

# DFMA Analysis of XYZ Headphone

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**Abstract:** Electronic gadget headphone connected to the ears, to get better sound and better experience. Imperization of the existing product to convert modified product to utilize the product efficiency and the good experience towards the customer satisfaction. Day by day new innovative and innovation products are comes in market, because of that DFMA design for a manufacturing and assembly subject used to improve the product value toast market conditions analyzing the product. Convert in existing to modification of the product here, the headphone converted with reducing the number of components 17 to 11 improvement of design and easy carry comfortable to use direct connected to ears with Bluetooth connection.

**Keywords:** Modification, component count, redesigned product, existing product, DFM, DFMA, DFME, DFS, DFFMA.

## 1. Introduction

XYZ Headphone is an electronic gadget which is directly connected to the ears, people used to get better sound experience out of it. the sound or a voice comes from a speaker it will directly connect between the ear and sound.

The designer has been designed this gadget use as per earphone but the looking towards the strength and gripes while usability of product. They added some feature and name the head phone. It has a small pair of loudspeakers or its around of the head users, headphones are converting the frequency of speaker to the corresponding sound.

## 2. Function

Table 1 Specifications

BRAND	JBL
MANUFACTURER	JBL INDUSTRIES
MODEL	JBL 450
PRODUCT DIEMENSION	32MMX 32OHMXCP3.5MM
ITEM MODEL NUMBER	450
HARDWARE INTERFACE	NO
BATTERIES	NO
BATTERIES REQUIRED	NO
MATERIAL	ABS AND OTHERS
MANUFACTURER PARTS	
COUNTRY OF ORIGIN	INDIA
ITEM WEIGHT	145.86 GRMS

Firstly, connect the pin to the mobile, iPod, tab, laptop etc. devices and then wear the headphone. Whatever audio files that we play will be listened through the headphone. Headphone wear to the head and connected to ears for more comfortable for user.

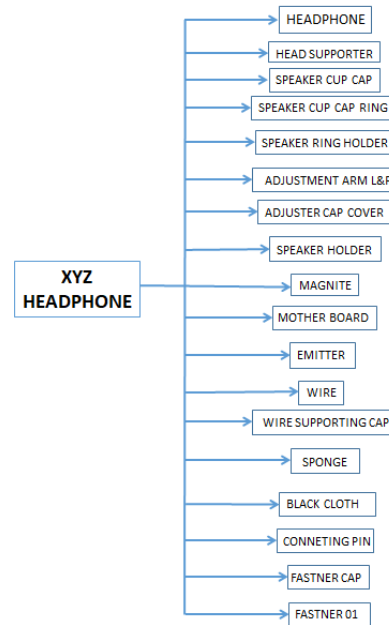


Fig. 1. Product structure

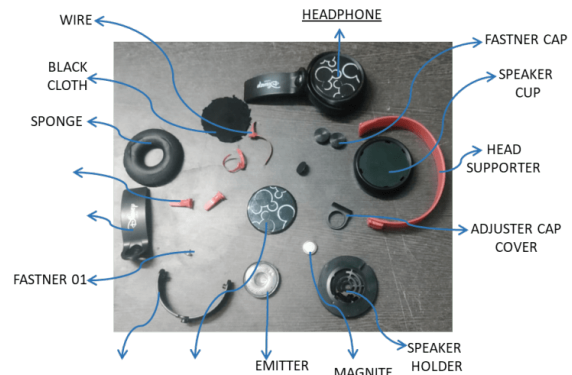
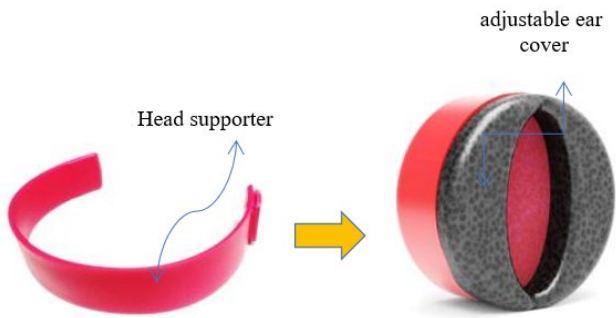
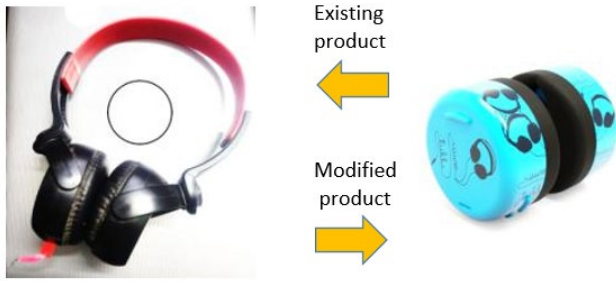


Fig. 2. Product components

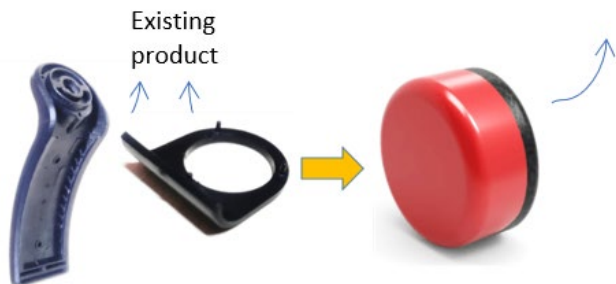
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*Guidelines of DFA followed with Redesign and Improvement: Guide lines are referred by class notes:*

**Guideline 1:** Overall component count should be minimized.

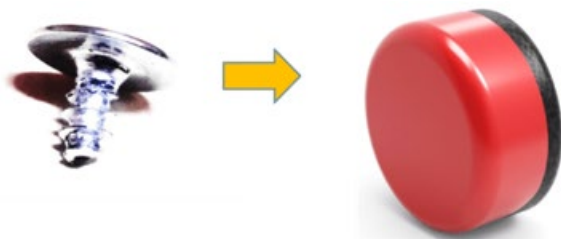


The part count has been reduced giving an adjustable ear cover and the adjustable hook the reduced plastic components



The part count has been reduced giving an adjustable ear cover and the adjustable hook the reduced components of product like Adjustment arm L&R and adjuster cap cover.

**Guideline 2:** Make minimum use of separate fasteners.

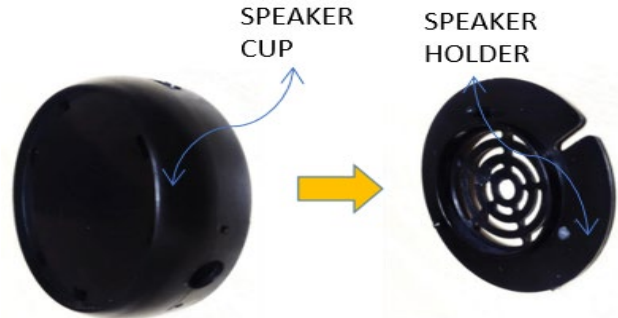


Separate fasteners mean reducing the standard components from the existing product, example: (screws and motherboard) etc.

