Teaching New Quality Applications to the Next Engineering Generation

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Outline

- The Course Outline and Rules
- Some Quality Engineering Tools:
  - Basic Quality Tools & Examples
  - Advanced Quality Tools & Examples
- Some Quality Analyses Methods
  - PDCA/DMAIC/Lean/FMEA/FTA/DOE
- Some Student Project Examples
- Conclusions & QC Appendix

Quality Engineering Course Syllabus

http://web.cortland.edu/matresearch/MFE634SylS17.pdf

Topic
Intro; Juran, Basic Concepts; Company-wide Q; COPQ
Quality Assessments & Audits; ISO/Baldrige/Standards
Quality improvements: Gurus, Quality Tools & Process Capability
Six Sigma (DMAIC) improvement; More on Process Capability
Design for Quality (DFSS); Matrix Tools: QFD. Qual. Comp. SW
Design of Experiments (DOE) in Quality improvement
Fractional Factorial Design of Experiments. Applications.
Midterm: Quality Assessment, Improvement, Lean, Inspections
Spring Break; no classes
Lean Manufacturing/VSM/5Ss; Supply Chains; Outsourcing
Inspections, Testing and Metrology: MSA/Gage R&R
Acceptance Sampling; OC function; Sample Size
Statistical Process Control/SPC; Control Charts
Reliability models: FMEAs, Fault Trees; data analysis tools
Final Group Project Presentations

Midterm Exam	25%
Average of best in-class quizzes	15%
Final, comprehensive exam	30%
Presentations & Participation	10%
Final Project & Portfolio	**20%**

The Spirit of Final Projects: we are not looking into the merits or demerits of said project topics (which is the work of politicians) but into the possible flaws they have or had, and on ways to improve these, which is what Quality Engineers do.

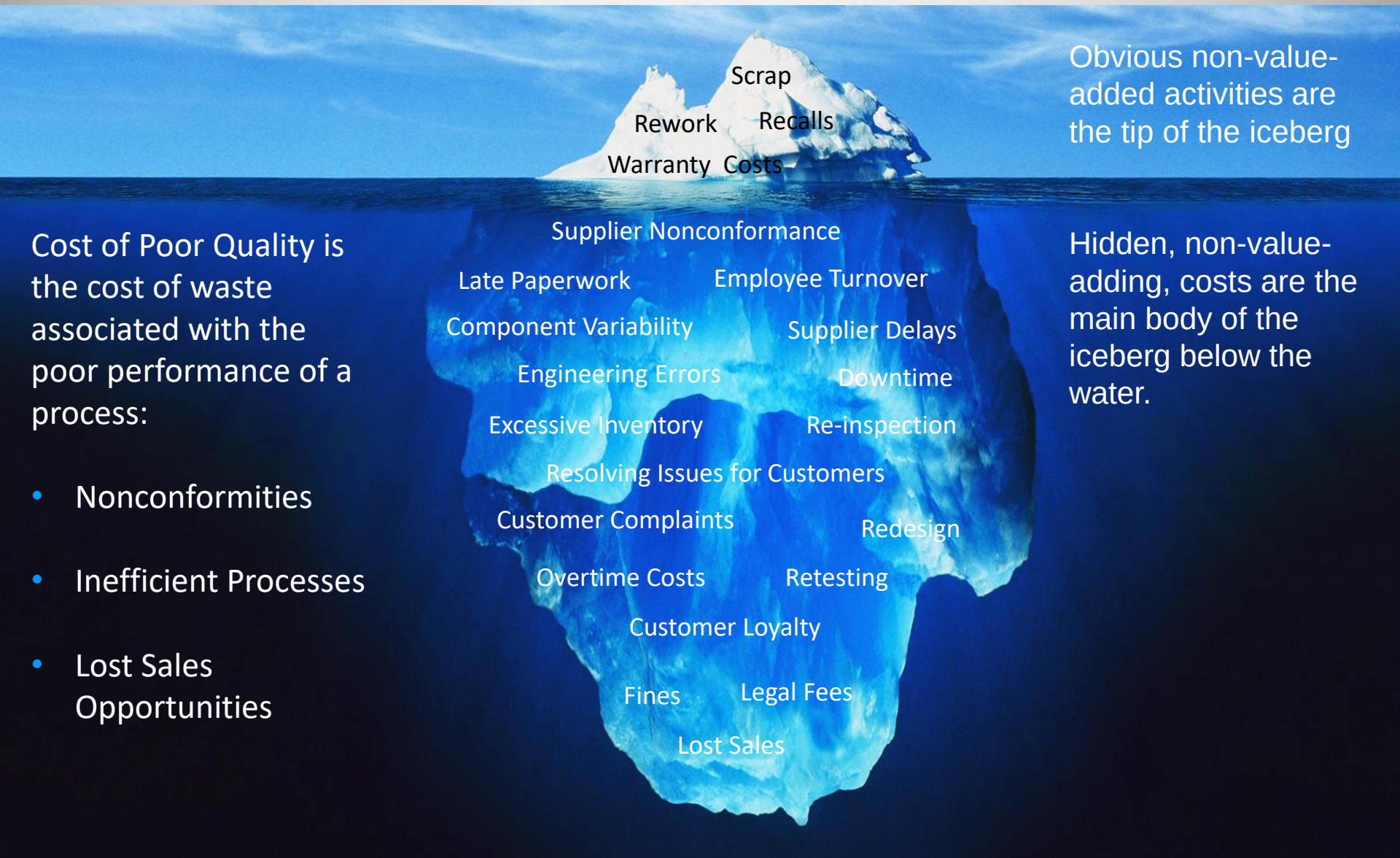
Examples of Past Project Topics

1. An Epidemic Prevention operation (Ebola): ways to improve prevention/control of spread of this disease
2. An Industrial Rescue (manufacturing jobs re-shoring efforts): ways to repatriate them.
3. International Relief effort (Ebola): improving eradication efforts & international aid Ebola in areas affected.
4. A Health Insurance organization (Obama-Care internet deployment): problems occurred in the deployment of the Web Page designed for new customers obtaining the Health Insurance this law provides
5. A Health Care organization (Veterans Administration hospital system): the serious administrative problems occurred in VA, that led to the Resignation of the Secretary of the VA (who was a minister in the Obama cabinet) & ways to improve.
6. Judicial Organization (prison/incarceration systems): large prison population problems (& ways to improve).
7. A Charitable/Service Organization (Habitat for Humanity): ways to improve deliverance of services abroad.
8. A Government Organization (USAid: Agency for Int'l Development): problems of providing economic aid, and ways to resolve, or improve them.
9. An International Relief effort (Refugee migration into Europe): the resettlement of war refugees in European countries where they have arrived.
10. Health & Social organization (Syrian war refugee resettlement camps): problems in the organization of refugee camps (health, education, etc.)
11. Epidemic Prevention operation (ZITA infection): ways to improve prevention/control of disease spread
12. Demographic Crisis Management (illegal immigration): repatriation of immigrants and their repercussions.
13. Industrial Production Disaster (Flint MI water system): discovery of water issues in public drinking system.
14. Health Care organization (Medicare extension): problems in extending Medicare to the general population.
15. Weather Disaster Management (Baton Rouge, LA & Sandy Storm): problems with providing aid to disaster zones & their cost in human, social, and other issues.
16. Anti-Terrorism Prevention Operation (Airport access safety and control): inspection of passengers, baggage , crews, support personnel, etc. to prevent terrorism.
17. Total Electricity Loss Mitigation (Puerto Rico's generators burned down Sept. 2016) consequences include failures in water supply, air conditioning, traffic control, etc.
18. Industrial Organization (Volkswagen emissions): illegal devices that hide emissions and ways to prevent this.
19. Mining Disaster (Chilean miners trapped): organization /implementation of efficient efforts to rescue them.

Some Basic Quality Tools

- Brainstorming/COPQ
- Cause-and-Effect Diagrams
- Check Sheets
- Histograms
- Box Plots
- Pareto Charts
- Scatter Diagrams
- Flow/Process Charts

Iceberg Model - Cost of Poor Quality



Obvious non-value-added activities are the tip of the iceberg

Cost of Poor Quality is the cost of waste associated with the poor performance of a process:

- Nonconformities
- Inefficient Processes
- Lost Sales Opportunities

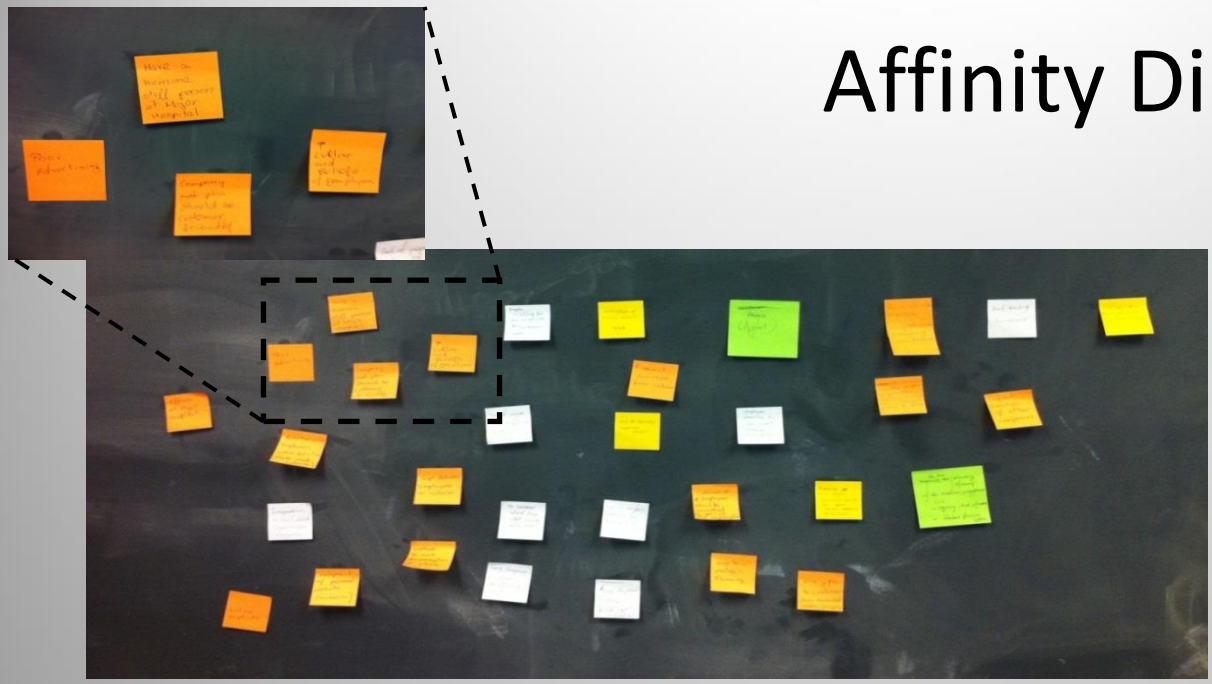
Hidden, non-value-adding, costs are the main body of the iceberg below the water.

Critical to Quality Characteristics

CTQs are the key measurable **characteristics** of a product or process whose performance standards or specification limits must be met in order to make a high quality product which performs the desired functions.

- We will get to know about CTQC's by doing a doing a COPQ analysis related to the several failures that we have discussed so far.
- To build a COPQ we perform :
  - a brainstorming session and
  - create an affinity diagram.

Affinity Diagram Process



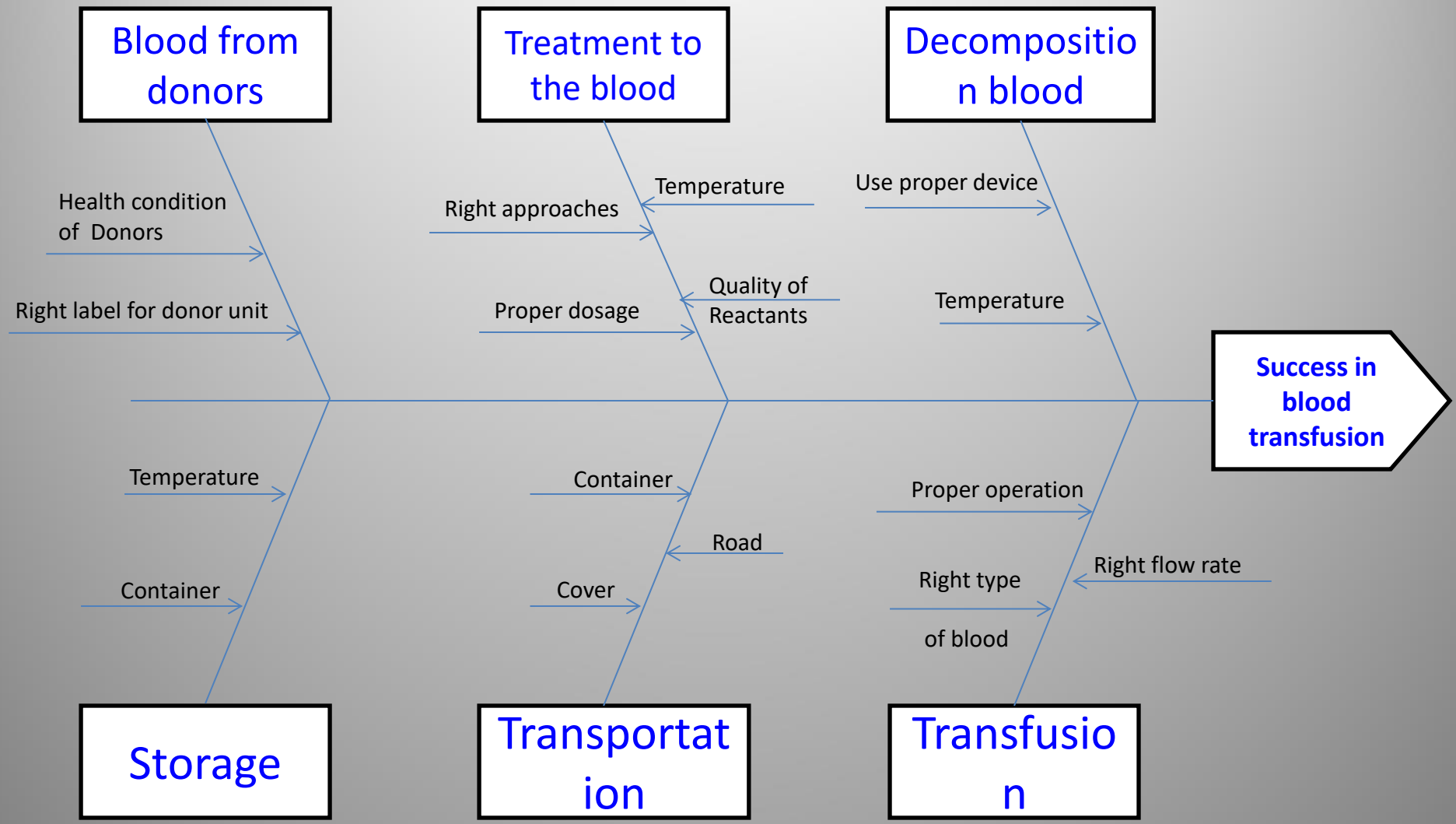
1st Step

2nd & 3rd Step

COPQ related to failure

Cost of Poor Quality				
Process	**Internal Failure**	**External Failure**	**Appraisal**	**Prevention**
Prepare(include both long and short term):				
Monitoring Hurricane	Inspection Equipment Failure		Test all equipment	Technical Support, Periodical Inspection
Emergency Notification		False Notification		Recheck
Building Reinforce			Test Structural Strength	
Prepare to Evacuate	Evacuation team failure	False Evacuation Runs	Mock Drills for Evacuation	Have Plenty of Staff and Trained Professionals
Power Backup Guarantee	Equipment Failure	Business, Communication Failure		Make Available Alternative Power Resource
Reservoir Protection	Dam Failure, Construction Problem	Flooding	Reservoir Inspections	Build Walls Higher, Leave More Space Around Dams
Build Shelters	Shelter Collapsing	People Getting Injured/Dying	inspection of Shelters	Tents Support, Use Good Quality Material, Flood Proof Shelters
Stock Emergency Supplies	Storage Equipment Failure, Shortage	Theft, Lost		Periofical Inspection
Protect Property(temporary methods)		Damage to Property		Periofical Inspection
During:				
Send Emergency Team				
Evacuation Notices		False Notics		Recheck

Ishikawa Chart



Pareto Chart Worksheet

Because our goal is finding ways to reduce the damage caused by hurricane, so the input is damage cost in different aspects. And use Minitab to draw the Pareto Chart of Aspect.

And then get the conclusion:
The damage of Residential cost most.
Thus, we should pay more attention to Residential and think about how to deal with it.

