UNIVERSITY OF LIVERPOOL

School of Engineering

Design for Environment, Manufacture and Assembly (DfEMA)

MNFG413

Assignment 2 (DfMA)

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Project Group-12,
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Contents

1. Executive Summary

SUMMARY

This report suggests possible design, material and processing changes decided while considering Design for Environment Manufacturing and Assembly on behalf of TDS Appliances Ltd to design a new product based on analysis and data acquired from disassembling the "Cookworks Food Processor". It also takes into consideration the findings of the first round of DFE analysis that majorly focused on making the product more sustainable.
A list of design recommendations is also prepared using the data derived from analyzing the product using Durham method.

2. Introduction

Two-part analysis is done in the whole DFEMA analysis of the product where redesigns are recommended on 3 different criteria which are environmental impact, improving the flow of assembly process and improving the manufacturing methods. All the changes are related but must follow a certain flow so the changes can be more efficiently be applied. This report is made with the aim of delivering possible improvements that could be made during the assembly and manufacturing stage to reduce the part count, use faster manufacturing routs, and reduce the overall cost of operation using the DFMA methodologies. The mentioned changes are based on the data gained by dismantling the cookworks food processor as much as possible for TDS

Appliances Ltd. The following redesign recommendations also take the DFE analysis done on this product to consideration which focused on finding ways for it to be more sustainable without affecting any of its major functions and feature while making it more user friendly and ergonomic.

2.1 Product Description

The Cookworks Food Processor is excellent food processing equipment that comes with a bowl capacity of 1.4L and with default stainless steel chopper blade and adds 3 different types of blades which are used for chopping, slicing, shredding, and beating the food items such as fruits, vegetables, etc. The power consumption is 500 watts of the product, having 2 speed and pulse function. This food processor has an overall dimension of 260 x 227 x 392 mm, weighing about 2.4 kg.

3. Summary of DfE process

After basic analysis like making BOM and functional analysis an MET matrix is drafted for the product that lists the materials used, energy consumed, and toxins produced in each stage in products life cycle.

Functional analysis and product lifecycle helps to distinguish between the parts and function based on their contribution to the product

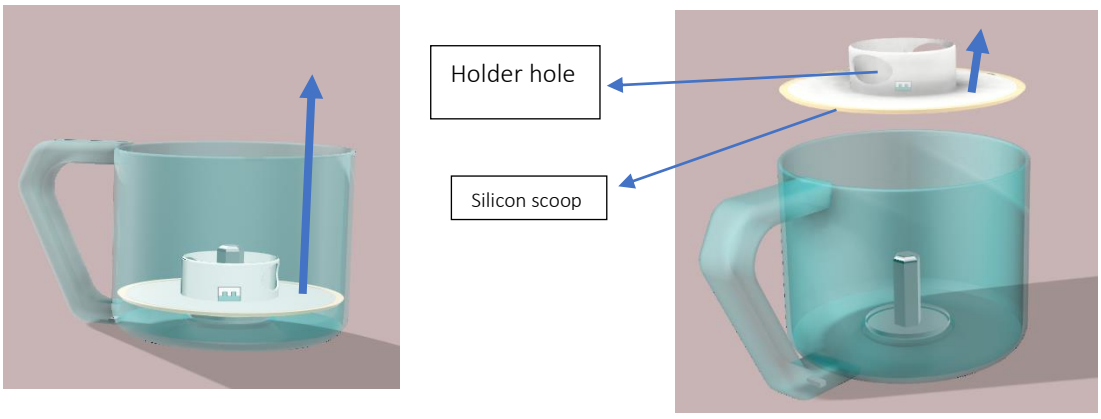
In MC Donald Smith and T Short method a detailed analysis is performed on 5 steps of the life cycle that include the choices used during each method and use the help of color code to give a better understanding hazardous, sustainable, and safe materials and provide possible replacements.

Ten golden rules are written in association to our product suggesting the focus of redesign

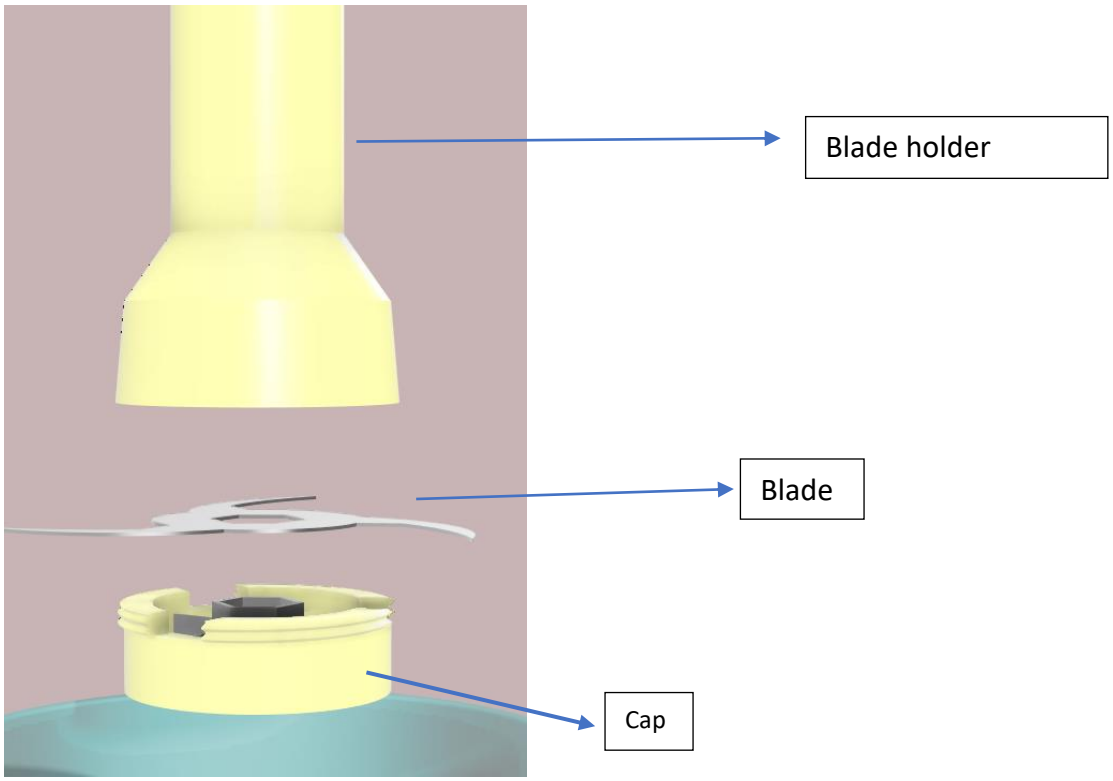
3.1 Final Redesign in DfE

Redesign in container and blades-

1. Adding a plunger between the main bowl and the blade.

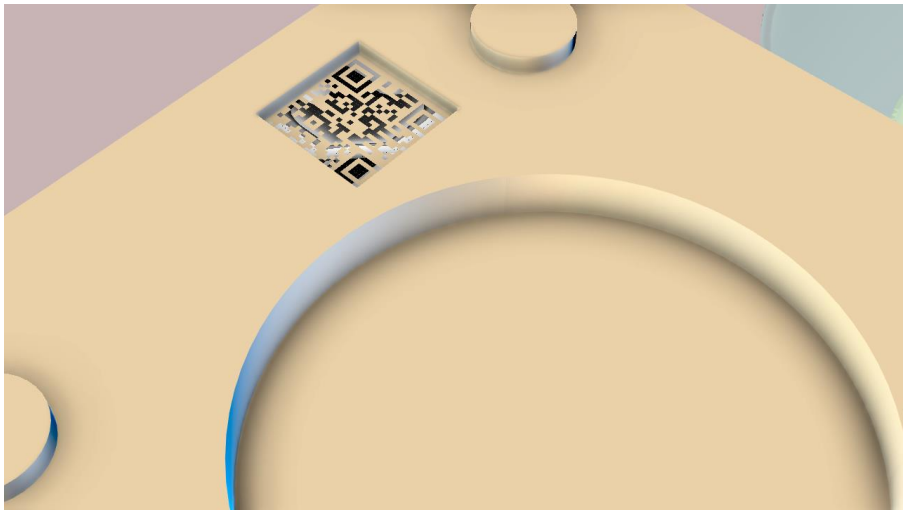


2. Blades that are screwed to main blade holder and the screws are covered with a cap



Redesign in motor housing-

QR code embossed on the plastic base linked to website containing information regarding disposal materials and spare parts.

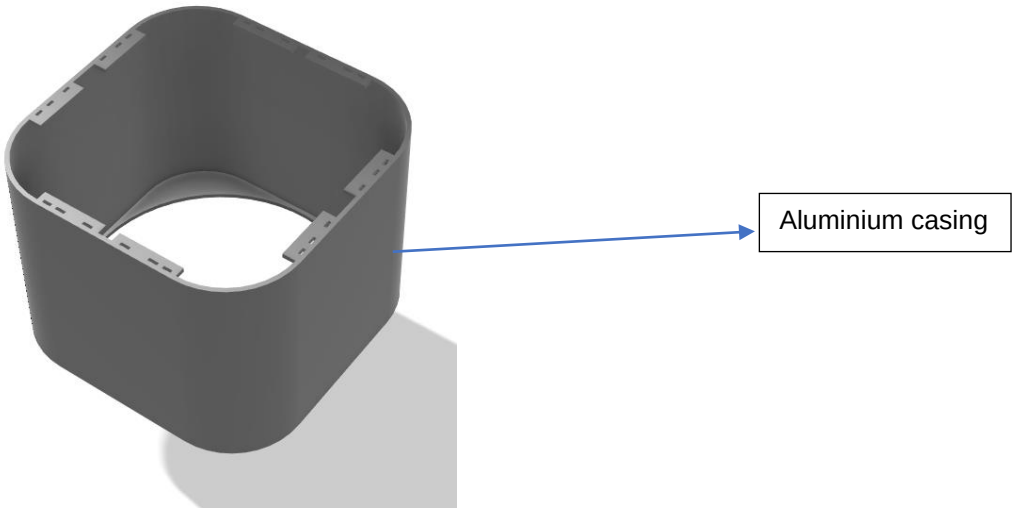


Material change-

Using **Natural Rubber** suction cups
Replacing PVC parts like PVC wires with **mPPE**

Use of **Vegetable oil or synthetic ester** grease.

Using **Recycled Aluminum** for the motor housing, knob, and knob housing.



Packaging Redesign-

- Instead of Packing everything separately all parts should be stacked and covered in one single plastic covering.
- Instead of adding a lot of graphical printing on the packaging they could

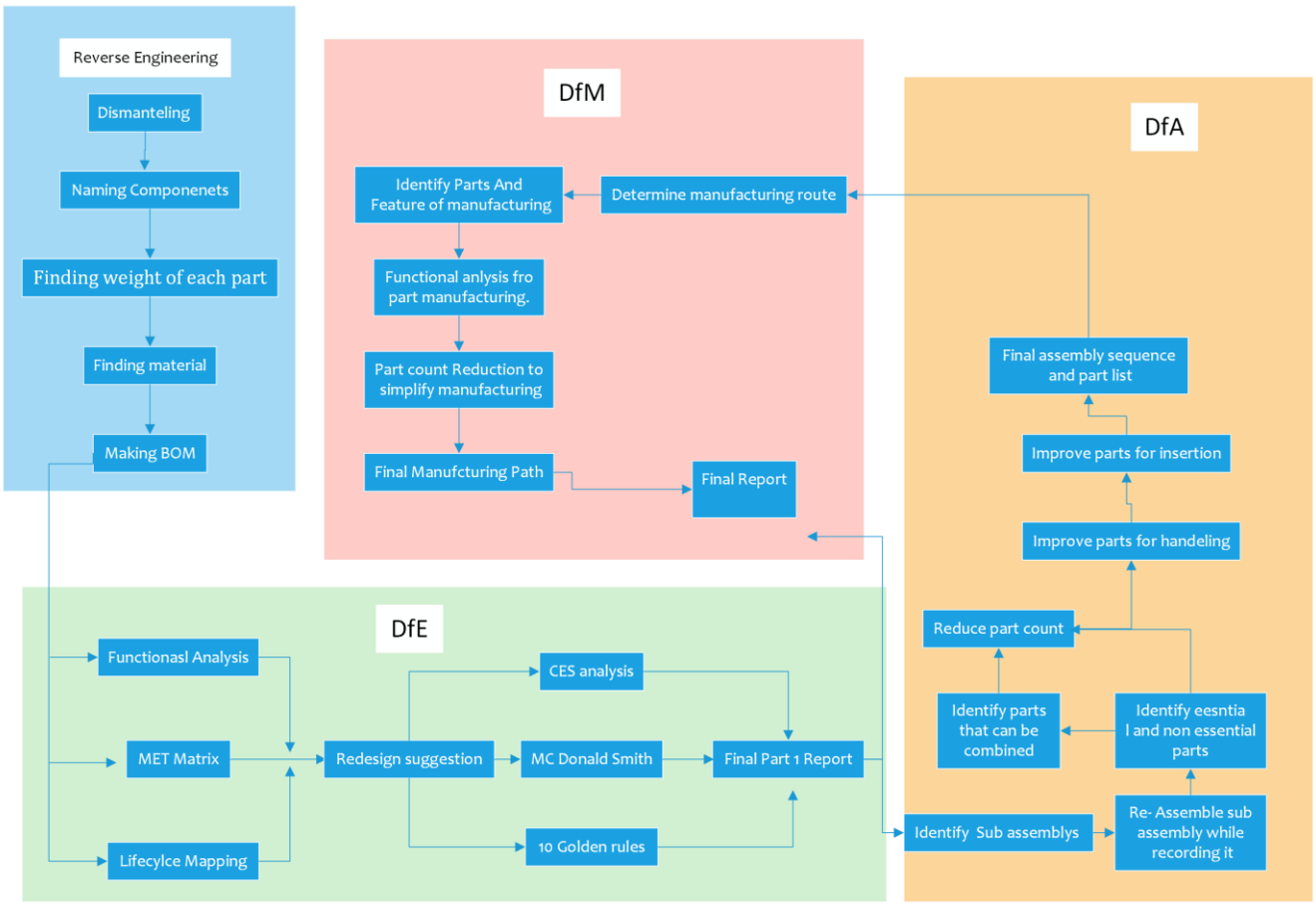
be kept minimalistic.