Separate fasteners mean reducing the standard components from the existing product by giving plan surface for the

modified product. No need to use a screw for usability.

**Guideline 3:** Design the product with a base component for locating other components



The components should be located to other component the speaker holder and the speaker cup both are located each other easily so this guide line 03 taken for this reason.

**Guideline 4:** Do not require the base to be repositioned during the assembly.

The assembly is done in sequence manner so no need to consider this guide line.

**Guideline 5:** Make the assembly sequence efficient.

The assembly is done in sequence manner so no need to consider this guide line.

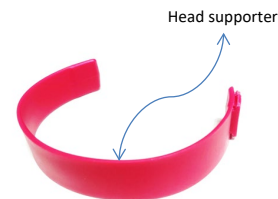
**Guideline 6:** Avoid component characteristics that complicate the retrieval.

The assembly is done in retrieval manner so no need to consider this guide line.

**Guideline 7:** Design the components for a specific type of retrieval, handling and insertion method.

The assembly is done in retrieval manner so no need to consider this guide line.

**Guideline 8:** Design the components for end-to-end symmetry wherever possible.



Components for symmetry with a rotational axis so this guide line will be taken.

**Guideline 9:** Design the components for symmetry about their axes of insertion wherever possible.



Component has a symmetry to the end to end so this guide line has been taken.

**Guideline 10:** Design the components that are not symmetric about their axes of insertion to be clearly asymmetric.

This guideline is not required in product so no need to select this guideline.

*Guideline 11:* Design the components to mate through straight line assembly, all from the same direction.

straight line assembly



Component mate through straight line assembly all from same direction in the product every component mate in a straight line so this guideline will apply to product.

*Guideline 12:* Make use of chamfers, leads and compliance to facilitate insertion and alignment and overcome handling difficulties.

Components should have chamfers or radius to avoid the sharp edges, it may injure the user while using the product. In existing product its sharp edges but redesigned product given a radius for edges. That it should not injure while using it.

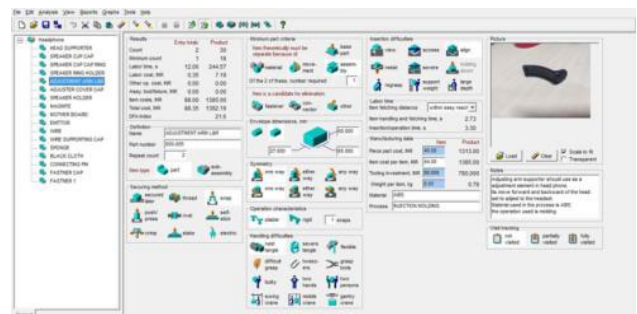
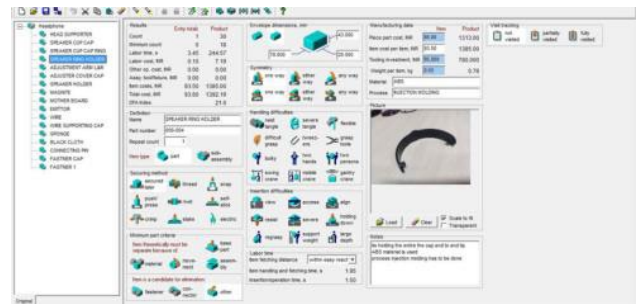
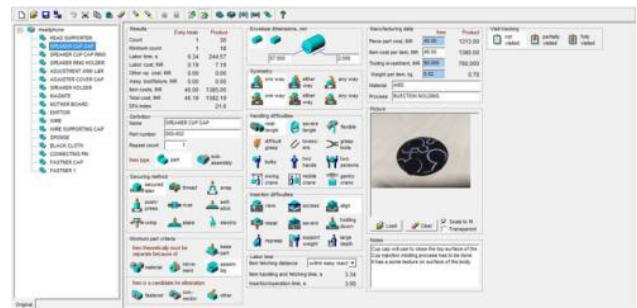
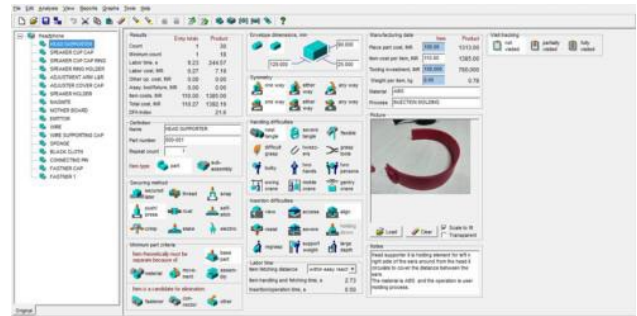
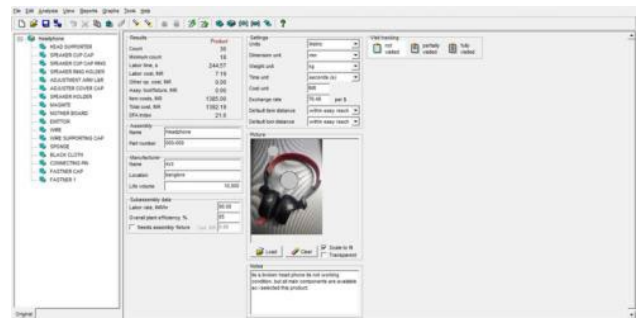
*Guideline 13:* Maximize component accessibility.