Input

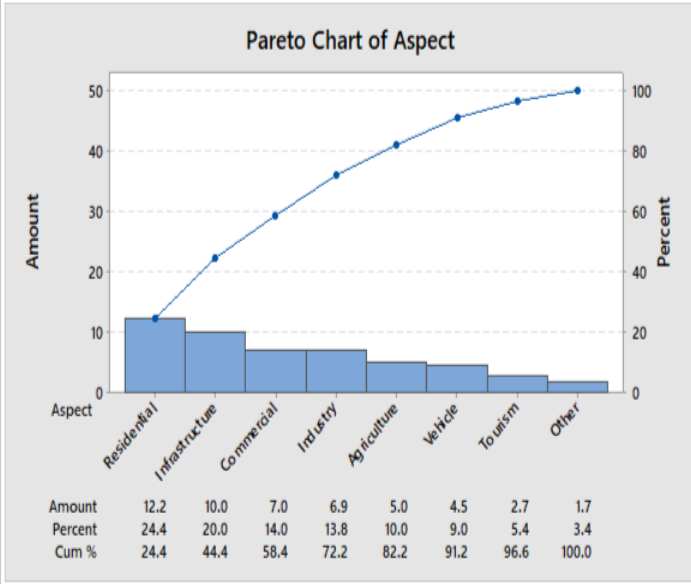
Describe the data:

Damage cost in various aspect

Output

Click here to copy and paste a Pareto chart from another application

close



Click here to enter data directly into a table and create a Pareto chart

open

Summary

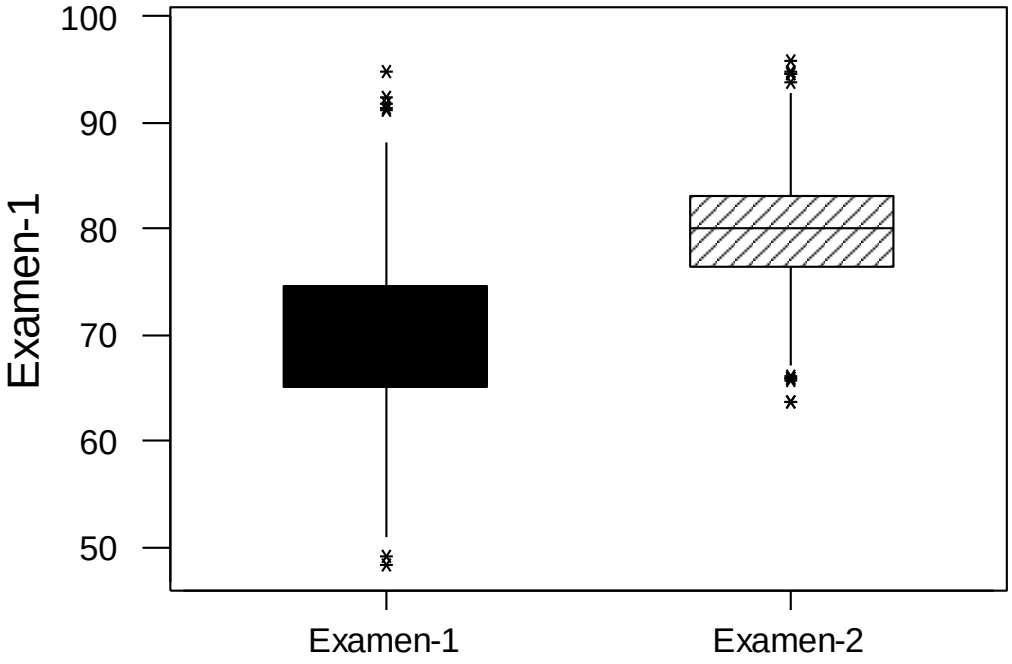
Objective:

To figure out which aspect has the highest value of damage cost

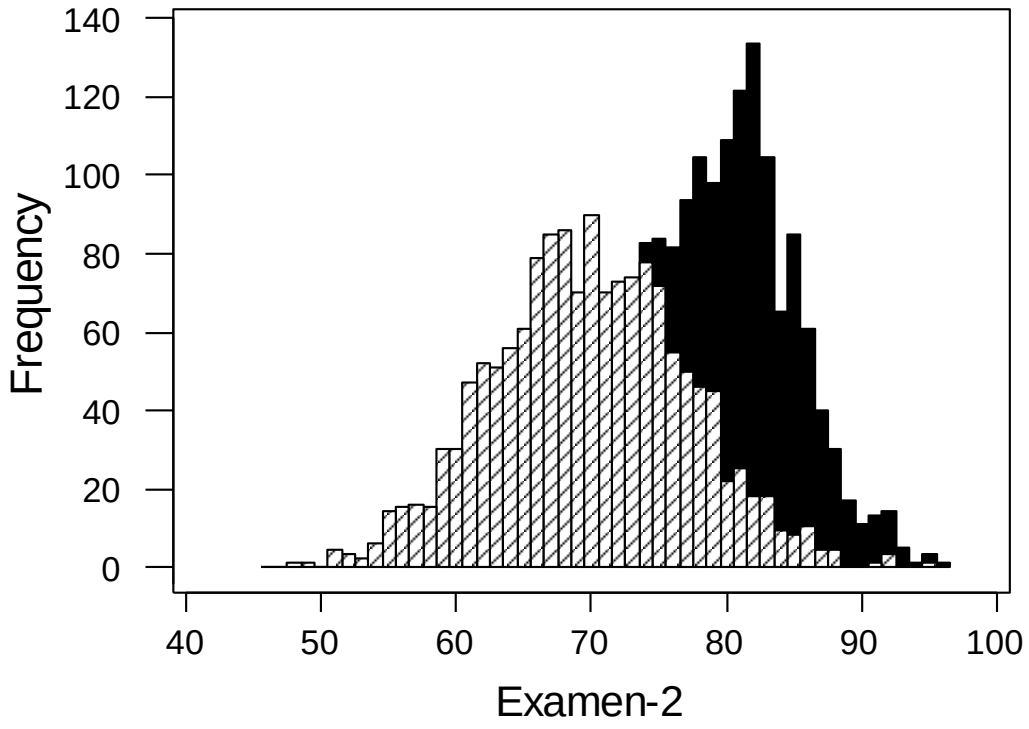
Conclusion:

According to the chart, the damage of Residential cost most. We should pay more attention to Residential.

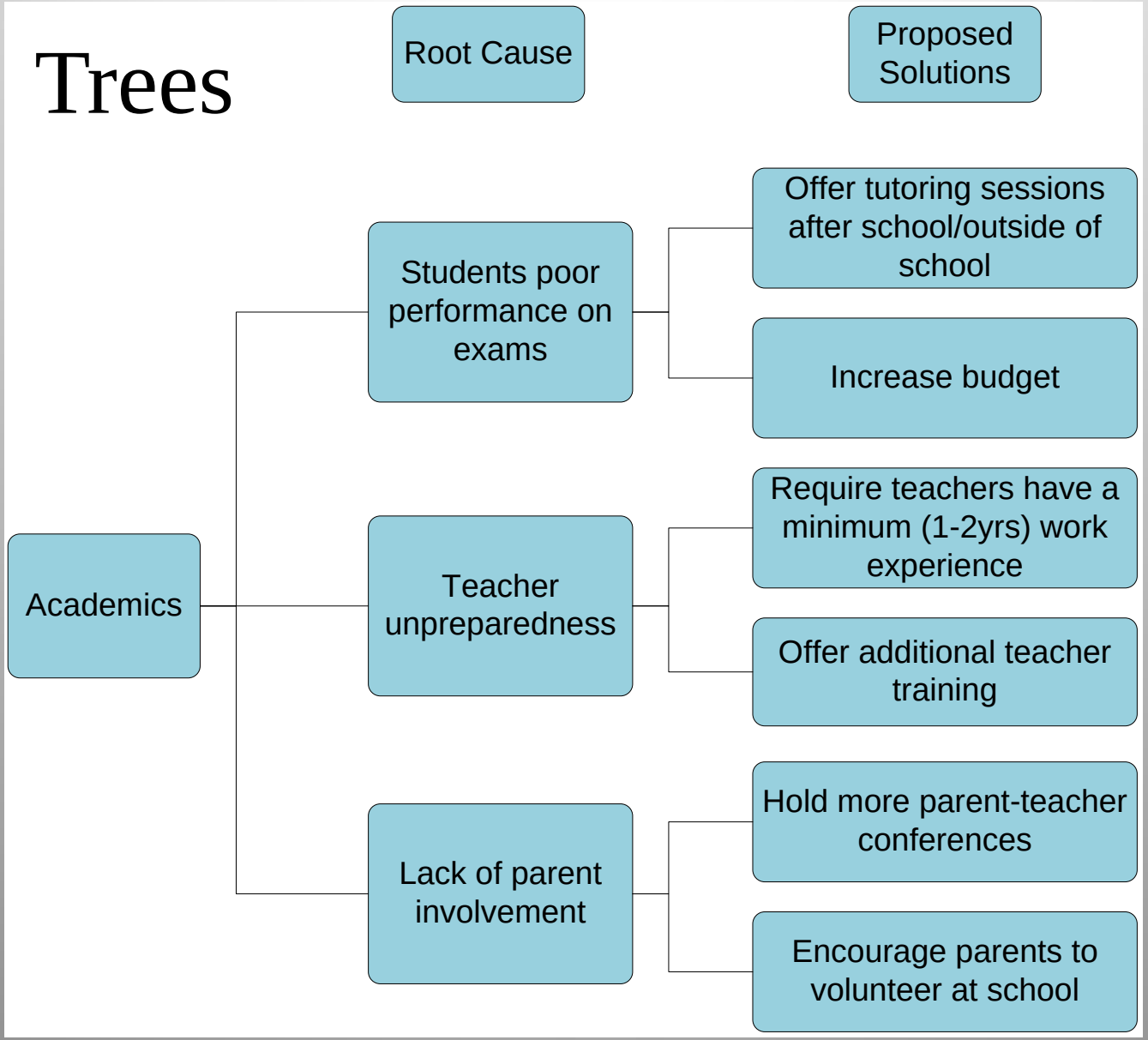
Box Plots for Comparisons



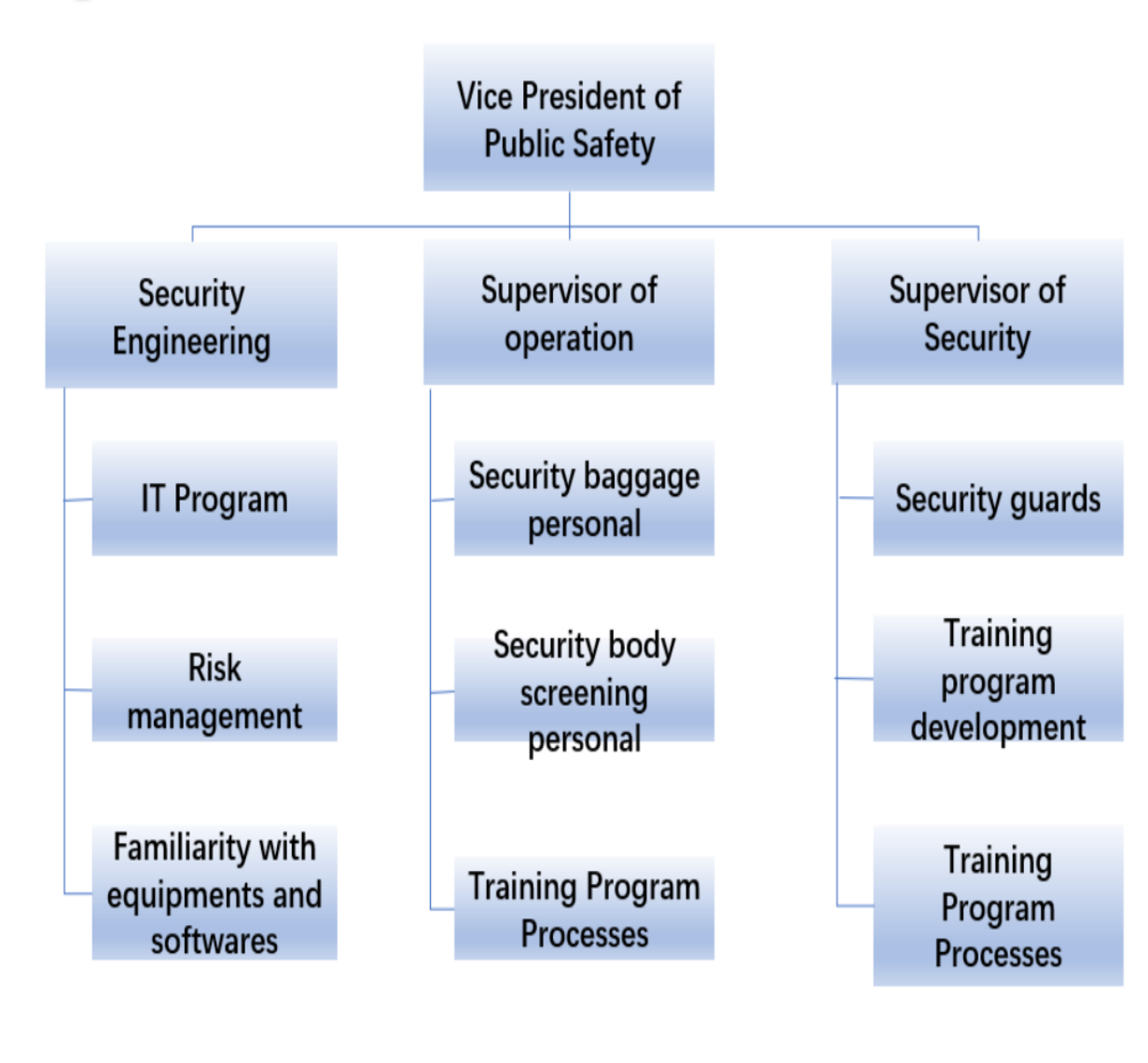
Histograms for Comparisons



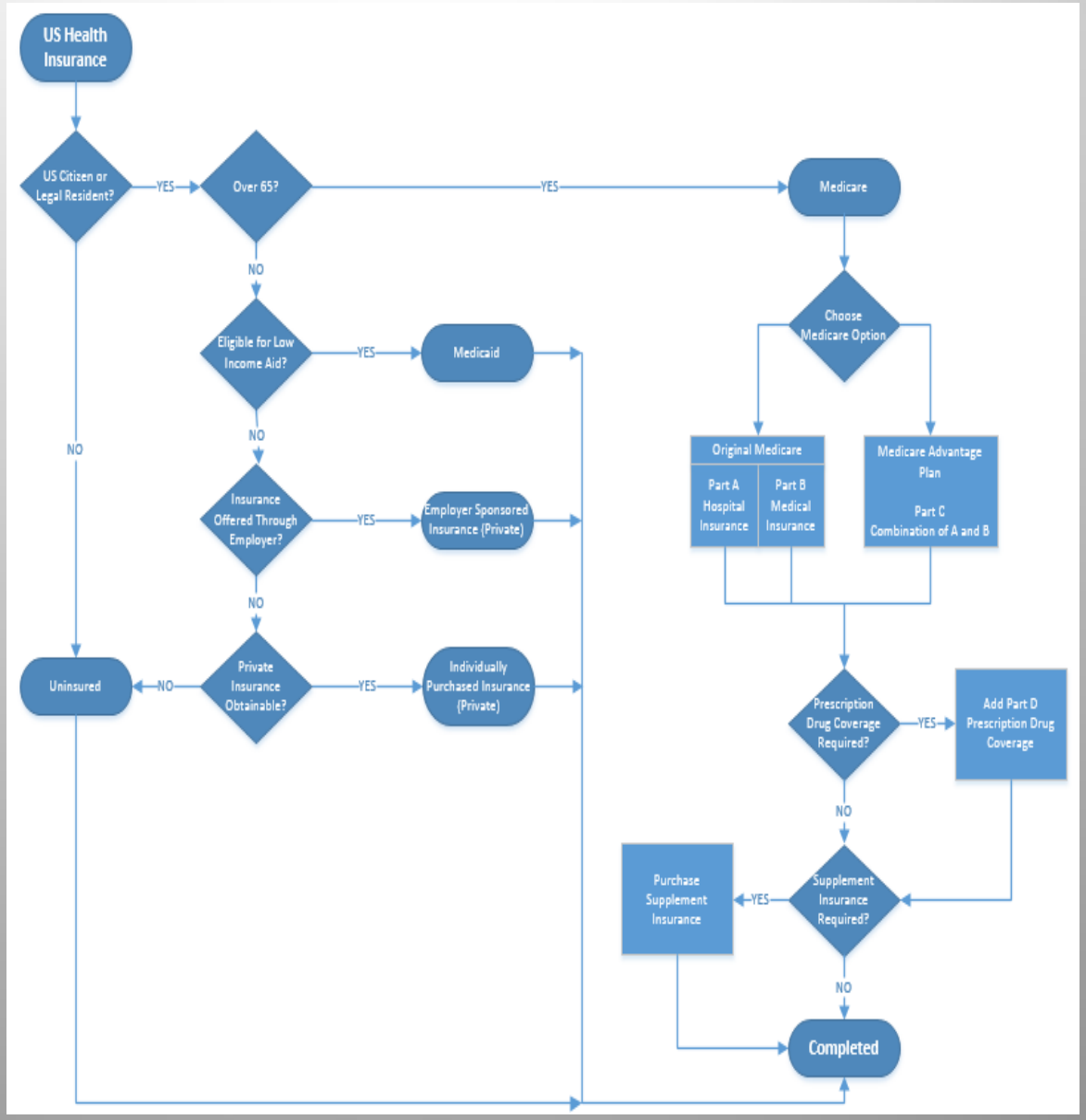
Trees



Organization Chart



Current Process Flow Chart



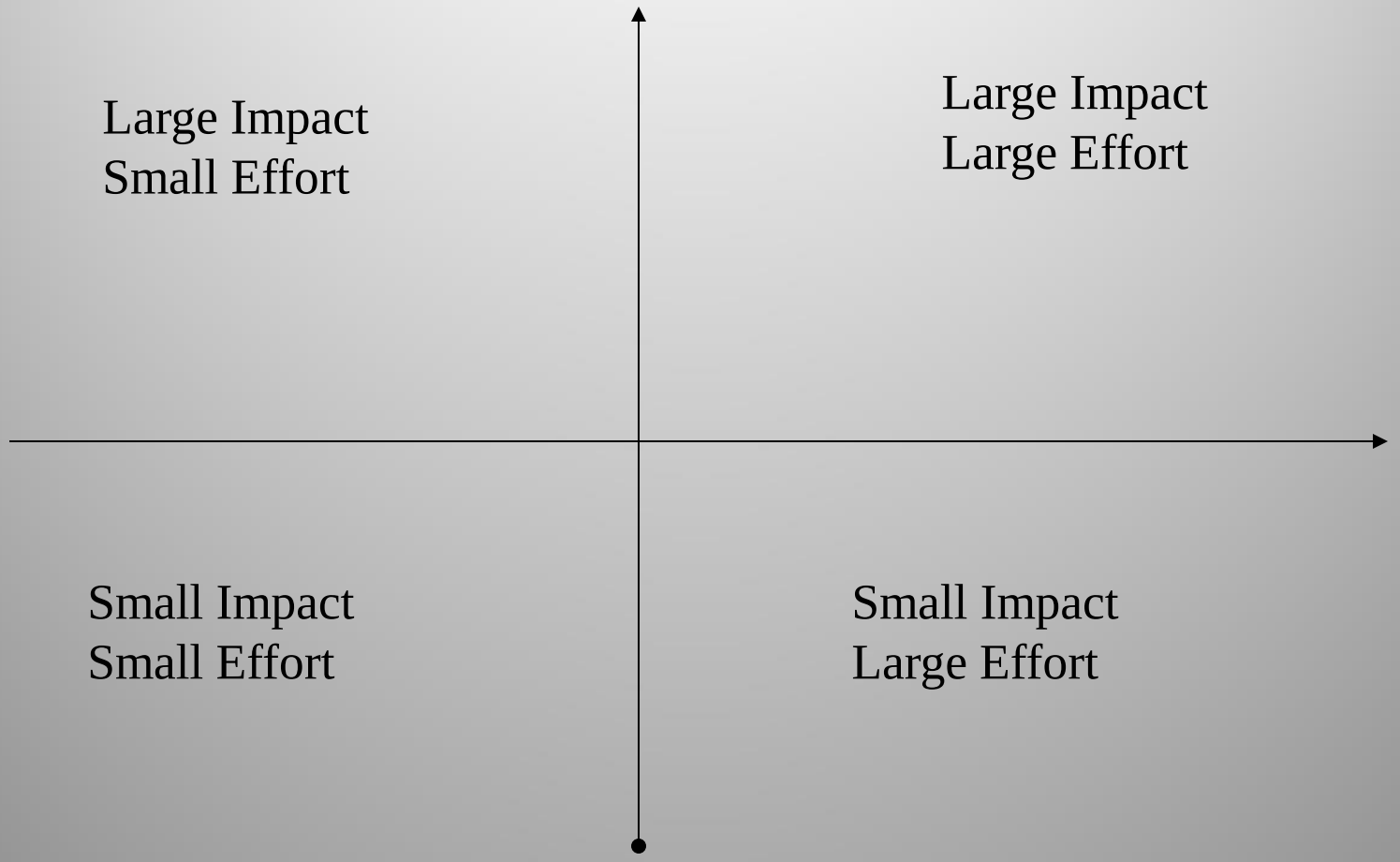
Project Evaluation

Project	Savings ($billion)	Probability	Cost ($mil)	Time(years)	PPI
A	30	0.9	2000	1	13.5
B	1	0.8	180	0.5	8.88
C	0.4	0.5	10	1	8
D	20	0.2	1000	2	2