4. Overview of DFA and DFM tools

DFM/A tools and ideas give an organized way to developing simpler designs for goods that can be efficiently built. They aid in quantifying production and assembly issues as well as identifying potential for novel design. Although they demand more upfront effort than more traditional design strategies, the result is to offer benefits such as considerable cost reductions and decreased time to market. This is mostly due to fewer engineering modifications; fewer parts to specify, record, and acquire; and a less complicated product with improved assembly and production characteristics [1].

There are multiple tools available for DFMA analysis, but the earliest DFMA method used in industry is the Boothroyd method This gives a methodical approach to analyzing the initial food processor design. Boothroyd created certain standards for part handling, insertion, and fastening, which will be addressed in the redesign. It seeks to minimize portion of numbers, which can have a ‘snowball' impact in terms of costs/effort as procedures like Drawings, production, and inventory management for specific items aren't any readily possible. Other. The advantages of using such technologies include increasing collaboration amongst people in the early stages. stages of the design process, as well as those nearing completion. By enhancing. The benefits of concurrent engineering may be apparent in designs that communicate customer demands.
Whereas in knight method the decisions are made on a very earlier stage that involve analyzing designs to rectify the mistakes quicker which leads to more accurate redesign and helps reduce the overall cost. By using cost analysis tool is used to analyses redesigns early in the implementation phase to avoid needless changes later in the design process to further cut costs.

The 'Team-Based DFMA Methods' established by Appleton and Garside are employed. Collaboration amongst designers provides for solutions that were not before considered. Team-based techniques are more effective. Subjective, but significantly less complicated, and hence offers direct solutions Nonetheless, the methodology is restricted in that answers may change based on the viewpoint of the individual. Assembly and production procedures may be more difficult for some to comprehend than others. Although differences in an individual's degree of comprehension may constitute a barrier during conversation, the nature of this technique allows team members to share their overview with others, allowing a free flow of debate in the team. Furthermore, the procedure begins by categorizing the component. The processes and portions are segregated using color coding, and the table is filled with suggestions from team members utilizing a structure. Methodologies that use technology to impede the creative process are discouraged. This might cause the team to become preoccupied with the minutiae rather than the needs of the consumer. The many color codes may be perplexing for individuals unfamiliar with the DfAM approach; consequently, color labelling is essential.



5. Application of tools

5.1 DfA and DfM Analysis

The subassembly selected for redesign as a team was the sub assembly for the motor to external output where the goal of DFA was to reduce the no. of joints by reducing the no. of screw joints and then moving forward with the DFM process

to optimize the manufacturing process so it can accommodate the changes without making it more complex.

5.2 DFA Matrix

The methodology followed by the team for the redesign of the sub assembly is the Durham Method which unlike most DFA methods does not abide by guidelines or depend on software forms instead is dependent on structure and lets the design team be more creative in their process and unlike other methods Durham method encourages teamwork and let there be more fluent exchange of ideas.
The process begins by

- Setting up all necessary tools for assembly and disassembly of the selected sub assembly
- Parts involved in the sub assembly have distinguishable names written on yellow post its.
- The team members use the recording of the assembly to note down their observation s from each step of the assembly on blue post it while pink ones are used to note the time to finish each stage of assembly.
- The post its are now placed on the chart where the yellow post-it's with part names are placed first then followed by time to assemble pink post-it and then the blue post-it is containing the observations.
- This process is then performed in 3 more phases to eliminate parts by category
  Phase2- mark essential parts and combinable parts to reduce part count.
  Phase3- Mark parts that are hard to manage and make improve parts handling.
  Phase4- Mark parts that are hard to insert and make improvements then revise the assembly.

Color code

Key	Cell color			Essential	Non-essential	Easy handling	Hard handling	Easy insertion	Hard insertion
Code	Order of assembly	Parts	Change			H	H	H	H


ASSEMBLY SEQUENCE
MOTOR FRONT COVER
MOTOR SCREW BASE COVER
BODY
RING GEAR
RING GEAR BOX SCREW
GEAR BOX BASE
PLANET GEAR 1,2,3
PLANET CARRIER
COVER SCREW
TOP COVER
PARTS ADDED
ESSENTIAL PART
NON ESSENTIAL PART
NOTES ON PROCESS AND PARTS
CHANGES TO REDUCE PART COUNT
ALTERING THE SCREW POSITION
INCREASING THE DEPTH OF SCREW MOUNT
INCREASE THE BASE AREA FOR RING GEAR
SNAPFIT ON TOP COVER
ESSENTIAL PARTS
REVISED ASSEMBLY PROCESS
CHANGES TO IMPROVE PART HANDLING
EASIER PARTS TO HANDLE
REVISED ASSEMBLY PROCESS
CHANGES TO IMPROVE PART INSERTION
EASIER PARTS TO INSERT.
REVISED ASSEMBLY PROCESS
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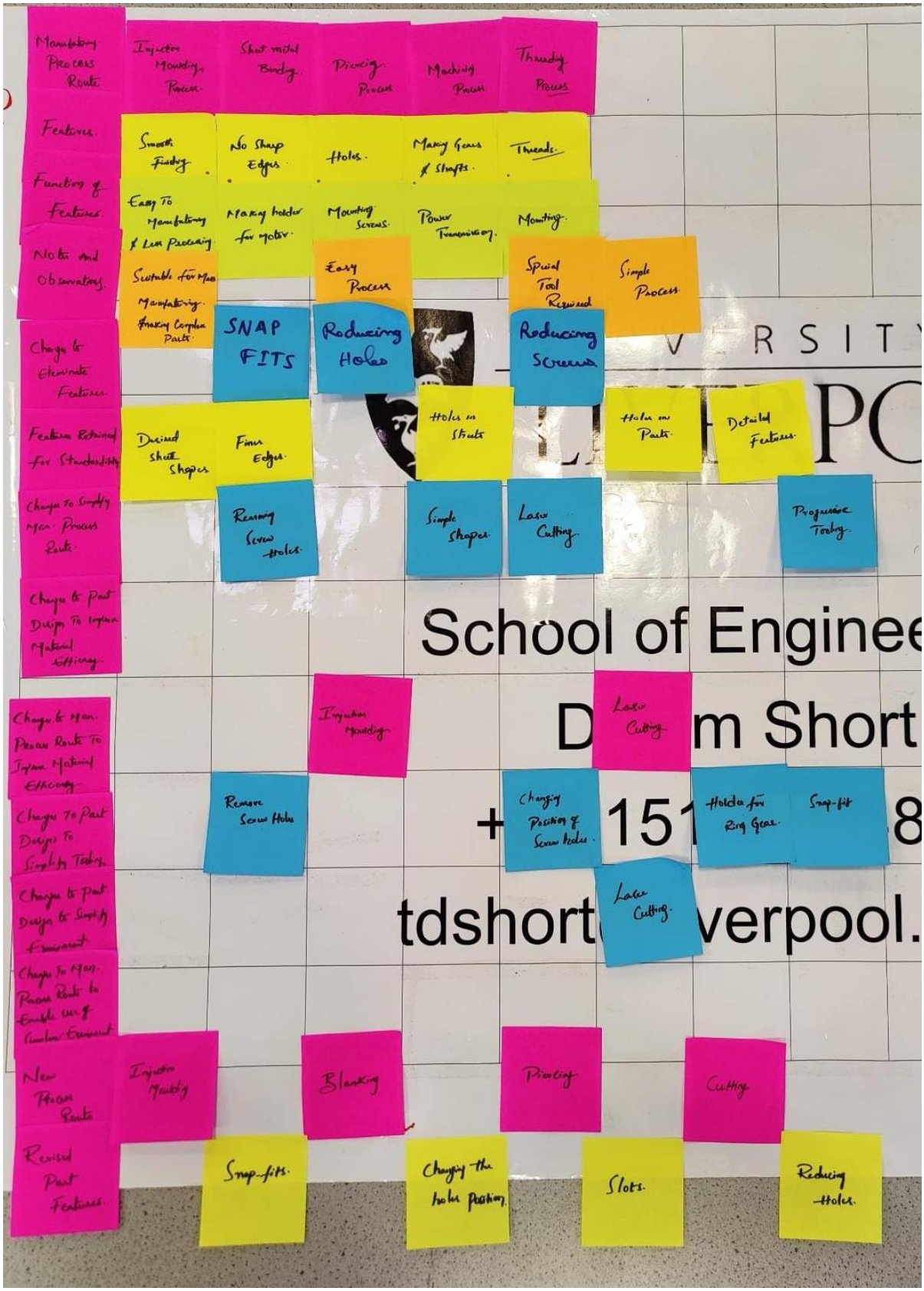
Sub-assemblies	Motor gearbox and body sub assembly.										Bottom ant top body assembly.				Sub assembly for activation feature in bowl handle.								
Part added	Motor cover	Motor cover screw	body	Ring gear	Ring gear screws	Gear box base	3 planet gears	Planet carrier	Cover screw	Top cover	Top body	Gasket	Screw	Bottom cover	Main bowl	Jar Lock 1	Jar lock 2	Spring	Jar screw	Jar Fitter	Jar fitter screw	Main body	Wiring
Handling	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Insertion	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Assembly sequence	Motor front cover connected to motor housing.		Ring gear connected to main housing.			Planet gears connected to gear base	3 planet gears connected to ring gear	Planet carrier connected to planet gears	Top cover connected to body.		Place gsket between top and bottom body		Screw the base to main body		Load spring and screw two parts inside the main bowl hande					Fint the jar fitter inside the main body with screws			Connect the mechanisum to capacitor circuit
Time to assemble	2min 22s		1min 33s			46s	5s	10s	38s		3min 7s				2min 15s					38 s			40s
Changes to reduce part count	Altering screw hole position		Altering screw hole position	Increasing base diameter of ring gear	Altering screw hole position	Making holes on base of ring gear			Snap fit for the cover		Merge gasket with bottom body.				Threading at bottom of jar handle	Magnet			Screw with magnet mount	Magnetic switch		Mount for magnetic switch	
Essential parts	Motor cover	Motor cover screw	Body	Ring gear		Gear box base	3 planet gears	Planet carrier	Top cover		Top body		Screws	Bottom cover	Main bowl							Main body	Wiring
Revised assembly process	Place the ring gear inside the body		Align the motor cover and start putting 4 screws			Planet gears connected to gear base	3 planet gears connected to ring gear	Planet carrier connected to planet gears	Snap fit top cover		Screw bottom cover to the main body				Screw magnet to bottom of bowl handle.					Mount the magnetic switch to main body			Wiring
Changes to improve part handling			Make hole for snap fit		Connect with same screw as motor mounting				Snap fit wedge			Remove and merge with bottom cover				Replace by magnet				Replace by magnetic switch			
Easier parts to handle	Motor cover	Motor cover screw	Body			Gear box base	3 planet gears	Planet carrier	Top cover		Top body		Screws	Bottom cover	Main bowl	Magnet mount screw				Magnet switch		Main body	Wiring
Revised assembly process			Align the motor cover and start putting 4 screws						Snap fit top cover		Screw bottom cover to the main body				Screw magnet to bottom of bowl handle.		Mount the magnetic switch to main body						
Changes to improve intersection			Grove to fit ring gear						Snap fit														
Easier part to intersect	Motor cover	Motor cover screw	Body			Gear box base		Planet carrier	Top cover		Top body		Screws	Bottom cover	Threading at bottom of jar handle	Magnet			Screw with magnet mount	Magnetic switch		Mount for magnetic switch	
Revised assembly process Time to assemble	Place the ring gear inside the body. 5s		Align the motor cover and start putting 4 screws. 40s			Planet gears connected to gear base. 46	3 planet gears connected to ring gear 5s	Planet carrier connected to planet gears 10s	Snap fit top cover 5s		Screw bottom cover to the main body 3min				Screw magnet to bottom of bowl handle. 45s					Mount the magnetic switch to main body 20s			Wiring 40s

5.3 DFM Matrix

Followed by the outcome of DFE and DFA analysis manufacturing is organized to go through the possibly needed process that will be used which is then optimized so it can be faster and cheaper without compromising quality. Like the DFA process all the manufacturing techniques used are mentioned in the first row on pink post its after this yellow post it is used to note down the significant features of each of the manufacturing methods along with functionality of those feature. Prepare notes on orange post its in reference to how these methods would improve the manufacturing process. All parts that have changed along the DFE and DFA process are identified stating the change that needs to be made. After which the manufacturing process rout is optimized step by step addressing details that could be rectified to make that stage of manufacturing simpler. These steps include analysis of tooling rout, use of equipment's, material efficiency and processing. All the changes are noted to sum up the final route for manufacturing that is to be implemented.