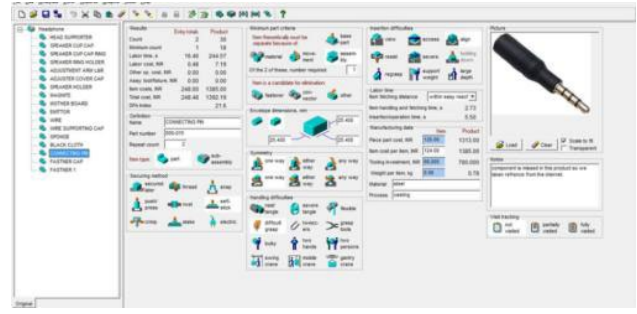
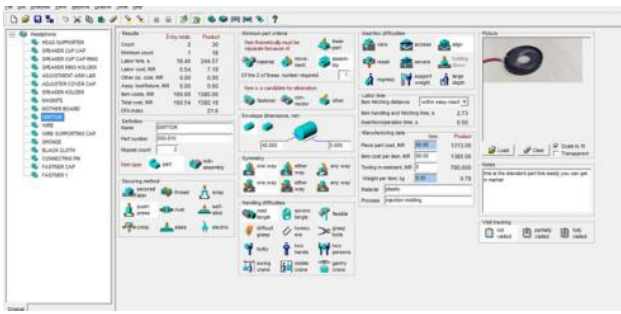
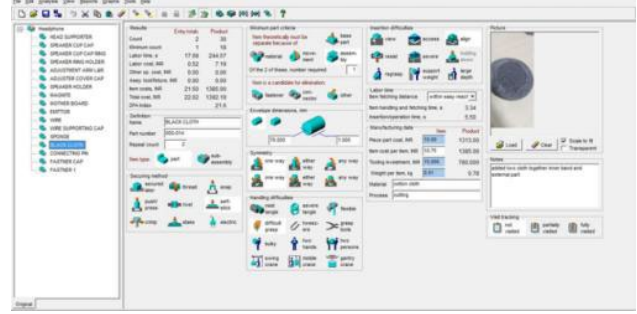
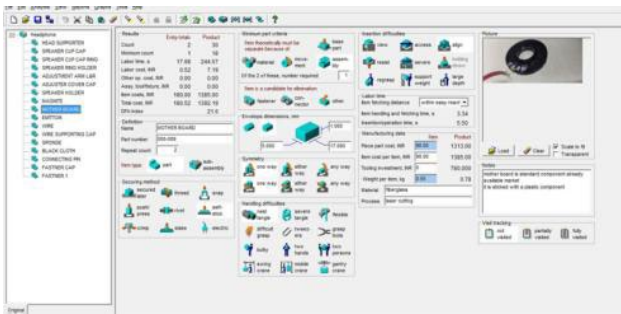
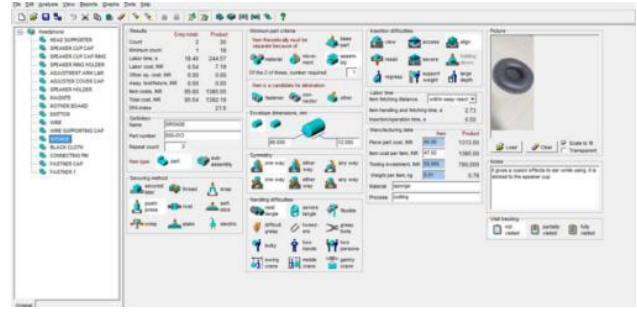
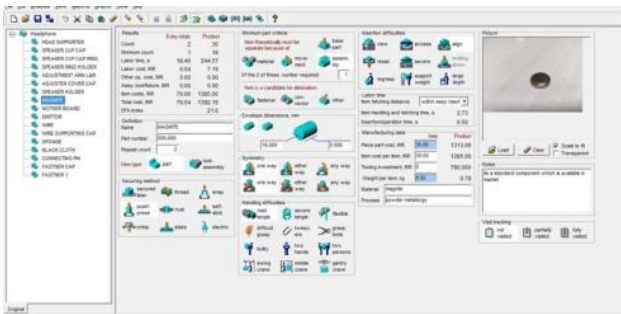
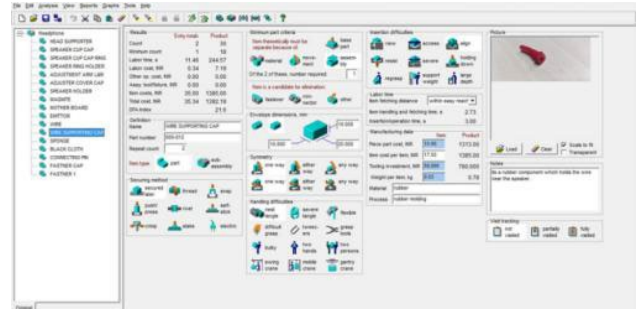
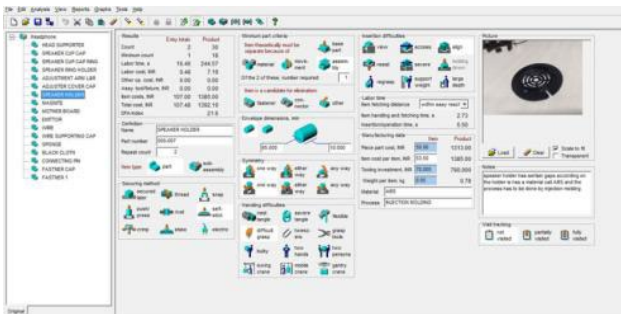
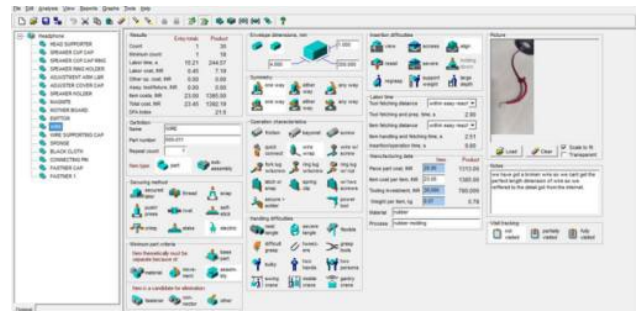
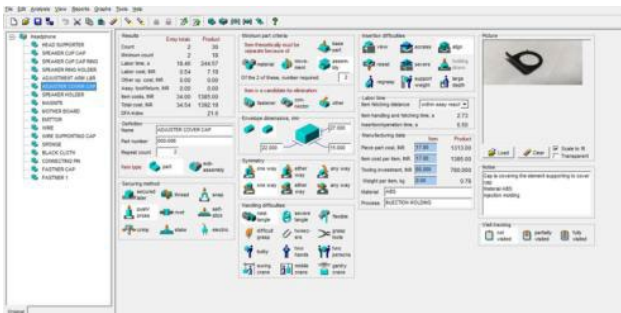


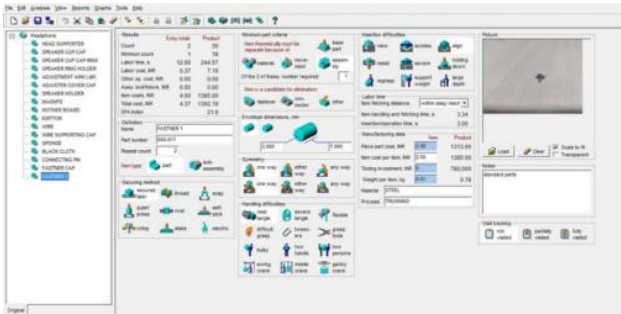
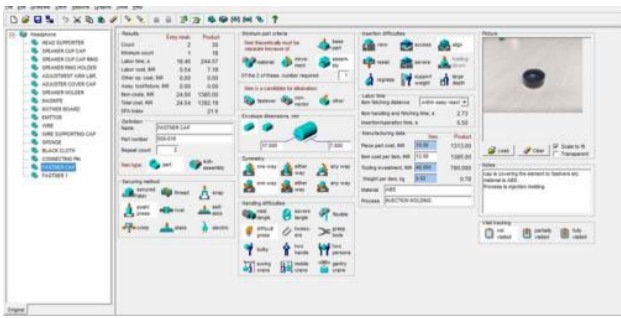
Components should maximize component accessibility in existing product push lock system is fixed but it's hard to use, in redesign twist and lock system will be added its easy accessibility.

