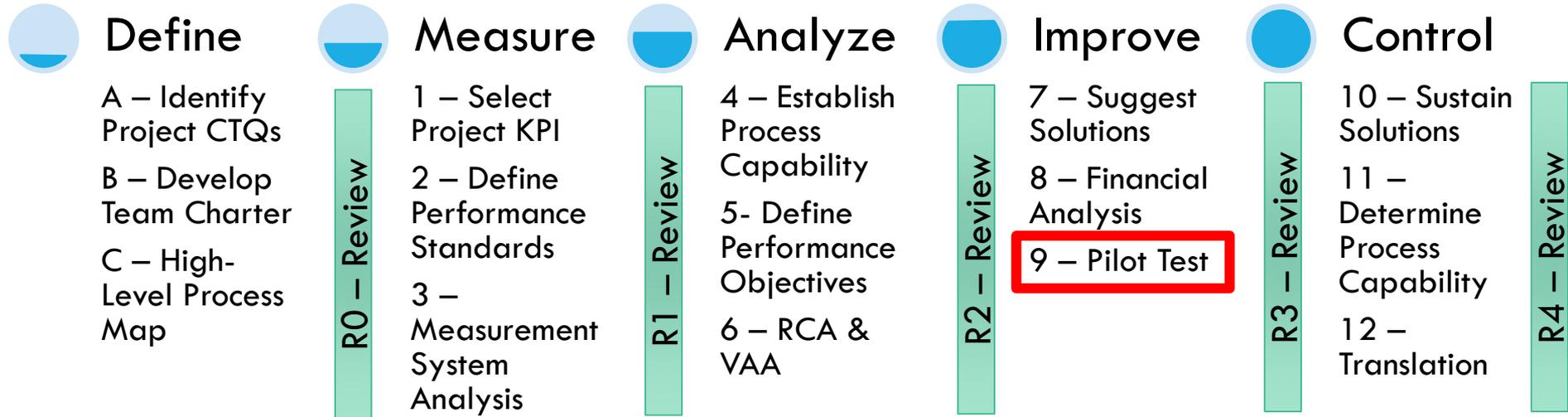
Reduce recreational eating

Request spouse to cook vegetables/soups

REDUCING WEIGHT EASE IMPACT MATRIX

Impact	High	Stop eating while still not full Healthy breakfast Increase obesity Awareness	Stop eating between meals Regular Exercise Sleeping early Reduce recreational eating
	Low	Control diet during travel Request spouse to cook vegetables/soups	Regular meals Control diet while eating out with friends
		Easy	Difficult
		Ease	

DMAIC MODEL



9 — PILOT TEST

Focus Y, X

Test out the options in a safe, controlled environment

Sample Tools:

- Simulation
- Test Bed

PILOT RUN



When a solution has been identified, you need to validate that the solution is adequate.

Pilot: a process improvement that you will test on a small scale in a real business environment.

The Pilot objective is to collect data from the test site to:

- Confirm that your proposed solution will achieve the targeted performance (e.g. increasing service level or reducing congestion)
- Identify any potential implementation problems (technology, training, etc.) prior to full scale implementation