Color code

Key	**Cell color**			**Essential**	**Non-essential**
Code	Process	features	Change		


Manufacturing Process Route
Injection Moulding Process
Sheet metal Bending
Piercing Process
Machining Process
Threading Process
Features
Smooth Finishes
No Sharp Edges
Holes
Making Gears & Shafts
Threads
Function of Features
Easy To Manufacturing & Less Processing
Making holder for motor
Mounting Screws
Power Transmitting
Mounting
Notes and Observations
Suitable for Mass Manufacturing
Making Complex Parts
Easy Process
Special Tool Required
Simple Process
Changes to Eliminate Features
SNAP FITS
Reducing Holes
Reducing Screws
Features Retained for Standardisation
Desired Sheet Shapes
Fine Edges
Holes on Struts
Holes on Parts
Detailed Features
Changes To Simplify Manufacturing Process Route
Removing Screw Holes
Simple Shapes
Laser Cutting
Progressive Tooling
Changes to Part Design To Improve Material Efficiency
Changes to Manufacturing Process Route To Improve Material Efficiency
Injection Moulding
Laser Cutting
Changes To Part Design To Simplify Tooling
Remove Screw Holes
Changing Position of Screw Holes
Holder for Ring Gear
Snap-fit
Changes to Part Design to Simplify Assembly
Laser Cutting
Changes to Manufacturing Process Route to Enable Use of Simulation Environment
New Process Route
Injection Moulding
Blanking
Piercing
Cutting
Revised Part Features
Snap-fits
Changing the holes position
Slots
Reducing Holes
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Manufacturing process route	Injection molding	Sheet metal bending	Stamping	Deep drawing	Cold turning	Machining	Milling
Features	Mass production, complex shapes, fast operation	Fast, smooth edges	Mass production, variety of 2d shapes	Smooth and thin finish.	Precise and no marks.	Versatile and precise	Precise, standardizes.
Functional features	Top cover, bottom cover, main bowl and bowl cover, plunger. Jar fittings and lock	Motor holders, heat sinks,	Motor parts, Screw Holes,	Small metal support, wires, main	Screws, brass parts,	Main body, Smoothening, Motor components	Motor Gear, planet gears and ring gears
Notes and observation	Can replace milling of planet gears	Processes used while dealing with sheet metal or aluminum sheets				Can replace milling	
Changes to eliminate features	Molding of ring and planet gears, adding snap fit parts	Bending snap holes on aluminum body	Holes on aluminum body	Deep drawing aluminum body.		Trimming and smoothening parts	
Essential features	Top cover, bottom cover, main bowl and bowl cover, plunger	Motor holders, heat sinks,	Motor parts, Screw Holes, main body	Small metal support, wires.	Screws,		Motor Gear
Features required for standardization			Screw holes	Wires	Screws	Brass parts	Gear ratio
Change to part design to simplify process route	Molding whole jar without joints, adding snap fits.	Simple bending shape for motor holder			Using same size Philips head screw	Readily available brass parts.	Used readily available gears.
Changes to simplify process route	no molding of main body	Might be readily available		Might be readily available	Only change in length	Brass magnet holder.	
Changes to part design to improve material efficiency	Use of recycled PP for existing external Parts made of virgin pp			Main body made of recycled aluminum, use of PU wires	Lesser no. of screws needed	Easy to manufacture-drill and threading.	
Changes to simplify process route improve material efficiency	Mixing with virgin pp to increase strength.			Quick process of deep drawing.			
Changes to part design to simplify tooling	Less amount of separate body parts no need for trimming and smoothing	Snap fit holes in body					Brass magnet holder
Changes to simplify process route for tooling	Lesser groves for screw holes				Reduce no of screws	Less amount of threading, less machining	Easy to machine
Changes to part design to simplify equipment	Lesser screw joints, less joints for jar fitter					Brass magnet fit	
Changes to simplify process route to enable use of simpler equipment.	Less need of screwing parts together, no need for spring to be manufactured					Less tools for fitting spring-loaded parts	
New process route	Injection molding	Sheet metal bending	Stamping	Deep drawing	Cold turning	Machining	
Revised part features	Top cover, bottom cover, main bowl and bowl cover, plunger, snap fits,	Motor holders, heat sinks, main body	Motor parts, Screw Holes, main body	Small metal support, wires, main, main body	Screws, brass parts, readily available parts	Main body, Smoothening, Motor components, brass magnet	

5.4 Additional Method- Cost Analysis

S.No.	Component Name	Original design			Redesign using DFE & DFA		
		Materials	Weight (g)	Cost (£)	Materials	Weight (g)	Cost (£)
1.	Motor stator	Mild steel	180	0.11	Mild steel	180	0.11
2.	Motor rotor	Copper, mild steel	133	0.15	Copper, mild steel	133	0.15
3	Starlock	Steel	4	0.03	Steel	4	0.03
4	Spring c clip	Carbon steel	2	0.04	Carbon steel	2	0.04
5	Beveled bearing	Steel	5	0.03	Steel	5	0.03
6	washers	Steel	3	0.02	Steel	3	0.02
7	screws	410 stainless steels	65	0.45	410 stainless steels	40	0.32
8	Motor mount	Aluminum	22	0.04	Aluminum	22	0.04
9	Gear box	Nylon	63	0.4	Nylon	63	0.4
10	Sun gear	Steel	63	0.4	Steel	63	0.4
11	Fan	PP	2	0.02	PP	2	0.02
12	Outer casing	PP	262	2.62	Aluminum	188	0.35
13	Bottom cover	PP	315	3.16	PP	315	3.16
14	Top cover	pp	100	1	PP	200	2
15	Switches	Ldpe/ copper	22	0.045	Ldpe/ copper	22	0.045
16	Knob	pp	12	0.06	pp	12	0.06
17	Suction cup	PVC	15	0.05	rubber	15	0.15
18	Bowl	ABS	601	15.02	ABS	601	15.02
19	Bowl lock mechanism	PP/ABS	20	0.47	Magnet/brass	30	1
20	Spring	steel	0.2	0.001	-		
21	Wires	PVC/Copper	21	0.16	PVC/Copper	21	0.16
22	Blade	SS / PP	214	1.46	SS / PP	214	1.46
Total weight		2124			2135		
Total cost		25.336			24.465		

Cost analysis helps to compare redesign on scale of raw material cost. Which should not associate to final cost as various processes might make it more expensive than the raw material cost, but this helps us understand what components of the redesign are leading it to be more or less expensive than original design.
This analysis shows although the total weight after redesign has increased there is an reduction in the coast of raw material this is mainly caused due to use of aluminum to make the body rather than PP which is a bit expensive than aluminum but while processing aluminum has to go through multiple stages of processing which might increase the cost of redesign it is also noticed that the increase in weight is also due to aluminum body but the weight has been reduced slightly due to removal of jar lock set.
As this method does not include the manufacturing cost of the product it is not possible to use it as a reliable tool for DFMA analysis.

6. Final Design and Discussions

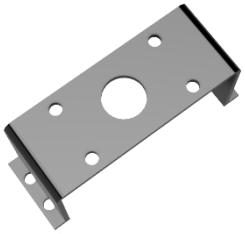
Redesign – 1

In this redesign the sub assembly that mounts the motor and gear box to the main body is redesigned to reduce the no. of screws and also the time needed for assembly and dismantle.

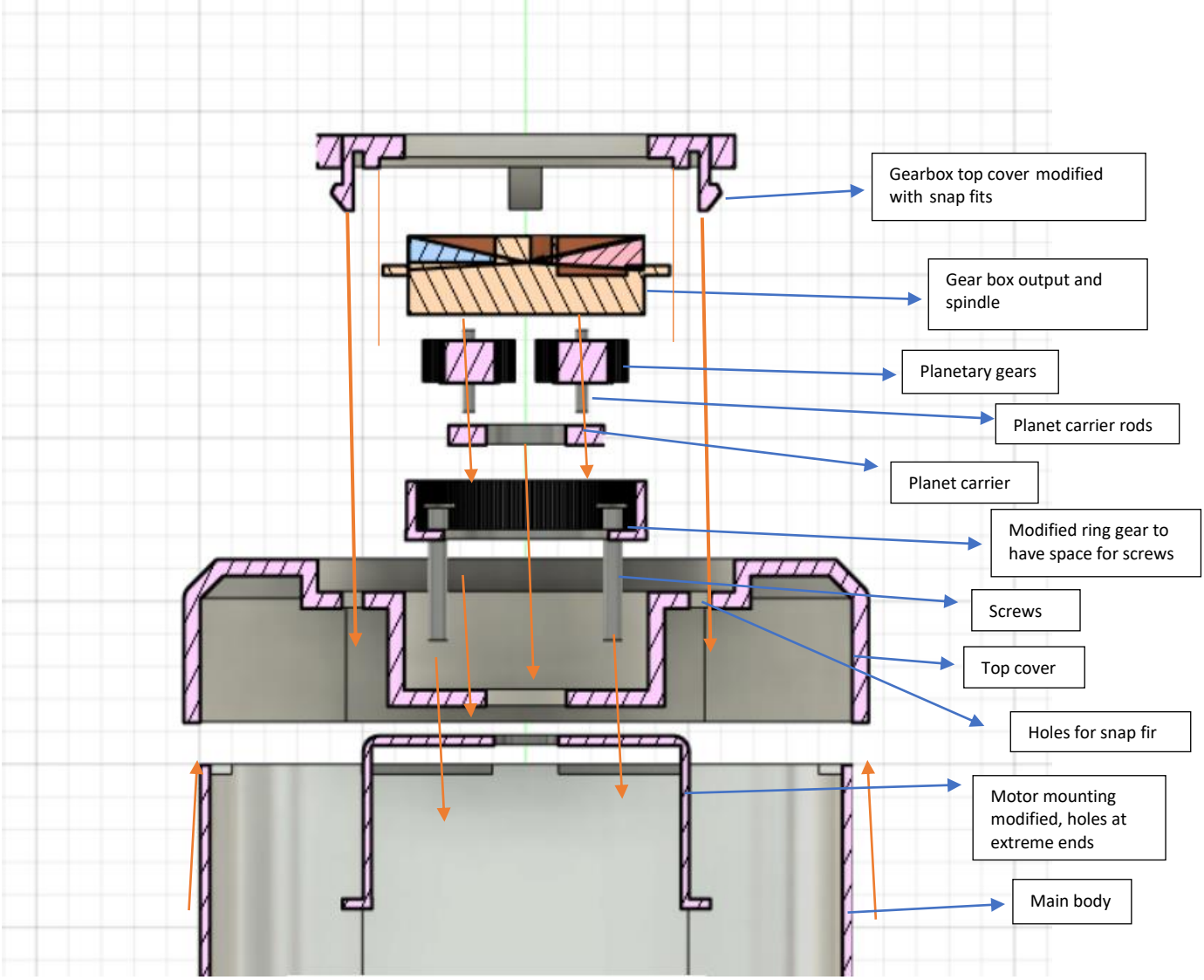
The parts that are re- designed-

Ring gear bottom is expanded to fit screws that can go through the top cover to connect to the motor mounting

the holes on motor mounting is changed to aligned with the ring gear holes



The gear box cap and top cover is modified to accommodate snap fit join


Gearbox top cover modified with snap fits
Gear box output and spindle
Planetary gears
Planet carrier rods
Planet carrier
Modified ring gear to have space for screws
Screws
Top cover
Holes for snap fir
Motor mounting modified, holes at extreme ends
Main body