### 3. Improvement in Product Assembly

*Boothroyd Analysis of Existing Product:*





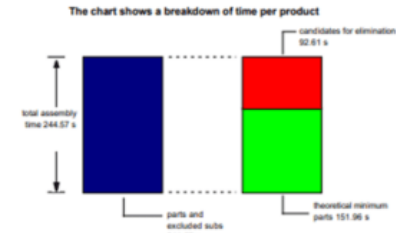


**Executive Summary - DFA**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:09 PM  
Headphone

Headphone S.K.dfa  
Product: Original

Per Product data	Entries (including repeats)	Labor Time, s	Labor Cost, INR
Component parts	30	244.57	7.19
Subassemblies partially or fully analyzed	0	0.00	0.00
Subassemblies not to be analyzed (excluded)	0	0.00	0.00
Standard and library operations	0	0.00	0.00
<b>Totals</b>	<b>30</b>	<b>244.57</b>	<b>7.19</b>



### 4. Boothroyd Reports of Existing Product

**Design for Assembly: Structure Chart**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:10 PM  
Headphone

Headphone S.K.dfa  
Product: Original

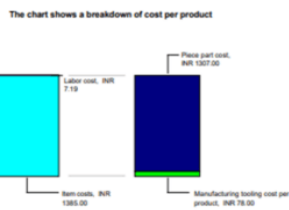


**Executive Summary - DFMA**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:10 PM  
Headphone

Headphone S.K.dfa  
Product: Original

Product life volume	10,000
Number of entries (including repeats)	30
Number of different entries	17
Theoretical minimum number of items	18
DFA Index	21.6
Total weight, kg	0.78
Total assembly labor time, s	244.57
Total cost for manufactured items (including tooling), INR	1385.00
Total assembly labor cost, INR	7.19
Other operation cost per product, INR	0.00
Total manufacturing piece part cost, INR	1313.00
Total cost per product without tooling, INR	1314.19
Assembly tool or fixture cost per product, INR	0.00
Manufacturing tooling cost per product, INR	78.00
Total cost per product, INR	1392.19



**Design for Assembly: Analysis Totals**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:11 PM  
Headphone

Headphone S.K.dfa  
Product: Original

Per product data

	Entries (including repeats)	Number of different parts	Total time, s	Labor cost, INR	Item costs (including tooling), INR	Weight, kg
<b>Parts</b>	30	17	244.57	7.19	1385.00	0.78
<b>Subassemblies:</b>						
Partially or fully analyzed	0	0	0.00	0.00	0.00	0.00
Named only	0	0	0.00	0.00	0.00	0.00
Excluded	0	0	0.00	0.00	0.00	0.00
<b>Operations:</b>						
Standard	0	0	0.00	0.00	-	-
Library	0	0	0.00	0.00	-	0.00
<b>Column Totals</b>	<b>30</b>	<b>17</b>	<b>244.57</b>	<b>7.19</b>	<b>1385.00</b>	<b>0.78</b>

Cost totals based on a product life volume of 10,000

	Labor cost, INR	Other operation costs, INR	Manuf. piece part cost, INR	Total cost without tooling, INR	Asy. tool or fixture cost, INR	Manuf. tooling cost, INR	Total cost, INR
<b>Cost per product</b>	7.19	0.00	1313.00	1314.19	0.00	78.00	1392.19
<b>Production life cost</b>	71,932	0	13,130,000	13,141,932	0	780,000	13,921,932

DFA Index

Theoretical minimum number of items	18
DFA Index	21.6

Production data

Overall plant efficiency, %	85.00
Labor rate, INR/hr	90.00

**Design for Assembly: Suggestions for Redesign**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:12 PM  
Headphone

Headphone S.K.dfa  
Product: Original

Reduce the number of items in the assembly by combining with others or eliminating the following parts or subassemblies. Note that combining an item with another may eliminate further items such as fasteners or operations, resulting in much larger time reductions than those indicated.

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction
Headphone	SPEAKER RING HOLDER	1	3.45	1.41
	ADJUSTMENT ARM LAR	1	12.06	4.93
	SPEAKER HOLDER	1	18.46	6.73
	MAGNETE	1	18.46	7.33
	MOTHER BOARD	1	17.88	7.23
	EMITTER	1	18.46	7.33
	WIRE SUPPORTING CAP	1	11.46	4.60
	SPONGE	1	18.46	7.33
	BLACK CLOTH	1	17.88	7.23
	CONNECTING PIN	1	18.46	6.73
	FASTNER CAP	1	18.46	7.33
	FASTNER 1	1	12.88	5.18
Totals			181.77	74.32

Add assembly features such as chamfers, lips, leads, etc. to make the following items self-aligning.

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction
Headphone	HEAD SUPPORTER	1	1.50	0.61
	SPEAKER CLIP CAP	1	1.50	0.61
	SPEAKER CLIP CAP RING	2	3.00	1.23

**Design for Assembly: Suggestions for Redesign**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:12 PM  
Headphone

Headphone S.K.dfa  
Product: Original

	SPEAKER HOLDER	2	1.56	0.64
	MAGNETE	2	1.56	0.64
	MOTHER BOARD	2	1.66	0.68
	EMITTER	2	1.56	0.64
	WIRE SUPPORTING CAP	2	1.56	0.64
	SPONGE	2	1.56	0.64
	BLACK CLOTH	2	1.66	0.68
	CONNECTING PIN	2	1.56	0.64
	FASTNER CAP	2	1.56	0.64
	FASTNER 1	2	1.66	0.68
Totals			22.19	9.07

Review the following items and operations that may cause ergonomic difficulties for the assembly worker.

Parent assembly	Name	Repeat count
Headphone	SPEAKER HOLDER	2
	BLACK CLOTH	2
	CONNECTING PIN	2
	FASTNER CAP	2

**Design for Assembly: Suggestions for Redesign**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:12 PM  
Headphone

Headphone S.K.dfa  
Product: Original

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction
	ADJUSTMENT ARM LAR	2	3.00	1.23
	ADJUSTER COVER CAP	2	3.00	1.23
	SPEAKER HOLDER	2	3.00	1.23
	MAGNETE	2	3.00	1.23
	MOTHER BOARD	2	3.00	1.23
	EMITTER	2	3.00	1.23
	WIRE	1	0.00	0.00
	WIRE SUPPORTING CAP	2	3.00	1.23
	SPONGE	2	3.00	1.23
	BLACK CLOTH	2	3.00	1.23
	CONNECTING PIN	2	3.00	1.23
	FASTNER CAP	2	3.00	1.23
	FASTNER 1	2	3.00	1.23
Totals			42.00	17.17

The individual assembly items listed below next or target and/or are difficult to grasp. Consider redesign of the items to eliminate or reduce their handling difficulties.

