

# Application of Value Analysis/Value Engineering principles to Cylindrical Lock Product

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Bangalore, India**

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**ALLEGION™**

PIONEERING SAFETY™



# Agenda

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Allegion Intro

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Project Background

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VAVE Approach & Methodology

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Conclusion

# Redefining Security

We're a team of experts with a common goal:

Protect today.

Innovate for tomorrow.

Never settle for the status quo.

Our pioneering brands are redefining security, inventing new technology that keeps people safe wherever they are – from home to work to school. Focusing on security around the door, we are at the leading edge of the convergence of technologies, whether mechanical, electronic, cloud solutions, or many more yet to be envisioned.



**ALLEGION™**



# We are Allegion™

## About Allegion

- 25+ brands
- 130 countries
- 700+ patents
- 7,000 channel partners
- 8,500+ employees
- 1 Allegion

Just a few of Allegion's key products and solutions

### Electronic Locks & Door Openers

Our easy-to-install-and-secure solutions include electronic keypad locks, electromagnetic locks, keyless locks, standalone and networked lever, locks and door openers.



### Access & High End Solutions

Readers and credentials offer smart, multi-technology solutions for controlling access anywhere. For those needing more security, we offer fire safety, biometrics, video, and other advanced solutions.



### Wireless Devices

Wireless readers, reader interfaces, gate kits and elevator control kits are ideal for remote and hard-to-wire applications.



### Other Devices

To see our full line of product offerings, please visit: [allegion.com](http://allegion.com)

Redefining Security

### Health & Accessibility

Innovative design and operating mechanisms aid safety, health and comfort.



### Mechanical Locks, Doors, Exit Devices and Push Bars

Hardware that addresses not just safety and security needs, but also building safety codes, and the need for quiet spaces.



# Project Background



# Project Background

ND is a major cylindrical lock product in Schlage commercial portfolio which offers a variety of functions. Schlage offers Cylindrical lock to suit competitor key systems.

One of those offerings was having performance issues and the end result was the product was put “On Hold”

## Major customer complaints

- Push Button not working
- Very difficult to install

## Next Steps

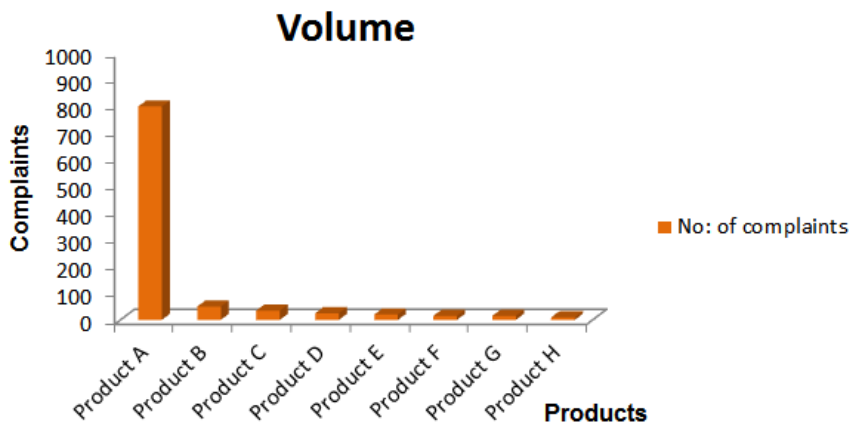
- Root Cause Analysis
- Competitive Analysis
- Value Engineering Study



# Pre-Workshop

# Pre-Workshop

## Basis of Selection



## High Level Objectives

- Improve Functionality
- Lower the product cost

## Resources

Team Member	Title	Location
Leif Selstad	Product Management Leader	Carmel
Greg Hebner	Product Manager	Colorado
David Hurlbert	Engineering Manager	Colorado
Subbiah G	Mechanical Engineer	Bangalore
Snehil Solanki	Mechanical Engineer	Colorado
Randy Davis	Test Technician	Colorado
Steve Couch	Technical Support	Colorado
Yelenia Heras	Planner	Mexico
Oscar Adrian Ibarra	BOM Leader	Mexico
Roberto Rodriguez	Quality & Manufacturing	Mexico
Elvira Silva	BOM Leader	Mexico
Elfego Ubaldo	SQE	Mexico

