Group 2:
State-wide Reopening

MFE 634 | Professor Romeu

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Spring 2021

Overview

- Background

- Problem Statement

- Quality Methods Used

- Problems Detected

- Proposed solutions

- Conclusion

Background

- What is Covid-19?

  - Very contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

- First detected in the US in January 2020

  - 33 million positive cases; 581,000 deaths

- Governor Andrew Cuomo implemented a stay-at-home order for the state

  - Restrictions on gatherings and non-essential travel

  - Economic, social and political issues arose

Problem Statement

- *It has been over a year since the coronavirus pandemic started to wreak havoc on the United States. Other than the social and public health crisis that this has created, the economic crises is just as catastrophic. In order to return to some level of normal, local and federal governments must focus on re-opening the economy in an efficient, calculated and responsible manner. By re-opening the economy, business can start to open, and people can go back to work and make money. However, if certain measures and controls are not put in place to control the spread of the virus in relation to the economy, then we run the risk of fueling another wave of severe infections.*
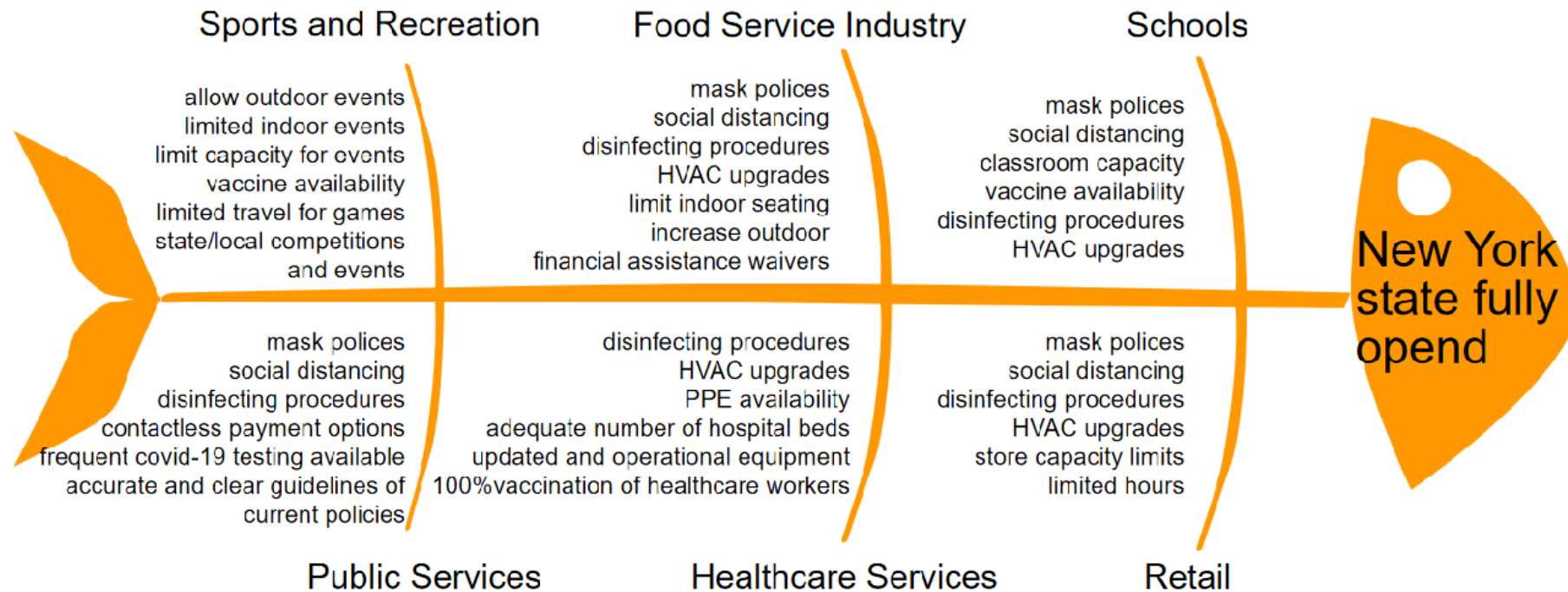
Quality Methods Used

- Brainstorming / Ishikawa Chart

- Process Capability analysis

- DMAIC Process

- Quality Function Deployment

- Design of Experiments (DOE)
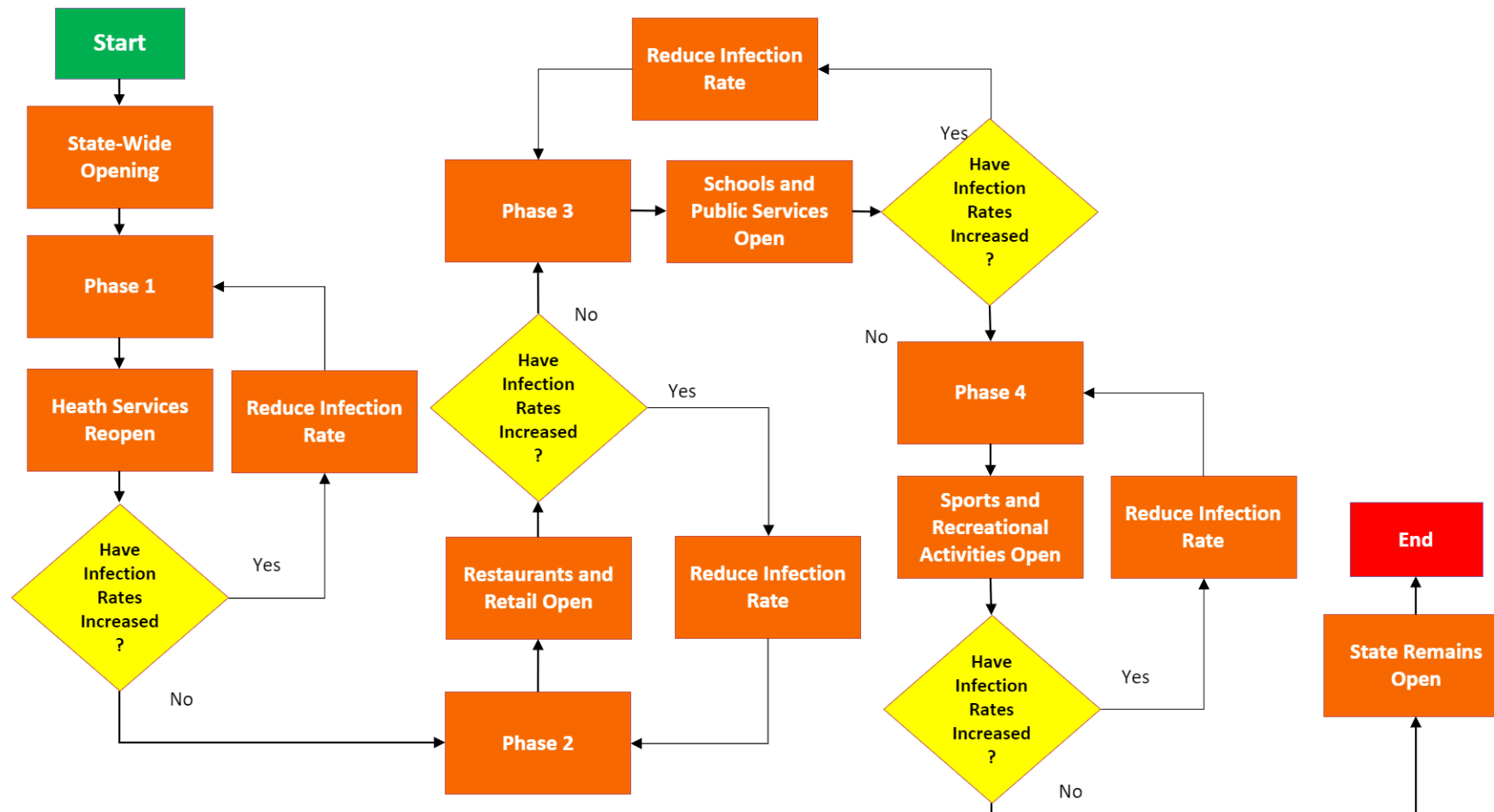
- Value Stream Map (VSM)

