Pre-Processing Standardization for HP Visco Components

DMAIC Project

Lean Six Sigma I

Author: Ian Navin

The Visco Department at the Lee Company builds two types of components: Standards and High Pressures. The high-pressure components undergo a different pre-processing method than the standards. The standards are cleaned in a degreaser, while the HP are cleaned in a degreaser and an acid. The acid used for the HP is also used for chemical deburring, so the cleaning can impact the consistency of the flow performance by attacking the drilled orifices. The standard degreaser is non-invasive, and the operation can be completed in less time than the acid cleaning. A study into standardizing the pre-processing methods for the standard and high-pressure components is being performed.

Project Title: Pre-Processing Standardization for HP Visco Components

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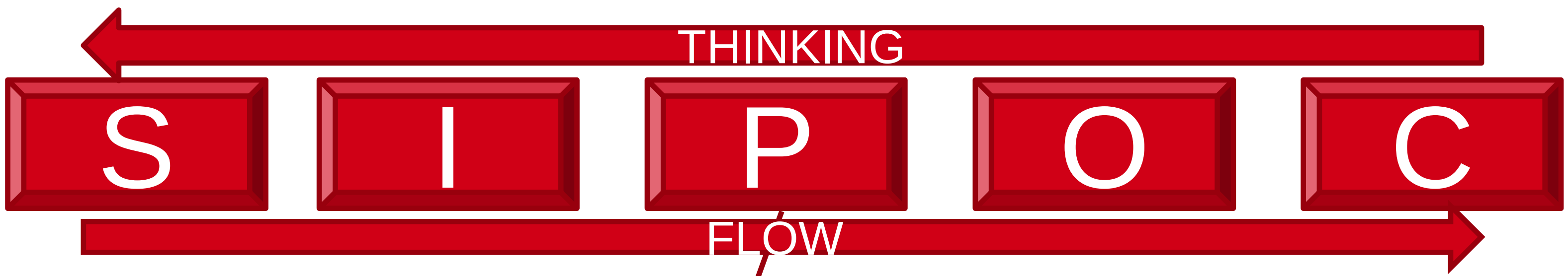
Define

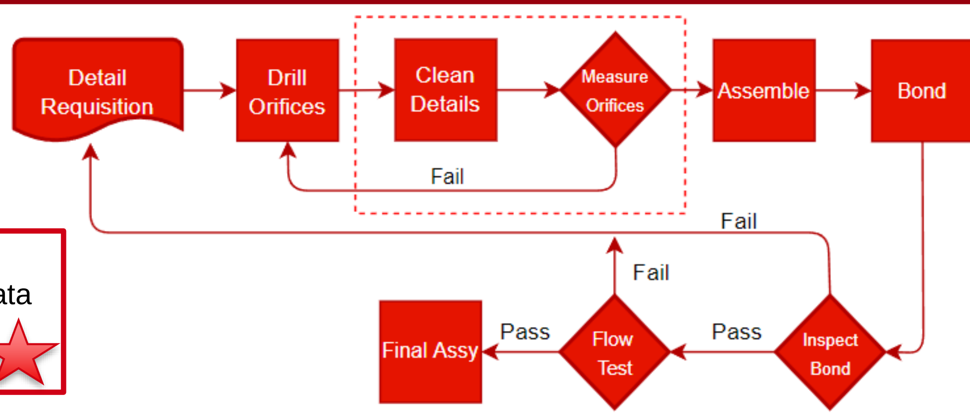
Requires materials and specifications to produce fret assembly

Requires bonded assembly that meets flow requirements

Supplier	Input	Process	Output	Customer



Supplier	Input	Output	Customer
Stock Room Acid Room Visco Assy Dept.	BOM Detail Components, Cleaning Fluid, Prints, Specs, Assembled Fret, Bonding Program	Bonded Fret Fret within flow specifications	Visco Department for final assembly



Process Focus Captured by Dotted box. Measurement data collected from Full Process (Final Assembly)

PM Lead: Ian Navin

Project: Pre-Processing Standardization for Visco Components

Latest update: Jan. 27th 2022

Business Case

Our mission is to design and build state-of-the-art products that exceed customer's expectation for utility, performance, and quality. The Lee Company constantly strives to improve the product designs, the manufacturing process, and the quality system. The ultimate goal is zero defects and a satisfied customer. This process improvement will directly impact the quality of our product and the on-time delivery to our customers which will have a great impact on their satisfaction.

Problem Statement

Utilization of multiple pre-processing methods for similar products can lead to longer processing times, as well as unintentional performance issues of the assembly. Standardizing the pre-processing can reduce inefficiencies in both performance and lead time requirements.

Project Goal

The goal of this project is to standardize the pre-processing methods of the Visco Components.

Customer CTQ(s)

The customer requires the assembled components from the batch processing to flow within the specified flow tolerance. They also require the parts to meet their required lead times.

Success Criteria

1. Pre-processing standardized
2. Processing Time/Cost Savings
3. Consistent flow performance of assemblies
4. Increased on-time delivery
5. Reduced Scrap Rates

Defect Definition

The defect that I will measure is the metering orifice size and consistency. The metering orifice size directly correlates to the flow performance.

Process(es) Affected

1. Pre-Processing Method (Cleaning)
2. Measurement

IN Scope

Metering hole consistency, pre-processing methods (materials, time, quantity), Visco Dept, Visco products

OUT Scope

Assembly and post-processing affect on flow performance, Furnace Dept., print tolerances, metering hole manufacturing process

Assumptions / Constraints (Top 4)

1. Assumption: Acid strength will play a large roll in consistency of metering holes
2. Assumption: Gage R&R must be performed on measurement system before starting the measurement of metering holes
3. Assumption: Parts that are drilled and parts that are etched will behave the similarly
4. Constraint: Supply shortages of degreasing fluid leading to potential new fluid analysis

Target Benefits (Top 3)

1. Increase metering hole size consistency prior to assembly
2. Decrease Scrap Rates
3. Reduce processing time and cost

Schedule – Main Stages

Name	Baseline Finish	Actual Finish	Status
Define	01/31/2022	01/27/2022	Complete
Measure	02/21/2022		In Process
Analysis	03/14/2022		Not Started
Improve	04/04/2022		Not Started
Control	04/18/2022		Not Started
PDCA	04/18/2022		Not Started

Project Team

Name	Role/Responsible	Commitment
Ian Navin	Project Lead	30%
Scott Whynall	Chief Engineer (Manager)	5%
Greg Vereneau	Group Manuf. Engineer	5%
Andrew Bellemare	Manuf. Engineer	5%
Tim Held	Production Manager	5%
Rob Brown	Production Supervisor	15%
Mike Sherwonit	Quality Engineer	15%
Dan SantaMaria	Group Vice President	3%

DICE (Baseline)

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DICE Baseline

Project Name:	Pre-Processing Standardization for Visco Components	**Page __1__ of __1__**
Name:	Ian Navin	Date: 01/27/22

DICE Equation **D + (2 x I) + (2 x C1) + C2 + E = Score**

section	Duration	Integrity	Commitment - C1 Senior Mgmt	Commitment - C2 Team members	Effort
criteria	If projects is: < 2 months, place 1 2 < D < 4 months, place 2 4 < D < 8 months, place 3 > 8 months, place 4	1 pt if – Capable leader Motivated team More than 50% of time dedicated 4 pts – If one of the above is missing 2 or 3 pts – if they are in between	1 pt – if need clearly articulated 2 pt or 3 pt – if neutral 4 pt – any signs of reluctance	1 pt – if employee is eager 2 pt – if just willing 3 pt or 4 pts – if anything else	1 pt – if 10 % over 2 pt – if 10-20 % over 3 pt – if 20-40 % 4 pt – if 40% and over
Score:	2	2	1	1	1

Total Score: 10

7	14	17	28
WIN		WORRY	WOE

Navin_Ian_DICE_HW2

Measure

CTQ Flow down Y

Project Deliverables (X's)

Customer CTQs (Y's)	Importance	Orifice Measurement Consistency	Measurement System Accuracy	Train Production Floor to use new Standard	Measurement System Program	Cleaning Cycle Time	Standardized Cleaning Methods/Instructions	Cost Analysis	Measuring Cycle Time		Total
On-Time Delivery	4	H	M	M	L	H	L	L	M		120
Reduce Rework	3	H	M	M	M	M	M	M	M		90
One Cleaning Standard for All Products	2	H	M	L	L	M	H	H	L		72
Consistent Orifice Size (Flow Performance)	5	H	H	H	H	L	M	L	L		210
Reduce Scrap	3	H	M	M	M	M	M	M	L		84
Total		153	81	77	69	65	55	45	31		

QFD Controls

CTQ Flowback x

Project Deliverables (X's)

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Reduce Scrap	3	H	M	M	M	M	M	M	L		84
Total		153	81	77	69	65	55	45	31		

House of Quality
(QFD)

Test-Retest Study – Device Accuracy

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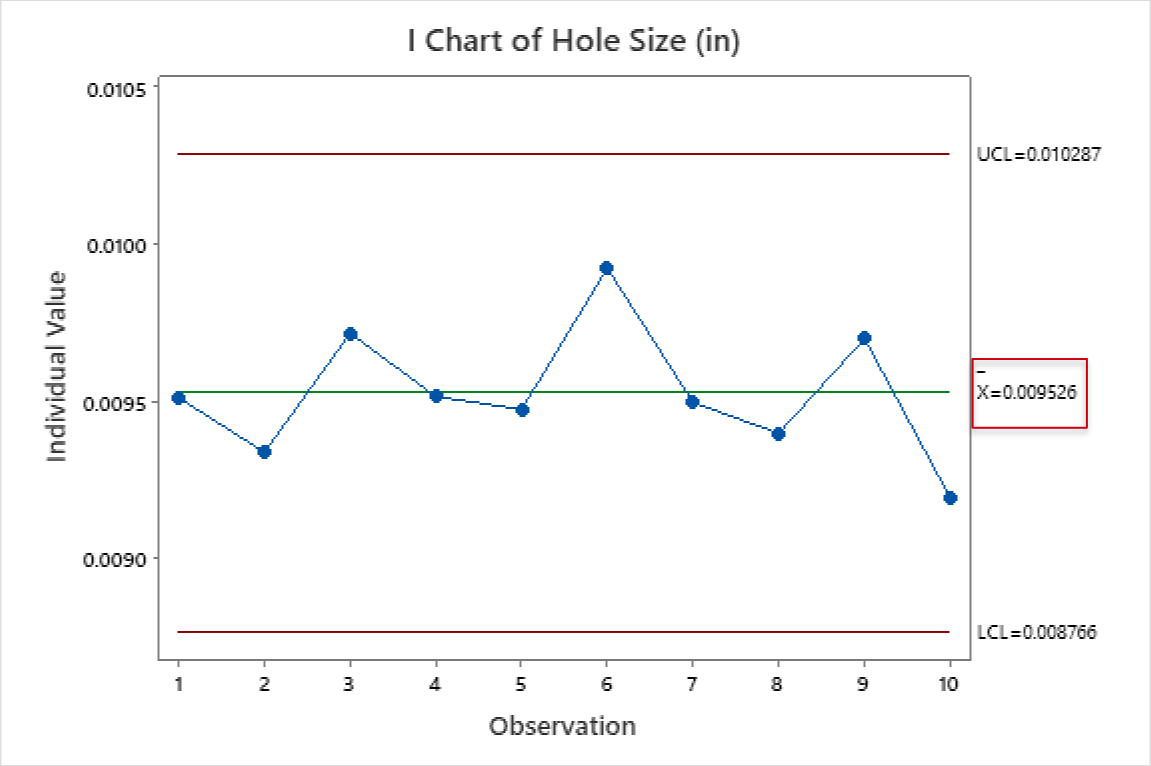

My true-value = 0.00950”
Inaccuracy = I bar Mean – “true value”
Inaccuracy = 0.009526” – 0.0095” = 0.000026” off my current measure
(0.000026”/0.0095”)*100 = 0.2736% Inaccuracy
The UCL = 0.010287” and the LCL = 0.008766”

The Process and Measurement System are in <u>Control and Accurate</u>

Please be advised, some of the data and/or technical wording has been omitted and replaced with generic terms in order to keep the information proprietary.

Test-Retest Study – Device Precision

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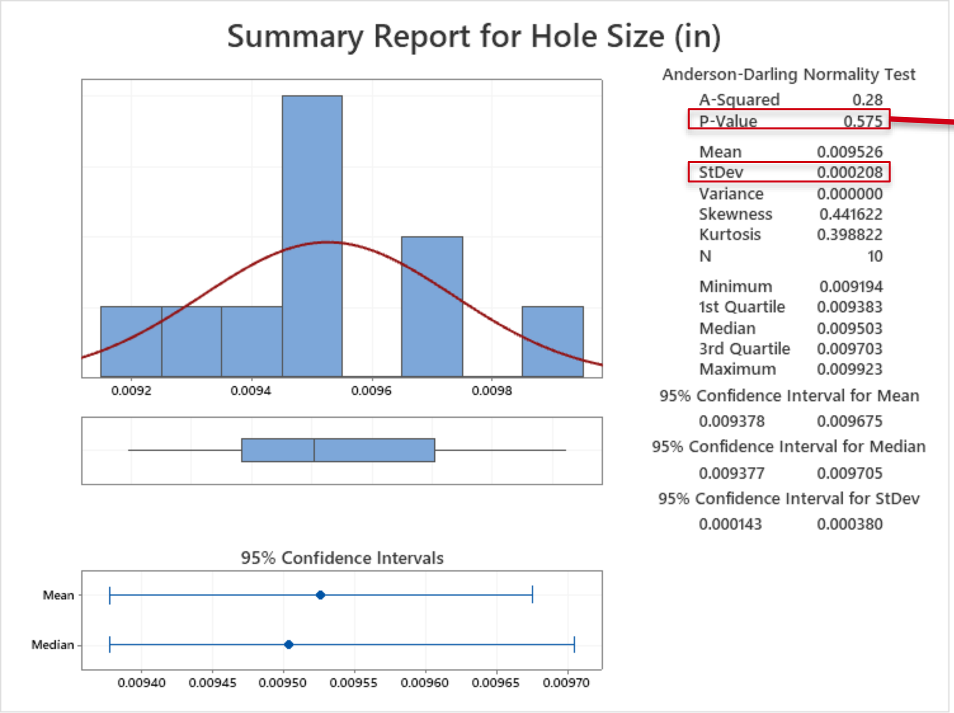

My data is normal since the P-Value of 0.575 is greater than 0.05.

The Measurement System IS NOT Precise!

My tolerance for my current process is = +/- 0.0005”
Standard Deviation = 0.00208”
(1/10) x Tolerance = (1/10) x (0.0005 x 2) = 0.0001”
0.000208 > 0.0001

Please be advised, some of the data and/or technical wording has been omitted and replaced with generic terms in order to keep the information proprietary.

