



# MULTI - TOOLED HAND DRILLING MACHINE

*ME220 - 2022 : Engineering Design and  
Innovation*

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# Introduction

- **Multi - tooled Hand Drilling Machine** is a drilling machine that can change the tool without removing and replacing the cutter manually. Therefore we can have multiple drilling tools within a single machine.  
It is consist of ;
  - different types of drilling tools ,
  - a circular plate ,
  - drill bit ,
  - chuck ,
  - power supplying component and
  - other common parts of a hand drilling machine.
- It is under the Work Station category. This product can be used to drill various materials in different shapes, different sizes in different scenarios.

- This product will be more useful for our targeted customers because this hand drilling machine make the work easy by ;
  - Saving time ,
  - Minimizing working effort ,
  - Increasing working efficiency and
  - Cost effective
- Market ;
  - Working station category.
  - Construction projects
  - Work stations
  - For use of Carpenters, Technicians
  - Domestic usages
  - In Universities and Technical schools & etc.
- Available commercial products ;
  - Drilling machines that should change cutting tools manually .
  - CNC machines.

## MISSION STATEMENT : MULTI - TOOLED HAND DRILLING MACHINE

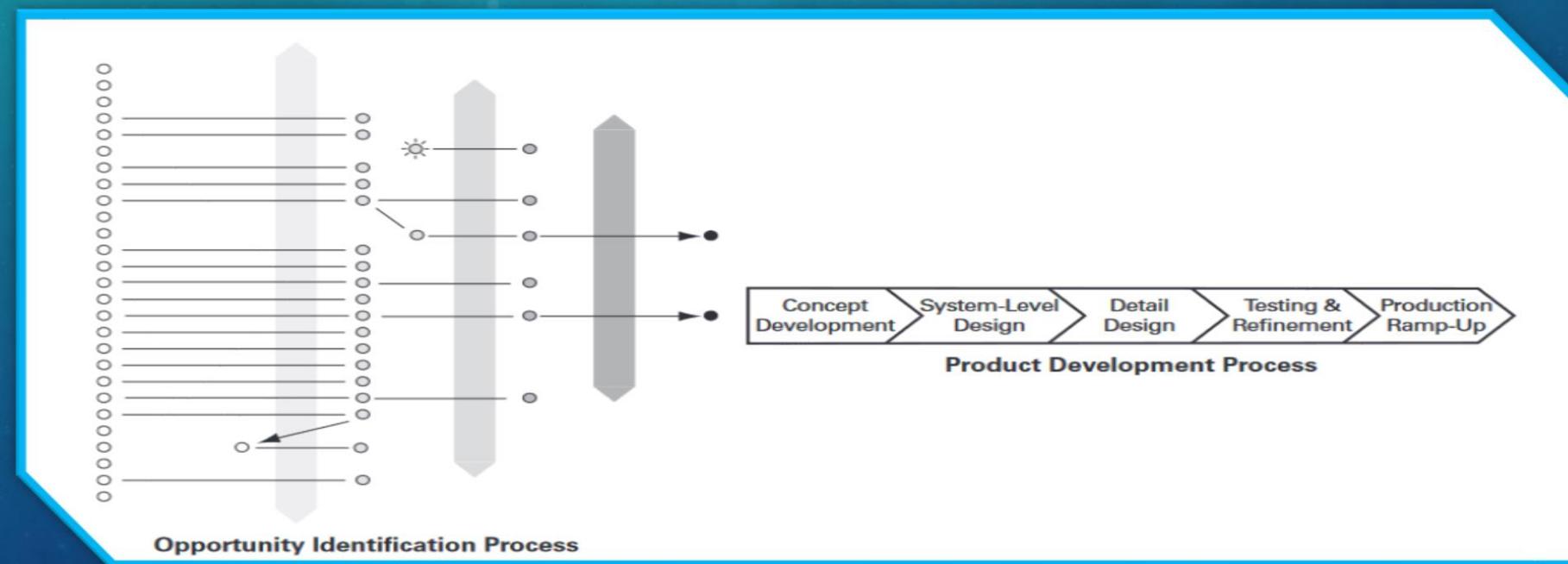
Product description	<ul style="list-style-type: none"> <li>Multi - tooled Hand Drilling Machine that can change the tool without removing and replacing the cutter</li> </ul>
Benefit proposition	<ul style="list-style-type: none"> <li>This hand drilling machine make the work easy by saving time</li> <li>minimizing working effort</li> <li>increasing working efficiency cost effective</li> </ul>



