Project on Reducing Downtime of assets (LCD Projectors)

Project Lead : Dileep K

Location : Qatar

Vertical : Buildings and Assets

Period : Jan'2020

قطر تستحق الأفضل

Qatar Deserves The Best

Who we are...

Ashghal contributes to achieving the goals of Qatar National Vision 2030 by leading the transformation of Qatar's infrastructure and public buildings so as to develop the nation into one of the most advanced countries in the world in this field.

The authority is managing and coordinating projects worth more than 100 billion Qatari Riyals. Adopting best practices in infrastructure development and management, Ashghal has employed a powerful model of strategic outsourcing and partnership with world leading project management organizations to ensure Qatar's infrastructure is on par with the most developed nations worldwide.

Ashghal is currently working on a wide range of infrastructure programmers across the country, including: the Expressway Programme which will deliver some of the largest expressways in Qatar, and the Local Roads & Drainage Programme which will deliver many roads and integrated infrastructure projects in local areas. Ashghal is also cooperating with working relevant Qatari authorities on significant building projects that include healthcare, educational, and general sector projects.

Within Ashghal, the Asset Affairs directorate manages the operations and maintenance of all roads and drainage systems, which includes over 1.2 million unique assets. The effective execution of both planned and corrective maintenance is critical to Ashghal's mission to provide a customer centric service to all citizens and residents of Qatar.

Our portfolio

Why do we need to do this project

One of our milestone projects was modernization of 24 schools in the region of Duhali which include (Replacement of false ceilings, replacement of water coolers, addition of fire alarm system, addition of emergency stairs and converting class rooms in to smart class rooms by installing LCD projectors in all the classrooms). This project started on June 2010 and successfully completed on December 2011.

All these assets in these 24 schools are managed by Ashghal asset and equipment management team through our third part contract team from 2011 till 2018, From 2018 our internal engineering team has taken over the management of these assets.

For the first half of 2019 we had repeated down time of issues particularly with LCD projectors and this was reported during our monthly review meetings and also this has impacted some of the major events and incurred additional cost

VOW – Voice of Customer	Name	Artifacts
"Hope we have necessary preventive action in place to avoid failures of LCD projectors….	Director Primary schools department	**Email removed in external PPT**
Primary concern in June 2019 Monthly review meeting: 1) LCD projectors are not functioning properly 4) When issue is reported it is not fixed on time	Project governance panel	**Project governance panel – Slides removed in external PPT**

VOP – Voice of Process	Report	Artifacts
Average down time of 272 LCD projects installed across 24 schools in Duhali region for the period of March 2019 to August 2019 is at 18.06% as per the asset down time report	Asset Down time report	**Excel report removed in external PPT**

Project Charter , Project Goal and Team

Business case

Ashghal asset management team is managing 272 LCD projectors installed across 24 schools in Duhali region, as per the assets management SLA agreement contract we are required to maintain asset down time of less than 10% how ever the actual down time is at 18.4% which lead to customer dissatisfaction and this would lead to a service penalty of xxxxx Qatari riyal

Statement of Opportunity

There stands an opportunity to reduce the LCD projector down time to meet SLA requirements, improve customer satisfaction and avoid service penalty.

Project Goal

To reduce LCD projector down time from 18.06% to 10% before December 2019

Scope

In scope	272 LCD Projectors installed in 24 schools in Duhali region
Out of scope	All other assets in Duhali region and projects in other regions

Time Lines

Phase	Define	Measure	Analyze	Improve	Control
Plan	Aug'19	Sep'19	Oct'19	Oct'19	Dec'19
actual	Aug'19	Sep'19	Oct'19	Nov'19	Dec'19

Project Potential benefits

Operational Benefit :

•Customer satisfaction

•Reduction of Escalation effort

Financial Benefit :

Avoiding service penalty of xxxxx Qatari riyal

Project team

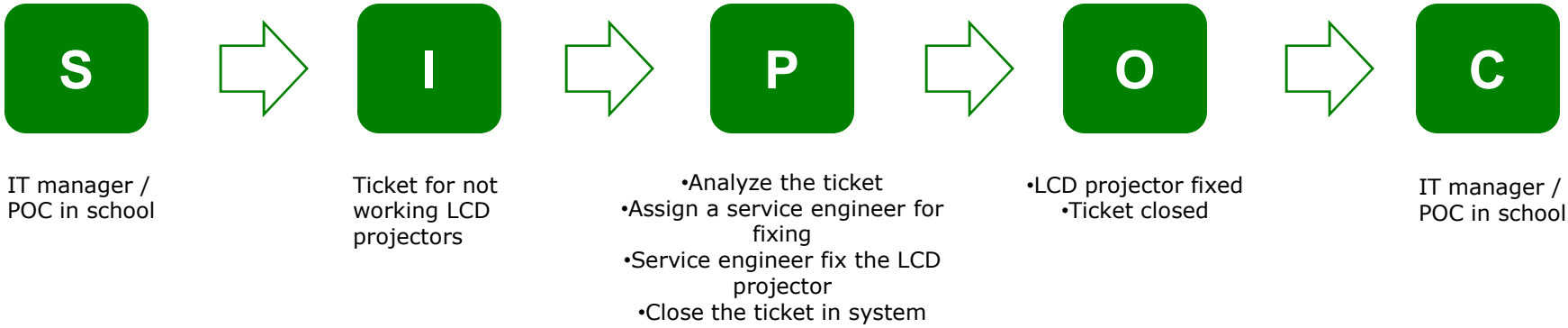
	Project Lead (BB)
	Dileep K Manager – Asset management
Project Team	Asset management team
Customer	Primary school department
Project Sponsor	Ashghal governance committee
Project Champion	Raquibul Alam
Quality Coach (MBB)	Zahidul Mahin
Yellow belt	Jayabalan