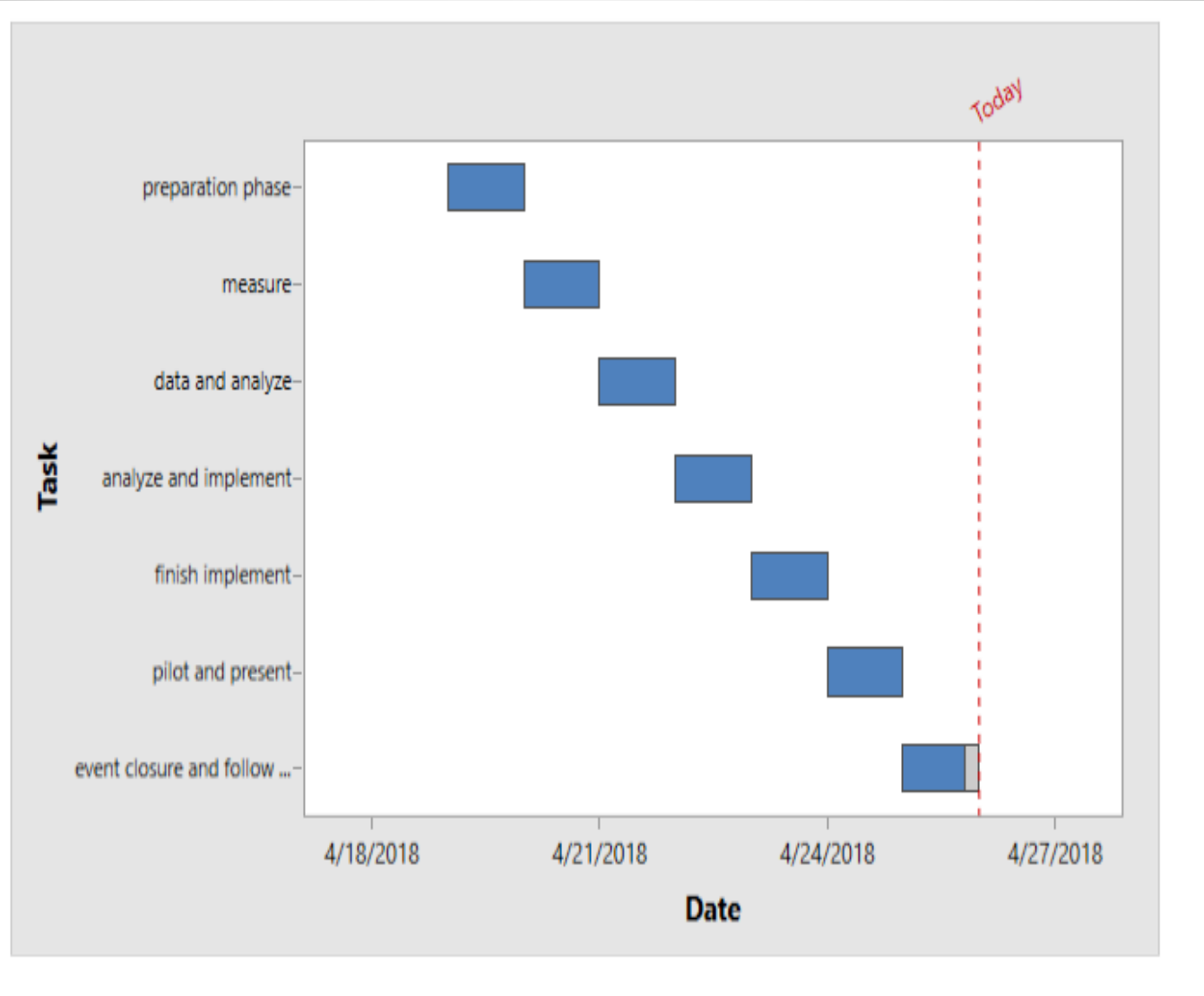
PROJECT SELECTION:

By looking at the above PPI for each project, Rebuild the two reservoirs takes highest project priority. And Improve Emergency response time and Create hurricane survivor App also have high project priority.

Impact v. Effort Chart



Tasks Gantt Chart

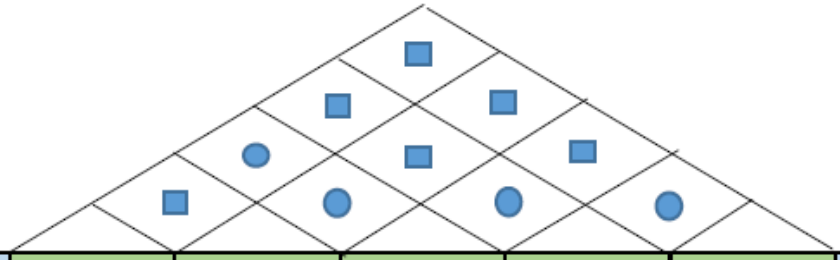


Advanced Q Tools

- Quality Function Deployment/QFD
- Value Stream Maps/VSM/SIPOC
- Control Charts/SPC Analysis
- Process Capability Analysis
- Takt Time/JIST Production
- Supply Chains

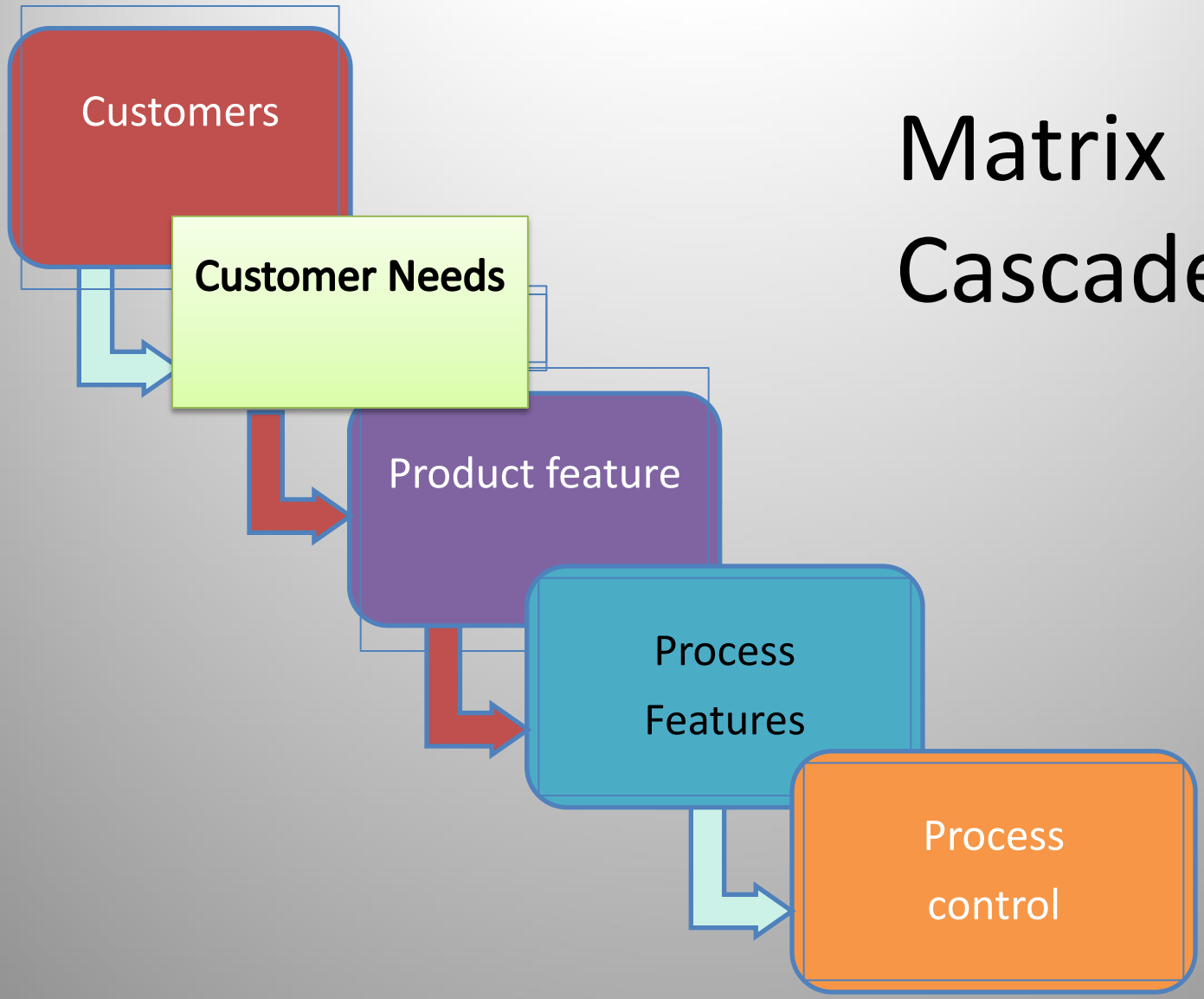
The Eight Wastes

- **Overproduction**: too much or too early
- **Waiting**: for information, people, materials
- **Transportation**: moving things around
- **Process Design**: too many or too few steps
- **Inventory**: work in progress, electronic files
- **Motion**: poor layout and ergonomics
- **Defects**: errors, scrap, rework, etc.
- **Underutilization**: of personnel or resources



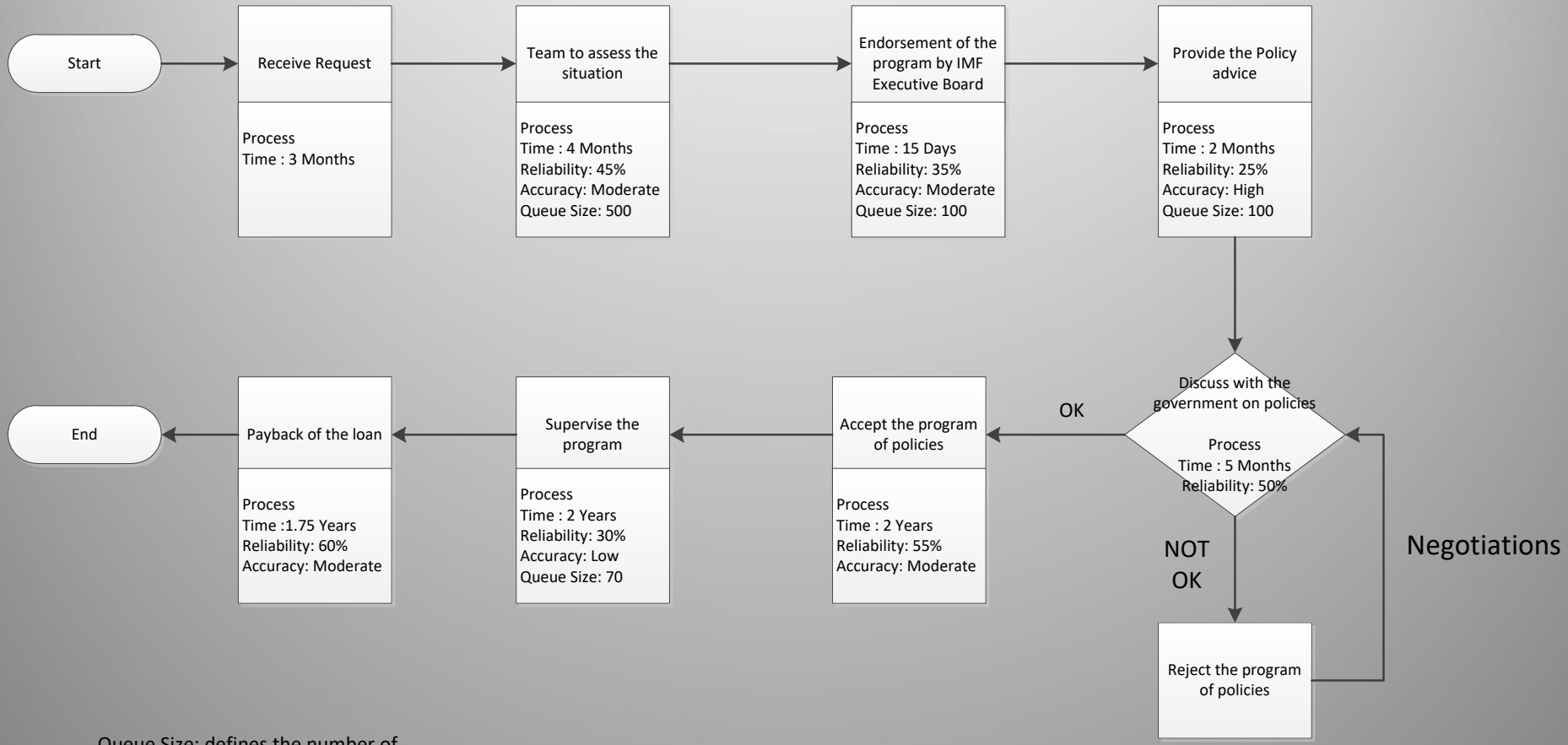
Engineering Recommendations / Voice of Customer	IMPORTANCE	Building Foundation Performance	Rescue Teams	Hospital Preparation	Critical Electrical Systems	Drainage Systems	RELEVANCE	Puerto Rico	Katrina	Harvey
Flood Protection	3	9	3	3	6	9		A	A	B
Power outage	2	9	3	6	9	6		B	A	A
Safety for the Residents	3	9	9	9	6	9		A	A	A
Basic amenities	2	3	3	3	3	3		A	B	C
Food and grocery supplies	3	3	6	3	3	3		B	B	C
Medical tool kits&preparation	3	3	6	9	3	3		B	C	A
CTQ Priority Score		36	30	33	30	33				
Percentage		22.222222	18.518519	20.37037	18.518519	20.37037				