Key business gales	<ul style="list-style-type: none"> <li>Environmentally friendly</li> </ul>
Primary market	<ul style="list-style-type: none"> <li>Work stations</li> <li>Carpenters</li> <li>Technicians</li> <li>Construction sites</li> </ul>
Secondary Market	<ul style="list-style-type: none"> <li>For domestic usages</li> <li>Universities</li> <li>Technical schools</li> </ul>
Assumptions and constrains	<ul style="list-style-type: none"> <li>New product plate forms</li> </ul>
Stakeholders	<ul style="list-style-type: none"> <li>Purchases and users</li> <li>Distributors and resellers</li> </ul>
	<ul style="list-style-type: none"> <li>Foreign customers and working stations</li> <li>Online buying and selling plate forms ( Alli express, eBay)</li> </ul>

# Opportunity Identification

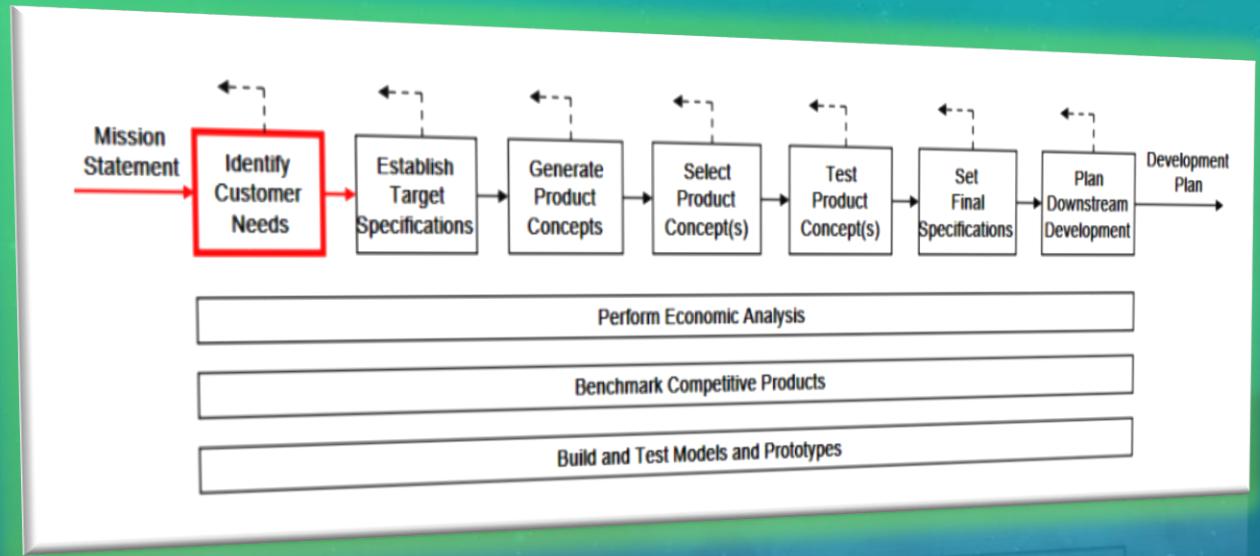
- An opportunity is
  - An idea for a new product,
  - Product description in primary form,
  - A newly sensed need,
  - A newly discovered technology, or
  - A rough match between a need and a possible solution.



- Opportunity Identification Process ;



# Customer Needs Analysis



Identifying customer needs is itself a process, for which we present a five-step method.

Gather raw data from customers

Interpret the raw data in terms of customer needs.