Brainstorming

Schools	Food Service Industry	Retail	Public Services	Healthcare services	Sports and Recreation
Mask policies	Mask policies	Mask policies	Mask policies	Disinfecting procedures	Allow outdoor events
Social Distancing	Social Distancing	Social Distancing	Social Distancing	HVAC upgrades	Limited indoor events
Classroom capacity	Disinfecting procedures	Disinfecting procedures	Disinfecting procedures	PPE availability	Limit capacity for events
Vaccine availability	HVAC upgrades	HVAC upgrades	Contactless payment options	Adequate number of hospital beds	Vaccine availability
Disinfecting procedures	Limit indoor seating and increase outdoor	Store capacity limits	Frequent COVID-19 testing available	Updated and operational equipment	Limited travel for games
HVAC upgrades	Financial assistance waivers/programs	Limited hours	Accurate and clear guidelines of current policies	~100% vaccination of healthcare workers	State/local competitions and events

Ishikawa Chart

NYS Reopening

Sports and Recreation

allow outdoor events
limited indoor events
limit capacity for events
vaccine availability
limited travel for games
state/local competitions
and events

Food Service Industry

mask polices
social distancing
disinfecting procedures
HVAC upgrades
limit indoor seating
increase outdoor
financial assistance waivers

Schools

mask polices
social distancing
classroom capacity
vaccine availability
disinfecting procedures
HVAC upgrades

New York
state fully
opend

mask polices
social distancing
disinfecting procedures
contactless payment options
frequent covid-19 testing available
accurate and clear guidelines of
current policies

disinfecting procedures
HVAC upgrades
PPE availability
adequate number of hospital beds
updated and operational equipment
100%vaccination of healthcare workers

mask polices
social distancing
disinfecting procedures
HVAC upgrades
store capacity limits
limited hours

Public Services

Healthcare Services

Retail

Flow Chart

Quality Function Deployment (QFD)

Customer Needs

Customers	Retail stores/restaurnts open	Job availability	More capacity in public places	Less restrictions on travel	Government assistance	Public safety
Retail stores	9	9	5	0	6	9
Restaurants	9	9	5	0	6	9
Government officials	0	5	0	1	1	9
Everyday citizens	5	9	0	9	9	9
Workers	6	9	0	9	5	9
Business owners	9	5	0	5	5	5

Product features

| Customer needs	New technical and non-technical jobs	Government stimulus check/pandemic relief fund	Vaccinated public	Investment in new and old industries	Safety plan	Thriving economy
Retail stores/restaurnts open	5	9	7	7	5	9
Job availability	9	4	7	9	0	9
More capacity in public places	0	0	1	1	5	0
Less restrictions on travel	0	0	0	0	9	0
Government assistance	5	9	0	7	0	7
Public safety	0	0	9	0	9	5

Process features

| Product Features	Data collection	Problem defining	Data analyzing	Improvement plan	Processes supervision	Controlling implements
New technical and non-technical jobs	1	1	5	1	5	5
Government stimulus check/pandemic relief fund	5	0	5	0	5	0
Vaccinated public	5	5	5	9	5	1
Investment in new and old industries	9	1	9	1	5	5
Safety plan	5	9	5	9	7	5
Thriving economy	9	9	9	9	8	5