Matrix Cascade



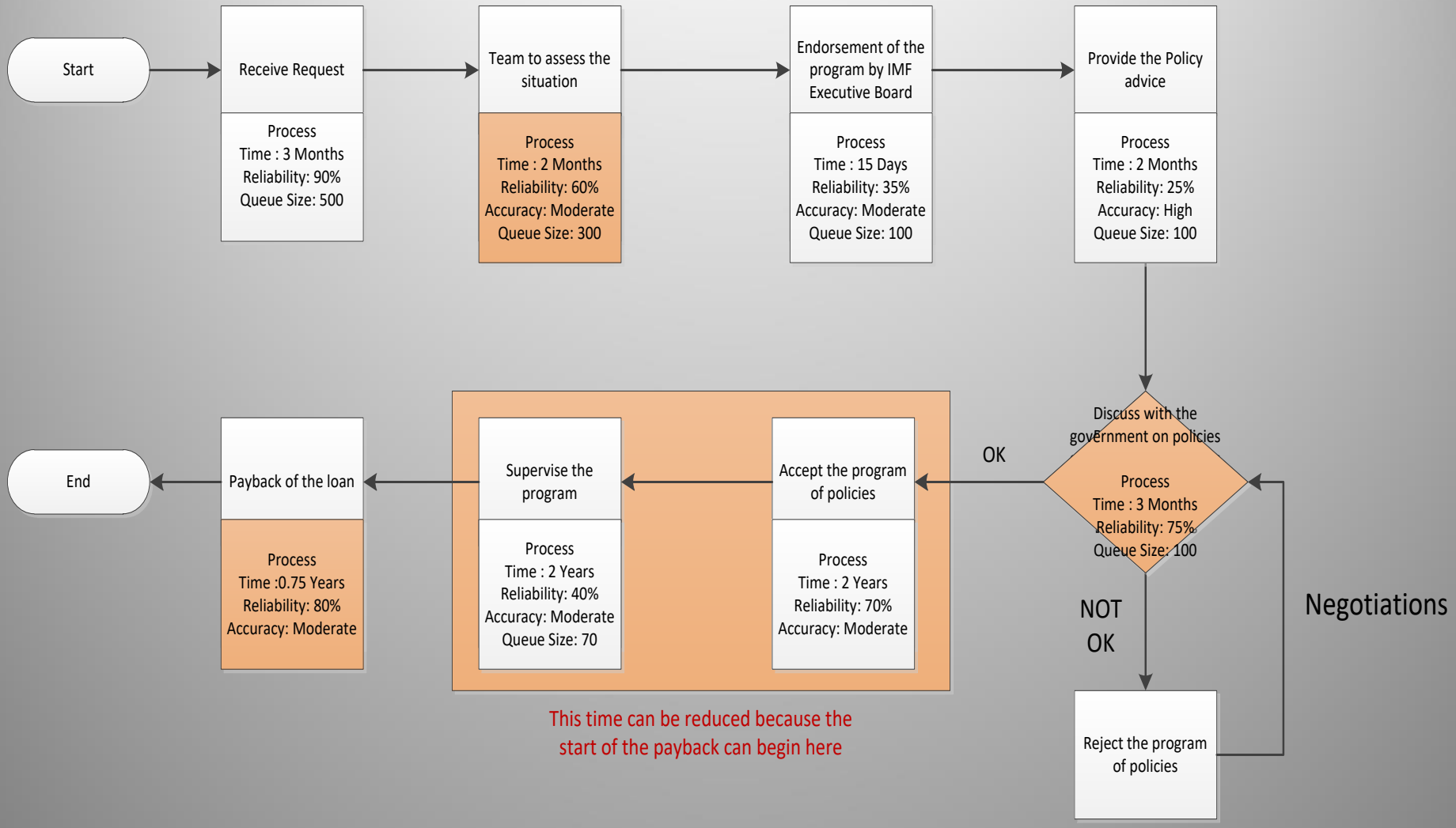
Value Stream Map: Current State

The Process in our case is IMF's "Stand-By Arrangements" lending option

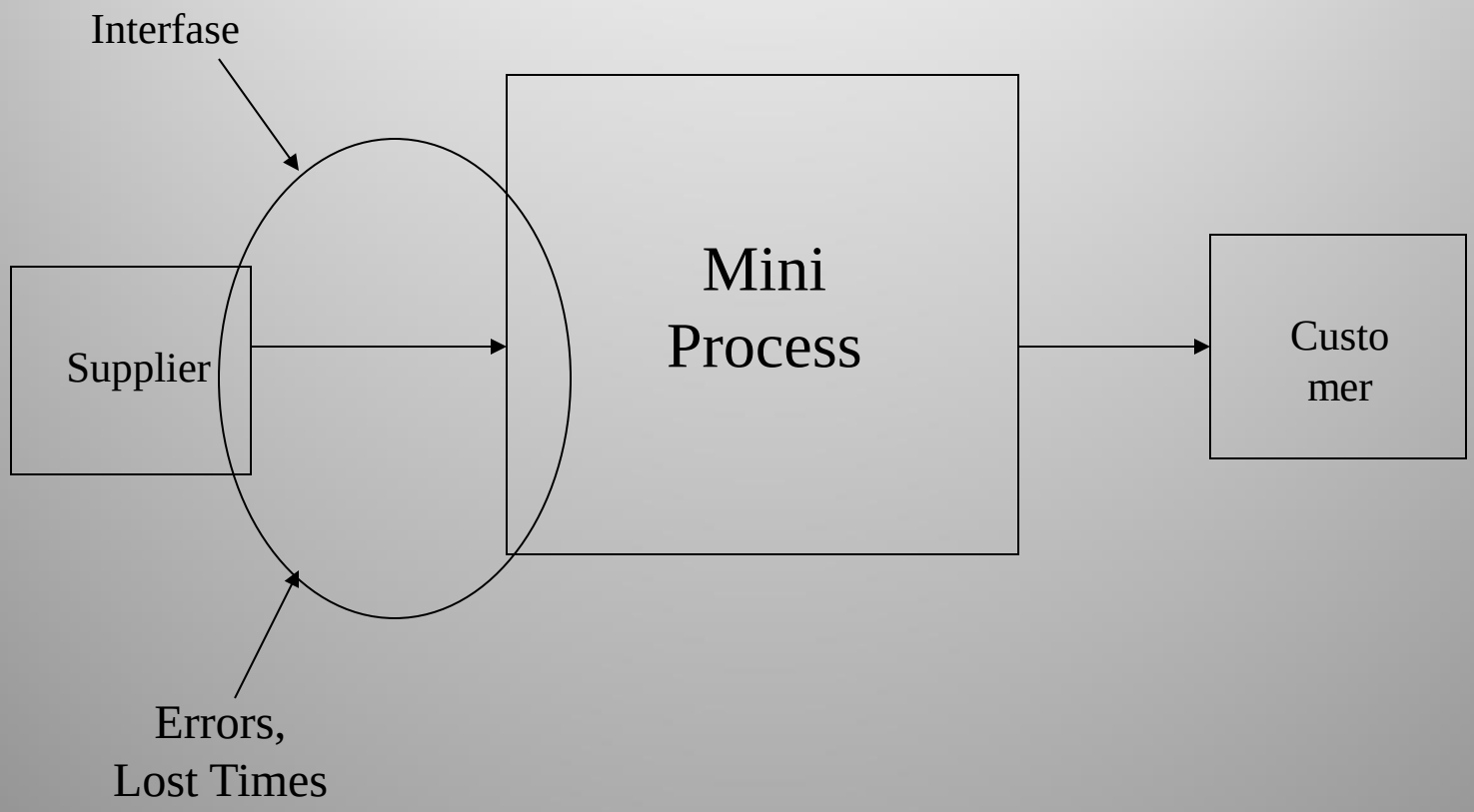


Queue Size: defines the number of documents impending for review per month

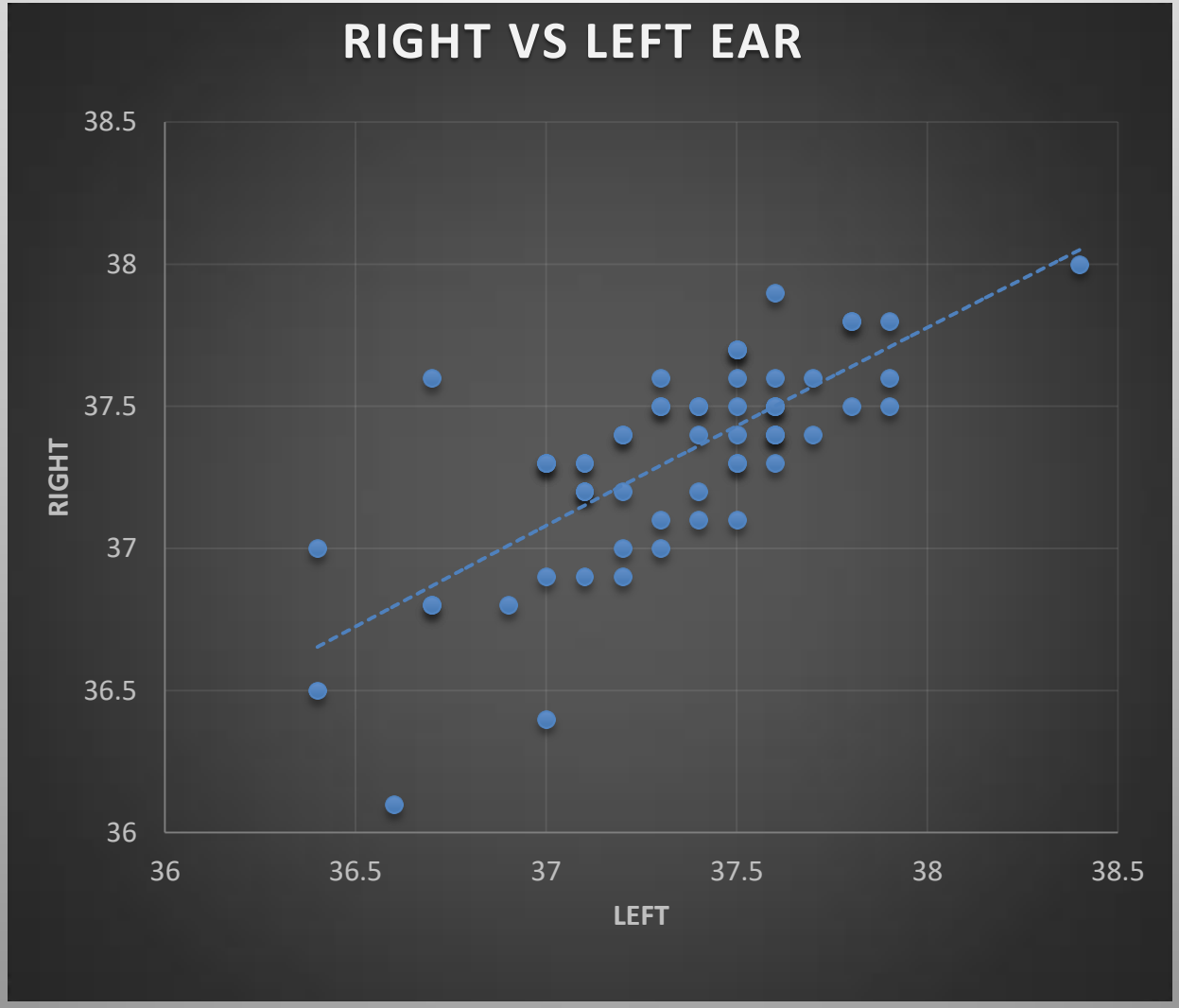
Value Stream Map: Final State



SIPOC: Supplier/Input/Process/Output/Customer
Every Step, a Mini-Process



SCATTER PLOT



Determine Pace for JIST Production

Takt Time Calculation Example:

Over 10 Days	Demand
1	30
2	40
3	50
4	60
5	10
6	30
7	40
8	20
9	60
10	40
10	**380**

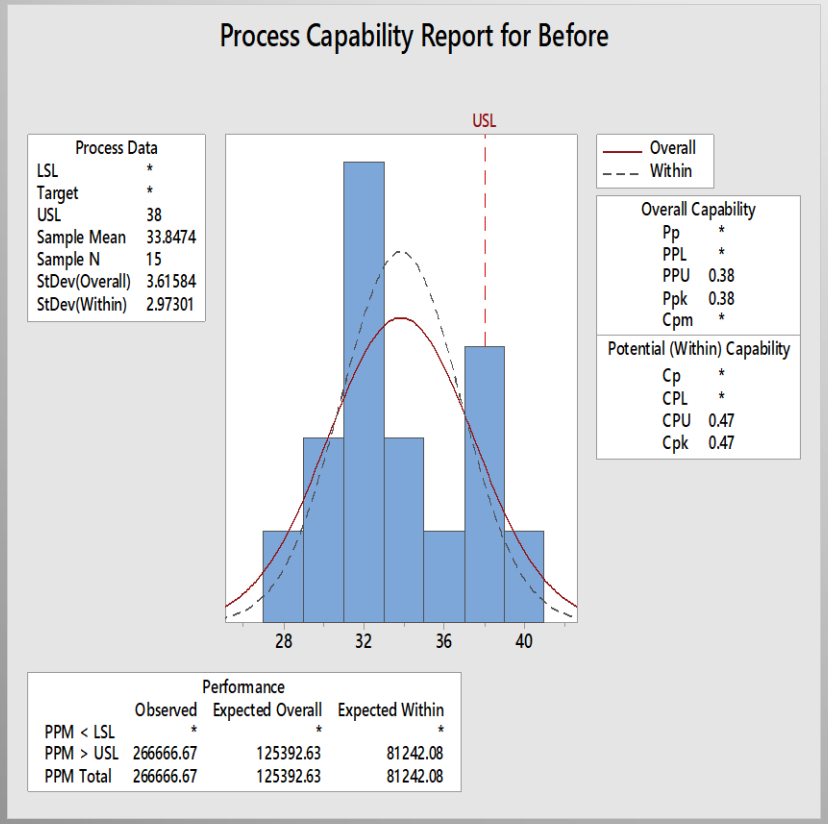
Per Day:

$$\frac{\text{Time available in period (840 min.)}}{\text{Average demand (38)}} \rightarrow 22.1 \text{ minutes}$$

Based on 2 shifts of 7 hours

Process Capability Analysis

Before



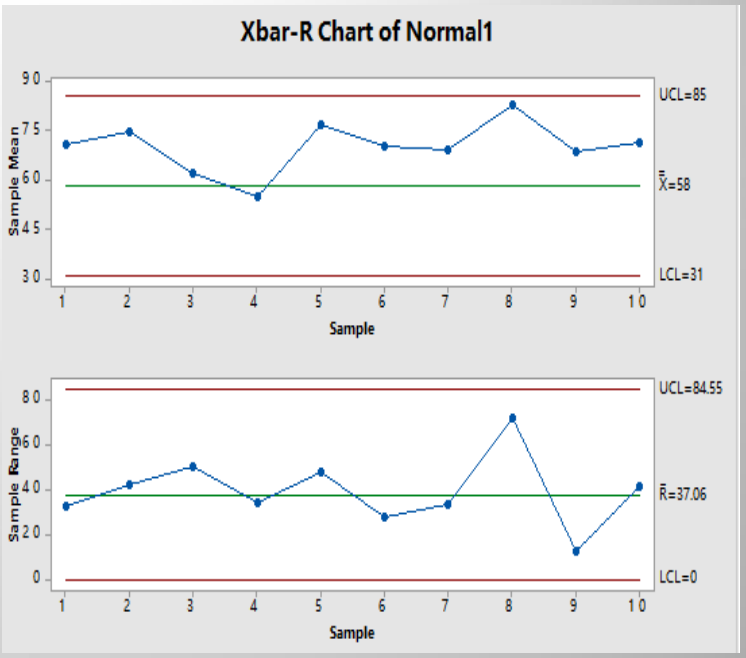
After

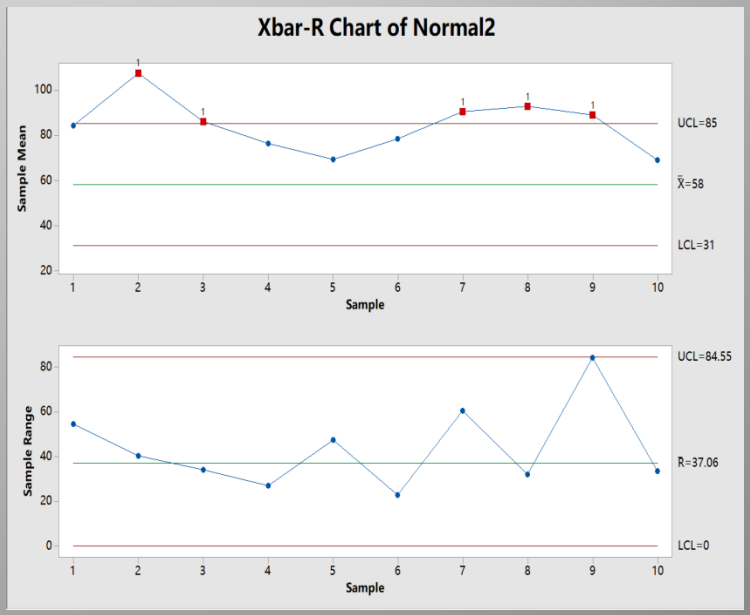
Graph X(bar)-R Chart

Normal2	
78.540	54.018
95.406	108.598
134.679	98.615
94.470	101.852
105.208	84.302
82.947	71.159
63.510	84.306
90.370	66.263
75.978	95.978
56.107	48.522
65.879	88.625
72.423	86.083
51.421	89.227
108.312	111.887
87.982	85.905
114.411	82.355
98.815	75.410
132.831	48.451
77.207	45.628
79.273	73.409