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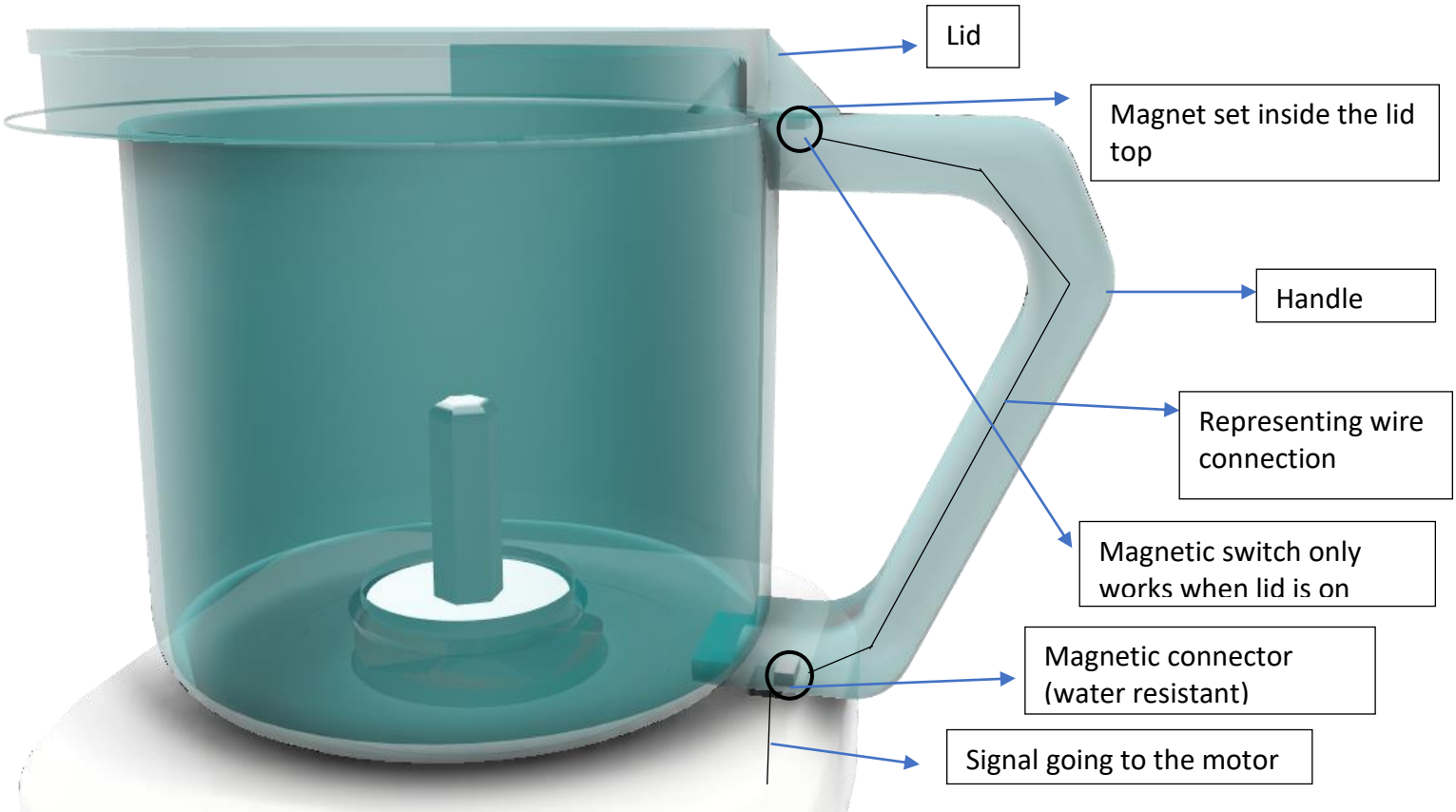
Redesign 2

This redesign aims to reduce the use of jar locking and jar fitter system . Which is used to make sure the food processor doesn't start without the lid.

Redesign suggest use of an connector with magnetic switch fit inside the main bowl and magnet in the lid which helps achieve the same effect as lock sysytem



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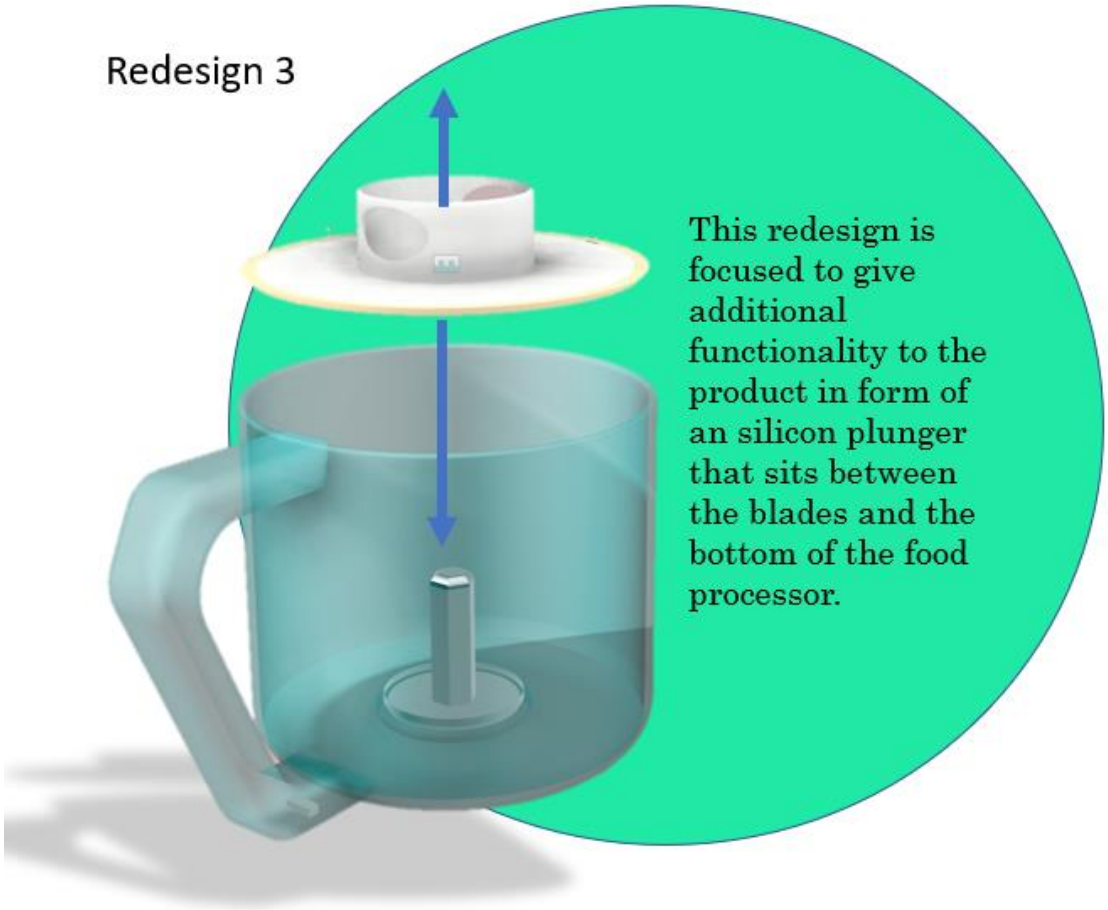
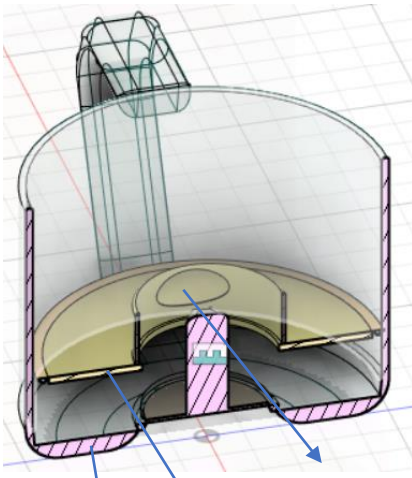
Redesign 3

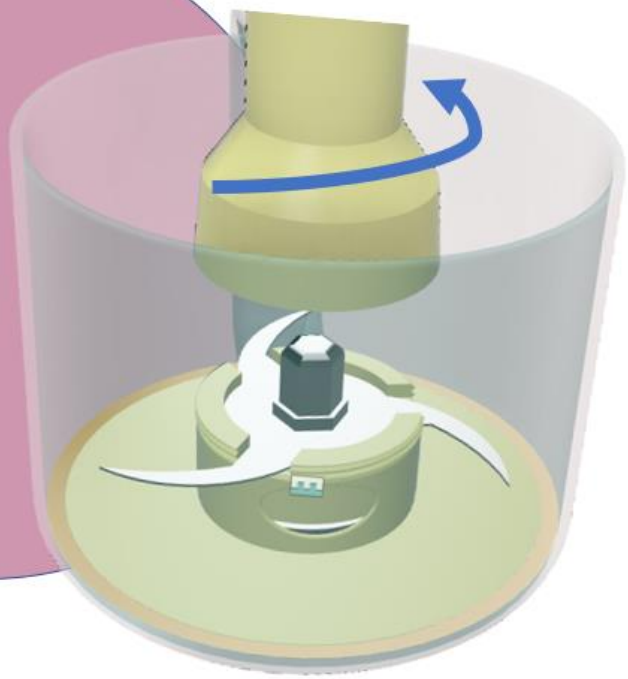


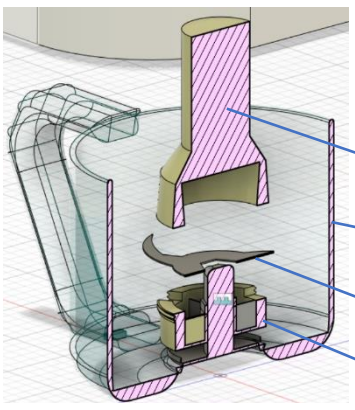
This redesign is focused to give additional functionality to the product in form of an silicon plunger that sits between the blades and the bottom of the food processor.

