MFE 634:

PRODUCTIVITY AND QUALITY ENGINEERING

RE-OPENING OF SCHOOLS

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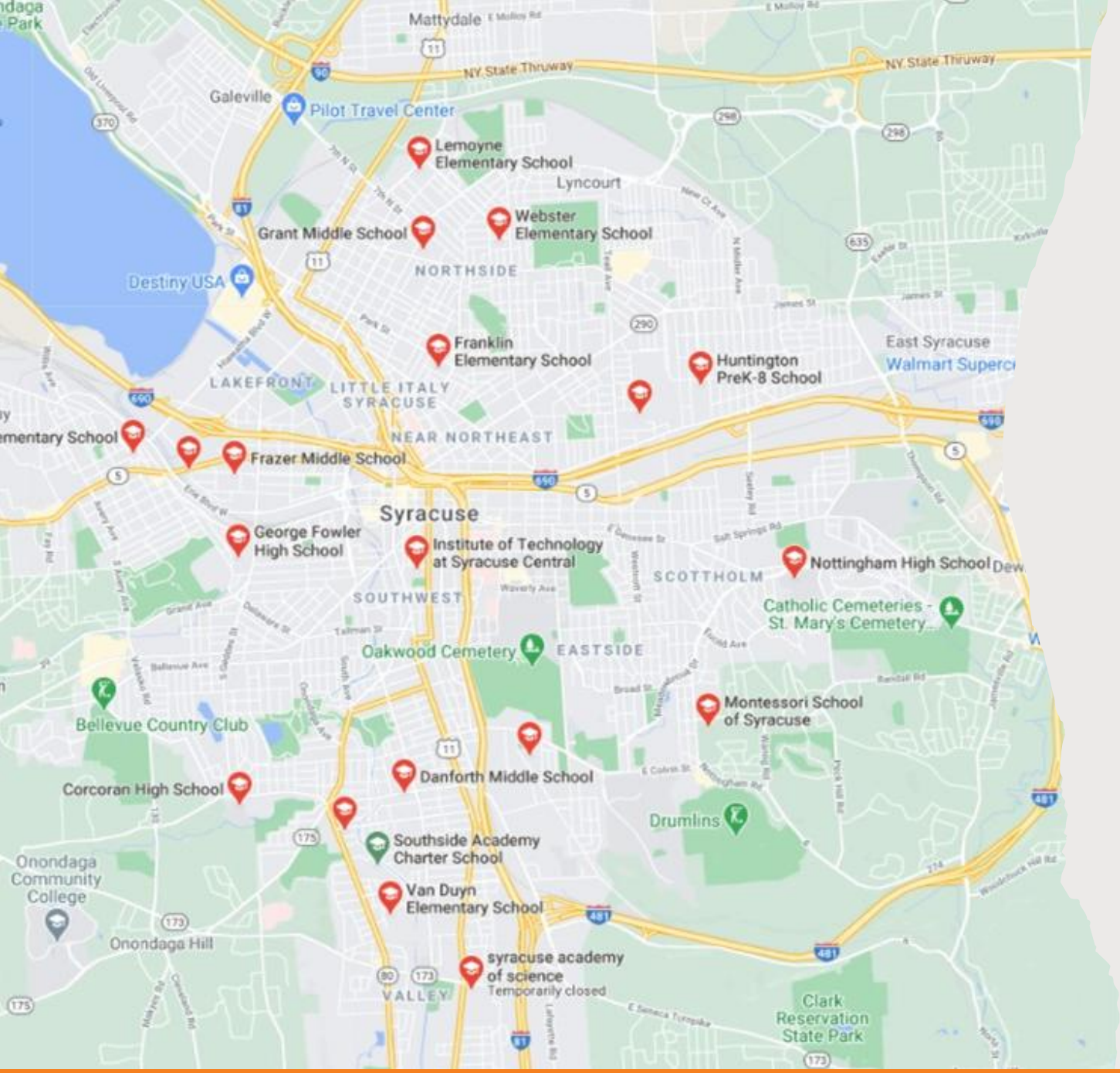
INTRODUCTION

- The most important actions for school administrators to take before reopening in-person services and facilities are **planning and preparing**.
- Some of the strategies school administrators should consider while developing their EOP(Emergency Operations Plans):
  - ✓ **Monitor local COVID-19 data**
  - ✓ **Adopt mitigation strategies to promote healthy behaviors**
  - ✓ **Examine accessibility of information and resources to reduce spread of COVID-19**
  - ✓ **Assess students' special needs**



SCHOOLS IN SYRACUSE, NY

High Schools

- Corcoran
- Henninger
- Institute of Technology (ITC)
- Nottingham
- PSLA @ Fowler

Alternative Programs

- Adult Education
- Elmcrest
- McCarthy @ Beard
- Oasis Academy
- PFLA

Middle & Pre-K-8 Schools

- Brighton Academy
- Clary Middle School
- Ed Smith Pre-K-8 School
- Expeditionary Learning Middle
- Frazer Pre-K-8 School
- Grant Middle School
- Huntington Pre-K-8 School
- HW Smith Pre-K-8 School
- Lincoln Middle School
- Roberts Pre-K-8 School
- Syracuse Latin
- Syracuse STEM @ Blodgett

Elementary Schools

- Bellevue Elementary School
- Delaware Primary
- Dr. Weeks Elementary School
- Franklin Elementary School
- LeMoyne Elementary School
- McKinley-Brighton Elementary
- Meachem Elementary School
- Montessori @ Lemoyne
- Porter Elementary School
- Salem Hyde Elementary School
- Seymour Dual Language Academy
- STEAM @ Dr. King
- Van Duyn Elementary School
- Webster Elementary School

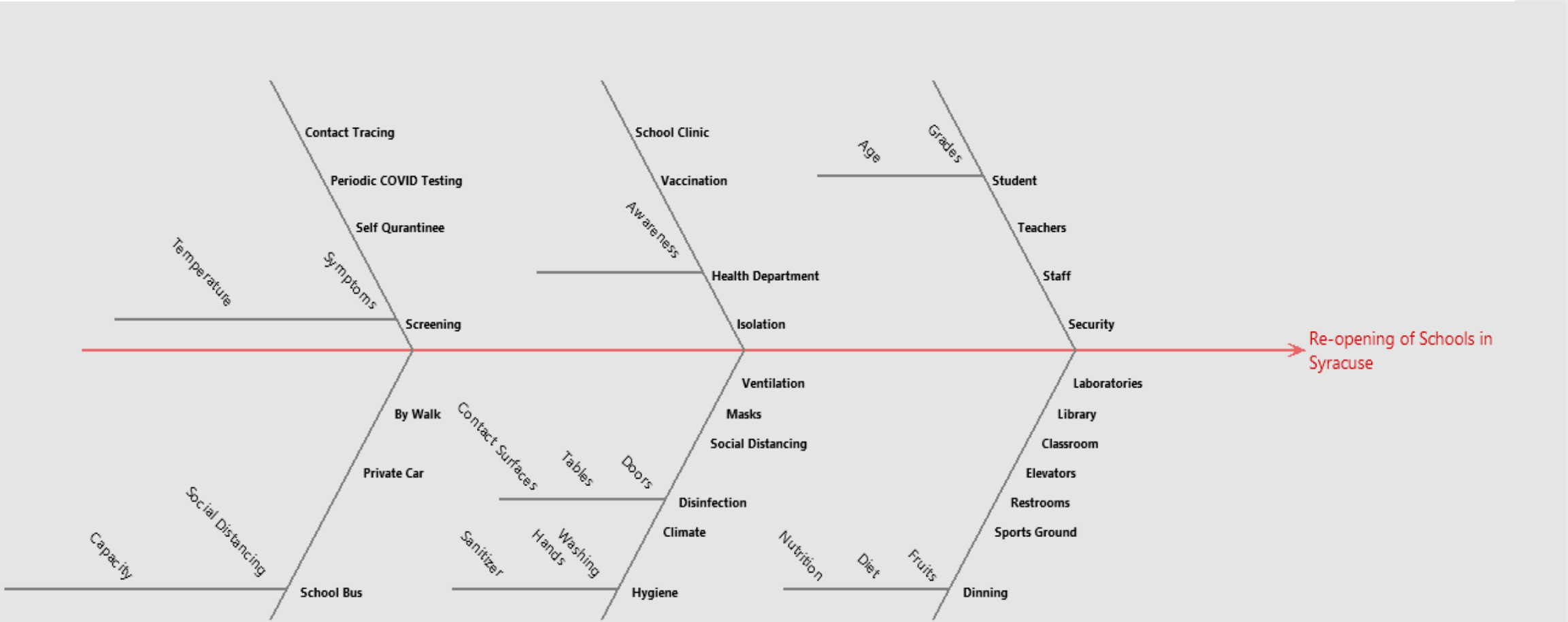
BRAINSTORMING

Brainstorming is a group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members

AFFINITY DIAGRAM

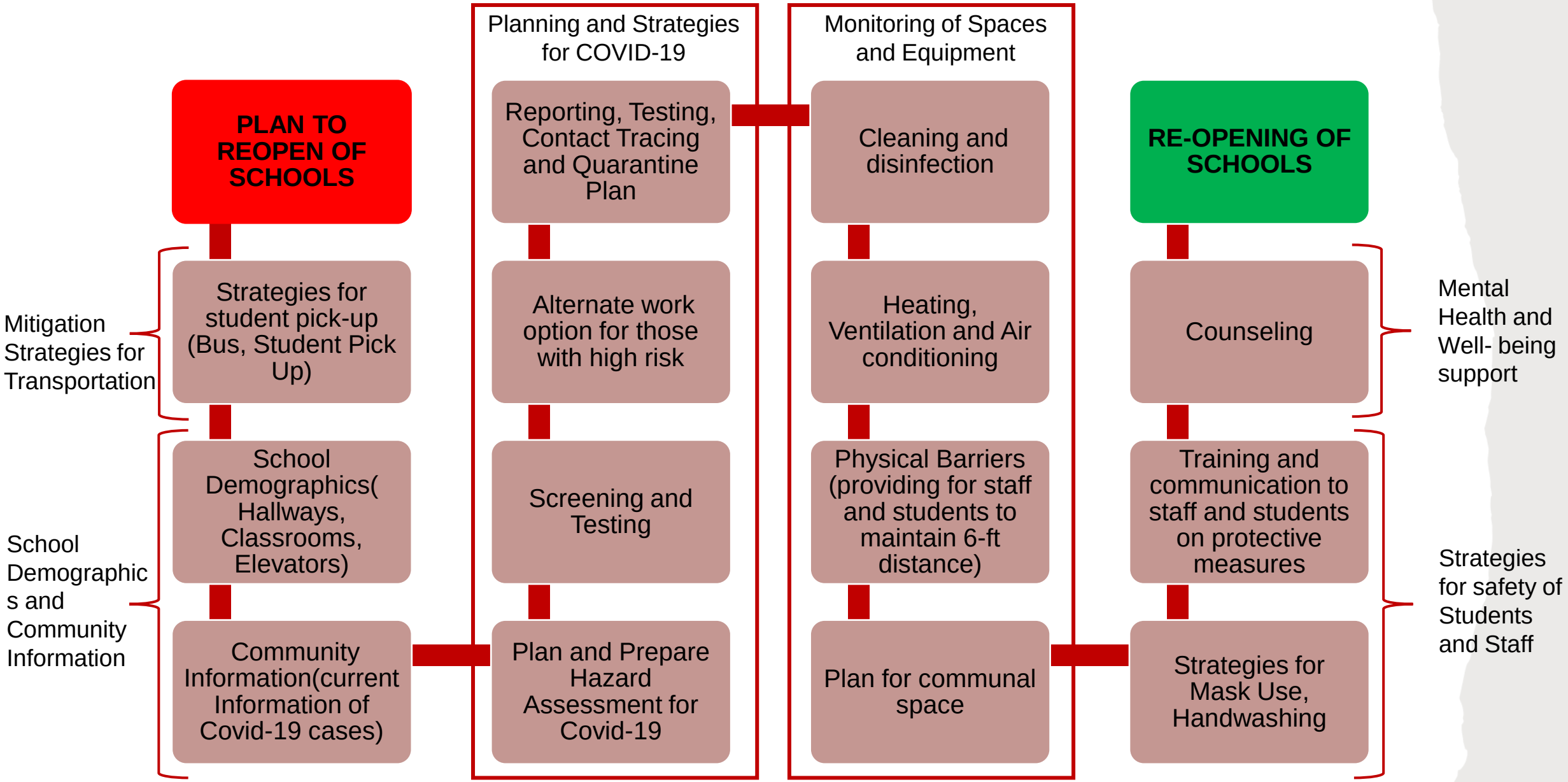
MEASUREMENTS	MATERIALS	MAN	ENVIRONMENT	METHODS	MACHINES
School Clinic	Dinning	Students	Screening	Ventilation	By Walk
Vaccination	Nutrition	Faculty	Symptoms	Masks	Private Car
Health Department	Diet	Staff	Temperature	Social Distancing	School Bus
Awareness	Fruits	Security	Self-quarantine	Disinfection	Social Distance
Isolation/ Quarantine	Sports Ground		Periodic COVID Testing	Doors, Tables, Contact Surfaces	Capacity
	Restrooms		Contact Tracing	Climate	
	Classroom			Hygiene	
	Elevators			Washing Masks	
	Laboratories & Library			Sanitizer	

ISHIKAWA CHART

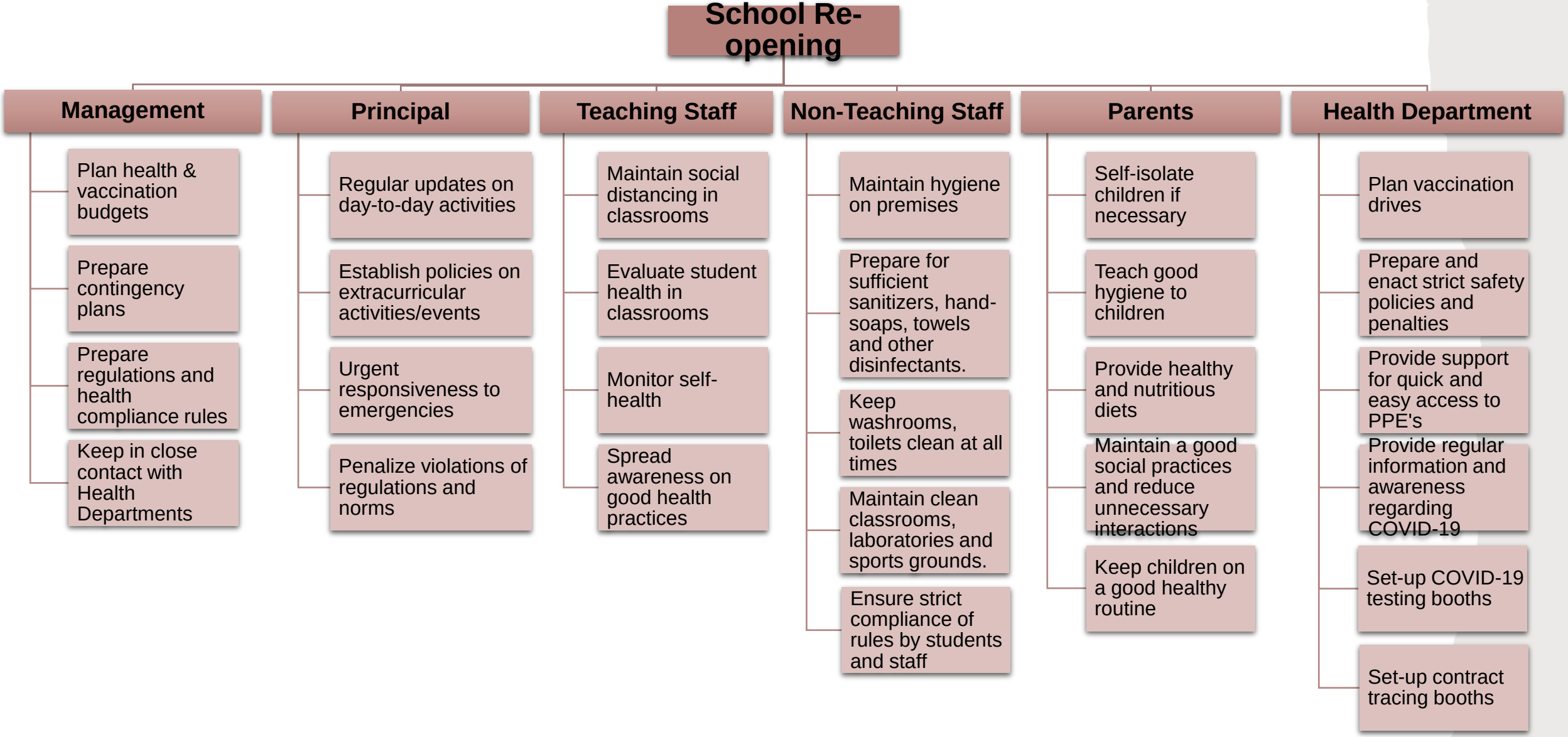


PROCESS FLOW CHART

PROCESS FLOW CHART (contd...)



ORGANIZATIONAL FLOWCHART



COST OF POOR QUALITY

COPQ	Internal Failures	External Failures	Appraisal Failures	Prevention Failures
Hygiene	- Not washing hands before and after meals - Improper Ventilation	- Insufficient cleaning materials - Unclean utensils and takeaway boxes - Usage of unsanitary equipment	– Periodic checklists for cleaning equipment inclusive of checking expiration – Food quality checks	- Quality checks by health department - Sufficient inventory for hygiene related materials
Social Distancing	- Students and faculty ignoring the 6 feet gap - Overcrowding of spaces	- Lack of open spaces	– Proper planning for classroom capacities, social distancing practices	- Awareness on social distancing protocols and repercussions
PPEs	- No usage of masks, face-shields, gloves	- Shortage of PPEs from supplier	- Quality checks of PPEs received in the facility - Demand Planning for PPEs	- Awareness on wearing PPEs and their consequences for not wearing them
COVID Testing & Tracing	- Lack of testing technology - Lack of testing materials - Lack of testing sites - Lack of contact tracing system	- Improper disposals of used testing materials - Lack of training to handle highly contagious samples	- Training of employees for testing, tracing and equipment handling - Proper database management for testing, tracing	- Proper checklists for every equipment and material - Barcodes for sample classification and error-proofing
Personnel	- Lack of knowledge for using online class platforms - Lack of awareness on safety measures and precautions - Shortage of health	- Lack of surveillance for maintaining safety measures - Software malfunctions	- Proper training for online classes to faculty and students - Scrutiny for maintain safety measures	- Simplified steps for connecting over internet for online classes - Proper resource allocation for health staff

QUALITY ASSESSMENT

INDIVIDUALS TO INTERVIEW

- Head of Department of Public Safety
- Head of Health Department
- Head of Transportation Department
- Head of Information Technology Department
- School Principal
- Teaching & Non-Teaching Staff
- Parents

QUALITY ASSESSMENT QUESTION AND ANSWERS FOR INDIVIDUALS TO INTERVIEW

Head of Department of Public Safety:

- Will there be consistent patrolling in and around school?
  - ✓ Yes, in and around the campus will be patrolled even after school hours.
- Will there be an officer present at crowded places on school premises (library, canteen, etc.)?
  - ✓ Yes, there will an officer present to maintain the capacity of crowded places and avoid the spread of COVID-19.

Head of Health Department:

- What kind of face coverings are permitted?
  - ✓ Face covering are required by all students when on campus and it should be covering the students nose and mouth.

QUALITY ASSESSMENT QUESTION AND ANSWERS FOR INDIVIDUALS TO INTERVIEW

Head of Transportation Department:

- Are the contracted-transportation providers subject to the same minimum standards required by schools?
  - ✓ Yes, contracted transportation providers must ensure that students wear face coverings while travelling in bus. They should also ensure that students adhere to social distancing requirements during transportation to and from school and are required to adhere to the vehicle cleaning and disinfecting protocols.
- Will the buses run with the same frequency?
  - ✓ The buses will run with the same frequency while maintaining the minimum standards required for COVID-19.

QUALITY ASSESSMENT QUESTION AND ANSWERS FOR INDIVIDUALS TO INTERVIEW

Head of Information Technology Department:

- ❑ Will students have access to a Hybrid course structuring?
  - ✓ Yes, students will have access to the remote applications enabling an online course study module.
- ❑ Can students sign in to Zoom without any issues?
  - ✓ Yes, students can log on to Zoom without any issues and can contact IT Department immediately if in any trouble.

School Principal:

- ❑ Will students receive emails if there are any change in rules?
  - ✓ Yes, emails will be sent out on a weekly basis to inform students of any state or school rule updates.

QUALITY ASSESSMENT QUESTION AND ANSWERS FOR INDIVIDUALS TO INTERVIEW

Teaching & Non-Teaching Staff:

- What are the obstacles faced by teachers in the online style of instruction?
  - ✓ Since a few teachers are not accustomed to the online training mode, they face problems with the use of online resources and software.
- Is the non-teaching staff well equipped for maintaining hygiene and safety in school premises?
  - ✓ Training sessions have been conducted in order to train the staff with the safety protocols and procedures.