Descriptive Statistics: Normal

Variable	Mean	StDev	Variance
Normal	59.69	18.68	348.82



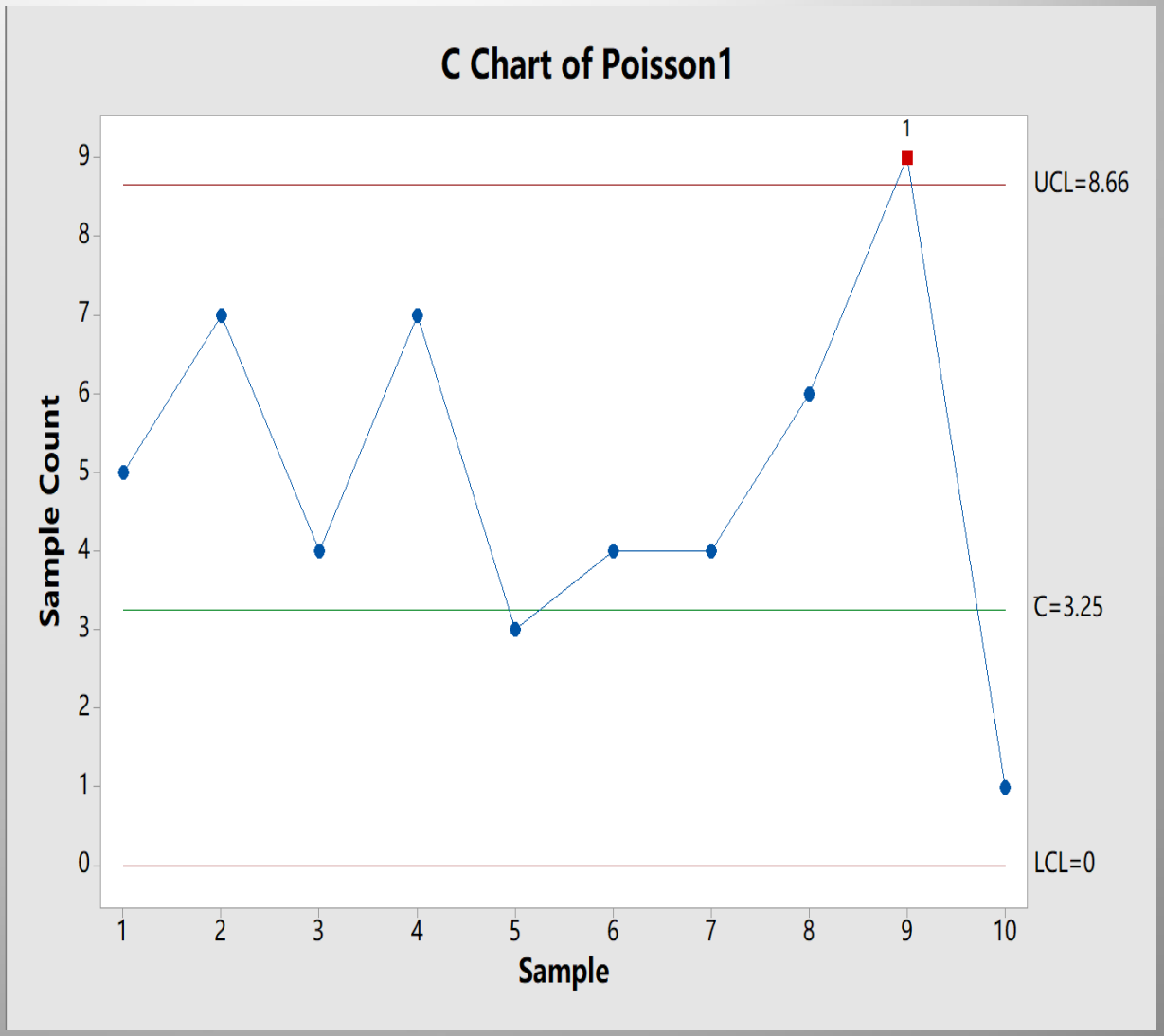


Graph C-Chart

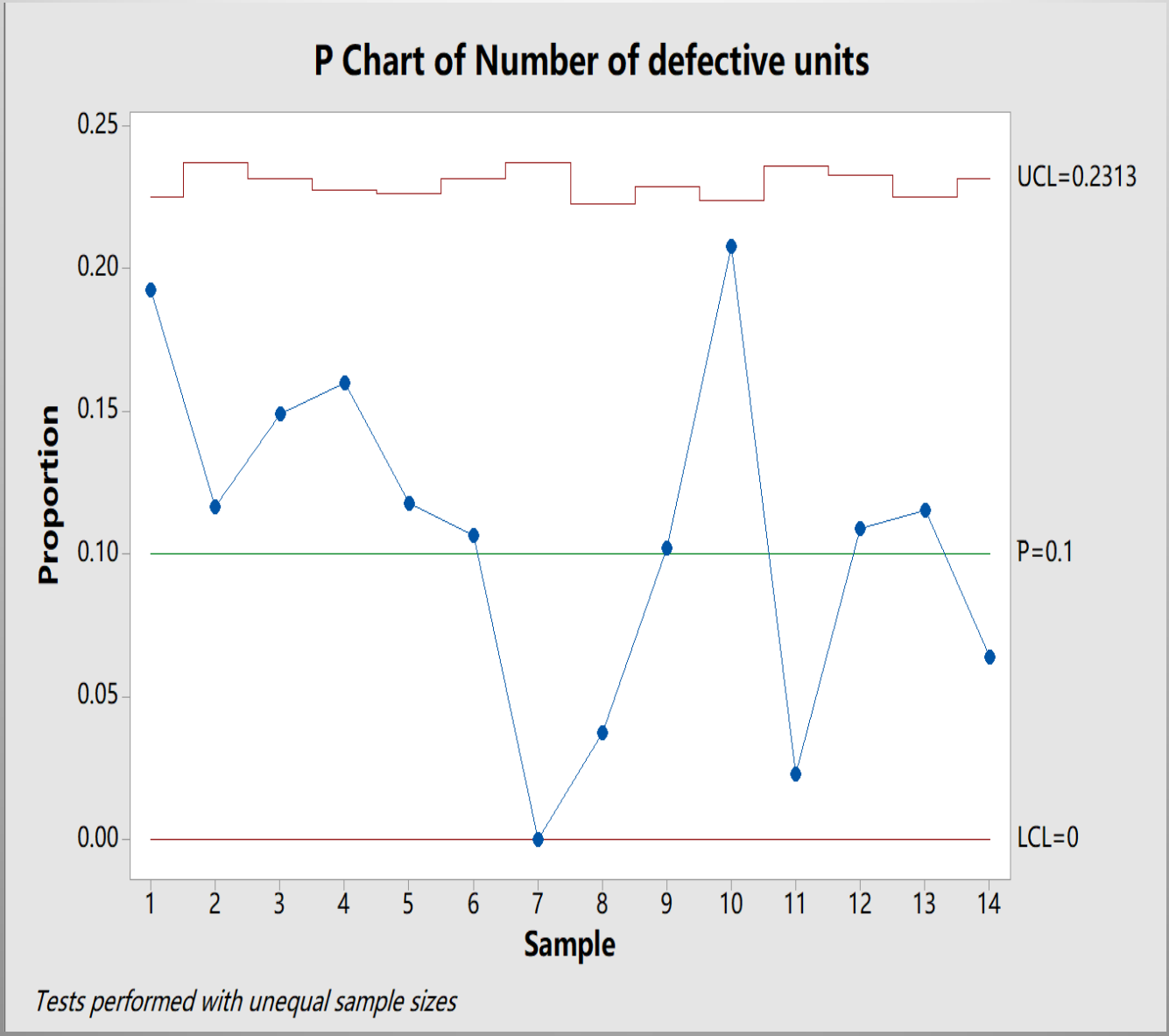
Poisson
1
5
7
4
7
3
4
4
6
9
1

Descriptive Statistics: Poisson

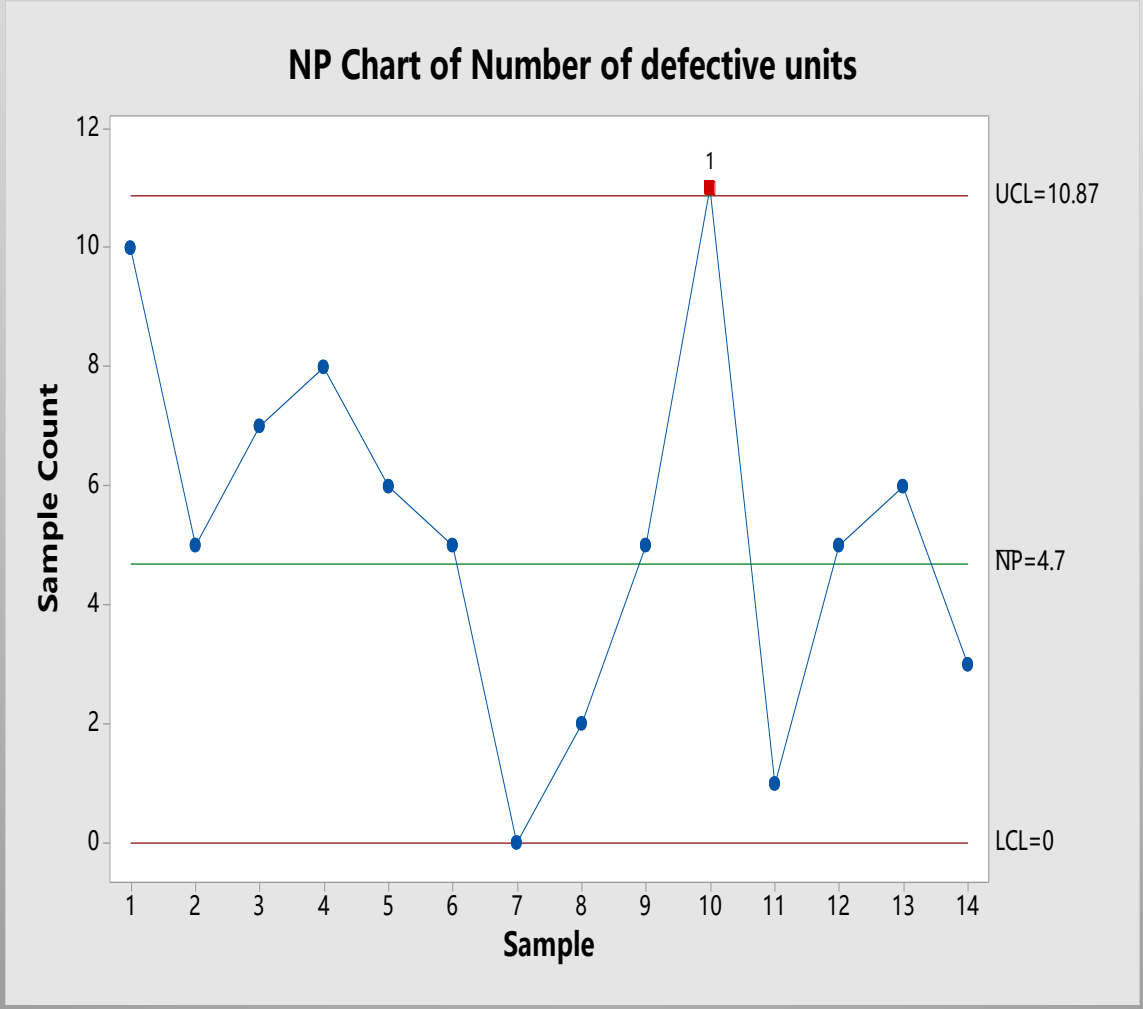
Variable	Mean	StDev	Variance
Poisson	3.250	1.822	3.321



Graph P-Chart



Graph NP-Chart

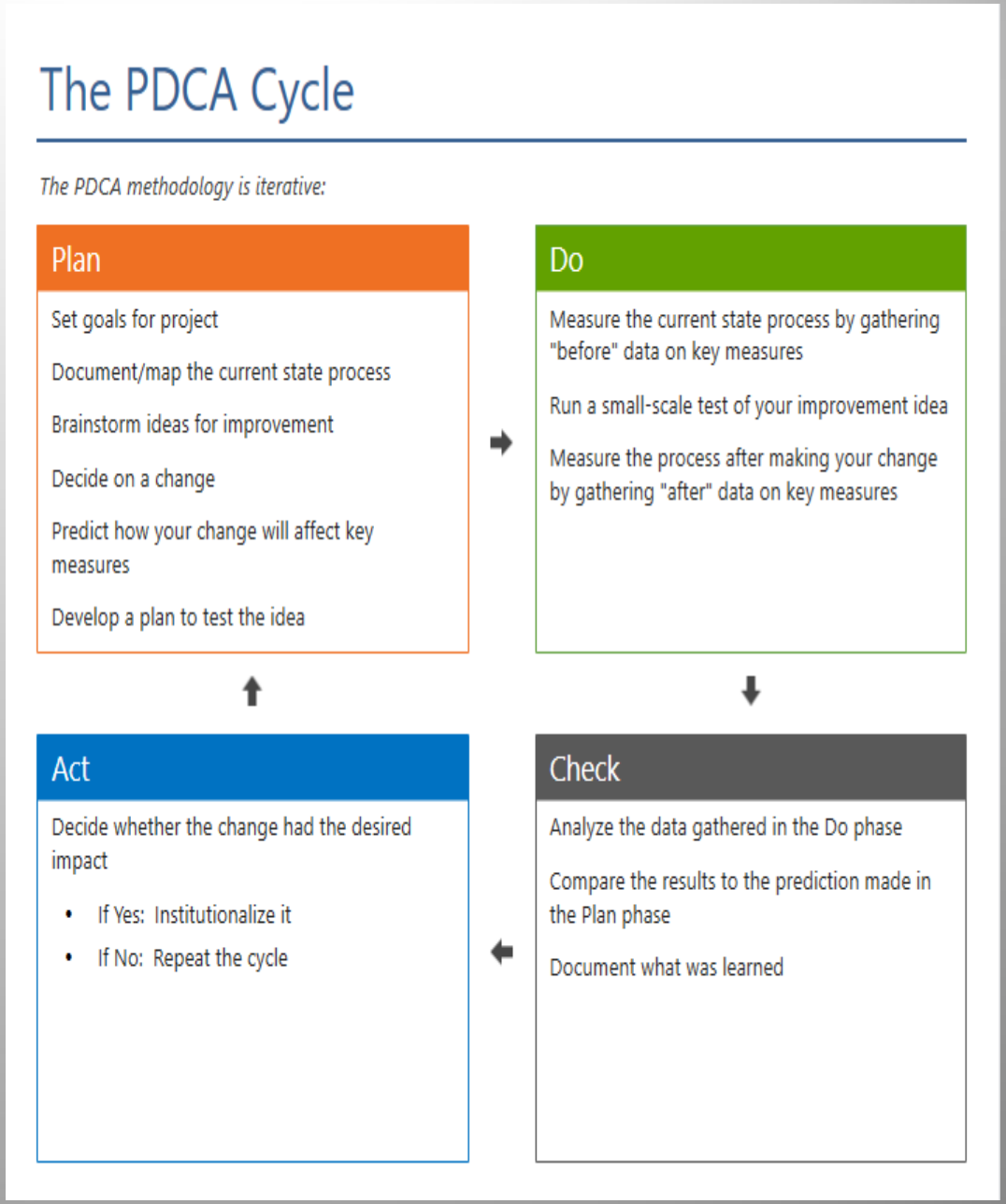


Analysis Methods

- PDCA/Lean/Kaizen
- Six Sigma/Lean-Six Sigma
- Meas. Sys. Anal./MSA
- Reliability Analysis
  - FMEAs/FEMECAs
  - Fault Trees
- Regression Modeling
- Design of Experiments (DOC)

The PDCA Cycle

The PDCA cycle is a four–step model for carrying out change. And the PDCA cycle should be repeated again and again for continuous improvement.



The reasons that PDCA are an appropriate model

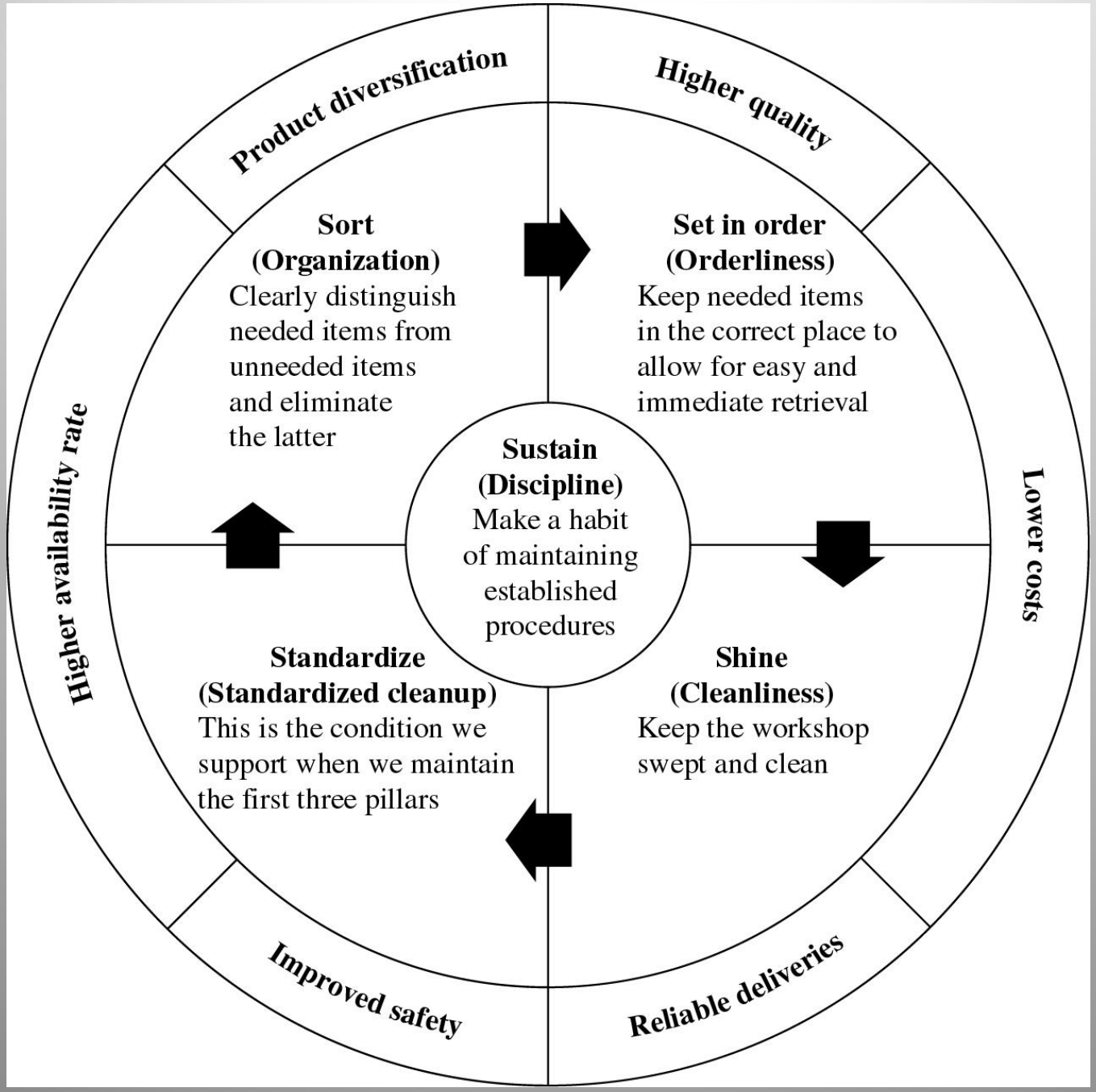
- We wan to find some optimal ways to reduce the damage caused by hurricanes by developing a new or improved design of the process followed.
- We are planning data collection and analysis in order to verify and prioritize problems or root causes.
- Based on the results obtained, changes will be implemented in the processes followed.

Lean Characteristics

Fig. 13-2

From	***To***
Functional alignment/focus	Product/process focus
Functional ‘silos’	Co-location, collaboration
Weak communications	Constant, visible communication
Specialization	Multi-skilling, teamwork, balance
Overhead allocation	Product lines as businesses
Slow, batch, inventory	1-piece flow or ‘Flow of value’

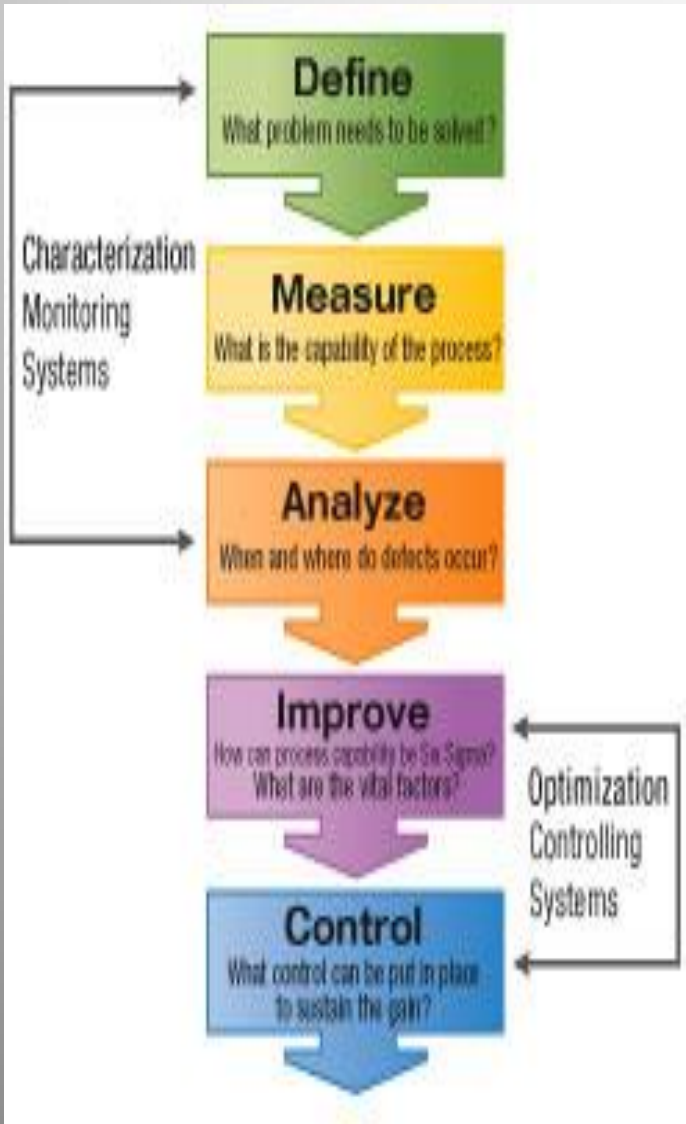
Five - S


Product diversification
Higher quality
Higher availability rate
Lower costs
Improved safety
Reliable deliveries
Sort
(Organization)
Clearly distinguish needed items from unneeded items and eliminate the latter
Set in order
(Orderliness)
Keep needed items in the correct place to allow for easy and immediate retrieval
Sustain
(Discipline)
Make a habit of maintaining established procedures
Standardize
(Standardized cleanup)
This is the condition we support when we maintain the first three pillars
Shine
(Cleanliness)
Keep the workshop swept and clean

Lean Manufacturing and the “3 M”

- Kaisen: continuous improvement
  * Achieved by reducing **the three Evil M’s**
  - **Muda**: waste or non-value
    - Added activities
  - **Mura**: inconsistent use of people
    - And of processes
  - **Muri**: excessive demands on people
    - And of processes

DMAIC



DEFINE
Problem and project goals.

MEASURE
Current process followed.

ANALYZE
Cause and effect relationships .

IMPROVE
Improve Process using special techniques.

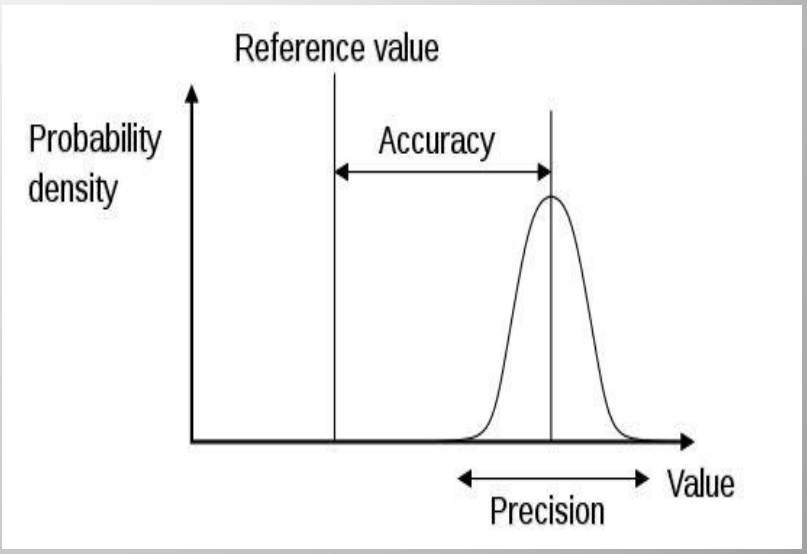
CONTROL
Make correction and implement control system.

ANOVA Gauge R&R

- It is a measurement systems analysis technique.
- Gauge R&R measures the amount of variability induced in measurements by the measurement system itself, and compares results to the total variability
- Observed to determine the feasibility of the measurement system.
- Repeatability: The variation in measurements taken by a single person or instrument on the same or replicate item and under the same conditions.
- Reproducibility: the variation induced when different operators, instruments, or laboratories measure the same or replicate samples.
- Gauge R&R addresses only the precision of a measurement system.

Accuracy & Precision

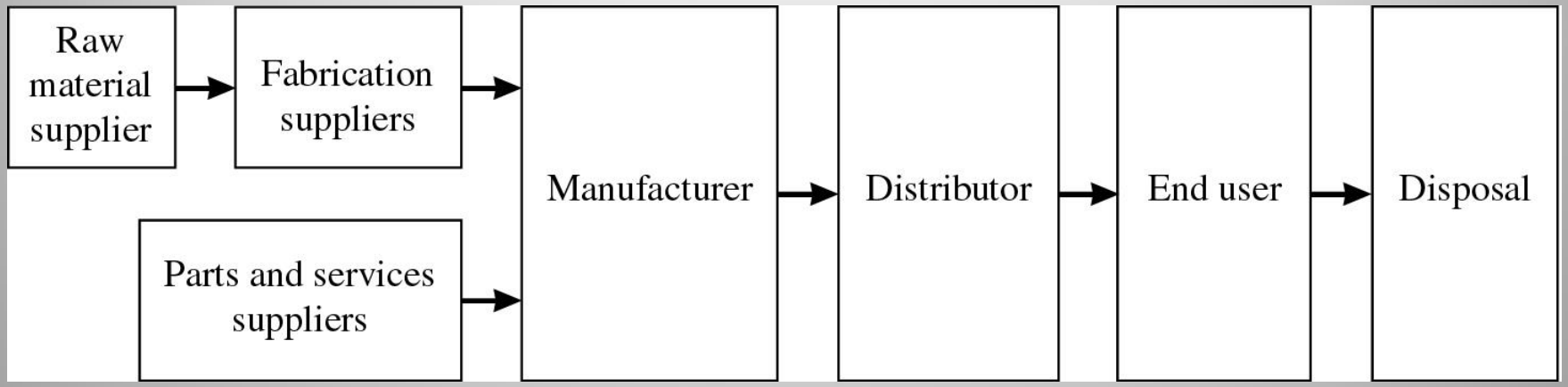
- Accuracy is the proximity of measurement results to the true value
- Precision is the repeatability or reproducibility of the measurement



$$\text{accuracy} = \frac{\text{number of true positives} + \text{number of true negatives}}{\text{number of true positives} + \text{false positives} + \text{false negatives} + \text{true negatives}}$$

$$\text{precision} = \frac{\text{number of true positives}}{\text{number of true positives} + \text{false positives}}$$

Example of Supply Chain:



Use Quality Companion to Develop a Supply Chain

(2) Failure Mode and Effects Analysis (FMEA) to an example of Group Project Topic problem.