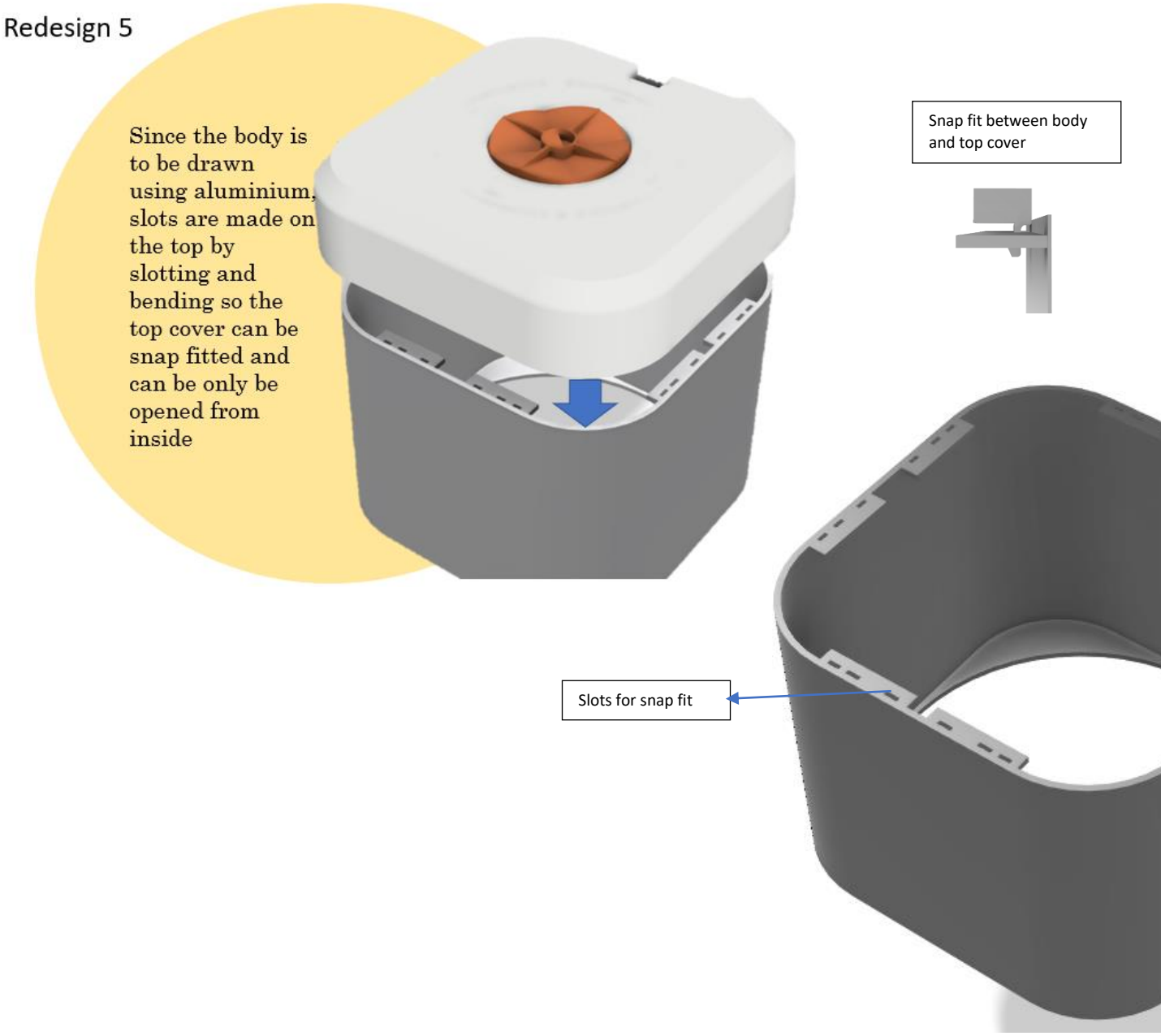


Redesign 4

This redesign focuses on making the blade removeable so it is recyclable at end of its life and also be replaced in case of damage.







6.1 Final Design & Discussion-

The final design includes important adjustments based on the product's DfM and DFA analyses. These changes are advised based on the criteria of making the product more sustainable, easier to assemble, and with fewer parts.
During the DFA analysis, the following suggestions for optimizing assembly procedures are made:
The motor installation and gear box were optimized by reworking the ring gear to have a bigger base area with holes that could be directly installed into the top cover of the food processor. The screws are secured into the modified motor mount, where the screw holes are stamped to a location more suited for bearing the load from the ring gear. After the ring gear

is installed, the planet carrier is raised to keep it above the screw heads. After the entire gear box has been built as normal and put into the cavity, the top cover for the gear box is snap fitted into the top cover of the food processor. A snap fit is intended to fit into the top cover and gear box cover for this.

The second subassembly is improved by eliminating the bottom gasket that exists between the main body and the bottom part. Because the gasket has been considered superfluous, the bottom casing has been rebuilt with an increased height so that it may fit well with the main body without requiring significant changes in proportions.

The third modified subassembly is the jar locker and jar fitter mechanism, which ensures that the motor does not start without the lid on. Magnets and magnetic switches were employed to perform this security feature via electronics to replicate this effect. As a result, the handle is redesigned to fit a magnetic switch that is attached to the magnetic connector at the bottom of the jar and then to another connector that provides the signal to the motor. When the lid is closed, a cavity is created to accept a magnet that will trigger the magnetic switch.

The manufacturing method is suggested to involve the use of deep drawing to create the recycled aluminum shell that forms the primary body of the food processor. After that, the primary body is stamped and bent. Suggestion to utilize injection molding instead of milling for gear production, as well as for snap fit manufacturing. Screw and brass component standardization reduces the requirement for machining procedures. In addition, the number of threading processes is lowered by lowering the number of screws fit that are replaced by snap fit.

6.2 Advantages and Limitation.

The following are the advantages and limitation of all suggested redesigns in the DFA and DFM process.

- The new motor assembly with the main body has fewer screw joints, and the modification in assembly sequence has shortened the assembly process by 2 minutes while improving part handling. This also aids the production process by lowering the number of screws and holes that must be threaded.
  The shortcoming of this redesign is that it does not contain the redesign computation, making it difficult to tell what the real snap fit dimensions would be. If the snap fit is not handled properly or breaks during any operation, the gadget will no longer be usable.
- The merging of the gasket is proposed because it is just present for cosmetic purposes and may be removed to save material, decrease part count, and make the assembly easier. If the aluminum main body idea is adopted, it may assist offer a comparable aesthetic vibe.
- The removal of the jar fitter and jar locking device would significantly decrease the part count and save a significant amount of assembly time. This device would also respond quicker, and the magnetic waterproof couplings would create a seamless design with no leaks and a pleasing magnetic click.
  The wire must seem unseen so that it does not appear out of place in the translucent jug. The possibility of a switch breaking due to repeated falling impact. This device can be accommodated with ease despite the loss of a gratifying mechanical click and the necessity for additional development phases.

Change Proposed	Reason	DfE/M/A driven
Redesign of ring gear and motor mount	Reduces two step screwing assembly to one saving time and reducing part count	DFA
Increase the height of gear box assembly base	To accommodate changes in the ring gear	DFA
Introduction of cantilever snap fits for gear box cover and top cover	To remove the screwing process and reduce the part count	DFA
Use of recycled aluminum to make the main body	Although needs 3 steps to prepare it is more sustainable, more aesthetically pleasing and more durable increasing life of product	DFM
Cantilever Snap fits to join the main body to top cover	Easy to manufacture and reduces additional screw joints and machining. The assembly is quick and dependable	DFE
Introduction of plunger part	It helps in cleaning of the jar with ease hence saving food and water wastage during its life cycle.	DFE
Removeable blade placed between holder and base	Helps make recycling process easier at end of its lifecycle and possible to replace blade if damaged.	DFE
QR code embossed on the base of main body.	Can be linked to user manual, order spare parts and part information needed during recycling.	DFE
Redesign jar and cover to accommodate magnetic switch and magnet	Reduces manufacturing, assembly time and has seamless design.	DFA
Use of recycled PP plastic for top and bottom covers and other components that	Although not very cost effective it is sustainable and could be unique selling	DFM

use virgin PP	point.	
Use of rubber or silicone suction cups	They are more sustainable than PVC suction cups.	DFM
Minimalistic packaging without much graphics printed.	Reduces environmental impact and does not produce toxins while decomposing.	DFE
Using a single plastic bag to cover everything inside the box	Reduces the use of single use plastic. Sustainable packaging	DFE

7. Conclusion

The redesigns offered to the firm are made after many phases of examination, which are separated into two parts. The product is extensively assessed at both stages to identify any potential adjustments that might result in a beneficial change to the newly created product. The primary focus of phase one was on methods to make the product more sustainable throughout its life cycle, including end-of-life circumstances.
This phase was primarily concerned with optimizing the assembly and manufacturing processes to improve overall process efficiency by reducing part counts, improving handle during assembly, and identifying simpler manufacturing routes by comparing possible design and material changes that make tooling, equipment use, and use of standardized parts easier.

TDS Appliances Pvt. Ltd.'s suggestions the observation aims to shorten the product's assembly time by reorganizing the pieces and redesigning components that must be manufactured. The redesign of the subassemblies makes the product easier to handle and assemble overall, while also lowering the part count. The recommendation to adopt standardized components and hole sizes lessens the burden on the firm to create all fundamental parts from scratch. Although certain changes, such as the use of recycled aluminum and magnetic switch locks, may be more expensive, they provide additional value by making them distinctive in the marketplace and more sustainable. Working with recycled materials might be tricky, but it can help you target a certain group of consumers who want sustainable products. Because the original product lacked an aluminum casing and a snap joint, it is more difficult to determine whether they are good practical changes that can be implied or perform well, but it is the company's responsibility to analyze current market contenders and work on developing products that have the potential to stand out. For these reasons, the proposed design enhancements are highly advised because they may stand out while being straightforward for the company to produce and evaluate.

8. References

[1] https://eds-p-ebscohost-com.liverpool.idm.oclc.org/eds/detail/detail?vid=0&sid=9c135e08-94ff-4e57-97fa-3b99c9955685%40redis&bdata=JnNpdGU9ZWRzLWxpdmUmc2NvcGU9c2l0ZQ%3d%3d#AN=lvp.b5744192&db=cat00003a

[2] https://www-emerald-com.liverpool.idm.oclc.org/insight/content/doi/10.1108/01445150010321814/full/html

[3] https://www.emerald.com/insight/content/doi/10.1108/01445151211212262/full/html

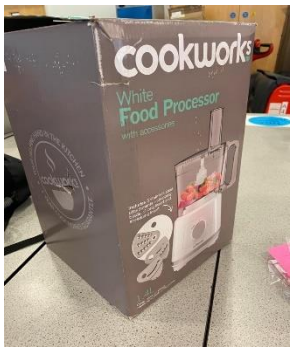
9. Appendixes

Product Disassembly

Helps understand disassembly process to better understand the re designed assembly.

The Disassembling of the food processor could be divided into 4 major steps.

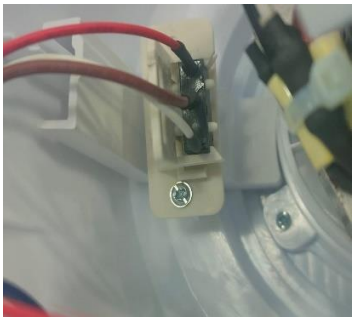
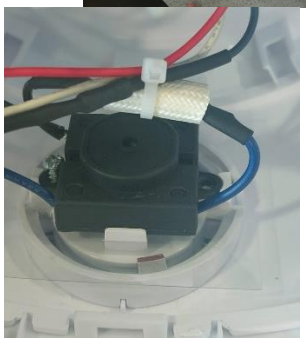
1. **Unboxing** the food processor comes in a carboard box unboxing involves
    - Removing the box seal.
    - Removing supports that holds the product in place.
    - Remove the Jar, Blades, and other accessories from the LDPE packaging.
    - Remove the motor unit from plastic packaging.

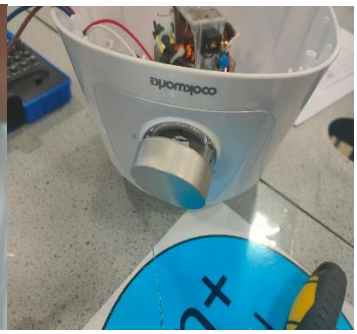



2. **Motor unit disassembly** this involved opening the main casing for the motor and other electronics.
    - Remove 4 screws from motor housing base.
    - Remove suction cups from bottom.
    - Remove base housing connector.
    - Unscrew wire and capacitor fixed on base.
    - Unscrew jar fitter and micro switch.
    - Unscrew main switch, remove regulator know and unscrew its housing.

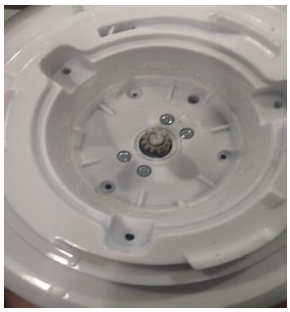
- Unscrew the Gear box assembly inside the motor housing.
- Remove the gear box and unscrew motor outside motor housing.





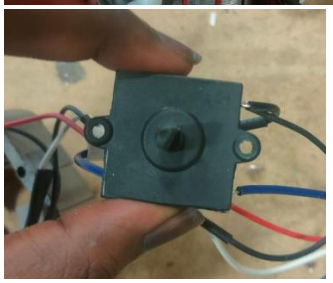




3. **Disassembling motor and wiring** where all the electronic and motor components are separated as much as possible.

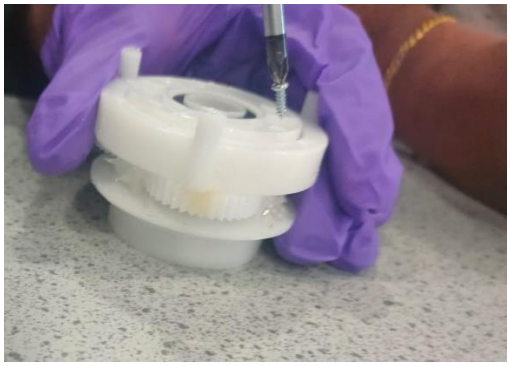
- Cut wire to Capacitor, micro switch, and main switch.
- Remove resistor from the plug.
- Using a Vise gear and fan of motor are removed.
- Unscrew brackets in both side of motor to separate all motor parts.
- Carbon brushes are removed using pair of pliers.

