Syracuse University

MFE634 Exam 2 Presentation

Prevention and Mitigation of Bush Fire in Australia

Group 1

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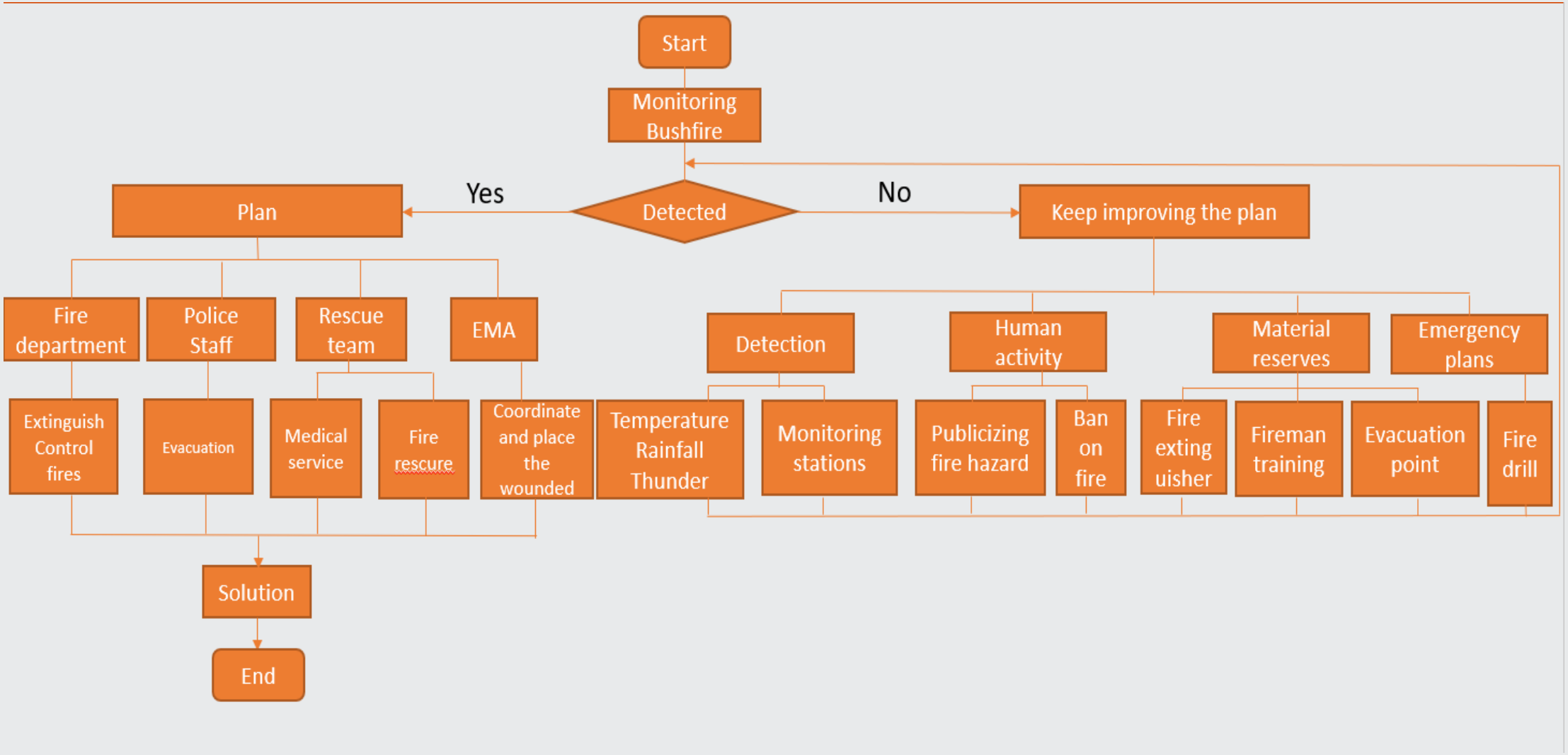
Background

Recent bushfire occurring in Australia is claimed to be the worst wildfire in decades. Several uncontrolled fires began in June 2019, developed to hundreds of fires still burning today.

Over 34 people were killed, 5900 houses are destroyed, some endangered species may be driven to extinction, billions of dollars are wasted.

Flow Chart


Start
Monitoring Bushfire
Detected
Yes
No
Plan
Keep improving the plan
Fire department
Police Staff
Rescue team
EMA
Extinguish Control fires
Evacuation
Medical service
Fire rescure
Coordinate and place the wounded
Solution
End
Detection
Human activity
Material reserves
Emergency plans
Temperature Rainfall Thunder
Monitoring stations
Publicizing fire hazard
Ban on fire
Fire exting uisher
Fireman training
Evacuation point
Fire drill

Internal & External Failure

Internal Failure	External Failure
Failure of alert system	Drought because low precipitation
Lack of evacuation plan	Dense forest and plantation
Slow reaction of first response team	Traffic jam & bad road condition
No prevention actions	Wind accelerate spread
Outdated fire department equipment	Lack of fireman

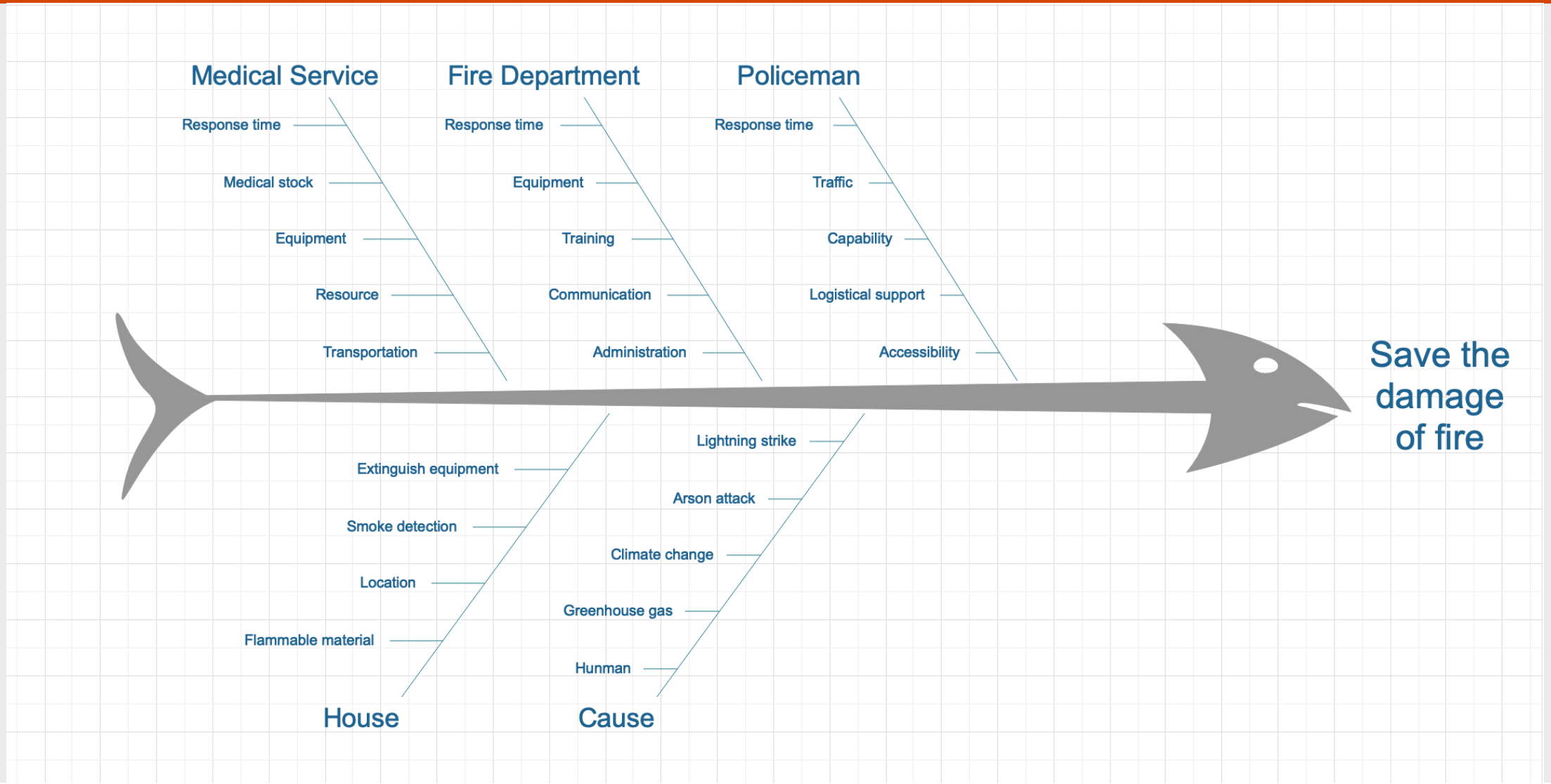
COPQ

Process	Internal Failure	External Failure	Appraisal	Prevention
Signal of Bushfire	Dense Houses Building materials are mostly flammable	Global Warming Arson Insufficient rainfall		Building houses with non-flammable materials Reduced house density Prepare for extreme weather
Government	lack of labor lack of equipment	Insufficient funds		Ask for help, funding and equipment from surrounding countries
Post-disaster relief (animals)	Many animals live in the forest and have not been treated professionally after the fire			Establish animal rescue stations in response to fire