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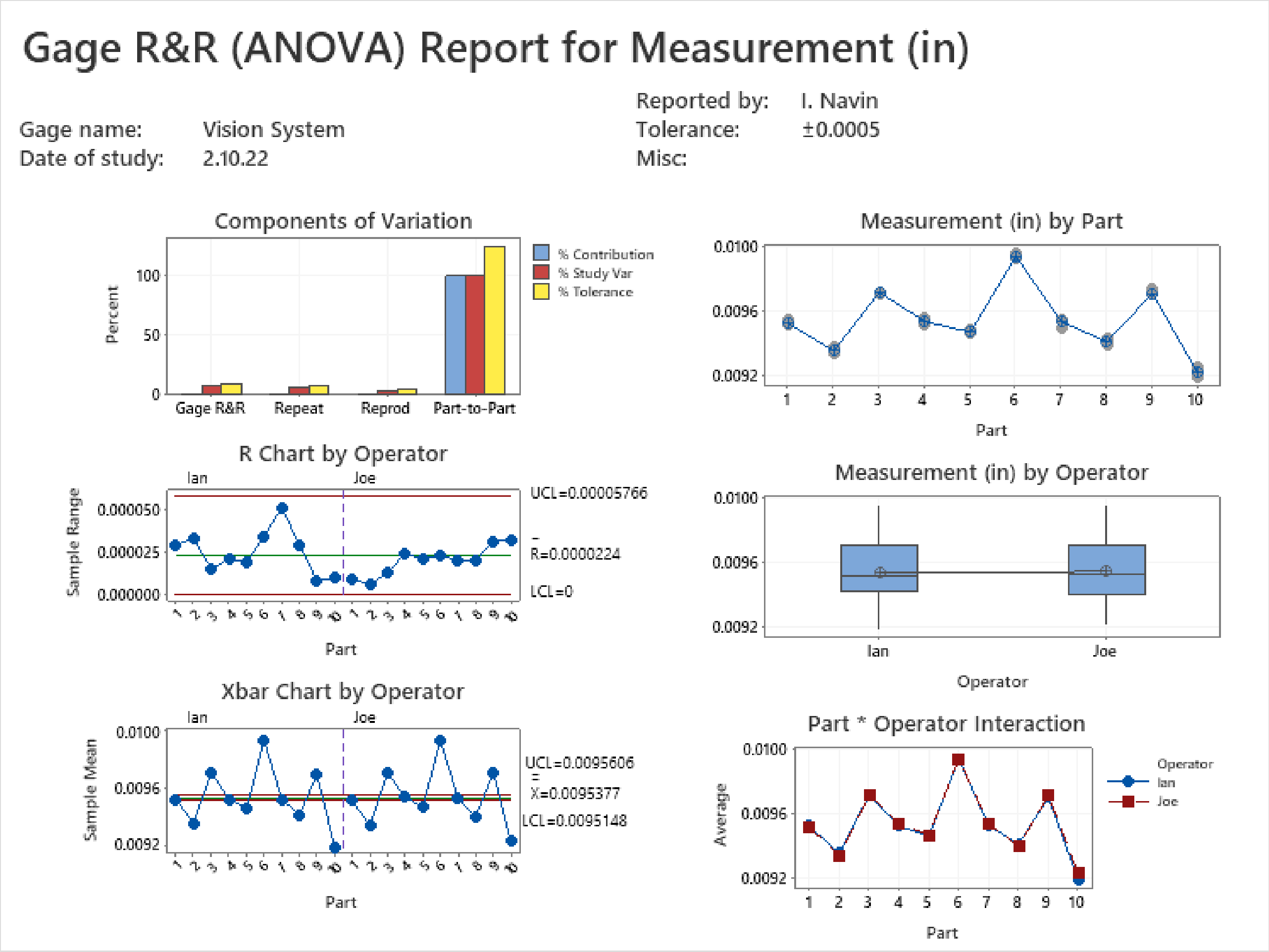
Baseline Gage R&R – 10 Part, 3 Trial, 2 Operator



Baseline Gage R&R – 10 Part, 3 Trial, 2 Operator

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part	9	0.0000023	0.0000003	645.424	0.000
Operator	1	0.0000000	0.0000000	0.954	0.354
Part * Operator	9	0.0000000	0.0000000	2.364	0.030
Repeatability	40	0.0000000	0.0000000		
Total	59	0.0000023			

α to remove interaction term = 0.05

Gage R&R

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.0000000	0.57
Repeatability	0.0000000	0.39
Reproducibility	0.0000000	0.18
Operator	0.0000000	0.00
Operator*Part	0.0000000	0.18
Part-To-Part	0.0000000	99.43
Total Variation	0.0000000	100.00

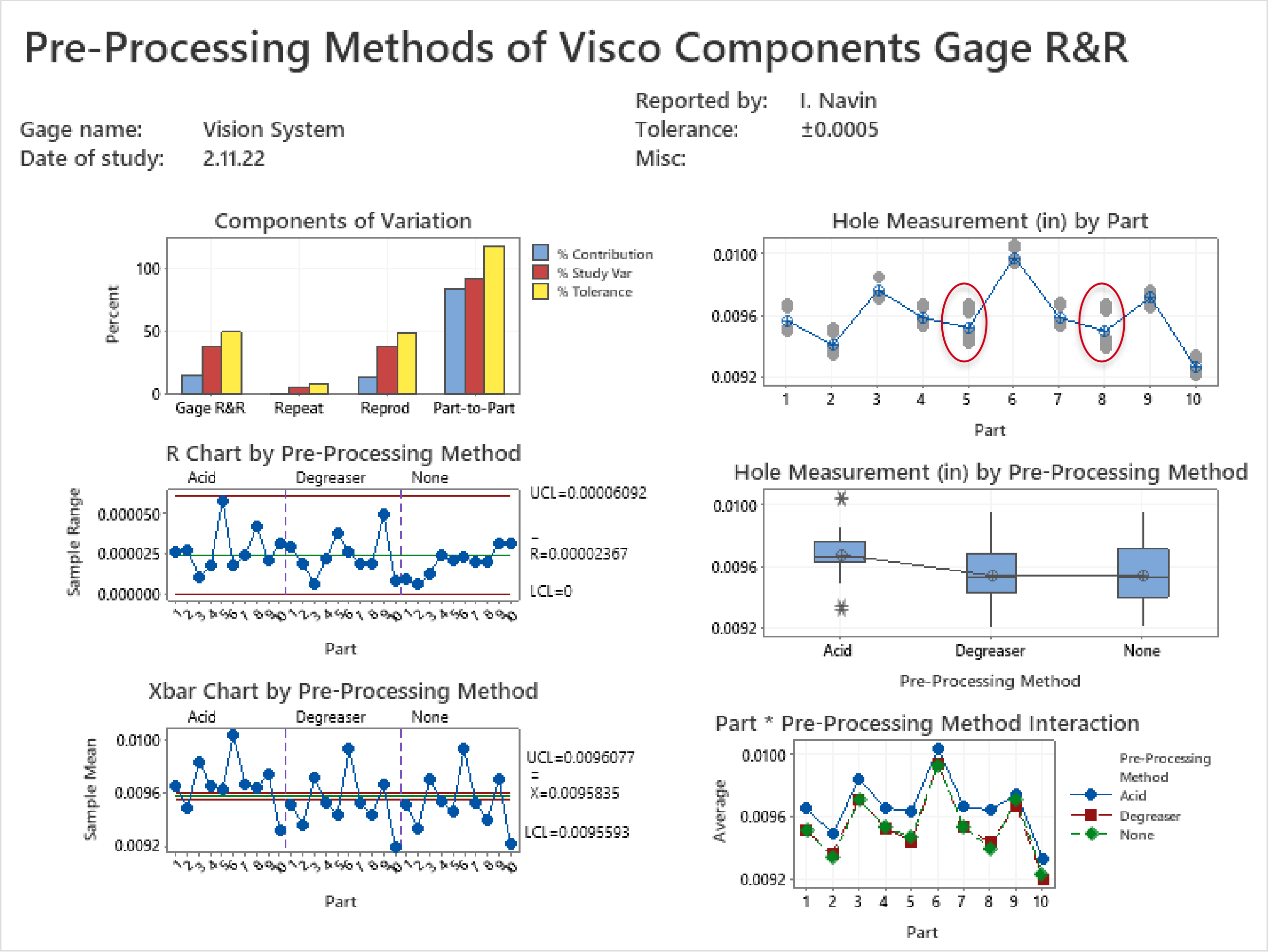
Process tolerance = 0.001

Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)	%Tolerance (SV/Toler)
Total Gage R&R	0.0000157	0.0000940	7.55	9.40
Repeatability	0.0000130	0.0000779	6.26	7.79
Reproducibility	0.0000088	0.0000525	4.22	5.25
Operator	0.0000000	0.0000000	0.00	0.00
Operator*Part	0.0000088	0.0000525	4.22	5.25
Part-To-Part	0.0002069	0.0012414	99.71	124.14
Total Variation	0.0002075	0.0012449	100.00	124.49

Number of Distinct Categories = 18

Pre-Processing Gage R&R – 10 Part, 3 Trial, 3 Operator (Cleaning Methods)



Pre-Processing Gage R&R – 10 Part, 3 Trial, 3 Operator (Cleaning Methods)

Gage R&R for Hole Measurement (in)

Gage name: Vision System
Date of study: 2.11.22
Reported by: I. Navin
Tolerance: ±0.0005
Misc:

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part	9	0.0000032	0.0000004	140.221	0.000
Pre-Processi	2	0.0000004	0.0000002	72.324	0.000
Part * Pre-Processi	18	0.0000000	0.0000000	13.471	0.000
Repeatability	60	0.0000000	0.0000000		
Total	89	0.0000036			

α to remove interaction term = 0.05

Gage R&R

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.0000000	15.14
Repeatability	0.0000000	0.41
Reproducibility	0.0000000	14.73
Pre-Processi	0.0000000	13.04
Pre-Processi*Part	0.0000000	1.69
Part-To-Part	0.0000000	84.86
Total Variation	0.0000000	100.00

Process tolerance = 0.001

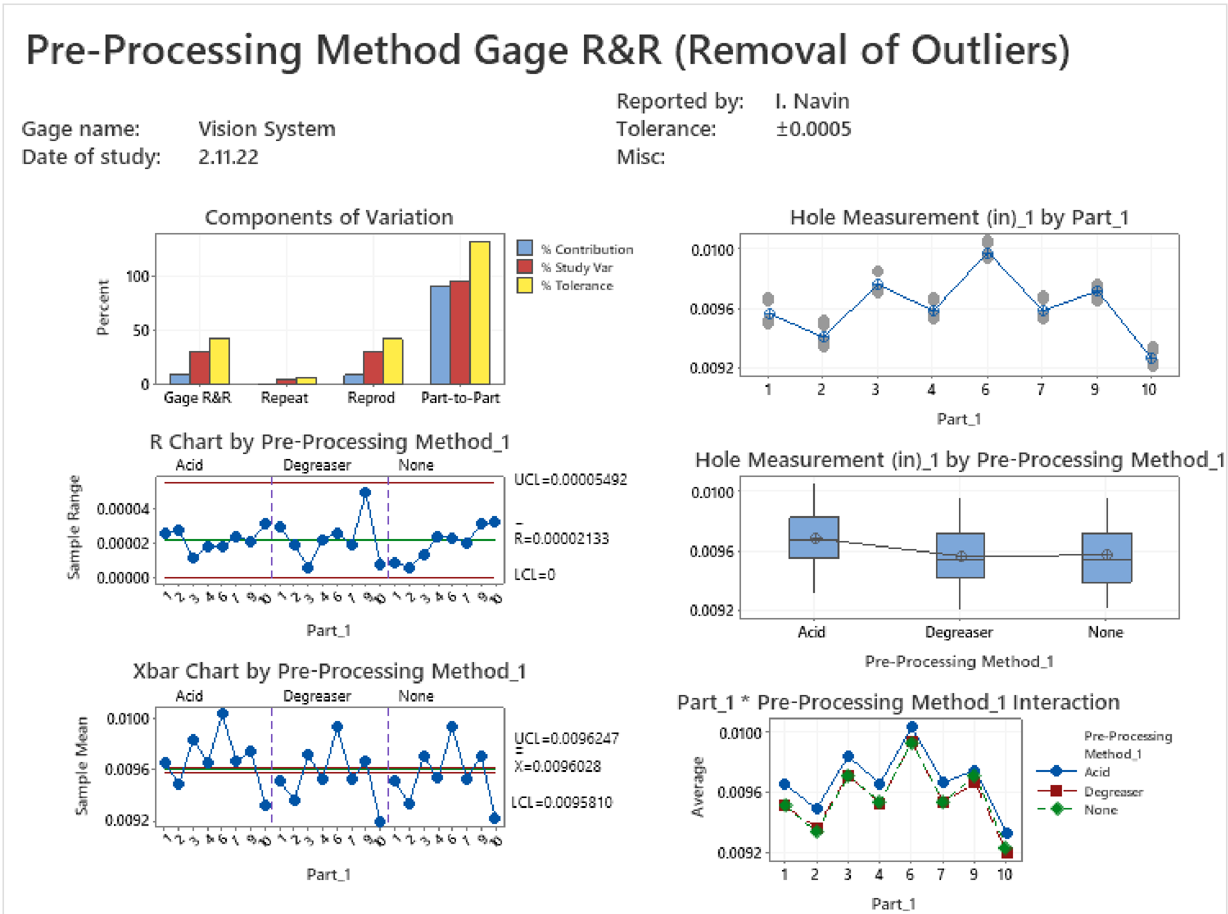
Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)	%Tolerance (SV/Toler)
Total Gage R&R	0.0000833	0.0004998	38.91	49.98
Repeatability	0.0000137	0.0000820	6.38	8.20
Reproducibility	0.0000822	0.0004930	38.39	49.30
Pre-Processi	0.0000773	0.0004638	36.11	46.38
Pre-Processi*Part	0.0000279	0.0001671	13.01	16.71
Part-To-Part	0.0001972	0.0011831	92.12	118.31
Total Variation	0.0002141	0.0012844	100.00	128.44

Number of Distinct Categories = 3

Gage R&R Analysis

Pre-Processing Gage R&R (Removal of Outliers) – 10 Part, 3 Trial, 3 Operator (Cleaning Methods)



Pre-Processing Gage R&R (Removal of Outliers) – 10 Part, 3 Trial, 3 Operator (Cleaning Methods)

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
Part_1	7	0.0000030	0.0000004	386.979	0.000
Pre-Processi	2	0.0000002	0.0000001	98.994	0.000
Part_1 * Pre-Processi	14	0.0000000	0.0000000	7.543	0.000
Repeatability	48	0.0000000	0.0000000		
Total	71	0.0000033			

α to remove interaction term = 0.05

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.0000000	9.51
Repeatability	0.0000000	0.28
Reproducibility	0.0000000	9.23
Pre-Processi	0.0000000	8.62
Pre-Processi*Part_1	0.0000000	0.61
Part-To-Part	0.0000000	90.49
Total Variation	0.0000001	100.00

Process tolerance = 0.001

Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)	%Tolerance (SV/Toler)
Total Gage R&R	0.0000710	0.0004263	30.83	42.63
Repeatability	0.0000122	0.0000731	5.29	7.31
Reproducibility	0.0000700	0.0004200	30.37	42.00
Pre-Processi	0.0000676	0.0004058	29.35	40.58
Pre-Processi*Part_1	0.0000180	0.0001080	7.81	10.80
Part-To-Part	0.0002192	0.0013153	95.13	131.53
Total Variation	0.0002304	0.0013826	100.00	138.26