EXAMPLES

Medicine companies

Agriculture

Beta versions of software

Development sector interventions

BENEFITS

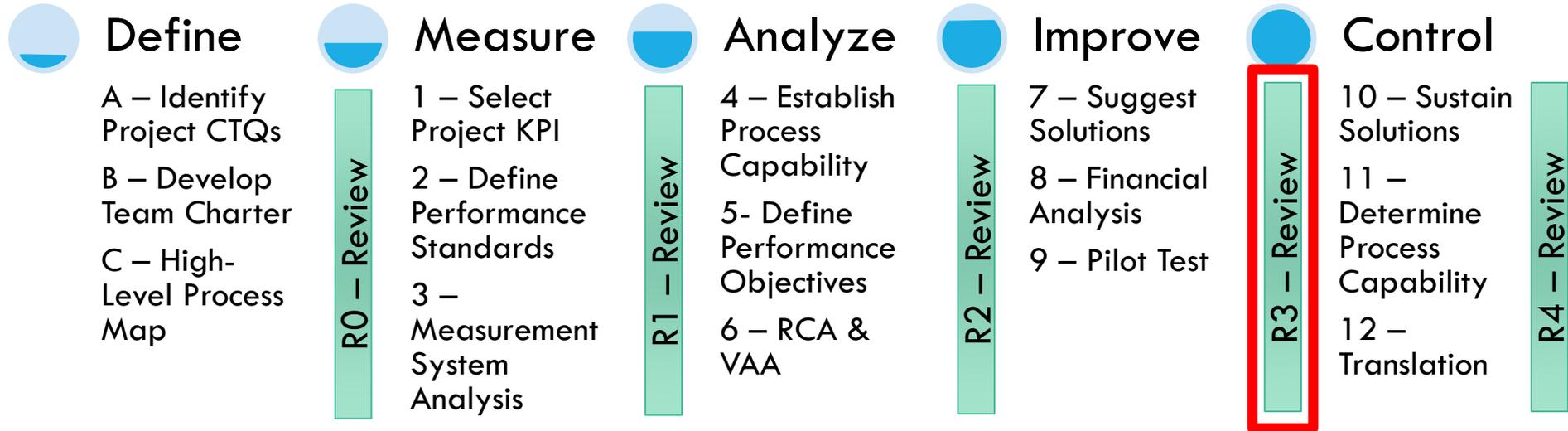
Pilot run validates assumptions and analysis of the project team

Gives more confidence in solution

Provide a chance to fine tune the solution

Helps in getting buy-in of the stakeholders

DMAIC MODEL



R3 – IMPROVE PHASE REVIEW

Proposed Solution(s):

Tool Usage:

Financial Analysis (if investment required):
Cost Benefit Analysis of Each Solution Proposed

Notes/Graphs:

Pilot Test Results:



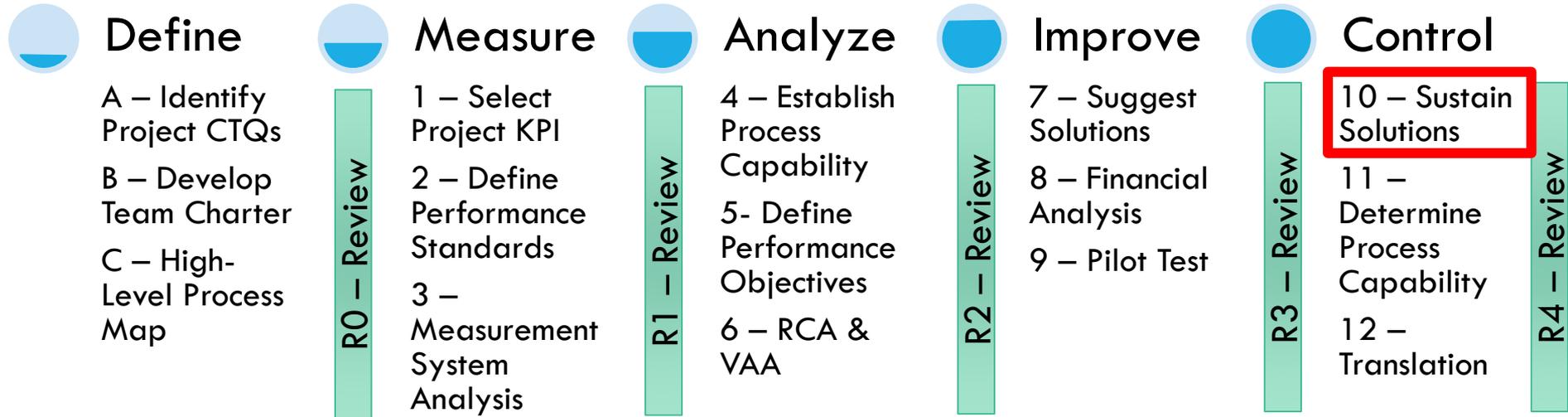
CONTROL PHASE STEPS

10. Sustain Solutions

11. Determine Process Capability

12. Translation

DMAIC MODEL



10 – SUSTAIN SOLUTIONS

Focus Y, X

Mistake-proof the issue such that the problem never recurs

Sample Tools:

- Poka Yoke
- Visual Management
- Control Charts
- FMEA

POKA YOKE (MISTAKE PROOFING)

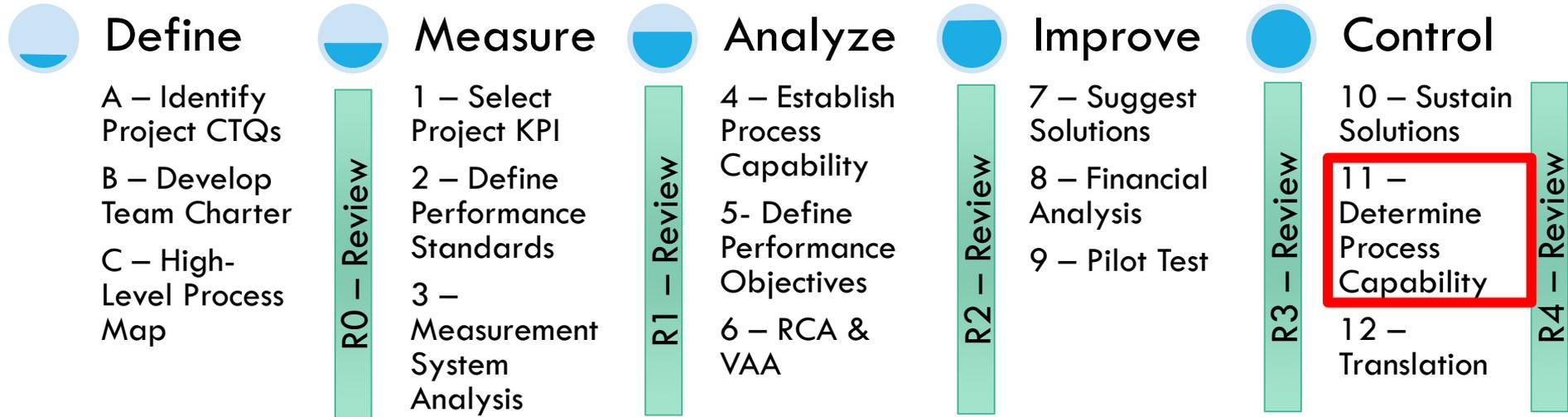
- ❖ Elimination: redesign the system to eliminate the chance of the error.
- ❖ Facilitation: provide methods of guidance, hard and soft, to minimize the chance of an error.
- ❖ Mitigation: lessen the effect of the error if the resulting defect gets to the customer.
- ❖ Flagging: proven methods for insuring 100% chance of capturing and removing all defective units prior to shipment

STANDARD WORK – WHAT?

Method of improving work efficiency by:

- Designing the best method to complete a work task
- Documenting the method
- Training employees involved in process to use this method