Affinity Diagram

Causes	House	Fire department	Policeman	Medical service
Lighting strike	Flammable materials	Response time	Response time	Response time
Humans	Location	Equipment	Traffic condition	Medicine stock
Climate change	Smoke detection	Regular training	Capability	Medical equipment
Greenhouse gas emissions	Extingishing equipent	Communication	Logistical support	Medical resources
Arson attack		Administration	Number of people	Transportation
		Real-time feedback	Accessibility	

Fishbone Chart



List of Individual to Interview

- Director of fire department
- Families of victims
- Wildlife Conservancy
- Nature conservation concil

Question & Answer

- *Director of fire department:*

What preparations did you do before the fire broke out?
We have multiple solutions to deal with wildfires, like equipment and manpower. But this year's wildfire is much larger than expected

- *Families of victims:*

Do you think you have any serious property damage?

Our house, car, and property in the house are basically burnt out. Although we have insurance, we still have a lot of losses.

- *Wildlife Conservancy:*

How is this year different than previous wildfires？

For our part, the number of wild animal disasters has increased and we need more veterinarians to treat injured wild animals.

- *Nature conservation council:*

How much has the fire affected the local natural environment?

Although mountain fires occur almost every year, this year's scale is so large that people, wildlife and vegetation have suffered losses, and the balance has been broken in a short time.

Six Sigma


5. Control
Maintain the improved process
1. Define
Define the process and the problem
2. Measure
Measure the current performance
3. Analyse
Analyse the process for issues and root causes
4. Improve
Determine and implement improvement actions

Six Sigma

Design

- The high temperature& thunder
- Lack of resource
- Too late to rescue (government)
- Information is blocked
- Many flammable wastes

Six Sigma

Measure

- Verify the project need
- Document the process
- Plan for data collection
- Measure the Process Capability

Six Sigma

Analyze

- Data collection(Temperature from August to September)

- Hypothesis test

Six Sigma

Analyze

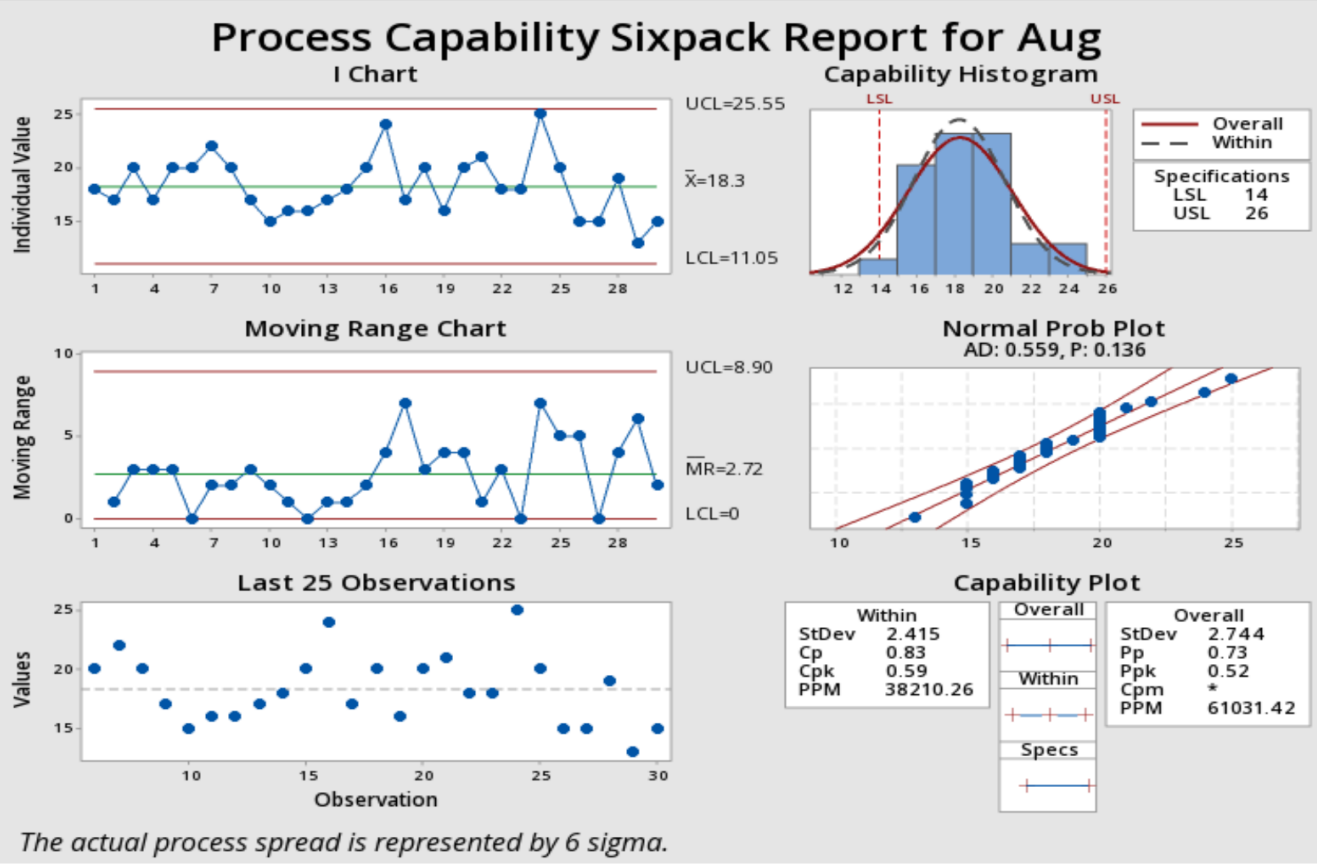
Temperature in Aug 2019 (Before)		
18	16	21
17	16	18
20	17	18
17	18	25
20	20	20
20	24	15
22	17	15
20	20	19
17	16	13
15	20	15

Temperature in Sep 2019 (After)		
22	20	23
19	26	22
22	19	21
27	18	20
21	27	20
28	27	21
18	15	26
19	17	18
17	20	21
16	21	17

