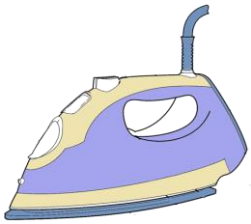
Value Analysis of Steam Iron for Cost Optimization



About The Authors

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Mr.Sunny Dharmajidnyasu, holds a Bachelor degree in Mechanical Engineering with over 4 years of professional experience in field of Design and Development, Value Analysis and Value Engineering, TDBM.

Abstract :

Tata Technologies founded, in 1989, enables ambitious manufacturing companies to design and build better products through engineering services outsourcing and the application of information technology to product development and manufacturing enterprise processes.

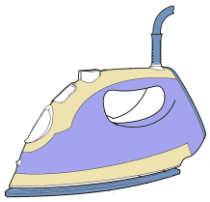
In this highly competitive market, Industries strives hard to meet the requirements of the customers and tries to reduce overall cost by developing new alternatives, Value Engineering technique helps to achieve such goals.

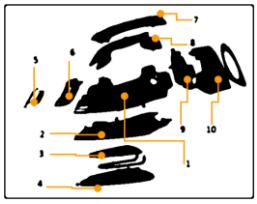
This project narrates how usage of Value Engineering technique helped to find avenues for improvement in a steam iron and reduce the cost, making it a competitive product in the market.The product undertaken is a highly optimized design, belongs to one of the well renowned global organization and had already undergone multiple cost reduction activities.

The Value Engineering study resulted in saving potential of arround Rs.1.46 Cr (199K USD) per year with minimum changes in toolings & without changing asestatics of the product and maintaining the performance.

1. Introduction

1.1 Introduction to steam iron





1.Main Body(water tank)
2.Inner Housing(Skirt)
3.Sole plate Cover
4.Sole Plate
5.Fill Cover
6.Front Cover
7.Handle Upper
8.Handle Lower
9.Reel frame
10.Rear cover

Fig1.1: Exploded view of an Electric Steam iron

1.2 Working Principle

A steam iron relies on a basic combination of heat, pressure and steam to remove wrinkles from clothes. When an electric current is passes through a coil (or any other heating element present in the iron), it gets very hot. This heat is then transferred to the base plate (the smooth, flat surface that you place against clothes while ironing) through conduction. However, if the iron ~~is~~ continuously draw electricity from power supply, the heating element continues to get hotter and can burn the cloth. Therefore, thermostats are deployed to control the temperature.

Selection of Project :

The purpose of this project is to identify opportunities for savings of 10% or Rs. 45 per steam iron by using Value Methodology for making it cost competitive in domestic market.

Cross Functional Team :

Team Member	Role	Department
Bharat Waghmode (VMA)	Team Leader	Project Manager – VAVE
Prasad Talathi	Team Member	Head - Costing & Sourcing
Avinash Bhosale (VMA)	Team Member	Design
Sunny Dharmajidnyasu	Team Member	Design
Akhil Desai	Team Member	Manufacturing
Juee Deshpande	Team Member	Electrical & Electronics
A. Gopalakrishnan	Team Member	Costing

Scope & Constraint :

Value Analysis of Steam iron excluding soleplate and thermostat.
Mentain performance and aesthetics of the product.

2. VE Job Plan:

The following phases of VE Job Plan were followed for this value analysis study.

2.1 Information Phase :

The information about the VE project is the backbone of the whole exercise. By gathering factucal data in information phase helped us to understand working and costing of product from system level to part level.

Typical information gathered was:

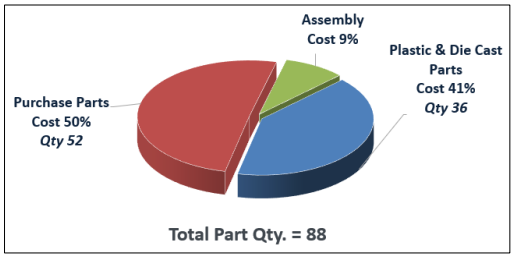
- Technical Specification and Feature Study
- Engineering BOM Study (Details of Material,Process,Overheads etc.)
- Costed BOM break up analysis - (Cost spread between sub-assemblies, parts)
- CAD data study
- Teardown Analysis and Product study