# Information Phase

## Challenges in the current product

Mis-Alignment between components

Difficult to install

Difficulty in assembling the levers

Interference (driver bar on lever catch) issues

Push button activation issue



# Information Phase

Component	Existing Cost (\$)
A	9.3
B	7.10
C	2.18
D	2.12
E	2.25
Total	22.95

- Components 'A' & 'B' have complex features machined-in for assembly purposes
- Handling of component 'C' in the factory was challenging as they undergo various secondary operations

# Information Phase

## Teardown Objective:

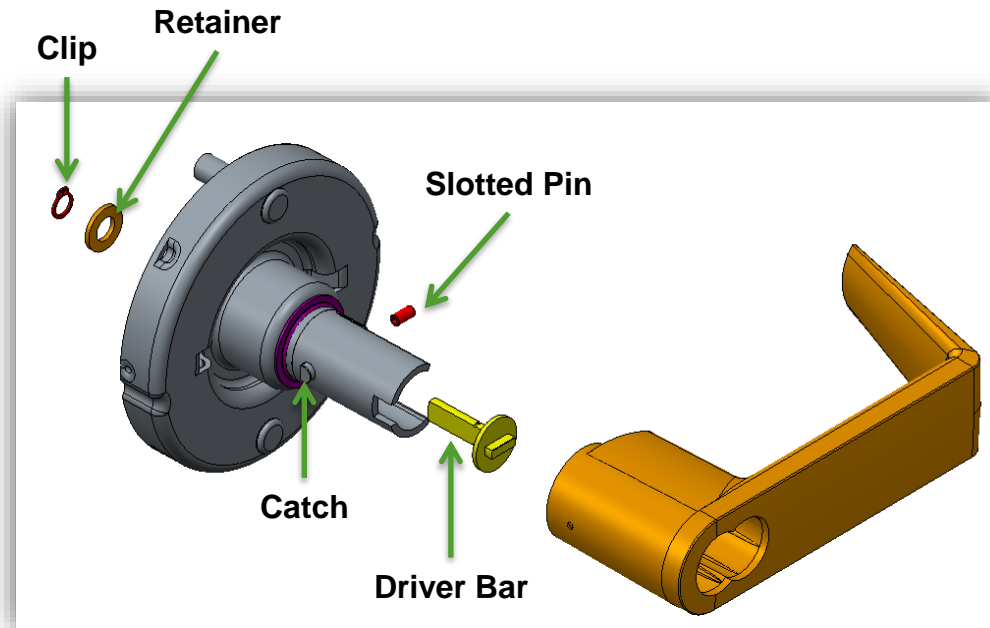
- Perform competitor benchmarking analysis
- Identify key design contributors across our and competitor products
- Completed Strengths Weaknesses Opportunities Threats (SWOT) analysis

Features	Current Product	Competitor A	Competitor B	Competitor C	Competitor D
Driver Bar Attachment	Within Spindle (with 4 components)	Press fit	Steel Screw Cap	Push and fit two legs	Within Spindle
Ease of Assembly	No	Yes	Yes	Yes	No
Ease of Installation	No	Yes	Yes	Yes	Yes
Cost	High	Low	High	Low	High