Organize the needs into a hierarchy of primary, secondary, and (if necessary) tertiary needs

Establish the relative importance of the needs

Reflect on the results and the process

# Questionnaire

- Your age?
- What's your occupation?
- Have you ever used a hand drilling machine?
- If yes, what is your experience with it? (ex:- what is the work done by using it)
- What do you think about drilling machine improving parts?
- Is it easy to use without removing the drill bit?
- If yes, what are the difficulties you face when using a normal hand drilling machine?
- Would it be easy if you can use a drilling machine without changing the drill-bit?
- If there's a product in the market like this with affordable price , would you buy it?
- Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole ?
- Any suggestions about the product? (Improvements, quality )

# AFFINITY WORKSHEET

CATEGORY A	CATEGORY B	CATEGORY C	CATEGORY D
The vibration of the machine should be decreased	Use quality material to improve durability and improve a drill bit quality	Powering it with a rechargeable battery might help with portability	Chuck drilling is difficult to handle
not harmful	Measure diameter of the hole	Lightweight	flexible
Add safety components	Reduce Drill bit's slips	know the diameter of the hole	
Make a magnetic	Steadiness	Reduce difficulties	

**CATOGARY A**  
**CATOGARY B**  
**CATOGARY C**  
**CATOGARY D**

**CUSTOMER NEEDS INCREASES**

CATEGORY A	CATEGORY B	CATEGORY C	CATEGORY D
drill bit chucks there for its will easy to remove and replace drill bits		in holding the drill specially when drilling above head parts	
Make efficiency, time saving and reduce human errors	Sometimes the screws are too tight and it takes a lot of time to remove them	It's too heavy. Difficult to handle	
Have to swap the drill bits many times	Improve chuck of the machine	Improve Torque selection ring of the machine	

CATEGORY A	CATEGORY B	CATEGORY C	CATEGORY D
Improve Drill bit of the machine			
User friendly			
Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole			



# Analytical Hierarchy Process (AHP)

		1	2	3	4	ITEMS	5	6	7	8	9			
	The vibration of the machine should be decreased	not harmful	Add safety components	Make a magnetic drill bit chucks there for its will easy to remove and replace drill bits	Male efficiency, time saving and reduce human errors	Male efficiency, time saving and reduce human errors	Have to swap the drill bits many times	Improve Drill bit of the machine	User friendly	Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole		ROW TOTAL	RELATIVE IMPORTANCE (%)	SCAL IMPORTANCE
<b>ITEMS</b>	<b>The vibration of the machine should be decreased</b>	1	0.2	0.2	5	0.1	0.2	5	0.2	5		16.9	6.978	4.3
	<b>not harmful</b>	5	1	1	10	0.2	0.2	10	0.2	5		32.6	13.46	4.6
	<b>Add safety components</b>	5	1	1	10	0.2	0.2	10	0.2	5		32.6	13.46	4.6
	<b>Make a magnetic drill bit chucks there for its will easy to remove and replace drill bits</b>	0.2	0.1	0.1	1	0.1	0.1	5	0.2	0.2	7	2.89	4.1	
	<b>Make efficiency, time saving and reduce human errors</b>	10	5	5	10	1	5	10	5	10	61	25.19	4.9	

Have to swap the drill bits many times	5	5	5	10	0.2	1	10	5	10	51.2	21.14	5	
Improve Drill bit of the machine	0.2	0.1	0.1	0.2	0.1	0.1	1	0.1	0.2	2.1	0.867	1	
User friendly	5	0.2	0.2	5	0.2	0.2	10	1	5	26.8	11.07	4.5	
Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole	0.2	0.2	0.2	5	0.1	0.1	5	0.2	1	12	4.955	4.2	