Six Sigma

Analyze

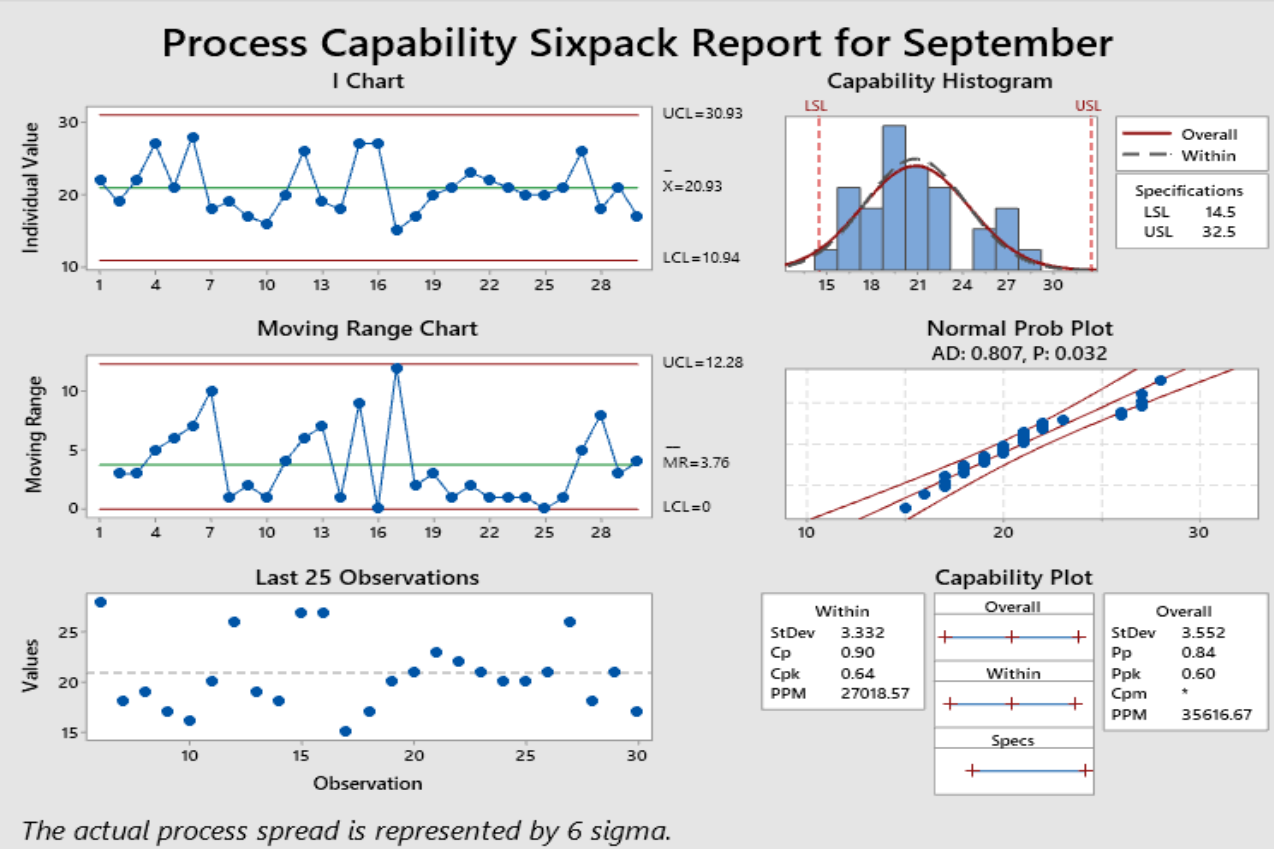
Descriptive Statistics: Before



Six Sigma

Analyze

Descriptive Statistics: After



Six Sigma

Improve

- Improvement Strategy
- Process Failure Mode and Effect analysis (FMEA)
- Design of Experiments (DOE)
- List of remedies selected

Six Sigma

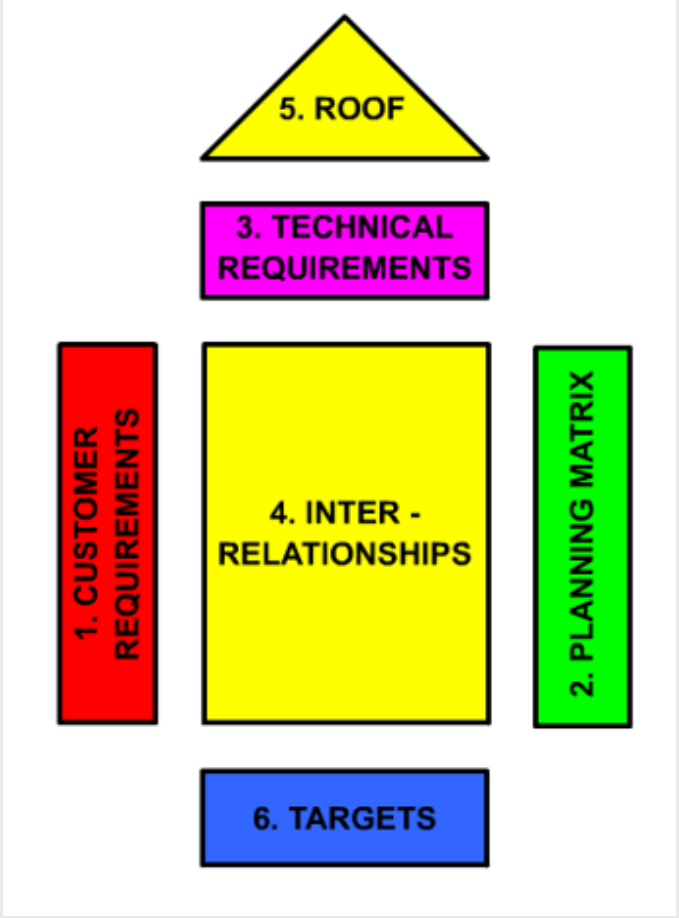
Control (use 5S method)

- Sort: Identify the reason and region of bushfire
- Set in order: Flow chart for dealing with emergency bushfire
- Shine: Staff (fireman、policeman) should follow the original plan to deal with bushfire immediately
- Standardize: Make a checklist to see whether all the equipment and staff are working well
- Sustain: Keep everyone in order and save the damage of bushfire

Quality Function Deployment

To identify and carry the voice of the customer through each stage of product or service development and implementation

- Customer Requirements
- Planning Matrix
- Technical Requirements
- Targets
- Interrelationships
- Roof



Customer Needs (who was impacted by the Bush Fire)

- People
- Buildings and Infrastructure
- Commerce
- Toursim
- Species diversity
- Agriculture

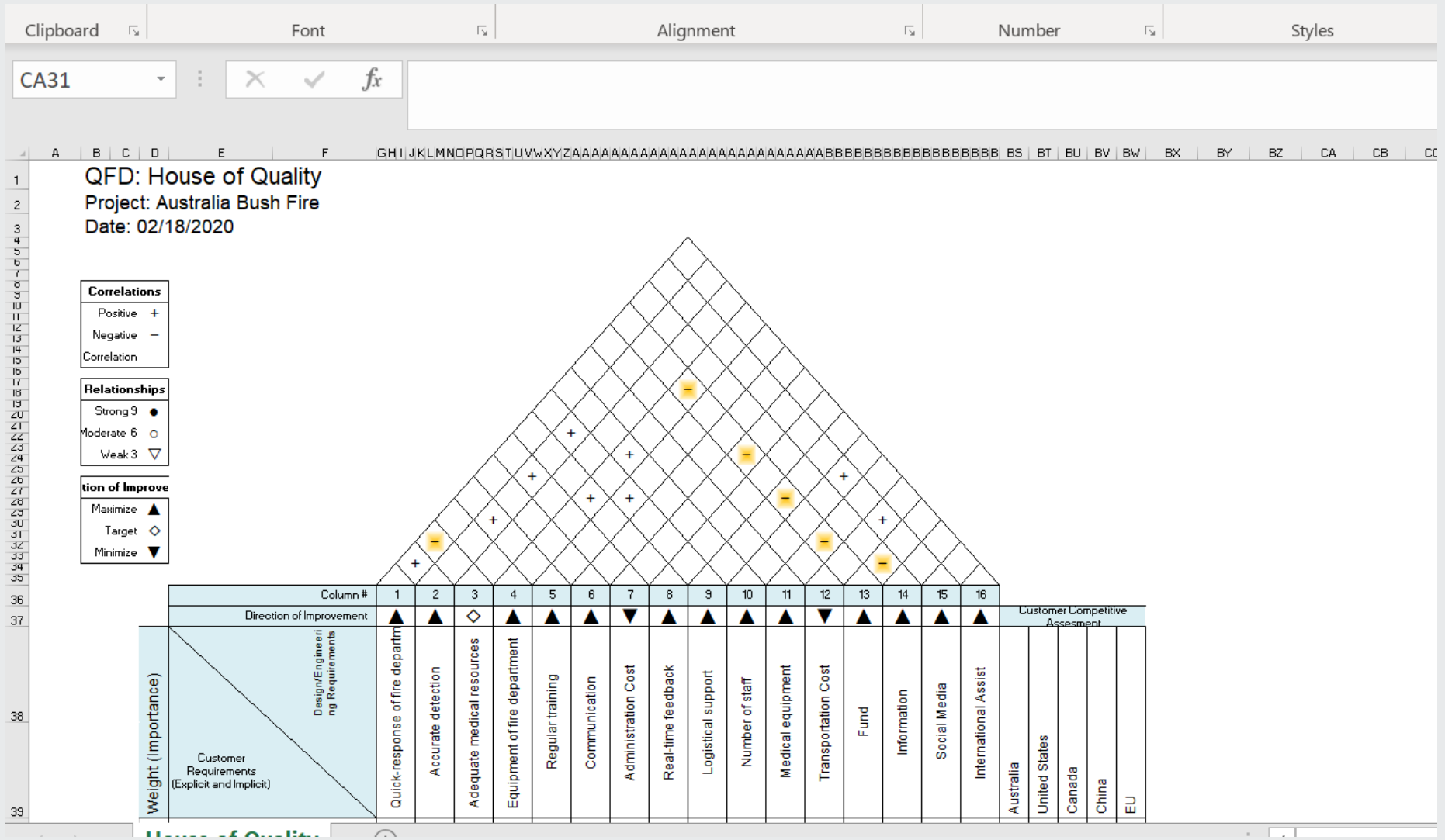
Planning Matrix

- Quantifying the customers' requirement priorities
- Adjusting priorities based on issues concerning the design team