Brand	Customer Product	Benchmark 1	Benchmark 2	Benchmark 3	Benchmark 4
Price	$29.99	$28.07	$18.45	$27.67	$20
Picture					
Dimensions	11.7"L x 5.7"H	11.06 x 4.33 x 5.7 Inches	-	10.28 x 4.53 x 5.35 Inches	-
Sole Plate Material	TrueGlide™ Nonstick	Non stick coated sole plate	Non Stick coated sole plate	American Heritage Black Soleplate	Non Stick
Volts	120V	(220 - 240) V	120V	120V	240 V
Warranty	2 Year Limited	2 year warranty	2 years Warranty	-	2 years Warranty
Wattage	1200 W	1250 W	1200 W	1440 W	1400 Watts
Cord shortage	Yes	No	No	No	No
Features	Auto-Cleaning		Self cleaning facility	Self clean	Self Clean Function
	SmartSteam™ Control	Variable steam	Variable Steam output	Variable steam settings	Variable Steam Settings
	vertical steam	Vertical steam	Vertical Ironing		Vertical Steam
	Even Steam Stainless		19 steam vents for uniform		
	Burst of steam				Steam Boost : 60gms
	Water tank- 320 ml Precision Point Soleplate easy-fill water tank 3-way automatic shutoff Cord Reel Spray Mist and Steam Burst Buttons	Large Tank - 230 ml steam output of 15 g/min Adjustable thermostatic control Over heat safety protection circuit	140 ml water tank 360° Swivel cord Safety Plus: Thermal Fuse Power Cord length: -1.8 m	Water tank - 180 ml Steam output up to 17 g/min 180 degree cord freedom Sideways opening door Extra large filling hole	Water Tank Capacity : 150ml Steam Rate : 0-14gms/min Safety : Auto Off Swivel Cord : Yes

Fig2.1.1: Technical Specification and Feature Study

Part Number	Description	Material Type	Part Type	Quantity
2	Soleplate	ADC12	Plastic	1
3	Soleplate Cover	SECC	Purchase	1
4	Thermostat		Purchase	1
4	Therm adjust	PA66	Plastic	1
6	Burst silicon	silicone	Purchase	1
7	burst connector	PA66	Plastic	1
8	Ceramic boss	Ceramic	Purchase	5
8	Skirt	PBT	Plastic	1
10	washer	PF	Purchase	3
11	Screw	Steel	Purchase	3
12	spring Washer	Steel	Purchase	6
13	Decorate	PP	Plastic	1
14	Screw	Steel	Purchase	2
15	Steam silicon	silicone	Purchase	1
16	Watertank cover	PP	Plastic	1
17	Burst contactor	PP	Plastic	2
18	Anti drip valve	PP5	Plastic	2
18	Anti drip spring	SUS	Purchase	2
20	Valve silicon	silicone	Purchase	2
20	Pipe1	Silicone	Purchase	1
22	Pipe2	Silicone	Purchase	1
22	Clean silicon	Silicone	Purchase	1
23	Screw	Steel	Purchase	1
24	Bi-metal		Purchase	1
26	Screw	Steel	Purchase	1