Problems Detected

- Safety plan

- Unvaccinated public

- Investment in industries needed

- Government stimulus check and pandemic relief fund needed

- Lack of new technical and non- technical jobs

Process Capability Analysis

infection rate for all region — Normal
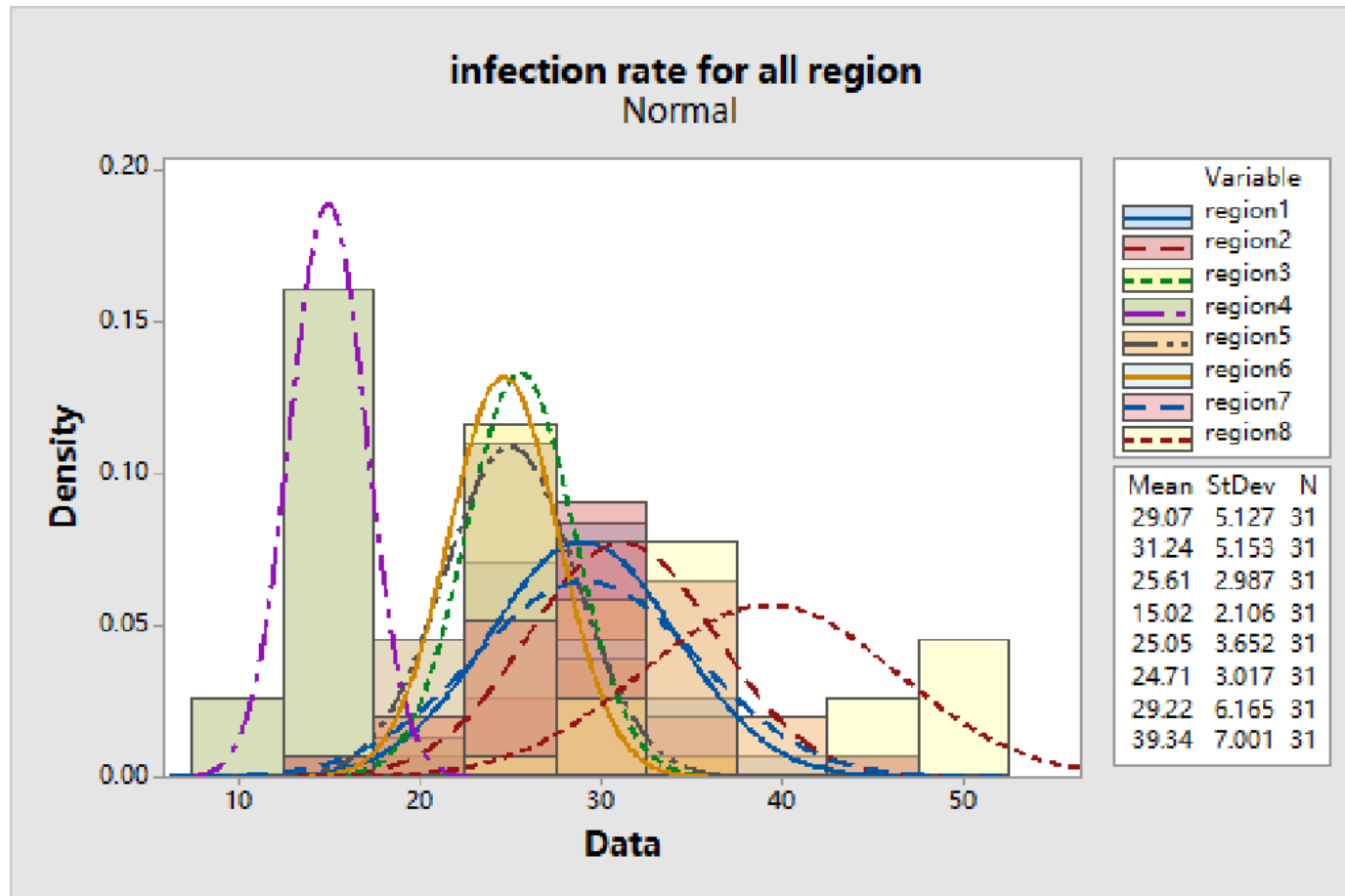
- We want the number of new patients from all regions to be lower than 20 per day
- We conclude that Region4 is the best while Region8 is the worst.
- We plan to learn from Region4's strong points to offset Region8's weakness.
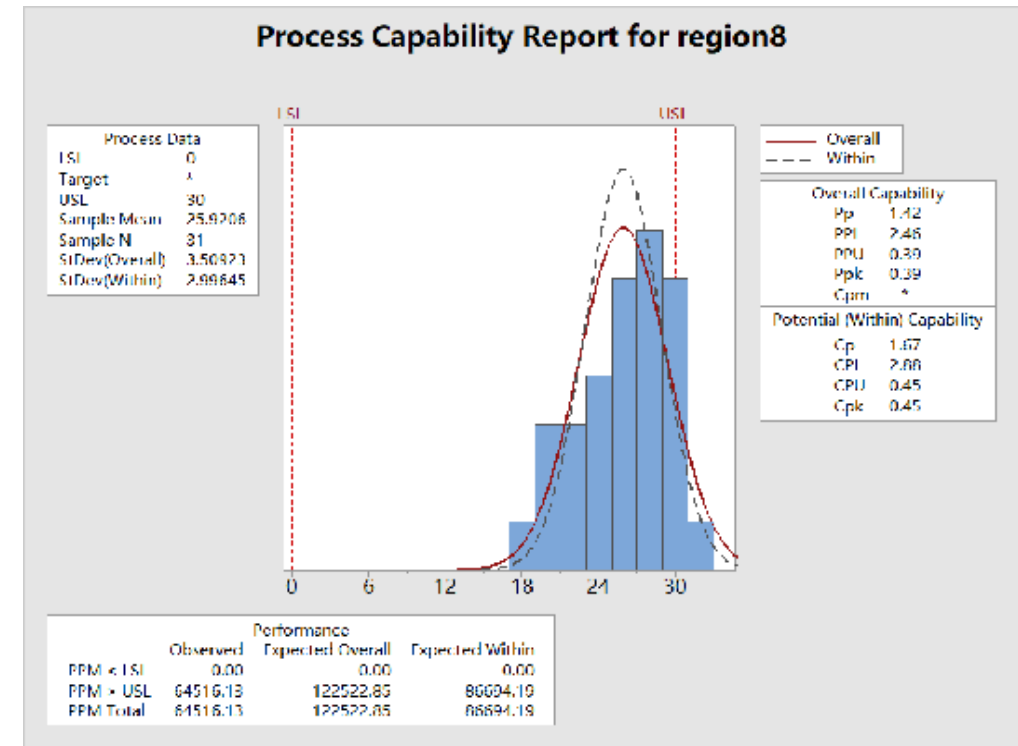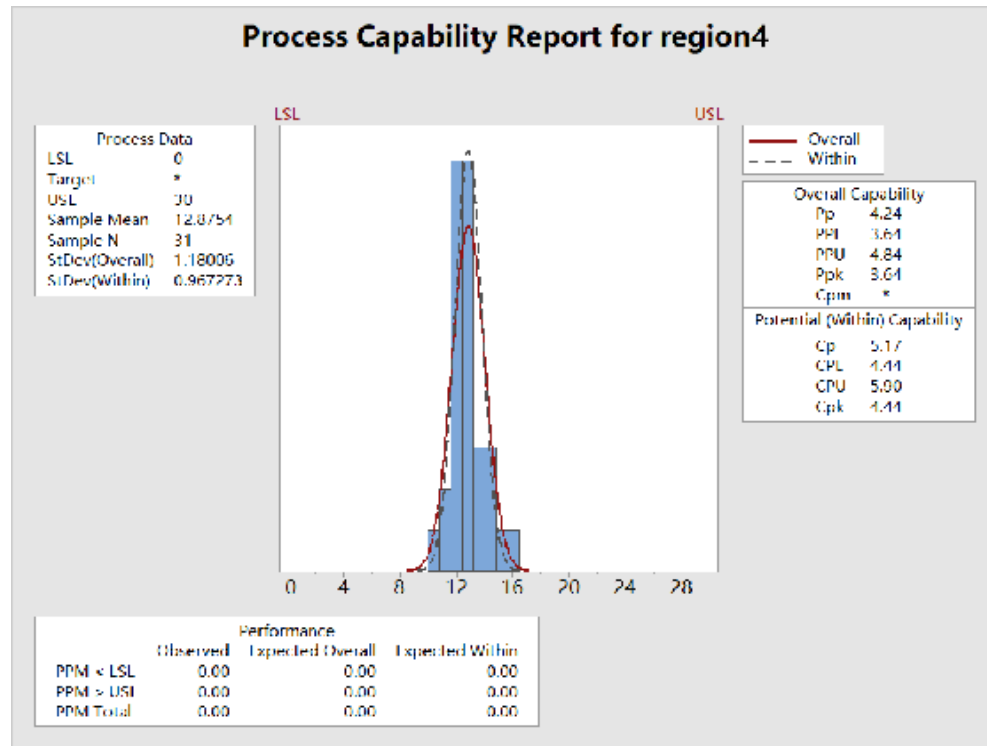
Process Capability Analysis
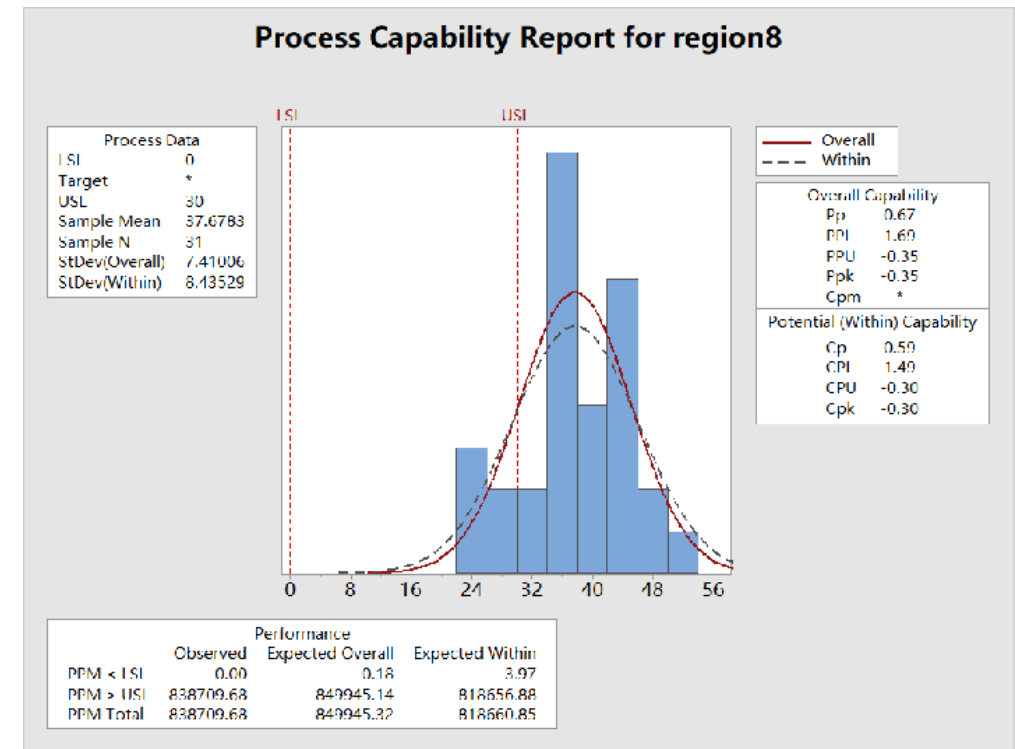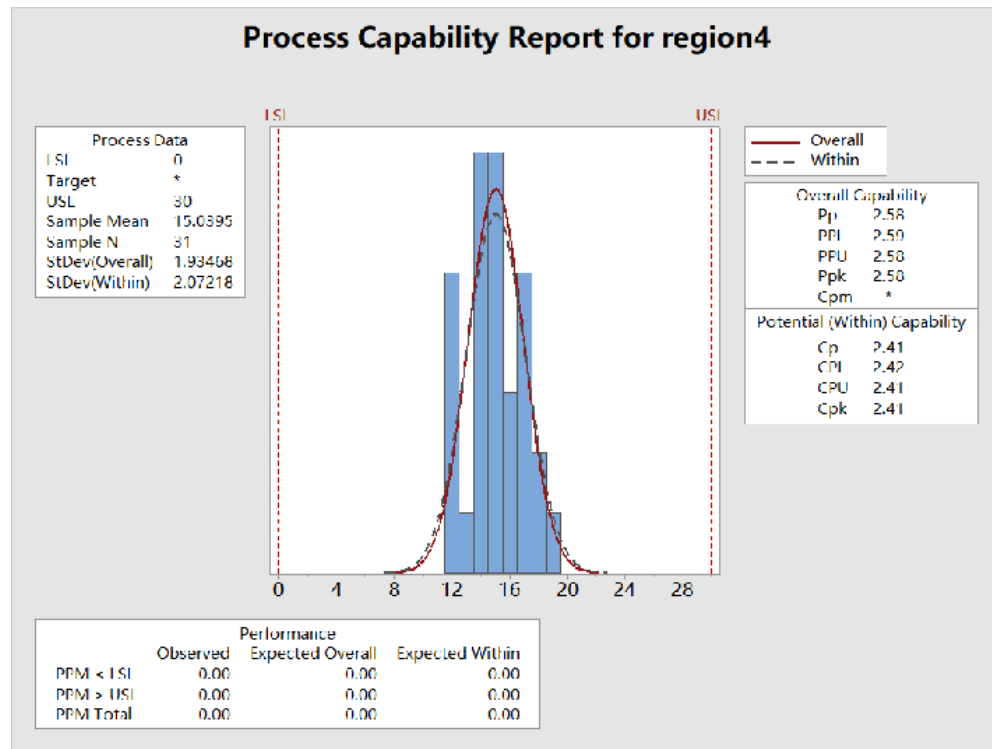
Before