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction
Headphone	HEAD SUPPORTER	1	0.79	0.32
	SPEAKER CLIP CAP	1	0.83	0.34
	SPEAKER CLIP CAP RING	2	1.56	0.64
	ADJUSTMENT ARM LAR	2	1.08	0.44
	ADJUSTER COVER CAP	2	1.56	0.64

**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:11 PM  
Headphone

Headphone S.K.dfa  
Product: Original

No.	Name	Part number	Type	Repeat count	Total count	Securing method	Minimum items	Minimum part values
1	Headphone	300-000	Man	1	1			
2	HEAD SUPPORTER	300-001	Part	1	1	Push	1	Base part
3	SPEAKER CLIP CAP	300-002	Part	1	1	2 Step, use	1	Assembly
4	SPEAKER CLIP CAP RING	300-003	Part	2	2	2 Step	2	Assembly
5	SPEAKER RING HOLDER	300-004	Part	1	1	2 Step, use	1	Base
6	ADJUSTMENT ARM LAR	300-005	Part	2	2	2 Step	2	Assembly
7	ADJUSTER COVER CAP	300-006	Part	2	2	Push	2	Assembly
8	SPEAKER HOLDER	300-007	Part	2	2	2 Half slots	1	Assembly
9	MAGNETE	300-008	Part	2	2	Push	1	Assembly
10	MOTHER BOARD	300-009	Part	2	2	2 Half slots	1	Assembly
11	EMITTER	300-010	Part	2	2	Push	1	Assembly
12	WIRE	300-011	Part	1	1	Electrical	1	Assembly
13	WIRE SUPPORTING CAP	300-012	Part	2	2	2 Step, use	1	Assembly
14	SPONGE	300-013	Part	2	2	Push	1	Assembly
15	BLACK CLOTH	300-014	Part	2	2	2 Half slots	1	Assembly
16	CONNECTING PIN	300-015	Part	2	2	2 Half slots	1	Assembly
17	FASTNER CAP	300-016	Part	2	2	Push	1	Assembly
18	FASTNER 1	300-017	Part	2	2	2 Step, use	1	Assembly
19	Totals for Headphone				30		18	

**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:11 PM  
Headphone

Headphone S.K.dfa  
Product: Original

No.	Name	Handling problems	Insertion problems	Ergonomic problems	Total fitting and preparation time, s	Item handling time, s	Insertion operation time, s	Total labor time, s	Labor cost, \$/R
1	Headphone								
2	HEAD SUPPORTER	X	X		0.00	2.73	6.00	9.23	0.27
3	SPEAKER CLIP CAP	X	X		0.00	3.34	3.00	6.34	0.19
4	SPEAKER CLIP CAP RING	X	X		2.90	2.73	2.00	13.53	0.40
5	SPEAKER RING HOLDER	X	X		0.00	1.80	1.50	3.41	0.10
6	ADJUSTMENT ARM LAR	X	X		0.00	2.73	3.00	12.00	0.36
7	ADJUSTER COVER CAP	X	X		0.00	2.73	3.00	16.43	0.54
8	SPEAKER HOLDER	X	X	X	0.00	2.73	5.00	16.46	0.48
9	MAGNETE	X	X	X	0.00	2.73	6.00	16.49	0.54
10	MOTHER BOARD	X	X		0.00	3.34	3.00	17.68	0.52
11	EMITTER	X	X		0.00	2.73	6.00	16.43	0.54
12	WIRE	X	X		2.90	2.83	3.00	15.21	0.45
13	WIRE SUPPORTING CAP	X	X		0.00	2.73	3.00	11.46	0.34
14	SPONGE	X	X		0.00	2.73	3.00	16.43	0.54
15	BLACK CLOTH	X	X	X	0.00	3.34	5.00	17.68	0.52
16	CONNECTING PIN	X	X	X	0.00	2.73	5.00	16.49	0.48
17	FASTNER CAP	X	X	X	0.00	2.73	6.00	16.49	0.48
18	FASTNER 1	X	X		0.00	3.34	3.00	12.68	0.37
19	Totals for Headphone							244.87	7.18

component. Important thing is in this is body and attached components to body, the material used plastic ABS. the sponge will be work as decreasing or increasing process to fit in to ears if any proper fitting not accrues then the hook has been given back side of the sponge that will help to perfect fitting to the user.

Design for Assembly: Product Worksheet  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:11 PM  
Headphone

Headphone S.K.dfa  
Product: Original

No.	Name	Special assembly tool or fixture cost.	Price per unit per item, NR	Tooling investment, NR	Tooling cost per item, NR	Part or item cost, NR	Total item cost, NR	Other operation cost, NR
1	Headphone	0.00						
2	HEAD SUPPORTER	0.00	100.00	100.00	10.00	110.00	110.00	
3	SPEAKER CUP CAP	0.00	40.00	40.00	0.00	40.00	40.00	
4	SPEAKER CUP CAP RING	0.00	20.00	20.00	0.00	20.00	20.00	
5	SPEAKER RING HOLDER	0.00	85.00	85.00	0.00	85.00	85.00	
6	ADJUSTMENT ARM L&R	0.00	40.00	40.00	0.00	40.00	40.00	
7	ADJUSTER COVER CAP	0.00	17.00	17.00	0.00	17.00	17.00	
8	SPEAKER HOLDER	0.00	90.00	90.00	0.00	90.00	90.00	
9	MAGNETE	0.00	35.00	0	0.00	35.00	35.00	
10	MOTHER BOARD	0.00	90.00	0	0.00	90.00	90.00	
11	EMITTOR	0.00	40.00	0	0.00	40.00	40.00	
12	WIRE	0.00	20.00	30.00	0.00	20.00	20.00	
13	WIRE SUPPORTING CAP	0.00	15.00	30.00	0.00	15.00	15.00	
14	SPONGE	0.00	40.00	10.00	0.00	40.00	40.00	
15	BLACK CLOTH	0.00	10.00	10.00	0.00	10.00	10.00	
16	CONNECTING PIN	0.00	120.00	80.00	0.00	120.00	120.00	
17	FASTNER CAP	0.00	10.00	40.00	0.00	10.00	10.00	
18	FASTNER 1	0.00	2.00	0	0.00	2.00	2.00	
19	Totals for Headphone	0.00	1313.00	780.00	70.00		1383.00	

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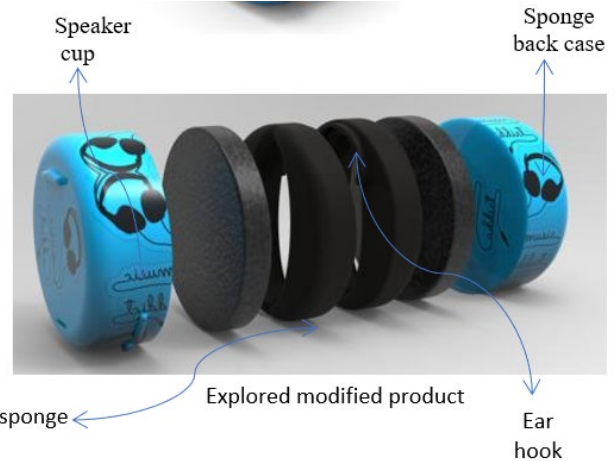
Design for Assembly: Product Worksheet  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:11 PM  
Headphone