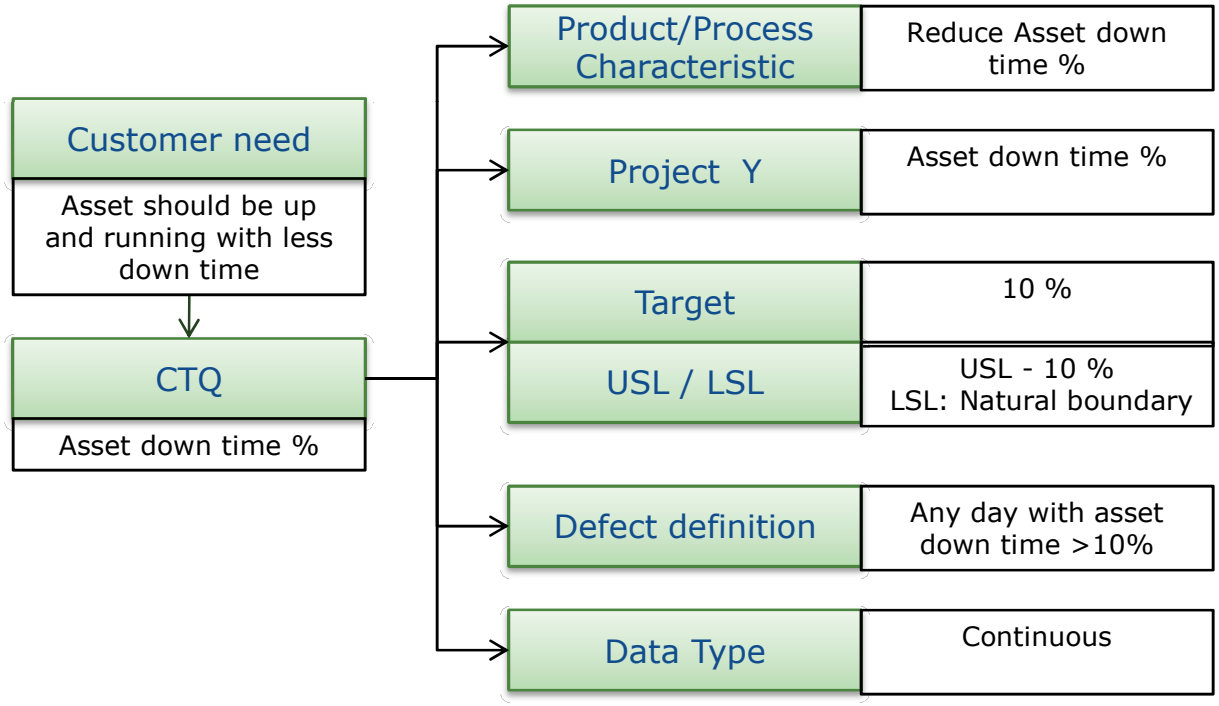
Operational Definitions

Project Y	Asset down time % =1-(total assets down time /(272*24hrs))
Defect	Any day with asset down time greater than 10%
Opportunity	272 LCDs daily

Note : Financial values masked in external PPT

SIPOC, SPO & CTQ



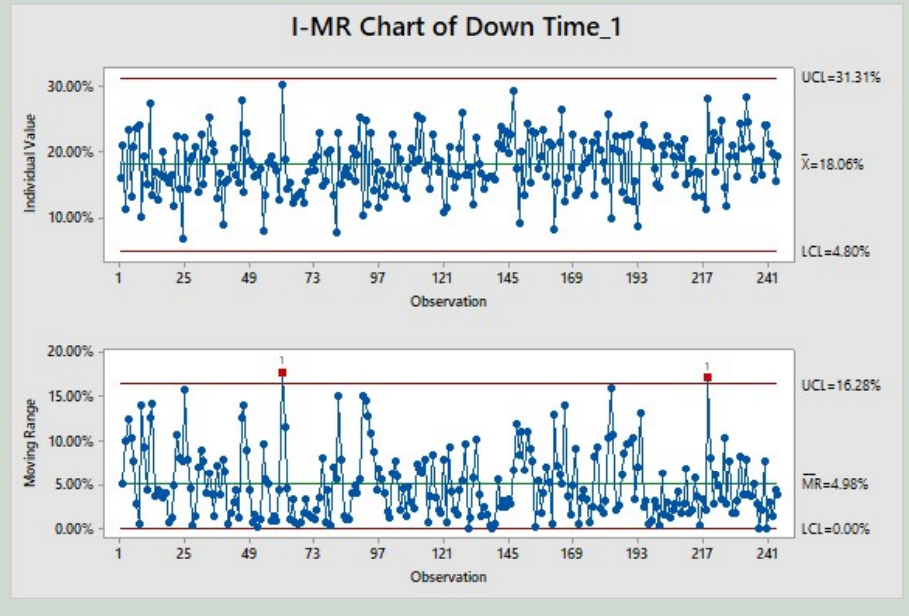


Detailed process flow and Standard operating procedure SOP

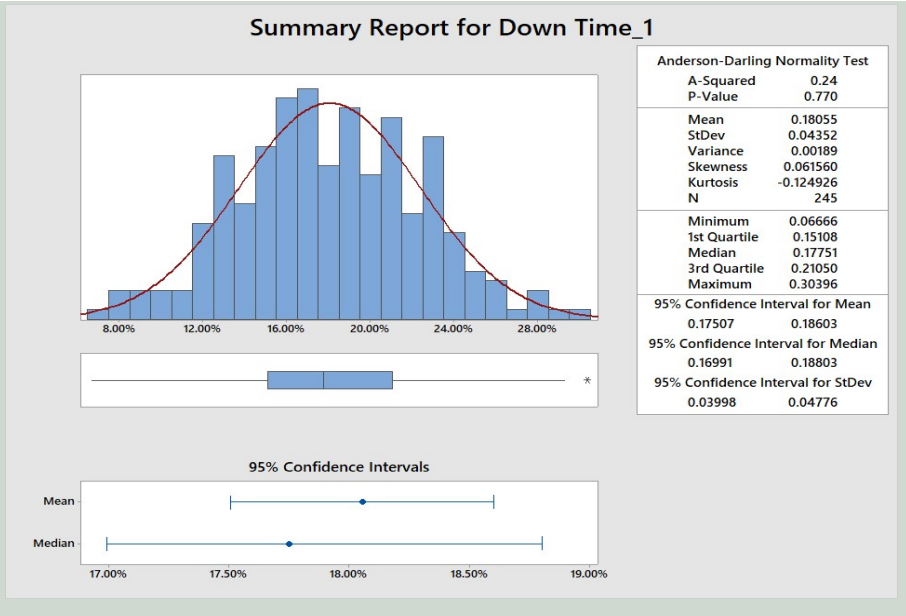
SOP word document is removed in external PPT

Base line study

IMR Chart for stability test



Graphical Summary for normality and Descriptive statistics



Takeaway :