Fig 2.1.2: Engineering BOM Study



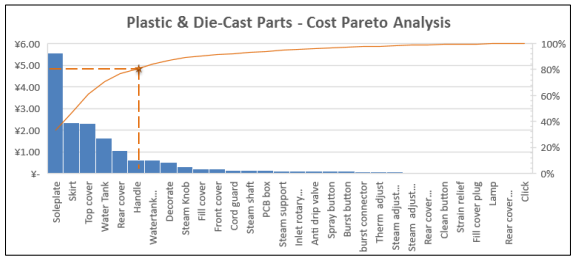


Fig 2.1.3: Cost Break up analysis

Fig2.1.4:CAD Data Study

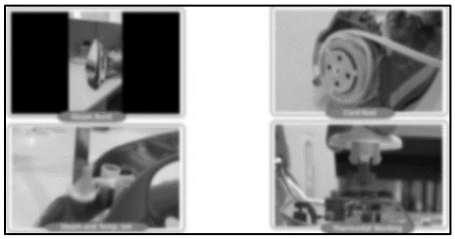


Fig2.1.5: Teardown Analysis

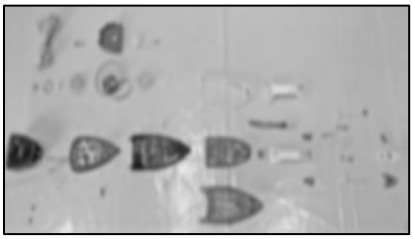


Fig2.1.6: Exploded view

2.2 Function Anaysis Phase :

The project team did following activities in Function Phase -

2.2.1 Random function identification

2.2.2 Technical FAST diagram

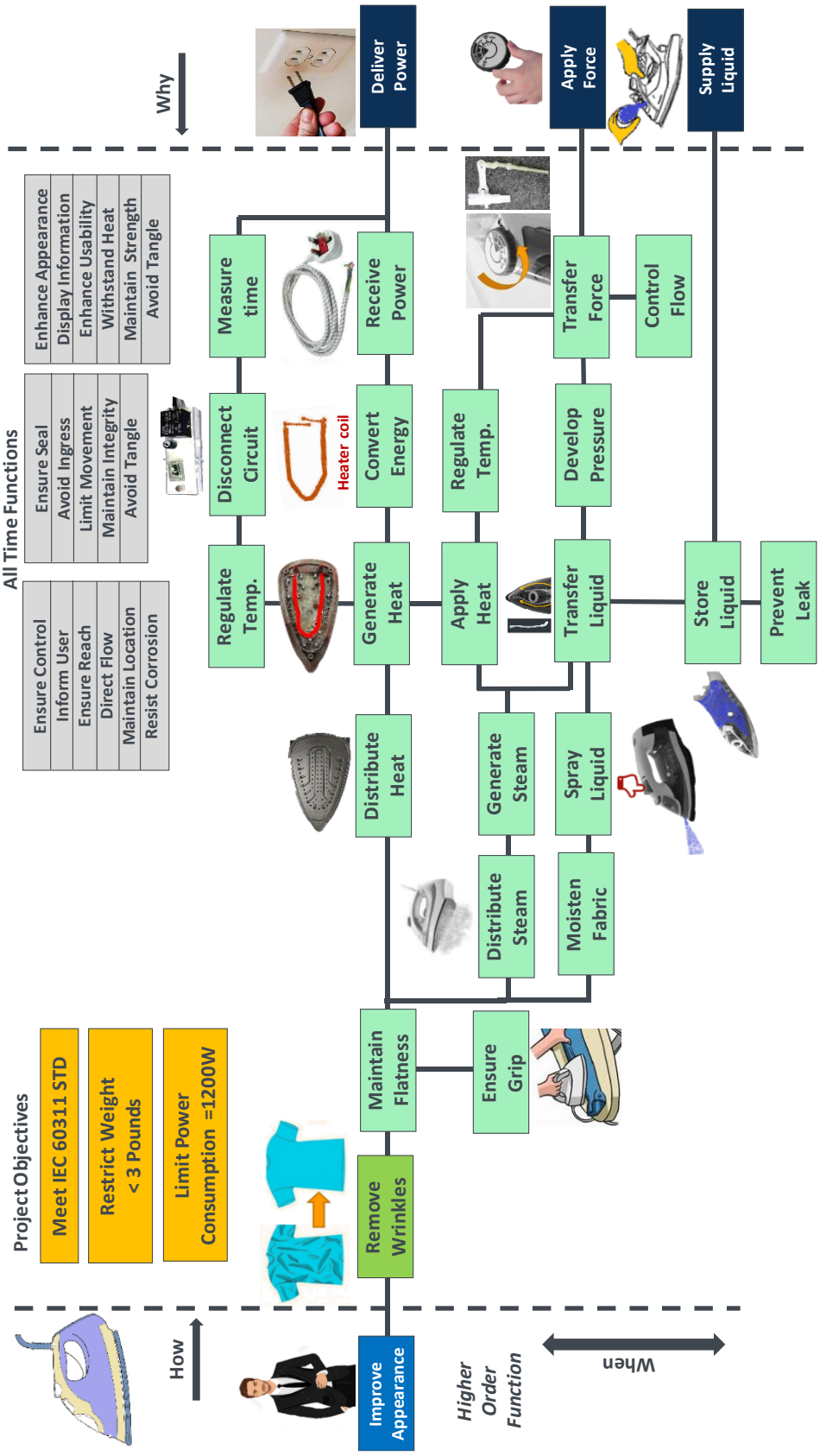
2.2.3 Function Resource Matrix Analysis and Function cost worth analysis