Number of Distinct Categories = 4

Performance Standards

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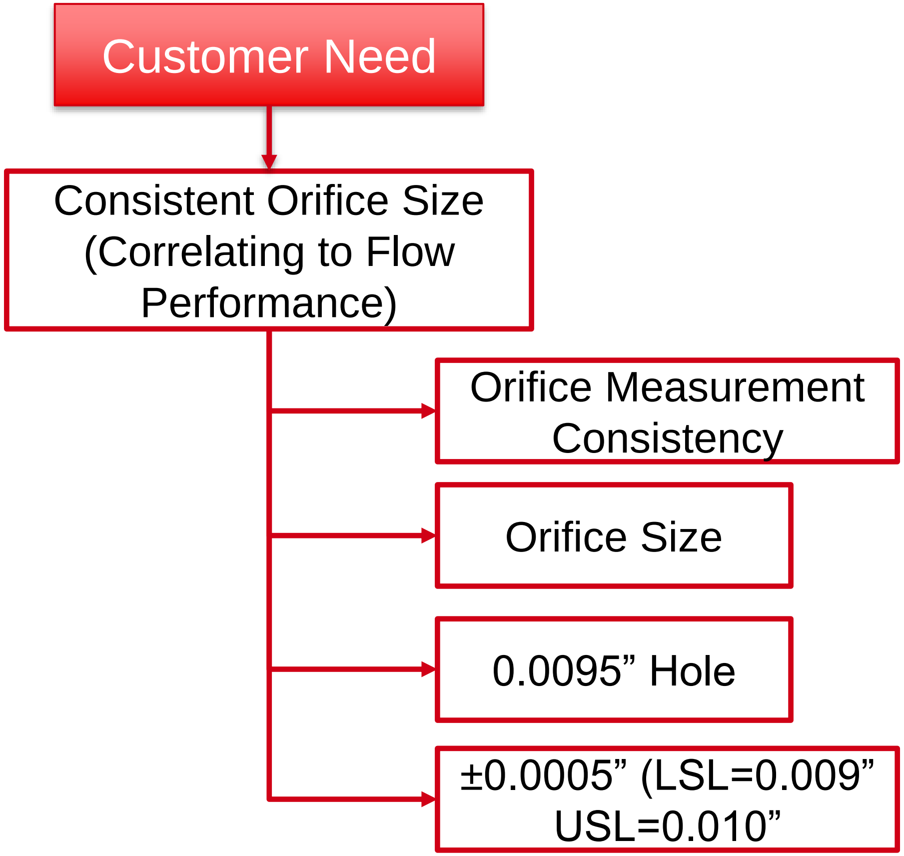
Process(es):

1. Pre-Processing (Cleaning) of Orifices

What is you Y=f(x):

Consistent Orifice Size = f(measurement consistency, MSA, training for production floor on new standard, measurement system program)



VSM Current State (Acid Cleaning)

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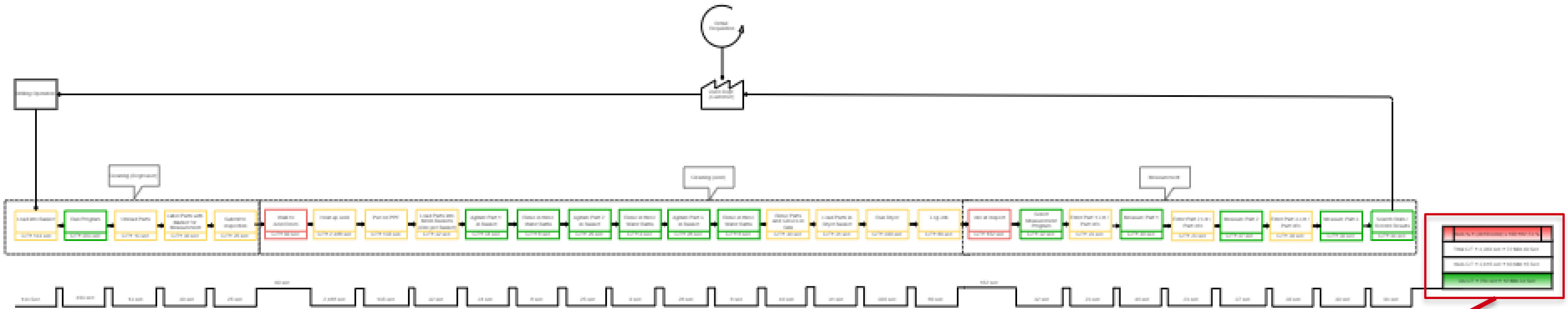

KEY		
Value Added	Essential Non-Value Added	Non-Value Added
Cycle Time	Cycle Time	Cycle Time

NVA % = (3615/4369) x 100 =82.74 %
Total C/T = 4,369 sec = 72 Min 49 Sec
NVA C/T = 3,615 sec = 60 Min 15 Sec
VA C/T = 754 sec = 12 Min 34 Sec

Navin_Ian_VSM_Current State

See Page 1 for Acid VSM

VSM Current State (Degreaser Cleaning)

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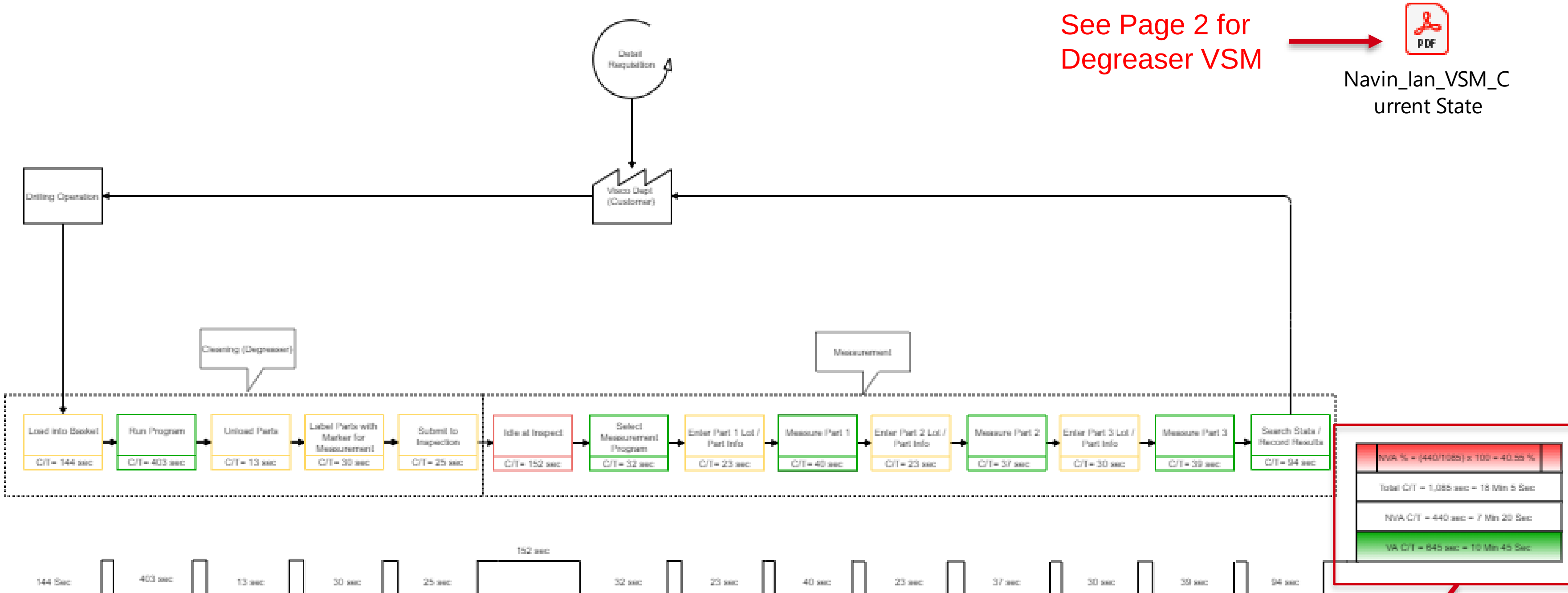
See Page 2 for Degreaser VSM

Navin_Ian_VSM_Current State



KEY

Value Added	Essential Non-Value Added	Non-Value Added
Cycle Time	Cycle Time	Cycle Time

NVA % = (440/1085) x 100 = 40.55 %
Total C/T = 1,085 sec = 18 Min 5 Sec
NVA C/T = 440 sec = 7 Min 20 Sec
VA C/T = 645 sec = 10 Min 45 Sec

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Analyze

Interpreting Project Capability - ANOVA

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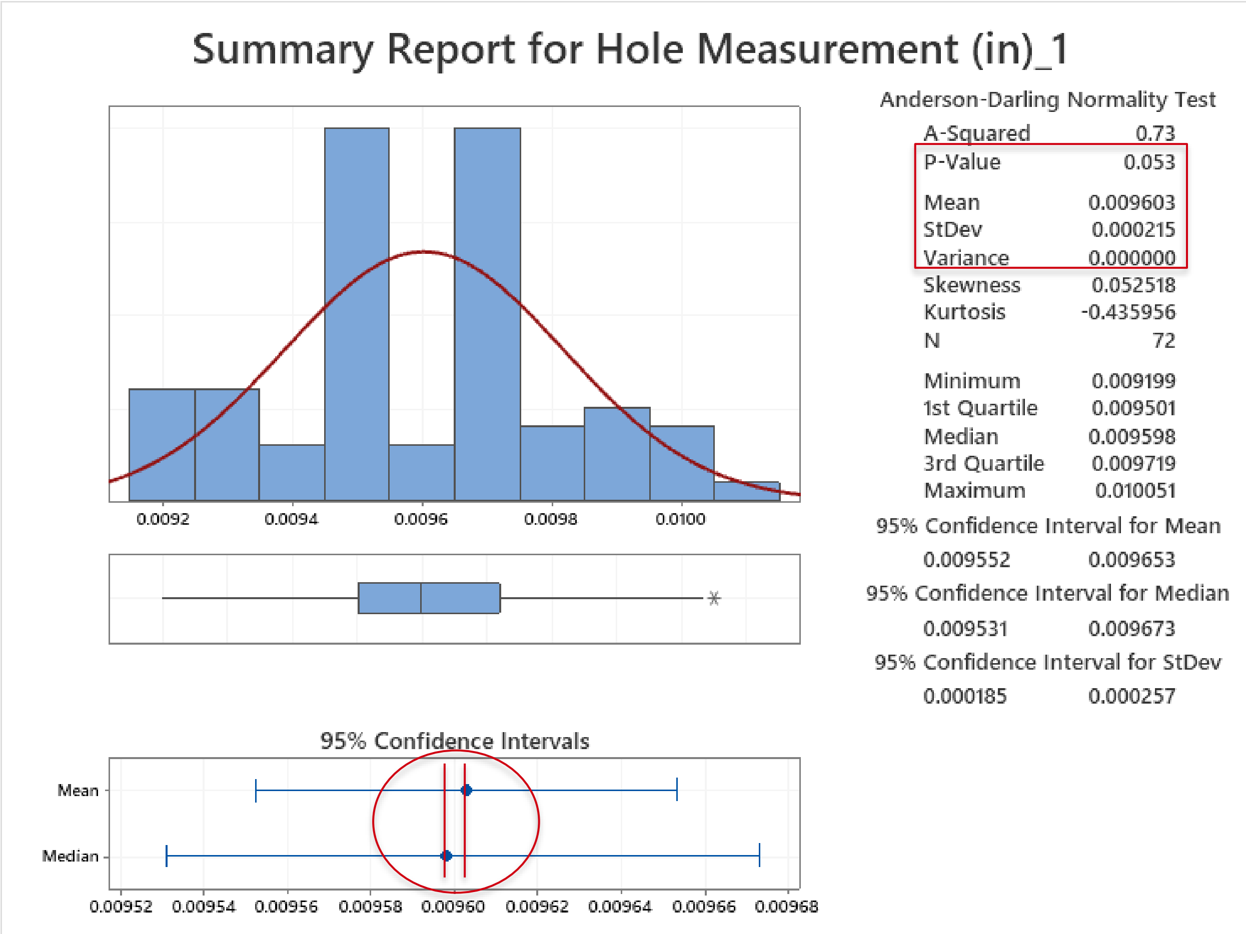
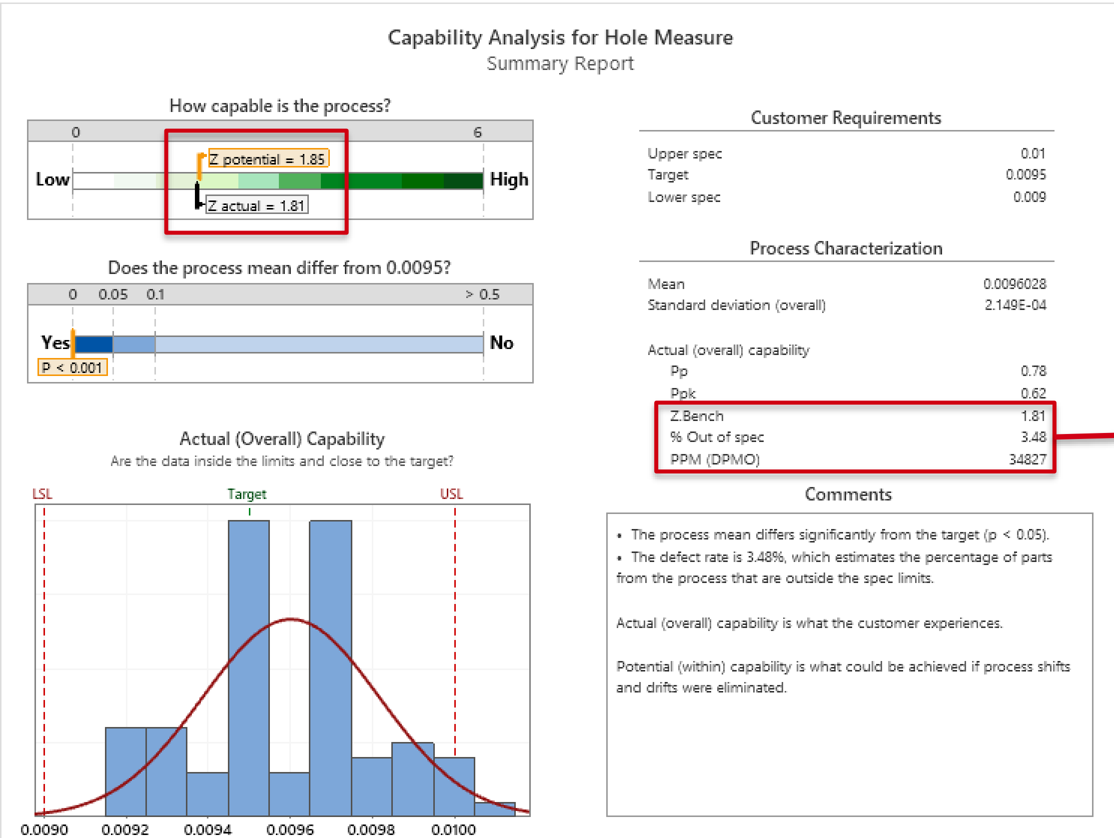


Target Size = 0.0095”
P-Value = 0.053
(Normally Distributed)
Mean = 0.009603”
Stnd Dev = 0.000215
Variance = 0.0000