To be improved

- Regular training of fireman
- Accurate detection for forest fire
- Increase the number of firefighters
- Improve administration

HOQ



QFD: House of Quality

Project: Australia Bush Fire

Date: 02/18/2020

Correlations	
Positive	+
Negative	–
Correlation	

Relationships	
Strong 9	●
Moderate 6	○
Weak 3	▽

tion of Improve	
Maximize	▲
Target	◇
Minimize	▼

Column #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Direction of Improvement	▲	▲	◇	▲	▲	▲	▼	▲	▲	▲	▲	▼	▲	▲	▲	▲

Weight (Importance)	Customer Requirements (Explicit and Implicit) / Design/Engineering Requirements	Quick-response of fire departm	Accurate detection	Adequate medical resources	Equipment of fire department	Regular training	Communication	Administration Cost	Real-time feedback	Logistical support	Number of staff	Medical equipment	Transportation Cost	Fund	Information	Social Media	International Assist	Customer Competitive Assesment: Australia	United States	Canada	China	EU

HQQ

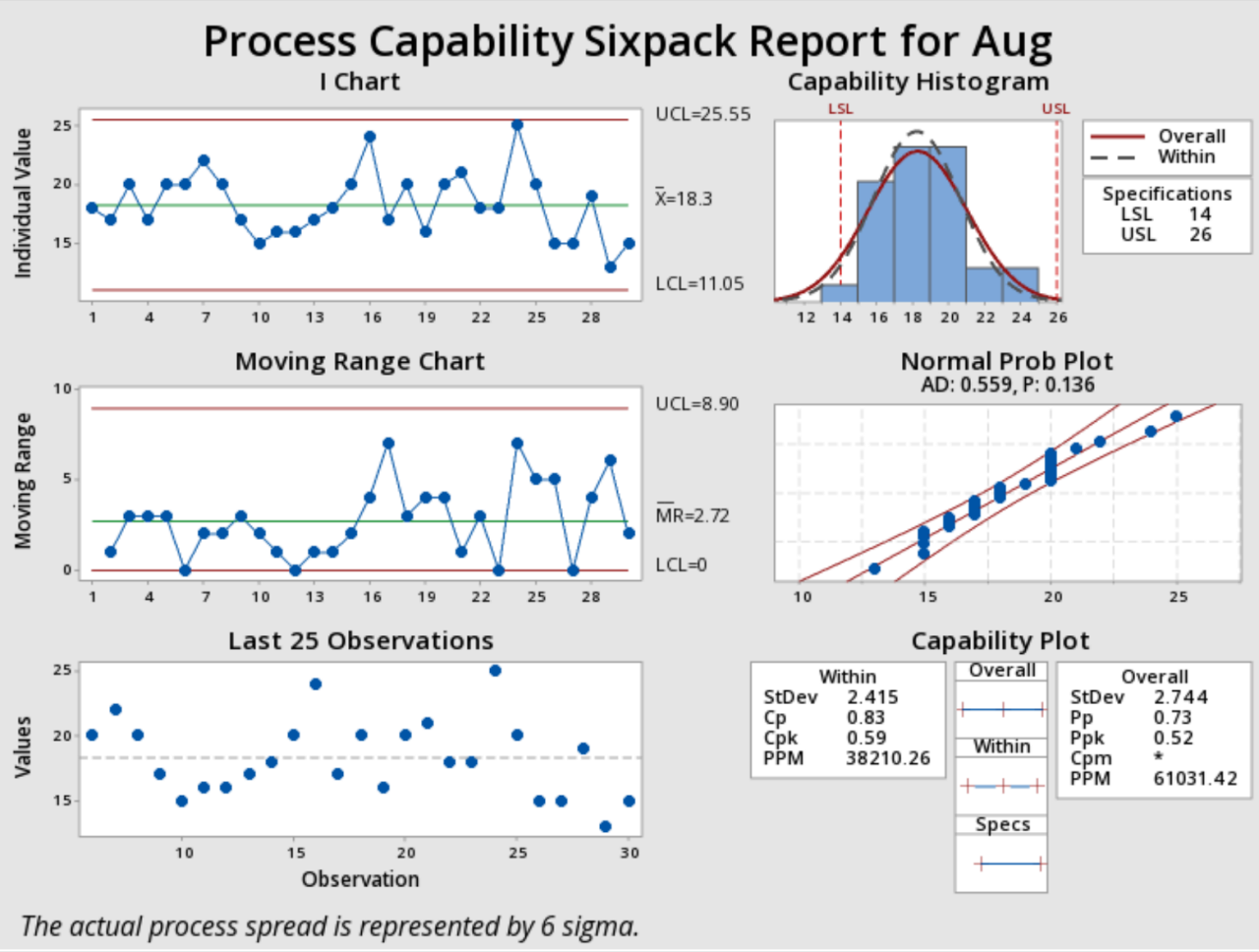
House of Quality

Weight (Importance)	Customer Requirements (Explicit and Implicit) \ Design/Engineering Requirements	Quick-response of fire department	Accurate detection	Adequate medical resources	Equipment of fire department	Regular training	Communication	Administration Cost	Real-time feedback	Logistical support	Number of staff	Medical equipment	Transportation Cost	Fund	Information	Social Media	International Assist	Australia	United States	Canada	China	EU
	Column #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Customer Competitive Assesment				
	Direction of Improvement	▲	▲	◇	▲	▲	▲	▼	▲	▲	▲	▲	▼	▲	▲	▲	▲					
8	Personal Safety	●		○		●	●	●	○			●						3	3	4	1	5
2	Buildings and Infrastructure	●				●				○				●				5	4	2	2	4
4	Commerce			○					○						○			2	2	4	3	2
2	Toursim		●					●			○							4	4	3	3	4
3	Species diversity				○	●			●					●		○		3	4	4	4	3
3	Agriculture		●			○					○							3	5	3	5	4
5	Education						○						○					2	4	2	2	3
3	Industry		●							●								3	3	2	3	2
	Weight Chart	96	124	68	56	156	124	96	68	54	36	24	18	24	18	18						
	Column #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16					

Process Capability Analysis

Analysis for August.