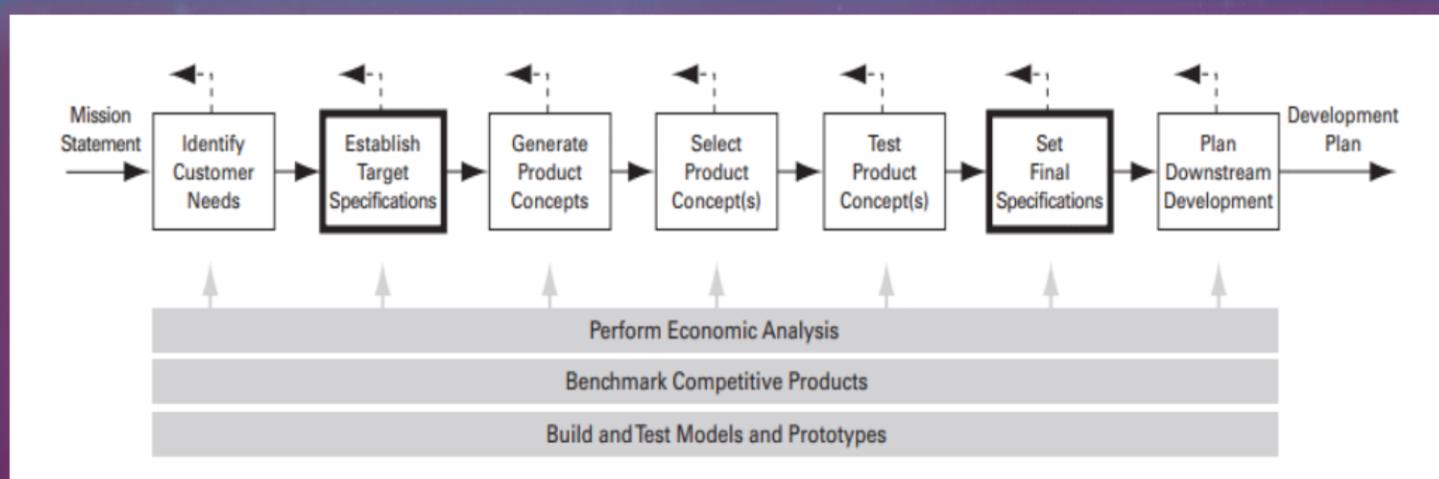


NEED	EXPECTED	NORMAL	EXCITER	STATUS	IMPORTANCE	Critical Needs
Make efficiency, time saving and reduce human errors	X			DIFFICULT	5	X
Have to swap the drill bits many times			X	NEW	4.334	X
not harmful		X			3.071	X
Add safety components		X			3.071	X
User friendly	X				2.677	
The vibration of the machine should be decreased	X			NEW	2.005	X
Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole	X				1.333	
Make a magnetic drill bit chucks there for its will easy to remove and replace drill bits			X		1.672	
Improve Drill bit of the machine		X			1	

## Ranking of Needs

# Product Specification

Product Specification is a precise description of what the product has to do. Some firms use the terms “**product requirements**” or “**engineering characteristics**” in this way. Other firms use “**specifications**” or “**technical specifications**” to refer to key design variables of the product such as the oil viscosity or spring constant of the suspension system.



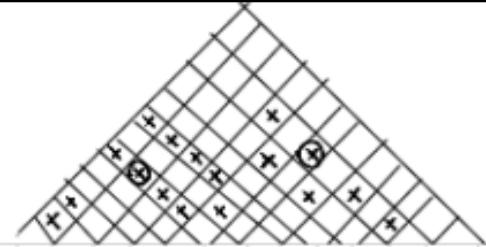
# SPECIFICATION TABLE

Metrics	Value
Drills bits ( Drilling tools)	Diameter = 6mm, 7mm, 12.5mm, 13mm, 16mm Length = 93mm, 109mm, 151mm Angle = 135 deg
Circular Plate	Diameter = 45 mm
Drill bits holder	Diameter = 45 mm
Chuck	Diameter = 0- 17 mm
Power source	230V
Weight	1200g

Torque	12 Nm
Capacity	Up 13 MM
Rotation Speed	0-2400 rpm
Reaching Current	1.5A
Battery Pack	Lithium Battery
Frequency	50/60 Hz

Metric Number	Need No	Metric	Importance	Units
1	1,2,7	Drills bits ( Drilling tools)	1	mm , deg
2	4,5	Circular Plate	3	mm
3	4,5	Drill bits holder	3	mm
4	3,6	Chuck	2	mm
5	1,5	Power source	3	V
6	4,5	Weight	3	g
7	1	Torque	5	Nm
8	1,3,5	Capacity	3	MM
9	1,6	Rotation Speed	2	rpm
10	3,4	Reaching Current	3	A
11	1,5	Battery Pack	3	-
12	3,6	Frequency	2	Hz