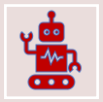
Parents:

- Are parents sending their kids to school feeling uncomfortable?
  - ✓ Majority of the parents are comfortable sending their children to schools for in-person experience. However, a few students will be taking online courses

PLANNING FOR

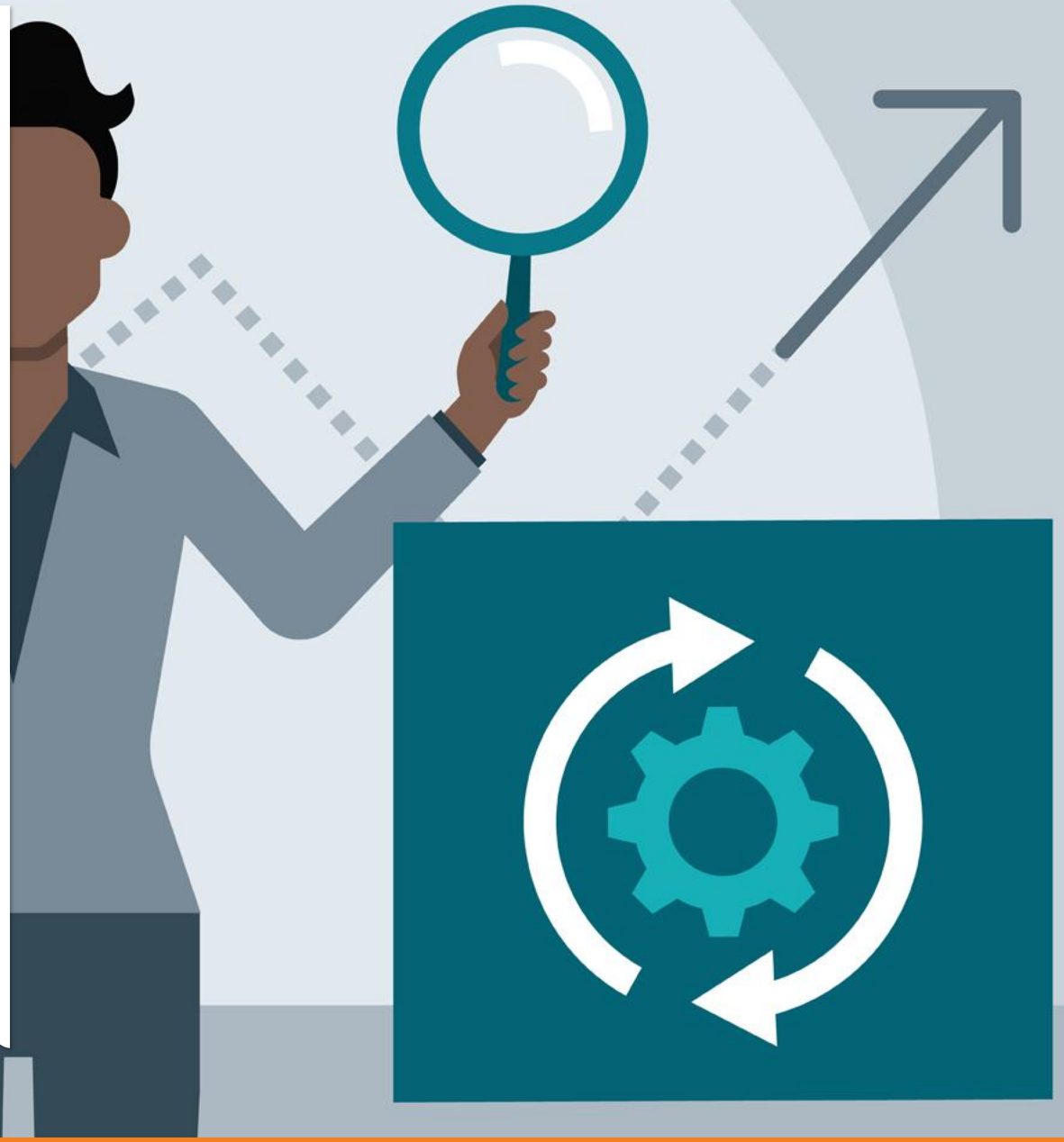
LEAN SIX SIGMA

THE PHASES..

	Define	1. Business Case 2. Problem Statement 3. Communication Plan 4. Stakeholder Analysis 5. SIPOC Chart 6. CTQC's
	Measure	1. Ishikawa Diagram 2. Key Performance Indicator 3. Risk Assessment
	Analyze	1. Data Collection 2. Pareto Chart 3. Probability Chart 4. Box Plot 5. Histogram 6. Capability Six Pack Report
	Improve	1. Recommendations 2. Poke-Yoke (Error Proofing)
	Control	1. Checklists 2. Risk Analysis & Control 3. Contingency Planning

PHASE 1: DEFINE

- The goal of this phase is to identify potential projects, select and define a project while setting up a project team.
- It includes problem identification and the probable business case associated with it.



PHASE 1: DEFINE (contd…)

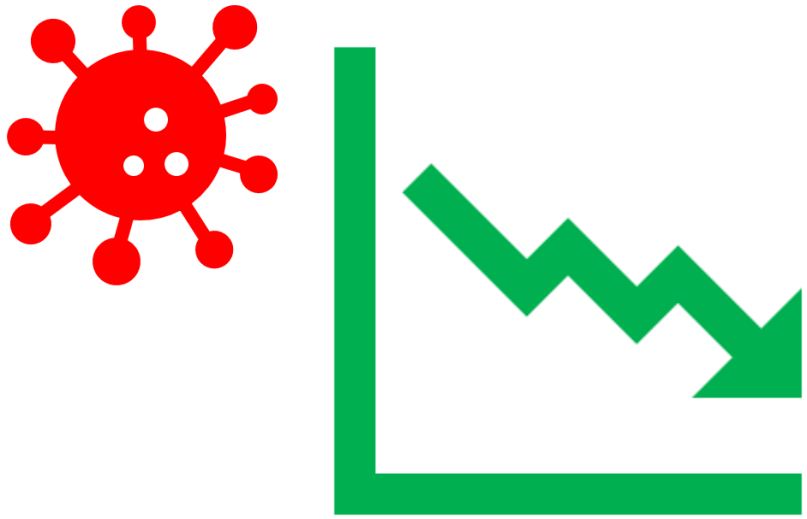
1. **Business Case:**

   - **100% Re-opening of Schools in Onondaga District – Syracuse by June 2021 to maintain a safe and secure in-person schooling experience to students and staff.**
   - **To avoid health safety and hygiene lapses that would incur large financial losses and legal consequences.**

PHASE 1: DEFINE (contd…)

2. Problem Statement:

- ✓ **By June 2021, a 100% re-opening of Schools in Syracuse Onondaga District requires the total number of COVID 19 positive cases less than 5% of the total number of student enrollments.**



3. Communication Plan:

Version :	1				
Date:	03/07/2021				
Stakeholder Name	**Method (email updates, invite to tollgate, phone call, send slides)**	**Purpose (why & what)**	**Team member responsible (or sponsor)**	**Frequency (dates)**	**Notes**
Management	e-mail updates, invite to tollgates, scheduled meetings, phone calls	critical approvals, project updates	Shreya	at tollgate, monthly	Interaction as needed
Principal	e-mail updates, invite to tollgates, scheduled meetings, phone calls	information, execution	Shreya	at tollgate	Participate in weekly meetings
Parents	e-mail updates, send slides, invite to tollgates, weekly meetings, phone calls	regular information, execution, keep updated	Saad	weekly, at tollgate	Closely Involved
Teachers	e-mail updates, invite to tollgates, scheduled meetings	process information	Saad	As needed	Participate in weekly meetings
Students	e-mail updates, scheduled meetings	process information	Dhanesh	As needed	Interaction as needed
Health Department	e-mail updates, invite to tollgates, scheduled meetings, phone calls	key updates, legal procedures	Manas	As needed	Interaction as needed

PHASE 1: DEFINE (contd...)

4. Stakeholder Analysis:

Version :	1		Keep the Stakeholder Analysis Confidential			
Date:	03/07/2021					
Stakeholder Name	**Stakeholder impact on project**	**Stakeholder level of influence on success of project**	**Stakeholders current attitude towards project**		**Stakeholder score (H=3, M=2, L=1,**	**Action Plan for Stakeholder**
	(H, M, L)	**(H, M, L)**	**(+, 0, -)**	**Comments**	**+=1, 0=2, -=3)**	
Management	H	H	+	Driving the project, interested in the outcome	9	
Principal	H	H	+	Driving project	9	Avoid getting influenced or carried away in a direction towards personal objectives.
Parents	M	M	+	Supports project, interested in outome	4	
Teachers	L	L	0	Familiar with project and objective	2	
Students	L	H	-	key priority and crucial to the project outcome	9	Be ready for any obstacles regarding design/process flows and operations.

PHASE 1: DEFINE (contd…)

5. SIPOC Chart:

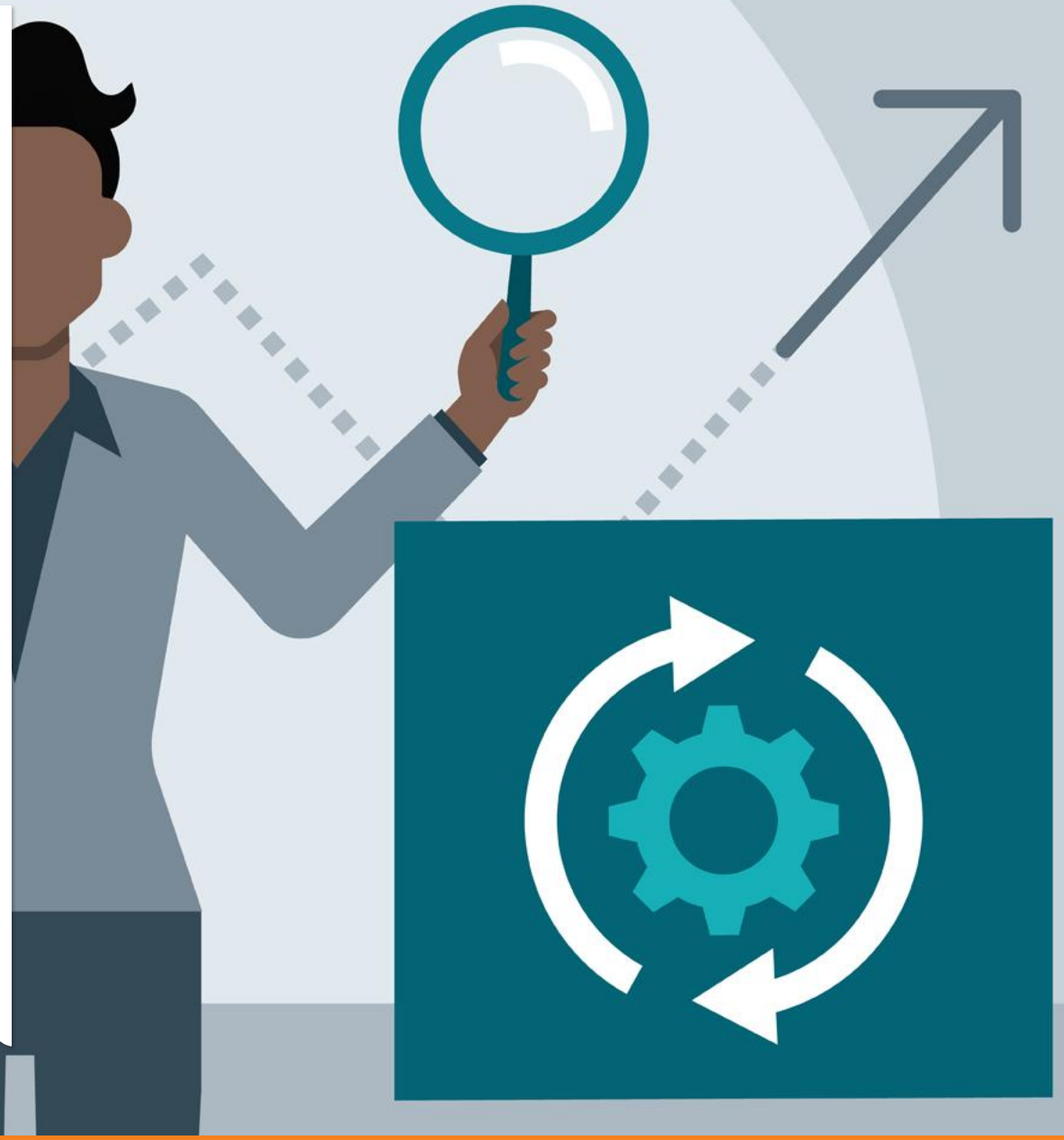
SIPOC: Re-opening of Schools						
S	**I**	**Process Requirements**	**P**	**O**	**Customer Requirements**	**C**
Suppliers	**Inputs**		**Process**	**Outputs**		**Customers**
NIH	COVID 19 guidelines & mandates		Refer COVID 19 guidelines --- Evaluate Virus related risks --- Understand & Assess state-wide restrictions --- Get Approvals from State Health Dept. --- Collaborate with SUNY Upstate Hospital --- Procure sufficient PPE materials --- Enforce regulations and prevention procedures	Accurate COVID 19		Teachers
CDC	Virus related information & vaccine updates			Accurate virus propagation and prevention information		Parents
Mayor's Office	State-wide info on restrictions and policies			Correspond and plan better COVID contingency strategies		Students
Syracuse Dept. of Health	Permissions & grants related to School activities			Quick Policy approvals and outbreak containment support		
SUNY Upstate Hospital	Vaccination, Rapid Testing and Screening facilities and services			Quick testing, results and vaccination drives		
PPE Manufacturers	Masks, Sanitizers, Face-shields, Gloves			Sufficient inventory of protective materials		
Management	Updated directions to the respective school authorities			Ability to implement effective strategies		
Principal	Execute orders and enact protocols for smooth learning			Enact rules and drive good hygiene and social practices		

6. Critical to Quality Characteristics (CTQC) Chart:

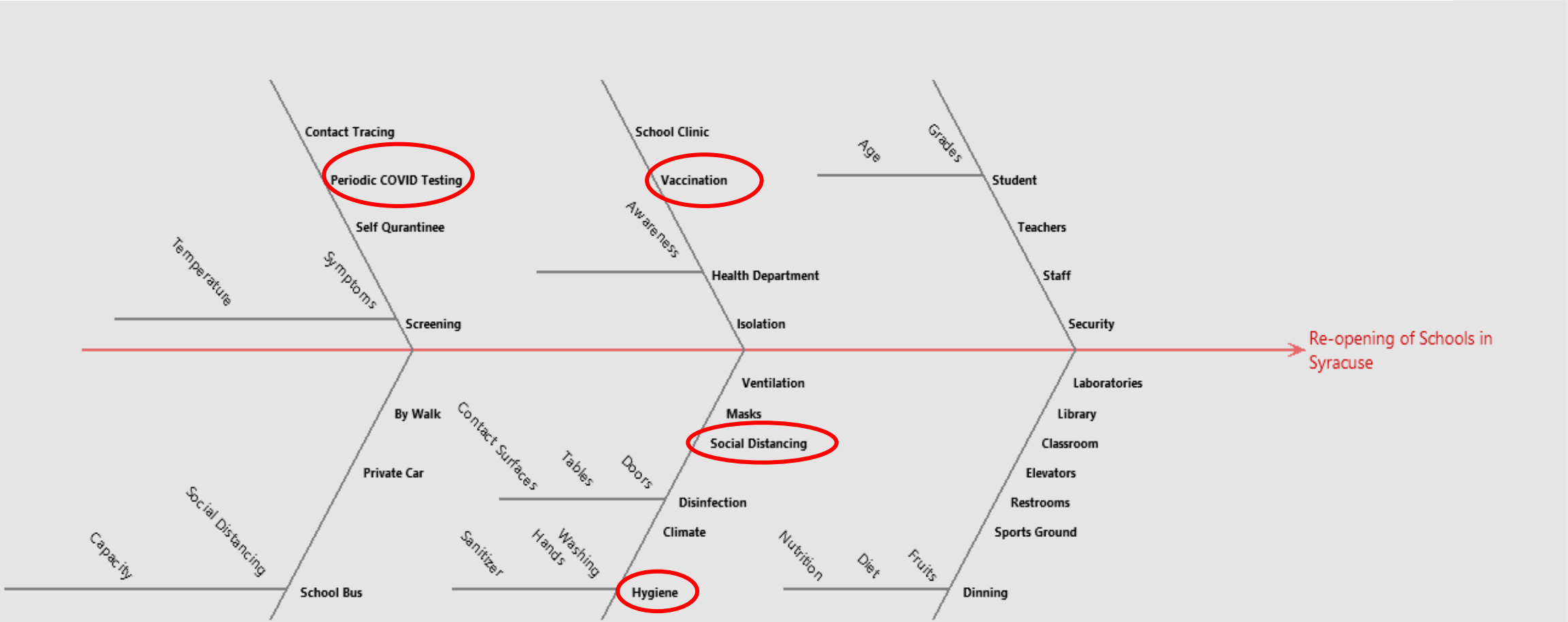
Customers	Need	Drivers	CTQC's
➉Management ➉Principal ➉Teachers ➉Parents ➉Students	➉Low positive cases ➉Avoid out-breaks ➉Sufficient PPE's ➉Vaccination ➉Rapid Testing & Screening	➉Accurate Information ➉Practical strategies ➉Quick Implementations ➉Efficient Inventory Management ➉Detailed Risk Analysis and Control Planning	➉Infection rate ➉Number of positive cases/per unit period ➉Inventory cycle count ➉Physical inventory (demand rate vs supply rate) ➉Turns ratio

PHASE 2: MEASURE

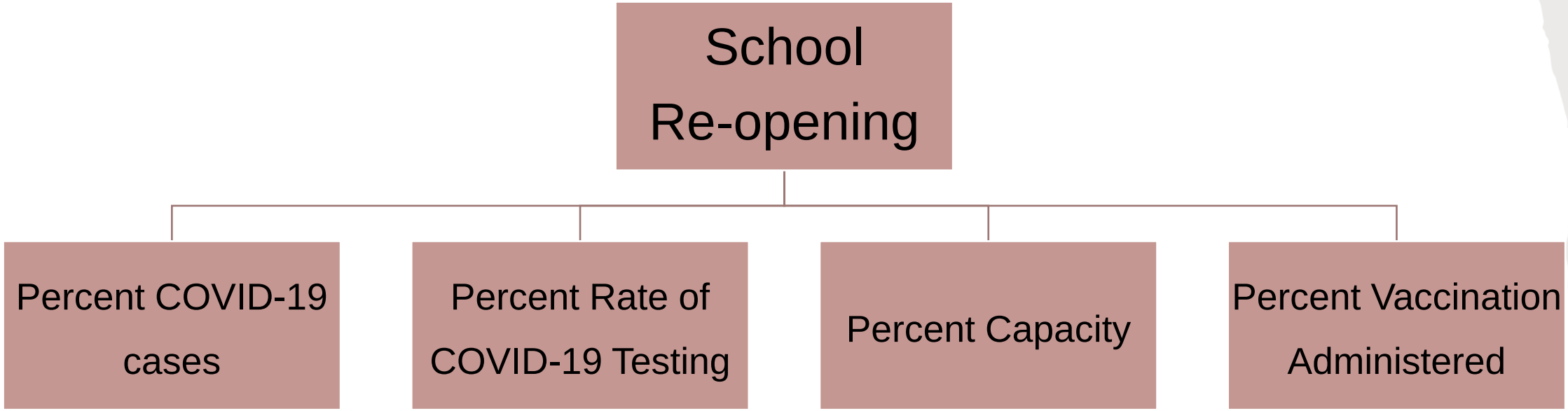
- The goal of this phase is to measure the **process** to determine its current performance and quantify the problem.
- It consist of documenting the process and planning for Data Collection.