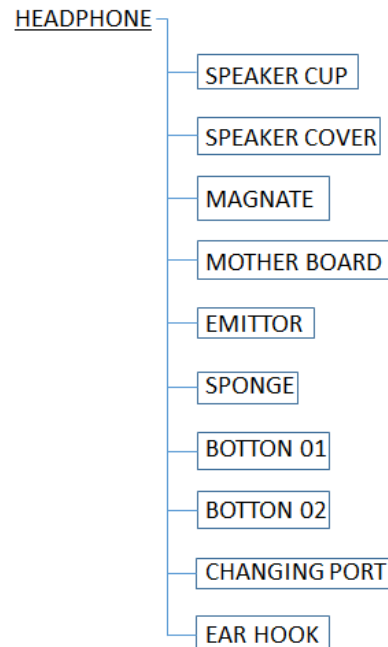
Headphone S.K.dfa  
Product: Original

No.	Name	Total other operation cost, NR	Total cost, NR	Weight per item, kg	Total weight, kg	Material
1	Headphone					
2	HEAD SUPPORTER	110.27	0.00	0.00	0.00	ABS
3	SPEAKER CUP CAP	40.19	0.02	0.02	0.02	ABS
4	SPEAKER CUP CAP RING	40.40	0.02	0.04	0.04	ABS
5	SPEAKER RING HOLDER	85.00	0.03	0.03	0.03	ABS
6	ADJUSTMENT ARM L&R	80.35	0.03	0.06	0.06	ABS
7	ADJUSTER COVER CAP	34.54	0.00	0.00	0.00	ABS
8	SPEAKER HOLDER	107.48	0.00	0.10	0.10	ABS
9	MAGNETE	35.54	0.02	0.04	0.04	Aluminum
10	MOTHER BOARD	180.52	0.00	0.10	0.10	FR4
11	EMITTOR	180.54	0.00	0.10	0.10	plastic
12	WIRE	20.45	0.07	0.07	0.07	rubber
13	WIRE SUPPORTING CAP	35.34	0.03	0.06	0.06	rubber
14	SPONGE	30.54	0.01	0.02	0.02	sponge
15	BLACK CLOTH	22.02	0.01	0.02	0.02	carbon cloth
16	CONNECTING PIN	240.48	0.00	0.01	0.01	steel
17	FASTNER CAP	24.54	0.02	0.04	0.04	ABS
18	FASTNER 1	4.37	0.01	0.02	0.02	STEEL
19	Totals for Headphone	0.00	1382.19		0.79	

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Structure:



Design for Assembly: Product Worksheet  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:11 PM  
Headphone

Headphone S.K.dfa  
Product: Original

No.	Name	Manufacturing process	Unit tracking	Notes
1	Headphone		0	On a broken head phone its not working condition
2	HEAD SUPPORTER	INJECTION MOLDING	0	Head supporter it is holding element for it is rig
3	SPEAKER CUP CAP	INJECTION MOLDING	0	Cup cap will use to close the top surface of the
4	SPEAKER CUP CAP RING	INJECTION MOLDING	0	Ring it is use to gain the between two parts
5	SPEAKER RING HOLDER	INJECTION MOLDING	0	It is holding the wire the cap and to send to ABS
6	ADJUSTMENT ARM L&R	INJECTION MOLDING	0	Adjusting arm supporter should use as a adjust
7	ADJUSTER COVER CAP	INJECTION MOLDING	0	Cap it covering the element supporting to cover
8	SPEAKER HOLDER	INJECTION MOLDING	0	Speaker holder it is use to gain according to it
9	MAGNETE	metallic material	0	It is a standard component which is available in it
10	MOTHER BOARD	laser cutting	0	mother board is standard component already av
11	EMITTOR	Injection molding	0	It is the standard part it is ready you can get
12	WIRE	rubber molding	0	Wire have got a holder wire as we want get the
13	WIRE SUPPORTING CAP	rubber molding	0	It is a rubber component which holds the wire rig
14	SPONGE	cutting	0	It gives a custom effects to use white using it is
15	BLACK CLOTH	cutting	0	It is a cloth together some band and another
16	CONNECTING PIN	cutting	0	component is present in this product so we use
17	FASTNER CAP	INJECTION MOLDING	0	Cap it covering the element to bottom etc. etc
18	FASTNER 1	TURNING	0	standard parts
19	Totals for Headphone		0	

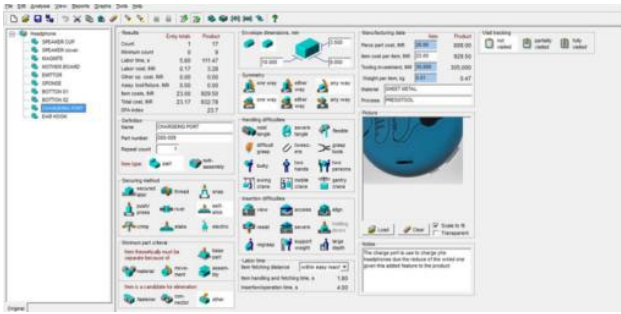
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### 5. Modified Product

By considering the guidelines and reports that generates the modification has been done. Some components have been eliminated and some are merged and made into single







### 7. Boothroyd Reports of Existing Product

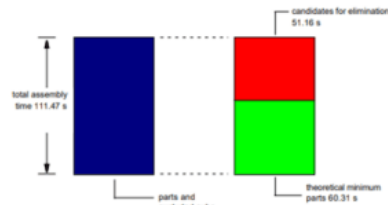
**Executive Summary - DFA**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:18 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

Per Product data	Entries (including repeats)	Labor Time, s	Labor Cost, INR
Component parts	17	111.47	3.28
Subassemblies partially or fully analyzed	0	0.00	0.00
Subassemblies not to be analyzed (excluded)	0	0.00	0.00
Standard and library operations	0	0.00	0.00
<b>Totals</b>	<b>17</b>	<b>111.47</b>	<b>3.28</b>

The chart shows a breakdown of time per product



**Design for Assembly: Structure Chart**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:19 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

- Headphone
- └─ SPEAKER CUP
- └─ SPEAKER cover
- └─ MAGNITE
- └─ MOTHER BOARD
- └─ EMITTER
- └─ SPONGE
- └─ BOTTON 01
- └─ BOTTON 02
- └─ CHARGING PORT
- └─ EAR HOOK

**Executive Summary - DFMA**  
Boothroyd Dewhurst, Inc.

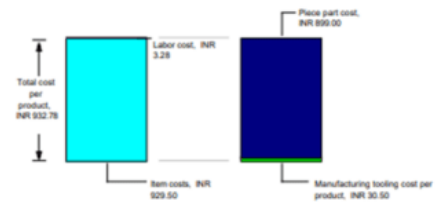
Thursday, April 28, 2022 6:18 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

Product life volume	10,000
Number of entries (including repeats)	17
Number of different entries	9
Theoretical minimum number of items	9
DFA Index	23.7
Total weight, kg	0.47
Total assembly labor time, s	111.47
Total cost for manufactured items (including tooling), INR	929.50
Total assembly labor cost, INR	3.28
Other operation cost per product, INR	0.00
Total manufacturing piece part cost, INR	899.00
Total cost per product without tooling, INR	902.28
Assembly tool or fixture cost per product, INR	0.00
Manufacturing tooling cost per product, INR	30.50
Total cost per product, INR	932.78

\*Note: Item weight not given for some items. Total weight may be incomplete.