# Functional Analysis Phase

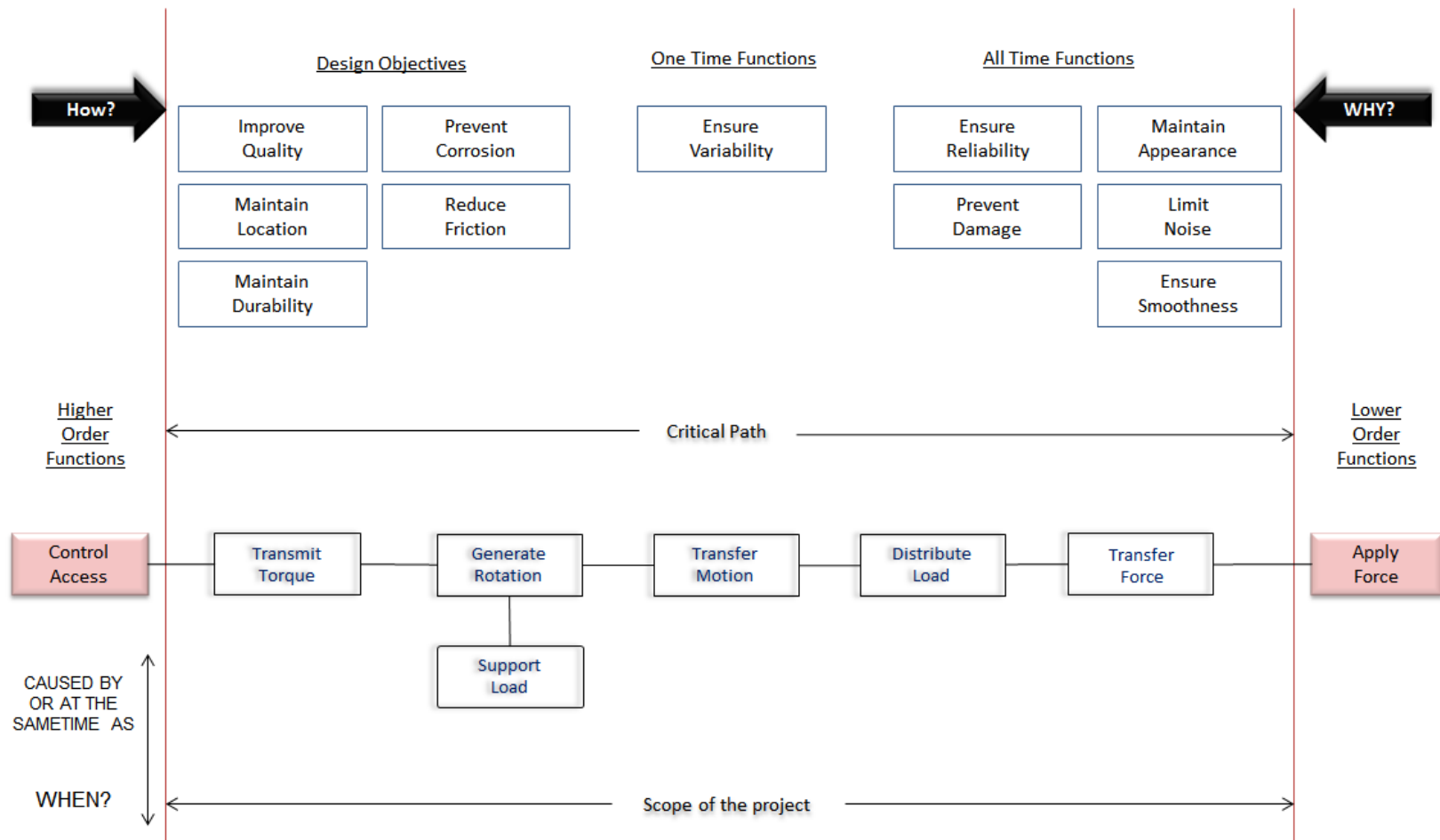
## Identified Random Functions

Component	Function		Basic/Secondary
	Active Verb	Measurable Noun	
Driver Bar	Transmit	Torque	<b>Basic</b>
	Maintain	Location	Secondary
	Prevent	Corrosion	Secondary
	Reduce	Friction	Secondary
	Ensure	Smoothness	Secondary
	Distribute	Load	Secondary
	Ensure	Variability	Secondary
	Transfer	Motion	Secondary
	Ensure	Reliability	Secondary
	Limit	Noise	Secondary
	Generate	Rotation	Secondary
	Support	Load	Secondary
	Maintain	Appearance	Secondary
	Maintain	Location	Secondary
	Slotted Pin	Maintain	Location
Distribute		Load	Secondary
Maintain		Durability	Secondary
Support		Load	Secondary
Limit		Noise	Secondary
Ensure		Smoothness	Secondary
Retainer	Maintain	Location	<b>Basic</b>
	Reduce	Friction	Secondary
	Distribute	Load	Secondary
	Support	Load	Secondary
	Maintain	Durability	Secondary
	Improve	Quality	Secondary
	Transfer	Force	Secondary
Catch	Maintain	Location	<b>Basic</b>
	Prevent	Damage	Secondary
	Support	Load	Secondary
	Ensure	Smoothness	Secondary
	Limit	Noise	Secondary
	Maintain	Appearance	Secondary
	Distribute	Load	Secondary
Clip	Maintain	Location	<b>Basic</b>
	Transfer	Force	Secondary
	Maintain	Durability	Secondary
	Distribute	Load	Secondary