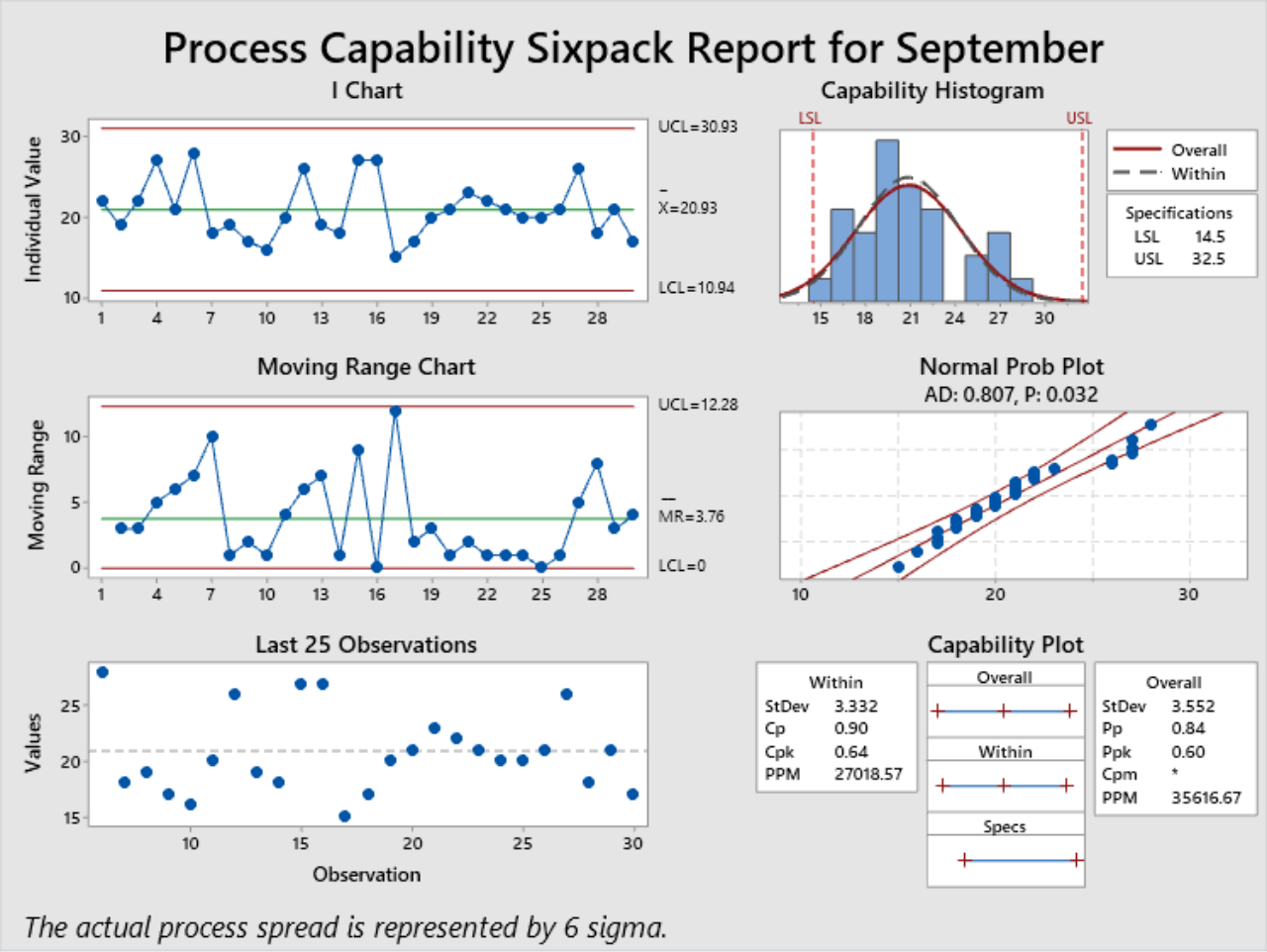
- Random data with mean 20
- LSL= 14; USL=26
- $\bar{X}$= 18.3; σ=2.74
- Cp=0.83; Cpk=0.59



Process Capability Analysis

Analysis for September.

- Random data with mean 20
- LSL= 14.5; USL=32.5
- $\bar{X}$= 20.93; σ=3.56
- Cp=0.90; Cpk=0.64



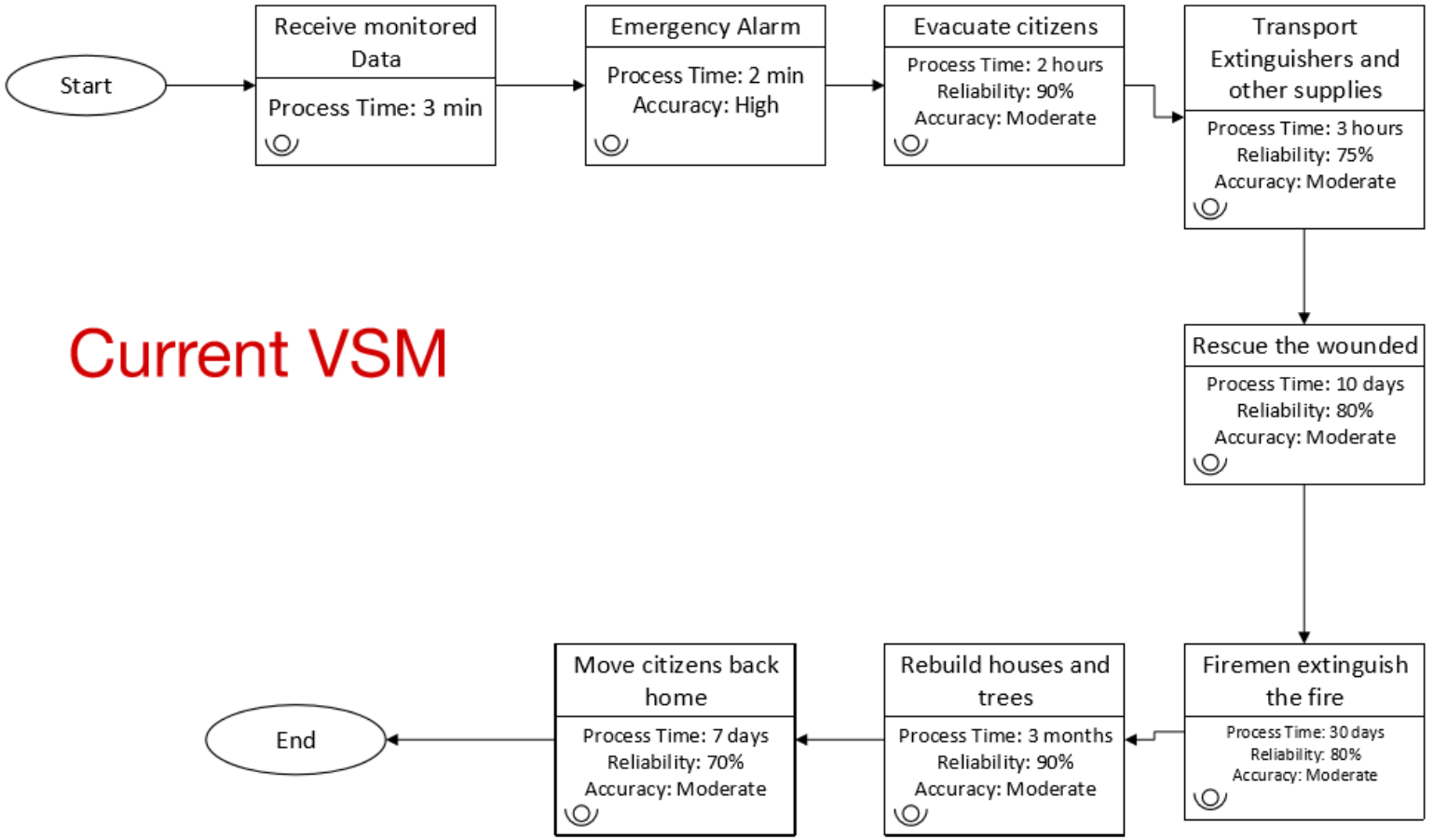
Design of Experiment

			Factorial Experiments 2^3 (DOE-ASQ)						Run Results			
Run	Humid	Temp	Process	H*T	H*P	T*P	H*T*P		Y1	Y2	Avg.	Var.
1	-1	-1	-1	1	1	1	-1		-4.6359	0.0937	-2.2711	11.1845
2	1	-1	-1	-1	-1	1	1		11.8444	6.85149	9.34795	12.4646
3	-1	1	-1	-1	1	-1	1		-5.3306	-0.4176	-2.8741	12.0684
4	1	1	-1	1	-1	-1	-1		9.02536	16.2048	12.6151	25.7725
5	-1	-1	1	1	-1	-1	1		9.7995	11.9148	10.8572	2.2373
6	1	-1	1	-1	1	-1	-1		16.5886	22.0542	19.3214	14.9362
7	-1	1	1	-1	-1	1	-1		9.30193	13.5927	11.4473	9.2054
8	1	1	1	1	1	1	1		17.8069	20.6317	19.2193	3.98956
Total SUM									64.4003	90.9258	77.663	91.8585
Sum Y+	13.2373	15.9803	15.2732	12.6883	13.3654	13.9655	13.9852					
Sum Y -	14.3803	11.2386	11.2194	14.6343	13.6825	13.5662	12.0735					
Ave. Y+	3.2368	4.5132	3.6345	3.8233	3.3049	3.5685	3.6032					
Ave. Y-	3.5437	2.6835	2.8763	3.5332	3.6251	3.2856	0.8152					
Effect	-0.5231	1.3764	0.7856	-0.4373	-0.2103	0.1943	0.2076					
Var.+	0.3236	0.6758	0.1221	0.3121	0.3957	0.1269	0.4249					
Var.-	0.4398	0.0786	0.5982	0.4483	0.3264	0.6398	0.3459					
F	1.3898	0.1201	5.3043	1.4012	0.7262	5.0393	0.7994					

Value Stream Map (VSM)