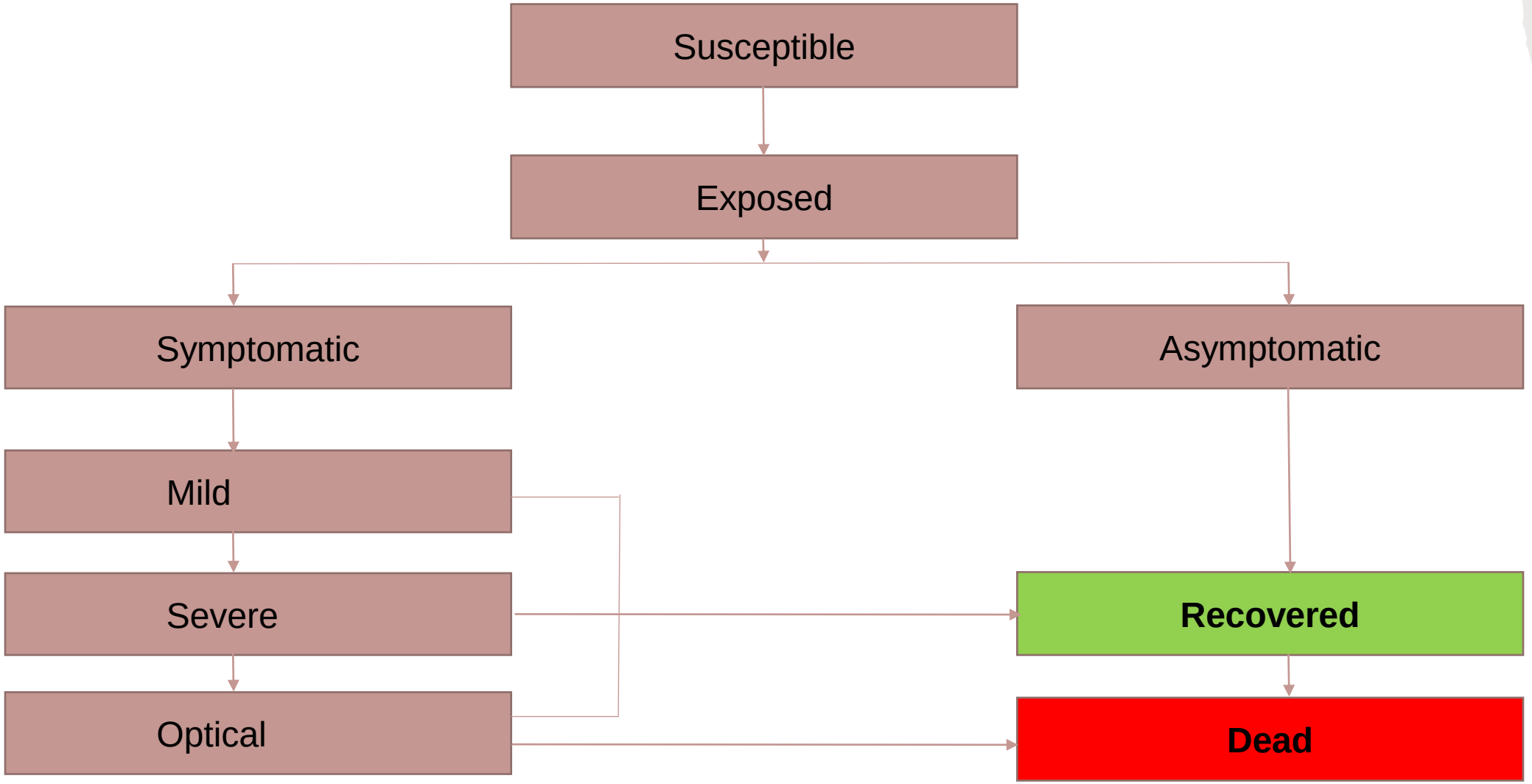
ISHIKAWA CHART



KEY PERFORMANCE INDICATORS

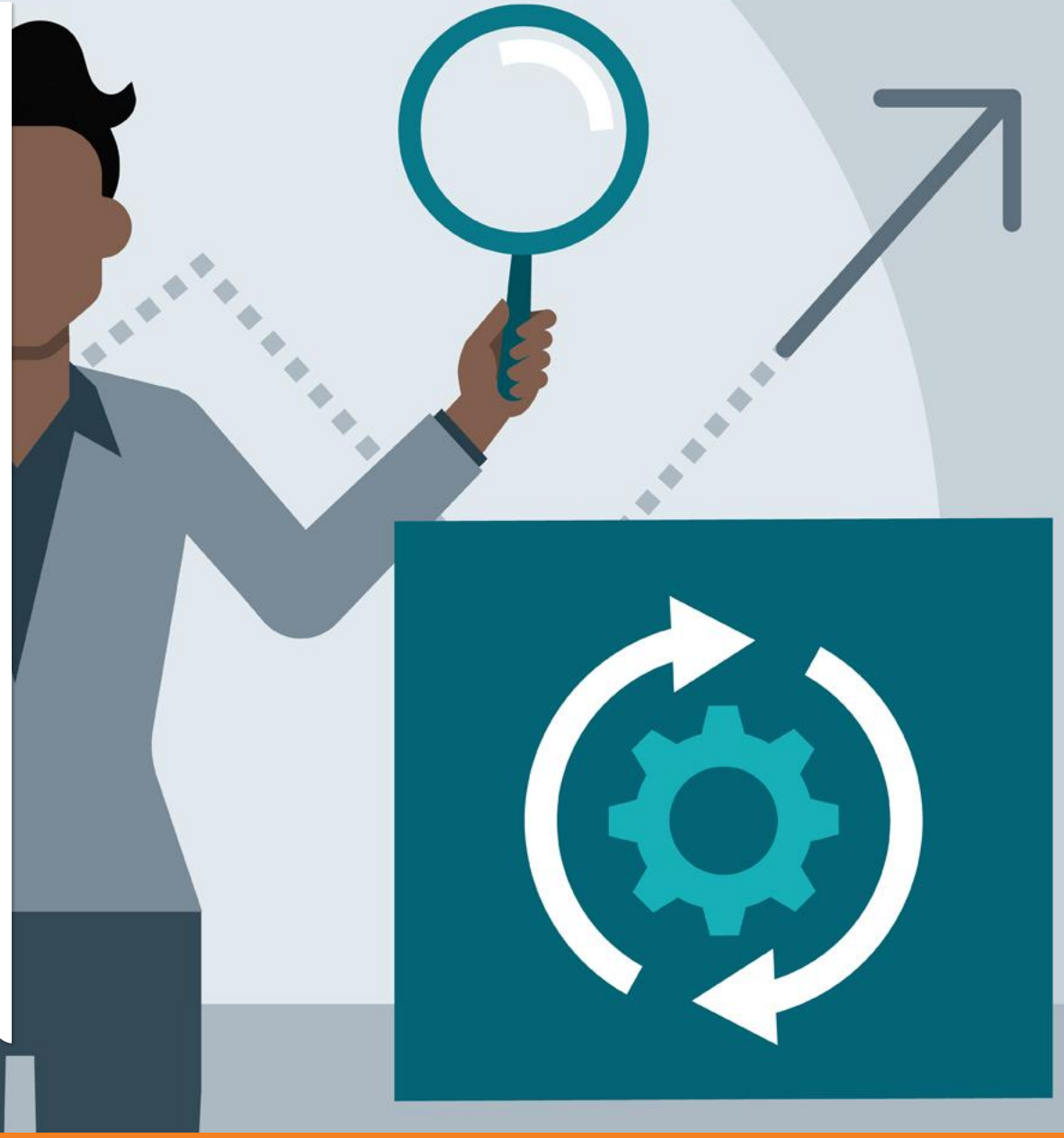


RISK ASSESSMENTS



PHASE 3: ANALYZE

- The Analyze Phase of **DMAIC** helps project teams identify problems in the production process that cause product defects.
- This phase of Six Sigma methodology is loaded with tools to help spot the problems in the production process and to determine if these problems are the root causes of defects.



PHASE 3: ANALYZE – DATA COLLECTION
INFECTED CASES IN ONEIDA COUNTY

District	County	Enrollment	Total cases / 1000 students	Total cases	Students In-Person	Students remote	Staff
Sherrill	Oneida	1411	28.3	40	9	20	11
Waterville	Oneida	705	25.5	18	10	0	8
Oriskany	Oneida	653	23	15	1	3	11
New Hartford	Oneida	2565	22.2	57	18	24	15
Clinton	Oneida	1247	21.7	27	11	10	6
Sauquoit Valley	Oneida	942	20.2	19	7	5	7
Whitesboro	Oneida	3053	19	58	4	33	21
Remsen	Oneida	439	18.2	8	3	0	5
Adirondack	Oneida	1161	18.1	21	5	8	8
Westmoreland	Oneida	919	16.3	15	7	2	6
Holland Patent	Oneida	1241	16.1	20	5	6	9
NY Mills	Oneida	560	16.1	9	3	3	3
Camden	Oneida	2010	15.4	31	0	14	17
Rome	Oneida	5288	11.9	63	0	32	31
Utica	Oneida	9665	6	58	0	10	48

PHASE 3: ANALYZE – DATA COLLECTION
INFECTED CASES IN ONONDAGA COUNTY

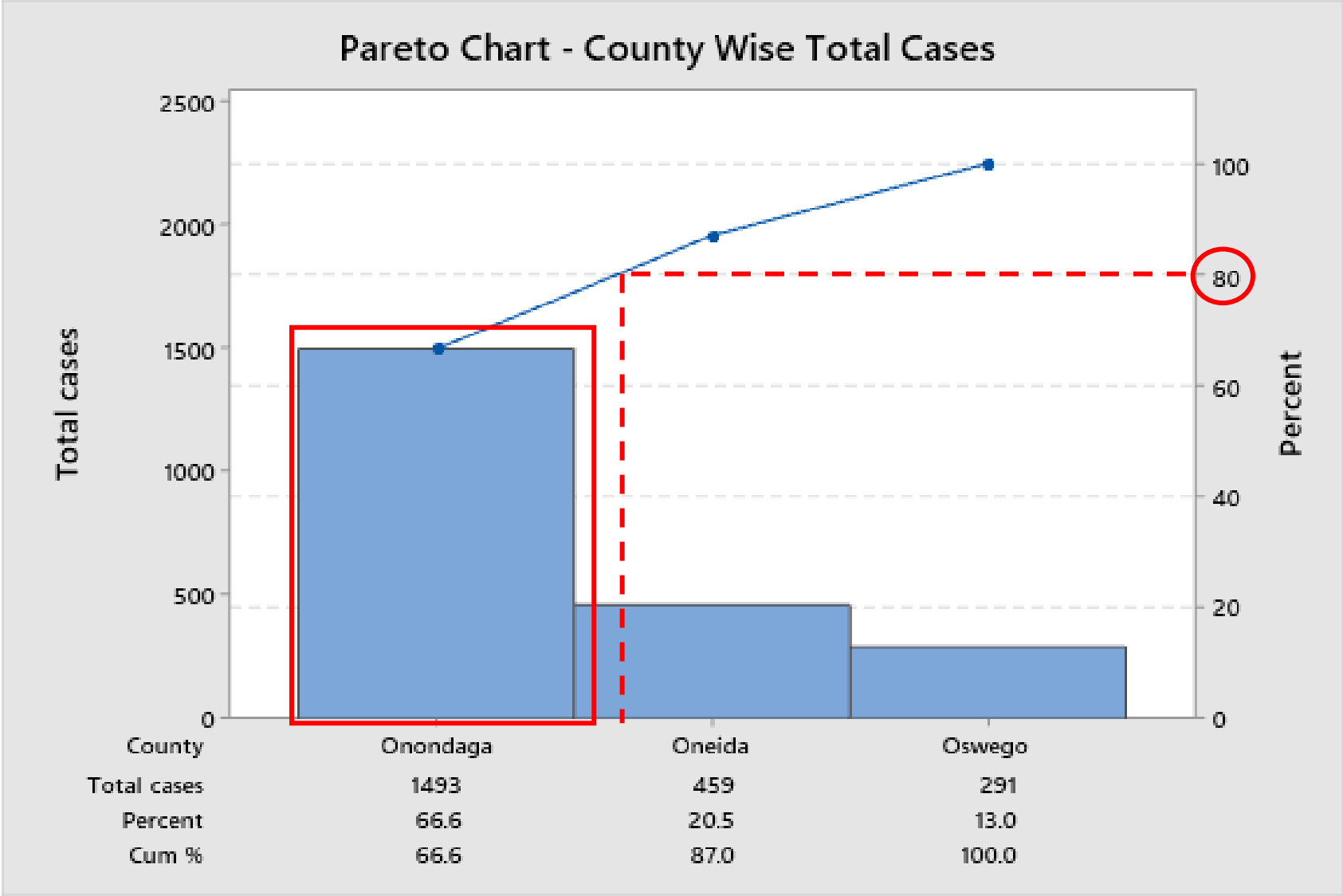
District	County	Enrollment	Total cases / 1000 students	Total cases	Students In-Person	Students remote	Staff
Skaneateles	Onondaga	1296	46.3	60	35	15	10
Solvay	Onondaga	1457	30.9	45	24	10	11
Lafayette	Onondaga	869	29.9	26	6	15	5
Westhill	Onondaga	1699	28.3	48	37	0	11
Baldwinsville	Onondaga	5333	28.1	150	93	24	33
West Genesee	Onondaga	4300	24.9	107	68	10	29
Liverpool	Onondaga	6836	24.4	167	108	16	43
Tully	Onondaga	738	24.4	18	15	3	0
North Syracuse	Onondaga	8248	22.3	184	102	41	41
Syracuse	Onondaga	20028	21.6	433	150	122	161
Fayetteville-Manlius	Onondaga	3993	20.8	83	39	11	33
Jordan-Elbridge	Onondaga	1020	19.6	20	12	3	5
Jamesville-DeWitt	Onondaga	2597	18.1	47	37	4	6
Lyncourt	Onondaga	393	17.8	7	3	1	3
Marcellus	Onondaga	1478	17.6	26	11	3	12
Onondaga	Onondaga	821	17.1	14	4	7	3
Fabius-Pompey	Onondaga	593	15.2	9	1	3	5
East Syracuse							

PHASE 3: ANALYZE – DATA COLLECTION
INFECTED CASES IN OSWEGO COUNTY

District	County	Enrollment	Total cases / 1000 students	Total cases	Students In-Person	Students remote	Staff
Central Square	Oswego	3574	22.9	82	26	32	24
Altmar-Parish-Williamstown	Oswego	450	22.2	10	6	1	3
Mexico	Oswego	2003	20.5	41	25	3	13
Fulton	Oswego	3226	20.1	65	45	1	19
Phoenix	Oswego	1644	13.4	22	10	4	8
Pulaski	Oswego	972	13.4	13	5	3	5
Hannibal	Oswego	1400	12.9	18	3	6	9
Oswego	Oswego	3528	9.9	35	16	3	16
Sandy Creek	Oswego	653	7.7	5	1	2	2

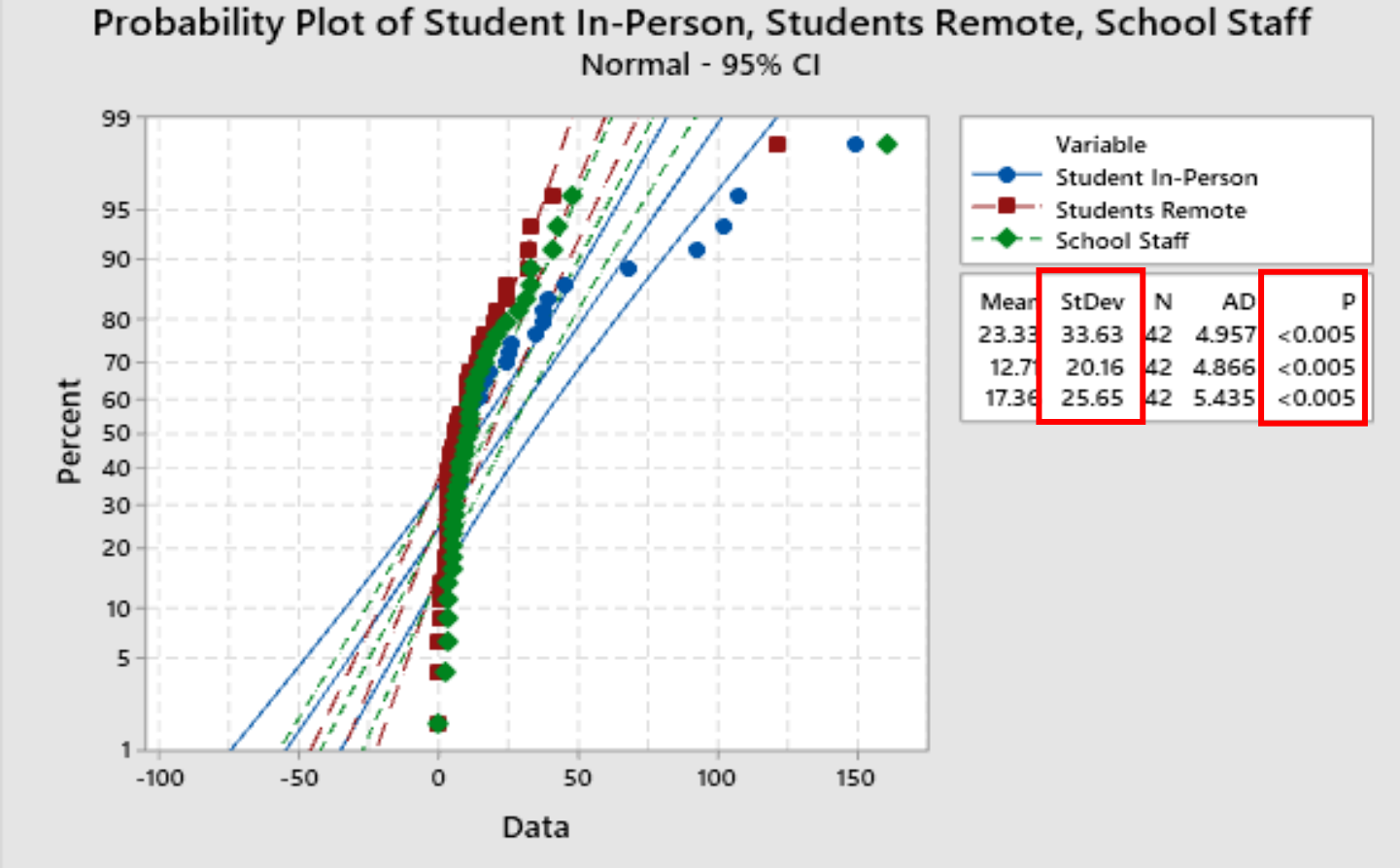
PHASE 3: ANALYZE

- Pareto principle is also known as 80/20 rule.
- In the graph, almost 66% and 14% of the total cases by county are from Onondaga and Oneida respectively.
- **Hence, for our project we will be concentrating on Onondaga County.**



PHASE 3: ANALYZE

The p-value is 0.005 which is lesser than the significance level of 0.05 and it hence it does not follow normal distribution.



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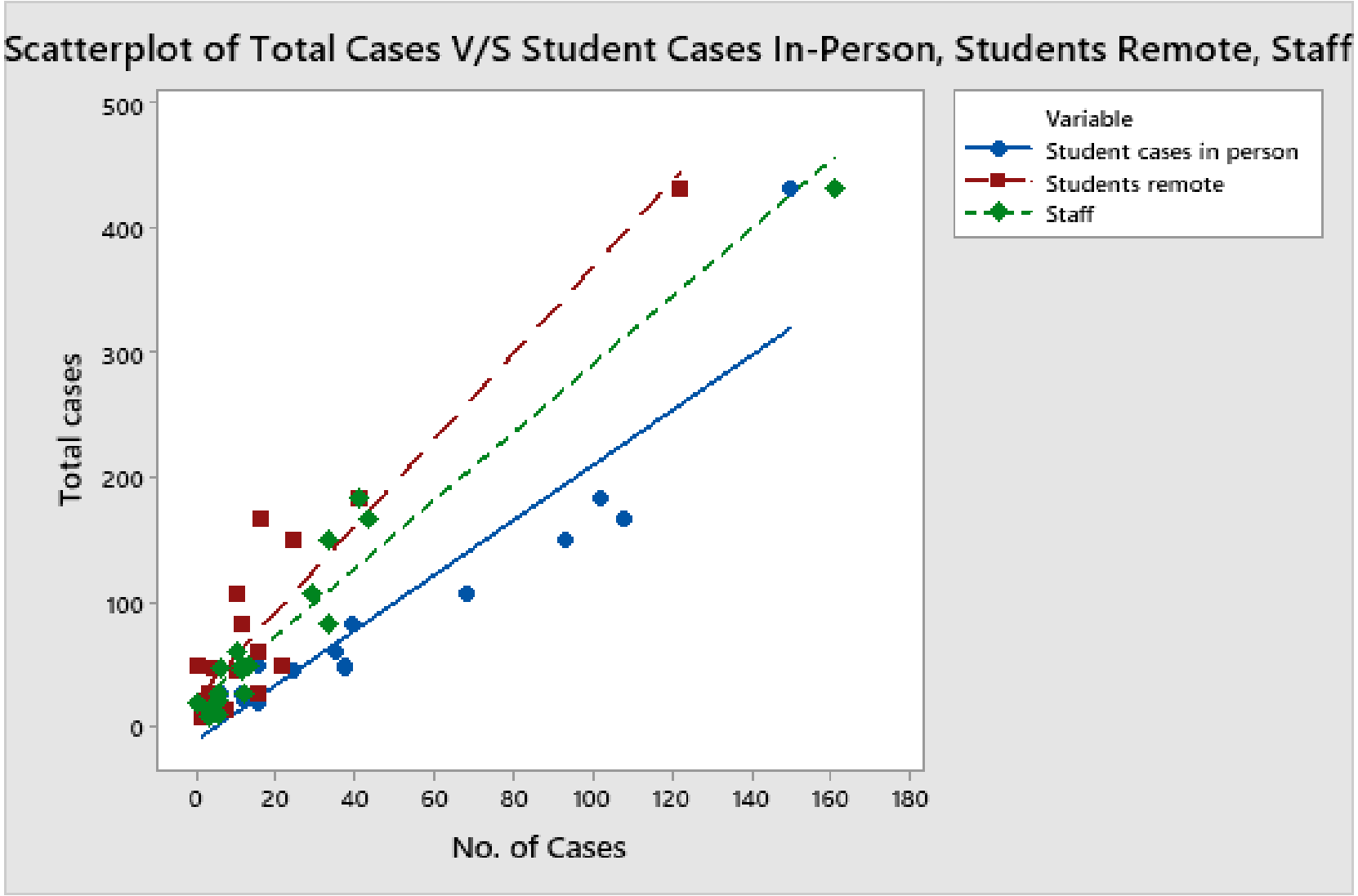