Automatic fare collection machine

Failure Mode Criticality Number=α*frequency*hours or cycles*β

=100%**517*1min*100%=*517*

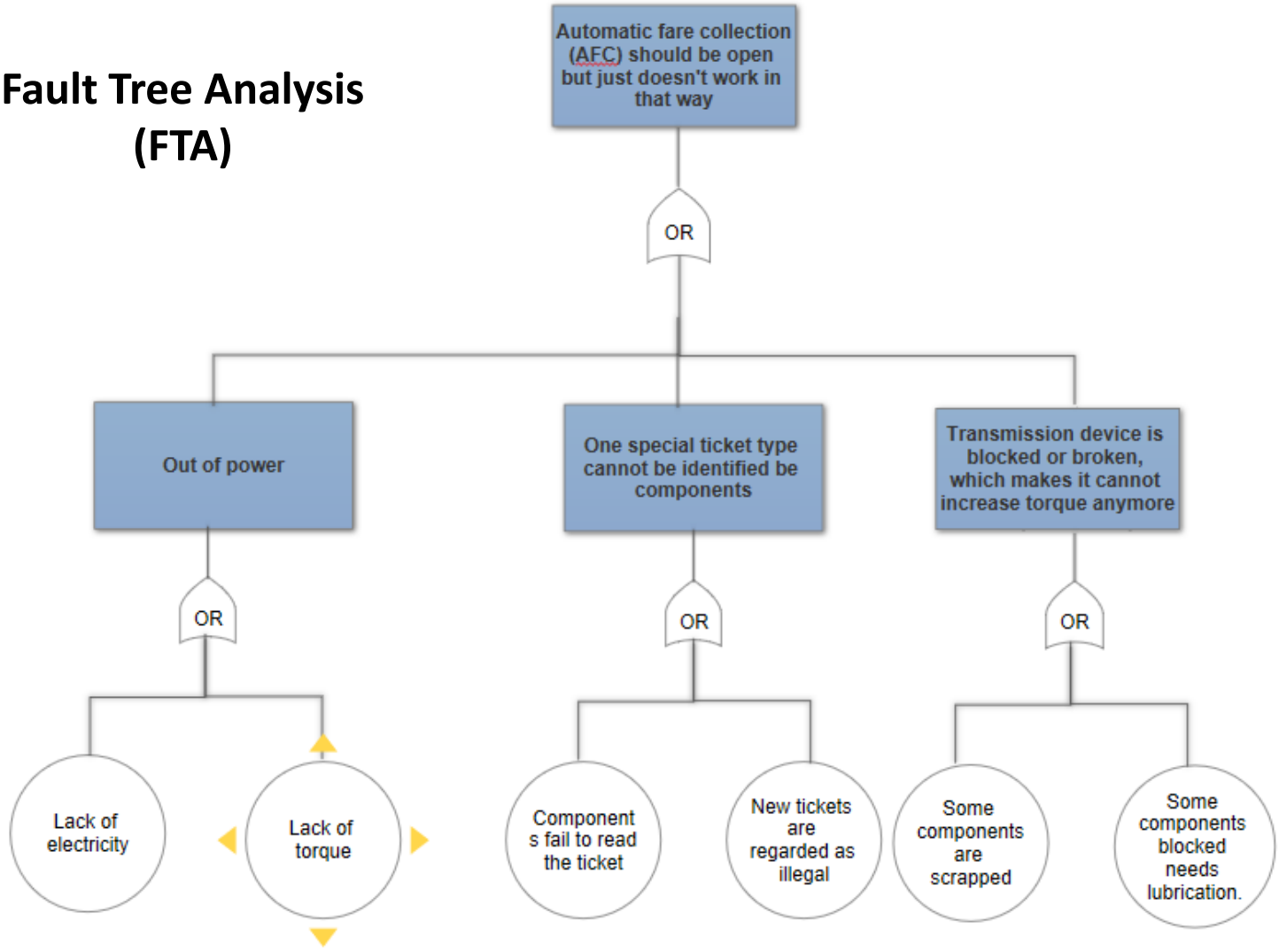
α the percentage of occurrence of each failure mode

frequency the rate of occurrence

β best estimate of percentage of occurrence of failure effects (probability failure effect will occur)

Function	Failure Modes	Local Effect	End Effect	Severity	Cause	Action
Used by a media holder to confirm travel rights and board a subway	Cannot identify tickets	Machine will not be open state although it should be	Prevent passengers from boarding and increase takt time significantly	catastrophic	The ticket of new type has not been added to the approval list	Modify the database as soon as possible

Fault Tree Analysis (FTA)



- Optimize: DOE Analysis

Factors
- Wind Speed
- Water Level
- Weight of the product

Factorial Experiments 2^3 (DOE-ASQ)												
Run	A	B	C	AB	AC	BC	ABC	Y1	Y2	Y3	Avg	Var
1	-1	-1	-1	1	1	1	-1	0.52	2.06	0.49	0.68	1.69
2	1	-1	-1	-1	-1	1	1	6.99	8.19	8.02	7.73	0.42
3	-1	1	-1	-1	1	-1	1	5.67	10.36	6.57	7.53	6.17
4	1	1	-1	1	-1	-1	-1	6.50	8.11	13.33	9.31	12.74
5	-1	-1	1	1	-1	-1	1	15.67	11.45	14.22	13.78	4.60
6	1	-1	1	-1	1	-1	-1	15.97	20.52	19.64	18.71	5.82
7	-1	1	1	-1	-1	1	-1	16.35	11.78	9.91	12.68	10.96
8	1	1	1	1	1	1	1	20.73	23.11	21.31	21.72	1.54

Coded Coefficients

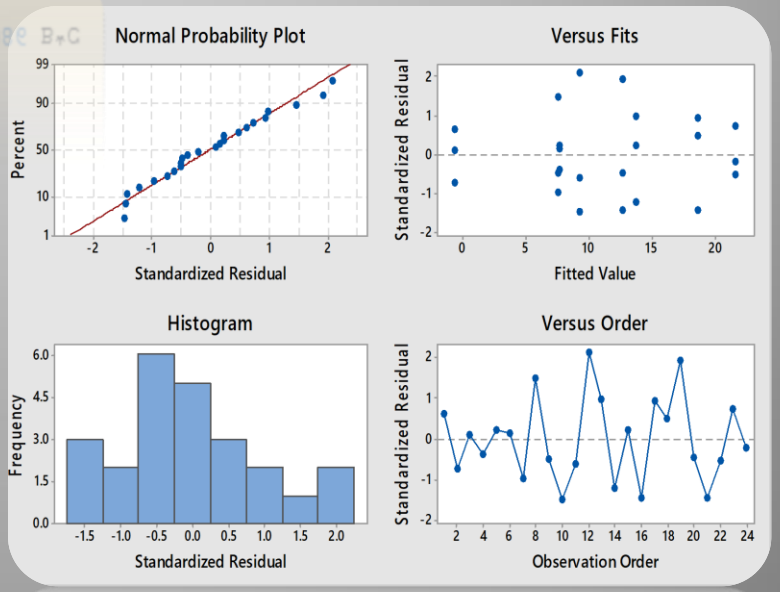
Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		11.348	0.478	23.72	0.000	
A	6.039	3.020	0.478	6.31	0.000	1.00
B	2.925	1.463	0.478	3.06	0.008	1.00
C	10.746	5.373	0.478	11.23	0.000	1.00
A*B	-0.631	-0.316	0.478	-0.66	0.519	1.00
A*C	0.944	0.472	0.478	0.99	0.338	1.00
B*C	-1.971	-0.986	0.478	-2.06	0.056	1.00
A*B*C	2.686	1.343	0.478	2.81	0.013	1.00

Regression Equation in Uncoded Units

Yield = 11.348 + 3.020 A + 1.463 B + 5.373 C - 0.316 A*B + 0.472 A*C - 0.986 B*C
+ 1.343 A*B*C

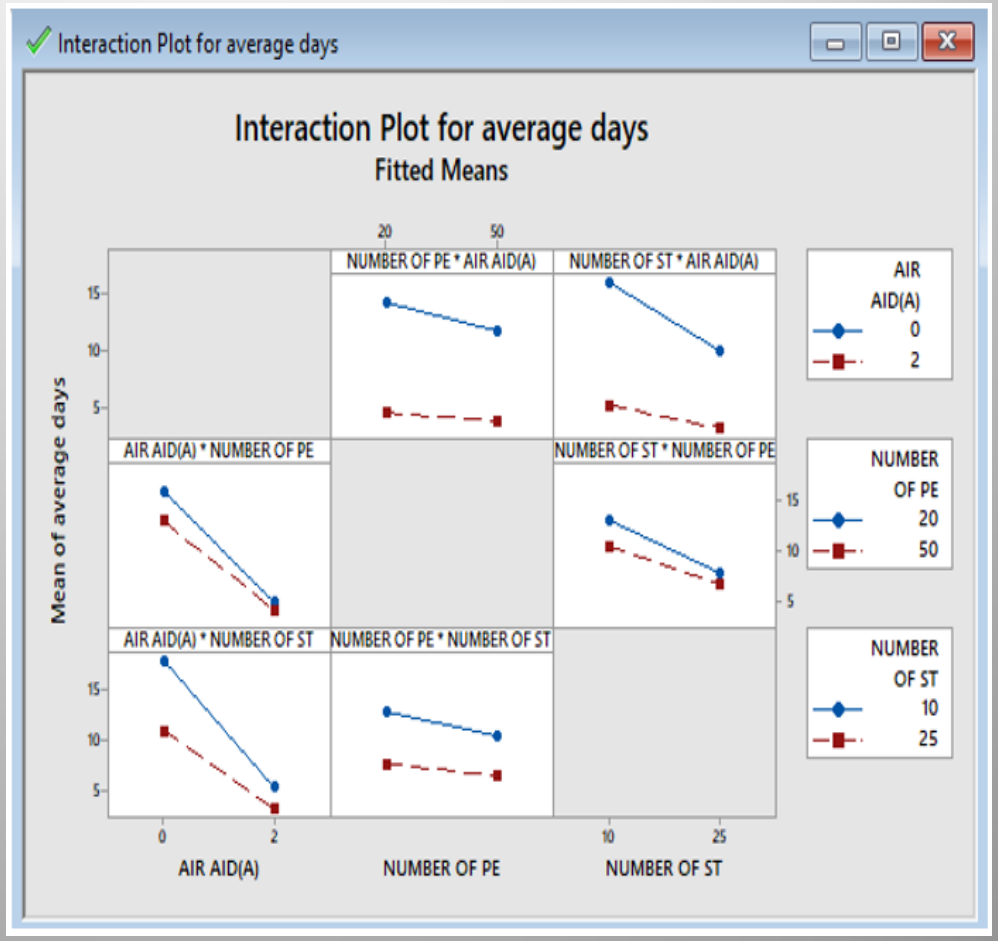
DOE Results

DOE Graphics



MINITAB OUTPUT

- From the result of Minitab, it is obviously that the slopes of the 2 line in all segments of the plot are nearly the same, so the conclusion could be drawn that all interaction effects are not significant. They would have been significant if the lines were intersection.



Student Final Project Examples

Weather Disaster Mitigation Project Examples

- Baton Rouge & Sandy Storm Weather Disaster Management
- http://web.cortland.edu/matresearch/2017WeatherDisasterMgmtFinPres.pdf
- Florida Hurricane Weather Disaster Management
- http://web.cortland.edu/matresearch/DFSSQFDFlaHurr.pdf.pdf
- Harvey/Houston Hurricane Weather Disaster Management
- http://web.cortland.edu/romeu/HurricaneHarveyPptS2018.pdf
- COPQ to study Refugee Migration from Syria to Europe
- http://web.cortland.edu/matresearch/COPQIntReliefS2016.pdf

Qual. Rel. & Cont. Imp. Institute/QRCII
http://web.cortland.edu/romeu/QR&CII.htm

Public Systems Improvement Examples

- Subway operations improvement and terrorism prevention
  - http://web.cortland.edu/matresearch/ProcCapabSubway.pdf
- AMTRAK operations improvement & terrorism prevention
  - http://web.cortland.edu/matresearch/AmtrakSixSigPPT2018.pdf
- Puerto Rico's Total Electricity Loss Mitigation
  - http://web.cortland.edu/matresearch/2017PRElectLossFinPres.pdf
- River/Canal Ops. improvement & terrorism prevention
  - http://web.cortland.edu/matresearch/RiverCanalOpsMFe.pdf
- Quality Assessment of Medicare Extension Project
  - http://web.cortland.edu/matresearch/QualAssessMedicare.pdf
- Quality Assessment of a Public School District
  - http://web.cortland.edu/matresearch/SchoolProjS09.pdf

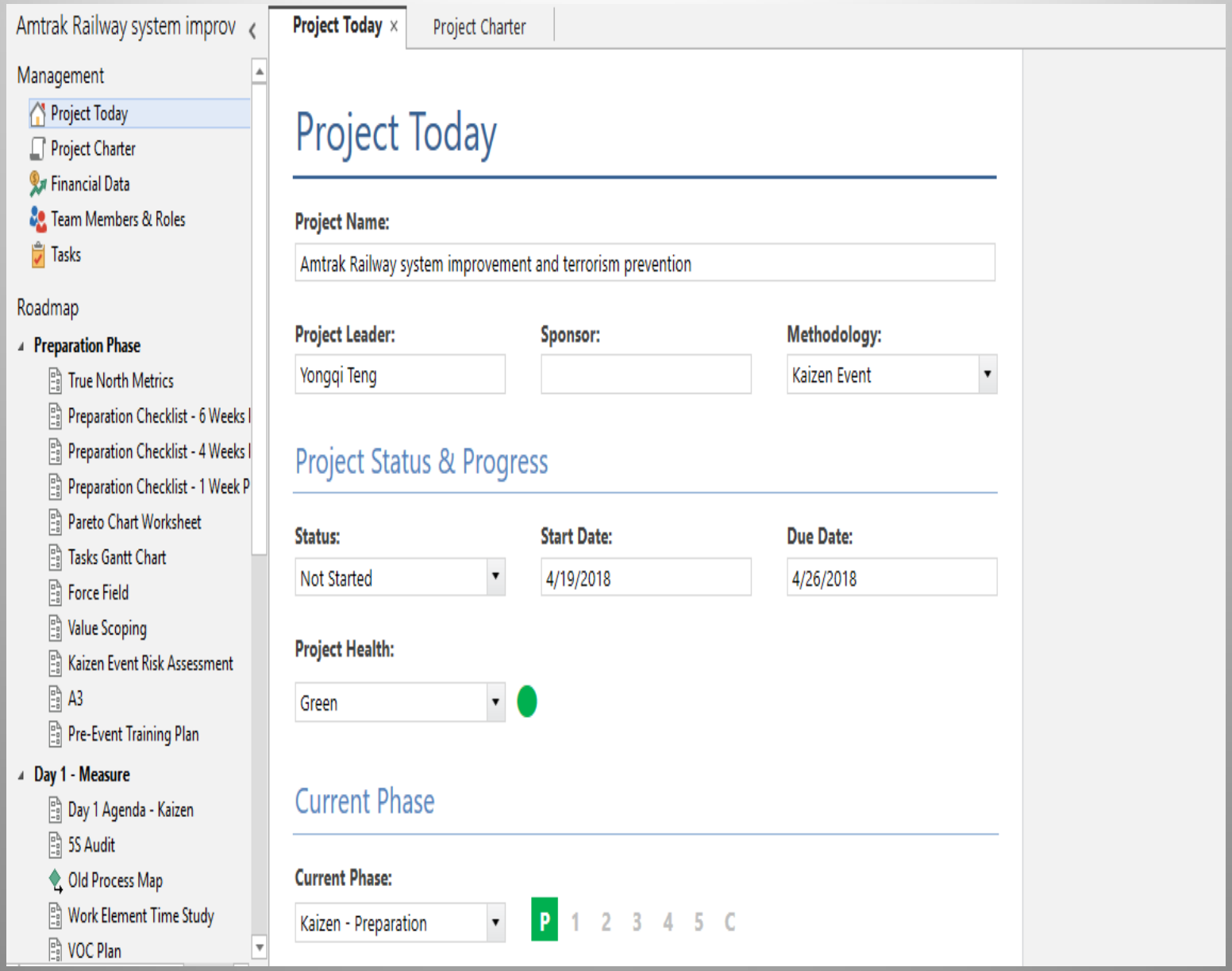
Conclusions

- These new Quality analyses are feasible
  - Student Projects have proven it
- These new Quality analyses are necessary
  - Such social services need improvement
- These new Quality analyses are convenient
  - Quality Engineering community needs
  - New Areas in which to implement their tools!
- It is time to implement them!