DMAIC MODEL



11 — DETERMINE PROCESS CAPABILITY

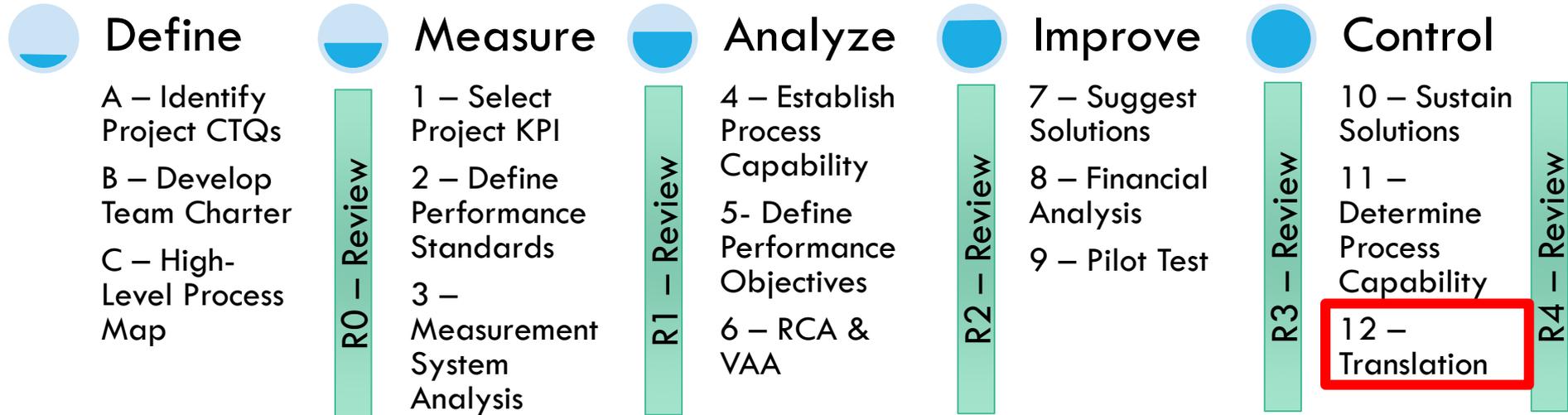
Focus Y, X

Determine post improvement capability and performance; Financial Validation

Sample Tools:

- Capability Indices

DMAIC MODEL



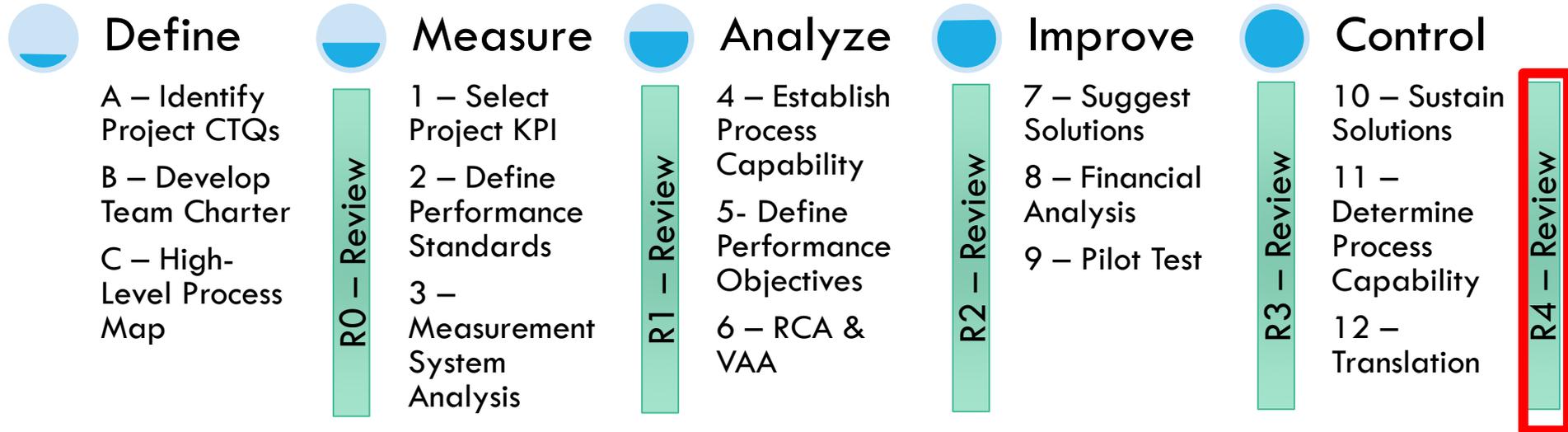


12 – TRANSLATION

Focus X

Develop and implement process control plan

DMAIC MODEL



R4 – CONTROL PHASE REVIEW

Systems for sustaining the Improvement (SOPs, Poka Yoke, Control Charts, etc...)