The capability of region4 perfectly corresponds with our goal. Region8 contains a lot of problems in its capability. The only problem is p is over value. It means region4 doesn't correspond with normal distribution. However, there might be a positive effect in it, which we can use to improve region8.

Process Capability Analysis

Process Capability Report for region4

Process Capability Report for region8

After

Region4's capability index is double from what it was before. Region8's capabilities have also improved significantly. Still, region4 is the best while Region8 is the worst, however, all qualities have improved.

Process Capability Analysis


improvement of region8
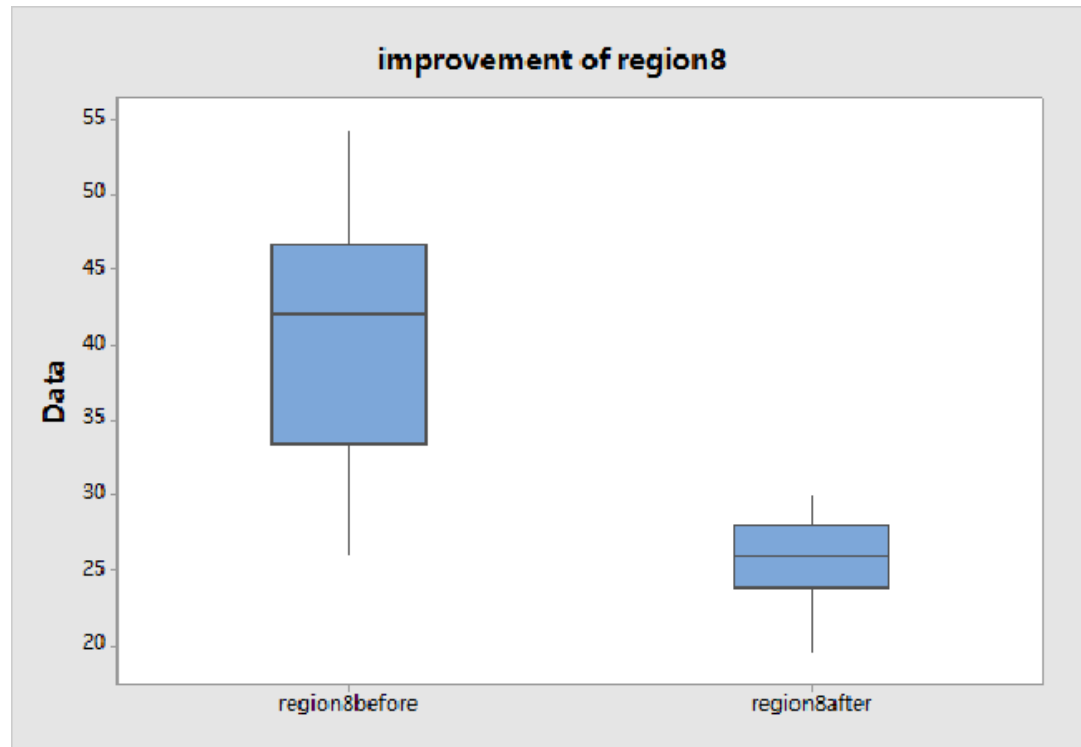
Conclusion

- From the previous plots, we can conclude the following:
- Regions before had poor fits.
- Regions after improved and have better fits.
- Region 4 aligns with Target goal.
- Region 8 is not centered on the Target goal.
- Ppk is < 1.33 which many industries use as a benchmark, this means the process can be improved.
- Cpk and Ppk are approximately equal, meaning the process is in statistical control.
- Pp and Ppk are not approximately equal, meaning the process is not centered between the specification limits.