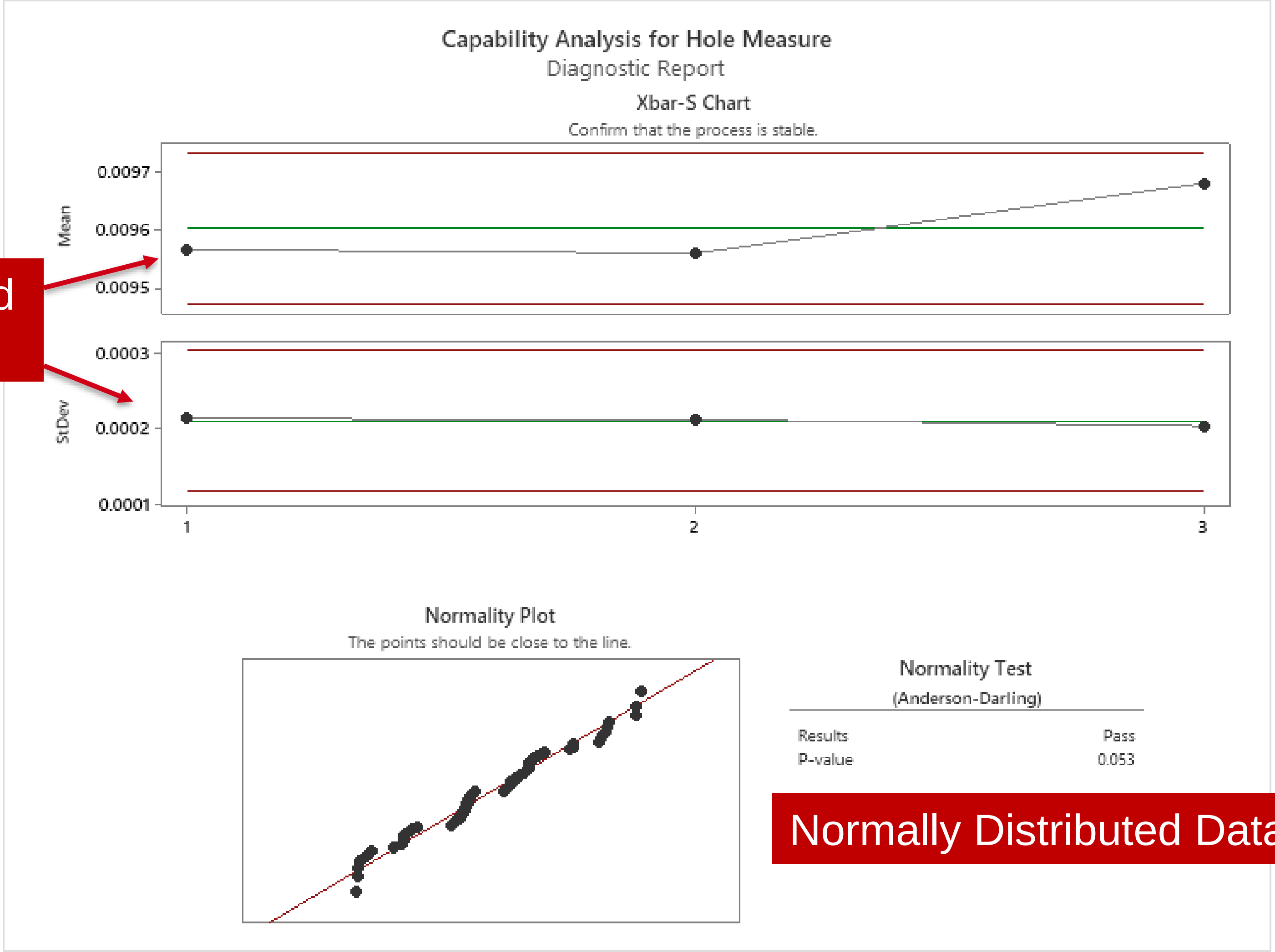
Interpreting Project Capability - ANOVA



Z-Bench (Sigma Value) = 1.81
DPMO = 34,827

Interpreting Project Capability - ANOVA

Stable and in Control



Normally Distributed Data

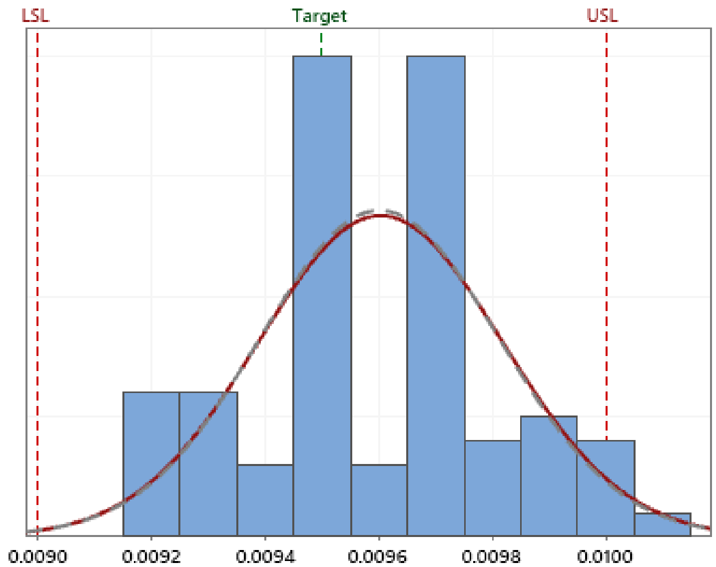
Interpreting Project Capability - ANOVA

Capability Analysis for Hole Measure

Process Performance Report

Capability Histogram

Are the data inside the limits 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	72
Subgroup size	24
Mean	0.0096028
Standard deviation (overall)	2.149E-04
Standard deviation (within)	2.113E-04

Capability Statistics

Actual (overall)	
Pp	0.78
Ppk	0.62
Z.Bench	1.81
% Out of spec (observed)	4.17
% Out of spec (expected)	3.48
PPM (DPMO) (observed)	41667
PPM (DPMO) (expected)	34827
Potential (within)	
Cp	0.79
Cpk	0.63
Z.Bench	1.85
% Out of spec (expected)	3.22
PPM (DPMO) (expected)	32234

Current

Potential

Interpreting Project Capability - ANOVA

Capability Analysis for Hole Measure

Report Card

Check	Status	Description
Stability	✓	The process mean and variation are stable. No points are out of control.
Number of Subgroups	i	You only have 3 subgroups. For a capability analysis, it is generally recommended that you collect at least 25 subgroups over a long enough period of time to capture the different sources of process variation.
Normality	✓	Your data passed the normality test. As long as you have enough data, the capability estimates should be reasonably accurate.
Amount of Data	!	The total number of observations is less than 100. You may not have enough data to obtain reasonably precise capability estimates. The precision of the estimates decreases as the number of observations becomes smaller.

Analyzing Our Process

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Is your Process Stable? My process is stable. The control charts show that I am stable in my variance and the mean is in control with the acid deviating a bit. I do agree with the statistics. Though I think there is work to improve the acid pre-processing method.

What does your Process Shape look like? The process shape is in a bell curve shape being normally distributed. The process is shifted from the mean to the right and the defective percentage (3.48%) is over on the upper spec limit. I agree with this since the acid makes the hole size bigger which would shift everything to the right of the target of 0.0095” on the mean and over the spec limit.

How does your Process’ Spread look so far? The spread looks good with the tails of the bell curve being approximately the same and the peak being in the center. Though there is a decent spread, it is hard to keep the variation tight with such a small measurement (into the one tenth of a thousandth of an inch, 0.0001”).

Does your Process look Centered so far? The process is almost centered with a target of 0.0095” and the mean of 0.0096028. I agree that this is probably the case again because of the acid that makes the holes larger.

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Ishikawa / Fishbone Diagram

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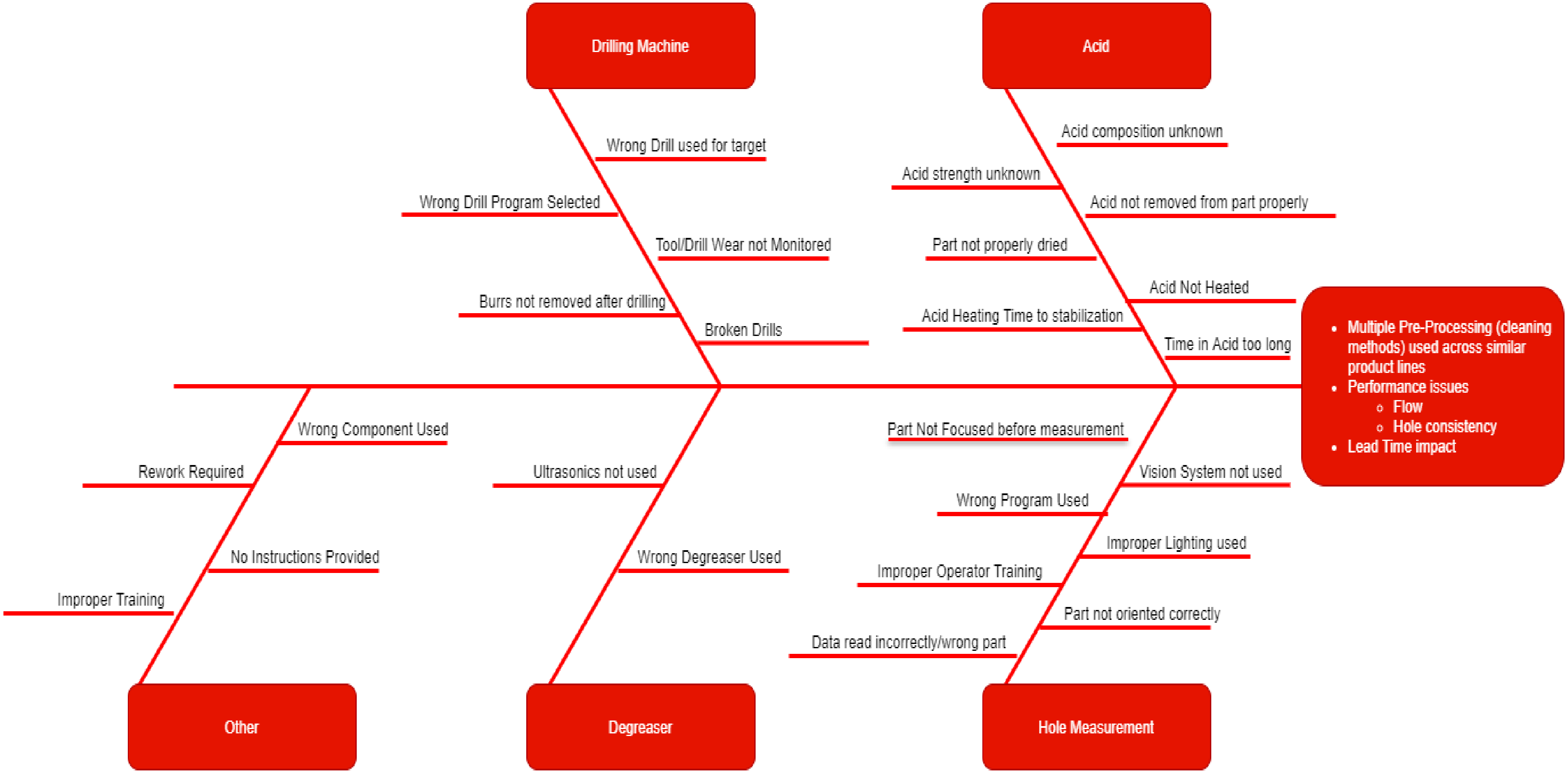

Problem: Acid Cleaning shifts the mean hole target and increases the hole variance

Why does Acid Cleaning shift the mean hole target and increase the hole variance?	→ **Because** the acid attacks the metal
Why does the acid attack the metal	→ **Because** the acid strength is unpredictable
Why is the acid strength unpredictable?	→ **Because** it gets stronger as it is used (non-linear)
Why does the acid strength change non-linearly	→ **Because** of the certain acid composition used
Why does the acid have the certain composition	→ **Because** the vendor/manufacturer made this composition specifically for chemical deburring

Hypothesis Testing - Basic Statistics

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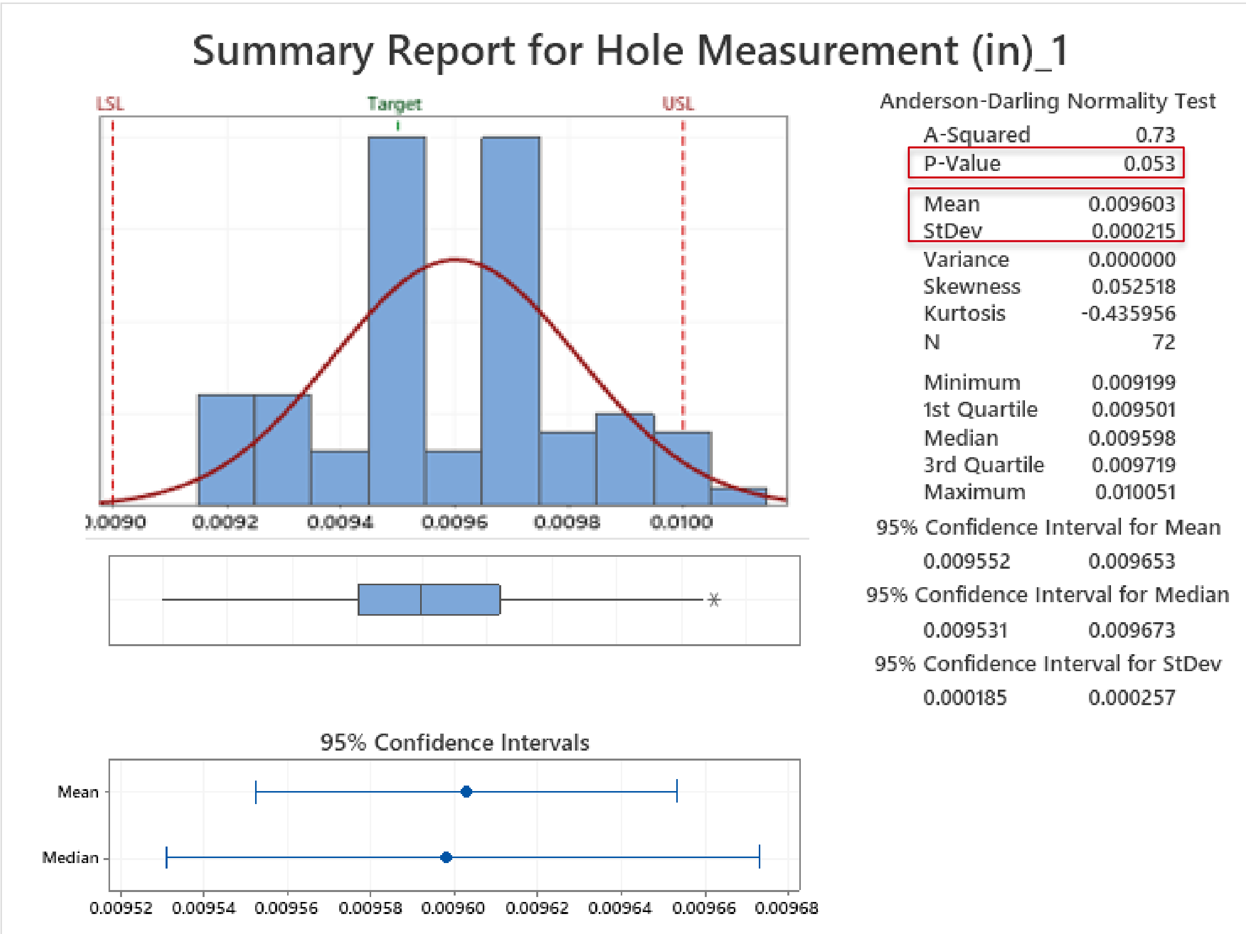


Target Size = 0.0095”
P-Value = 0.053
(Normally Distributed)
Mean = 0.009603”
Stnd Dev = 0.000215
Variance = 0.0000