Data type	Distribution	Special cause	Central tendency	Dispersion	Target
Continuous	P- Value – 0.77	No	Mean : 18.055%	Stdev : 4.35%	Mean : ≤10%
	Normal		Median : 17.77	Min: 6.66%	Stdev : ≤4.35%
				Max: 30.39%	
				Q1: 15.10%	
				Q3: 21.05%	

Target as per SLA agreement

Baseline mean from past data

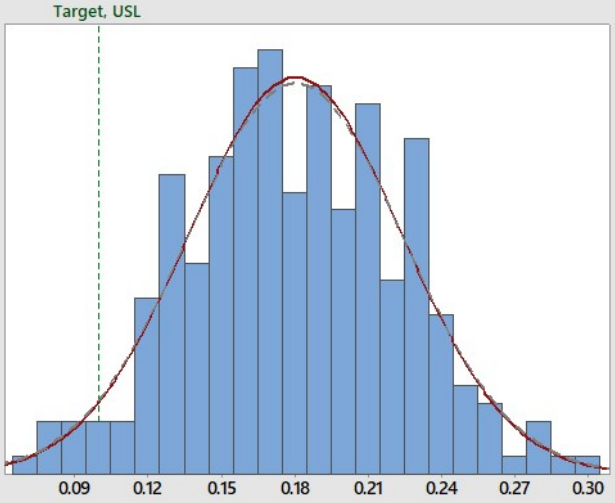
Note : Project Y metric is taken from system down time report circulated by MIS team based on time stamp data hence MSA was not performed

Process capability study

Continuous data process capability study

Capability Analysis for Down Time_1
Process Performance Report

Capability Histogram
Are the data below the limit and close to the target?



Actual (overall) capability is what the customer experiences.

Potential (within) capability is what could be achieved if process shifts and drifts were eliminated.

Process Characterization

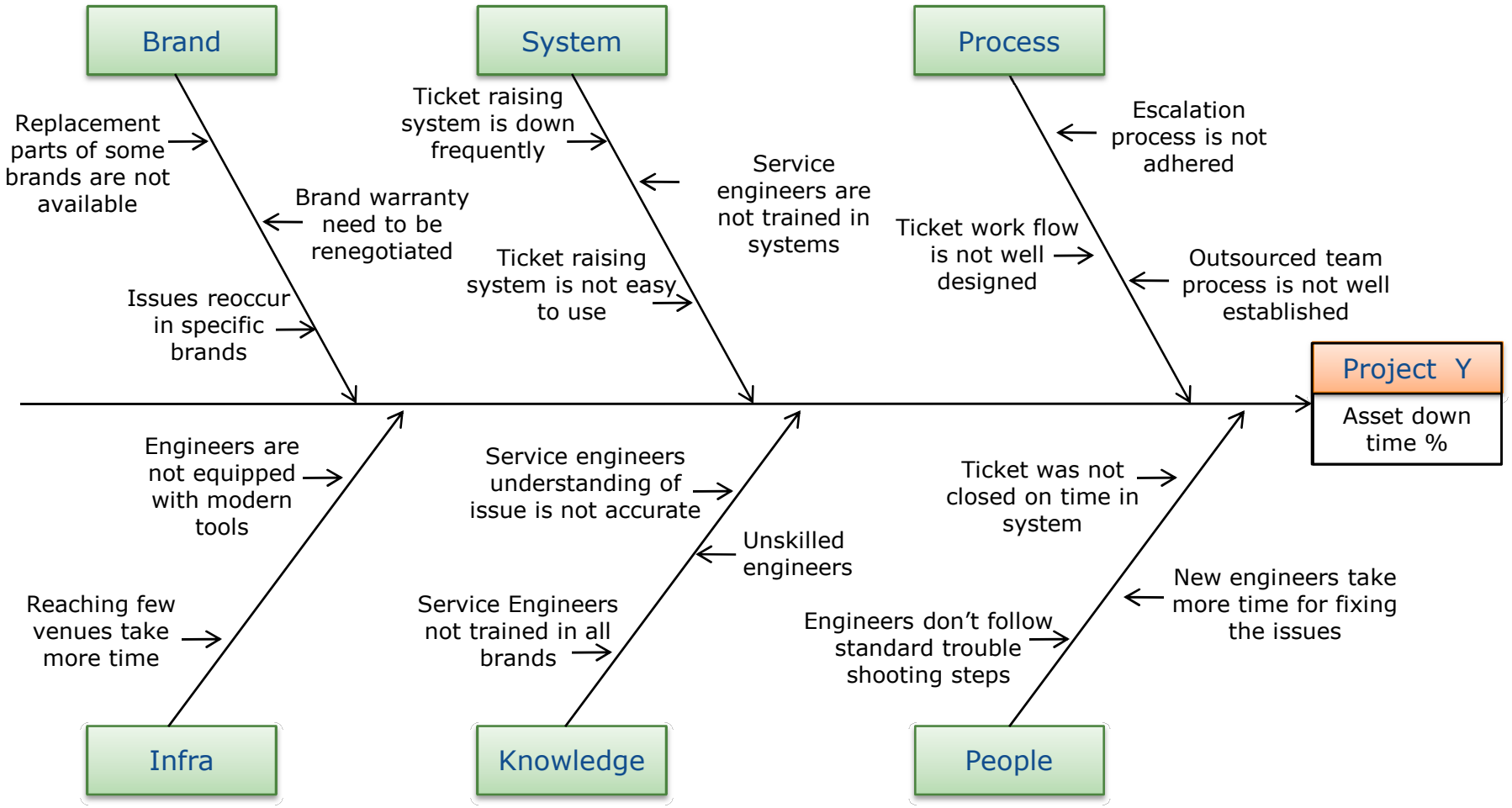
Total N	245
Subgroup size	1
Mean	0.18055
Standard deviation (overall)	0.043522
Standard deviation (within)	0.044175

Capability Statistics

Actual (overall)	
Pp	*
Ppk	-0.62
Z.Bench	-1.85
% Out of spec (observed)	96.73
% Out of spec (expected)	96.79
PPM (DPMO) (observed)	967347
PPM (DPMO) (expected)	967899
Potential (within)	
Cp	*
Cpk	-0.61
Z.Bench	-1.82
% Out of spec (expected)	96.59
PPM (DPMO) (expected)	965882