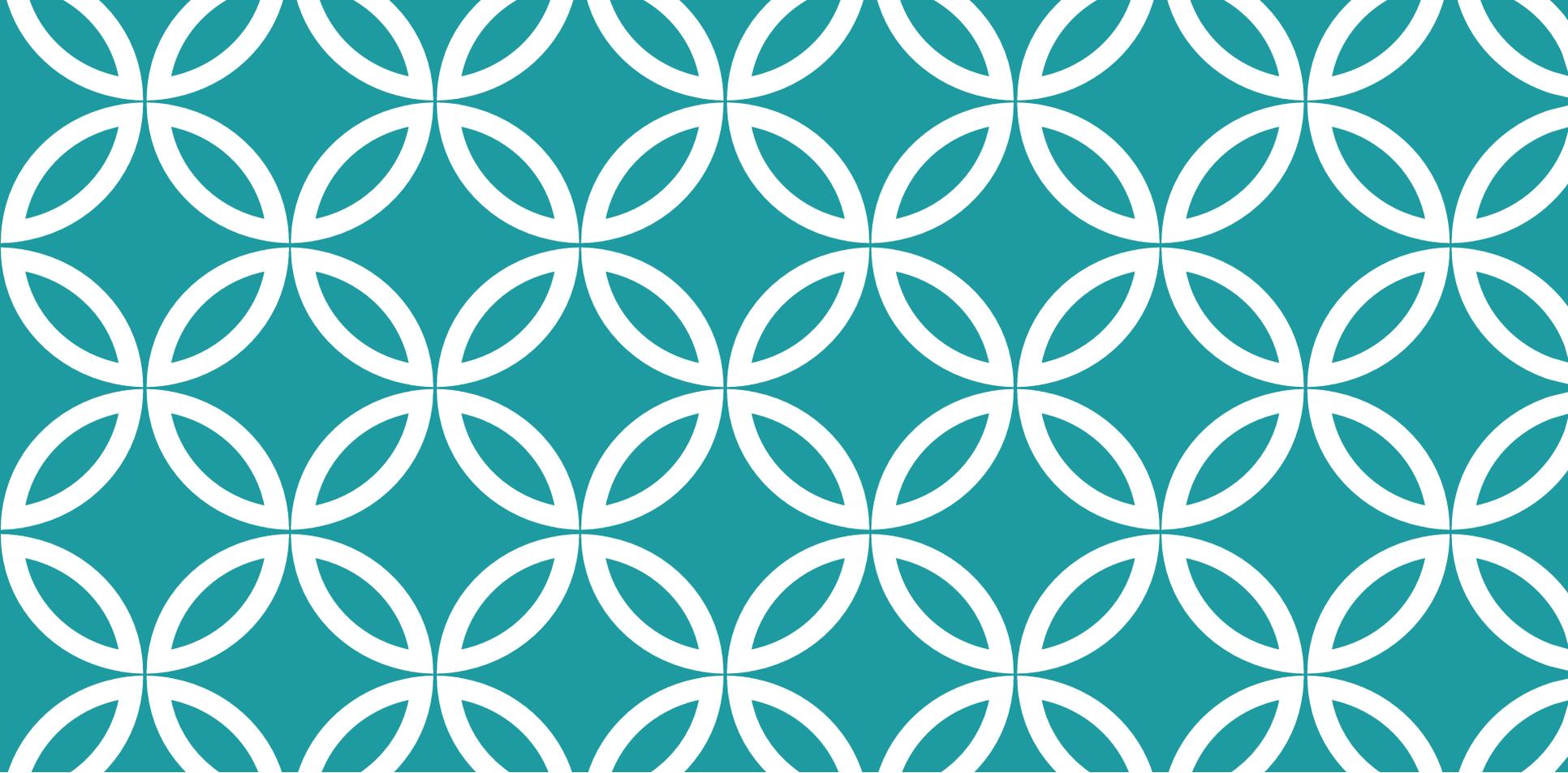
Tool Usage: (FMEA/Mistake Proofing/Visual Management/Control Charts)

New Process Capability:

Sigma Level:

DPMO:

Process Control Plan:



THANK YOU