# LIST OF METRICS FOR THE SUSPENSION



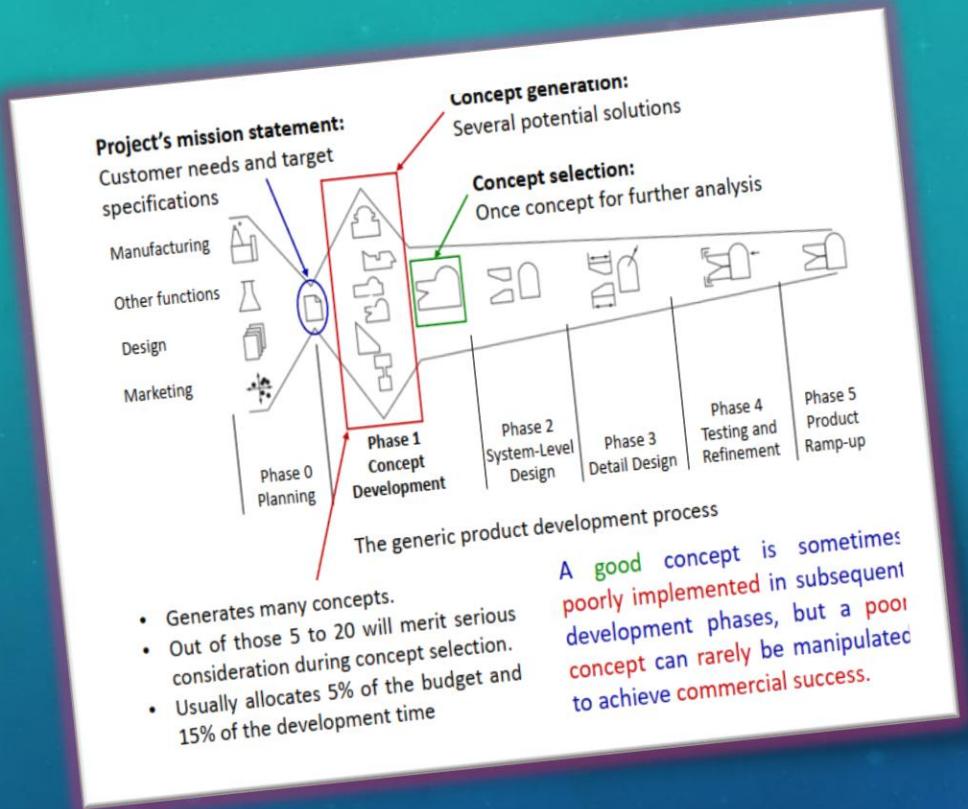
	Drills bits (Drilling tools)	Circular Plate	Drill bits holder	Power source	Weight	Capacity	Rotation Speed	Reaching Current	Battery Pack	Frequency	COMPLETION (%)
1	The vibration of the machine should be decreased	H	M	M	M	M	M	M	M	M	90
2	not harmful	M	M	M	M	M	M	M	M	M	150
3	Add safety components	H	H	L	H	H	H	H	H	H	111
4	Make a magnetic drill bit chucks there for it will easy to remove and replace drill bits	H	L	L	H	L					45
5	Make efficiency, time saving and reduce human errors	M	H	H	M	H	M	H	H	H	36.5
6	Have to swap the drill bits many times	H	M	H	M						36
7	Improve Drill bit of the machine	H	H	H	M	L	L				35
8	User friendly	L	H	H	H	H	H	H	H	H	165
9	Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole	H			M	L					13
	ABSOLUTE	90	122	173	90	80	86	63	101	64	54
	RELATIVE %	9	12	17	9	8	8	6	10	6	5
	IMPORTANCE	3	3	5	3	2	2	2	3	2	1

QFD

NO.		NEED	IMP.
1	The suspension	Make efficiency, time saving and reduce human errors	5
2	The suspension	Have to swap the drill bits many times	4
3	The suspension	not harmful	3
4	The suspension	Add safety components	3
5	The suspension	User friendly	3
6	The suspension	The vibration of the machine should be decreased	2
7	The suspension	Is it useful, if there's a part in the product which can measure the diameter and the depth of a hole	1
8	The suspension	Make a magnetic drill bit chucks there for its will easy to remove and replace drill bits	2
9	The suspension	Improve Drill bit of the machine	1