Z-Bench	
Short Term	Long Term
-0.35	-1.85

Potential causes



Data collection plan

Sl no	Potential Cause	Source	Data Type	Frequency	Owner	Review
1	Region of school from which issue was raised	Ticket life cycle report	Discrete	On All tickets	MIS team	Project lead
2	Brand of LCD		Discrete			
3	Skill level of engineers		Discrete			
4	Travel time to reach the school in which issues was raised	Engineers movement tracker	Continuous			
5	Tenure of engineers	Ticket life cycle report	Discrete			
6	Nature of breakdown		Discrete			

Cause validation

X1 : Region of school from which issue was raised

Distribution : Normal

Summary Report for D- Central

Anderson-Darling Normality Test	
A-Squared	0.21
P-Value	0.846
Mean	0.17982
StDev	0.04693
Variance	0.00220
Skewness	-0.048377
Kurtosis	-0.522772
N	98
Minimum	0.06666
1st Quartile	0.14344
Median	0.18016
3rd Quartile	0.21483
Maximum	0.28182
95% Confidence Interval for Mean	
0.17041	0.18923
95% Confidence Interval for Median	
0.16769	0.19462
95% Confidence Interval for StDev	
0.04115	0.05461

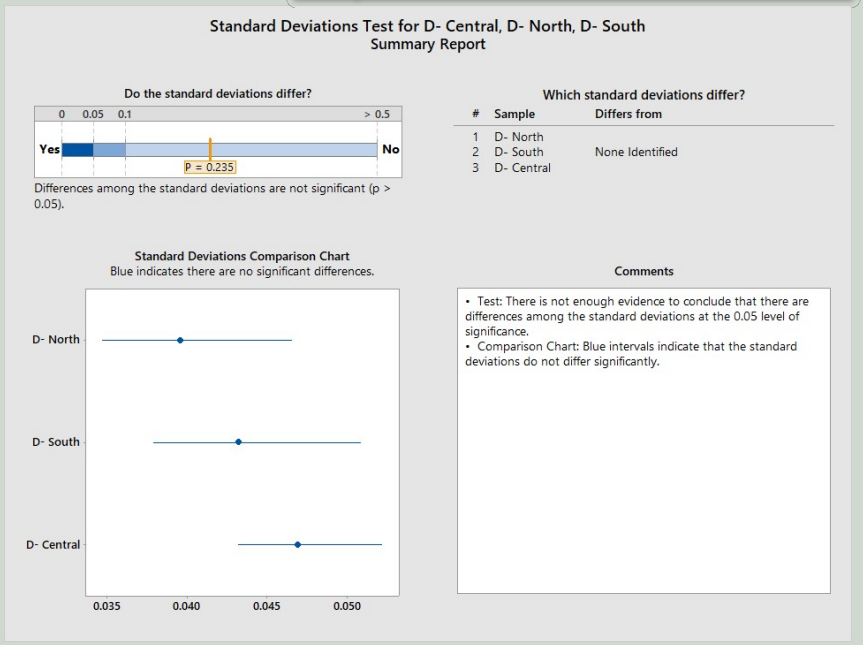
Summary Report for D- South

Anderson-Darling Normality Test	
A-Squared	0.31
P-Value	0.543
Mean	0.18109
StDev	0.04321
Variance	0.00187
Skewness	-0.111751
Kurtosis	0.249986
N	72
Minimum	0.07765
1st Quartile	0.15480
Median	0.18628
3rd Quartile	0.21331
Maximum	0.29318
95% Confidence Interval for Mean	
0.17094	0.19125
95% Confidence Interval for Median	
0.16645	0.19348
95% Confidence Interval for StDev	
0.03712	0.05170

Summary Report for D- North

Anderson-Darling Normality Test	
A-Squared	0.62
P-Value	0.102
Mean	0.18098
StDev	0.03958
Variance	0.00157
Skewness	0.543582
Kurtosis	0.314240
N	75
Minimum	0.09217
1st Quartile	0.15379
Median	0.17435
3rd Quartile	0.20810
Maximum	0.30396
95% Confidence Interval for Mean	
0.17187	0.19009
95% Confidence Interval for Median	
0.16421	0.18926
95% Confidence Interval for StDev	
0.03410	0.04716

Equal Variation : P Value 0.235



Takeaway :

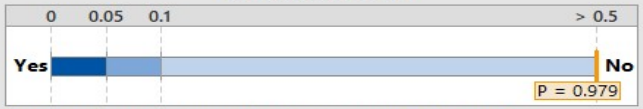
- There are three regions in Duhali namely Central, North, South
- All three data sets are following normal distribution
- All three data sets have same standard distribution

Cause validation

X1 : Region of school from which issue was raised

One-Way ANOVA for D- Central, D- North, D- South
Summary Report

Do the means differ?

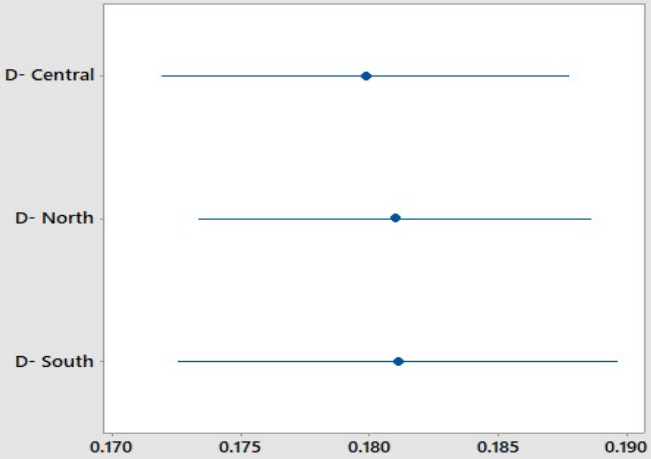


Differences among the means are not significant (p > 0.05).

Which means differ?

#	Sample	Differs from
1	D- Central	
2	D- North	None Identified
3	D- South	

Means Comparison Chart
Blue indicates there are no significant differences.



Comments

- Test: There is not enough evidence to conclude that there are differences among the means at the 0.05 level of significance.
- Comparison Chart: Blue intervals indicate that the means do not differ significantly.