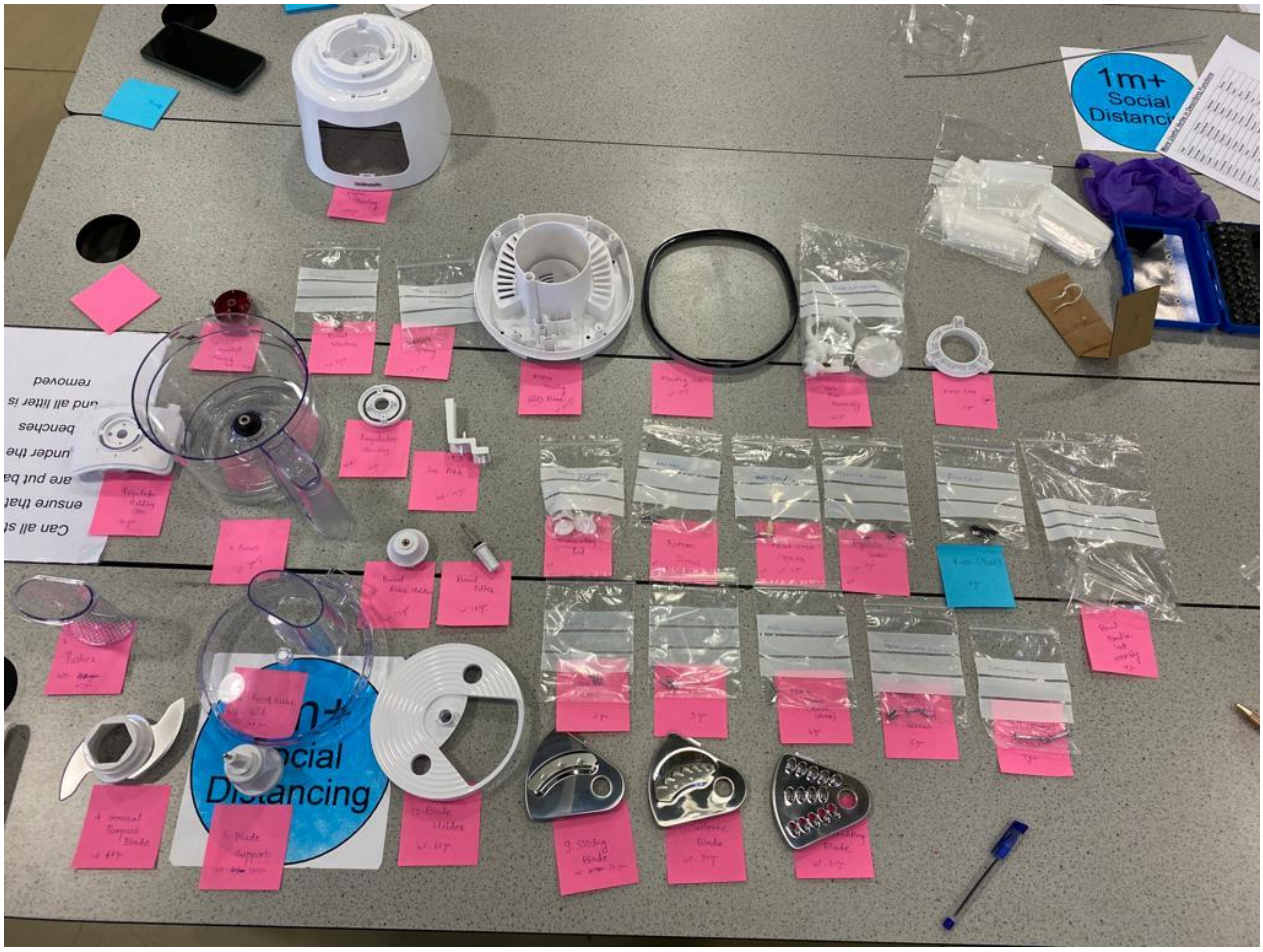



4. **Disassembly of jar components and gear box** involves removing attachments built in the jar separation of gear box.

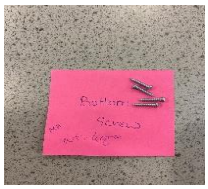
- Unscrew the bowl lock from the handle.
- Pull out the blade support.
- Unscrew the bowl fitter and remove the holder with set of pliers
- Remove shredding blade from blade holder.
- Unscrew casing of gear box.
- Separate planetary and its support from the ring gear.



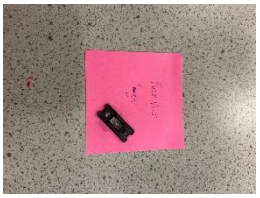
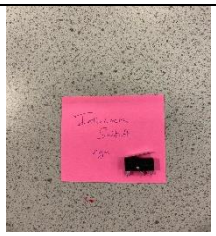
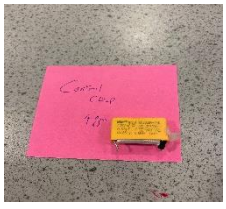
3. Bill of Materials

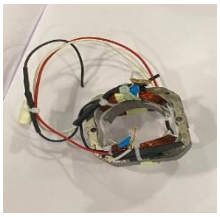
Bill Of Material						
Part Number	**Description**	**Material**	**Total Weight(kg)**	**Qty**	**Manufacturing**	**Image**
1	Transparent Lid	Acrylonitrile styrene	0.16	1	Injection Moulding	
2	Pusher	Acrylonitrile styrene	0.047	1	Injection Moulding	

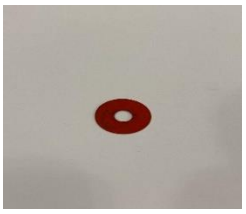
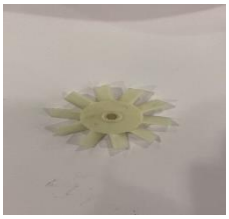
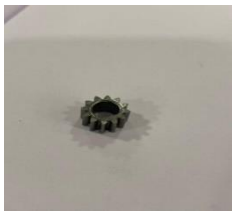
3	Bowl	Acrylonitrile styrene	0.394	1	Injection Moulding	
4	Motor Housing	Polypropylene	0.233	1	Injection Moulding	
5	Motor Housing Base	Polypropylene	0.215	1	Injection Moulding	
6	Suction Cap	PVC	0.0015	4	Injection Moulding	
7	Housing Bottom Screw	Steel	0.001	4	Thread Rolling Method	
8	Bowl Handle Lock Assn	Acrylonitrile styrene	0.018	1	Injection Moulding	
9	Jar Fitter Spring	PP	0.002	1	Injection Moulding	

10	Gear Box Screw	Steel	0.001	3	Thread Rolling Method	
11	Jar Fitter Screw	Steel	0.0015	2	Thread Rolling Method	
12	Gear Box Assm	Nylon	0.063	1	Milling/Hobbling	
13	General Purpose Blade	Blade -SS Body -PP	0.049	1	Progressive tooling	
14	Blade Holder	Polypropylene	0.065	1	Injection Moulding	
15	Bowl Fitter	Steel / Plastic	0.018	1	Thread Rolling	
16	Speed Switch Cover	Polypropylene	0.012	1	Injection Moulding	

17	Regulator Housing	Polypropylene	0.006	1	Injection Moulding	
18	Blade Support	Metal Part -SS Body - Polypropylene	0.05	1	Injection Moulding	
19	Bowl Fitter Holder	Metal Part - Brass Body - Polypropylene	0.017	1	Injection Moulding	
20	Regulator Holding Case	Polypropylene	0.03	1	Injection Moulding	
21	Regulator Case	Polypropylene	0.029	1	Injection Moulding	
22	Bowl Washer	Steel	0.001	3	Stamping	
23	Slicing Blade	Stainless Steel	0.036	1	Progressive tooling	

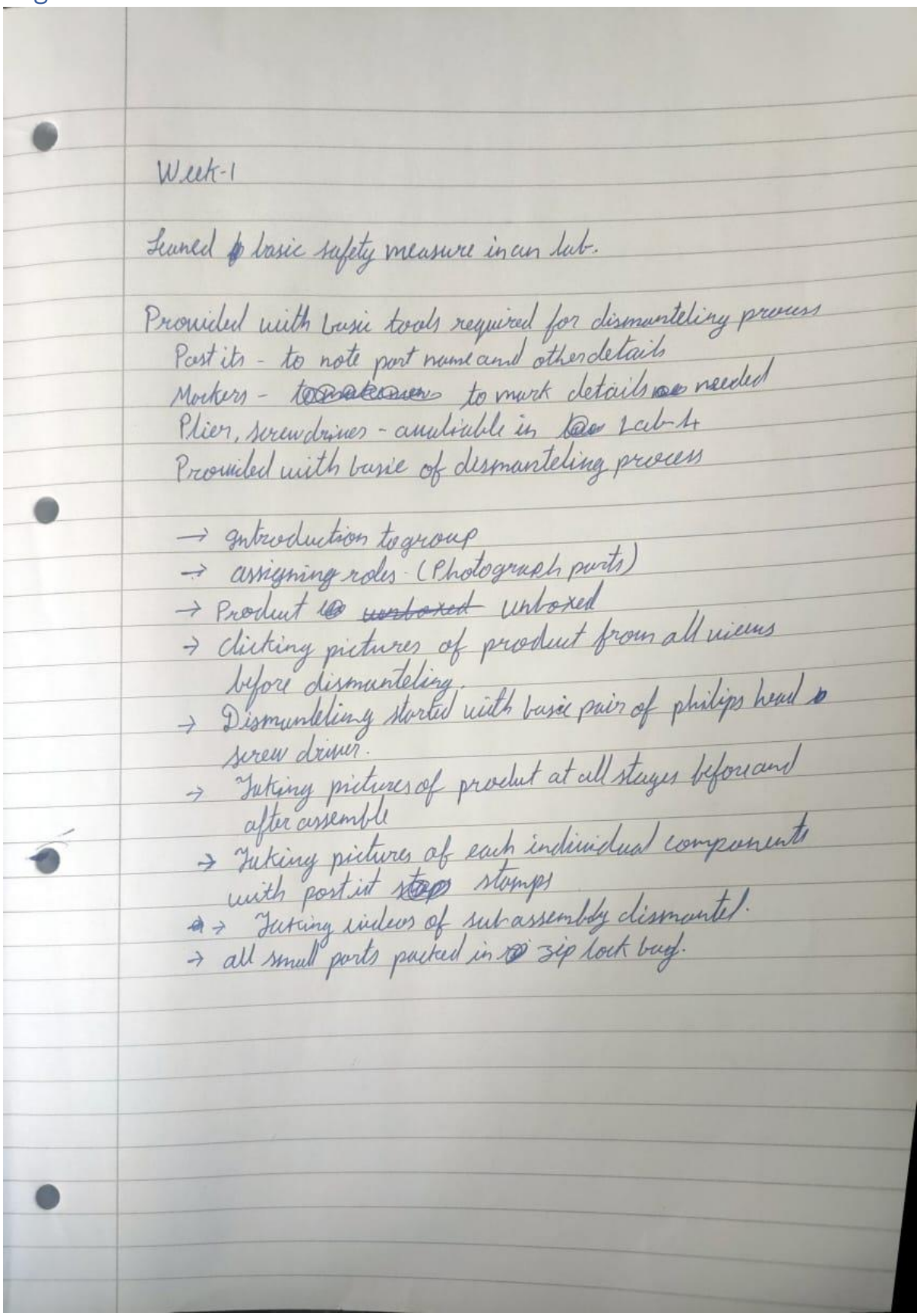
24	Shredding Blade	Stainless Steel	0.03	1	Progressive tooling	
25	Julienne Blade	Stainless Steel	0.034	1	Progressive tooling	
26	Fuse Holder	Plastic	0.001	1	Blow Moulded	
27	Fuse	Copper & glass	0.002	1	Blow Moulded	
28	Circuit Housing	Plastic	0.006	1	Injection Moulding	
29	Micro Switch	Plastic + metal lever and roller	0.002	1	Progressive tooling + Injection Moulding (plastic)	
30	Capacitor	metallized polypropylene film	0.004	1	Rolling	

31	Rotatory Switch	Plastic	0.014	1	Injection Moulding	
32	Connecting Wire	Aluminium wire with PVC Insulation	0.022	1	Drawing	
33	Cable Holder	steel screws, plastic	0.003	1	Thread rolling, Injection Moulding	
34	Jar Fitter Spring	Spring Steel	0.001	1	Coiling	
35	Motor Stator	Mild steel, copper coils, Al wires	0.346	1	CNC milling, drilling	
36	Motor Assembly Screw	Steel	0.001	4	Thread Rolling	
37	Motor Front Cover	Mild steel	0.034	2	Bending, forming, drilling, Riveting	

38	Washer	Carbon steel	0.001	4	Stamping	
39	Magnetic Spring	Steel, magnet	0.002	2	Coiling	
40	Washer	Carbon steel	0.001	4	Stamping	
41	Motor Fan	Nylon	0.004	1	Injection Moulding	
42	Motor Gear	Mild Steel	0.004	1	Milling/Hibbing	
43	Motor Rotor	Mild steel, Copper	0.198	1	CNC milling, Coiling	
44	Motor Base Screw cover	Steel	0.001	3	Thread Rolling	

45	Coil Motor Screw	Steel	0.002	2	Thread Rolling	
46	Regulator Screw	Steel	0.001	4	Thread Rolling	
47	Pulp Inserts	Cardboard	0.128	2	Pulp Moulding	
48	Plastic Bag	LDPE	0.001	4	Extrusion	
49	External Cover	Corrugated Cardboard	0.5	1	Corrugation, Pressing	
50	Base connector	ABS	0.1	1	Injection Moulding	

Log- Book



Week-1

Learned basic safety measure in an lab.