2.2.1 Random Function Identification –

Random Function Identification Worksheet				
Subject: **Steam iron**				
Component / Manufacturing Operation	**Function**		**Type (B/S)**	**Function**
	Active Verb	**Measurable Noun**		
Steam iron	Remove	Wrinkles	B	Remove Wrinkles
	Generate	Steam	S	Generate Steam
	Spray	Liquid	S	Spray Liquid
Fill Cover	Avoid	Ingress	S	Avoid Ingress
Front Cover	Ensure	Safety	B	Ensure Safety
Steam dial	Ensure	Control	B	Ensure Control
	Display	Information	S	Display Information
Spray And Burst Assembly	Moisten	Fabric	B	Moisten Fabric
	Develop	Pressure	S	Develop Pressure
Burst Rubber	Direct	Flow	B	Direct Flow
Steam adjuster	Control	Flow	B	Control Flow
	Transfer	Force	S	Transfer Force
Pipe - 2	Transfer	Liquid	B	Transfer Liquid
Power indicator light (Lamp)	Inform	User	B	Inform User
Soleplate	Distribute	Heat	B	Distribute Heat
	Distribute	Steam	B	Distribute Steam
	Maintain	Flatness	S	Maintain Flatness
	Resist	Corrosion	S	Resist Corrosion
Thermostat	Regulate	Temperature	B	Regulate Temperature
Power cord with plug	Receive	Power	B	Receive Power
	Ensure	Reach	S	Ensure Reach
Handle and Top Cover	Ensure	Grip	B	Ensure Grip
Rear Stopple	Enhance	Appearance	B	Enhance Appearance
Fill Rubber	Ensure	Seal	B	Ensure Seal
Water Tank	Store	Liquid	B	Store Liquid
Water Tank Cover	Prevent	Leak	B	Prevent Leak
Insulated Sleeve	Prevent	Burn	B	Prevent Burn
Skirt	Withstand	Heat	B	Withstand Heat
	Maintain	Strength	S	Maintain Strength
PCB And PCB Box	Disconnect	Circuit	B	Disconnect Circuit
	Measure	Time	S	Measure Time
SHAFT MOUNTING BRACKET	Enhance	Usability	B	Enhance Usability
	Avoid	Tangle	S	Avoid Tangle
Reset spring	Maintain	Location	B	Maintain Location
Steam Shaft	Maintain	Integrity	B	Maintain Integrity
Pump Support	Restrict	Movement	B	Restrict Movement
Heater	Generate	Heat	B	Generate Heat
	Convert	Energy	S	Convert Energy

Note – Some of identified random functions of product are listed because of space constaint. Only unique functions are shown in above list.

2.2.2 FAST Diagram –.



FAST diagram helped us to understand functional working of a steam iron and triggered some ideas for identifying opportunities for cost reduction.

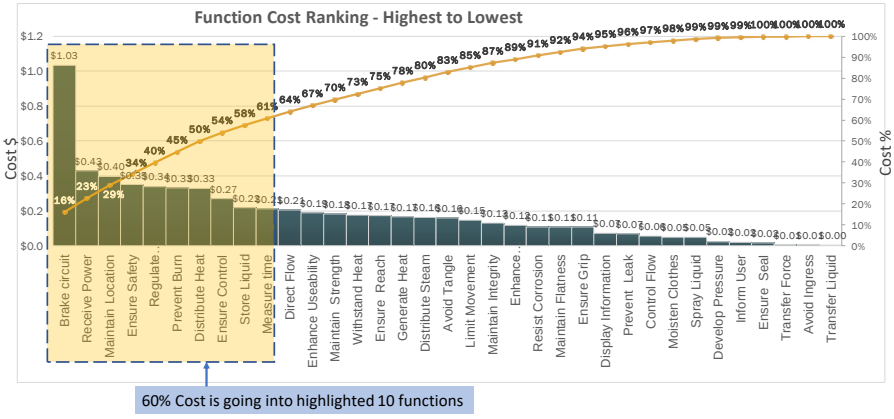
Key Takeaways from FAST :

- In Physical product, 2 functions i.e. {Regualte temp. and Control flow} are carried out by 2 different inputs (buttons). From FAST diagram we observed that they can be integrated into single input (button) without affecting end user requirement.
- From FAST diagram ,we observed that functions not in the critical path, gave us areas to focus on, for cost optimization opportunities.
  E.g.- By focusing on Store Liquid function we have generated alternative cost effective proposals without affecting performance.