# Functional Analysis Phase

## FAST Diagram



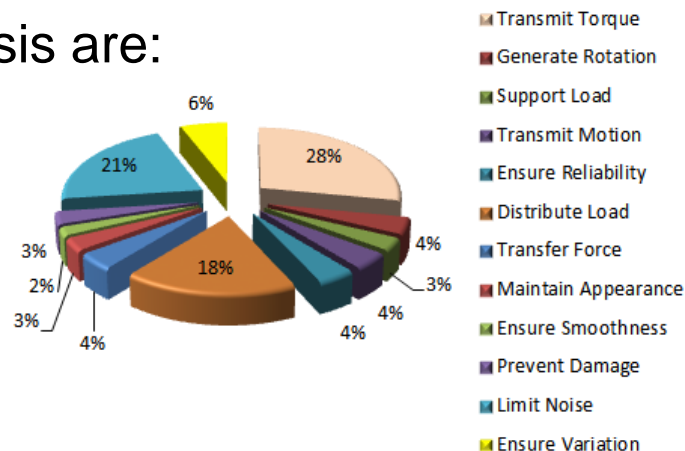
# Functional Analysis Phase

## Function Cost Worth Analysis

Function		Existing cost \$	Worth \$	Achieving Worth	Value Gap (Cost-Worth)	Value Index (Cost/Worth)	Rank
Active Verb	Measurable Noun						
Transmit	Torque	A	A1	Alternate design	7.23	4.65	1
Generate	Rotation	B	B1	Combine Parts	0.6	2.35	9
Support	Load	C	C1	Material Change	1.025	2.64	5
Transfer	Motion	D	D1	Optimize design	1.1	2.59	4
Ensure	Reliability	E	E1	Optimize design	0.65	1.73	8
Distribute	Load	F	F1	Optimize design	4.25	3.49	3
Transfer	Force	G	G1	Optimize design	0.85	2.35	6
Maintain	Appearance	H	H1	Alternate design	0.25	1.60	11
Ensure	Smoothness	I	I1	Material Change	0.15	1.00	12
Prevent	Damage	J	J1	Optimize design	0.8	2.86	7
Limit	Noise	K	K1	Alternate design	5.45	4.18	2
Ensure	Variability	L	L1	Optimize design	0.5	1.73	10
		\$33.38	\$10.52		\$22.86		

Top 3 prioritized functions from analysis are:

- Transmit Torque
- Limit Noise
- Distribute Load



# Creativity Phase by Functions

## IDEAS BY FUNCTION

F  
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s

**Transmit  
Torque**

Heat Treated Steel  
Casted Steel  
Increase the Area of Section  
Use longer bar  
Machine the profile out of solid bar

**Limit  
Noise**

Use Snap fit or tape  
Weld component  
Use Magnet  
Stake Component  
Use Threads

**Distribute  
Load**

Use Screw  
Increase Bearing surface  
Round profile for surface contact  
Design guiding features