The chart shows a breakdown of cost per product



**Design for Assembly: Analysis Totals**  
Boothroyd Dewhurst, Inc.

Thursday, April 28, 2022 6:20 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

Per product data	Entries (including repeats)	Number of different parts	Total time, s	Labor cost, INR	Item costs (including tooling), INR	Weight, kg
<b>Parts</b>	17	9	111.47	3.28	929.50	0.47
<b>Subassemblies:</b>						
Partially or fully analyzed	0	0	0.00	0.00	0.00	0.00
Named only	0	0	0.00	0.00	0.00	0.00
Excluded	0	0	0.00	0.00	0.00	0.00
<b>Operations:</b>						
Standard	0	0	0.00	0.00	-	-
Library	0	0	0.00	0.00	-	0.00
<b>Column Totals</b>	<b>17</b>	<b>9</b>	<b>111.47</b>	<b>3.28</b>	<b>929.50</b>	<b>0.47</b>

Cost totals based on a product life volume of 10,000							
	Labor cost, INR	Other operation costs, INR	Manuf. piece part cost, INR	Total cost without tooling, INR	Assy. tool or fixture cost, INR	Manuf. tooling cost, INR	Total cost, INR
Cost per product	3.28	0.00	899.00	902.28	0.00	30.50	932.78
Production life cost	32,785	0	8,990,000	9,022,785	0	305,000	9,327,785

\*Note: Weight not given for some items. Total weight may be incomplete.

<b>DFA Index</b>		
Theoretical minimum number of items		9
DFA Index		23.7
<b>Production data</b>		
Overall plant efficiency, %		85.00
Labor rate, INR/hr		90.00

**Design for Assembly: Suggestions for Redesign**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:20 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

Reduce the number of items in the assembly by combining with others or eliminating the following parts or subassemblies. Note that combining an item with another may eliminate further items such as fasteners or operations, resulting in much larger time reductions than those indicated.

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction	
Headphone	SPEAKER CUP	1	6.90	6.19	
	SPEAKER cover	1	12.06	10.82	
	MAGNITE	1	18.46	16.56	
	MOTHER BOARD	1	17.68	15.90	
	EMITTER	1	18.46	16.56	
	SPONGE	1	10.26	9.20	
	CHARGING PORT	1	5.80	5.20	
	EAR HOOK	1	6.90	6.19	
	<b>Totals</b>			96.52	86.59

Add assembly features such as chamfers, lips, leads, etc., to make the following items self-aligning.

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction
Headphone	SPEAKER cover	2	3.00	2.69
	MAGNITE	2	3.00	2.69
	MOTHER BOARD	2	3.00	2.69
	EMITTER	2	3.00	2.69
<b>Totals</b>			12.00	10.77

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**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:19 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

No.	Name	Part number	Type	Repeat count	Total count	Securing method	Minimum items	Minimum part offset
1	Headphone	500-000	Man					
2	SPEAKER CUP	500-001	Part	2	2	2 Step, up	1	Base part
3	SPEAKER cover	500-002	Part	2	2	2 Step, up	1	Assembly
4	MAGNITE	500-003	Part	2	2	2 Push	1	Assembly
5	MOTHER BOARD	500-004	Part	2	2	2 Self-align	1	Assembly
6	EMITTER	500-005	Part	2	2	2 Push	1	Assembly
7	SPONGE	500-006	Part	2	2	2 Self-align	1	Assembly
8	BOTTOM 01	500-007	Part	1	1	1 Push	1	Assembly
9	BOTTOM 02	500-008	Part	1	1	1 Push	1	Assembly
10	CHARGING PORT	500-009	Part	1	1	1 Self-align	0	None
11	EAR HOOK	500-009	Part	2	2	2 Step, up	1	Base part
12	<b>Totals for Headphone</b>				17		9	

**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:19 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

No.	Name	Handling problems	Insertion problems	Ergonomic problems	Fast fitting and preparation time, s	Item handling time, s	Insertion/operation time, s	Total labor time, s	Labor cost, \$/hr
1	Headphone								
2	SPEAKER CUP				0.00	1.95	1.00	6.90	0.20
3	SPEAKER cover	X	X	X	0.00	2.75	3.00	12.06	0.35
4	MAGNITE	X	X	X	0.00	2.75	6.00	18.46	0.54
5	MOTHER BOARD	X	X	X	0.00	3.90	5.00	17.68	0.52
6	EMITTER	X	X	X	0.00	2.75	6.00	18.46	0.54
7	SPONGE				0.00	1.10	4.00	10.26	0.30
8	BOTTOM 01				0.00	2.25	5.00	7.25	0.21
9	BOTTOM 02				0.00	2.25	5.00	7.25	0.21
10	CHARGING PORT				0.00	1.90	4.00	5.80	0.17
11	EAR HOOK				0.00	1.95	1.00	6.90	0.20
12	<b>Totals for Headphone</b>							111.47	3.28

**Design for Assembly: Suggestions for Redesign**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:20 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

The individual assembly items listed below nest or tangle and/or are difficult to grasp. Consider redesign of the items to eliminate or reduce their handling difficulties.

Parent assembly	Name	Repeat count	Time savings, s	Percentage reduction
Headphone	SPEAKER cover	2	1.56	1.40
	MAGNITE	2	1.56	1.40
	MOTHER BOARD	2	1.66	1.49
	EMITTER	2	1.56	1.40
<b>Totals</b>			6.34	5.69

Review the following items and operations that may cause ergonomic difficulties for the assembly worker.