Hypothesis Testing - 1 Sample t-Test

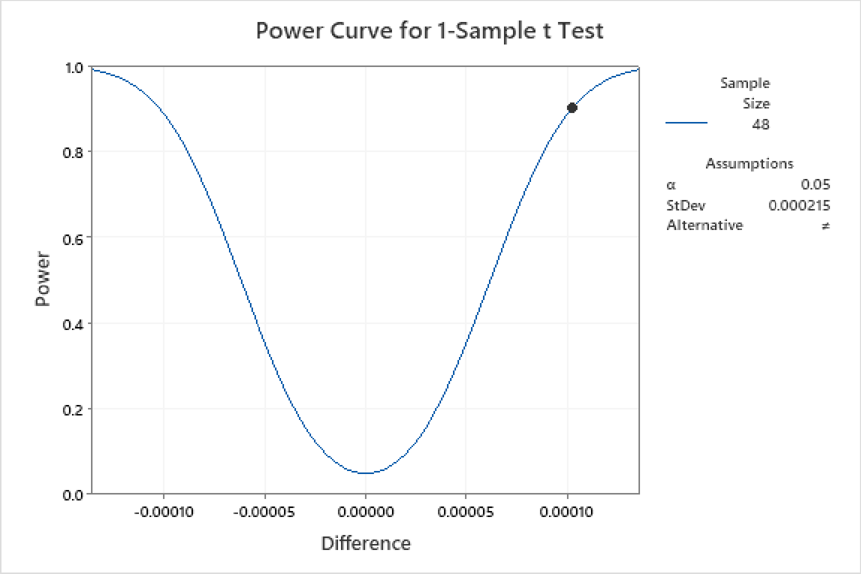
1-Sample t Test
Testing mean = null (versus ≠ null)
Calculating power for mean = null + difference
α = 0.05 Assumed standard deviation = 0.000215

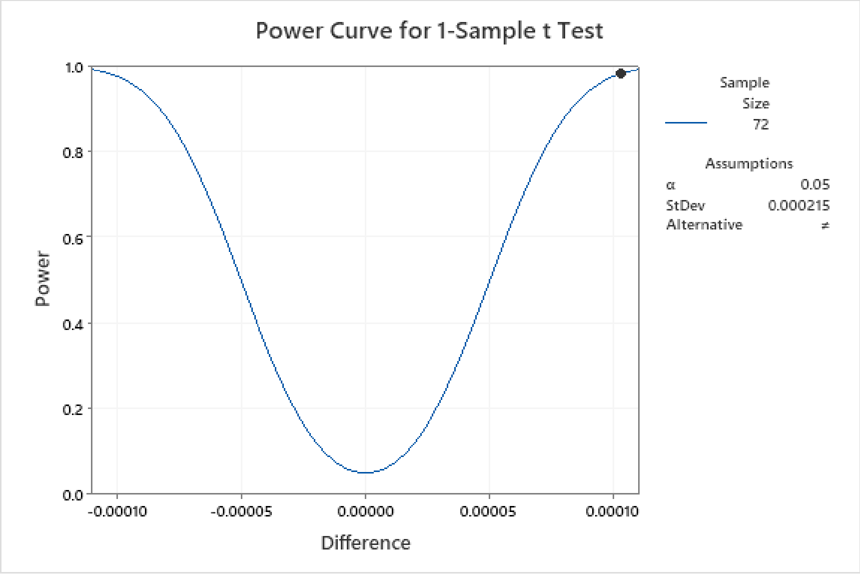
Results

Difference	Sample Size	Target Power	Actual Power
0.000103	48	0.9	0.901576

Results

Difference	Sample Size	Power
0.000103	72	0.979794





90% Target Power

Actual Sample Size

Hypothesis Testing - 1 Variance Test Report

Method

σ: standard deviation of Hole Measurement (in)_1

The Bonett method is valid for any continuous distribution.

The chi-square method is valid only for the normal distribution.

Descriptive Statistics

N	StDev	Variance	95% Lower Bound for σ using Bonett	95% Lower Bound for σ using Chi-Square
72	0.000215	0.000000	0.000192	0.000189

Test

Null hypothesis H_0: $\sigma^2 = 0.001$

Alternative hypothesis H_1: $\sigma^2 > 0.001$

Method	Test Statistic	DF	P-Value
Bonett	—	—	1.000
Chi-Square	0.00	71	1.000

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Hypothesis Testing – Test for Equal Variances

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Method

Null hypothesis	All variances are equal
Alternative hypothesis	At least one variance is different
Significance level	α = 0.05

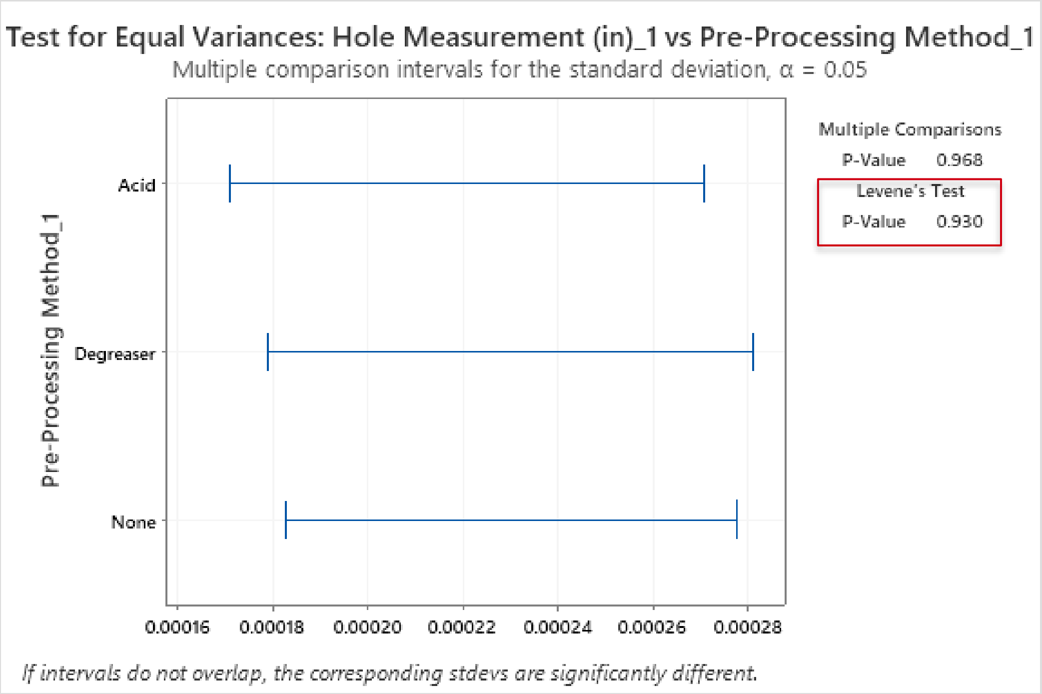
95% Bonferroni Confidence Intervals for Standard Deviations

Pre-Processing Method_1	N	StDev	CI
Acid	24	0.0002044	(0.0001489, 0.0003118)
Degreaser	24	0.0002130	(0.0001563, 0.0003224)
None	24	0.0002140	(0.0001613, 0.0003155)

Individual confidence level = 98.3333%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	—	0.968
Levene	0.07	0.930



Hypothesis Testing - One Way ANOVA Test

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Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Pre-Processing Method_1	3	Acid, Degreaser, None

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Pre-Processing Method_1	2	0.000000	0.000000	2.50	0.089
Error	69	0.000003	0.000000		
Total	71	0.000003			

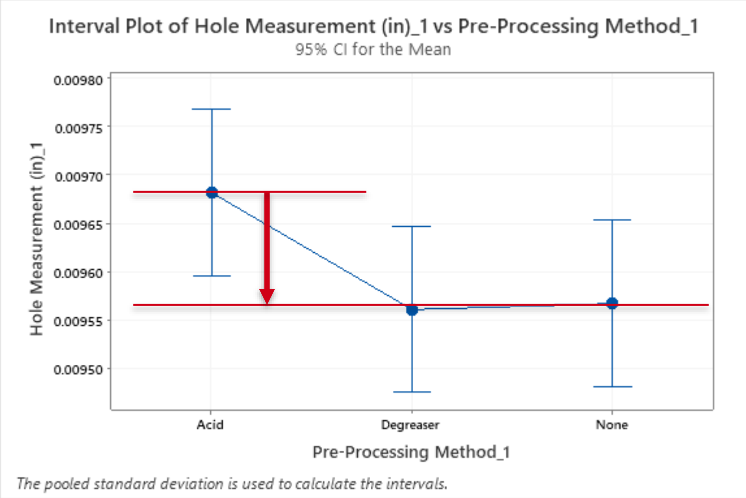
Model Summary

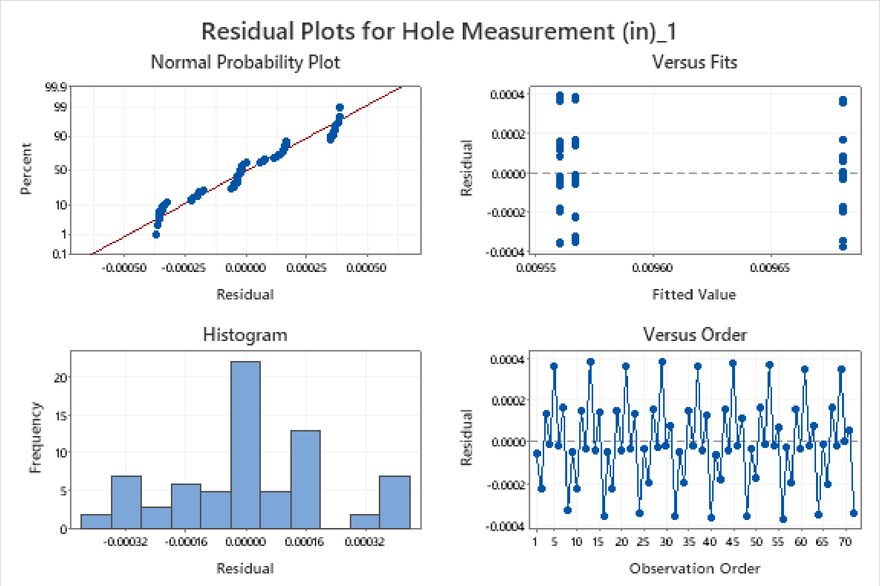
S	R-sq	R-sq(adj)	R-sq(pred)
0.0002105	6.76%	4.06%	0.00%

Means

Pre-Processing Method_1	N	Mean	StDev	95% CI
Acid	24	0.009681	0.000204	(0.009596, 0.009767)
Degreaser	24	0.009561	0.000213	(0.009475, 0.009646)
None	24	0.009567	0.000214	(0.009481, 0.009652)

Pooled StDev = 0.000210520





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Fishbone – Causes & Solutions

DMAIC

Project Name: Standardization of Pre-Processing Methods in Visco		Page __1__ of __1__
Name: Ian Navin		**Date**: __3.25.22__

Causal Group	Cause	Possible Solution	Prioritized #	Notes
Hole Measurement	Part not Focused before Measurement	Write Work Instruction for Vision System and Train Operators	3	
Hole Measurement	Vision System not used	Write Work Instruction for Vision System and Train Operators	3	
Hole Measurement	Improper Lighting used	Write Work Instruction for Vision System and Train Operators	3	
Hole Measurement	Improper Operator Training	Write Work Instruction for Vision System and Train Operators	3	
Hole Measurement	Part not Oriented Correctly	Write Work Instruction for Vision System and Train Operators	3	
Hole Measurement	**Wrong Program Used**	**Implement Use of scanning tool for Routing Barcode**	**1**	
Hole Measurement	**Data read incorrectly/wrong part data**	**Implement Use of scanning tool for Routing Barcode**	**1**	
Hole Measurement	**Parts sitting idle for too long at inspection**	**Train visco employees to use vision system / obtain new vision system for visco dept**	**2**	Seen from Gemba
Acid	**Acid composition unknown**	**Eliminate Acid Process - Standardize**	**1**	
Acid	**Acid strength unknown**	**Eliminate Acid Process - Standardize**	**1**	
Acid	**Acid not removed from part properly**	**Eliminate Acid Process - Standardize**	**1**	
Acid	**Part not properly dried**	**Eliminate Acid Process - Standardize**	**1**	
Acid	**Acid not heated**	**Eliminate Acid Process - Standardize**	**1**	
Acid	**Acid Heating Time to Stabilization**	**Eliminate Acid Process - Standardize**	**1**	
Acid	**Time in Acid too long**	**Eliminate Acid Process - Standardize**	**1**	
Degreaser	**Ultrasonics not used**	**Ultrasonics always used, so lock program**	**1**	
Degreaser	Wrong Degreaser Used	Test how new degreaser impacts hole dimensions	3	
Drilling Machine	Wrong Drill used for Target	Update drawings to show reference drill size target on vision system	4	Potential future 5S
Drilling Machine	Wrong Drill Program Selected	Update work instruction/re-training operators for Drilling Process	2	
Drilling Machine	**Drill toolbox not organized. Many operators keep drills at desk and not back in toolbox**	**Have operators put all drills back into toolbox once done using. Label all drill cases for measured drill size. Organize drawers with separators for drill size and drill type**	**1**	Complete 5S
Drilling Machine	Tool/Drill wear not Monitored	Have operators submit discs for measurement of hole. Look at variance across disc	2	
Drilling Machine	Burrs not removed after drilling	Update work instruction/re-training operators to ensure parts are deburred (drilling process)	2	
Drilling Machine	Broken drill	Write program to ensure that a missing hole is identified by vision system	4	
Other	Wrong Component Used	Bill of material reflect part number. Partial part number etched on part	4	
Other	**Rework Required**	**Eliminate Acid Process - Standardize**	**1**	
Other	No Instructions Provided	Engineering to Identify documents needed	2	
Other	Improper Training	Engineering and Manufacturing to come up with training plan/log (training schedule in	2	

	Prioritization Key	Impact	
		High	Low
Implement	Easy	1	2
	Hard	3	4

Navin_Ian_FishboneSol

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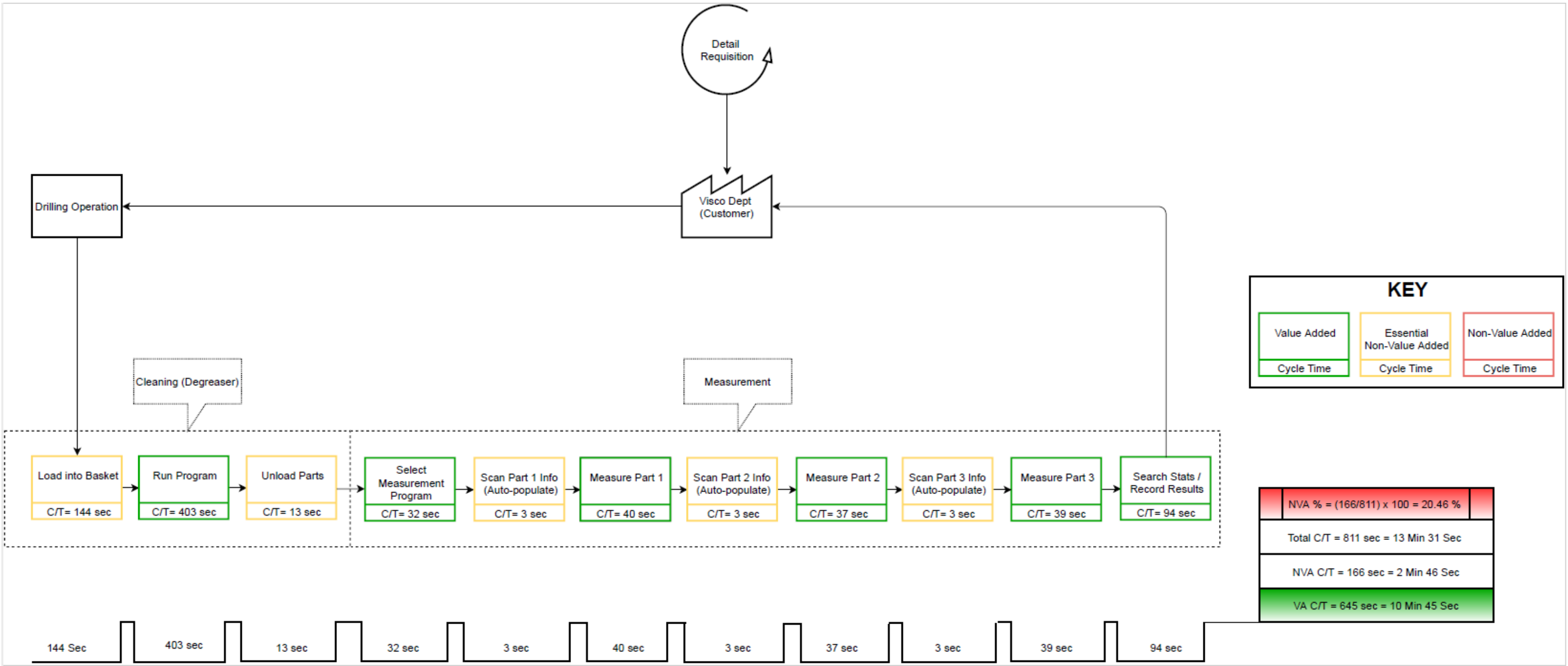
Future State VSM



NVA % = (166/811) x 100 = 20.46 %
Total C/T = 811 sec = 13 Min 31 Sec
NVA C/T = 166 sec = 2 Min 46 Sec
VA C/T = 645 sec = 10 Min 45 Sec

Navin_Ian_Future VSM

- When building the future state VSM,
  - Which of the two approaches did you use?
    - We ended up using a bit of both approaches. When building the future state VSM, we mapped what we wanted the future state to look like and then assessed what needed to be accomplished to achieve this future state. It was advantageous that we have a standard process for the degreaser already but having the degreaser VSM already mapped out for the current state, we were able to then look at areas of high non-value added and find solutions to make even the essential non-value-added turn over a quicker cycle time.
  - Which guidelines did you find useful?
    - Cellular manufacturing already exists to an extent for the drilling process, but parts were cleaned and measured in other departments. Now bringing the degreasing and vision systems to the Visco department, everything is central for the process. We eliminate a lot of non-value added, (i.e. the idle time for the parts to be measured) just by brining the systems to the department and training the personnel to use it. Quick changeover is used as well where the degreaser will be set to a standard cleaning time via a program and if a special program is needed, the department lead can make the changes as needed. We also use the standard work guideline within the new work instructions and process specifications that clearly define the steps and tasks needed to complete an operation, ensuring that all employees are performing these steps the same way. This leads to consistency in the drilling operation and how the parts are measured which will result in accurate results for the hole size, thus yielding lower scrap and rework.