2.2.3 Function Resource Matrix Analysis –

The cost for each function was allocated in Resource matrix analysis. From matrix analysis we got the Function cost ranking Highest to Lowest as shown in below figure. Team then targated functions which have higher cost.

Note : Function Resource Matrix Analys sheet is not shown here because of space constaint.



Function Cost Worth Analysis (FCW) –

We selected top 22 major cost contributing function for FCW. Based on the alternatives worth costs were found out & allocated to each of the functions in order to determine cost worth.

Sr.No	Functions	Type	Cost $	Worth	Basis of Worth	Value Gap	Value Index
1	Brake circuit	B	1.03	1.00	Mechanical arrangement	0.03	1.0
2	Receive Power	B	0.43	0.39	Reduce length of wire by 0.2m	0.04	1
3	Maintain Location	S	0.40	0.37	Design change	0.03	1.1
4	Ensure Safety	B	0.36	0.31	Integrate in Main body	0.04	1.1
5	Regulate Temperature	B	0.34	0.33	Use temperature sensors	0.01	1.0
6	Prevent Burn	B	0.33	0.31	Wood spacer	0.02	1.1
7	Distribute Heat	B	0.33	0.30	Reduce thickness	0.03	1.1
8	Ensure Control	B	0.27	0.26	Design change	0.01	1.0
9	Store Liquid	B	0.22	0.17	Blow moulded water tank	0.05	1.3
10	Measure time	S	0.21	0.21	Use sensor	0.01	1.0
11	Direct Flow	B	0.21	0.19	Pipe routing layout change	0.02	1.1
12	Enhance Usability	S	0.19	0.14	Integration of Mounting bracket with frame	0.05	1.3
13	Maintain Strength	S	0.18	0.14	Sheet metal Design	0.04	1.4
14	Withstand Heat	B	0.17	0.16	Design Change by Reducing thickness & add ribs	0.02	1.1
15	Ensure Reach	S	0.17	0.13	Reduce cord length	0.04	1.3
16	Generate Heat	B	0.17	0.14	Supplier Change of Heater	0.02	1.2
17	Distribute Steam	B	0.16	0.16	Reduce no. of steam holes and increase dia. of holes	0.01	1.0
18	Avoid Tangle	S	0.16	0.12	Manual cord reel arrangement	0.04	1.4
19	Limit Movement	B	0.15	0.10	Use Stopper arrangement	0.05	1.5
20	Maintain Integrity	B	0.13	0.13	Design change	0.001	1.0
21	Enhance Appearance	S	0.12	0.11	ID constraints	0.003	1.0
22	Resist Corrosion	S	0.11	0.11	Use of Stainless Steel Sole Plate	0.003	1.0

2.3 Creative Phase

The team focussed on developing alternatives, more cost effective ways of achieving the desired & high value gap functions.
Brainstorming sessions conducted involving cross functional teams, resulted in:

- Ideas Generated = 46
- Shortlisted Feasible ideas = 16

We selected functions which had high value gap or value index *(Highlighted in green)*. We conducted brainstorming sessions for achiving the same functions by alternative ways as shown below :

Sr.No.	Functions	Value gap	Alternate Ideas
1	Receive Power	4	1. Reduce Cord length 2. Use less gauge wire
2	Store Liquid	3.2	1. Blow Molded water tank 2. Removable water tank 3. Attach water tank to skirt by adhesive, eliminate water tank cover
3	Ensure Safety	3.1	1. Integrate cylinder housing in main body 2. Material Change from PP to HIPS
4	Enhance Usability	3.2	1. Integration of Mounting bracket with frame 2. Mounting bracket material change to PP
5	Maintain Strength	3.4	1. Use sheet metal frame 2. Change material of frame from ABS to PP 3. Reduce thickness by providing ribs
6	Avoid Tangle	3.1	1. Use motor for retraction 2. Design pull out mechanism 3. Provide detachable wire
7	Limit Movement	3.4	1. Provide top cap to cylinder 2. Use snaps as a stopper 3. Provide rubber cap

2.4 Evaluation Phase :

The VE project team picked up select ideas for important and high value gap functions and evaluated them using feasibility ranking method as shown in table below.