Null Hypothesis

Average asset down time % is same for all three regions

Alternate Hypothesis

Average asset down time % is different for all three regions

P-Value

P Value – 0.979

Takeaway :

- P-value is grater than 0.05 hence we reject alternate hypothesis and go with null hypothesis

Cause validation

X2 : Brand of LCD projector

Distribution : Normal

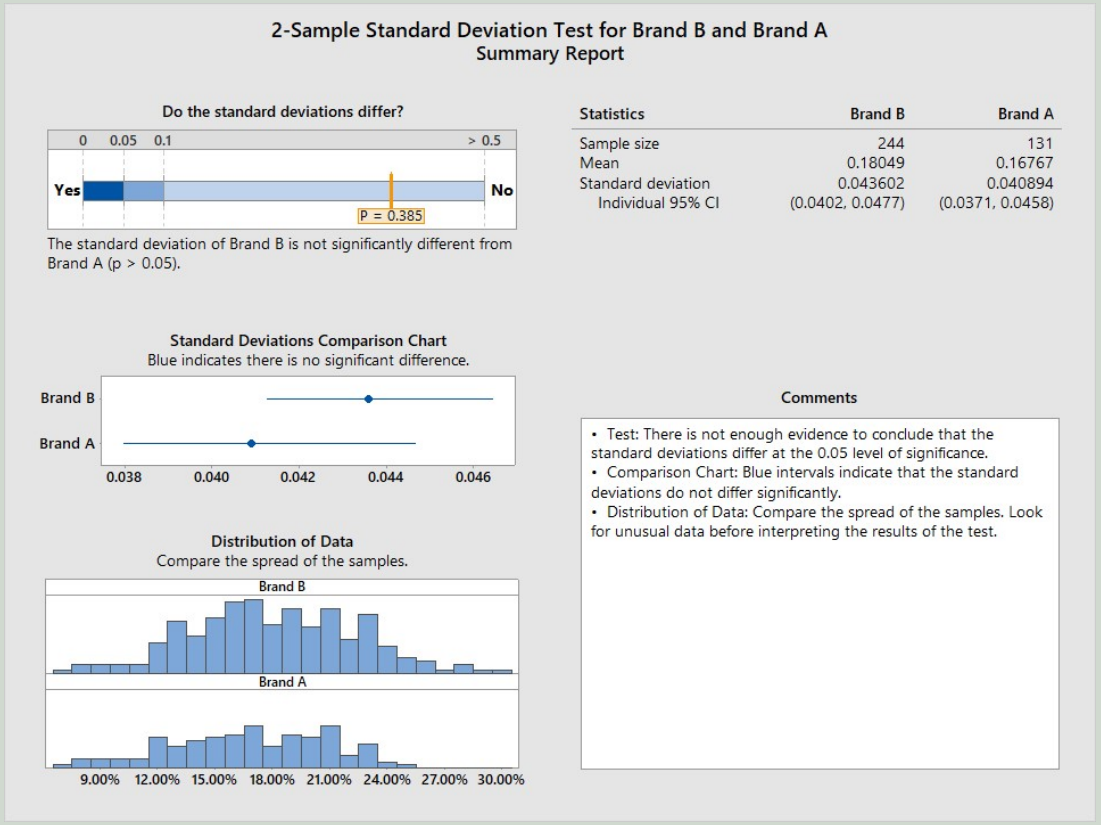
Equal Variation : P Value 0.385

Brand B

Anderson-Darling Normality Test	
A-Squared	0.26
P-Value	0.715
Mean	0.18049
StDev	0.04360
Variance	0.00190
Skewness	0.065360
Kurtosis	-0.133898
N	244
Minimum	0.06666
1st Quartile	0.15090
Median	0.17713
3rd Quartile	0.21058
Maximum	0.30396
95% Confidence Interval for Mean	
0.17499	0.18599
95% Confidence Interval for Median	
0.16978	0.18776
95% Confidence Interval for StDev	
0.04005	0.04786

Brand A

Anderson-Darling Normality Test	
A-Squared	0.52
P-Value	0.181
Mean	0.16767
StDev	0.04089
Variance	0.00167
Skewness	-0.272825
Kurtosis	-0.566590
N	131
Minimum	0.06666
1st Quartile	0.14039
Median	0.16720
3rd Quartile	0.20087
Maximum	0.24933
95% Confidence Interval for Mean	
0.16060	0.17474
95% Confidence Interval for Median	
0.16140	0.17580
95% Confidence Interval for StDev	
0.03647	0.04655



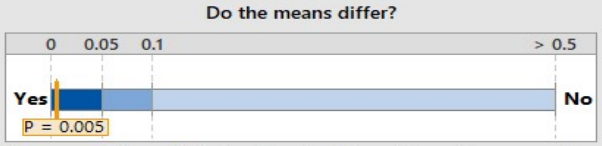
Takeaway :

- There are Two brands of LCD projectors in use **(Brand Names are masked in external PPT)**
- Both data sets are following normal distribution
- Both data sets have same standard distribution

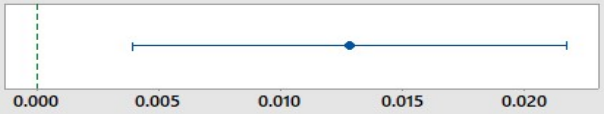
Cause validation

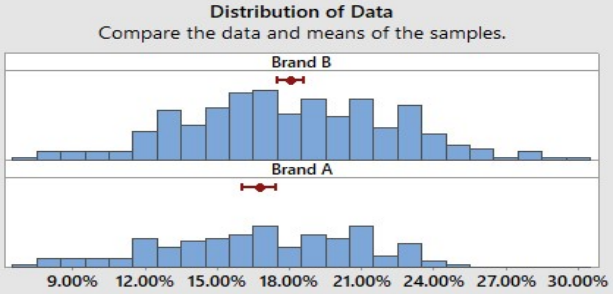
X2 : Brand of LCD projector

2-Sample t Test for the Mean of Brand B and Brand A
Summary Report



The mean of Brand B is significantly different from the mean of Brand A ($p < 0.05$).





Individual Samples

Statistics	Brand B	Brand A
Sample size	244	131
Mean	0.18049	0.16767
95% CI	(0.1750, 0.1860)	(0.16060, 0.17474)
Standard deviation	0.043602	0.040894

Difference Between Samples

Statistics	*Difference
Difference	0.012824
95% CI	(0.0038986, 0.021749)

*Difference = Brand B - Brand A

Comments

- Test: You can conclude that the means differ at the 0.05 level of significance.
- CI: Quantifies the uncertainty associated with estimating the difference in means from sample data. You can be 95% confident that the true difference is between 0.0038986 and 0.021749.
- Distribution of Data: Compare the location and means of samples. Look for unusual data before interpreting the results of the test.