Parent assembly	Name	Repeat count
Headphone	SPEAKER cover	2

**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:19 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

No.	Name	Manufacturing process	Unit tracking	Notes
1	Headphone			This is a headphone which hangs over the ear and has to be operated with 2 different settings.
2	SPEAKER CUP	INJECTION MOLDING		
3	SPEAKER cover	INJECTION MOLDING		THE SPEAKER COVER IS COVERED BY COTTON
4	MAGNITE	powder metallurgy		is a standard component which is available in mother board is standard component already as
5	MOTHER BOARD	laser cutting		has to be standard part like metal (you can get a
6	EMITTER	Injection molding		Follow a custom effects to ear which are 1.62
7	SPONGE	cutting		
8	BOTTOM 01	INJECTION MOLDING		ADDED THE BOTTOM TO THE SPEAKER TO GR
9	BOTTOM 02	INJECTION MOLDING		ADDED THE BOTTOM TO THE SPEAKER TO GR
10	CHARGING PORT	PRESS TOOL		The charge port is use to charge the headphone
11	EAR HOOK	INJECTION		HOOK IS HOLDING ELEMENT OF THE SPEAKER
12	<b>Totals for Headphone</b>			

**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:19 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

No.	Name	Special assembly tool or fixture cost, \$/hr	Piece part cost per item, \$/hr	Tooling investment, \$/hr	Tooling cost per item, \$/hr	Part or item cost, \$/hr	Total item cost, \$/hr	Other operation cost, \$/hr
1	Headphone	0.00						
2	SPEAKER CUP	0.00	130.00	60,000	3.00	133.00	246.00	
3	SPEAKER cover	0.00	30.00	70,000	3.00	33.00	107.00	
4	MAGNITE	0.00	30.00	0	0.00	30.00	70.00	
5	MOTHER BOARD	0.00	90.00	0	0.00	90.00	180.00	
6	EMITTER	0.00	80.00	0	0.00	80.00	160.00	
7	SPONGE	0.00	40.00	0	0.00	40.00	47.00	
8	BOTTOM 01	0.00	10.00	30,000	3.00	13.00	13.00	
9	BOTTOM 02	0.00	10.00	30,000	2.80	7.80	7.80	
10	CHARGING PORT	0.00	20.00	30,000	3.00	23.00	23.00	
11	EAR HOOK	0.00	10.00	40,000	3.00	13.00	26.00	
12	<b>Totals for Headphone</b>	0.00	690.00	365,000	30.80	829.80	829.80	

**Design for Assembly: Product Worksheet**  
Boothroyd Dewhurst, Inc.



Thursday, April 28, 2022 6:19 PM  
Headphone

modified Headphone S.K.dfa  
Product: Original

No.	Name	Total other operation cost, \$/hr	Total cost, \$/hr	Weight per item, kg	Total weight, kg	Material
1	Headphone					
2	SPEAKER CUP	246.00	0.02	0.04	0.04	ABS
3	SPEAKER cover	107.00	0.05	0.10	0.10	ABS
4	MAGNITE	70.00	0.00	0.04	0.04	Stainless
5	MOTHER BOARD	180.00	0.00	0.10	0.10	Stainless
6	EMITTER	160.00	0.00	0.10	0.10	Stainless
7	SPONGE	47.00	0.01	0.02	0.02	foam
8	BOTTOM 01	13.00	0.00	0.02	0.02	ABS
9	BOTTOM 02	7.80	0.00	0.02	0.02	ABS
10	CHARGING PORT	23.00	0.01	0.01	0.01	BRASS METAL
11	EAR HOOK	26.00	0.02	0.04	0.04	ABS
12	<b>Totals for Headphone</b>	899.00	0.09	0.52	0.47	

By considering the reports and guidelines of DFA the modifications and improvements has been done. The improved product can be seen in the figure.



Original product



Improved product

Table 2  
Comparison

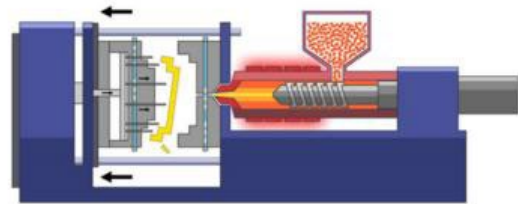
Original product	Redesigned product
Number of parts 17	Number of parts 09
Total time taken (s) 224.37	Total time taken (s) 111.47
Cost per product (Rs) 1392.19	Cost per product (Rs) 932.78
Weight (kg) 0.78	Weight (kg) 0.47
DFA Index 21.6	DFA Index 23.7

**8. Conclusion**

The DFA AND DFM analysis that the redesigned product has a better index level when it comes to assembly (DFA) as it is 21.6 compared to the original product’s index of 23.7. the Number of parts should be reducing the up to 8. total time has been reduced 112.9s will be reduced. Product cost will reduce with Rs459.41 have been saved for a part. Product weight also reduced (kg) 0.31 and total DFA index also reduce (2.1) in this

way the that DFMA will be help increase the whole feature of the product will be increase.

**9. Design for Manufacturing Analysis**



Injection molding

“Material used plastic ABS”. It is a type of plastic which is common thermoplastic polymer type of used in an “INJECTION MOLDING” application This plastic is popular for production because:

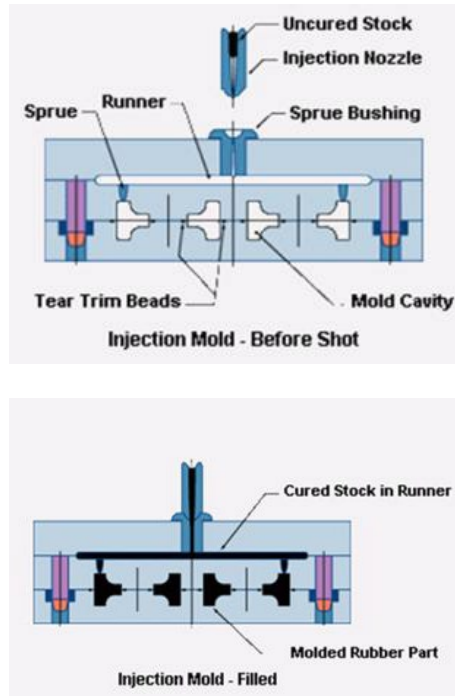
- Low cost
- Impact resistance
- Structure and strength
- Good low and high temperature
- Easy to paint and glue
- Chemical resistance

*Material used in product:* Stainless steel



“Screw Making Machines” Thread Rolling Machines Bolt Making machines in this process the rood feed from side and the rood inside the machine will rotate clockwise to make a thread on the rood and the screw will be able to use. according to screw dimension the rood will be change. The production should be continuing with requirement of screws like M2, M3, M4, M5, M6, etc.

*Material used in product:* Rubber material



The “rubber molding process” starts with heating a rubber material from hopper its move towards the rotating sprue than material should pass through the injection nozzle from the runner and sprue, gates the rubber material enter into the core and cavity part according to the need the core and cavity will be designed and manufactured then the material full fill the cavity the core will give a external surface to the rubber part. cooling will do for certain time than the rubber will be come out from the mold.

## 10. Conclusion

The DFMA analysis that the redesigned product has a better index level when it comes to assembly (DFA) as it is 21.6 compared to the original product’s index of 23.7. the Number of parts should be reducing the up to 8. total time has been reduced 112.9s will be reduced. Product cost will reduce with Rs459.41 have been saved for a part. Product weight also reduced (kg) 0.31 and total DFA index also reduce (2.1) in this way the that DFMA will be help increase the whole feature of the product will be increase.

## References

- [1] R. Hemanth and V. S. Desai, “DFMA Analysis of XYZ Earphone”, in *International Journal of Recent Advances in Multidisciplinary Topics*, vol. 3, no. 11, pp. 51–64, Nov. 2022.