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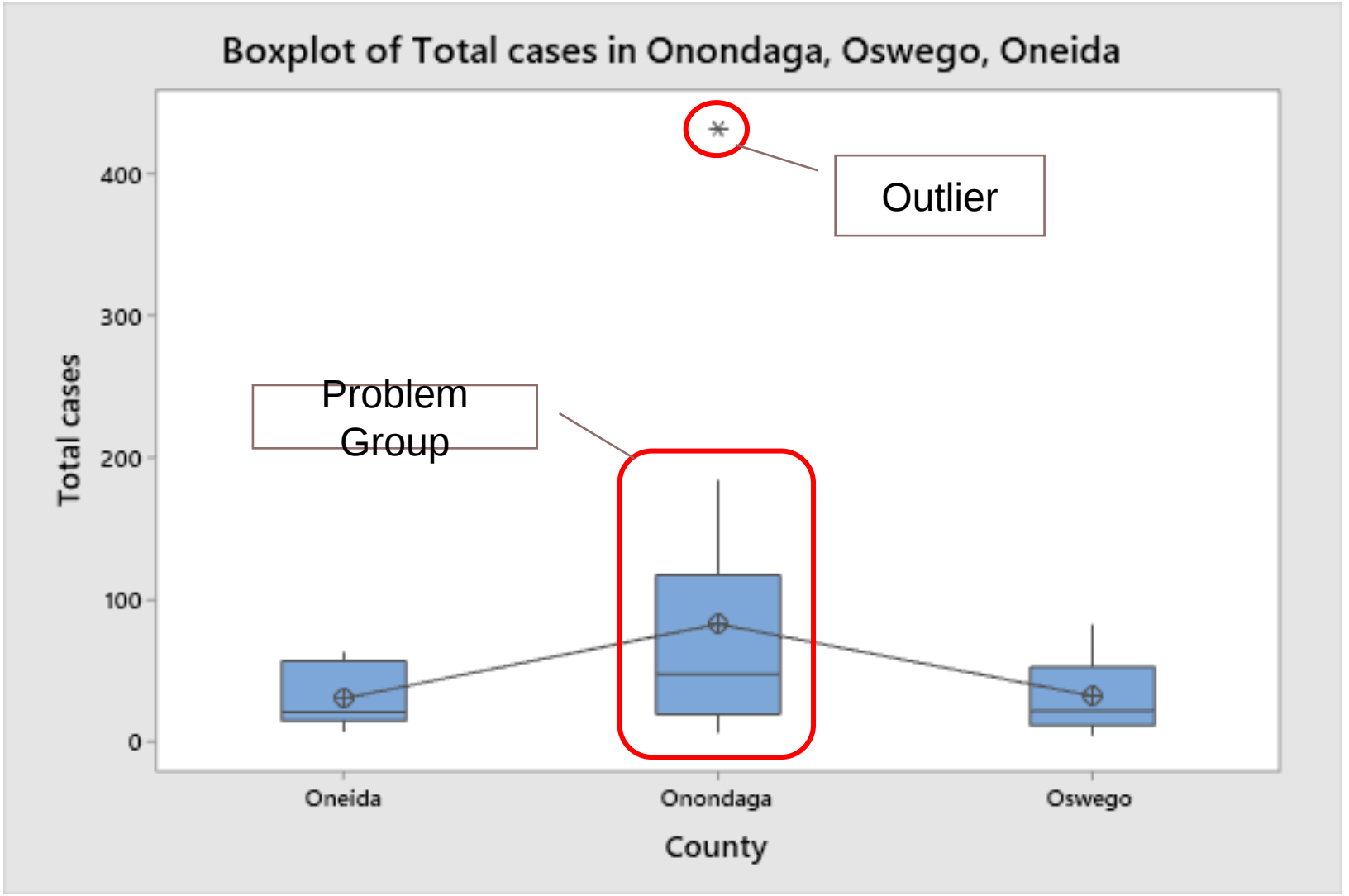

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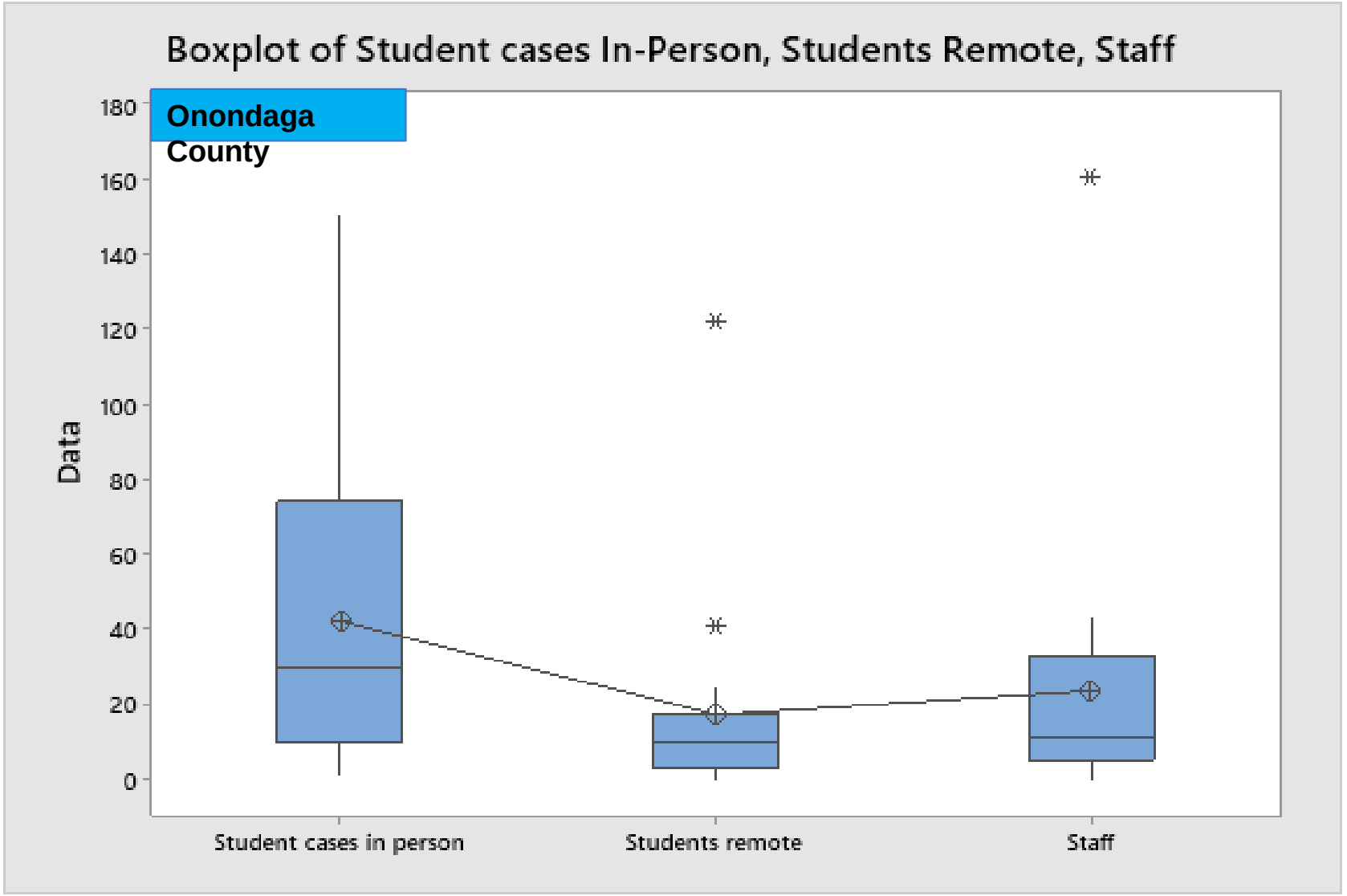

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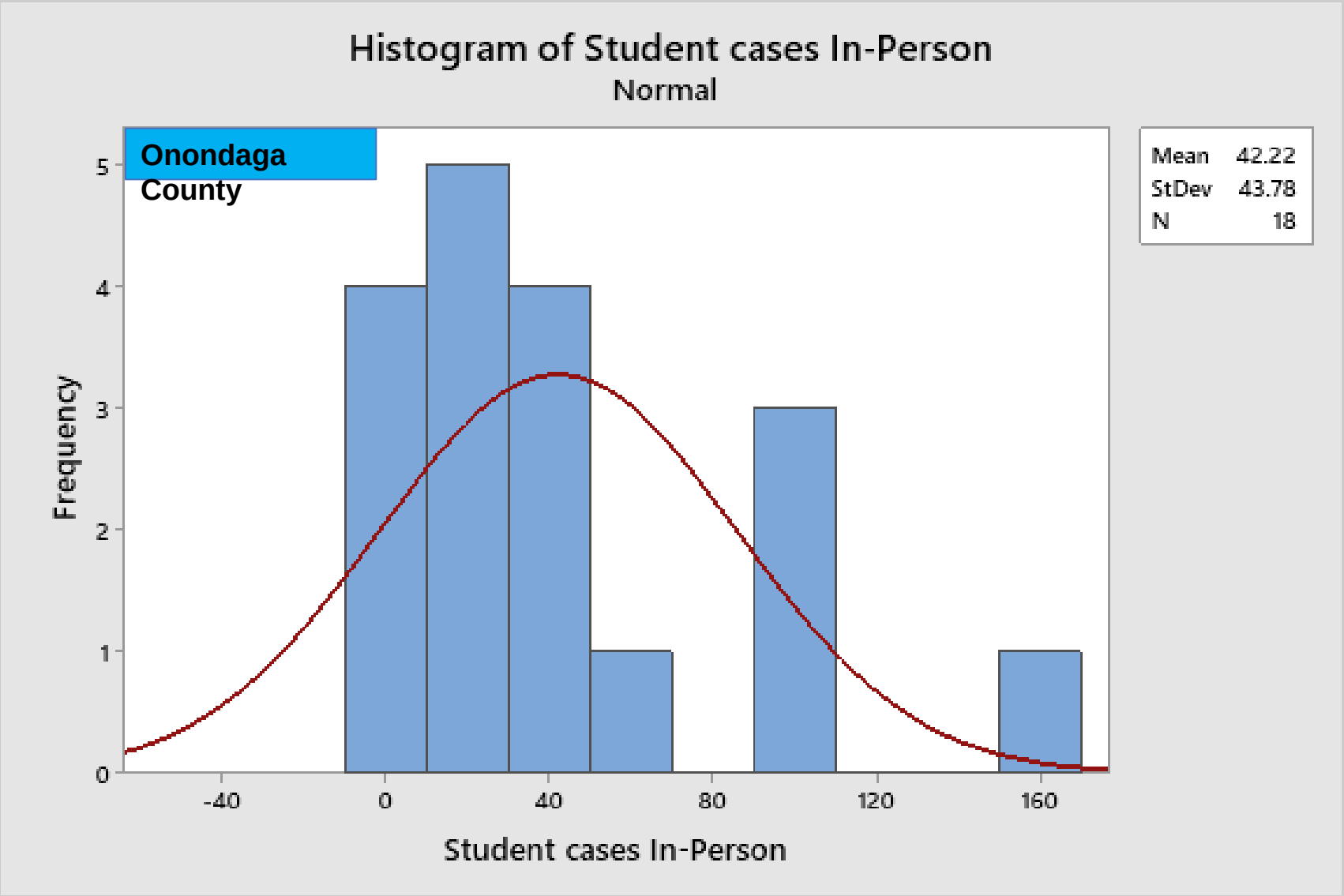

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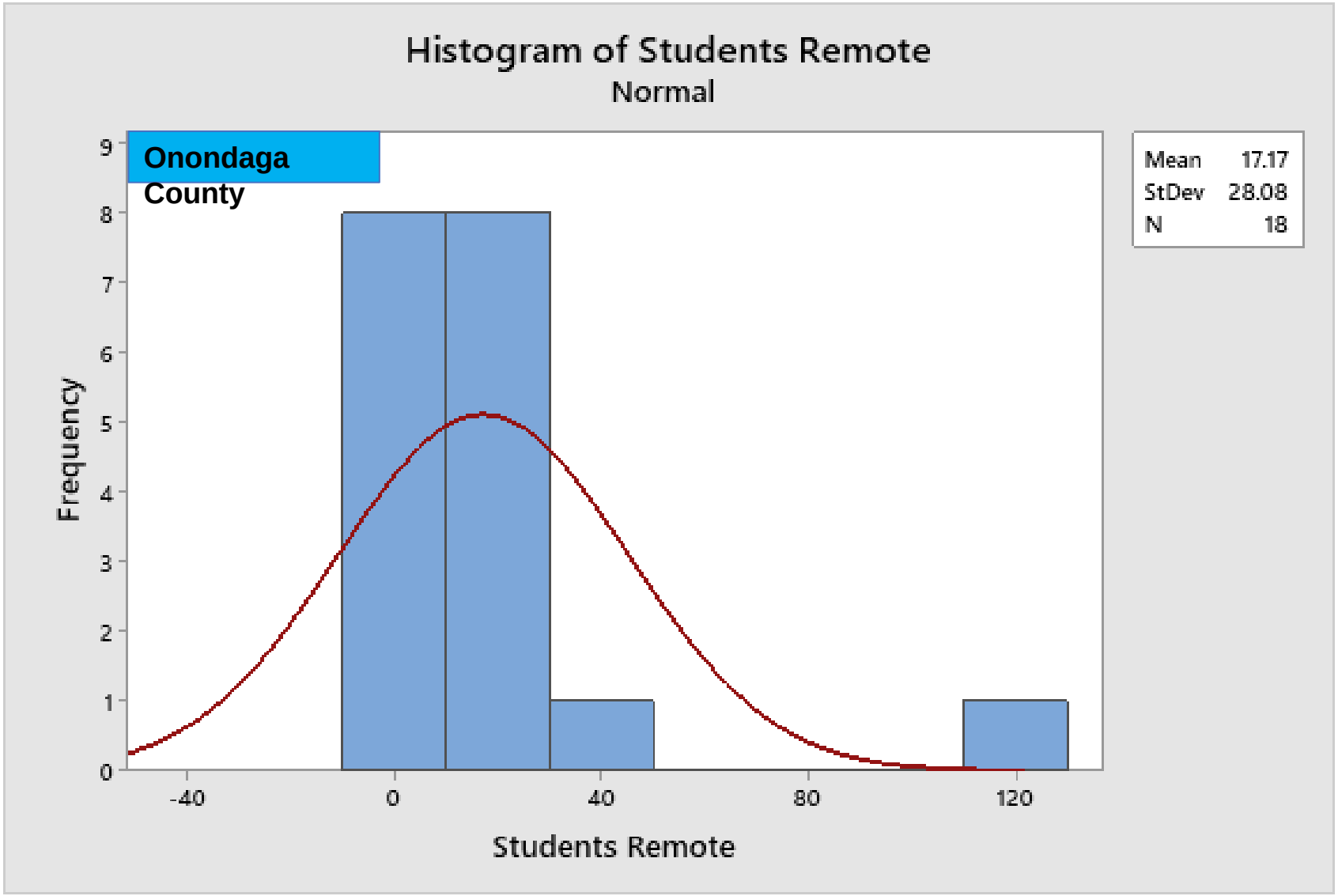

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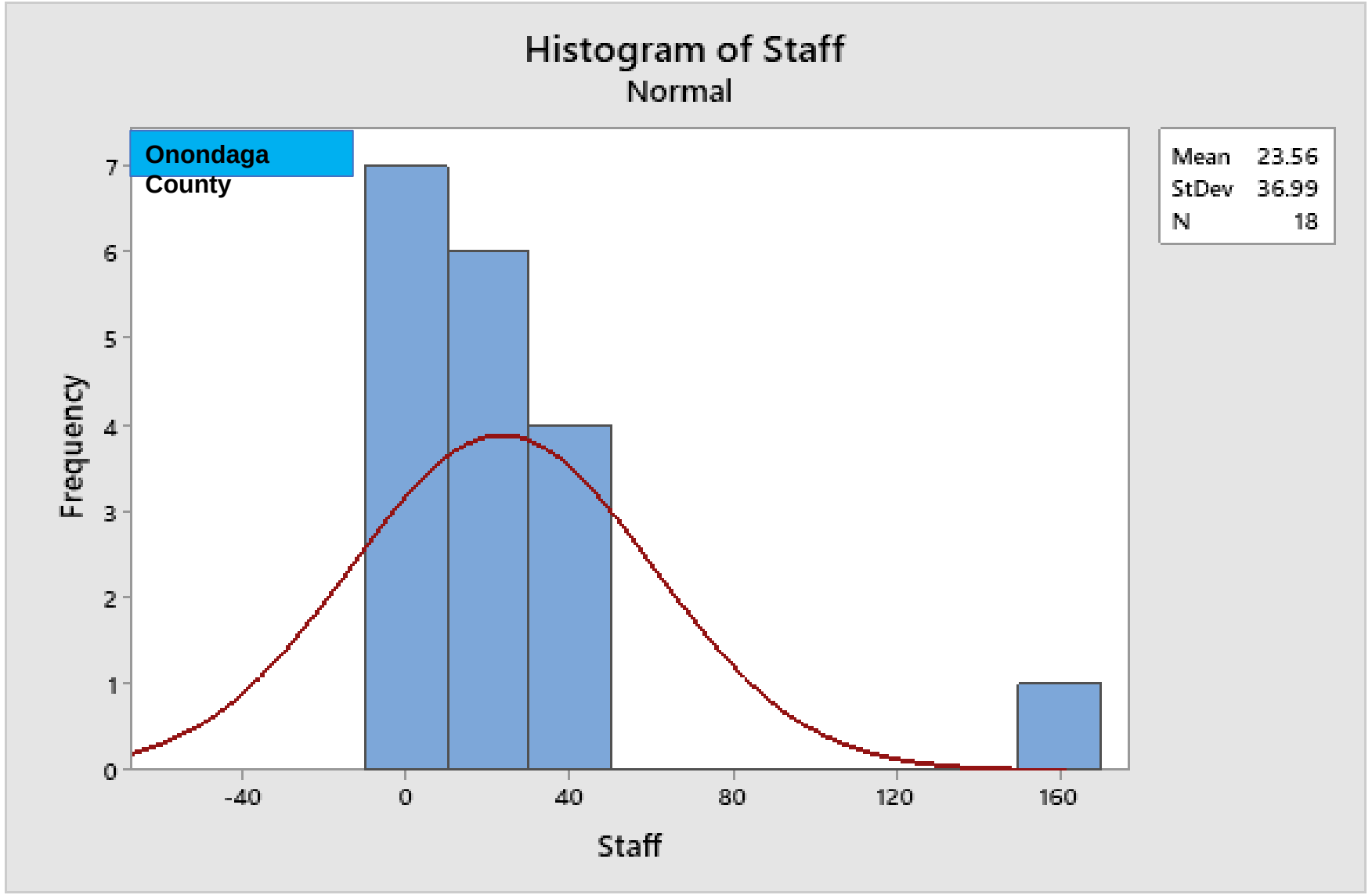

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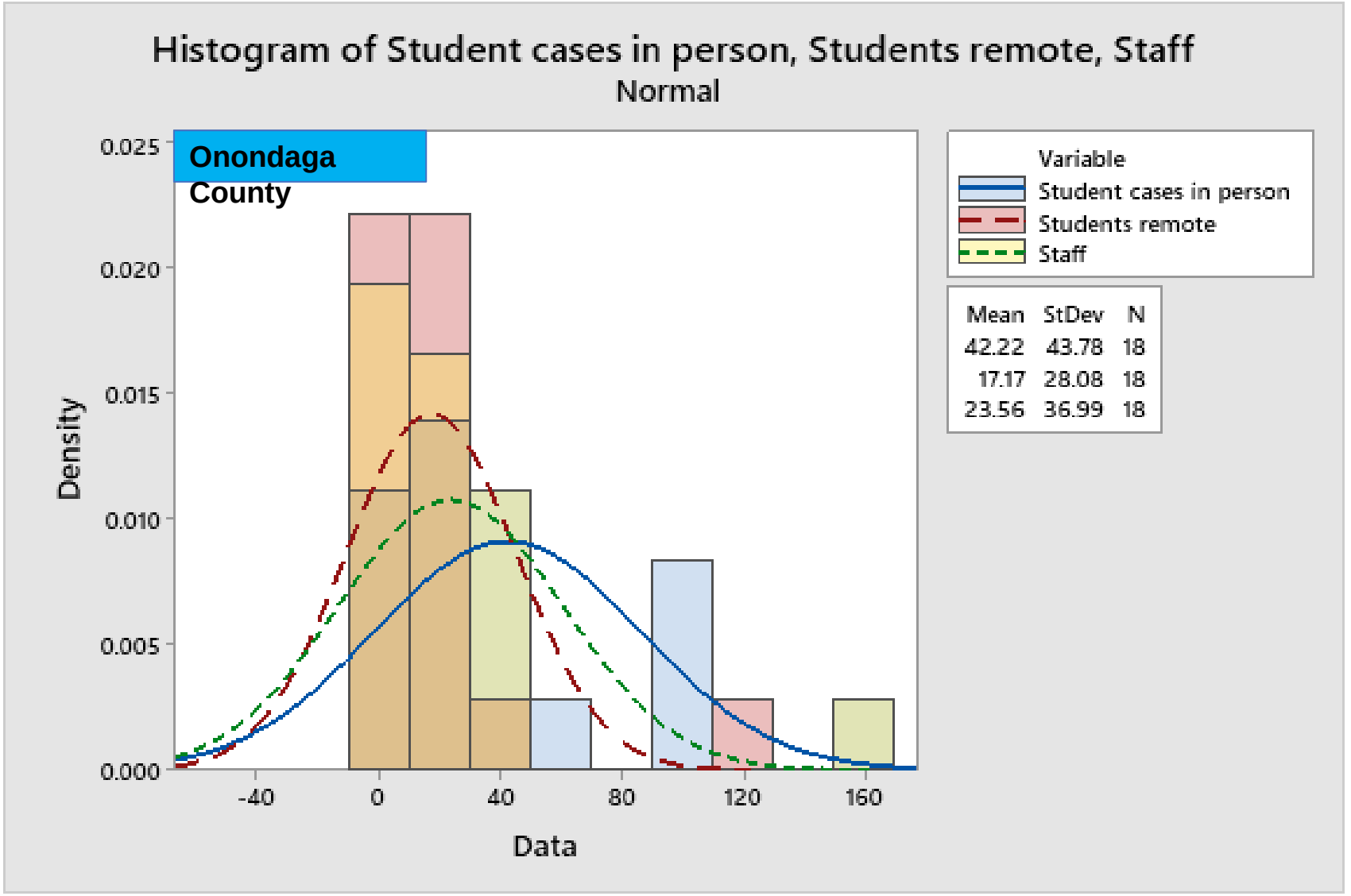