Null Hypothesis

Average asset down time % is same for both the brands

Alternate Hypothesis

Average asset down time % is different for both the brands

P-Value

P Value – 0.005

Takeaway :

- P-value is Less than 0.05 hence we reject Null hypothesis and go with Alternate hypothesis
- Brand B have higher average asset down time is greater than Brand A

Cause validation

X3 : Skill level of service engineers

Distribution : Normal

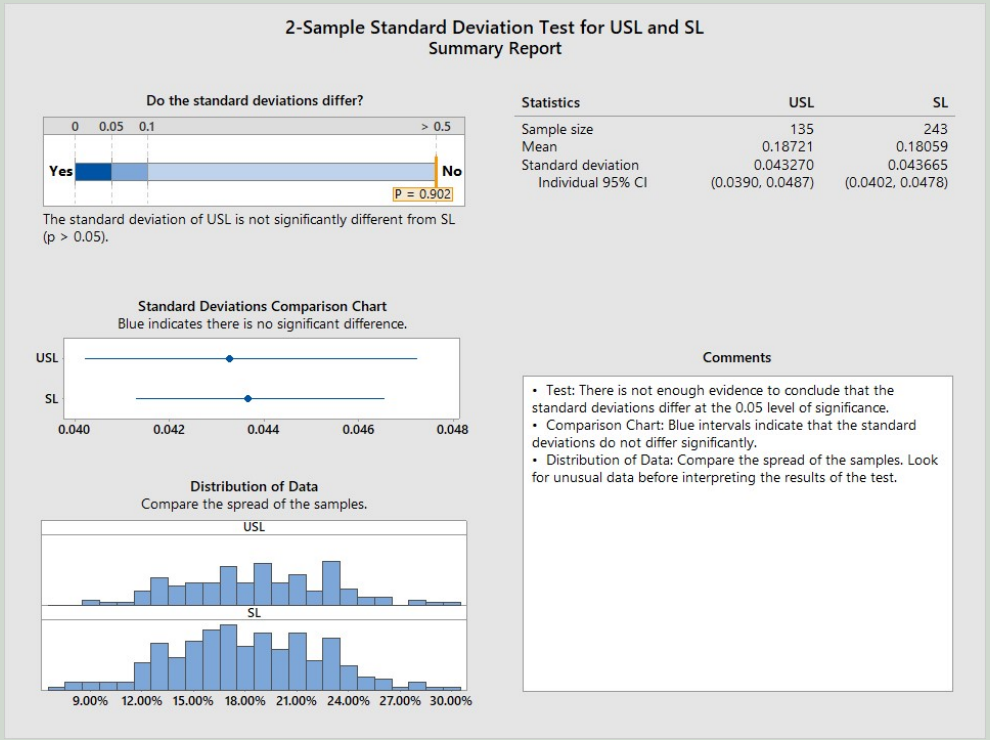
Equal Variation : P Value 0.902

Report for SL

Anderson-Darling Normality Test	
A-Squared	0.24
P-Value	0.762
Mean	0.18059
StDev	0.04366
Variance	0.00191
Skewness	0.059167
Kurtosis	-0.139326
N	243
Minimum	0.06666
1st Quartile	0.15073
Median	0.17751
3rd Quartile	0.21067
Maximum	0.30396
95% Confidence Interval for Mean	
0.17507	0.18611
95% Confidence Interval for Median	
0.16993	0.18798
95% Confidence Interval for StDev	
0.04010	0.04793

Report for USL

Anderson-Darling Normality Te	
A-Squared	0.34
P-Value	0.498
Mean	0.18721
StDev	0.04327
Variance	0.00187
Skewness	0.133644
Kurtosis	-0.355327
N	135
Minimum	0.08884
1st Quartile	0.15433
Median	0.18764
3rd Quartile	0.22355
Maximum	0.30396
95% Confidence Interval for Me	
0.17985	0.19458
95% Confidence Interval for Mec	



Takeaway :

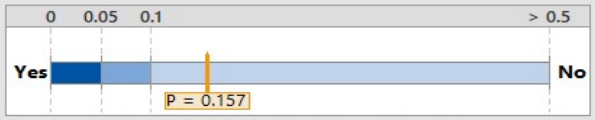
- Service engineers skill level are broadly classified as USL – Unskilled labors , SL Skilled Labors
- Both data sets are following normal distribution
- Both data sets have same standard distribution

Cause validation

X3 : Skill level of service engineers

2-Sample t Test for the Mean of SL and USL
Summary Report

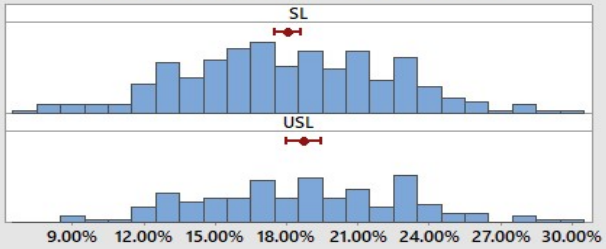
Do the means differ?



The mean of SL is not significantly different from the mean of USL (p > 0.05).

95% CI for the Difference
Is the entire interval above or below zero?

Distribution of Data
Compare the data and means of the samples.



Individual Samples

Statistics	SL	USL
Sample size	243	135
Mean	0.18059	0.18721
95% CI	(0.1751, 0.1861)	(0.17985, 0.19458)
Standard deviation	0.043665	0.043270

Difference Between Samples

Statistics	*Difference
Difference	-0.0066202
95% CI	(-0.015793, 0.0025529)

*Difference = SL - USL

Comments

- Test: There is not enough evidence to conclude that the means differ at the 0.05 level of significance.
- CI: Quantifies the uncertainty associated with estimating the difference in means from sample data. You can be 95% confident that the true difference is between -0.015793 and 0.0025529.
- Distribution of Data: Compare the location and means of samples. Look for unusual data before interpreting the results of the test.