Provided with basic tools required for dismanteling process
Post its - to note part name and other details
Markers - to mark details needed
Plier, screwdriver - available in Lab-4
Provided with basic of dismanteling process

→ Introduction to group
→ assigning roles (Photograph parts)
→ Product unboxed
→ Clicking pictures of product from all views before dismanteling.
→ Dismanteling started with basic pair of philips head screw driver.
→ Taking pictures of product at all stages before and after assemble
→ Taking pictures of each individual components with post it stamps
→ Taking videos of sub-assembly dismantel.
→ all small parts packed in zip lock bag.

Week-2

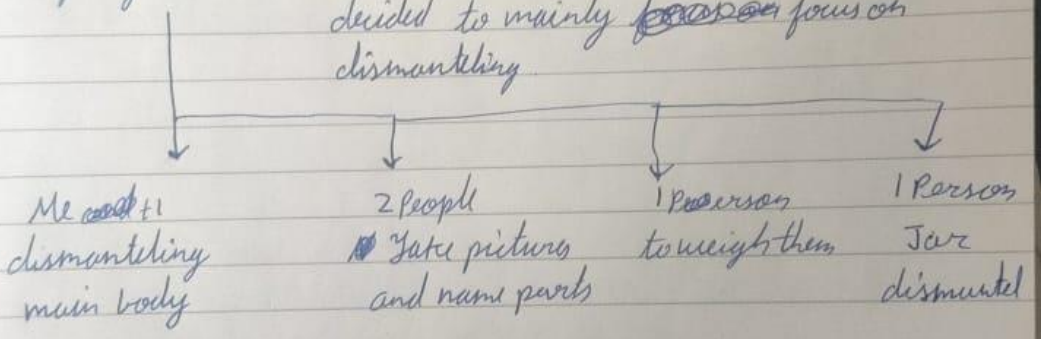
Change of group due to too many member

Group 6 → Group 12

Introduction to all members -
all members except me new to the uni (Jan intake)
so became unofficial Team lead.

- New product → Cookworks food processor.

Assigning work - since we were late to start
decided to mainly focus on
dismantling



Bottom part was hard to open (different shape of screws)

motor disassembly to long and complicated.

Trouble determing materials for some parts

Trouble determing function of some
parts

Week - 3

2 more members join the group. - Add them to WA group to share images and videos.

Total members - 8

Work lag by one week

2 peoples assined to note down product discription and dismanteling - 1 member responsible for dismanteling last week and 1 new member so he can understand the process

2 members assigned for Bom - 1 member responsible for measuring weights of parts and 1 new member so he can understand the parts while doing so

2 Members assigned to work on product life cycle and functional analysis. both responsible for taking photos and naming parts last week

Me and 1 member start working of data necessary for Met Matrix and Mcdonald smith chart.

Prepare the outline for both the charts collect basic info needed to fill the tables.

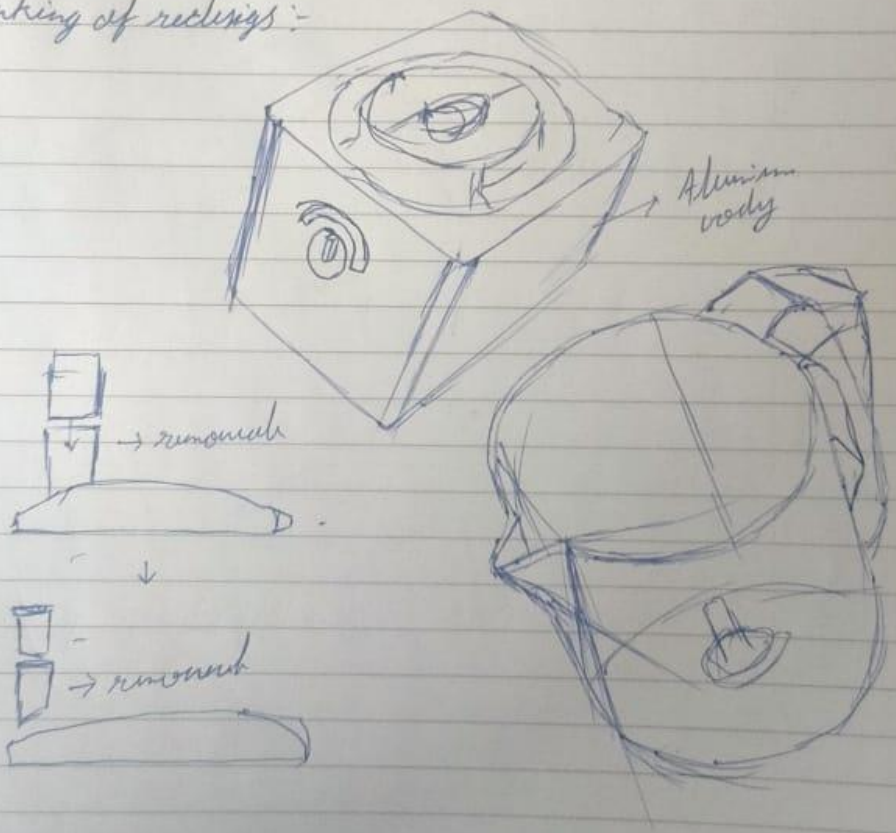
Week - 5

Going over all the parts to find few components of motor were missing in Bom.

Adding parts to BOM.

setting deadline to for sharing all tasks on WA group to compile for the final submission.

thinking of redesigns :-

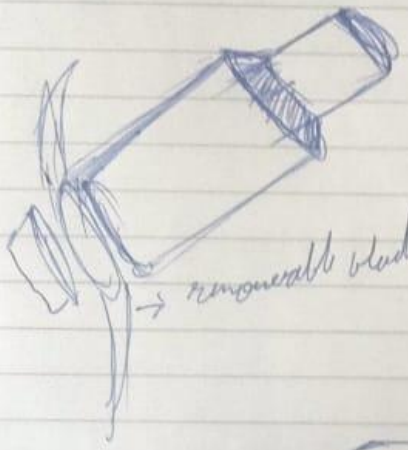


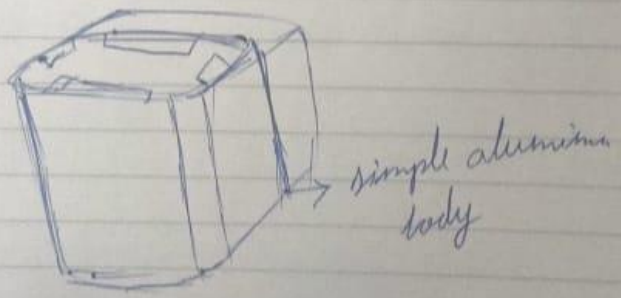
Week 6

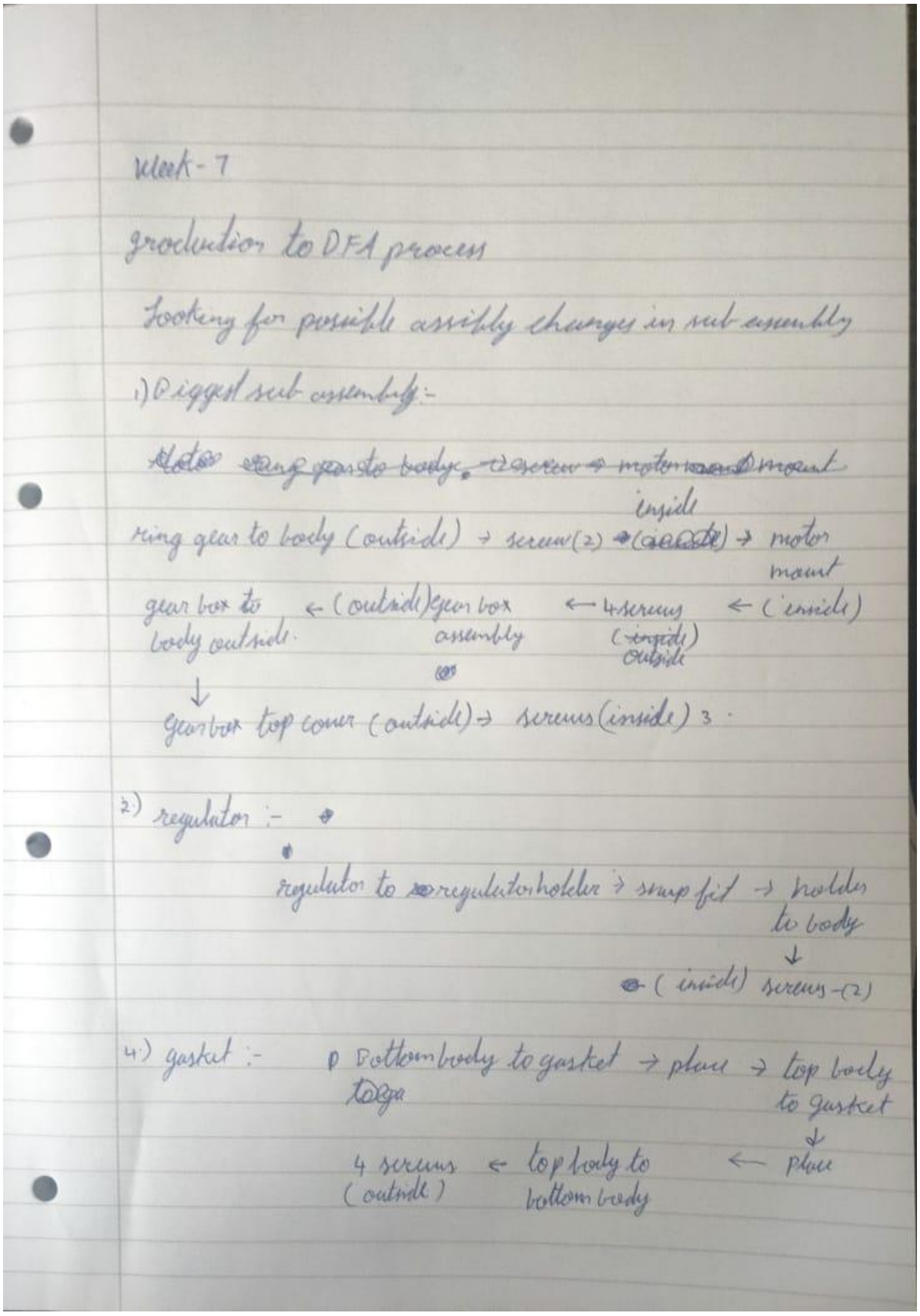
Compiling all common tables and to write the DFE report.

~~Finding~~ finalizing redesigns.

Plain packaging, single plastic cover.







Week - 7

Introduction to DFA process

Looking for possible assibly changes in sub assembly

1) Biggest sub assembly :-

~~Motor~~ ~~ring gear to body~~ ~~screw~~ ~~motor mount~~

ring gear to body (outside) → screw (2) → (inside) → motor mount

gear box to body outside. ← (outside) gear box assembly ← 4 screws (outside) ← (inside)

↓

gear box top cover (outside) → screws (inside) 3 .

2) regulator :-

regulator to regulator holder → snap fit → holder to body

↓

(inside) screws - (2)

4) gasket :- Bottom body to gasket → place → top body to gasket

↓

4 screws (outside) ← top body to bottom body ← place

Week 8 →

Sol to ~~the~~ Assembly re-design. →

Motor mounting →

Motor Mounting to body → hold → ring gear → screw (4)
(~~the~~ redesign hole) (redesign) outside →

↓

gear box top cover ← Place ← top to gear box ← gear box
to body (outside) (outside)

↓

Snapfit.