Sr. No.	Function	VAVE Ideas	State Of The Art / Proven Technology	Cost To Develop	Probability Of Implementation	Time To Implement	Potential Cost Benefit	Total Rank
			A	B	C	E	F	
1	Receive Power	Reduce Length of wire	8	8	8	8	7	39
2		Use less gauge wire	5	5	4	5	6	25
1	Store Liquid	Blow Molding water tank	9	5	7	4	7	32
2		Removable water tank	1	5	6	5	2	19
3		Attach water tank to skirt by adhesive, eliminate water tank cover	10	7	8	7	8	40
1	Ensure safety	Integrate cylinder housing in main body	8	9	9	8	3	37
2		Material Change from PP to HIPS	1	6	5	6	4	22
1	Enhance Usability	Integration of Mounting bracket with frame	3	8	9	8	7	35
2		Mounting bracket material change to PP	2	2	3	3	3	13
1	Maintain Strength	Use sheet metal frame	2	5	5	6	3	21
2		Change material of frame from ABS to PP	9	8	8	9	6	40
3		Reduce thickness by providing ribs	5	6	8	8	5	32
1	Avoid Tangle	Use motor for retraction	1	2	8	4	2	17
2		Design pull out mechanism	9	6	8	7	9	39
3		Provide detachable wire	2	6	5	4	5	22
1	Restrict Movement	Provide top cap to cylinder	10	8	9	8	5	40
2		Use snaps as a stopper	3	8	8	8	6	33
3		Provide rubber cap	5	5	9	8	5	32

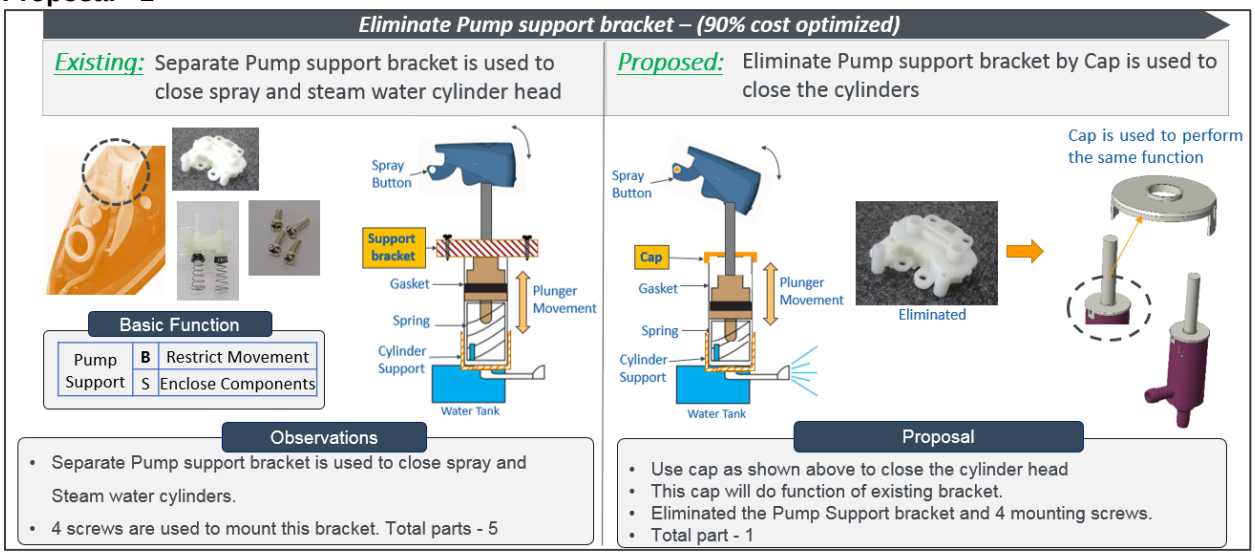
Based on above feasibility ranking,we have selected ideas for development phase which carrying more weight (Marked in Green).