Null Hypothesis

Average asset down time % is same for Skilled and unskilled service engineers

Alternate Hypothesis

Average asset down time % is Different for Skilled and unskilled service engineers

P-Value

P Value – 0.157

Takeaway :

- P-value is Greater than 0.05 hence we reject alternate hypothesis and go with Null hypothesis
- Skill level of service engineers do not impact the asset down time

Cause validation

X6 : Nature of breakdown

Distribution : Normal

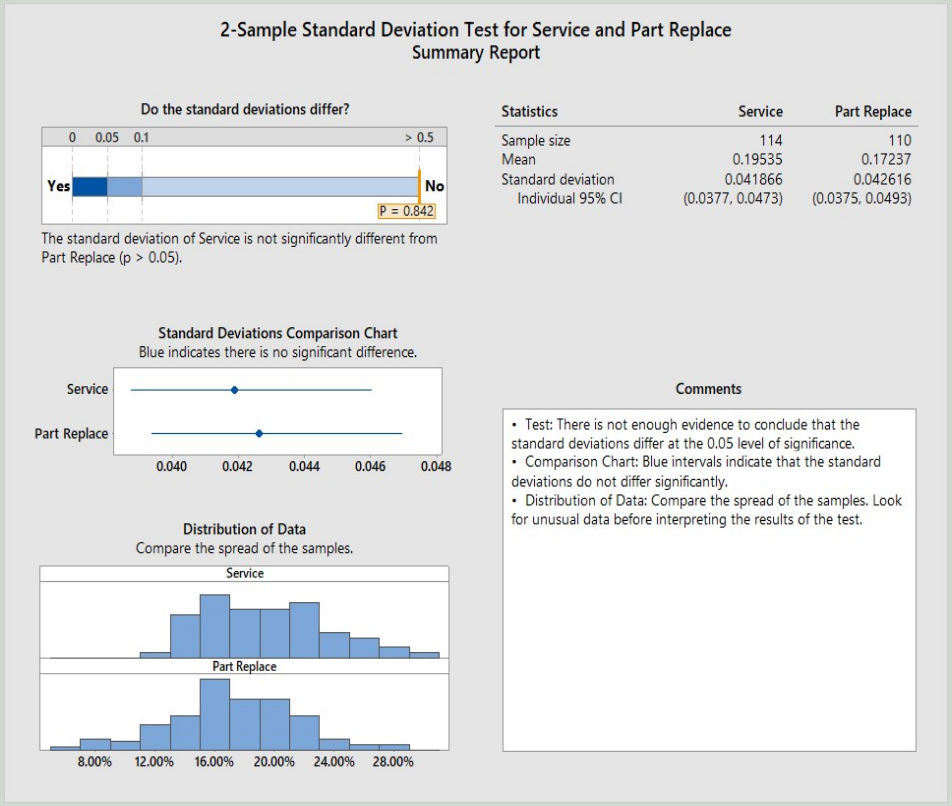
Equal Variation : P Value 0.842

Report for Service

Anderson-Darling Normality Test	
A-Squared	0.80
P-Value	0.036
Mean	0.19535
StDev	0.04187
Variance	0.00175
Skewness	0.384559
Kurtosis	-0.578572
N	114
Minimum	0.12848
1st Quartile	0.16246
Median	0.19179
3rd Quartile	0.22627
Maximum	0.30396
95% Confidence Interval for Mean	
0.18758	0.20312
95% Confidence Interval for Median	
0.18027	0.20427
95% Confidence Interval for StDev	
0.03705	0.04814

Report for Part Replacement

Anderson-Darling Normality Test	
A-Squared	0.23
P-Value	0.814
Mean	0.17237
StDev	0.04262
Variance	0.00182
Skewness	-0.0409762
Kurtosis	0.0691579
N	110
Minimum	0.06666
1st Quartile	0.14900
Median	0.17036
3rd Quartile	0.20334
Maximum	0.28318
95% Confidence Interval for Mean	
0.16432	0.18043
95% Confidence Interval for Median	
0.16264	0.18082
95% Confidence Interval for StDev	
0.03763	0.04913



Takeaway :

- Nature of breakdown are classified as “Part replacement” and “Service”
- Breakdown date set follow normal distribution , how ever Service data follow non normal distribution
- Both data sets have same standard distribution

Cause validation

X6 : Nature of break down

Mann-Whitney Test and CI: Part Replacement, Service

	N	Median
Part Replacement	110	0.17036
Service	114	0.19179

Point estimate for η1 - η2 is -0.02074
95.0 Percent CI for η1 - η2 is (-0.03282,-0.00944)
W = 10651.5
Test of η1 = η2 vs η1 ≠ η2 is significant at 0.0004
The test is significant at 0.0004 (adjusted for ties)

Null Hypothesis
Average asset down time % is same for service data set and part replacement data set
Alternate Hypothesis
Average asset down time % is different for service data set and part replacement data set
P-Value
P Value – 0.0004

Takeaway :

- P-value is less than 0.05 hence we reject null hypothesis and go with alternate hypothesis
- Nature of service impact the asset down time part replacement have higher asset down time %

Analyze phase summary

Vital X Impacting asset down time %
X2 Brand of LCD projector - Brand B have higher average asset down time is greater than Brand A
X6 : Nature of breakdown - Nature of service impact the asset down time part replacement have higher asset down time %

Other Logical Xs that will impact asset down time %
Ticket system need to be updated with business rules and workflow
Service engineers need to be equipped with state of the art equipments
Parts - procurement policy need to be changed to assist faster availability of parts
Parts - replacement agreement with brands need to be standardized with both the brands

Improve phase solution summary

"To be" process flow and Standard operating procedure SOP		
SOP word document is removed in external PPT	Latest SOP is updated with SLA agreement and agreed with all stake holders	Dileep K
Ticket raising platform is revamped with version 2 portal		
Ticket portal screenshot is removed in external PPT	It team developed version 2 ticket portal and released on November 2029	Ashghal IT team
Parts replacement agreement modified with vendors		
Commercial agreement is removed in the external PPT	Procurement team negotiated with the LCD brands for the part replacement agreement	Ashghal Procurement team
Equipments and tools need to be modernized		
	Procurement team and engineering team bought latest tools and equipments for service team	Ashghal Procurement team & Dileep K

Note : Process FMEA for to be process is removed from external PPT

What did we achieve

Before after process capability analysis

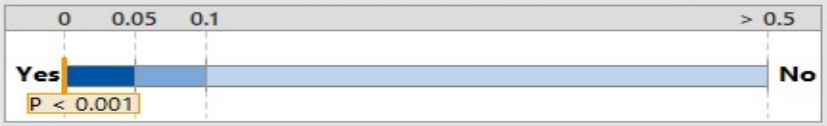
Before/After Capability Comparison for Before vs After
Summary Report

Reduction in % Out of Spec

59%

% Out of spec was reduced by 59% from 96.79% to 39.71%.