APPENDIX

A QUALITY COMPANION IMPLEMENTATION

A Quality Companion Project



Project Definition

Project Definition

Problem Statement:

Lower level of houses and buildings could be flooded during storm

Objective:

Use flood barriers to block water outside

Business Case:

Develop a portable, height-changeable, and reliable flood barrier

Benefit Type:

Cost Reduction

Product/Service:

Portable flood barrier

Process:

Preventing building be flooded

Value Stream:

Protect properties

Critical To:

All persona houses and public services buildings in NYC

Scope:

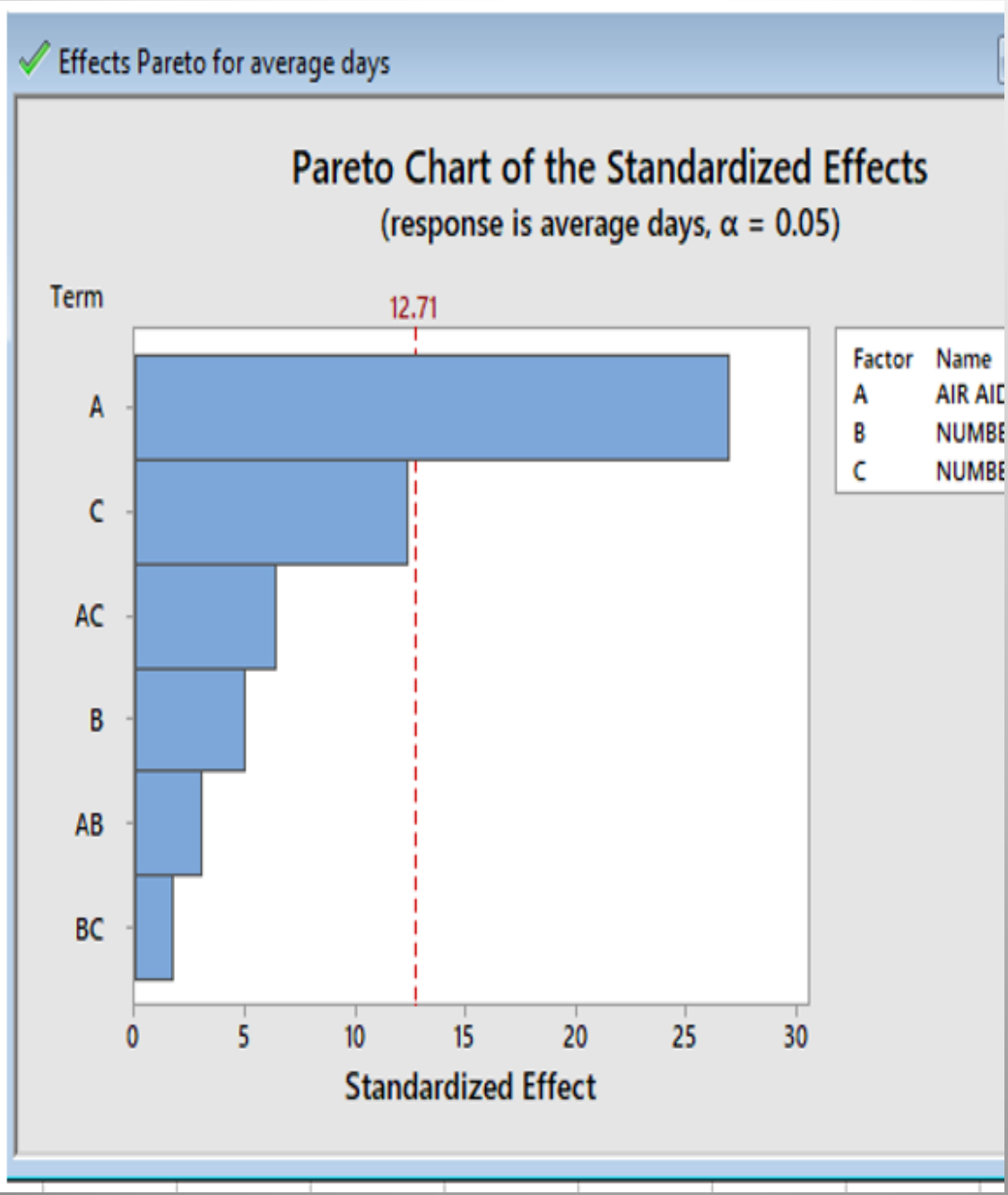
All area suffer from flooding in NYC

Results & Benefits:

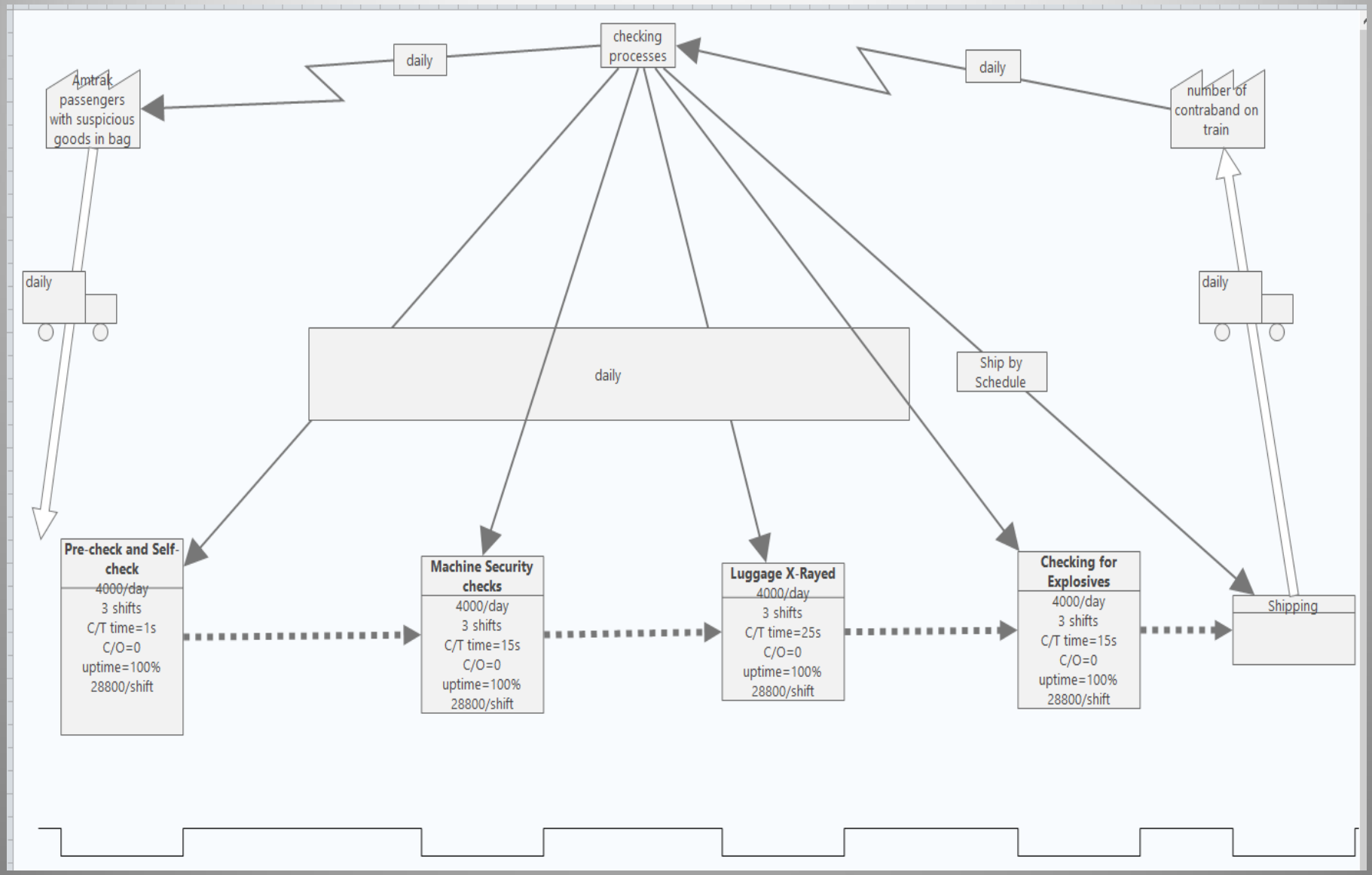
Protect personal and public properties

VOC Summary

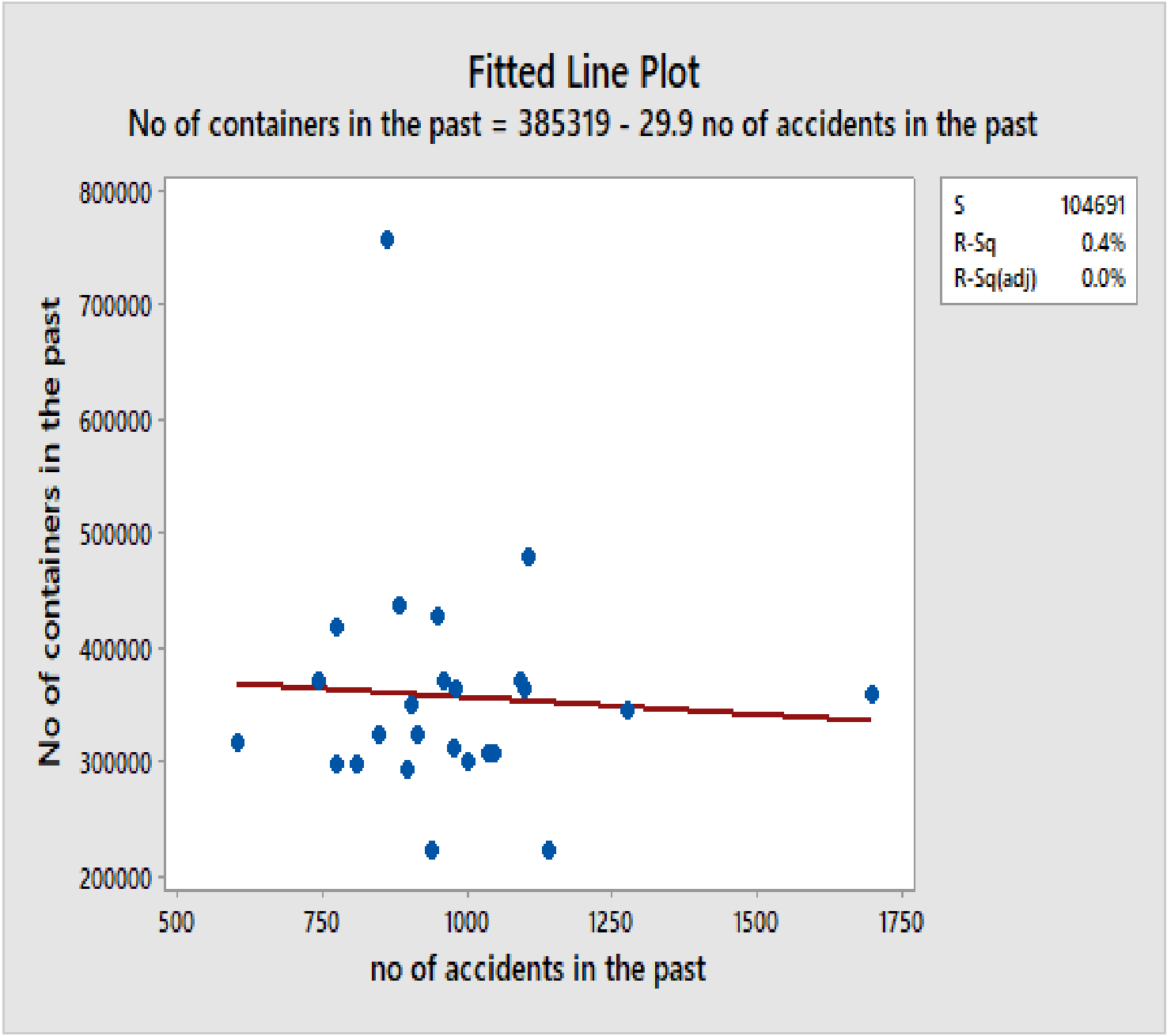
Customer	Voice of Customer	Key Customer Issue(s)	Customer Requirements
Who is the customer?	Actual customer statements or comments.	The real customer concerns, values, or expectations.	What are the specific and measurable customer requirements?
Residents		Absence of information while preparing for the hurricane.	Emergency contact information,nearby hospital information,flood insurance
Residents		Absence of information while preparing for the hurricane.	Location of safe zones nearby,Route guidelines,Traffic notifications
Residents		Insufficient Information regarding the location for occurrence of the hurricane.	News weather updates,regions the hurricane has affected,forecasts
Residents		Absence of information while preparing for the hurricane.	Daily supplies which includes groceries,water supply
Residents		Absence of information while preparing for the hurricane.	Medical supplies,first aid kits


Effects Pareto for average days
Pareto Chart of the Standardized Effects
(response is average days, α = 0.05)
Term
12.71
A
C
AC
B
AB
BC
0
5
10
15
20
25
30
Standardized Effect
Factor Name
A AIR AID
B NUMBE
C NUMBE

Quality-Comp. Value Stream Map



Fitted Line Plot



Gage R&R Study - ANOVA Method

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
PERSON	9	10.1251	1.12501	15.6594	0.000
OPERATOR	2	1.1085	0.55425	7.7148	0.004
PERSON * OPERATOR	18	1.2932	0.07184	1.7416	0.046
Repeatability	90	3.7125	0.04125		
Total	119	16.2392			

Alpha to remove interaction term = 0.25

Gage R&R

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.060958	40.99
Repeatability	0.041250	27.74
Reproducibility	0.019708	13.25
OPERATOR	0.012060	8.11
OPERATOR*PERSON	0.007648	5.14
Part-To-Part	0.087764	59.01
Total Variation	0.148722	100.00

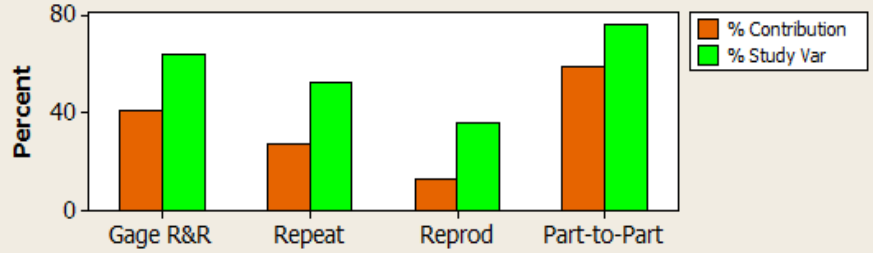
Source	StdDev (SD)	Study Var (6 * SD)	%Study Var (%SV)
Total Gage R&R	0.246897	1.48138	64.02
Repeatability	0.203101	1.21861	52.67
Reproducibility	0.140386	0.84232	36.40
OPERATOR	0.109819	0.65891	28.48
OPERATOR*PERSON	0.087454	0.52472	22.68
Part-To-Part	0.296250	1.77750	76.82
Total Variation	0.385645	2.31387	100.00

Gage R&R (ANOVA) for MEASUREMENT

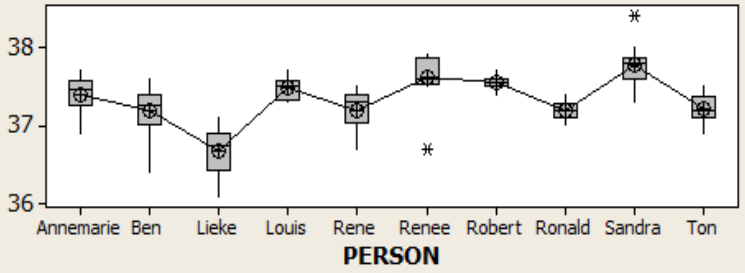
Reported by:
Tolerance:
Misc:

Gage name:
Date of study:

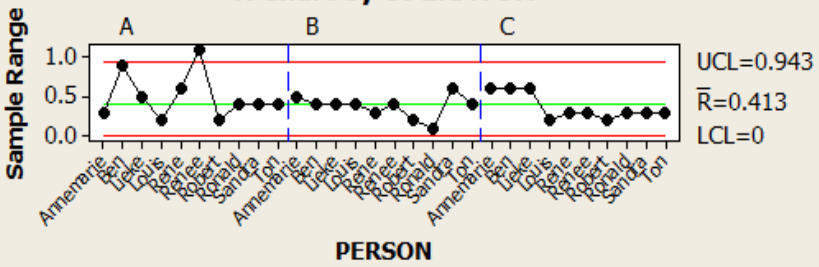
Components of Variation



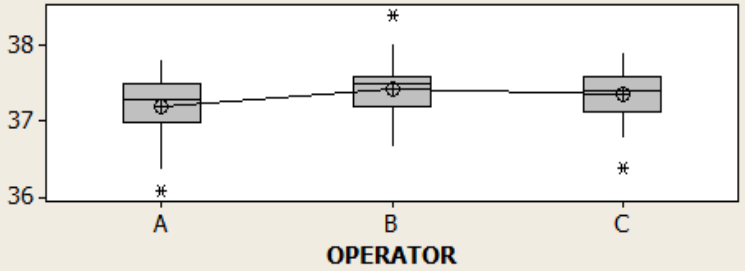
MEASUREMENT by PERSON



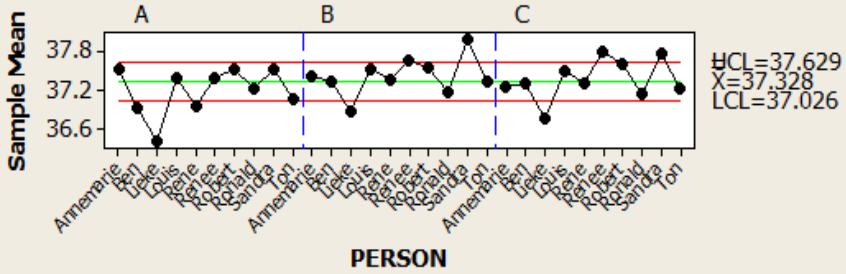
R Chart by OPERATOR



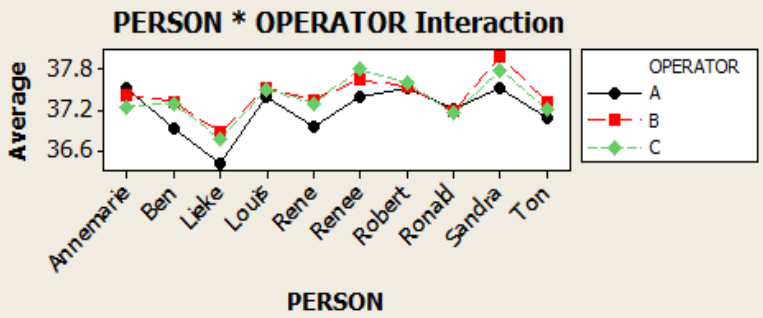
MEASUREMENT by OPERATOR

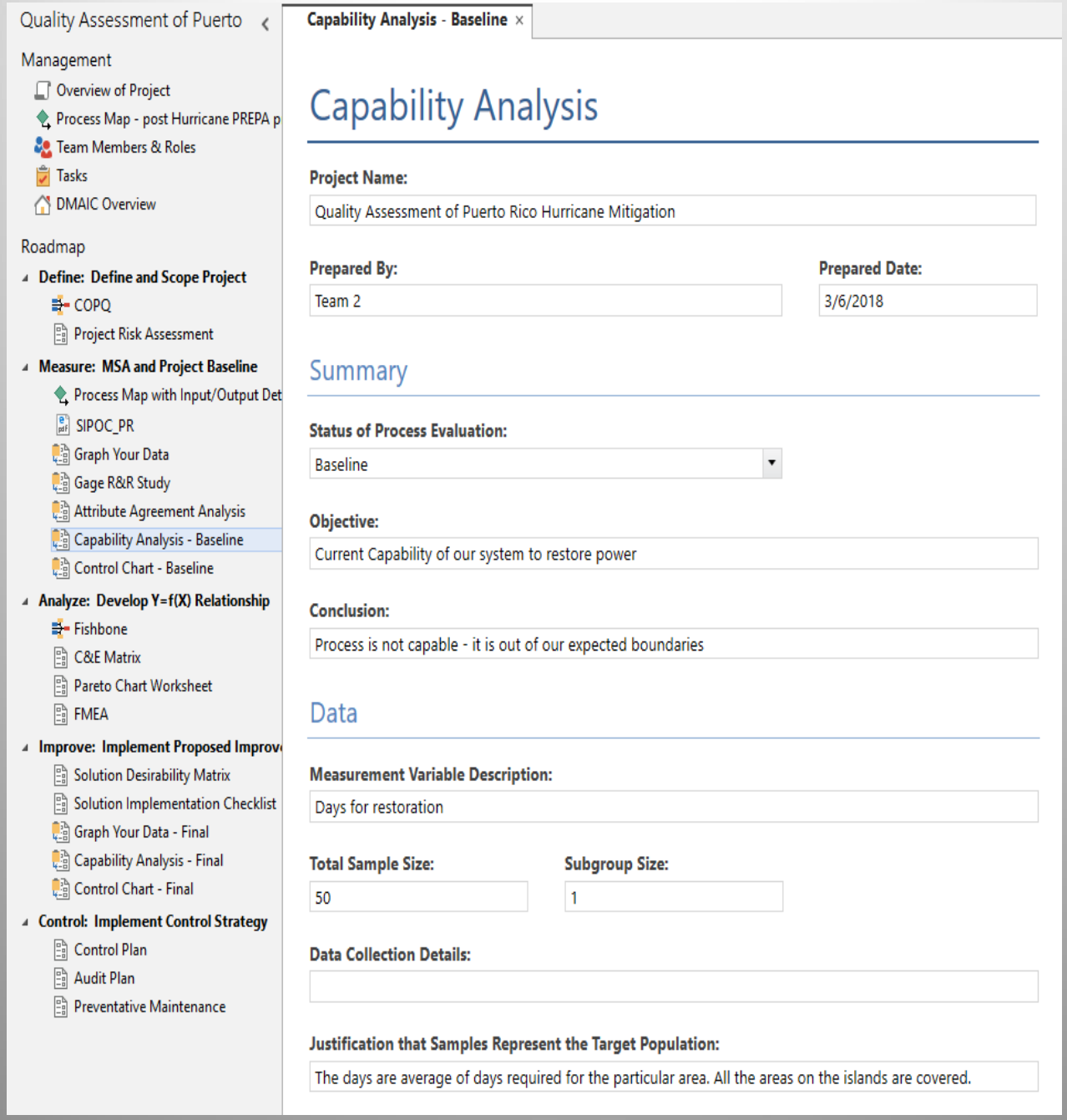


Xbar Chart by OPERATOR



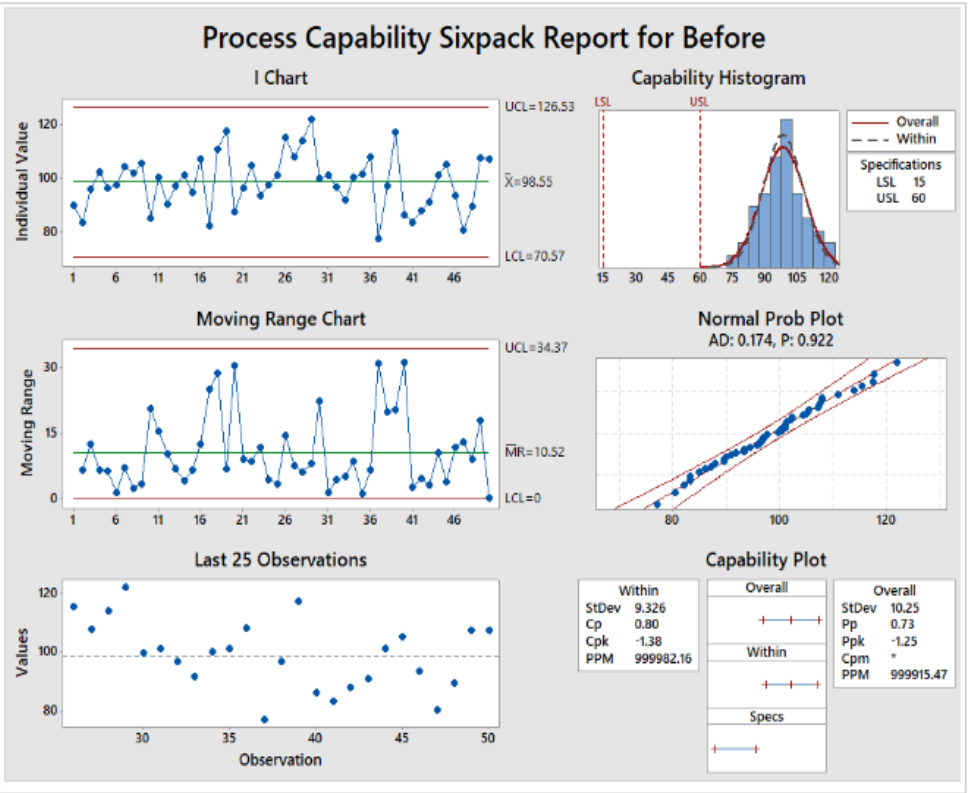
PERSON * OPERATOR Interaction




Quality Assessment of Puerto
Management
Overview of Project
Process Map - post Hurricane PREPA p
Team Members & Roles
Tasks
DMAIC Overview
Roadmap
Define: Define and Scope Project
COPQ
Project Risk Assessment
Measure: MSA and Project Baseline
Process Map with Input/Output Det
SIPOC_PR
Graph Your Data
Gage R&R Study
Attribute Agreement Analysis
Capability Analysis - Baseline
Control Chart - Baseline
Analyze: Develop Y=f(X) Relationship
Fishbone
C&E Matrix
Pareto Chart Worksheet
FMEA
Improve: Implement Proposed Improv
Solution Desirability Matrix
Solution Implementation Checklist
Graph Your Data - Final
Capability Analysis - Final
Control Chart - Final
Control: Implement Control Strategy
Control Plan
Audit Plan
Preventative Maintenance
Capability Analysis - Baseline
Capability Analysis
Project Name:
Quality Assessment of Puerto Rico Hurricane Mitigation
Prepared By:
Team 2
Prepared Date:
3/6/2018
Summary
Status of Process Evaluation:
Baseline
Objective:
Current Capability of our system to restore power
Conclusion:
Process is not capable - it is out of our expected boundaries
Data
Measurement Variable Description:
Days for restoration
Total Sample Size:
50
Subgroup Size:
1
Data Collection Details:
Justification that Samples Represent the Target Population:
The days are average of days required for the particular area. All the areas on the islands are covered.

Capability Analysis - Baseline ×

Graphical Output:



Results

Observations:

Since this is a generated data, we cannot rely on the x-bar chart and moving range chart completely. IF this data was observed during the actual study, our data would be in control and with acceptable process variation.
Our Process is completely outside our limits as it can be seen in capability histogram. The data is normally distributed. The negative cpk value indicates that we need to make a huge shift in our process to be "capable". Our process is not acceptable as the value is less than 1.0 for Cp and Pp.

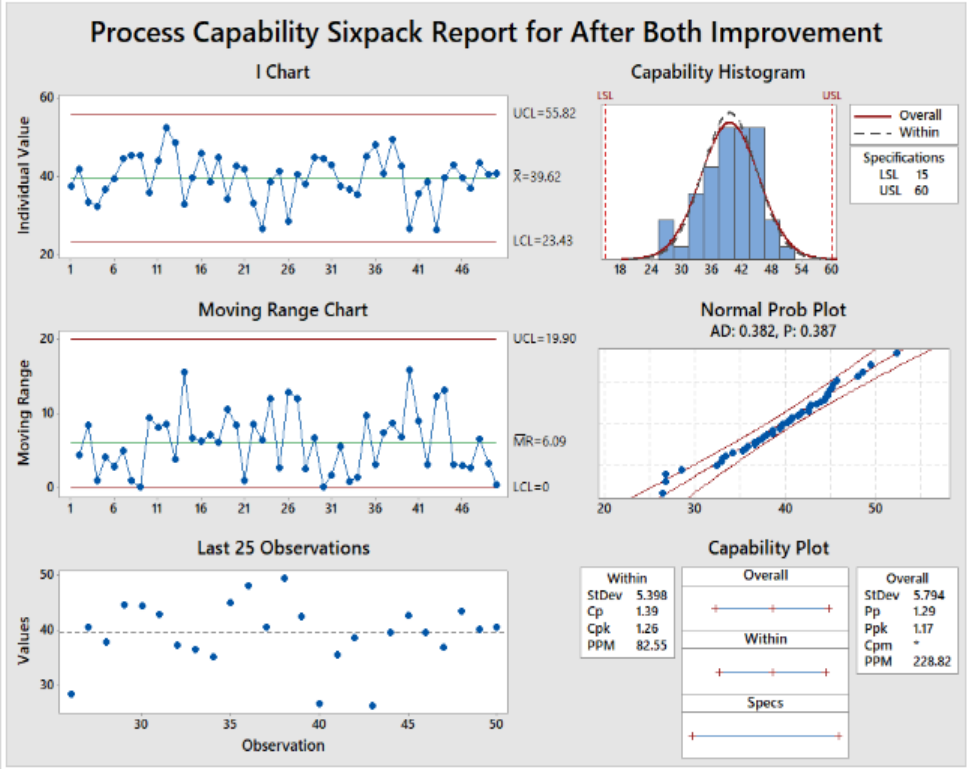
Next Steps:

The process needs improvement

Capability Analysis - Final ×

Analysis Output

Graphical Output:



Results

Observations:

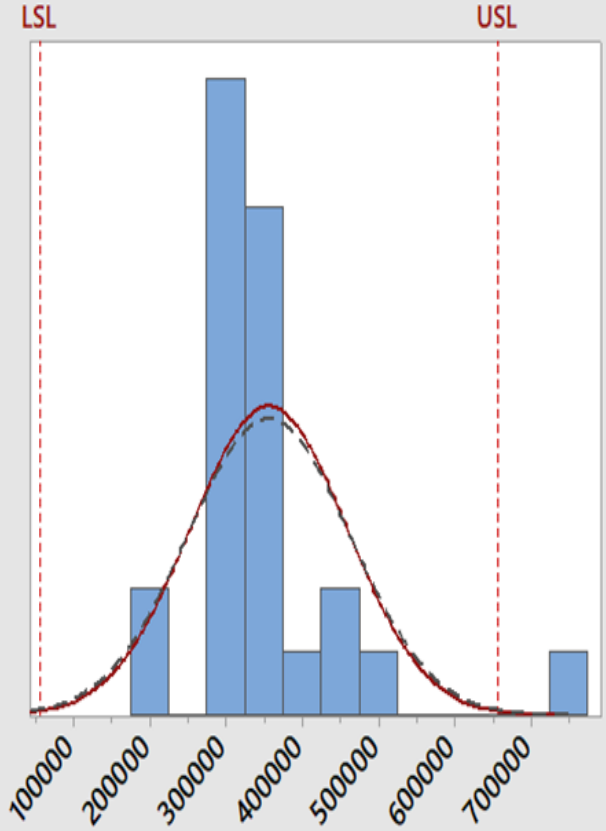
Our process of restoration has been brought down number of days between 15 - 60 days. The data is normal, under control and the process is capable.
Ppk of this process can further be improved by taking on more improvement projects.

Next Steps:

Additional projects to improve current process capability.

Analysis Output: Graphical Output

Process Capability Report for No of containers in the past



Process Data	
LSL	56720
Target	*
USL	655963
Sample Mean #	356341
Sample N	25
StDev(Overall)	102678
StDev(Within)	106995

Overall
Within

Overall Capability	
Pp	0.97
PPL	0.97
PPU	0.97
Ppk	0.97
Cpm	*

Potential (Within) Capability	
Cp	0.93
CPL	0.93
CPU	0.93
Cpk	0.93

Performance

	Observed	Expected Overall	Expected Within
PPM < LSL	0.00	1761.12	2552.61
PPM > USL	40000.00	1761.06	2552.54
PPM Total	40000.00	3522.18	5105.15

 # This estimated historical parameter is used in the calculations.

SUBWAY SYSTEMS OPERATIONS AND TERRRORISM PREVENTION

Measure& Analyze Phase- Project Companion

Process Details

Process:

Subway Systems Operation Improvement and Terrorism Prevention

Typical Process Time:	Typical People Count:	Takt Time:
3474	600	6 sec

Work Element Table

Work Element	Work Element Description	Time	Avg
Prescreening of Passenger		1.0 min	60.0 sec
Preeligibilty Checking& Activity Time		21.5 min	1,290.0 sec
Current Passenger's Activity Time		8.0 min	480.0 sec
Arrival of Train		1.0 min	60.0 sec
Crowd Movement Time		4.0 min	240.0 sec
Waiting Time Till Gate Opens		15.0 min	900.0 sec
In-between Activity Times for Entire P		7.4 min	445.2 sec
	Total:	57.9 min	

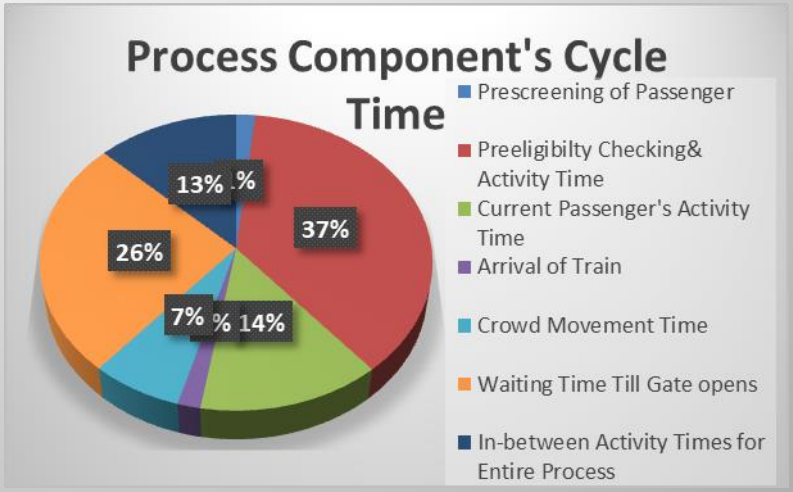
Summary

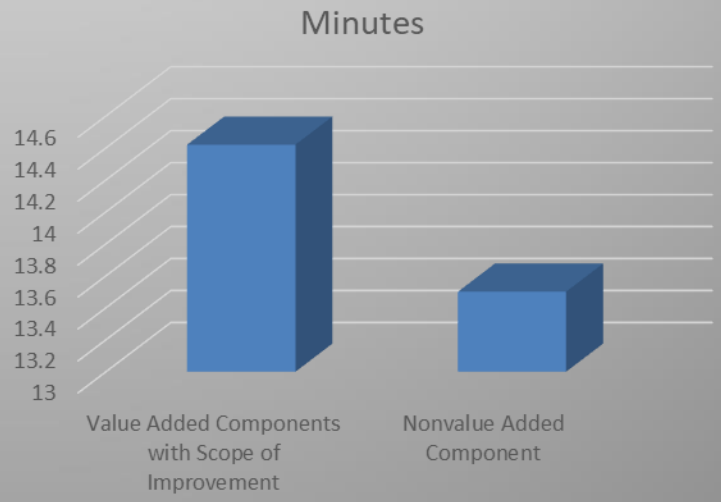
Objective:

To Identify Work Elements of Passengers' Screening and Boarding Process

Conclusion:

Identified all Work Elements of Passengers' Screening and Boarding Process





SUBWAY SYSTEMS OPERATIONS AND TERRRORISM PREVENTION: Improve Phase- Project Companion

Process Details

Process:

Subway Systems Operation Improvement and Terrorism Prevention

Typical Process Time:	Typical People Count:	Takt Time:
2341.2	600	4 sec

Work Element Table

Work Element	Work Element Description	Time	Avg
Prescreening/Baggage Scan of Passenger (I		1.0 min	60.0 sec
Further Inspection Needed		15.0 min	900.0 sec
Waiting Till Gate Opens		15.0 min	900.0 sec
Arrival of Train		1.0 min	60.0 sec
Crowd Movement Time		3.0 min	180.0 sec
In-between Activity Times for Entire Proces		4.0 min	241.2 sec
	Total:	39.0 min	

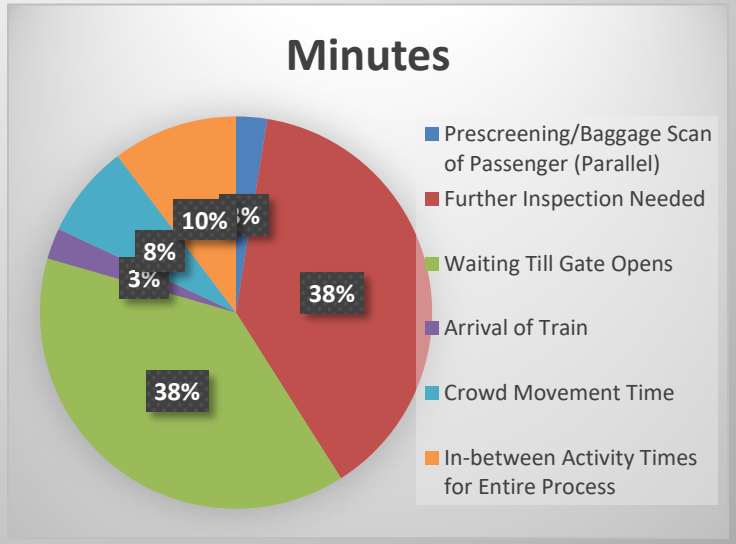
Summary

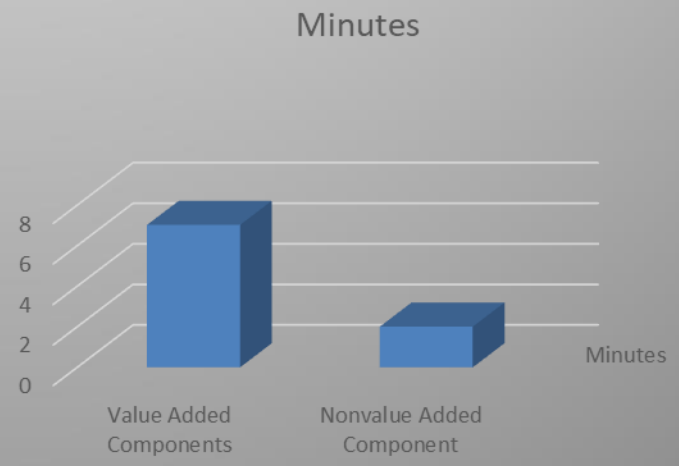
Objective:

To Identify Work Elements of Improved Passengers' Screening and Boarding Process

Conclusion:

Identified all Work Elements of Improved Passengers' Screening and Boarding Process





Design FMEA

Project Name: Sandy Storm Hurricane Project

Prepared By: Xiangyu Luo

Product/Service: Portable flood barrier

Designer: Xiangyu Luo

Part / Design Parameter	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN
Portable Flood Barrier	Barriers leaky	Customer angry	8	Damaged during delivery	5	Strenth the package	10	400
	Missing part	Customer angry	6	Fail to check	6	Offer backup parts	5	180
	Do not reach 1.5m height	Customer angry	3	Installed inproperly	2	Offer detailed Instruction	3	18
		Customer angry	1	Part Corroded	2	Protective paint	1	2

- Barriers Leaky
- Missing Part
- Do not reach 1.5m height

Process FMEA

Project Name: Sandy Storm Hurricane Project

Prepared By: Group 5

Product/Service: Portable flood barrier

Process: Preventing building be flooded

Process Step / Process Parameter	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN
Support system broke	Parts corroded	Being soaked all the time	8	fail to work	5	Protective paint	8	320
Accuracy of machine	Parts doesn't cooperate	Hard to assembly	6	Accuracy of machine is low	5	Quality check	3	90
Consistency of the material	Weak material composition at certain locations	Leakages in the Floating barrier	8	Inefficient Machining	6	Quality Check	6	288

- Support System Broke
- Accuracy of the Machine
- Material
- Consistent

Questions?