2.5 Development Phase :

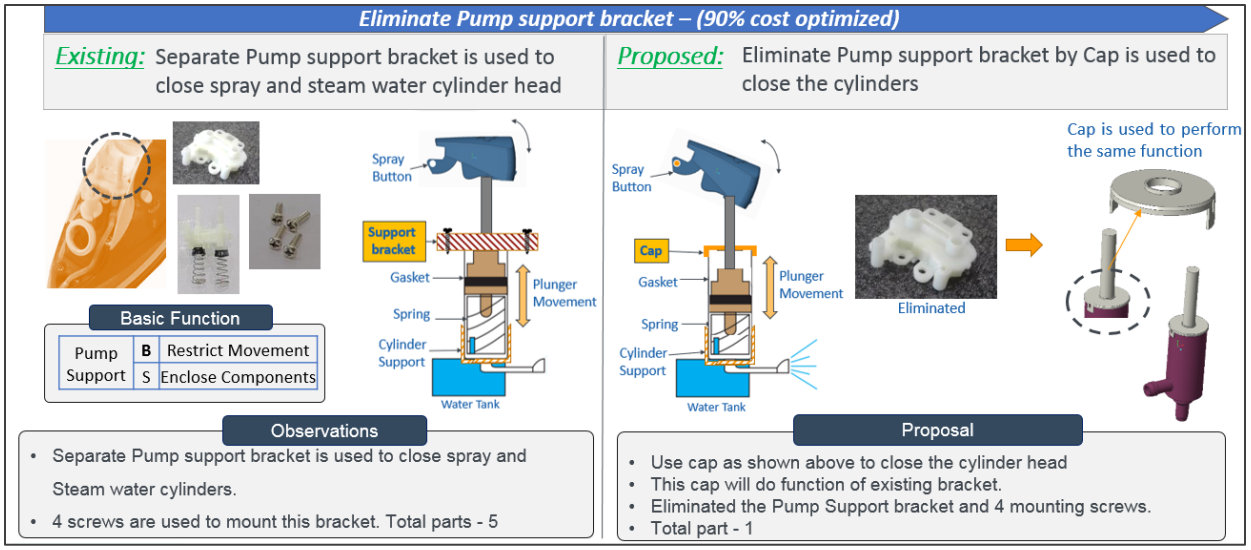
Objective of the development phase is to select and prepare the best alternatives for improving value. Project team has done following steps in development phase :

1. Beginining with the highest ranked value alternatives, developed a benefit analysis and implementation requirements, including estimated initial costs and implementation costs taking into account risk and uncertainty.
2. Compiled technical data package and prepared alternative proposals.

Proposal - 1



Proposal -2



2.6 Presentation Phase :

The above ideas were discussed and recommended to the the decision making authorities. Proposals were presented in 2 stages and these ideas are taken forward for implementation after their approval.

1. Presentation to senior management
2. Presentation to customer officials

Result :

2.6.1 Saving potential identified:

- Saving per product - $ 0.96 / per product (14% per product)
- Estimated Annual Saving – $ 0.5 Million

2.6.2 Implementation:

Recommendations of VE project team were successfully implemented at customer end and started delivering desired benefits. Clearcut increase in sales confirmed proper performance of product and end user acceptance.

2.7 Benefits :

2.7.1 Direct Benefits :

- Potential Saving per product – $ 0.96 / per product (14% per product)
- Accepted Saving per product – $ 0.86 / per product (12.8 % per product)

2.7.2 Additional Benefits **:**

- Horizontal deployment of accepted changes into other iron platforms
- Reduction of components (8%) leading to
  - Reduced assembly time & cost
  - Reduced inventory
  - Simplified Design
- Weight Reduction – More convenient to handle

Conclusion :

The project undertaken followed all the phases of structured Value Methodlogy and could successfully achieve 14% saving potential per product with no changes in aeshetics or performance of the product. The team exceeded 10% saving target set by the customer, thus bringing delight. This was a remarkable achievement and has imparted confidence to both management and customer for taking up more projects for Value Engineering studies.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