Total Ideas generated = 67  
Short listed ideas = 14



# Evaluation Phase



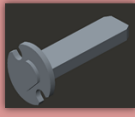


Cut-off Point = 30								
Idea Feasibility Ranking - Function "Transmit Torque"								
Ideas from Creative Phase	Criteria						Total Points	Ranking
	Ideas	Technical Feasibility	Implementation Probability	Implementation time	Tooling Costs	Estimated Cost Benefits		
	Concept 1	6	6	6	5	6	29	8
	Concept 2	6	7	6	6	4	29	5
	Concept 3	7	3	5	2	5	22	14
	Concept 4	6	6	6	6	7	31	3
	Concept 5	8	3	6	6	5	28	9
	Concept 6	6	8	5	6	2	27	10
	Concept 7	8	5	6	6	7	32	2
	Concept 8	8	6	6	4	6	30	4
Concept 9	6	3	5	3	8	25	11	
Concept 10	5	8	7	5	8	33	1	
Idea Feasibility Ranking - Function "Limit Noise"								
Ideas from Creative Phase	Criteria						Total Points	Ranking
	Ideas	Technical Feasibility	Implementation Probability	Implementation time	Tooling Costs	Estimated Cost Benefits		
	Concept 1	6	5	3	6	4	24	13
	Concept 2	7	4	3	6	3	23	14
	Concept 3	8	5	5	7	4	29	6
	Concept 4	5	8	8	5	6	32	2
	Concept 5	4	7	6	4	5	26	9
	Concept 6	9	6	5	6	4	30	3
	Concept 7	3	7	6	5	5	26	11
	Concept 8	8	7	8	7	8	38	1
Concept 9	6	7	6	4	5	28	7	
Concept 10	5	6	3	7	8	29	5	

# Evaluation Phase






## Weighted Criteria – Decision Matrix

Criterion Number	Enter Criteria Below	Meet ANSI/BHMA A 156.02 Grade 1 Requirements	Door Range	Fit standard door prep	Max cost delta from current function	Meet push button cycle requirements	Meet grade 1 door slam requirements	Fewest Additional Installation Steps	Ease of Installation	Better Alignment	Row Total
1	Meet ANSI/BHMA A156.02 Grade 1 Requirements	1	1	1	0.2	0.2	1	0.33	5	10	
2	Door Range	1	1	1	1	1	1	1	1	8	
3	Fit standard door prep	1	1	1	1	1	1	1	1	8	
4	Max cost delta from current function	1	1	1	0.2	0.2	0.2	0.2	5	9	
5	Meet push button cycle requirements	5	1	1	5	5	0.2	0.2	0.2	9	
6	Meet grade 1 door slam requirements	5	1	1	5	5	1	1	1	8	
7	Fewest Additional Installation Steps	1	1	1	5	5	1	1	1	8	
8	Ease of Installation	3	1	1	5	5	1	1	1	5	
9	Better Alignment	0.2	1	1	0.2	5	1	1	1	5	

## Function – Transmit Torque

Concepts						
Critical Needs	Weight Factor	Existing Design	Concept 1	Concept 2	Concept 3	Concept 4
Meet ANSI/BHMA A156.02 Grade 1 Requirements	10					
Door Range	8					
Max cost delta from current function	8					
Meet push button cycle requirements	9					
Meet grade 1 door slam requirements	8					
Fewest Additional Installation Steps	8					
Ease of Installation	5					
Fit standard door prep	5					
Better Alignment	5					
Cost is inline or less than the existing products	8					
<b>Score:</b>		<b>208</b>	<b>370</b>	<b>458</b>	<b>546</b>	<b>364</b>

## Function – Limit Noise

Concepts						
Critical Needs	Weight Factor	Existing Design	Concept 1	Concept 2	Concept 3	Concept 4
Meet ANSI/BHMA A 156.02 Grade 1 Requirements	10					
Door Range	8					
Max cost delta from current function	8					
Meet push button cycle requirements	9					
Meet grade 1 door slam requirements	8					
Fewest Additional Installation Steps	8					
Ease of Installation	5					
Fit standard door prep	5					
Better Alignment	5					
Cost is inline or less than the existing products	8					
<b>Score:</b>		<b>208</b>	<b>370</b>	<b>410</b>	<b>576</b>	<b>412</b>

Concepts	Weight Factor
Meet ANSI/BHMA A156.02 Grade 1 Requirements	10
Door Range	8
Fit standard door prep	8
Max cost delta from current function	9
Meet push button cycle requirements	9
Meet grade 1 door slam requirements	8
Fewest Additional Installation Steps	8
Ease of Installation	5
Better Alignment	5
Cost is inline or less than the existing products	8

Weighting Factor: 1 - 10  
 10 = Most Critical  
 1 = Least Critical

Score: 0.1 - 9  
 0 = No Effect  
 1 = Minimal or Poor  
 3 = Average or Moderate  
 9 = Highest or Absolute

# Development Phase

## Engineering Analysis of the concept

- Modelling & Drafting
- Design Failure Mode & Effect Analysis (DFMEA)
- Finite Element Analysis
- Technical Risk Analysis
- Tolerance Analysis
- Concept Validation Testing