Current Value Stream Map
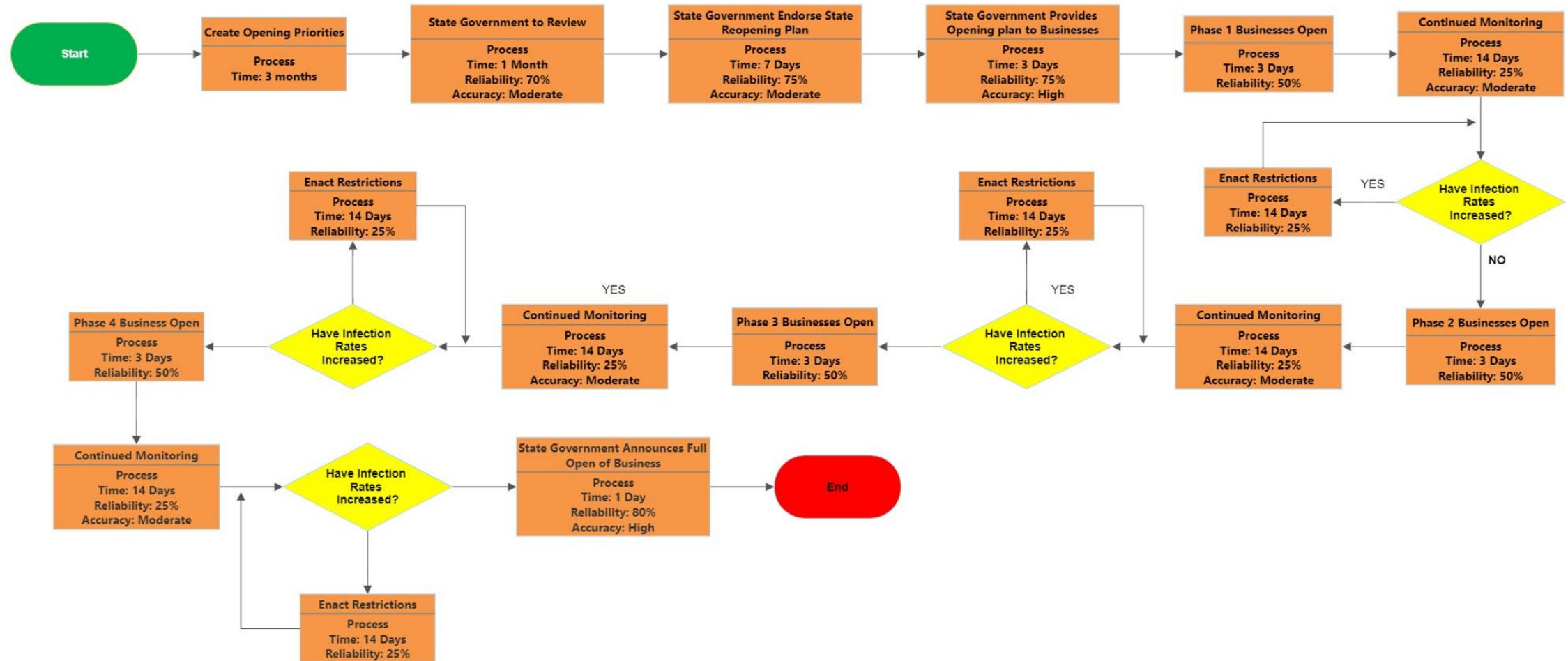
Future Value Stream Map
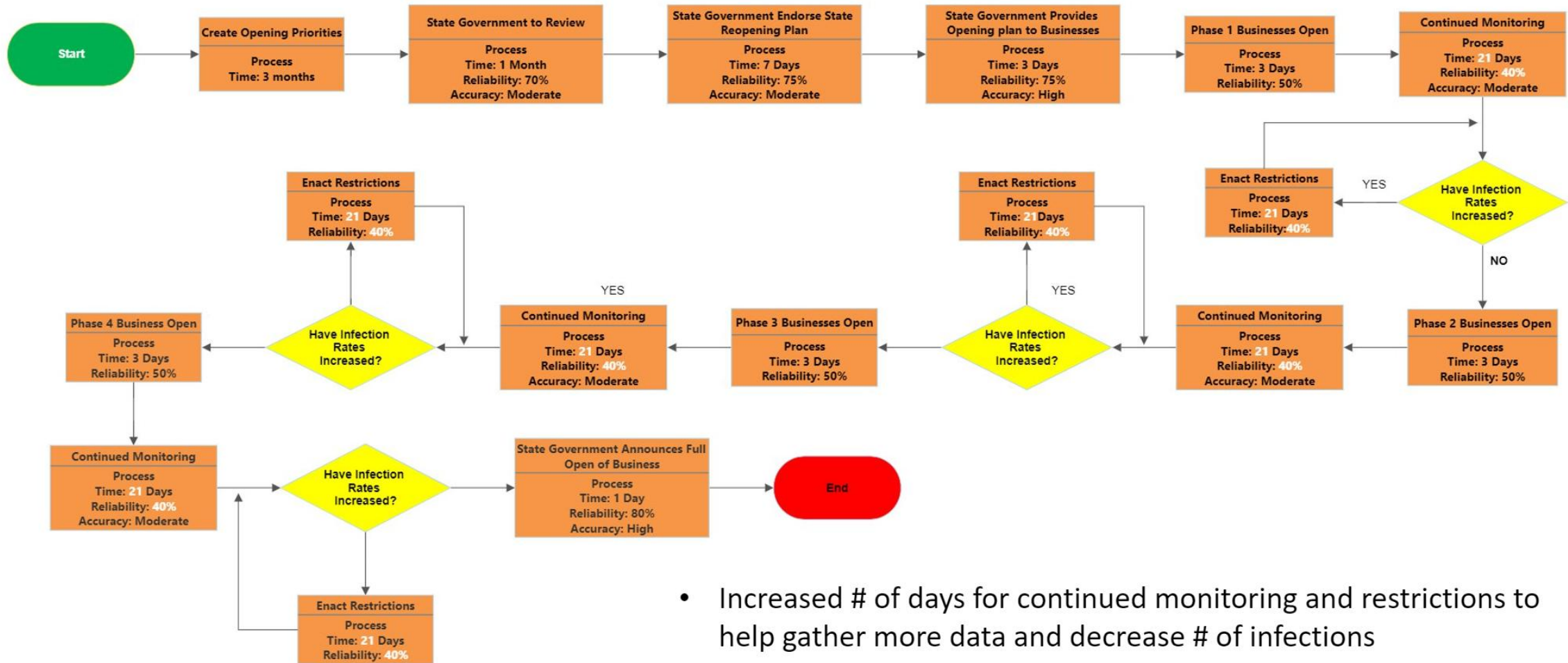
- Increased # of days for continued monitoring and restrictions to help gather more data and decrease # of infections
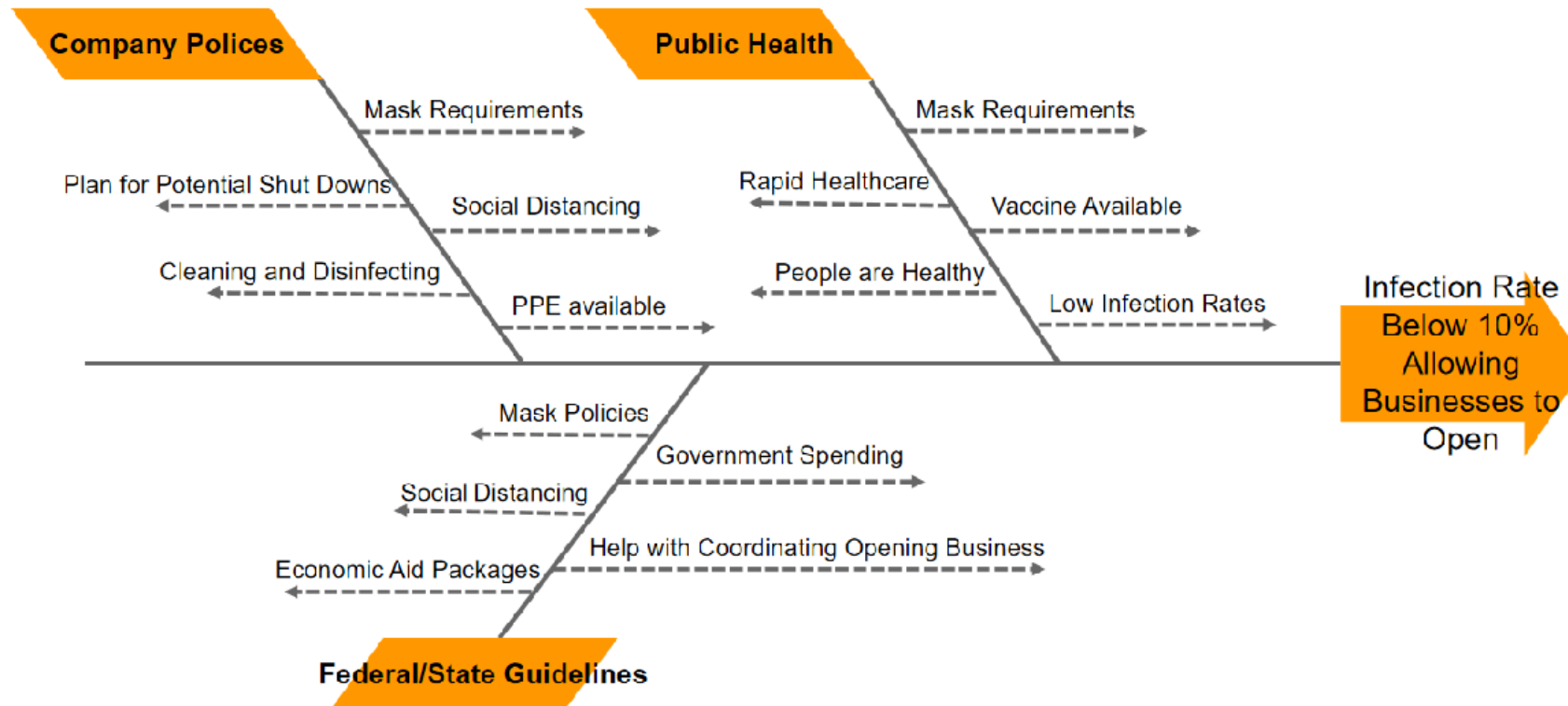
DMAIC Process: Define