Was the process standard deviation reduced?



Did the process mean change?

Customer Requirements

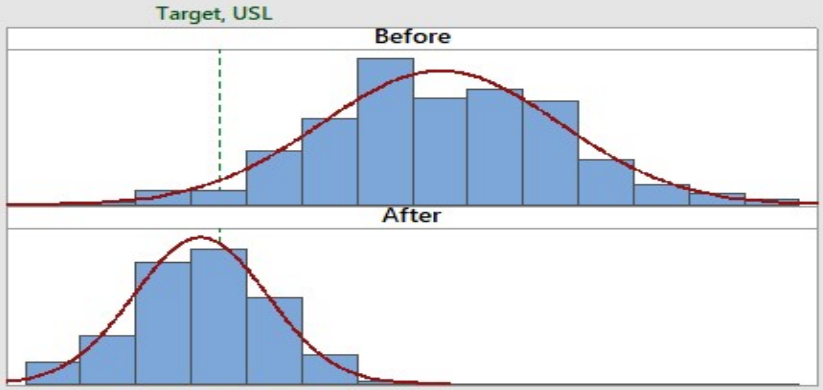
Lower Spec	Target	Upper Spec
*	0.1	0.1

Process Characterization

Statistics	Before	After	Change
Mean	0.18055	0.093668	-0.086882
StDev(overall)	0.043522	0.024273	-0.019250
Actual (overall) capability			
Pp	*	*	*
Ppk	-0.62	0.09	0.70
Z.Bench	-1.85	0.26	2.11
% Out of spec	96.79	39.71	-57.08
PPM (DPMO)	967899	397094	-570804

Actual (Overall) Capability

Are the data below the limit and close to the target?



Comments

Before: Before After: After

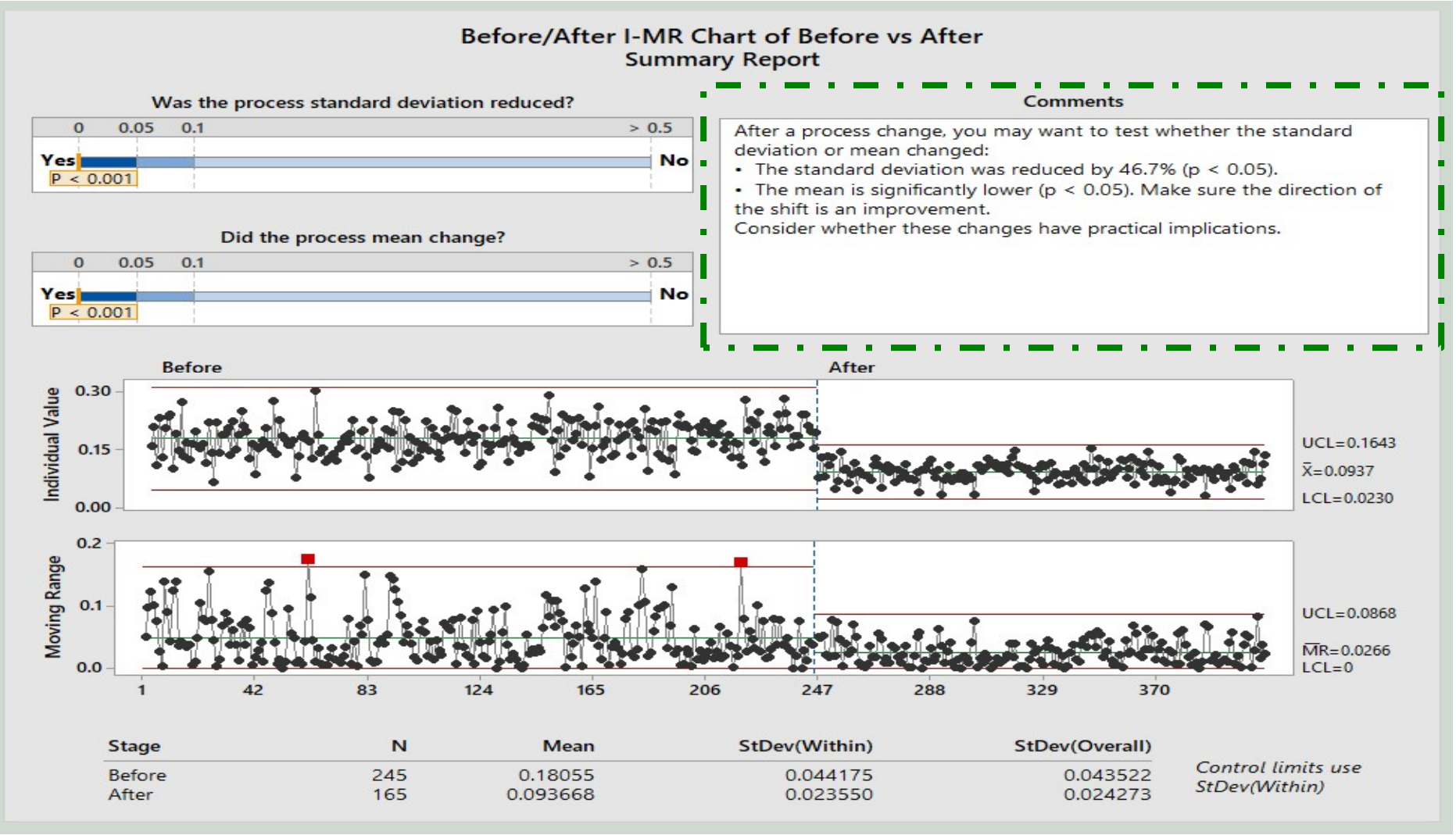
- The process standard deviation was reduced significantly ($p < 0.05$).
- The process mean changed significantly. It is now closer to the target ($p < 0.05$).

Actual (overall) capability is what the customer experiences.

Potential (within) capability is what could be achieved if process shifts and drifts were eliminated.

Control chart Before and after

Before after control chart



THANK YOU