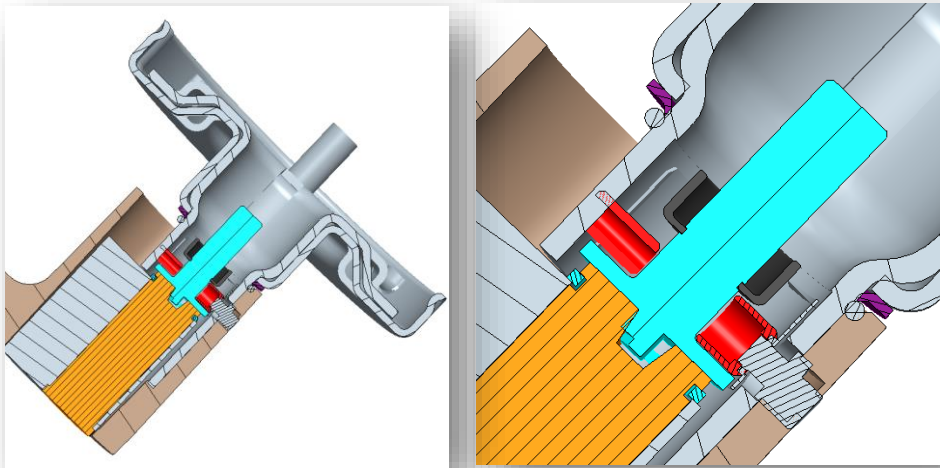
Tested Samples

Samples passed all tests

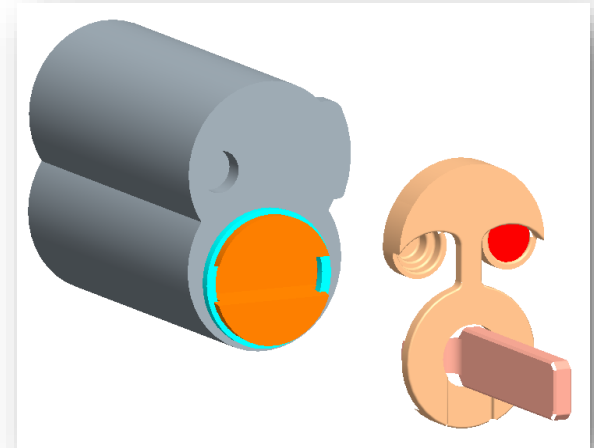
# Presentation Phase

- Prepared Project Report with benefits identified
- Design review with the cross-functional team was completed
- Approvals from necessary stakeholders was obtained