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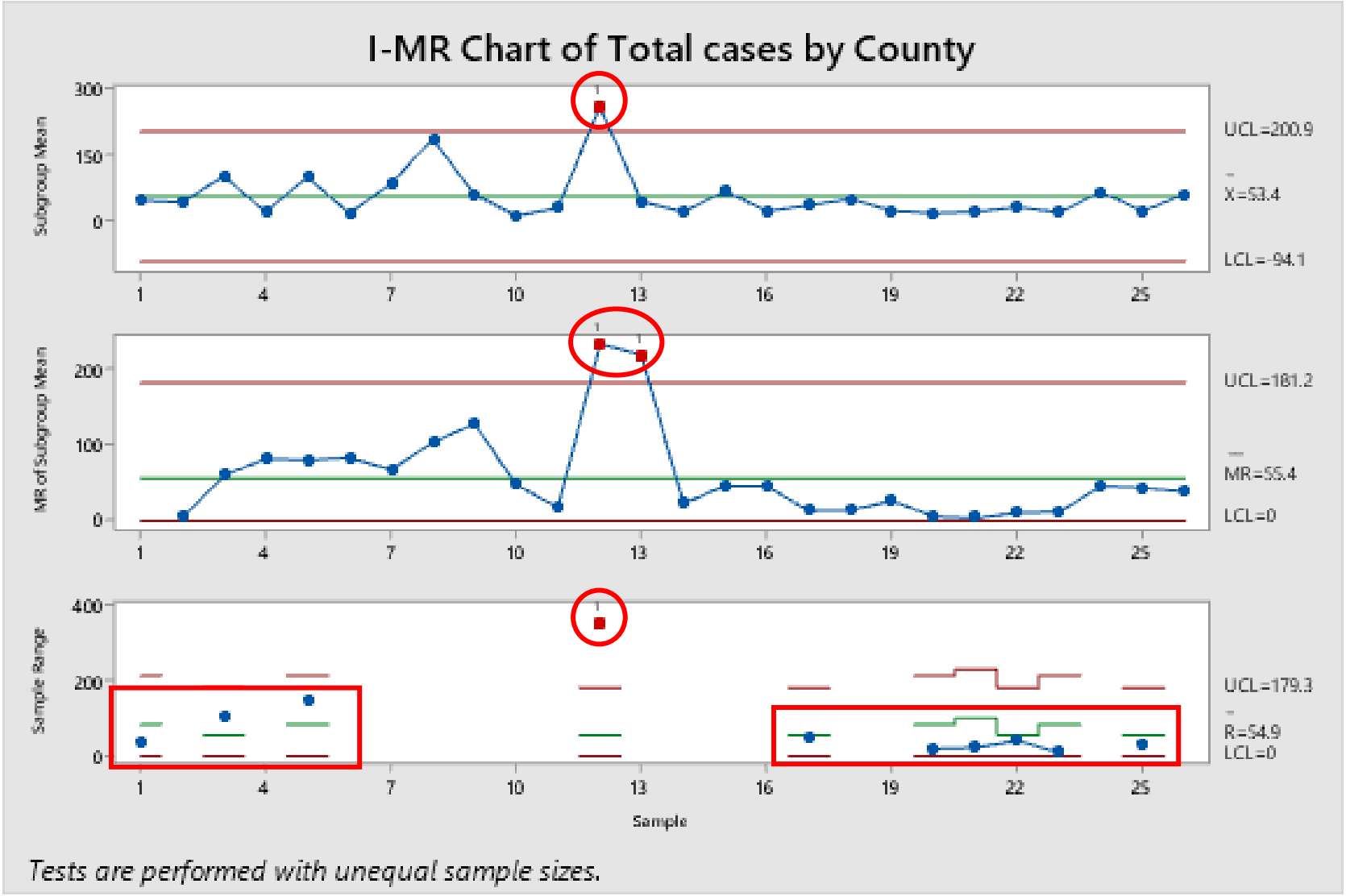

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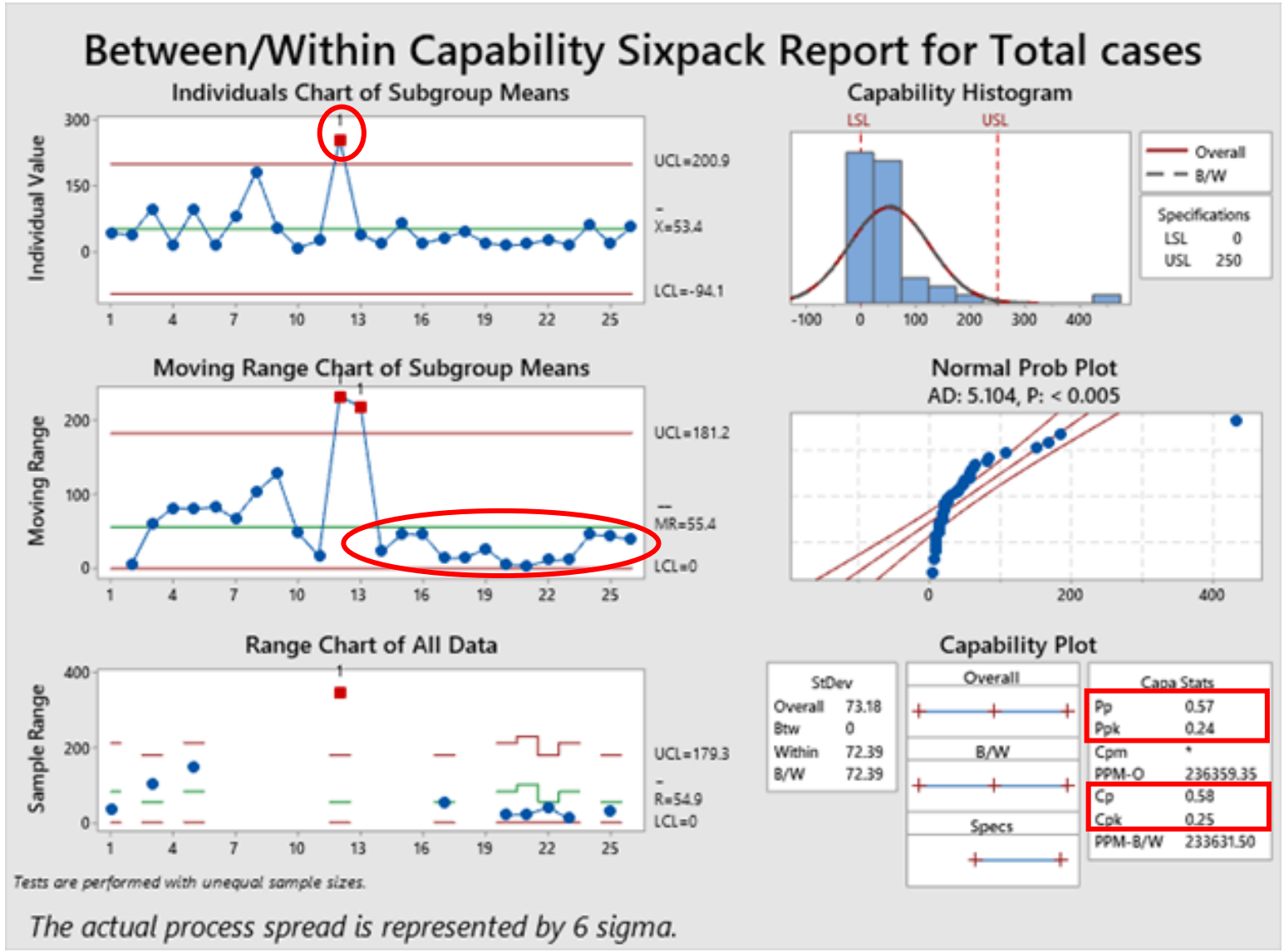
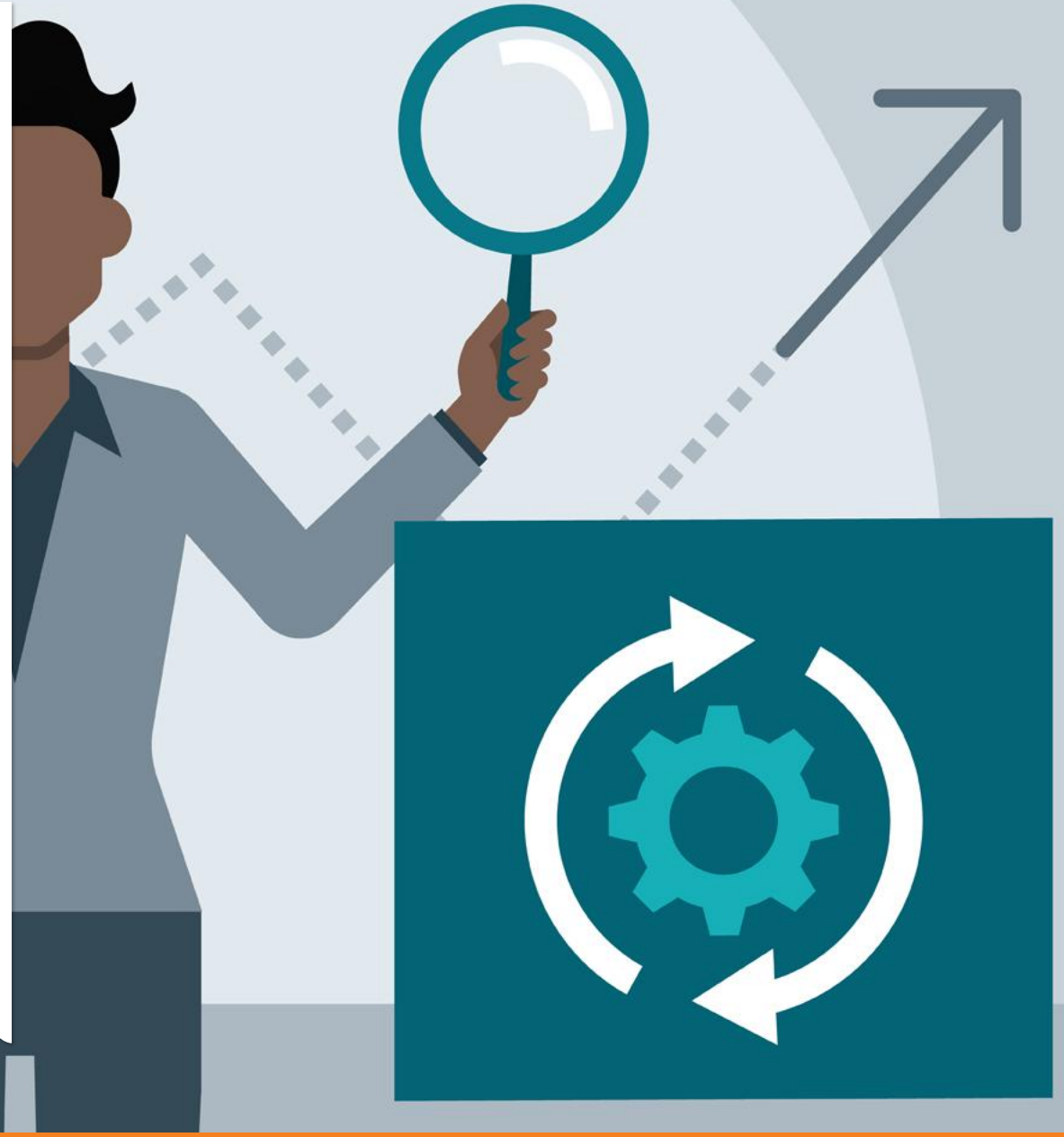


PHASE 4: IMPROVE

- The Improve Phase is where the team gets to solve the problem.
- They develop solutions, pilot the process changes, implement their ideas and collect data to confirm they made a measurable difference.



PHASE 4: IMPROVE

Various solutions to apply for different problems -

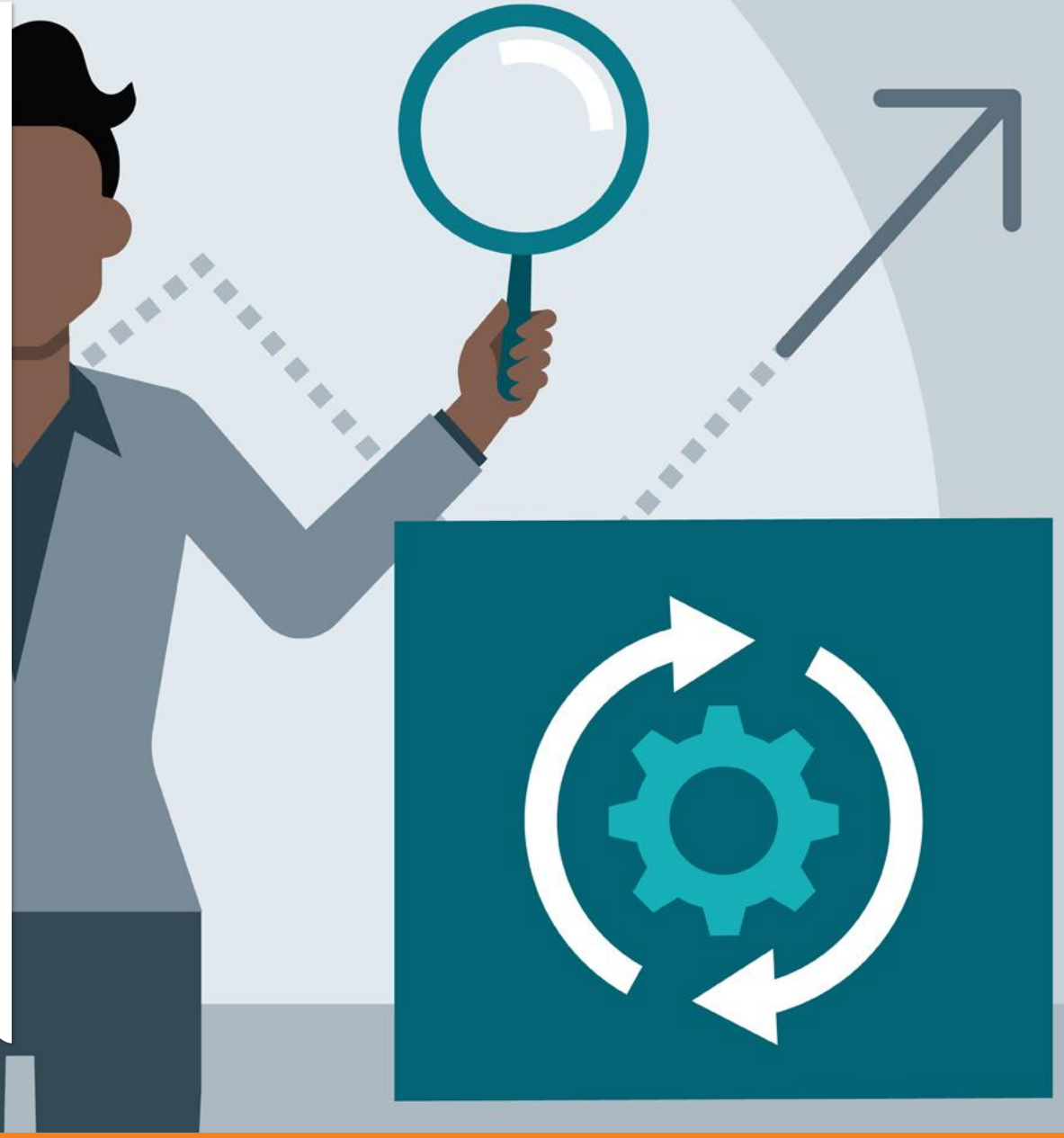
1. **Improvement strategies**
   - Risk Assessment Plans and Recommendations
   - Critical Analysis and Contingency Planning
2. **Failure Mode and Effect analysis**
   - Detailed FMEA Chart
3. **Design of Experiments**
4. **Poke-Yoke (Error Proofing)**

PHASE 4: IMPROVE - ERROR PROOFING

Factor	Problem Description	Solution	Impact Score (H=5, M=3, L=1)
Hygiene	Improper ventilation	▪ Revamp of ventilation system across the school ▪ Periodic check of air flow across the school and monitoring percentage of harmful gases in the air.	3
	Bad hygiene habits like not washing hands properly and not sanitizing any equipment before usage	▪ Awareness programs and daily activities highlighting the importance of good hygiene ▪ Posters and awareness sheets to be put up across school.	1
	No checks for expiration of cleaning and sanitizing equipment	▪ Checklists to be filled out daily for cleaning and sanitizing equipment. ▪ Proper database management of every material arriving in the school.	3
PPEs	Improper usage of PPEs by faculty and students alike	▪ Daily checks and penalties for improper usage. ▪ Proper training and lessons on use of PPEs	3
	Shortage of PPE	▪ Demand planning of PPEs and proper distribution of the same across the school daily. ▪ Database tracking of daily PPEs usage and wastage.	5
Covid Testing & Tracing	Lack of proper testing equipment and technology	▪ Procurement of proper equipment and training of assigned personnel for the testing technology. ▪ Checklists for using the equipment and including the monitoring of the expiration of equipment.	5
Personnel	Software malfunctions	▪ Strong periodic maintenance checks. ▪ Immediate response by the IT team to any query raised by the members of the institution.	3
	Lack of healthcare professionals	▪ Training given to non-medical staff for emergencies.	5

PHASE 5: CONTROL

- The Control Phase involves implementing the actual changes, whether they be physical, behavioral or both.
- In this phase we will present ways to help monitor the “new way” so that practices do not revert to the old way of doing things.



PHASE 5: CONTROL - CHECKLISTS

General Checklist for Control of Errors					
Sr. No.	**Factor**	**Preventive Measure**	**Periodic Interval**	**Responsible Party**	**Checkbox**
1	**Hygiene**	Check expiration dates of cleaning and sanitizing supplies	Daily	Non-teaching staff	☐
2		Air flow check through vents in classrooms, hallways and public areas	Daily	Non-teaching staff	☐
3		Daily database entry of new supplies arriving	Daily	Non-teaching staff	☐
4	**PPEs**	Awareness programs on usage of PPEs and hygiene	Weekly	Teaching Staff	☐
5		Checking proper usage of PPEs by members of the institution	Daily	Non-teaching staff	☐
6		Demand planning, tracking, distribution and wastage of PPEs	Weekly	Management	☐
7	**Covid Testing & Tracing**	Maintenace of all testing equipment and technology	Weekly	Health Department	☐
8		Step wise handling and usage of the testing technology	Daily	Health Department	☐
9		Database management of all the Covid-19 testing equipment & technology inclusive f expiration date check	Daily	Health Department	☐
10	**Personnel**	Maintenance of all servers and cloud systems for online classes	Weekly	Management	☐
11		Briefing to trained non-medical personnel	Daily	Health Department	☐
12		Resource allocation to all medical and non-medical	Daily	Health Department	☐

PHASE 5: CONTROL - DECISION TREE FOR SCHOOL REOPENING

Indicator	Lowest risk of transmission in schools	Lower risk of transmission in schools	Moderate risk of transmission in schools	Higher risk of transmission in schools	Highest risk of transmission in schools
New cases per 100,000 population in the last 14 days	<5	5 to <20	20 to <50	50 to ≤ 200	>200
(For comparison to new thresholds, equivalent new cases per 100,000 in 7-day period shown in parentheses)	(2-3 in 7 days)	(3-9 in 7 days)	(10-24 in 7 days)	(25-100 in 7 days)	(>100 in 7 days)
RT-PCR diagnostic test result positivity rate in the last 14 days	<3%	3% to <5%	5% to <8%	8% to ≤ 10%	>10%

DESIGN FOR SIX SIGMA

- The design for six sigma is a defined methodology to develop a product or service from the ground up.
- In this case, DFSS is implemented in order to ensure a safe and effective re-opening of schools.
- There are 6 phases of DFSS -
  1. Define
  2. Measure
  3. Analyze
  4. Design
  5. Verify

DESIGN

A. In-person sessions
B. Hybrid sessions
C. Online sessions

Factor	Design Recommendation
Hygiene	A. Installation of new and improved ventilation system across the school area. B. Introduction of proper database management system to track supplies, temperature checks of students, tests results and expiration dates of medical and sanitary equipment. C. Implementation of periodic checks of introduced systems across the school and proper documentation of the same.
PPEs	A. Formation of proper vigilance team to ensure usage of PPEs (like floor monitors) across the school to protect everyone from exposure to unnecessary germs. B. An interrupt-based system to be put into notify user of depletion of the PPEs stock in order to place an order for the next batch. C. Everyday passage of message and lessons of usage of PPEs in the mid of a pandemic.
Covid Testing & Tracing	A. Weekly safety and equipment handling training for medical teams and non-medical volunteers. B. Scheduled procurement for testing equipment's and proper maintenance checks of testing equipment. C. Training programs for volunteers in the contact-tracing team.
Personnel	A. Development of safety protocols for various everyday activities, like exiting the classroom, walking in hallways, using cafeteria, etc. B. Implementation of IT ticketing system, wherein anyone having an issue while using the online platform can raise a ticket, which the IT team should immediately solve. C. Remote solutions methods and an updated FAQs list circulated to all members of the institution.

VERIFY

A. In-person sessions
B. Hybrid sessions
C. Online sessions

Factor	Verifications
Hygiene	A. Air flow checks through defined checklists and range for air type. B. Vigilant checks of proper maintenance for implemented database for supplies, expiration dates, test results, etc. C. Checks for posters and notices regarding covid-19 and hygiene care shared across to all members via emails.
PPEs	A. Checklists distributed to students, to be filled out before they enter school, checking the proper usage of PPEs. B. Physical checks for supplies of PPEs and not be dependent on the interrupt-based system. C. Database management containing information of members disobeying the PPE usage rules and evaluating penalties awarded to them and actions used to correct the behavior.
Covid Testing & Tracing	A. Checklist for dictating step wise usage of equipment like syringes, swabs and containers and for training sessions for medical and non-medical volunteers. B. Maintenace sessions using the interrupt-based system for testing equipment. C. Proper database maintenance of all traced contacts of current infected members of the institution.
Personnel	A. Checklists for daily following of safety protocols and weekly reviews of the same or based on the upcoming positive cases. B. Weekly meetings and passage of information to state and district medical personnel. C. Checklists for IT members for handling IT tickets and cleaning the same and checklist based for

HOUSE OF QUALITY

The house of Quality is defined as a Product Planning Matrix that is built to show how customer requirements relate directly to the ways and methods which can be used to achieve those requirements.