Kaizen – 5S Event (Visco Dept. Drill Organization)

Kaizen Title: Visco Department Drill Organization (5S Event)

Team: Rob Brown

Kaizen Description: Organize and centralize all of the drills in the Visco department to reduce time spent looking for the correct drill to accomplish a hole target / flow rate.

Current State (description of problem w/waste found):

All the drills in the department are not organized or centralized. Many operators hoard drills in their desks which creates problems for operators needing a particular size. The drawers where the drills are located are not organized in any logical way, which makes finding drills difficult. Though drills are purchased to a certain size, they are not perfect, so drills are measured prior to use and after measurement, put into a case with the actual size. Different manufacturing methods may require a certain type of drill (twist or spade) and it is not clear within the drawer how to find them.

Kaizen Action:

- Three drawers have been created: 1. New Drills (unmeasured), 2. Measured spade drills, 3. Measured twist drills
- Set up all drawers with dividers and labeled dividers with drill range within that section (smallest in front to largest in back).
- All drills sorted and placed into the correct drawers
- All drills have been collected from operators and organized into labeled drill cases for the actual size. Drills placed in drawer 2 or 3.
- All operators trained to put drills into correct drawers and place measured drills in correct location

Future State (description of results & benefits):

The department is much more efficient and productive. The time to find and measure drills has reduced by 21% in one week trial. Some employees initially not happy giving up drills but are coming around to enjoy the drawers designated with pre-measured drills. Many employees happy since they can find drills faster and complete a job much easier. The organization prevents potential mix up of drills which could lead to rework and scrap.

Kaizen 1: Elimination of Acid Process - Standardize

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Kaizen Title: Elimination of Acid Process - Standardize

Team: Rob Brown, Ian Navin, and Greg Vereneau

Kaizen Description: Eliminate the acid clean process to standardize just using the degreaser cleaning process across all parts in the Visco department. Provide a large cost and time savings.

Current State (description of problem w/waste found):

Parts are sent to the acid room for an acid clean after already being cleaned in the degreaser. Consequently, the parts hole size is shifted from the target leading to flow problems which results in scrap and reworks. Total time to process using acid clean is 54 minutes and 44 second. This includes 69 seconds of transportation and 41 minutes and 28 seconds of acid heating.

Kaizen Action:

Transportation: To process using the acid, it takes the operator away from their work-station for 69 seconds to walk to and from the acid room

Waiting: Visco waits 41 minutes and 28 seconds just for the acid to heat and a total of 54 minutes and 44 seconds for the acid cleaning process

Over-Processing: The parts are shifted of the target hole size from the acid attacking the holes. Parts are already cleaned prior to going to the acid clean

Removed from all process specifications and work instructions. All routings marked up to remove acid clean. Routings on system for new printed jobs updated.

Future State (description of results & benefits):

Quantitative:

- Cost Reduction: Elimination led to 5x reduction in processing time = $3,408 per year cost estimate (processing only, not materials)
- Workforce Efficiency: Rework has dropped from 15% to 2% in a one-week trial period
- Quality: Sigma value from 1.18 (34,827 DPMO) to 2.23 (12,846 DPMO)
- Customer Impact: Expected to increase on – time delivery out of Visco department from 91% to 94%

Qualitative:

- Morale: Employees are happier not scrapping or reworking parts for a process out of their hands on parts they put a lot of effort into. More time and effort to put into other jobs.
- Simplification: Two routing operations and 14 process steps removed
- Standardization: One cleaning process for all discs in Visco department

Kaizen 2: Implementation of Barcode Reader

DMAIC

Kaizen Title: Implementation of Barcode Reader

Team: Tim Held, Ian Navin

Kaizen Description: Implement Barcode scanner to input part information into vision system. Extract statistical information from measurements.

Current State (description of problem w/waste found):

When operators using the vision system to measure the hole, they are required to input the part number and lot number. They currently type this in using a keyboard. When reviewing the statistical data for min, max, and average hole size of the disc, they need to re-type the same information. This is extra time, motion, and potential errors.

Kaizen Action:

Movement: There is wasted movement for the operator typing information in when they can just use a barcode scanner to scan the information from the routing.
Waiting: Typing the information increased the cycle time for the measurement, which the visco department is waiting for. Mistakes mean longer time to re-do the measurement and correct the error.
Defects: Improper information input will potentially lead to the wrong measurement information transfer to the visco department leading to potential scrap or rework.
Scanner implemented and programed to vision system.

Future State (description of results & benefits):

Implementation of the barcode scanner has reduced the part information input and statistical review for three discs from 2 minutes and 50 seconds to 1 minute and 43 seconds (~60% reduction). Errors in part information is expected to be zero, not including the potential of scanning the wrong job book which has not happened yet. Higher productivity and efficiency is accomplished. Morale is also boosted as assemblers feel more comfortable the correct measurement information. Inspectors are happy with the decrease in errors.

Kaizen 3: Visco Dept. Vision System Training

DMAIC

Kaizen Title: Train Visco Department on Vision System

Kaizen Description: Train the visco department assembler to use the vision system, so they don't have to rely on inspection. Incorporate a vision system into the visco department.

Team: Mike Sherwonit

Current State (description of problem w/waste found):

Visco operators must submit all B discs to be measured to final inspection where the vision system resides. Parts may sit idle until inspectors have the time to measure the parts. The Gemba found this to be around 152 seconds idle time, but this could be higher depending on inspectors' priorities. Visco operators must wait for the parts to be measured so they can continue their jobs.

Kaizen Action:

Transport: Parts must be transported out of the visco department to the final inspection department.
Waiting: Parts must sit idle until inspectors can get to parts. Training visco will free up inspectors, develop visco employees, and eliminate idle time.

All process specs updated to allow visco employees to utilize the vision system.

Requisition input for new vision system.

Future State (description of results & benefits):

Visco employees have been trained to use the vision system and measure their own parts. Future plans are to purchase a vision system for the visco department, so they don't have to go to another department to measure.
Idle time has been eliminated (152 seconds to 0 seconds). This drives down costs. Inspectors can focus on inspection jobs.
The visco employees are developed by learning new skills like using inspection equipment and reading statistics. Morale is boosted as visco employees enjoy the confidence of engineering to train them on new equipment and they don't have to wait for parts.

Kaizen Title: Default Ultrasonic Program

Team: Tim Held, Ian Navin

Kaizen Description: Standardization of default cleaning program in the degreaser to ensure parts are cleaned properly.

Current State (description of problem w/waste found):

When parts are cleaned in the degreaser, there are a few different programs to choose from. The proper program selection uses ultrasonics with specific time requirements in different vapor degreasing zones to properly remove drilling oil from the discs. Some parts in the shop (specials) require no ultrasonics as to not damage components but may not clean to the level required for the visco discs. There is no default program, just the last program selected and as a result, the wrong program is used on occasion which can impact the hole measurement and the bonding quality of the assemblies.

Kaizen Action:

Waiting: With the wrong program used, unnecessary waiting can occur. Default program ensures proper time for cleaning

Defects: Oil remaining on parts can throw off hole measurement and can lead to rework or scrap if parts (1. operator thinks hole is too small, then opens the hole, 2. operator thinks hole is meets target, but actually is too large).

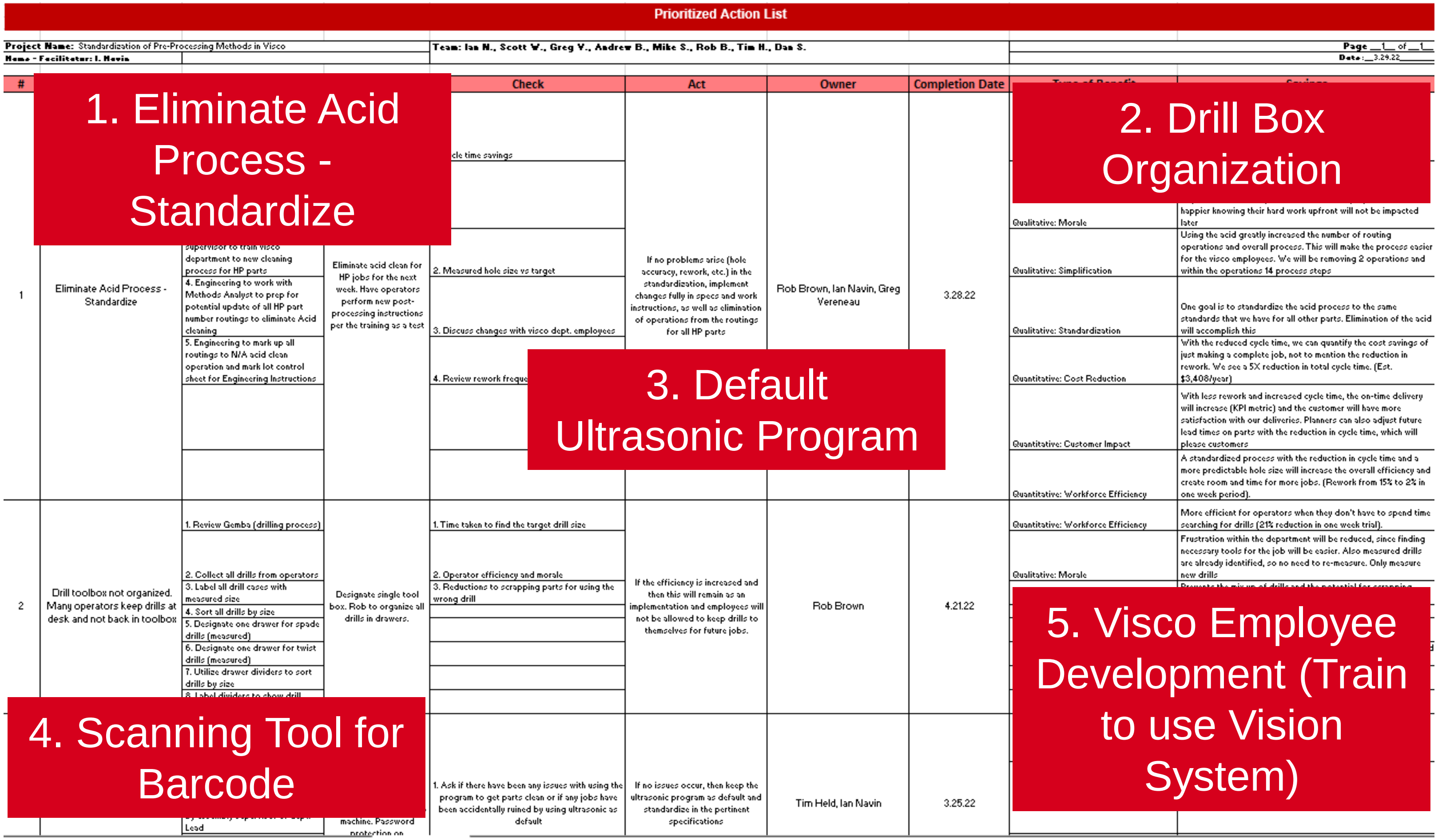
Pertinent process specs updated to reflect changes

Future State (description of results & benefits):

Ultrasonic program with correct times is set to default and locked (only supervisor has password). Sign on the cleaning machine to warn that the ultrasonics is default. If special cleaning is required, supervisor to change program. This simplifies many ultrasonic programs with differing times to just one.

PDCA – Prioritized Action List with Benefits

DMAIC



Prioritized Action List

Project Name: Standardization of Pre-Processing Methods in Visco

Name - Facilitator: I. Navin

Team: Ian N., Scott W., Greg V., Andrew B., Mike S., Rob B., Tim H., Dan S.

Page 1 of 1

Date: 3.29.22

#				Check	Act	Owner	Completion Date		
				cle time savings					
								Qualitative: Morale	happier knowing their hard work upfront will not be impacted later
		supervisor to train visco department to new cleaning process for HP parts		2. Measured hole size vs target				Qualitative: Simplification	Using the acid greatly increased the number of routing operations and overall process. This will make the process easier for the visco employees. We will be removing 2 operations and within the operations 14 process steps
1	Eliminate Acid Process - Standardize	4. Engineering to work with Methods Analyst to prep for potential update of all HP part number routings to eliminate Acid cleaning	Eliminate acid clean for HP jobs for the next week. Have operators perform new post-processing instructions per the training as a test	3. Discuss changes with visco dept. employees	If no problems arise (hole accuracy, rework, etc.) in the standardization, implement changes fully in specs and work instructions, as well as elimination of operations from the routings for all HP parts	Rob Brown, Ian Navin, Greg Vereneau	3.28.22	Qualitative: Standardization	One goal is to standardize the acid process to the same standards that we have for all other parts. Elimination of the acid will accomplish this
		5. Engineering to mark up all routings to N/A acid clean operation and mark lot control sheet for Engineering Instructions		4. Review rework freque				Quantitative: Cost Reduction	With the reduced cycle time, we can quantify the cost savings of just making a complete job, not to mention the reduction in rework. We see a 5X reduction in total cycle time. (Est. $3,408/year)
								Quantitative: Customer Impact	With less rework and increased cycle time, the on-time delivery will increase (KPI metric) and the customer will have more satisfaction with our deliveries. Planners can also adjust future lead times on parts with the reduction in cycle time, which will please customers
								Quantitative: Workforce Efficiency	A standardized process with the reduction in cycle time and a more predictable hole size will increase the overall efficiency and create room and time for more jobs. (Rework from 15% to 2% in one week period).
		1. Review Gemba (drilling process)		1. Time taken to find the target drill size				Quantitative: Workforce Efficiency	More efficient for operators when they don't have to spend time searching for drills (21% reduction in one week trial).
		2. Collect all drills from operators		2. Operator efficiency and morale				Qualitative: Morale	Frustration within the department will be reduced, since finding necessary tools for the job will be easier. Also measured drills are already identified, so no need to re-measure. Only measure new drills
2	Drill toolbox not organized. Many operators keep drills at desk and not back in toolbox	3. Label all drill cases with measured size	Designate single tool box. Rob to organize all drills in drawers.	3. Reductions to scrapping parts for using the wrong drill	If the efficiency is increased and then this will remain as an implementation and employees will not be allowed to keep drills to themselves for future jobs.	Rob Brown	4.21.22		
		4. Sort all drills by size							
		5. Designate one drawer for spade drills (measured)							
		6. Designate one drawer for twist drills (measured)							
		7. Utilize drawer dividers to sort drills by size							
		8. Label dividers to show drill							
		Lead	machine. Password protection on	1. Ask if there have been any issues with using the program to get parts clean or if any jobs have been accidentally ruined by using ultrasonic as default	If no issues occur, then keep the ultrasonic program as default and standardize in the pertinent specifications	Tim Held, Ian Navin	3.25.22		

PDCA

All other actions will be worked on later time for improvements. Time constraints did not allow for all to be completed.