Before VAVE

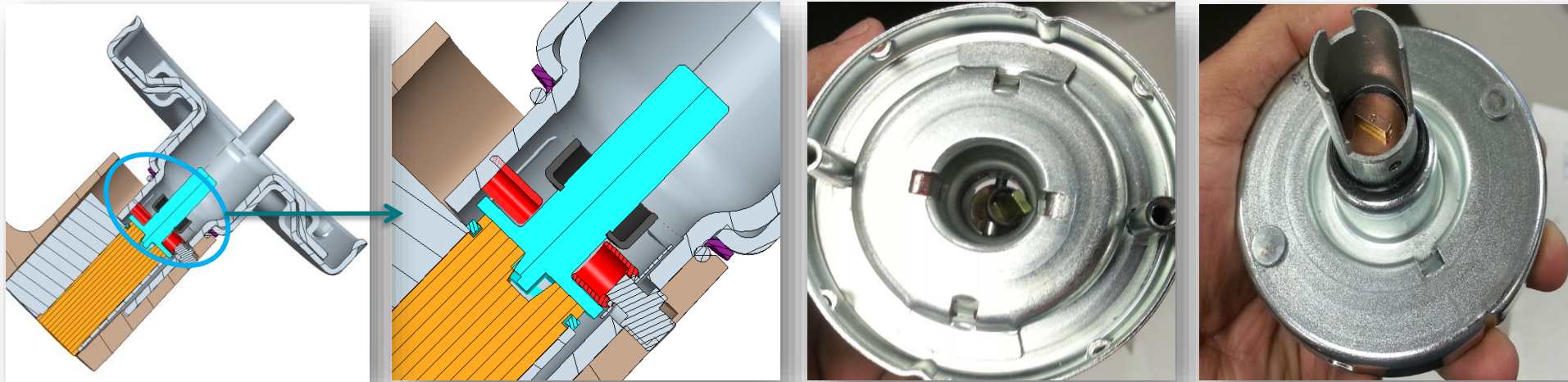


After VAVE



# Presentation Phase

## Existing Design



## New Design



# Presentation Phase

Component	Existing Cost (\$)	New Cost (\$)
A	9.3	7.30
B	7.10	
C	2.18	
D	2.12	
E	2.25	
F		5.63
G		4.25
H		0.75
Total	22.95	17.93

- Overall total **product savings** of **\$5.02** per lock assembly
- **Part Number Count improved** by 1 less component per lock assembly
- 1 less part results in **additional savings** related to drawing control, quality, logistics, packaging, assembly and material labor savings, etc.

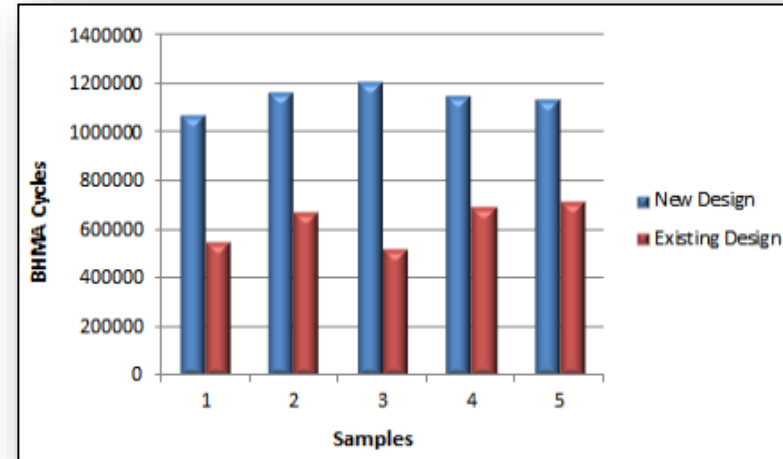


# Implementation Phase

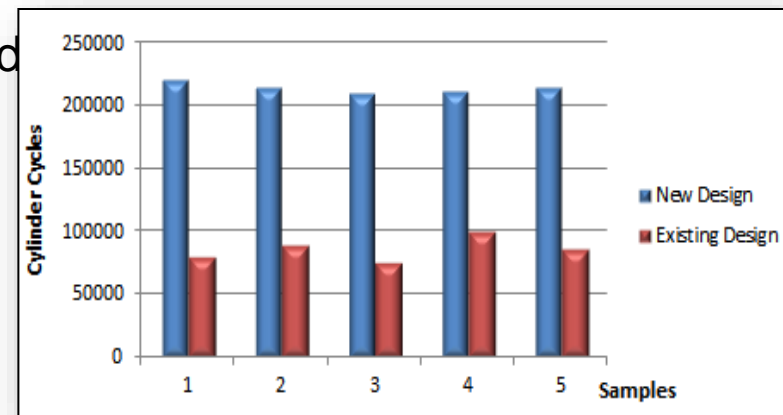
## Steps Completed in Implementation Phase:

- Finalized Design
- Released Purchase Order for tooling
- Tooling Developed
- Design Validation Testing
- First Article Inspection Approved
- Pilot Run & Production Parts (PPAP) Approved
- Manufacturing Readiness
- Product Launched

### BHMA Cycle Test



### Cylinder Cycle Test



# Post Workshop Audit

## Benefits

- \$136,000 in annualized savings
- Improved functionality
  - Component alignment issues resolved
  - Easier installation
  - Reduced plant assembly issues
  - Activation and interference issues resolved

**Product Performance is monitored.  
Customer is delighted with the quality of performance**



# Conclusion

- An effective collaboration of Root Cause Analysis and VAVE process contributed in developing a robust design that addresses.
  - A major customer dissatisfaction
  - Time required to Install
- This process contributed in revenue generated in terms of missed opportunity.