- As a result of the Covid-19 pandemic, on March 20th, 2020 New York State shut down to slow the spread of the virus. This closure led to the loss of over 1 million jobs in 2020 alone which accounts to over 8% of the state's workforce.
- **Evaluate Projects (Pareto Priority Index)**
  - Reopen import/export routes
  - Reopen retail businesses
  - Reopen manufacturing plants

Projects	Savings, $thousands	Probability	Cost, $ Thousands	Time (Years)	PPI
(1)	10	85%	2	0.25	17
(2)	15	90%	4	0.25	13.5
(3)	*30*	*95%*	*3*	*0.5*	*19*

DMAIC Process: Measure

Cause-and-Effect Diagram

DMAIC Process: Analyze

Process Capability Sixpack Report for reopening businesses
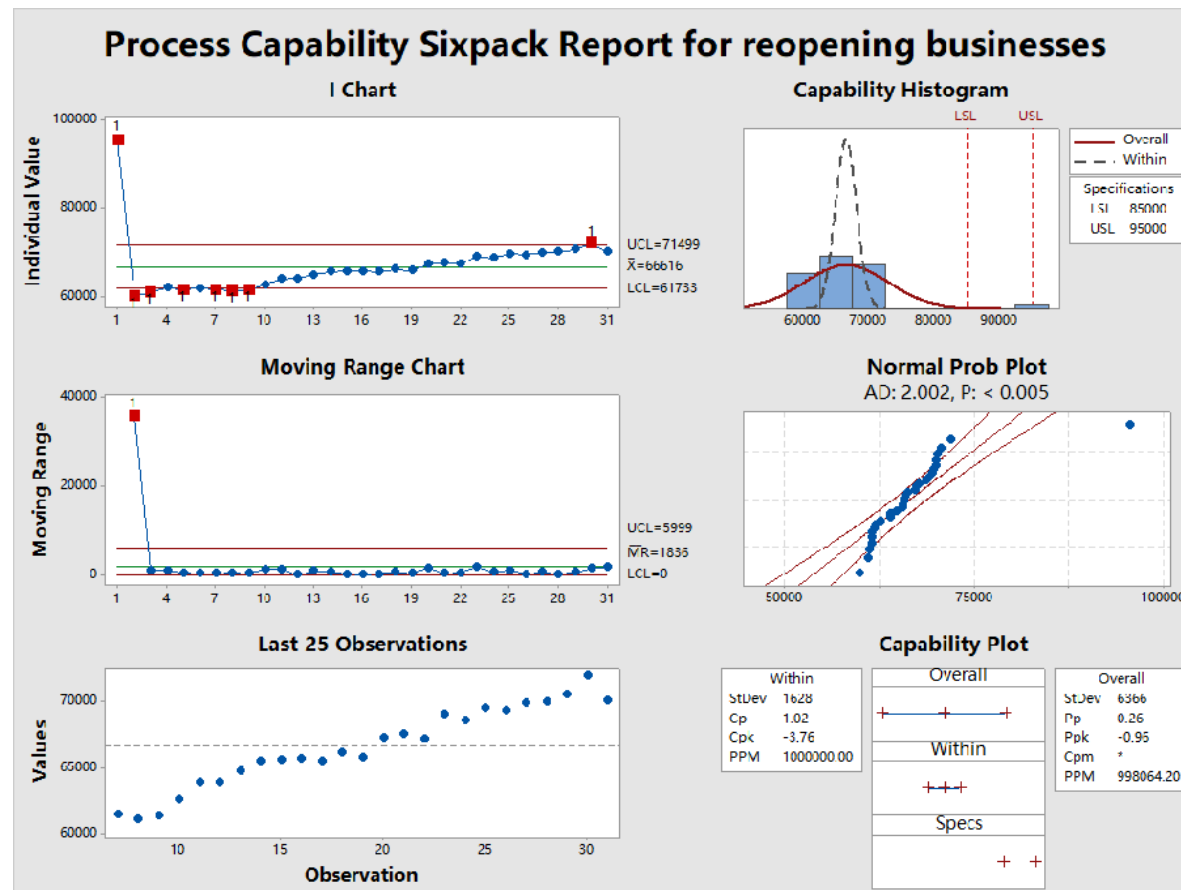
The chart shows a very stable curve of total reopening businesses as time goes by, and its increase slowly.