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Control

Future State Basic Statistics

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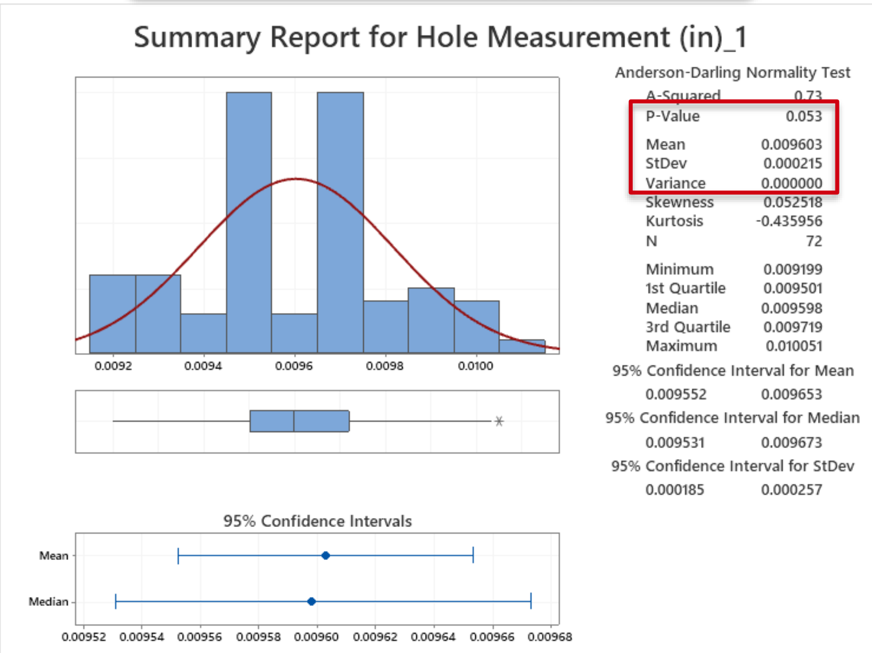
Current State

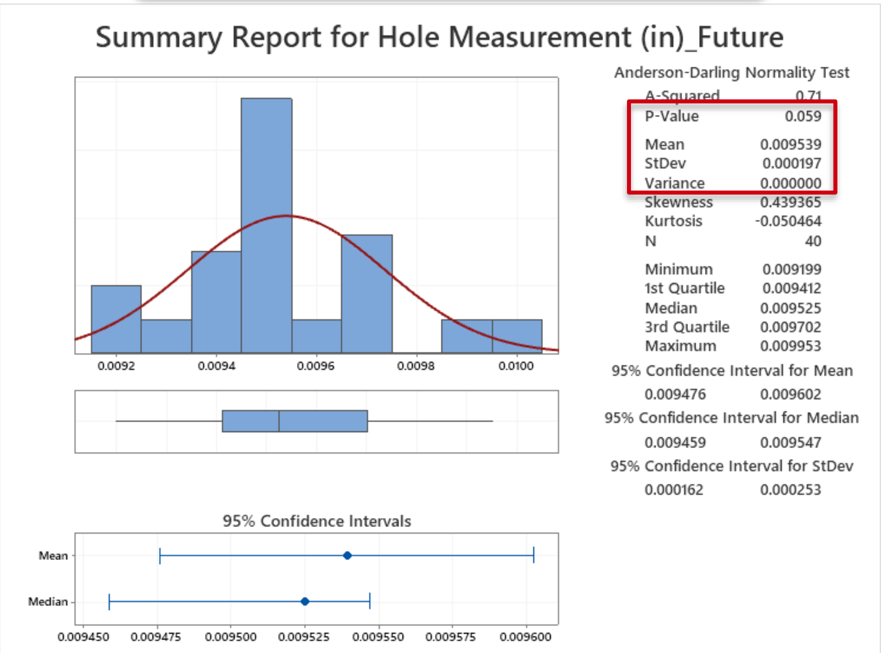
Data Normally Distributed
P-value = 0.053



Mean = 0.009603”
Standard Dev = 0.000215

Future State

Data Normally Distributed
P-value = 0.059

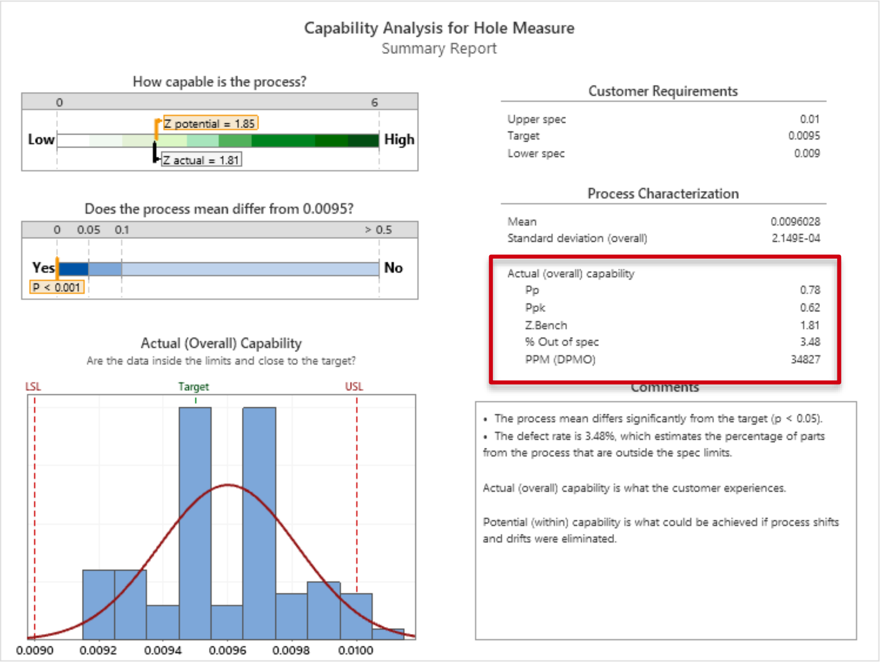


Mean = 0.009539”
Standard Dev = 0.00197

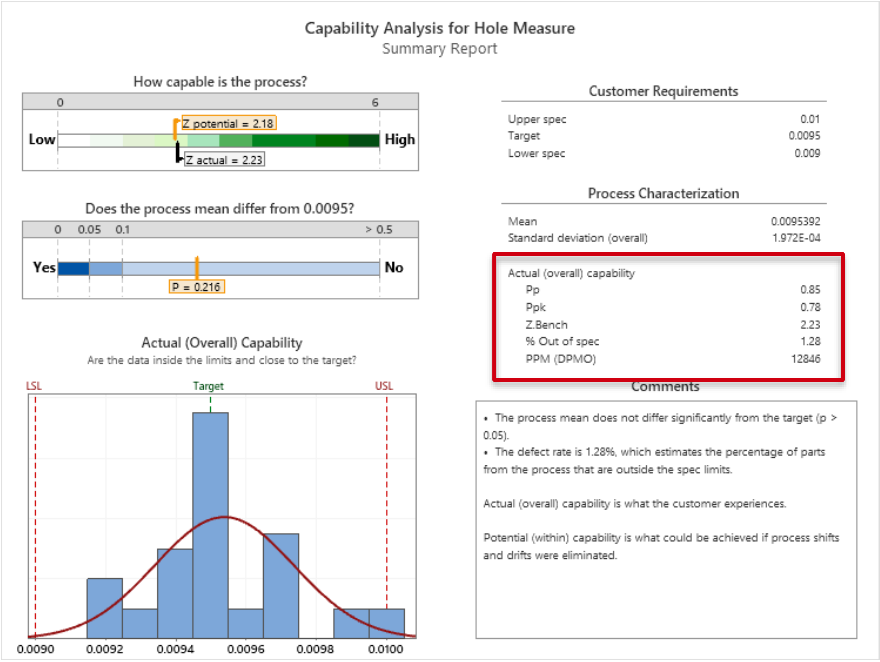
Future Capability Report …

DMAIC

Current State



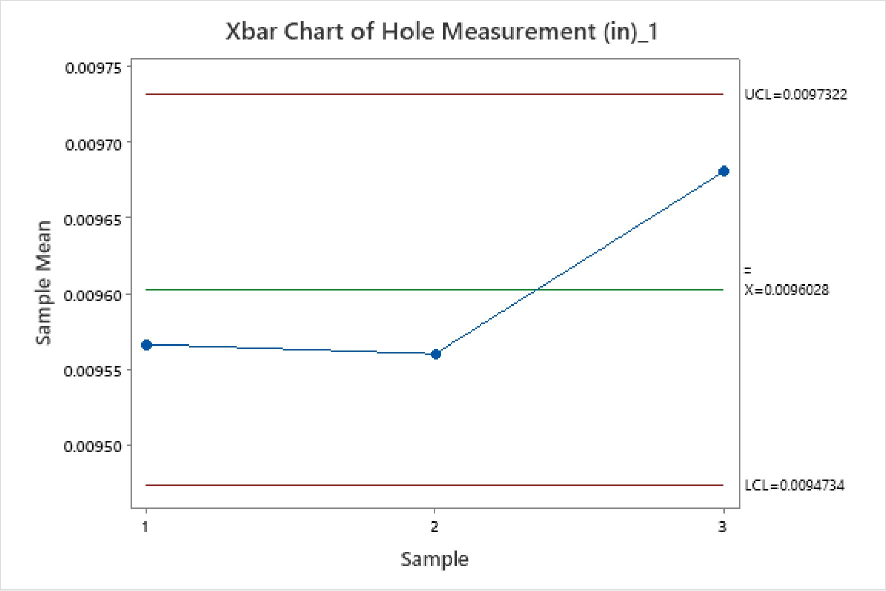
Future State



Future State X-Bar (SPC)

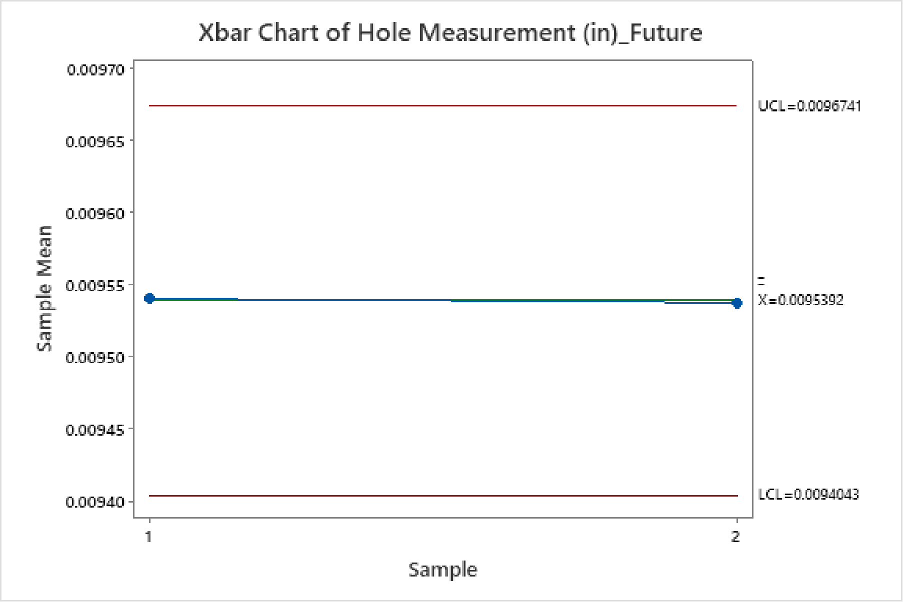
DMAIC

Current State
UCL = 0.009732
LCL = 0.009473



Current State Inaccuracy
0.009603 – 0.0095 = 0.000103

Future State
UCL = 0.009674
LCL = 0.009404



Future State Inaccuracy
0.009539 – 0.0095 = 0.000039

Future SPC Charts: I-MR Chart

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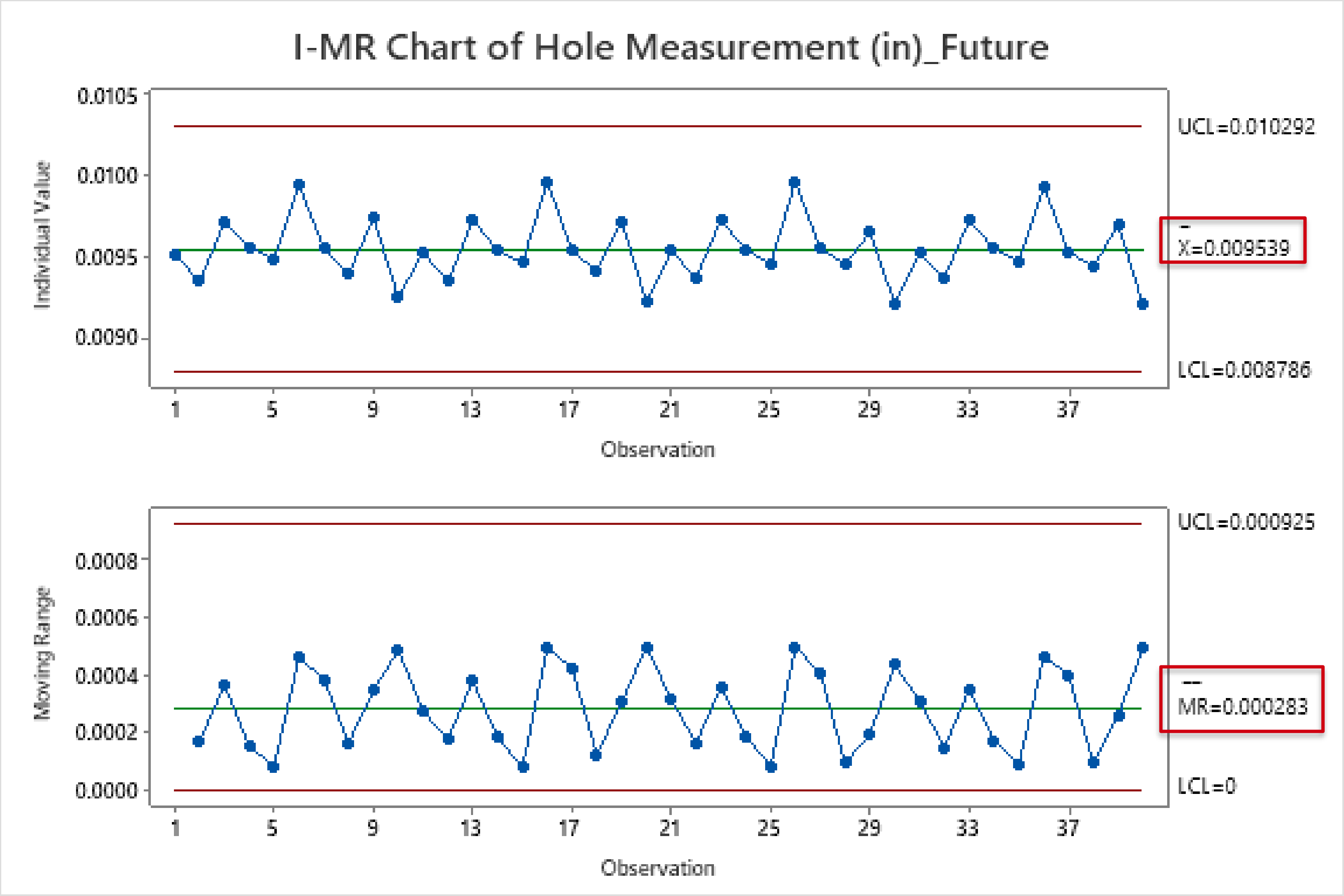

Future Capability Report Card

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Current State

Capability Analysis for Hole Measure
Report Card

Check	Status	Description
Stability	✓	The process mean and variation are stable. No points are out of control.
Number of Subgroups	i	You only have 3 subgroups. For a capability analysis, it is generally recommended that you collect at least 25 subgroups over a long enough period of time to capture the different sources of process variation.
Normality	✓	Your data passed the normality test. As long as you have enough data, the capability estimates should be reasonably accurate.
Amount of Data	!	The total number of observations is less than 100. You may not have enough data to obtain reasonably precise capability estimates. The precision of the estimates decreases as the number of observations becomes smaller.