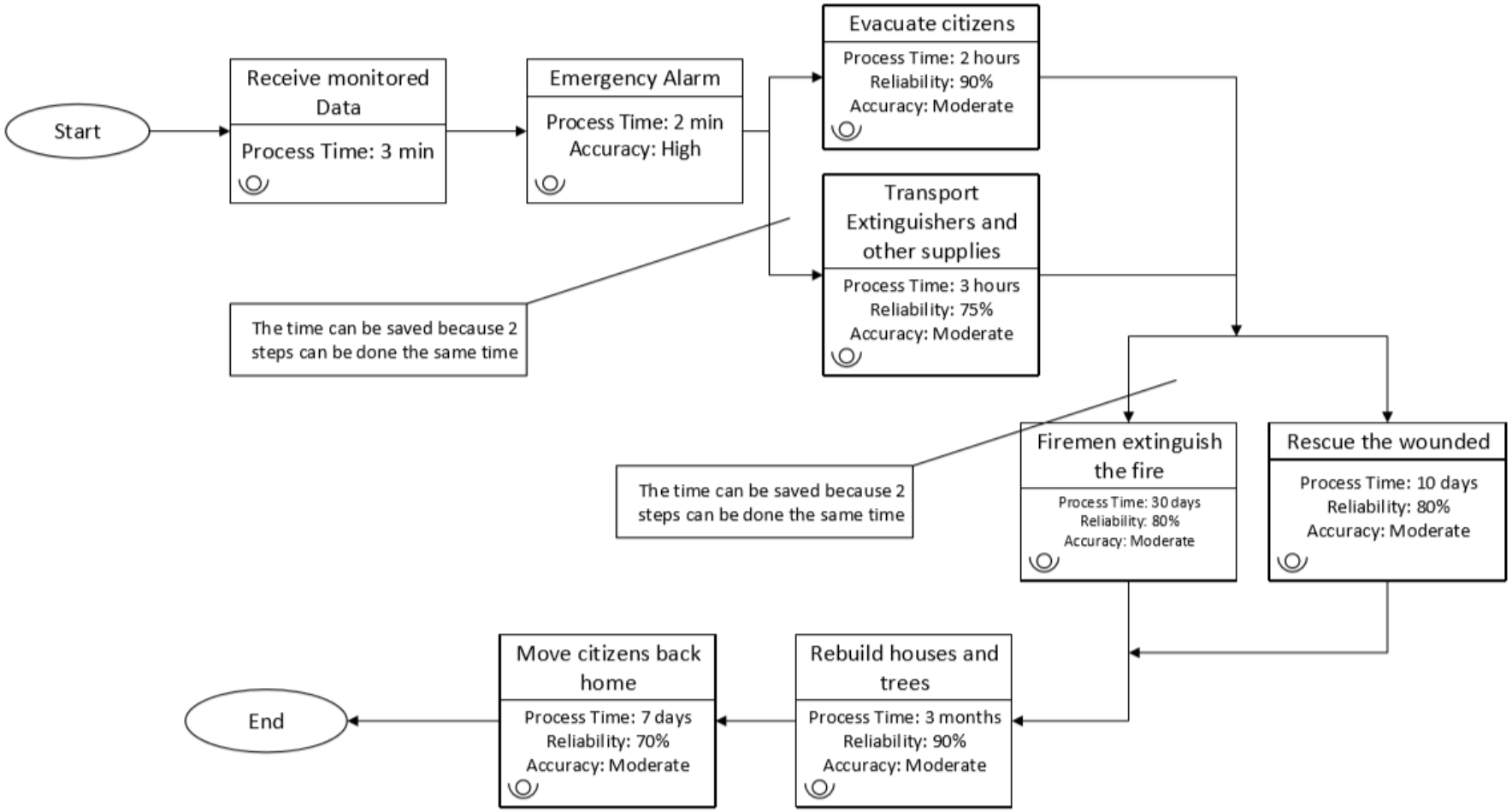
Before improved

Bush Fire VSM Group 1



Current VSM

Improved VSM



Value Stream Map (VSM)

After improved

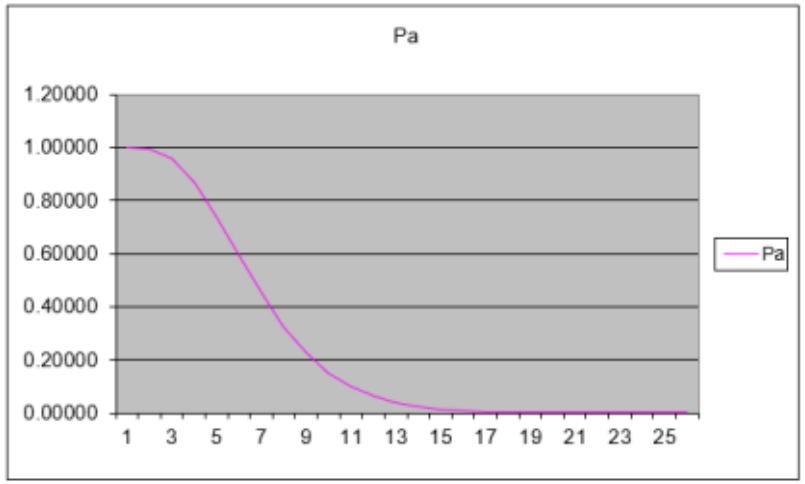
Acceptance Sampling Plan

- AQL=0.02

  LTPD=0.10

n	65	c	3

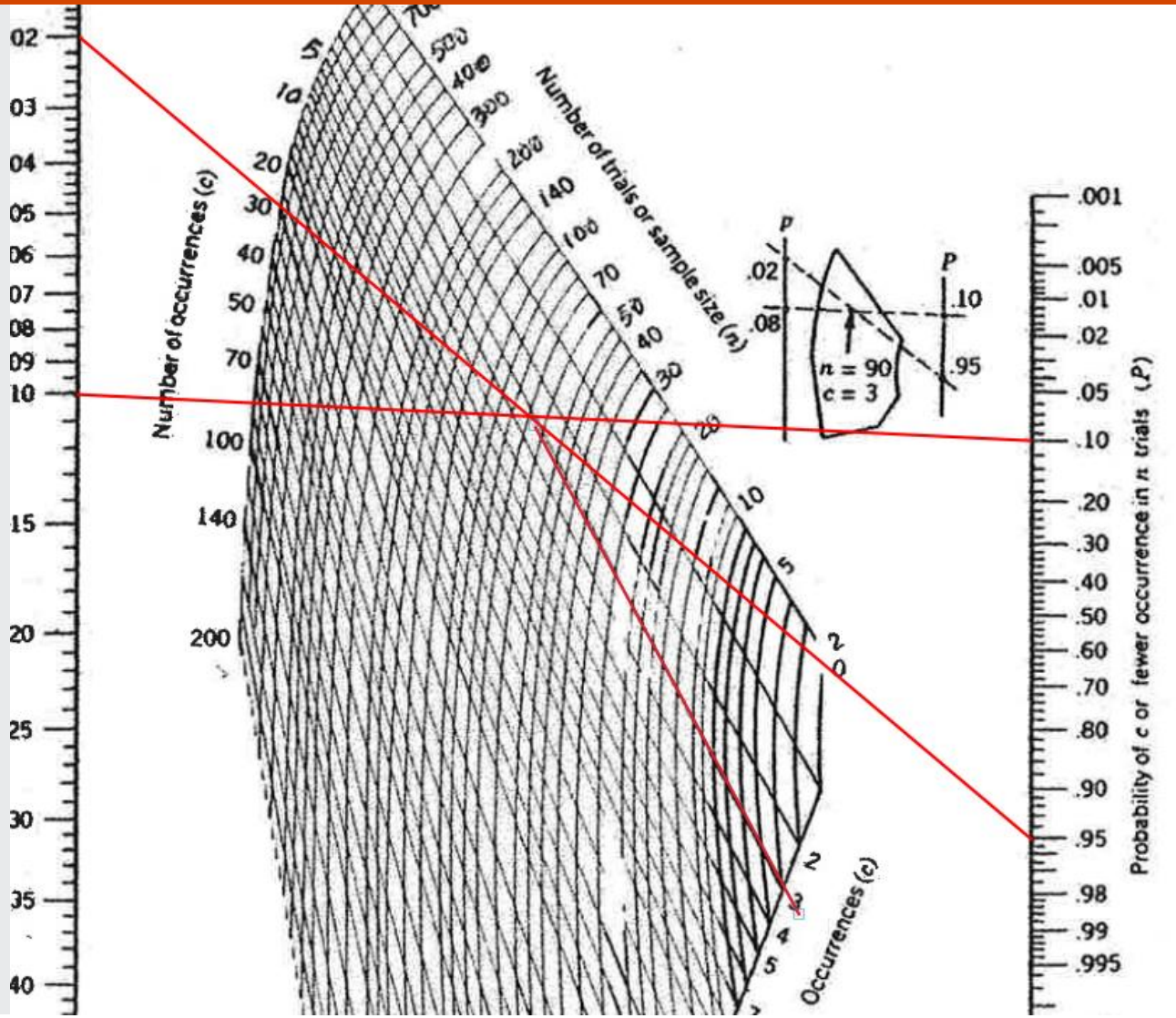
PD	Pa
0	1.00000
0.01	0.99583
0.02	0.95862
0.03	0.86888
0.04	0.73783
0.05	0.59001
0.06	0.44766
0.07	0.32459
0.08	0.22627
0.09	0.15240
0.1	0.09955
0.11	0.06327
0.12	0.03923
0.13	0.02377
0.14	0.01410
0.15	0.00820
0.16	0.00468
0.17	0.00262
0.18	0.00144
0.19	0.00078
0.2	0.00042
0.21	0.00022
0.22	0.00011
0.23	0.00006
0.24	0.00003
0.25	0.00001