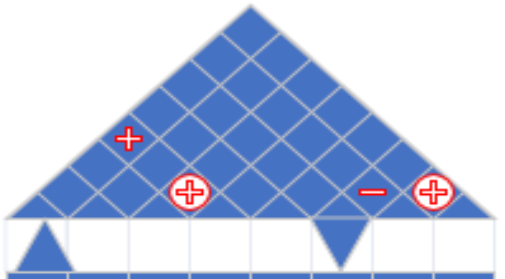
It is considered the primary tool used during quality function deployment to facilitate group decision making.

HOUSE OF QUALITY

LEGENDS	
5	Strong
3	Moderate
1	Weak

LEGENDS	
+	Positive
⊕	Strong positive
−	Negative
⊖	Strong negative

Hybrid	G
100% In person	P
100% Online	H



Customer Requirement	Faculty	Sanitization	PPE & Testing Equipment	Social Distancing	Zoom, Blackboard	Bus Drivers	Facilities	Quarantine Center
Learning	5	3			5		5	3
Hygiene		5		3			4	5
Testing		3	5				5	
Vaccination			5					
Transportation				3		5		
Personnel		5			3	1		
CTQ Priority Score	50	130	85	36	45	20	145	75
Percentage of School	9	22	15	7	8	4	25	13

Priority Score	1	2	3	4	5	6
10			H			P
9				P	G	H
10			H			GP
7			H		GP	
3				GP		H
5			H			GP

FMECA
FAILURE MODE, EFFECTS & CRITICALITY ANALYSIS

- **Failure Mode, Effects & Criticality Analysis (FMECA)** is a method which involves quantitative failure analysis.
- The **FMECA** involves creating a series of linkages between potential failures (Failure Modes), the impact on the mission (Effects) and the causes of the failure (Causes and Mechanisms).
- The intent of the Failure Mode, Effects & Criticality Analysis methodology is to increase knowledge of risk and prevent failure

FMECA

FUNCTION	FAILURE MODE	EFFECTS	SEVERITY	CAUSES	RECOMMENDED ACTIONS
HYGIENE	Improper ventilation	• Crowded place • Not enough room	5	• Better ventilation required	• Revamp of ventilation system across the school • Periodic check of air flow across the school and monitoring percentage of harmful gases in the air.
	Not washing hands properly and not sanitizing any equipment before usage	• Bad hygiene habits	0	• Spread of germs increases	• Awareness programs and daily activities highlighting the importance of good hygiene • Posters and awareness sheets to be put up across school.
	No checks for expiration of cleaning and sanitizing equipment	• Less inventory management • Lack of priority	6	• Poor planning • Loss of cost effectiveness	• Checklists to be filled out daily for cleaning and sanitizing equipment. • Proper database management of every material arriving in the school.
PPEs	Improper usage of PPEs by faculty and students alike	• No training on how to use PPEs	6	• Not protected against infections and viruses	• Daily checks and penalties for improper usage. • Proper training and lessons on use of PPEs
	Shortage of PPE	• Low supply	5	• Increase in	• Demand planning of PPEs and proper distribution of the same across the school daily

FMECA

FUNCTION	FAILURE MODE	EFFECTS	SEVERITY	CAUSES	RECOMMENDED ACTIONS
COVID TESTING AND TRACING	Lack of proper testing equipment and technology	• Low supply	9	• Increase in demand	• Procurement of proper equipment and training of assigned personnel for the testing technology. • Checklists for using the equipment and including the monitoring of the expiration of equipment.
PERSONNEL	Software malfunctions	• Not experienced	7	• System requirement not defined properly	• Strong periodic maintenance checks. • Immediate response by the IT team to any query raised by the members of the institution.
	Lack of healthcare professionals	• Lack of experienced professionals	10	• Leads to errors, higher morbidity, and mortality rates.	• Training given to non-medical staff for emergencies. • Proper resources provided to the healthcare professionals.

CRITICALITY ANALYSIS

- Criticality analysis is a process by which assets are assigned a criticality rating based on their potential risk.
- Criticality Analysis are more difficult to perform for a functional FMEA due to the lack of detailed failure data at this level.
- If failure data is available, criticality numbers are developed as follows:

FAILURE MODE CRITICALITY NUMBER

= α (% of occurrence of each failure mode) × frequency hours (rate of occurrence) × hours of cycle × β (probability that the failure effect will occur)

FAULT TREE ANALYSIS

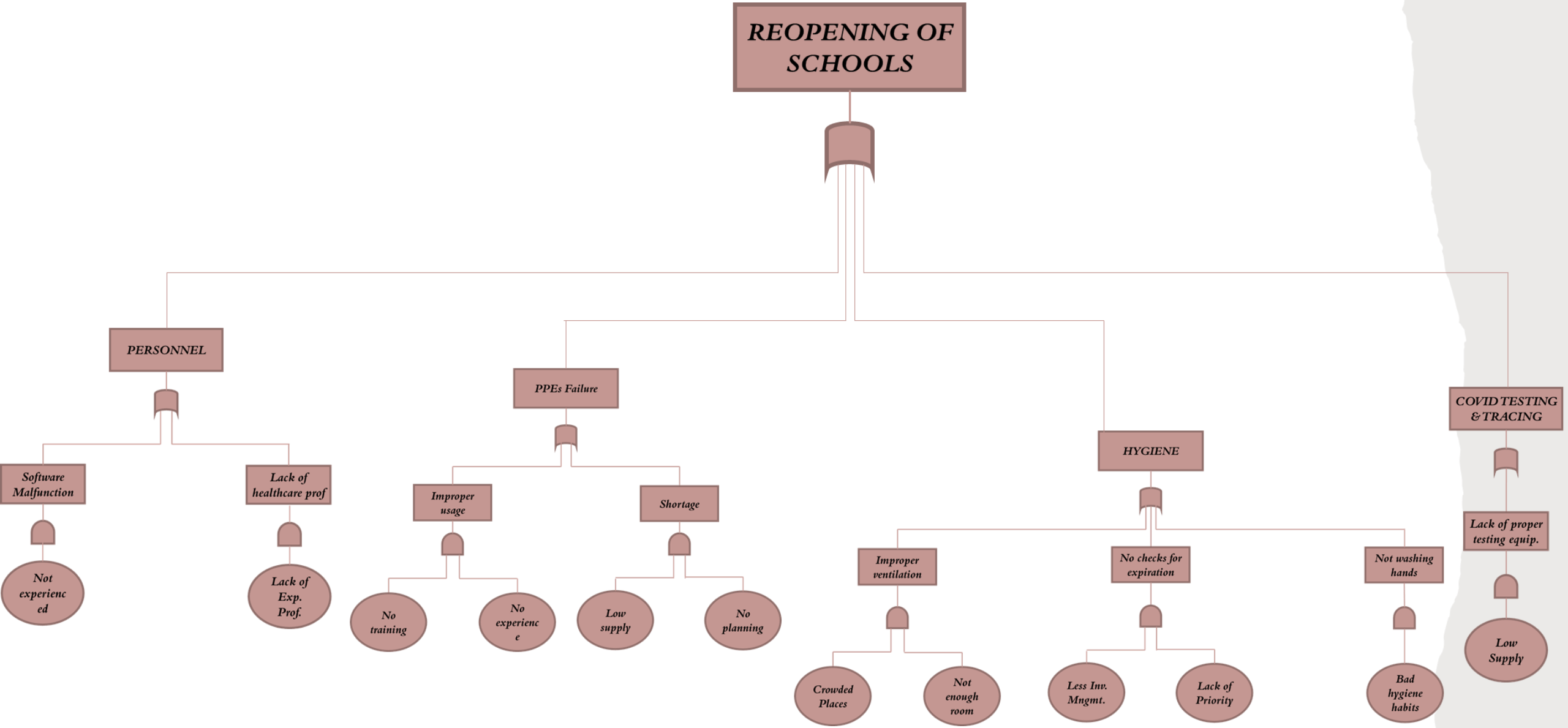
FTA

FTA | FAULT TREE ANALYSIS

Fault tree analysis (FTA) is a graphical tool to explore the causes of system level failures.

It uses **Boolean logic** to combine a series of lower-level events and it is basically a top-down approach to identify the component level failures that cause the system level failure to occur.

Fault tree analysis consists of two elements **“events”** and **“logic gates”** which connect the events to identify the cause of the top undesired event.


REOPENING OF SCHOOLS
PERSONNEL
Software Malfunction
Not experienced
Lack of healthcare prof
Lack of Exp. Prof.
PPEs Failure
Improper usage
No training
No experience
Shortage
Low supply
No planning
HYGIENE
Improper ventilation
Crowded Places
Not enough room
No checks for expiration
Less Inv. Mngmt.
Lack of Priority
Not washing hands
Bad hygiene habits
COVID TESTING & TRACING
Lack of proper testing equip.
Low Supply

VALUE STREAM MAPPING

Reopening of Schools (Current)

Value Stream Mapping for Re-opening of Schools (Current) Criteria - Spread of Infection Assumption - 100% in-person classes						
SL. NO.	Factor	STEPS	TIME (in mins)	CAPACITY (in numbers)	Percent Contamination	Comments/Remarks
1	Home	Wakes and goes out to the living room to meet family	15	3	0.25	
2		Goes to the washroom and gets ready and dresses up	25	-	0	
3		Packs her/his bag with the required study material for the day	7	-	0	
4		Packs his lunch in the bag, else carries it	2	1	0.1	
5		Wears the required footwear and wears her/his bag	2	3	0.25	
Total			51	3	0.12	
6	Travel	Leaves home and walks to the designated bus stop	4	-	0.25	
7		Meets with her/his peers at the bus stop	5	10	0.5	Social Disctancing is encouraged
8		Climbs the stairs of the bus and sits with her/his peers in the available space in the bus	12	10	0.6	
9		Climbs down the bus, by forming a proper queue	25	40	0.6	
Total			46	30	0.48	

10	Campus	Enters the school building and heads towards her/his locker	15	90	0.8	Social Disctancing is encouraged
11		Opens locker, collects required material, puts her/his bag in	10	90	0.8	
12		Goes to the cafetaria to have breakfast with her/his peers	25	100	0.8	Social Disctancing is encouraged
13		After leaving cafetaria student walks towards the classroom	10	100	0.8	Social Disctancing is encouraged
14		Enters classroom and sits at any available place	3	30	0.7	
15		Student leaves the classroom and moves towards the locker for collecting material for next class	10	90	0.8	Social Disctancing is encouraged
16		Student heads towards the cafetaria for lunch with peers	10	90	0.8	Social Disctancing is encouraged
17		Student collects food in a queue and settles down at available table	25	10	0.56	
18		Students head to washroom, whenever required	10	6	0.4	
19		Student continues attending class in the said manner from point 15 to 16	13	90	0.8	
20		Student will collect their materials and bag from the locker and move towards the bus in a queue	10	90	0.9	Social Disctancing is encouraged
Total			141	72	0.75	

21	Travel	Student climbs the bus and sits at any available place in the bus alongside her/his peers	25	40	0.67
22		Student climbs down the bus in queue and walks towards her/his home	10	10	0.69
Total			35	30	0.68
23	Home	Student reaches home and greets her/his family again and goes to freshen up	20	3	0.4
24		Once freshened up, the student can go about her/his everyday tasks and as well as going out to play	--	3	0.4
Total			20	3	0.4

VALUE STREAM MAPPING

Reopening of Schools (Future)

Value Stream Mapping for Re-opening of Schools (Future) Criteria - Spread of Infection Assumption - 50% in-person classes						
SL. NO.	**Factor**	**STEPS**	**TIME (in mins)**	**CAPACITY (in numbers)**	**Percent Contamination**	**Comments/Remarks**
1	Home	Wakes and goes out to the living room to meet family	15	3	0.125	
2		Goes to the washroom and gets ready and dresses up	25	-	0	
3		Packs her/his bag with the required study material for the day	7	1	0	
4		Puts sanitizers, extra masks and at least 2 pair of gloves in the bag	2	1	0	
5		Packs his lunch in the bag, else carries it	2	2	0.05	
6		Wears the required footwear, mask, gloves and face shield	2	3	0.125	
Total			53	3	0.05	

7	Travel	Leaves home and walks to the designated bus stop	4	-	0.125	
8		Meets with her/his peers at the bus stop	2	5	0.3	All while appropriately distancing and wearing the PPEs
9		Climbs the stairs of the bus, and avoids touching the support railing	25	5	0.25	Every student climbs the bus once the student in front is seated
10		Collects the sanitizer wipes near the driver's seat	5	15	0.15	
11		Cleans her/his designated seat	6	15	0.15	Each student is placed on every diagnoal seat and uses sanitizer to clean her/his hands once settles
12		While leaving the bus, the seat is cleaned by the student again	6	15	0.125	
13		Climbs down the bus avoiding touching any surfaces on the bus	25	15	0.2	Regardless once down, the student will use sanitizer to clean her/his hands
Total			73	15	0.18	

14	Campus	Enters the school building and heads towards her/his locker	20	45	0.35	All hallways are with limited to certain number of students after every class
15		As per a schedule, student would have to go to the testing site with a teacher or guide to get tested for the virus causing Covid-19	25	10	0.4	
16		Opens locker, collects required material, puts her/his bag in	15	45	0.35	All lockers are re-designated, every second locker is allocated
17		Cleans her/his hands with sanitizer and walks towards the classroom	1	10	0.5	
18		Collects sanitizer wipes at the entrance, cleans the desk	10	15	0.3	All seats placed 6 feet apart
19		While leaving classroom, cleans the desk again and moves towards the locker for collecting material for next class	10	15	0.3	
20		Sanitizies her/his hands once ot of the class.	1	10	0.2	
21		Student heads towards the cafetaria	20	45	0.4	All the patrons are seated at a minimum of 6 feet from each other and all lunch times are varied through the mid-day for all students
22		Student collects food using fresh pair of gloves and eats	10	10	0.4	A designated staff member will come and sanitize the table and guide the student out safely
23		Student changes mask once outside the cafetaria	1	10	0.2	
24		Whenever student heads to the washroom, needs to wash hands as per the flowchart for washing hands in all washrooms and wears gloves back again before heading out	10	3	0.3	
25		Student continues attending class in the said manner from point 17 to 20	22	45	0.35	
26		Student will be guided safely outside the building till the bus	26	45	0.3	Preferably done class wise

27	Travel	Student climbs the bus	7	15	0.3	
28		Collects the sanitizer wipes near the driver's seat	5	15	0.34	
29		Student climbs down the bus in a appropriate manner with other students and safely heads home	15	5	0.4	Preferably with a parent for students till middle school
Total			27	12	0.34	
30	Home	Student should head directly for the washroom and take a bath as soon as they reach their house without physically greeting her/his family	20	3	0.3	
31		Once freshened up, the student can go about her/his everyday tasks and avoid going out to play	--	3	0.3	
32		Once freshened up, the student can go about her/his everyday tasks and avoid going out to play	--	3	0.3	
Total			20	3	0.3	

RESULTS

As per the above comparison, we can deduce that the value stream mapping when the pandemic had just hit shows:

- **Currently:** Total time for the student is less and the capacity for each step is more this **leads to a high percent contamination**,
- **Future Case:** whereas when we re-open the school at 50% capacity as per the CDC recommended guidelines, the **time taken increases**, **the capacity decreases** but this leads too a **decrease in the percent contamination by around 50%.**

Sl. No.	Factor	Value Stream Mapping for Re-opening of Schools (Current) Criteria - Spread of Infection Assumption - 100% in-person classes			Value Stream Mapping for Re-opening of Schools (Future) Criteria - Spread of Infection Assumption - 50% in-person classes		
		Avg. TIME (in mins)	Avg. CAPACITY (in numbers)	Avg. Percent Contamination	Avg. TIME (in mins)	Avg. CAPACITY (in numbers)	Avg. Percent Contamination
1	Home	71	3	0.26	73	3	0.175
2	Travel	81	30	0.58	100	15	0.25
3	Campus	141	72	0.75	171	30	0.34
Total		293	35	0.53	344	16	0.25

GAGE R&R STUDY – ANOVA METHOD

OVERVIEW

- ✓ AVOVA Gauge R&R measures the amount of Variability induced in measurements by the measurement system itself and compares it to the total variability observed to determine the ability to successfully work with the measurement system.
- ✓ From the following data, our Gage R&R considerations are as follows:
  - ❑ **Part – Student Population Sample Subset**
  - ❑ **Operator – COVID-19 Screening Staff (A: Staff 1, B: Staff 2, C: Staff 3)**
  - ❑ **Measurement – Infection Rate**

GAGE R&R DATA

Part	Operator	Measurement
1	A	0.29
1	A	0.41
1	A	0.64
2	A	-0.56
2	A	-0.68
2	A	-0.58
3	A	1.34
3	A	1.17
3	A	1.27
4	A	0.47
4	A	0.5
4	A	0.64
5	A	-0.8
5	A	-0.92
5	A	-0.84
6	A	0.02
6	A	-0.11
6	A	-0.21
7	A	0.59
7	A	0.75
7	A	0.66
8	A	-0.31
8	A	-0.2
8	A	-0.17
9	A	2.26
9	A	1.99
9	A	2.01
10	A	-1.36
10	A	-1.25
10	A	-1.31

GAGE R&R DATA

Part	Operator	Measurement
1	B	0.08
1	B	0.25
1	B	0.07
2	B	-0.47
2	B	-1.22
2	B	-0.68
3	B	1.19
3	B	0.94
3	B	1.34
4	B	0.01
4	B	1.03
4	B	0.2
5	B	-0.56
5	B	-1.2
5	B	-1.28
6	B	-0.2
6	B	0.22
6	B	0.06
7	B	0.47
7	B	0.55
7	B	0.83
8	B	-0.63
8	B	0.08
8	B	-0.34
9	B	1.8
9	B	2.12
9	B	2.19
10	B	-1.68
10	B	-1.62
10	B	-1.5

GAGE R&R DATA

Part	Operator	Measurement
1	C	0.04
1	C	-0.11
1	C	-0.15
2	C	-1.38
2	C	-1.13
2	C	-0.96
3	C	0.88
3	C	1.09
3	C	0.67
4	C	0.14
4	C	0.2
4	C	0.11
5	C	-1.46
5	C	-1.07
5	C	-1.45
6	C	-0.29
6	C	-0.67
6	C	-0.49
7	C	0.02
7	C	0.01
7	C	0.21
8	C	-0.46
8	C	-0.56
8	C	-0.49
9	C	1.77
9	C	1.45
9	C	1.87
10	C	-1.49
10	C	-1.77
10	C	-2.16

GAGE R&R ANALYSIS

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part	9	88.3619	9.81799	492.291	0.000
Operator	2	3.1673	1.58363	79.406	0.000
Part * Operator	18	0.3590	0.01994	0.434	0.974
Repeatability	60	2.7589	0.04598		
Total	89	94.6471			

α to remove interaction term = 0.05

Two-Way ANOVA Table Without Interaction

Source	DF	SS	MS	F	P
Part	9	88.3619	9.81799	245.614	0.000
Operator	2	3.1673	1.58363	39.617	0.000
Repeatability	78	3.1179	0.03997		
Total	89	94.6471			

The p-value is less than 0.05 which indicates that Part and Operator are statistically significant, and that the **measurement system is capable.**

GAGE R&R ANALYSIS

Gage R&R

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.09143	7.76
Repeatability	0.03997	3.39
Reproducibility	0.05146	4.37
Operator	0.05146	4.37
Part-To-Part	1.08645	92.24
Total Variation	1.17788	100.00

Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)
Total Gage R&R	0.30237	1.81423	27.86
Repeatability	0.19993	1.19960	18.42
Reproducibility	0.22684	1.36103	20.90
Operator	0.22684	1.36103	20.90
Part-To-Part	1.04233	6.25396	96.04
Total Variation	1.08530	6.51180	100.00