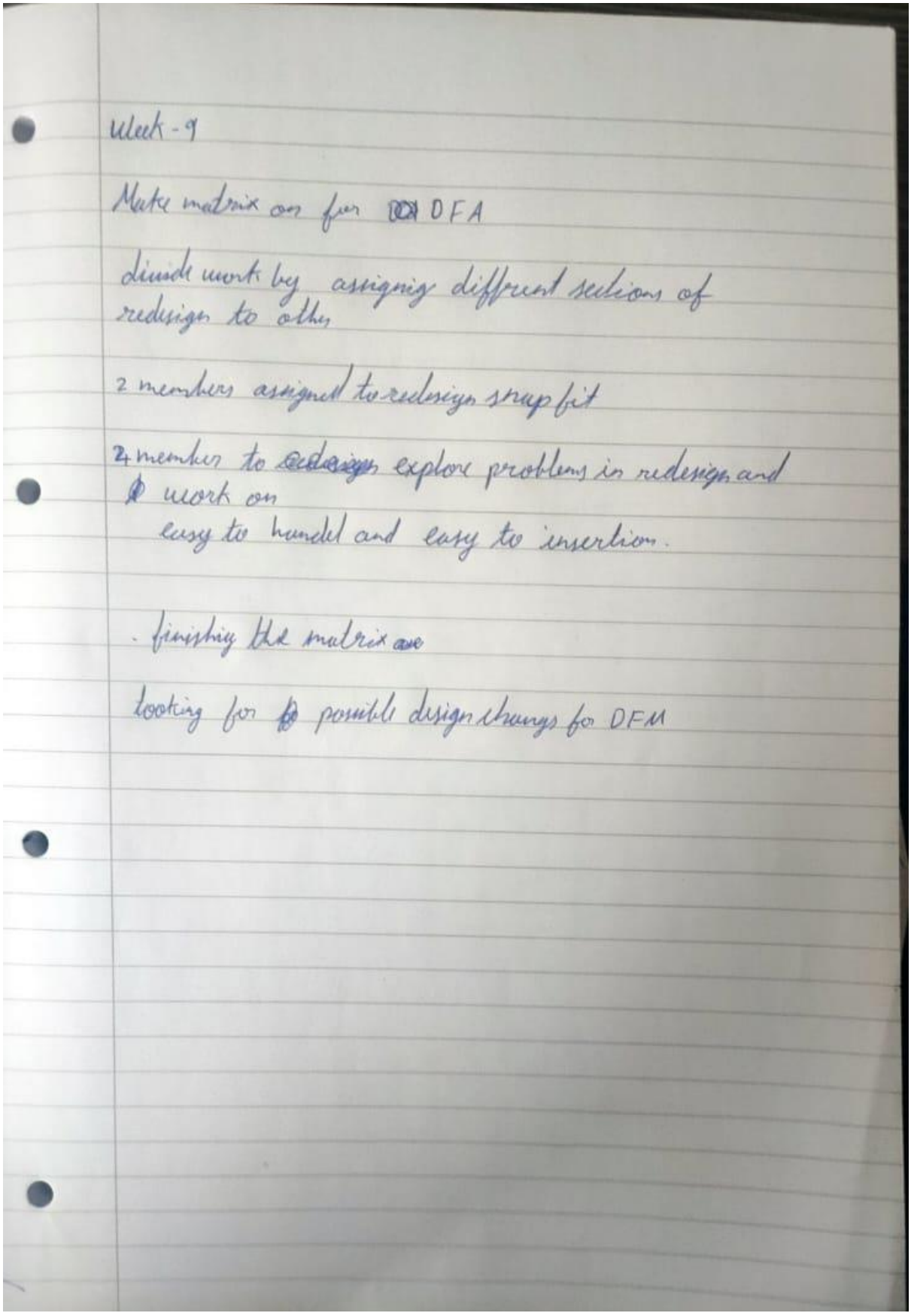
regulator → ~~body to reg~~ ~~regulator~~
(redesign)

body to regulator → snapfit
(body redesign)

Gasket → Gasket to bottom → (one part) → body
(removed) ↓

4 screws (outside)

finally selected Motor mounting



Week - 9

Make matrix on for DFA

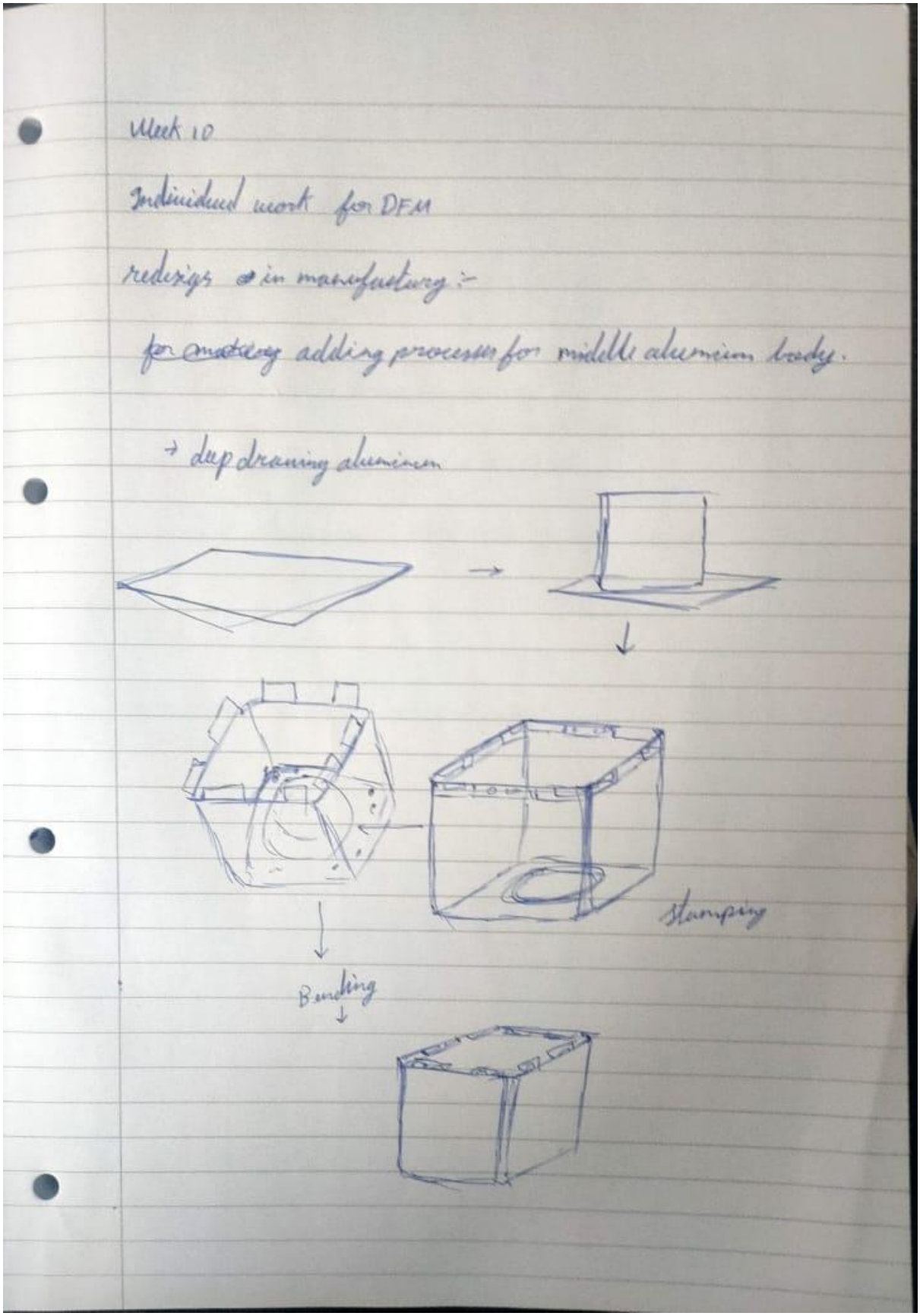
divide work by assigning different sections of redesign to other

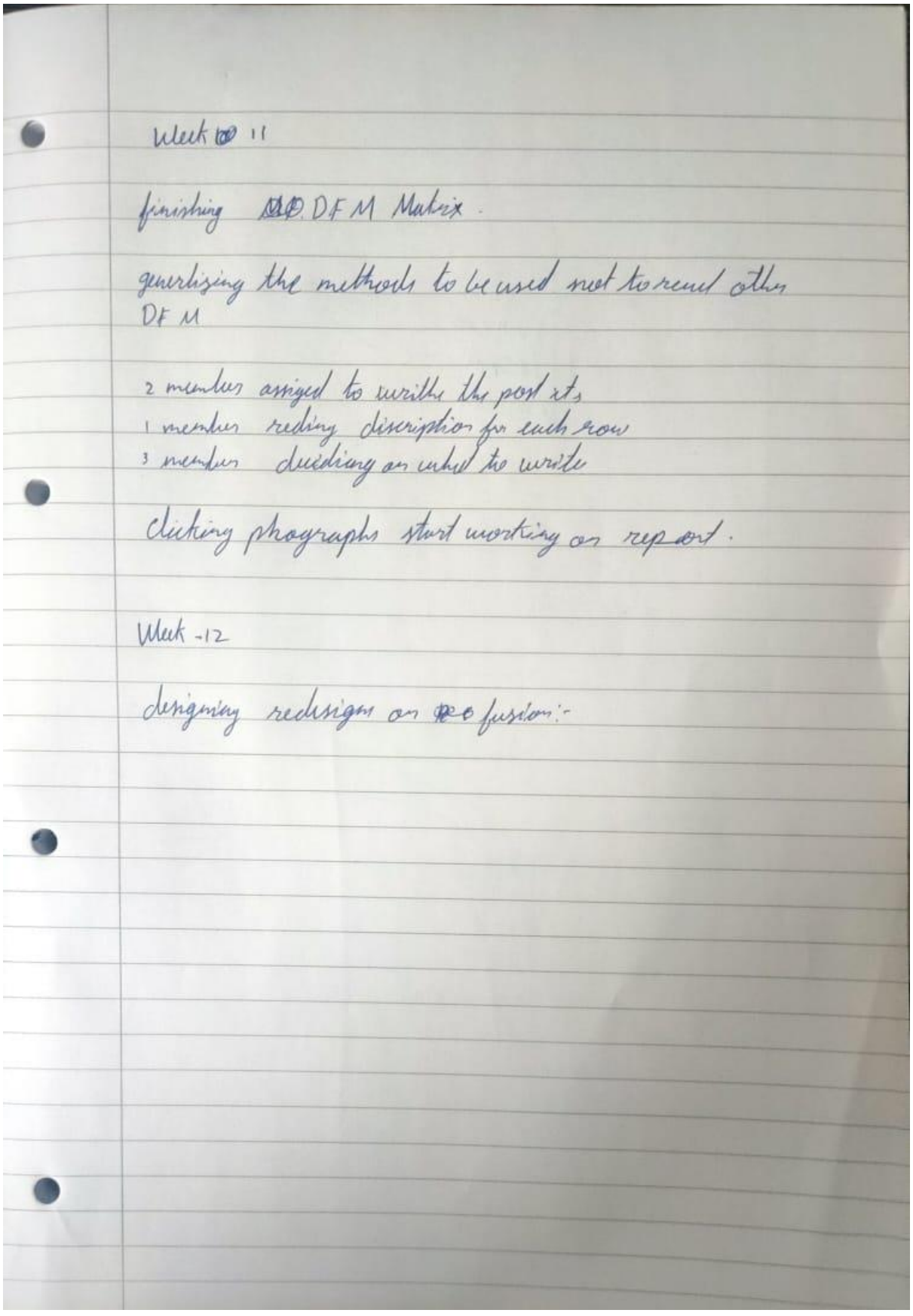
2 members assigned to redesign snap fit

2 member to explore problems in redesign and work on easy to handel and easy to insertion.

- finishing the matrix

looking for possible design changes for DFM


Week 10
Individual work for DFM
redesign in manufacturing :-
for ~~manufacturing~~ adding processes for middle aluminium body.
→ deep drawing aluminium
Stamping
Bending



Week 11

finishing DFM Matrix.

generlizing the methods to be used not to reuse other DFM

2 member assigned to write the post it's
1 member reding discription for each row
3 member deciding on what to write

clicking phographs start working on report.

Week -12

designing redesigns on fusion:-