Acceptance Sampling Plan

- n = 65

  c = 3



Statistical Variables

- α: Producer's Risk
- β: Consumer's Risk
- AQL: Acceptable Quality Level- the level of defectiveness, set by the producer as a minimum "goal", customers usually like zero defectiveness but there are always something uncertainty.
- LTPD: Lot Tolerance Percent Defective- the maximum defectiveness that the producer will accept in the product as to not affect the consumer negatively

Acceptance Sampling Plan

Method

Acceptable Quality Level (AQL)	2
Producer's Risk (α)	0.05
Rejectable Quality Level (RQL or LTPD)	10
Consumer's Risk (β)	0.1

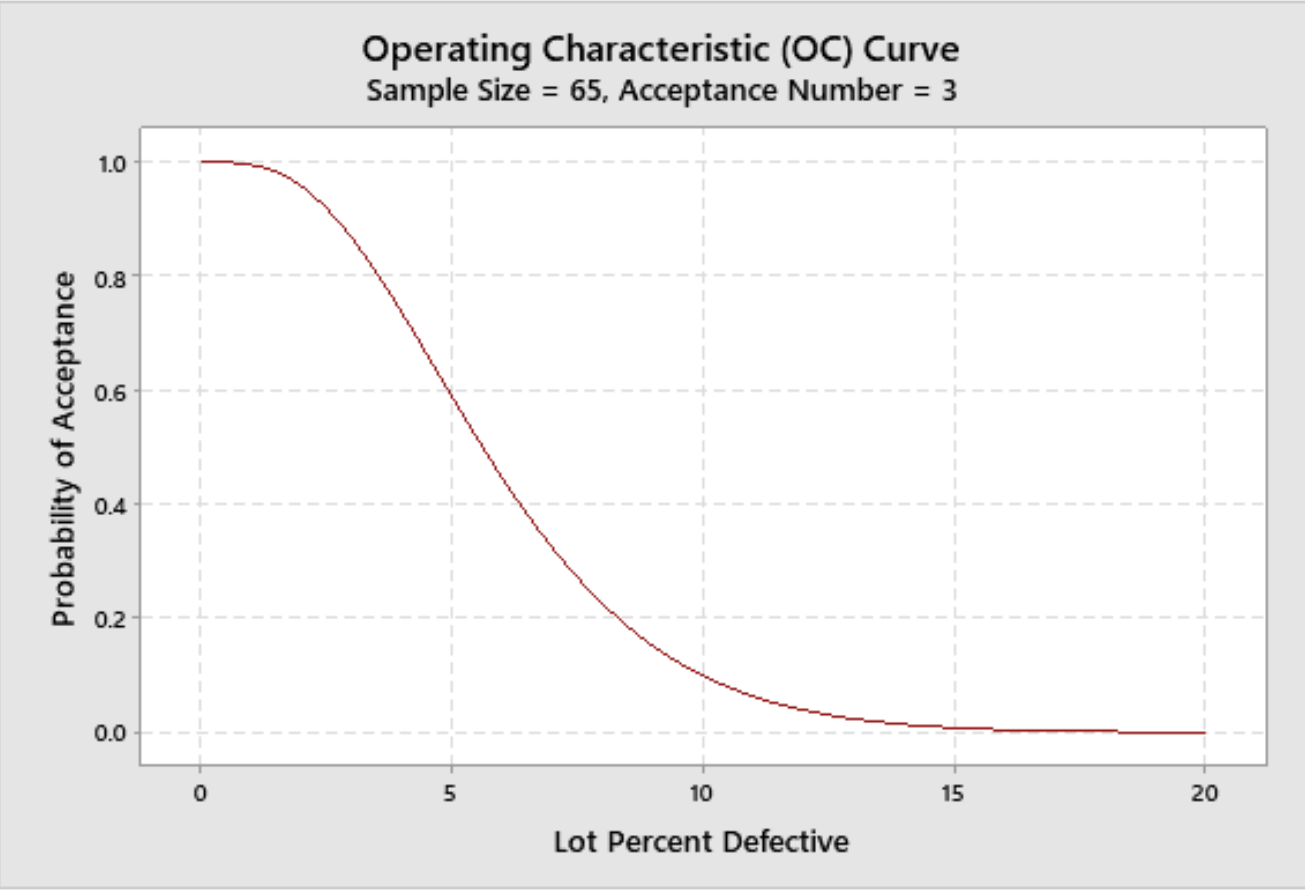
Generated Plan(s)

Sample Size	65
Acceptance Number	3

Accept lot if defective items in 65 sampled ≤ 3; Otherwise reject.

Percent Defective	Probability Accepting	Probability Rejecting
2	0.959	0.041
10	0.100	0.900