In terms of capability, it never matches what we want, namely, there should be 85,000-95,000 opening businesses per day to maintain the great economy comparing with 100,000 businesses before pandemic.

DMAIC Process: Improve

The state government can take the following measures to improve the opening of businesses

- **Define criteria of keeping businesses open, shutting them down**
  - Target hotspots for temporary closing businesses down to reduce the infection rate if daily infection rate is steadily greater than 5%.
- **Time sensitive deadlines**
  - Businesses need to be opened in timely manner in order to stabilize and improve the state economy
- **Create Phases**
  - Open businesses in phases to curb infection rates, 2-week phases in order to see infection rates

DMAIC Process: Control

Once the problem is defined, measured, analyzed and improved, we must include controls to maintain the process and ensure that it is followed correctly.

- Make sure all protocols are clearly documented and available to the public.
- Ensure public is fully aware of current guidelines
  - The use of social media, outdoor signage, and PSAs could help ensure this
- Maintain daily updates on rolling number infection rate, number of new people infected.
- Businesses to conduct temperature checks for individuals
  - Help identify those potentially infected before they can infect others
- Enforcement of social distancing and mask policies need to top priority for local law enforcement when trying to contain the spread of COVID-19.
  - Appropriate penalties for violators

Design of Experiments

- The State has determined that three factors impact the ability to open the State's economy.

- These factors are

A	Infection Rates	UprLimit	15%	LwrLimit	5%
B	Job Availability	UprLimit	50%	LwrLimit	10%
C	Capacity Allowed in Building	UprLimit	80%	LwrLimit	40%

- These factors were chosen to have the ability to monitor infection rates, look at job availability as businesses re-open, and to see a correlation between all 3 factors.

- The Process Capability ratio is unacceptable and infection rates must be reduced.

Design of Experiments

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➤ These factors were chosen to have the ability to monitor infection rates, look at job availability as businesses re-open, and to see a correlation between all 3 factors.

➤ The Process Capability of new stores is unacceptable and infection rates must be reduced.

Design of Experiments: Data

➢Data distribution for Design of Experiment

Run	A	B	C	AB	AC	BC	ABC	Y1	Y2	Y3	Avg.	Var.
1	-1	-1	-1	1	1	1	-1	-2.49522	-2.4232	1.721714	**-1.07**	**5.8280**
2	1	-1	-1	-1	-1	1	1	3.561609	0.72755	6.868266	**3.72**	**9.4457**
3	-1	1	-1	-1	1	-1	1	-1.70987	-0.75186	0.721008	**-0.58**	**1.4994**
4	1	1	-1	1	-1	-1	-1	10.97971	11.63553	13.4965	**12.04**	**1.7046**
5	-1	-1	1	1	-1	-1	1	10.51655	4.122255	8.611666	**7.75**	**10.7784**
6	1	-1	1	-1	1	-1	-1	14.7701	17.99574	13.5711	**15.45**	**5.2366**
7	-1	1	1	-1	-1	1	-1	11.18758	12.09465	9.996949	**11.09**	**1.1068**
8	1	1	1	1	1	1	1	19.7119	15.0226	20.19426	**18.31**	**8.1614**
							Sum	66.52235	58.42327	75.18146	66.70903	43.76087
											8.338628	5.470108

Design of Experiments: Data

ToSum

SumY+	49.5116	40.8596	52.5984	37.0314	32.1094	32.0562	29.1986
SumY-	17.1974	25.8494	14.1106	29.6776	34.5996	34.6528	37.5104
AvgY+	12.3779	10.2149	13.1496	9.2579	8.0274	8.0141	7.2997
AvgY-	4.2994	6.4623	3.5276	7.4194	8.6499	8.6632	9.3776
Effect	8.0786	3.7526	9.6220	1.8385	-0.6225	-0.6491	-2.0779
Var+	6.1371	3.1180	6.3208	6.6181	5.1813	6.1355	7.4712
Var-	4.8031	7.8222	4.6194	4.3221	5.7589	4.8047	3.4690
F	0.7826	2.5087	0.7308	0.6531	1.1115	0.7831	0.4643

Regression Estimation

Regression: b0+b1*A+b2*B+b3*C+b4*AB+b5*AC+b6*BC+b7*ABC

RegCoef	**b1**	**b2**	**b3**	**b4**	**b5**	**b6**	**b7**
estimat.	4.039277	1.8762837	4.8109835	0.919226	-0.311272	-0.324575	-1.038967

Var.of Model	5.4701084	**StdDv**	2.3388263
Var.of Effect	0.9116847	**StdDv**	0.9548218
Student T (0.0025;DF)=			2.1199053
C.I. Half Width=			2.0241319

Significant Factors & 95% CI Limits:

Factor	**A**	**B**	**C**	**AB**	**AC**	**BC**	**ABC**
Signific	Yes	Yes	Yes	No	No	No	No
LwrLimit	8.0786	1.7284	7.5978	-0.1857	-2.6467	-2.6733	-4.1021
UprLimit	10.1027	5.7767	11.6461	3.8626	1.4016	1.3750	-0.0538

Regression we will use:

Regression: 8.33+4.03A+1.87B+4.81C

Pareto Chart of Effect
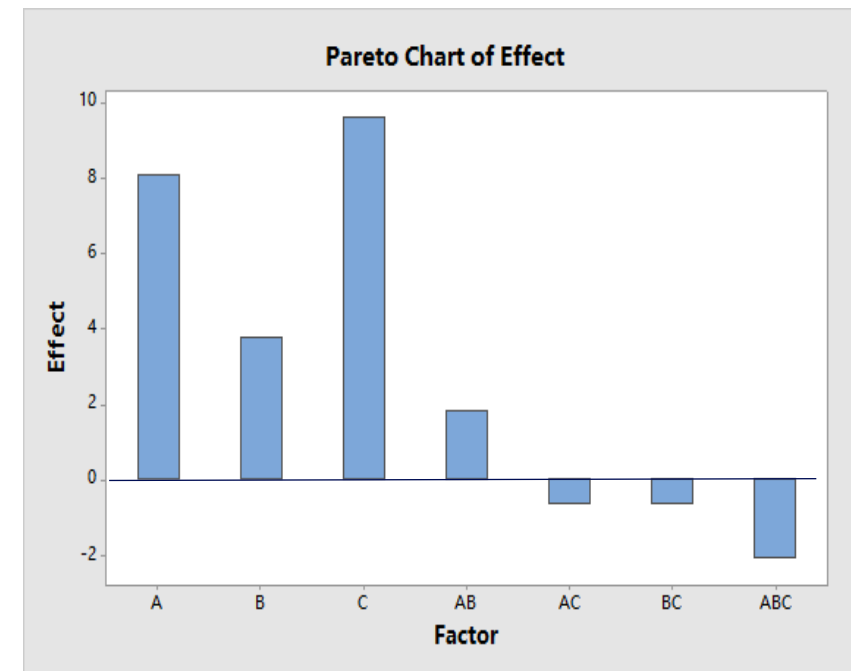
DoE – Unacceptable Process Capability