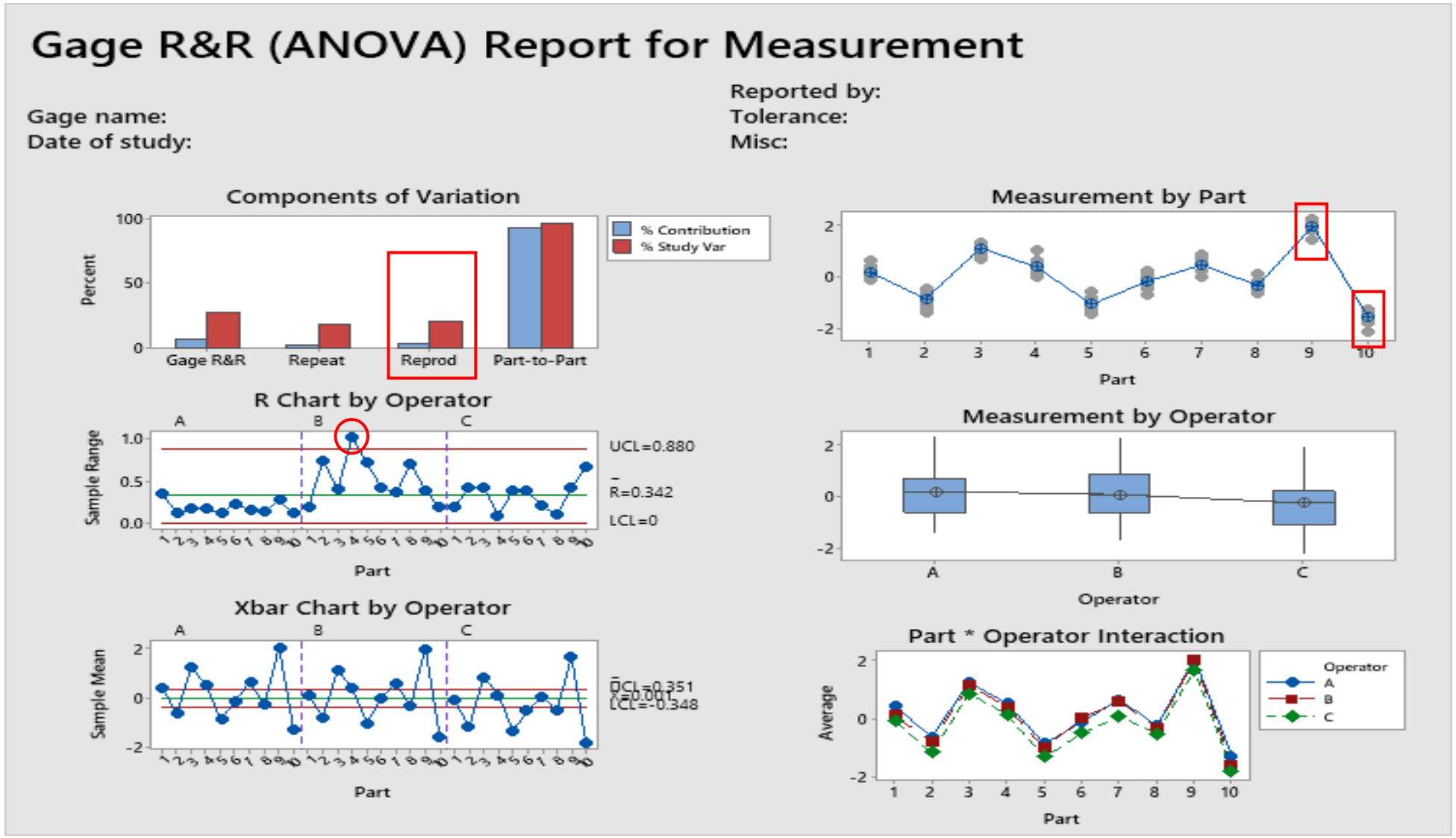
Number of Distinct Categories = 4

The %Contribution for Total Gage R&R variation is **7.76%.** When the %Contribution from Total Gage R&R variation is **high**, the measurement system is **proved to be unreliable.** The desirable range is **between 1% - 2%.**

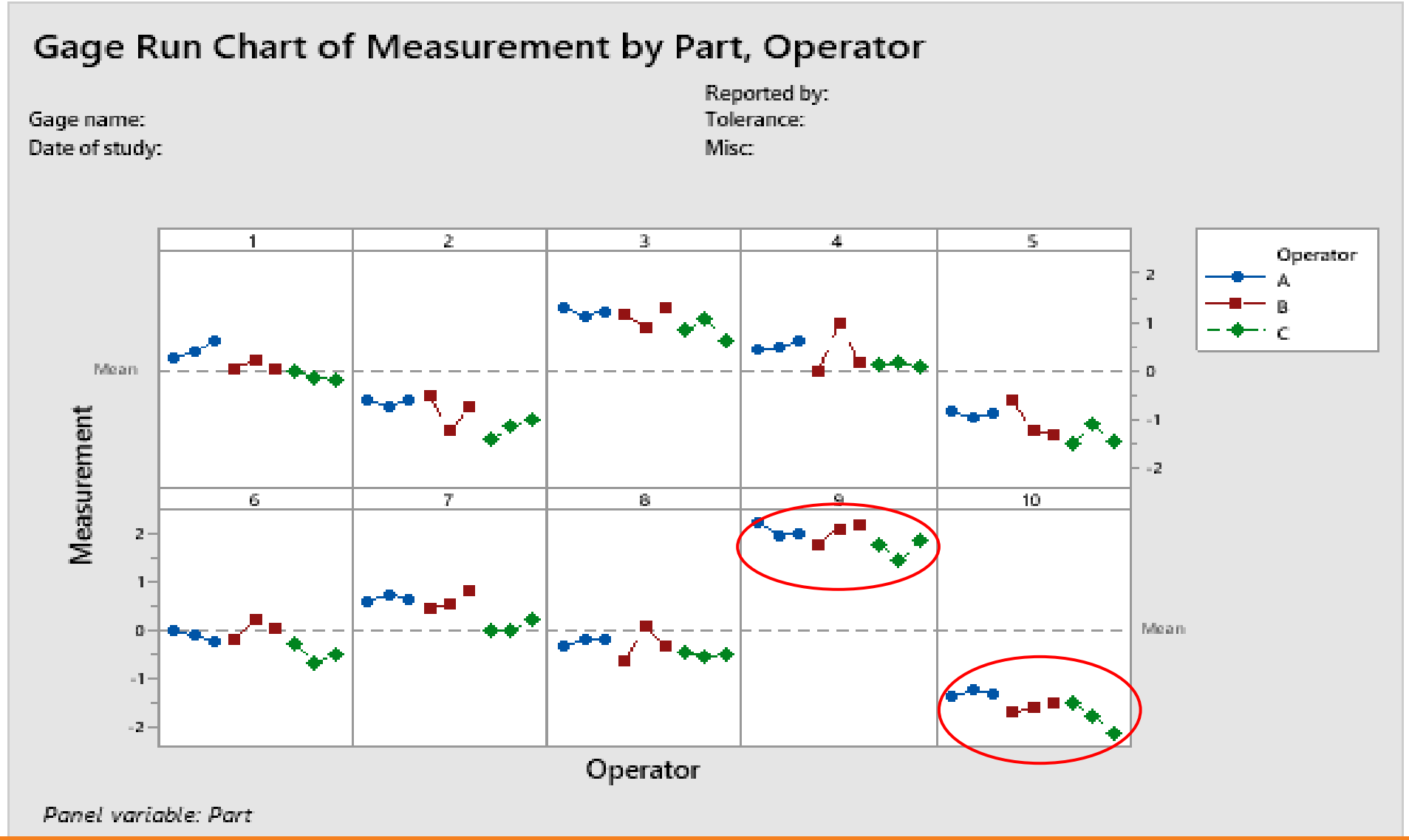
The %Contribution for part-to-part variation is **92.24%.** When the %Contribution from part-to-part variation is **lower than 97%**, the measurement system **cannot reliably distinguish between part observations**.

Results: **Our measurement system is needs improvement.** This is determined by looking at the sources of variation. The Gage R&R (the measurement system) accounts for **27.86% of observed variation**, while the part-to-part variation accounts for **96.04% of observed variation**. Minitab can detect 4 distinct categories, which indicates a lower set of categories/selection to achieve reliable results for this MSA. This is reinforced by the **X-bar chart, in which more than 50% of the parts fall within the upper and lower**

GAGE R&R STUDY- REPORT FOR MEASUREMENT



GAGE RUN CHART OF MEASUREMENT BY PART, OPERATOR



OVERVIEW

- Attribute Agreement Analysis is a method is used to assess whether the appraiser are consistent with themselves, with one another, and with known standard.
  - ✓ **Sample – Student Population Sample subset**
  - ✓ **Attribute – Covid-19 test Result**

    GO – (Covid 19) Positive

    NO – (Covid 19) Negative
  - ✓ **Inspector – Staff 1 and Staff 2**

ATTRIBUTE AGREEMENT ANALYSIS DATA

Sample	Attribute	Inspector	Result
1	go	1	go
2	no	1	no
3	no	1	no
4	no	1	no
5	no	1	no
6	no	1	no
7	no	1	no
8	no	1	no
9	no	1	no
10	no	1	no
11	no	1	no
12	no	1	no
13	no	1	no
14	no	1	no
15	go	1	go
16	go	1	go
17	go	1	no
18	no	1	no
19	go	1	go
20	no	1	no
1	go	1	go
2	no	1	no
3	no	1	no
4	no	1	no
5	no	1	no

ATTRIBUTE AGREEMENT ANALYSIS DATA

Sample	Attribute	Inspector	Result
6	no	1	no
7	no	1	no
8	no	1	no
9	no	1	no
10	no	1	no
11	no	1	no
12	no	1	no
13	no	1	no
14	no	1	no
15	go	1	go
16	go	1	go
17	go	1	no
18	no	1	no
19	go	1	go
20	no	1	no
1	go	2	go
2	no	2	no
3	no	2	no
4	no	2	no
5	no	2	no
6	no	2	no
7	no	2	no
8	no	2	no
9	no	2	no
10	no	2	no
11	no	2	no
12	no	2	no

ATTRIBUTE AGREEMENT ANALYSIS DATA

Sample	Attribute	Inspector	Result
13	no	2	no
14	no	2	no
15	go	2	go
16	go	2	go
17	go	2	no
18	no	2	no
19	go	2	go
20	no	2	no
1	go	2	go
2	no	2	no
3	no	2	no
4	no	2	no
5	no	2	no
6	no	2	no
7	no	2	no
8	no	2	no
9	no	2	no
10	no	2	no
11	no	2	no
12	no	2	no
13	no	2	no
14	no	2	no
15	go	2	go
16	go	2	no
17	go	2	go
18	no	2	no
19	go	2	go
20	no	2	no

ATTRIBUTE AGREEMENT ANALYSIS WITH APPRAISERS

Attribute Agreement Analysis for Result

Within Appraisers

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	20	20	100.00	(86.09, 100.00)
2	20	18	90.00	(68.30, 98.77)

 # Matched: Appraiser agrees with him/herself across trials.

Fleiss' Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	go	1.0000	0.223607	4.47214	0.0000
	no	1.0000	0.223607	4.47214	0.0000
2	go	0.6875	0.223607	3.07459	0.0011
	no	0.6875	0.223607	3.07459	0.0011

Kappa values range from –1 to +1. The higher the value of kappa, the stronger the agreement, as follows:

1. When Kappa = 1, **perfect agreement** exists.
2. When Kappa = 0, **agreement is the same** as would be expected by chance.
3. When Kappa < 0, **agreement is weaker** than expected by chance; this rarely occurs.

1. The Kappa value is 1 for **Appraiser 1** which indicates **perfect agreement within an appraiser** between trials.

2. Some of **Appraiser 2's** kappa values are **close**

ATTRIBUTE AGREEMENT ANALYSIS EACH APPRAISER V/S STANDARD

Each Appraiser vs Standard

Assessment Agreement

Appraiser	# Inspected	# Matched	Percent	95% CI
1	20	19	95.00	(75.13, 99.87)
2	20	18	90.00	(68.30, 98.77)

 # Matched: Appraiser's assessment across trials agrees with the known standard.

Assessment Disagreement

Appraiser	# no / go	Percent	# go / no	Percent	# Mixed	Percent
1	1	20.00	0	0.00	0	0.00
2	0	0.00	0	0.00	2	10.00

 # no / go: Assessments across trials = no / standard = go.
 # go / no: Assessments across trials = go / standard = no.
 # Mixed: Assessments across trials are not identical.

Fleiss' Kappa Statistics

Appraiser	Response	Kappa	SE Kappa	Z	P(vs > 0)
1	go	0.856631	0.158114	5.41781	0.0000
	no	0.856631	0.158114	5.41781	0.0000
2	go	0.856631	0.158114	5.41781	0.0000
	no	0.856631	0.158114	5.41781	0.0000

Most of the Kappa values are **larger than 0.80**, which **indicates good agreement between each appraiser and the standard**.

ATTRIBUTE AGREEMENT ANALYSIS BETWEEN APPRAISERS, ALL APPRAISERS VS STANDARD

Between Appraisers

Assessment Agreement

# Inspected	# Matched	Percent	95% CI
20	18	90.00	(68.30, 98.77)

 # Matched: All appraisers' assessments agree with each other.

Fleiss' Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
go	0.84375	0.0912871	9.24282	0.0000
no	0.84375	0.0912871	9.24282	0.0000

All Appraisers vs Standard

Assessment Agreement

# Inspected	# Matched	Percent	95% CI
20	18	90.00	(68.30, 98.77)

 # Matched: All appraisers' assessments agree with the known standard.

Fleiss' Kappa Statistics

Response	Kappa	SE Kappa	Z	P(vs > 0)
go	0.856631	0.111803	7.66194	0.0000
no	0.856631	0.111803	7.66194	0.0000

The Kappa values are **larger than 0.80**, which **indicates good agreement between appraisers**.

FACTORIAL REGRESSION

1. **Factorial Regression: Response versus A, B, C (w/o interactions)**

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		8.339	0.936	8.91	0.000	
A	-9.622	-4.811	0.936	-5.14	0.000	1.00
B	-4.470	-2.235	0.936	-2.39	0.027	1.00
C	3.510	1.755	0.936	1.87	0.076	1.00

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
4.58701	64.04%	58.64%	48.21%

Analysis of Variance

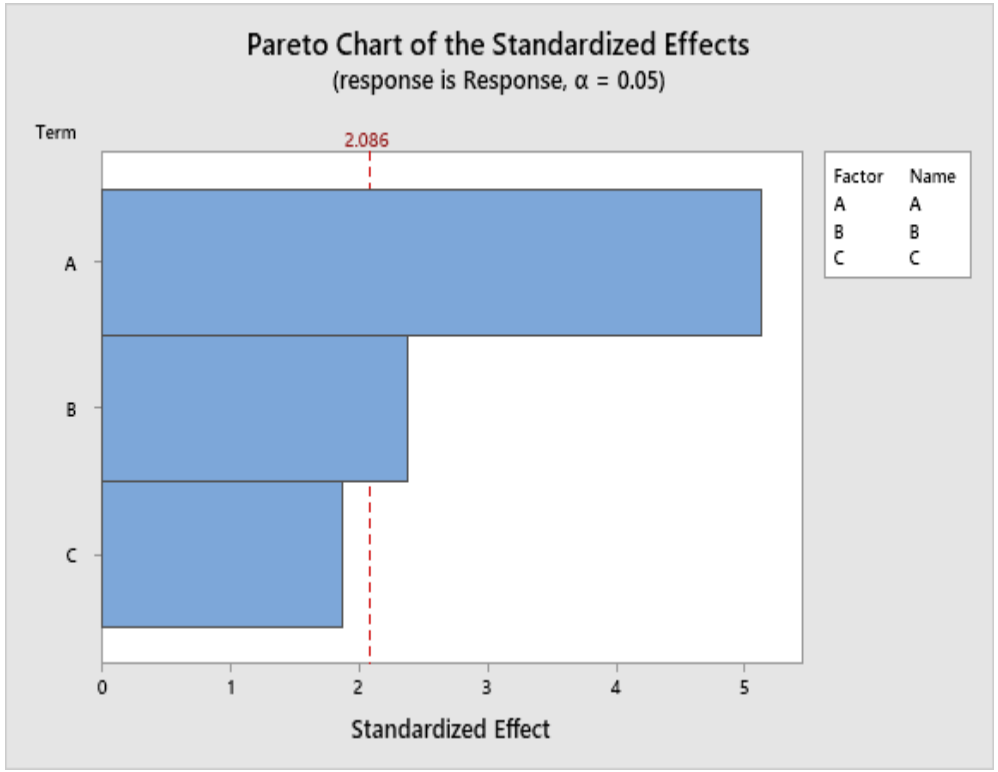
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	3	749.31	249.770	11.87	0.000
Linear	3	749.31	249.770	11.87	0.000
A	1	555.49	555.494	26.40	0.000
B	1	119.90	119.901	5.70	0.027
C	1	73.92	73.916	3.51	0.076
Error	20	420.81	21.041		
Lack-of-Fit	4	333.29	83.323	15.23	0.000
Pure Error	16	87.52	5.470		
Total	23	1170.12			

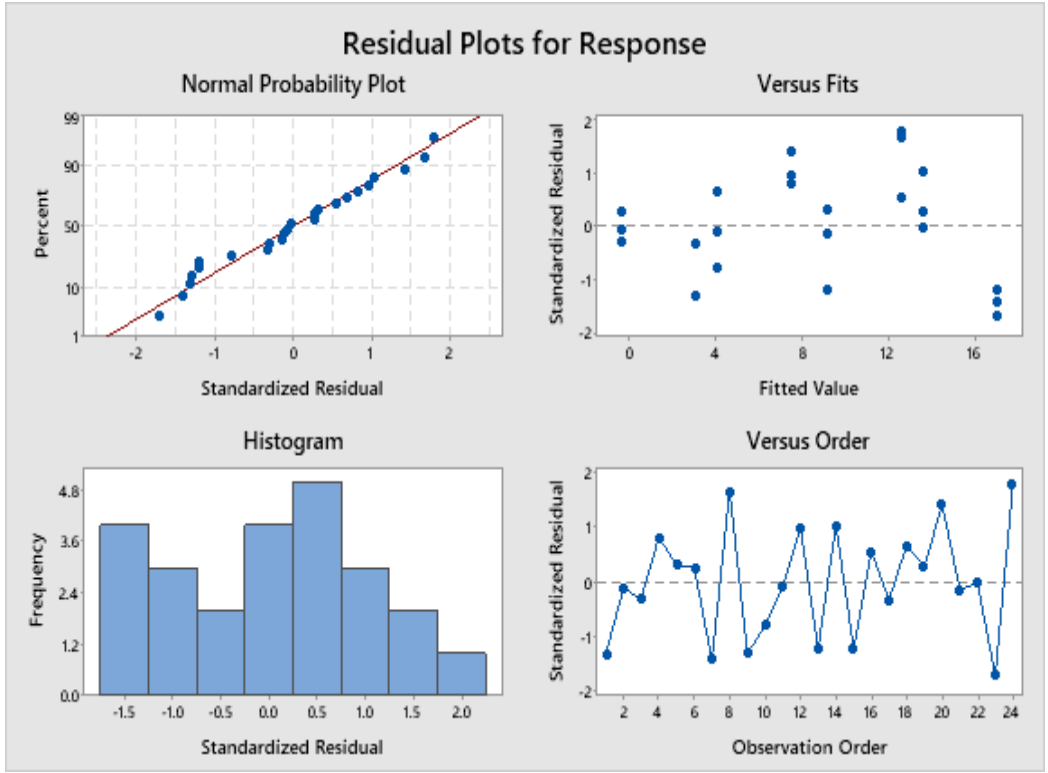
If the p-value is <= 0.05, the factors are significant.

Regression Equation in Uncoded Units

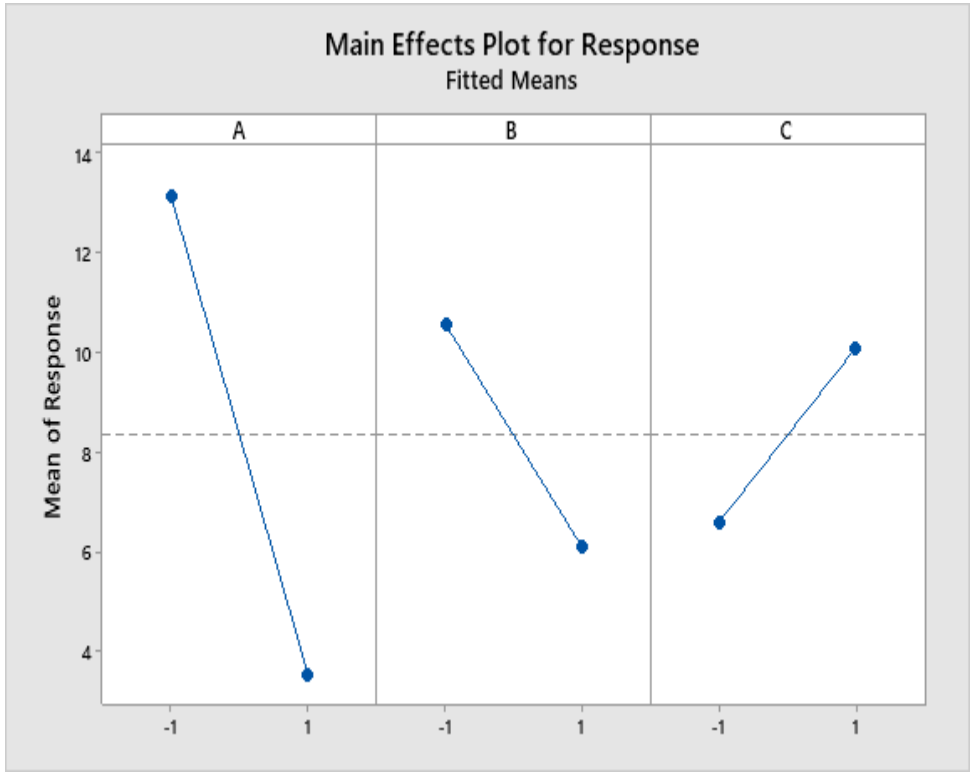
Response = 8.339 - 4.811 A - 2.235 B+ 1.755 C

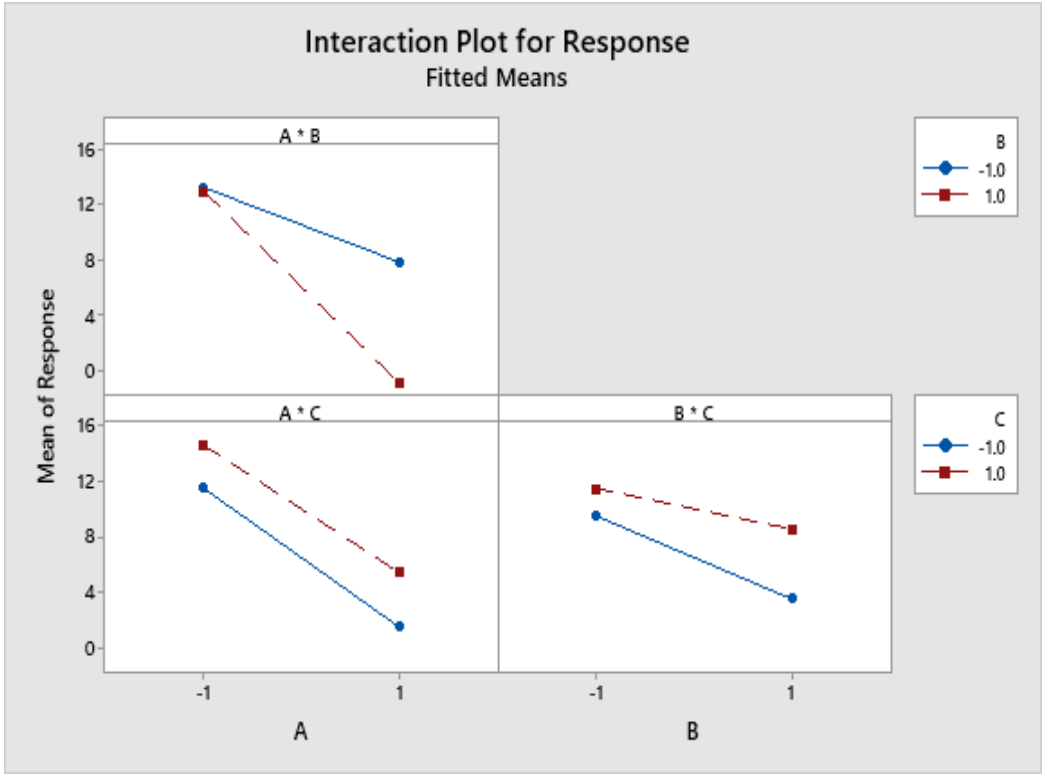
PARETO CHART & RESIDUAL PLOTS





MAIN EFFECT & INTERACTION PLOT





REGRESSION ANALYSIS WITH INTERACTIONS

3. Regression Analysis: Response versus A, B, C, AB, AC, BC, ABC (with interactions)

Regression Equation

Response = 8.339 - 4.811 A - 2.235 B + 1.755 C - 2.115 AB + 0.203 AC + 0.764 BC - 2.964 ABC

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	8.339	0.477	17.47	0.000	
A	-4.811	0.477	-10.08	0.000	1.00
B	-2.235	0.477	-4.68	0.000	1.00
C	1.755	0.477	3.68	0.002	1.00
AB	-2.115	0.477	-4.43	0.000	1.00
AC	0.203	0.477	0.43	0.676	1.00
BC	0.764	0.477	1.60	0.129	1.00
ABC	-2.964	0.477	-6.21	0.000	1.00

Here, interactions AC & BC are statistically not significant.