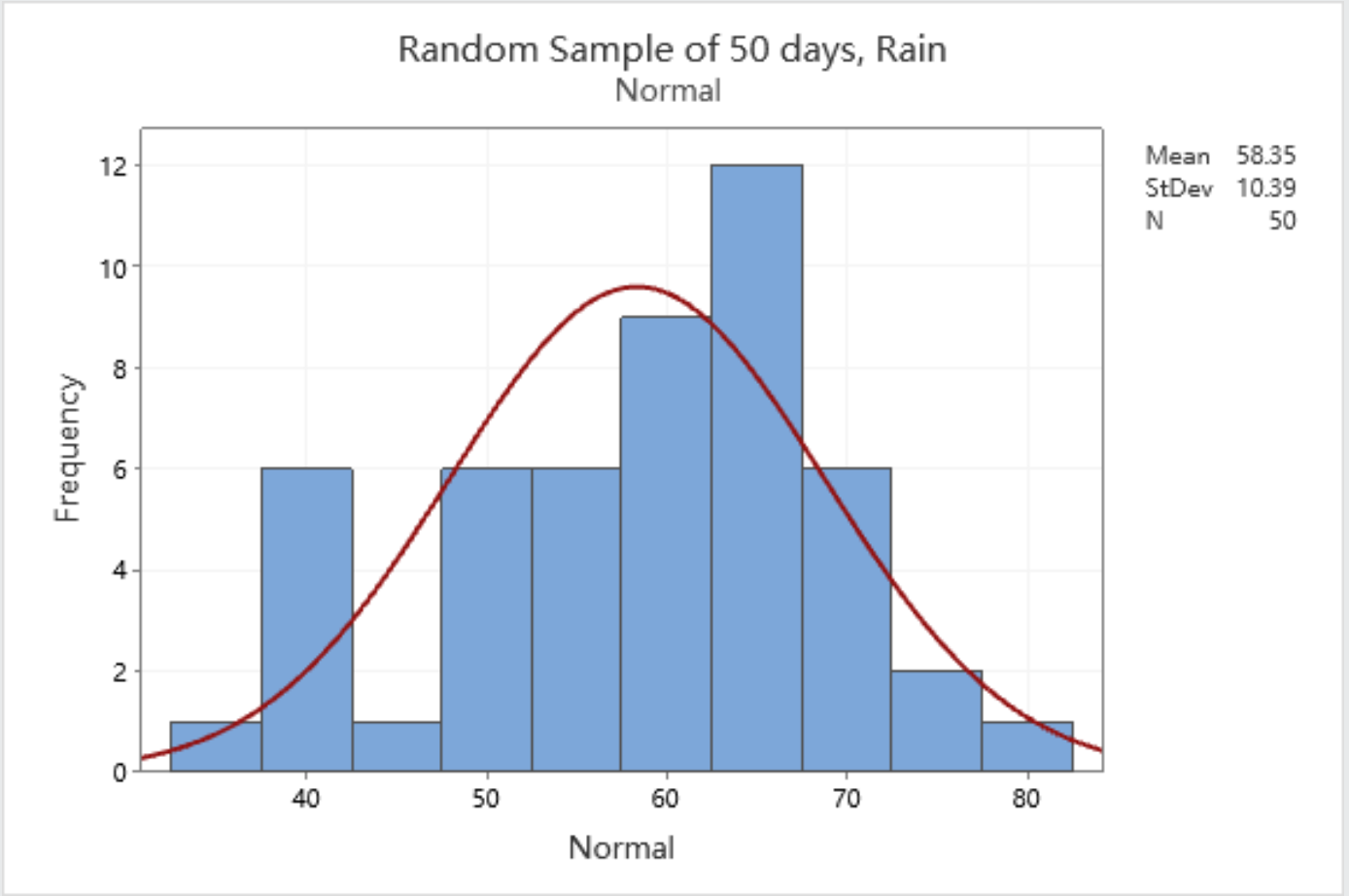
Acceptance Sampling Plan



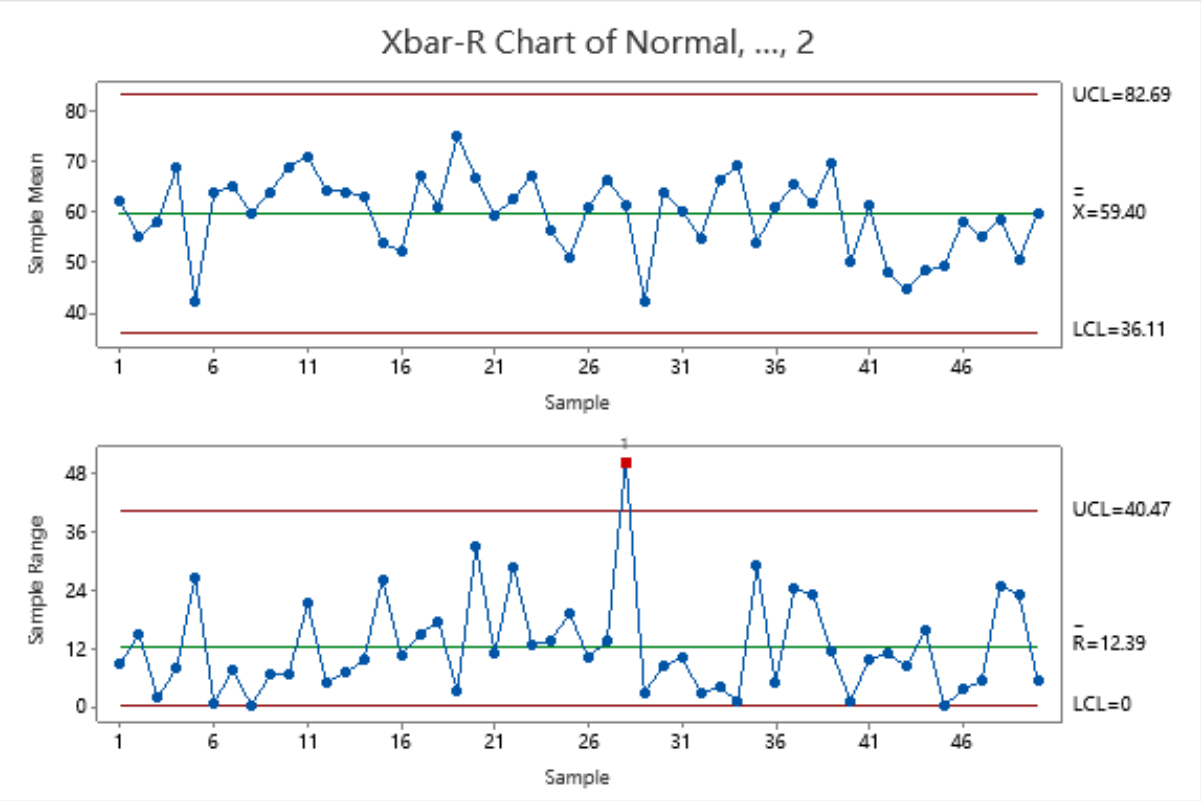

```
SUBC> Bernoulli .02.
MTB> Print c1

Data Display

 C1
 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0
 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0

MTB> sum c1

Sum of C1 = 5

MTB > Random 65 c1;
SUBC> Bernoulli .02.
MTB> Print c1

Data Display

 C1
 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 1 0 0

MTB> sum c1
```

SPC

	Normal	
1	66.1835	55.5740
2	62.3444	72.7081
3	56.9731	35.9176
4	64.4202	40.8626
5	55.5726	59.4523
6	63.7997	64.9041
7	61.1150	53.1376
8	59.6265	67.8257
9	66.8384	68.2974
10	65.1851	68.2704
11	81.1758	62.8627
12	66.5225	53.1690
13	67.1211	49.9513
14	67.6082	63.6924
15	40.4382	50.4816
16	46.7822	65.7875
17	59.2407	42.4047
18	69.4833	40.2040
19	73.0840	40.3744
20	49.9294	49.0538
21	53.7240	59.7017
22	47.8187	52.2776
23	60.5911	70.7533
24	62.8077	38.8455
25	60.4051	62.2711

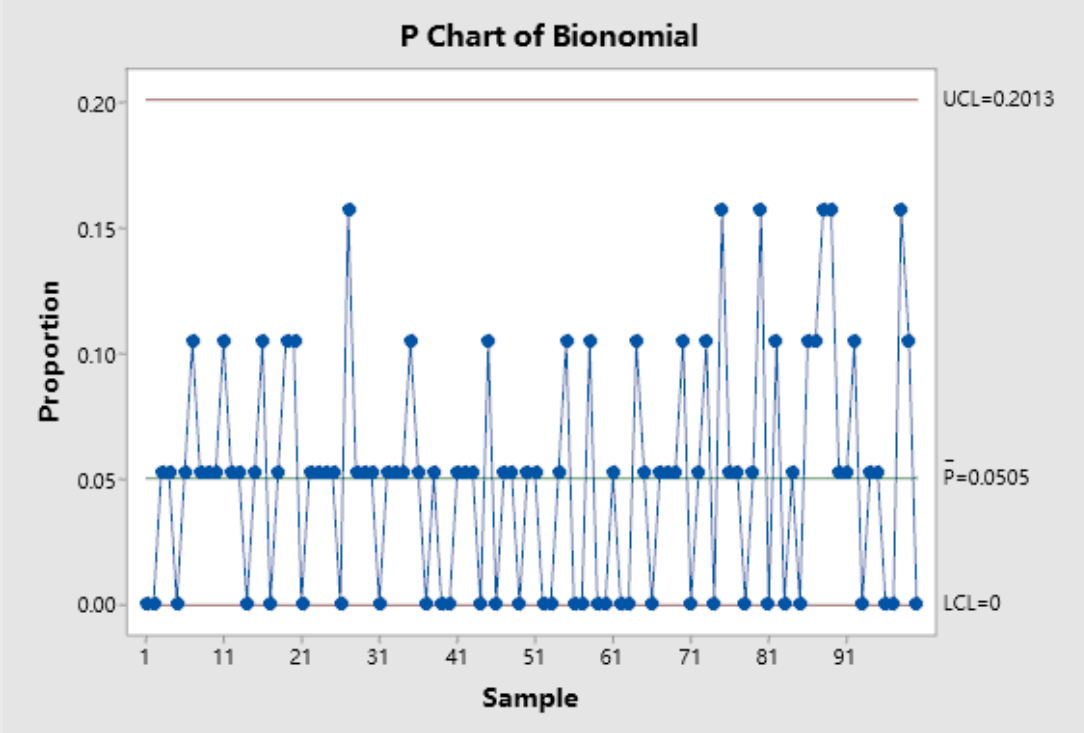


SPC



Test Results for R Chart of Normal, ..., 2

TEST 1. One point more than 3.00 standard deviations from center line.
Test Failed at points: 28



Conclusion

- It’s important to closely detect the temperature change as well as unusual weather in summer days, in order to take effective measures in advance
- To prepare well-organized emergence plans and perform regular fire drills are compulsory for reducing response time which is critical for fire control.
- Adequate resources such as fire engines, professional staff and hospital resources available guarantee a reliable capacity for rescue.

Thank you!