Original distribution of new stores:

LSL=5   **USL=25**

Distribution Plot
Normal, Mean=8.33, StDev=5.47

$$\text{Cpk}= \quad min\left\{\frac{\bar{x}-LSL}{3\delta}, \frac{USL-\bar{x}}{3\delta}\right\} \quad = \quad \textbf{(8.33-5)/F94(3*5.47)=} \quad \boxed{0.202925}$$

$$\text{Cp}= \quad \left\{\frac{USL-LSL}{6\delta}\right\} \quad = \quad \boxed{0.609385}$$

Factor	High	Low	Unit	Range	Mid.	Val+	Val-
A: Infection Rates	15	5	%	10	10	1	-1
B: Job Availability	50	10	%	40	30	1	-1
C: Capacity Allowed in Building	80	40	%	40	60	1	-1
(value of A and B is the ratio of added number to existed number one day before.)							

Regression: 8.33+4.03A+1.87B+4.81C
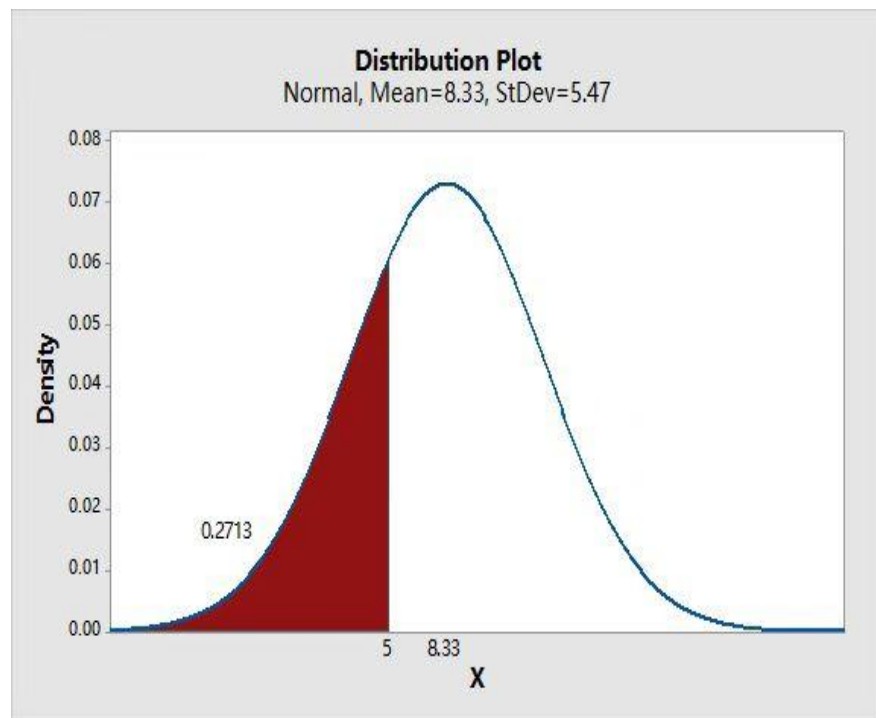
DoE – Improved Process

➤ Decided to reduce factor A by 10%,

➤ Moved factor B and C to its Max Range

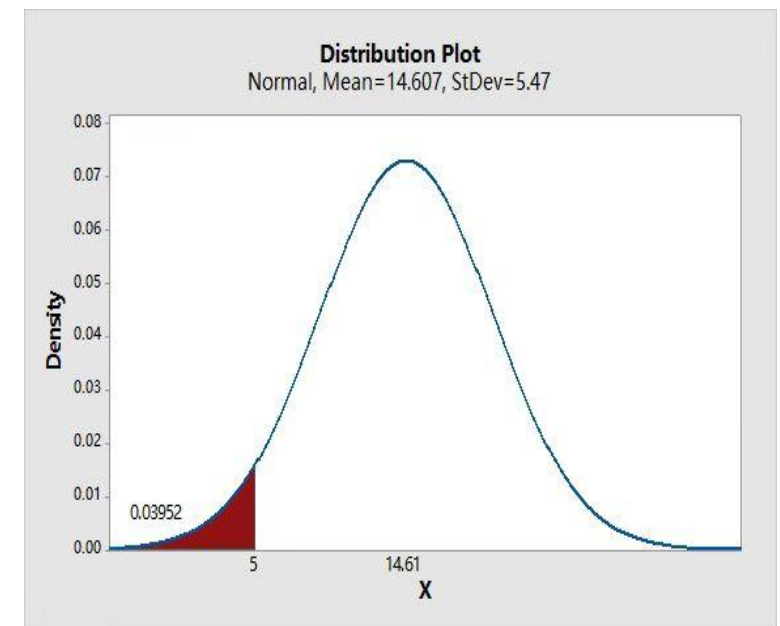**Coded value for:**   **A: -0.1**   **B: 1**   **C: 1**

Response=   **8.33+4.03(-0.1)+1.87(1)+4.81(1)=**   **14.607**

➤ Distribution improves and % scrap tiles is 3.92%

The improved Factors	=	(coded*range)/2+mid.		
A	**before:**	10%	**after:**	10.5%
B	**before:**	30%	**after:**	50%
C	**before:**	60%	**after:**	80%

After the improvement:

Distribution Plot
Normal, Mean=14.607, StDev=5.47

Proposed Solutions

- For monitoring infection rates, we used Process Capability Analysis to observe the characteristics of each region in the process capability report, to determine which regions to prioritize for additional restrictions or to alleviate restrictions.

- Using Design of Experiments, the percentages of the three influencing factors(infection rates, job availability, capacity allowed in building) were calculated and adjusted to maintain the stability of the reopening.

- Increase the number of days for continued monitoring and increase number of days for phase implementation to reduce infection rates.

- Increase availability of COVID-19 testing and monitoring equipment (temperature guns, self-screening awareness posters, provide masks for individuals, etc...)

General Conclusions

- In order for New York State to fully reopen, the economy must be a top priority.

  - Business need to be able to open and feel comfortable to allow customers

  - Vaccination of public will be key to helping speed up reopening

  - Schools and other childcare services need to be available for people those workers who have families and can't leave kids alone

  - Healthcare services need to be available and effective to help prevent further infection

- With the economy open it will allow both business and consumers to thrive and help come back to some level or normal.