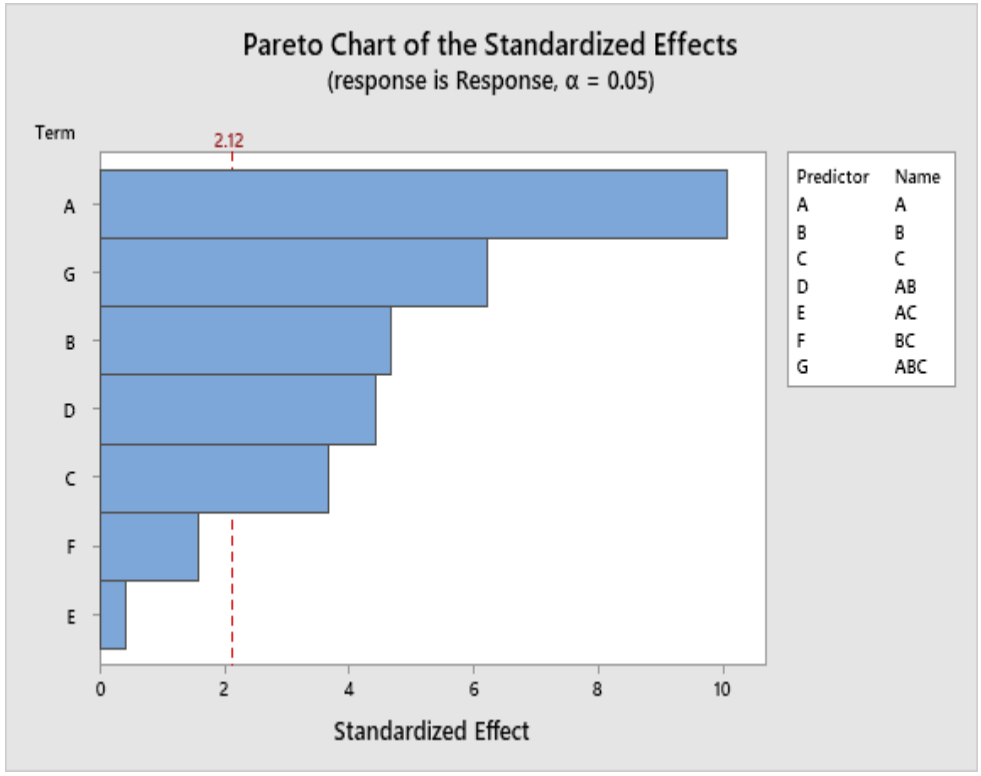
Model Summary

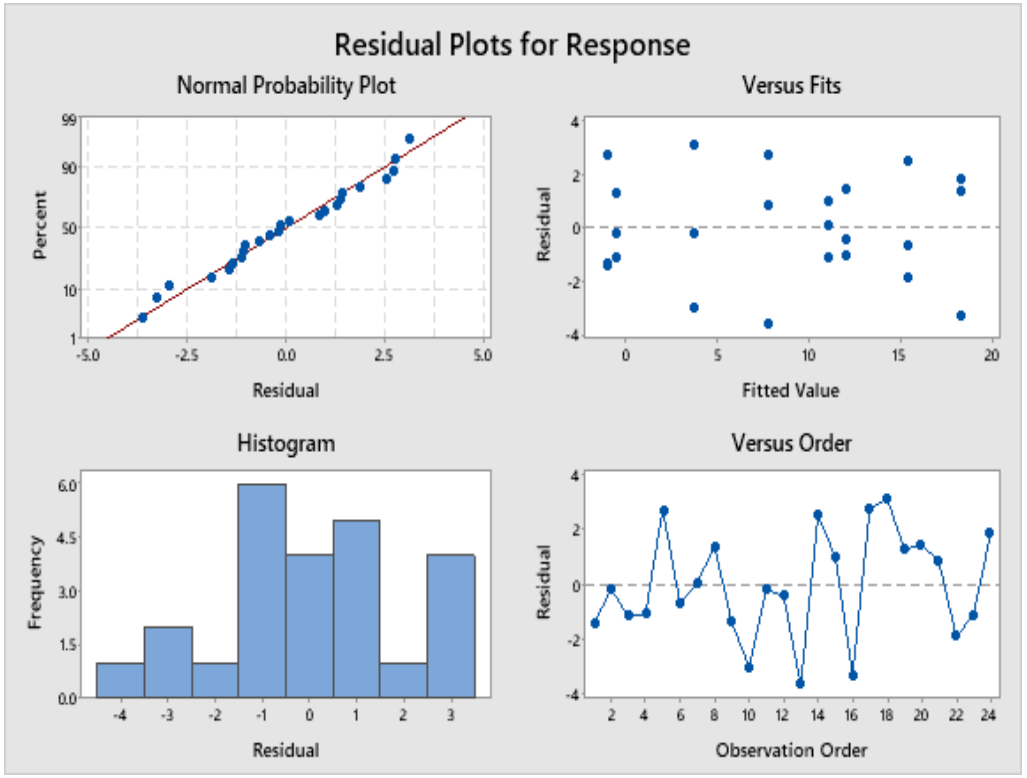
S	R-sq	R-sq(adj)	R-sq(pred)
2.33883	92.52%	89.25%	83.17%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	7	1082.60	154.657	28.27	0.000
A	1	555.49	555.494	101.55	0.000
B	1	119.90	119.901	21.92	0.000
C	1	73.92	73.916	13.51	0.002
AB	1	107.40	107.398	19.63	0.000
AC	1	0.99	0.991	0.18	0.676
BC	1	13.99	13.993	2.56	0.129
ABC	1	210.91	210.909	38.56	0.000
Error	16	87.52	5.470		
Total	23	1170.12			

PARETO CHART AND RESIDUAL PLOTS





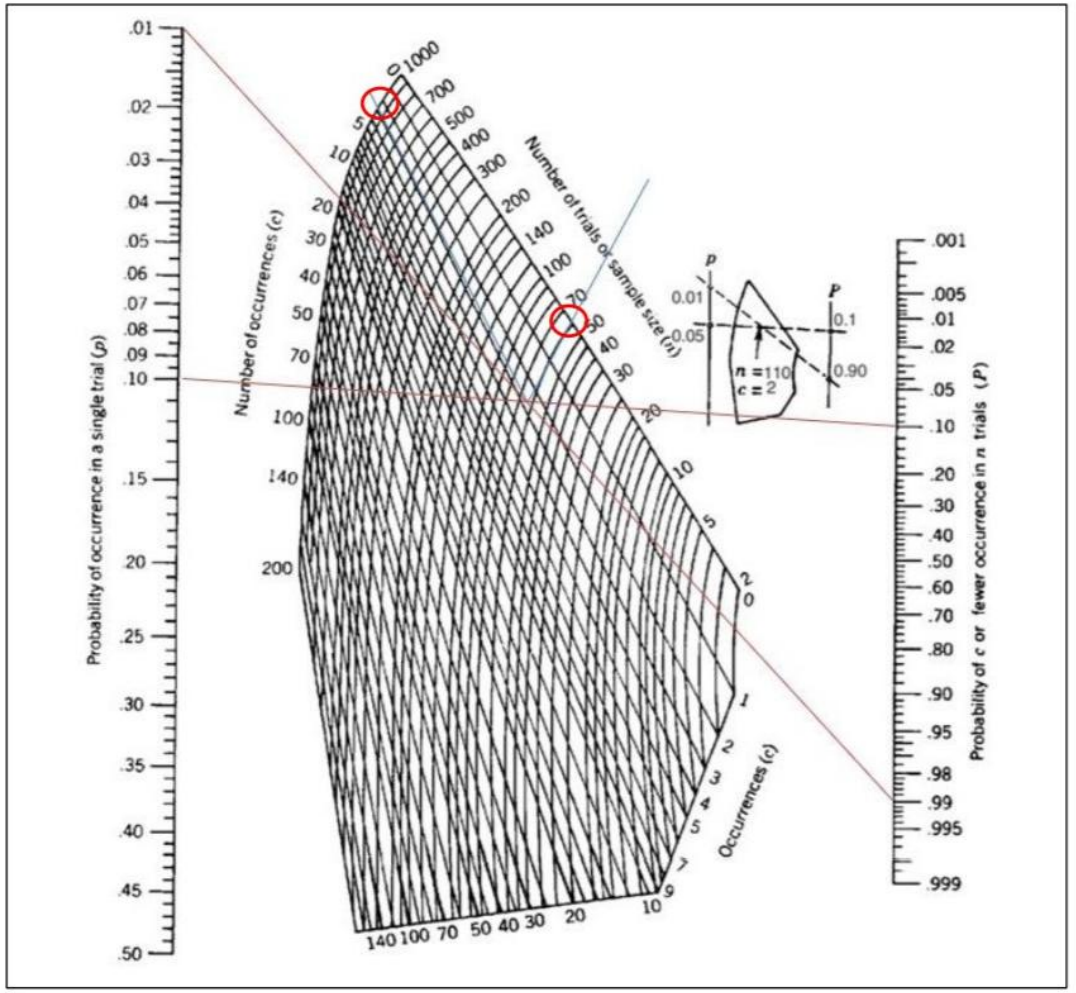
OC CURVES

AQL	0.01
LTPD	0.1

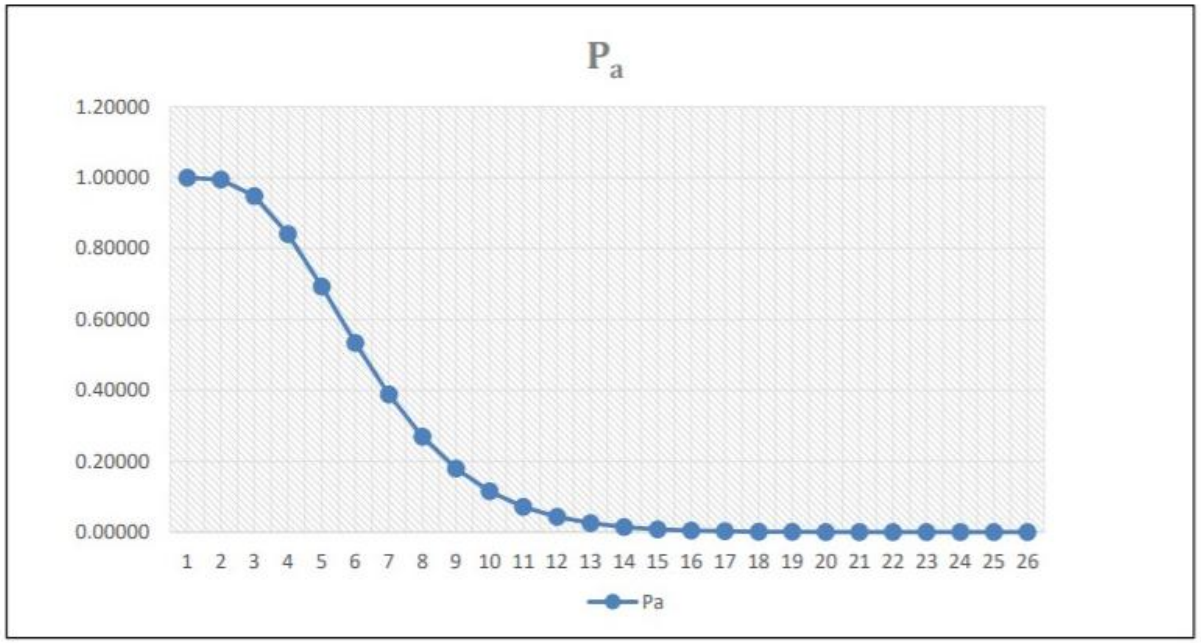
n	70
c	3

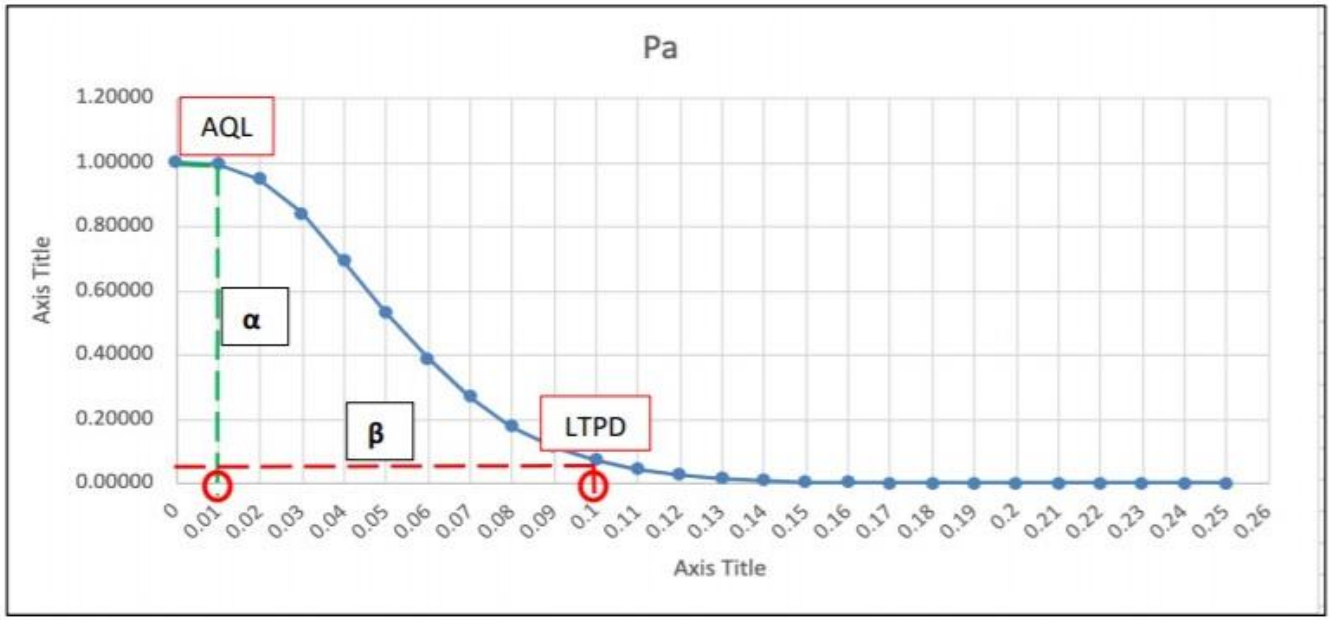
Lot or Batch Size:	3500
Lot Code	L

Sampling Size (N)	200
Ac = 0	Re = 1

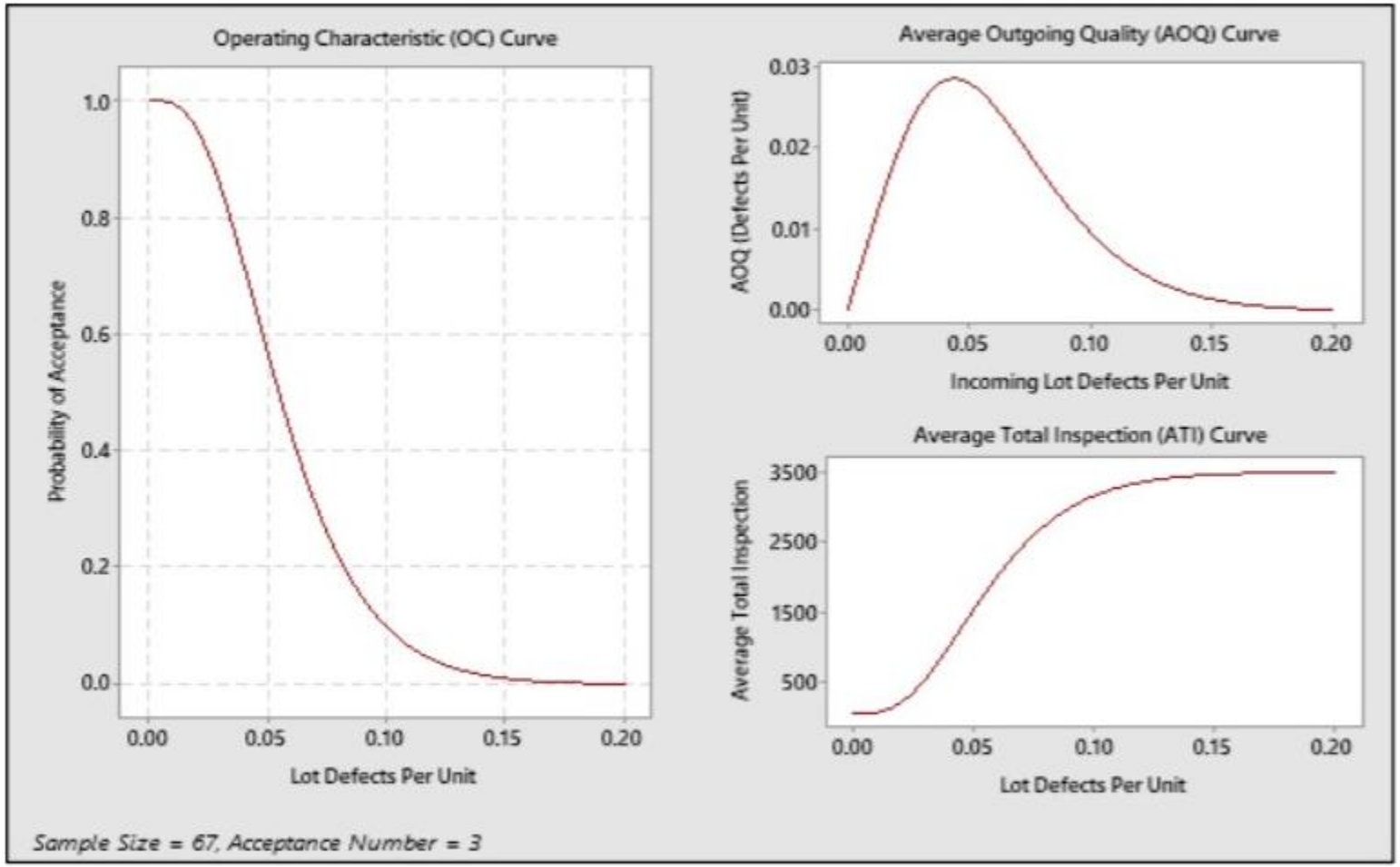


OC CURVES – EXCEL OUTPUT





OC CURVES – MINITAB OUTPUT



CONCLUSION

- We tested accuracy of the data by checking the distributions, using various types of quality tools – histograms, box plots, pareto chart, scatter plot to analyze factors crucial to reopening of schools
- We narrow it down to 5 different factors: **PPE, Hygiene, Social Distancing, COVID Tracing and Tracking & Personnel**
- From this we figure out that COVID tracking and tracing, PPE, social distancing are our main areas of focus.
- We conclude this from our Lean Six Sigma model and Design for Six Sigma to make sure that our reopening plan is right on track
- We tried out the figure out the relationship between the factors by performing House of Quality and FMECA
- Moving forward, we conducted a Gage R&R to identify if our measurement system is accurate and we found that our measurement system is faulty. Attribute Agreement Analysis – Appraisals all okay
- Factorial Regression and OC Curves are to identify which factors are crucial to reopening of schools which also verifies our assessment of infection rate to be vital hence, to reopen schools we need to have an infection rate less than 5%


THANK YOU :)