Future State

Capability Analysis for Hole Measure
Report Card

Check	Status	Description
Stability	✓	The process mean and variation are stable. No points are out of control.
Number of Subgroups	i	You only have 2 subgroups. For a capability analysis, it is generally recommended that you collect at least 25 subgroups over a long enough period of time to capture the different sources of process variation.
Normality	✓	Your data passed the normality test. As long as you have enough data, the capability estimates should be reasonably accurate.
Amount of Data	!	The total number of observations is less than 100. You may not have enough data to obtain reasonably precise capability estimates. The precision of the estimates decreases as the number of observations becomes smaller.

Summary of Future State

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Stability

The process is shown to be stable in the future state.

Shape

The process shape does not necessarily look better, but this may be due to the amount of data collected. We do see a larger bin in the center target range which is a good indication that more data will yield a better shape, though both states are similar. The shape of the process has shifted closer to the target.

Spread

The spread for both processes is approximately the same. Though the standard deviation for the future state reduced to 0.000197 vs the current state of 0.000215.

Center

The future state process is much more centered to the target than the current state. There is still room for improvement, which can be conducted on the drilling process side. Just considering the improvements from the post-processing methods, the mean shifted from 0.009603 in the current state to 0.009539 in the future state.

FMEA Highlights

DMAI**C**

- Final FMEA is reflective of the final timeline of the course work. Further work will be done to finish the FMEA once all of the controls are put into place for all the actions in our action log.
- Highest RPN's as of this course work timeline include:
  - Drilled parts do not perform the same as drilled parts
  - The new degreasing fluid impact on the parts performance and dimensional targets
  - Holes in the B-Discs not present (flow metering device will not flow)
- Largest Mitigation Impact (so far..)
  - Acid strength not monitored was brought from RPN of 147 to 7 by the acid process elimination.

FMEA w/ Assump & Contsr

PM Lead	Ian Navin	Project	Pre-Processing Standardization for Visco Components	Latest update	April 11, 2022

Business Case

Our mission is to design and build state-of-the-art products that exceed customer's expectation for utility, performance, and quality. The Lee Company constantly strives to improve the product designs, the manufacturing process, and the quality system. The ultimate goal is zero defects and a satisfied customer. This process improvement will directly impact the quality of our product and the on-time delivery to our customers which will have a great impact on their satisfaction.

Problem Statement

Utilization of multiple pre-processing methods for similar products can lead to longer processing times, as well as unintentional performance issues of the assembly. Standardizing the pre-processing can reduce inefficiencies in both performance and lead time requirements.

Project Goal

The goal of this project is to standardize the pre-processing methods of the Visco Components. This goal was met! More work to improve the process is to be done, but the main objective was a success.

Customer CTQ(s)

The customer requires the assembled components from the batch processing to flow within the specified flow tolerance. They also require the parts to meet their required lead times.

Success Criteria

1. Pre-processing standardized
2. Processing Time/Cost Savings
3. Consistent flow performance of assemblies
4. Increased on-time delivery
5. Reduced Scrap Rates
6. Proper Instructions and Drawing updates for Visco and Inspection Department

Defect Definition

The defect that I will measure is the metering orifice size and consistency. The metering orifice size directly correlates to the flow performance. The consistency can be viewed by the process variation and the orifice size to the target mean.

Process(es) Affected

1. Pre-Processing Method (Cleaning)
2. Measurement

IN Scope

Metering hole consistency, pre-processing methods (materials, time, quantity), Visco Dept, Visco products

OUT Scope

Assembly and post-processing affect on flow performance, Furnace Dept., print tolerances, metering hole manufacturing process

Assumptions / Constraints (Top 5)

1. Assumption: Team implementation and deployment to continue after course
2. Assumption: Departmental Training on new Work Instructions will continue to be successful
3. Assumption: Parts that are drilled and parts that are etched will behave the similarly
4. Constraint: Intertek Audit will impact implementation

Target Benefits (Top 6)

1. 5X Reduction in Cycle time from standardization (~$3,408 yearly savings)
2. Target hole size inaccuracy reduced from 0.000103 to 0.000039.
3. Sigma value increased from 1.81 to 2.23 (DPMO shift from 34,827 to 12,846
4. Decrease Scrap and Rework Rates (Down from 15% to 2% in one week trial)
5. 62.28% Reduction in Non-value-added time
6. Employee Development increased and moral boosted concurrently

Schedule – Main Stages

Name	Baseline Finish	Actual Finish	Status	Notes
Define	1/31/2022	1/27/2022	Complete	
Measure	2/21/2022	2/21/2022	Complete	
Analysis	3/14/2022	3/14/2022	Complete	
Improve	4/4/2022	4/4/2022	Complete	
Control	4/18/2022		In Process	Project to Continue after course. Initial Control for course complete as of 4/16/22
PDCA	4/18/2022		In Process	Project to Continue after course. Initial PDCA for course complete as of 4/16/22

Project Team

Name	Role/Responsible	Commitment
Ian Navin	Project Lead	30%
Scott Whynall	Chief Engineer (Manager)	5%
Greg Vereneau	Group Manuf. Engineer	5%
Andrew Bellemare	Manuf. Engineer	5%
Tim Held	Production Manager	5%
Rob Brown	Production Supervisor	15%
Mike Sherwonit	Quality Engineer	10%
Dan SantaMaria	Group Vice President	3%

Final DICE

DMAIC

DICE Improve Phase					
Project Name:	Pre-Processing Standardization for Visco Components		Page __1__ of __1__		
Name:	Ian Navin		3/20/2022		
	DICE Equation	D + (2 x I) + (2 x C1) + C2 + E = Score			
section	Duration	Integrity	Commitment - C1 Senior Mgmt	Commitment - C2 Team members	Effort
criteria	If projects is: < 2 months, place 1 2 < D < 4 months, place 2 4 < D < 8 months, place 3 > 8 months, place 4	1 pt if – Capable leader Motivated team More than 50% of time dedicated 4 pts – If one of the above is missing 2 or 3 pts – if they are in between	1 pt – if need clearly articulated 2 pt or 3 pt – if neutral 4 pt – any signs of reluctance	1 pt – if employee is eager 2 pt – if just willing 3 pt or 4 pts – if anything else	1 pt – if 10 % over 2 pt – if 10-20 % over 3 pt – if 20-40 % 4 pt – if 40% and over
Score:	2	2	1	1	2
		Total Score:	11		
	7	14	17		28
	WIN		WORRY	WOE	

Navin_Final DICE

Control Plan

DMAIC

Control	Unit of Measure	Target / Spec's range	Frequency	Method	Control Owner
Orifice Size	Inches	0.0095" (0.0090" – 0.0100")	First Fret for each job	Basic Statistics, Capability Analysis, X-Bar	Rob Brown
C/T of Operations	Minutes and Seconds	Less than or equal to 14 Minutes	Each Job	Basic Statistics, I-MR	Rob Brown
Rework	Number of Frets per Job	0 to 1 Fret	Each job	Basic Statistics, Capability Analysis	Rob Brown
Scrap	Number of Frets	0 to 1 Fret	Each Job	Basic Statistics, Capability Analysis	Rob Brown

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Communication Plan

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Communication	Description	Technique	Timing	Owner	Recipients
New Processes Documentation (Process Specs, Work Instructions)	Documents sent around for approvals / edits	Paper Copy sent in folder	Starts 4/15. Need by 4/29	I. Navin, R. Brown	S. Whynall, T. Held, D. SantaMaria, M. Sherwonit, G. Vereneau
Release of Documents	Notification of new document releases for use on production floor	E-Mail	5/2	I. Navin	S. Whynall, T. Held, D. SantaMaria, M. Sherwonit, G. Vereneau, R. Brown
DMAIC Project success and improvements, future planning	Presentation (virtual)	Microsoft Teams	4/22	I. Navin	S. Whynall, T. Held, D. SantaMaria, M. Sherwonit, G. Vereneau, R. Brown
Process Implementation and Controls	Team meeting to discuss roll out of implementation and controls and feedback from the production floor	Microsoft Teams	Bi-Weekly Starting 4/15	R. Brown, T. Held	I. Navin, S. Whynall, D. SantaMaria, M. Sherwonit, G. Vereneau

Training Plan

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Topic	Description	Technique	Timing	Trainer	Recipients
Use of Vision System	Scanning part and Lot number, orienting parts, ensuring correct program is selected, running program, extracting statistics	In Person Training	3/21, 2pm	I. Navin, M. Sherwonit	Visco Department, Final Inspectors
New Routing Process (Elimination of Acid)	Teach employees new routing	In Person Training	3/21 9am	R. Brown	Visco Department
Storage and measuring of drills	Teach new way to store, measure, and organize drills in central location	In Person Training	3/21 9am	R. Brown	Visco Department
Use of Ultrasonic Cleaner	Default program set to use ultrasonics. See department lead for changing of program for special parts	In Person Training	3/21 9am	R. Brown	Visco Department
Process Specs and WI for Visco Dept	New tooling, methods, routing	In Person Training	3/21 9am	R. Brown	Visco Department
New Degreaser Fluid	Results of new fluid and how to implement	Teams Meeting	3/30 10am	I. Navin	T. Held, R. Brown, S. Whynall
New Drawings	Teach operators to use new drawings. Location of reference drill size for each flow rate	In Person Training	6/17	I. Navin, R. Brown	Visco Department

Deployment Strategy

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#	Stage	Timeframe	Completion Date	Comments
1	PDCA Piloting (Initial Kaizens/5S)	1 Week	3/30/22	Complete
2	Implementation Plan	2.5 weeks	4/18/22	Complete
3	Management Buy-In (Initial Kaizens/5S)	1 day	4/22/22	Initial Buy-In
4	Document Improvements/Controls	2 weeks	4/29/22	In Process
5	Training (Initial)	4 days	5/5/22	In process with training from Kaizens
6	Metrics (Initial)	2 weeks	5/19/22	Bi-weekly updates
7	PDCA Piloting (Remainder)	2 weeks	06/3/22	Many to start after audit
8	Management Buy-In (Remainder)	2 days	6/7/22	
9	Documentation Improvements/Controls	4 weeks	7/5/22	Bottleneck = Drawings
10	Training (continued)	4 days	7/11/22	
11	Metrics (continued)	4 weeks	8/8/22	Continuation from # 6 bi-weekly for additional timeframe implementing new Buy-in

Customer Satisfaction

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How was my customer kept in the loop during the project?

My customer was the Visco Department. They were informed about this project at the start and were involved in many steps such as producing parts for the Gage R&R, the Gemba, and the trials of implementation.

Does this project satisfy the customer's needs?

This project does satisfy the Visco department as they have reduced cycle times, more consistent flowing parts, a reduction in rework and scrap, and they all were able to learn new skills such as using the vision system to measure parts.

What did you place as a monitoring feature in your project to ensure customer satisfaction going forward?

Moving forward, the Visco Department will be able to monitor the orifice size of their parts using the vision system in conjunction with the basic statistics, x-bar charts, and capability analysis. We will also use basic statistics and the capability analysis to monitor the rework and scrap moving forward. The cycle time will be monitored with basic statistics and the I-MR chart on a job-by-job basis.

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Lean Six Sigma DMAIC Lessons Learned

Project Name:	Standardization of Pre-Processing Method in Visco	**Attendees**: I. Navin, S. Whynall, M. Sherwonit, G. Vereneau, T. Held, R. Brown	**Page** __1__ of __1__
Prepared by:	I. Navin		**Date**: __________4.7.22________

Stage	Type	Description	Recommendation
select dropdown	select dropdown	briefly explain the incident that made you want to point it out	what do you propose to do next time if this happens again
Define	Problem	During the define phase, the group was a bit optimistic as to what we could accomplish in the short course time-frame. Vacations, priority production issues not considered	Realistically define what we want the project to accomplish. It is better to accomplish one task in a quick manner than to try and accomplish many tasks that will get lost during the project. Under promise and over deliver. Have more forethought considerations to team availability in the project timeframe. Can always open a new project for other items of consideration
Measure	Success	The vision system is an excellent system to use for measuring the frets	Utilize this vision system for all other frets to ensure we are hitting the target hole size. Write programs if necessary
Measure	Problem	The timeframe for production to obtain discs for this phase was longer than anticipated	Work more closely with Rob (Assembly supervisor) and Tim (Production supervisor) to plan out the prioritizations within the department to ensure the project does not fall behind
Analysis	Success	Minitab was an excellent source for analyzing six sigma systems, especially looking at the capability of a process or system	Obtain more seats for Minitab (at least one per group). Currently only accessible to Quality Department
All	Success	Production floor employees kept in the loop from the start of the project throughout many stages. They work the process everyday and provide a lot of great feedback that Engineering may not consider (especially during the Gemba). This also allows the employees to feel like their voice is heard and they take more pride in their work knowing they had a voice in the changes that have occurred.	Continue doing this for each project moving forward. Though not everything will be able to be implemented, keeping the production employees engaged allows them to accept changes more readily than resist the changes
All	Success	Weekly meetings with clear agendas and a summary with action items in the meeting minutes keeps the conversation on track and many times ended the meeting early	Instill in all meeting organizers the importance of agendas and clear action items. Everyone's time is very valuable. No need for unnecessary conversations that add no value to the project
Improve	Success	Scanning tools were used to input part number and lot data. This increased accuracy of the inputs and decreased time significantly	Implement scanning tools anywhere possible so that accurate information is input. Typing introduced human error. Especially important for proper lot traceability

Navin_Lessons Learned

Wall of FAME

DMAIC

5X Reduction in Cycle time (~$3,408 yearly savings)

Target hole size inaccuracy reduced from 0.000103 to 0.000039.

Sigma value increased from 1.81 to 2.23 (DPMO shift from 34,827 to 12,846

Employee Development increased and moral boosted concurrently

Decrease Scrap and Rework Rates (Down from 15% to 2% in one week trial)

62.28% Reduction in Non-value-added time