## SUSPENSION FORK

# Concept Generation



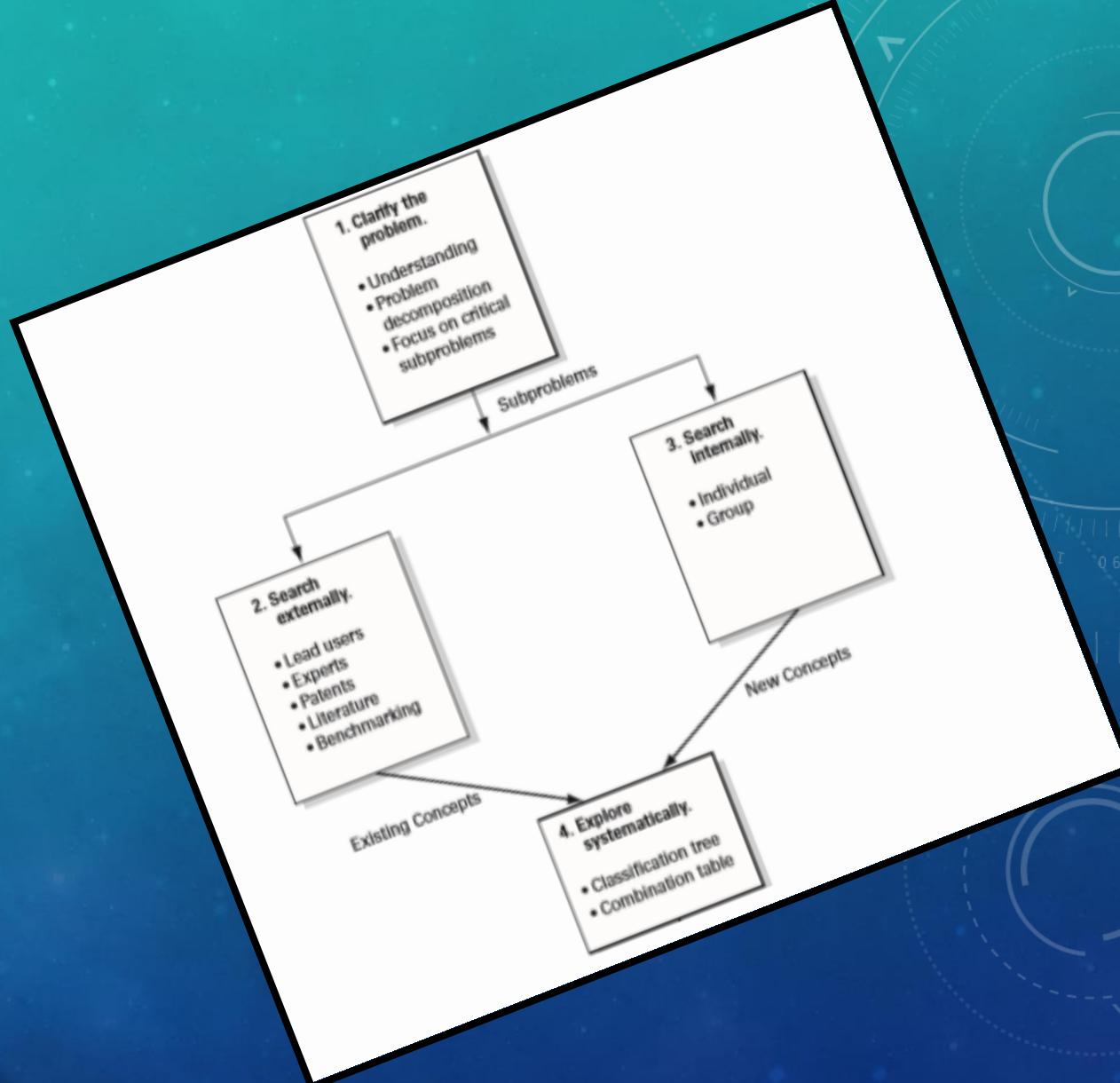
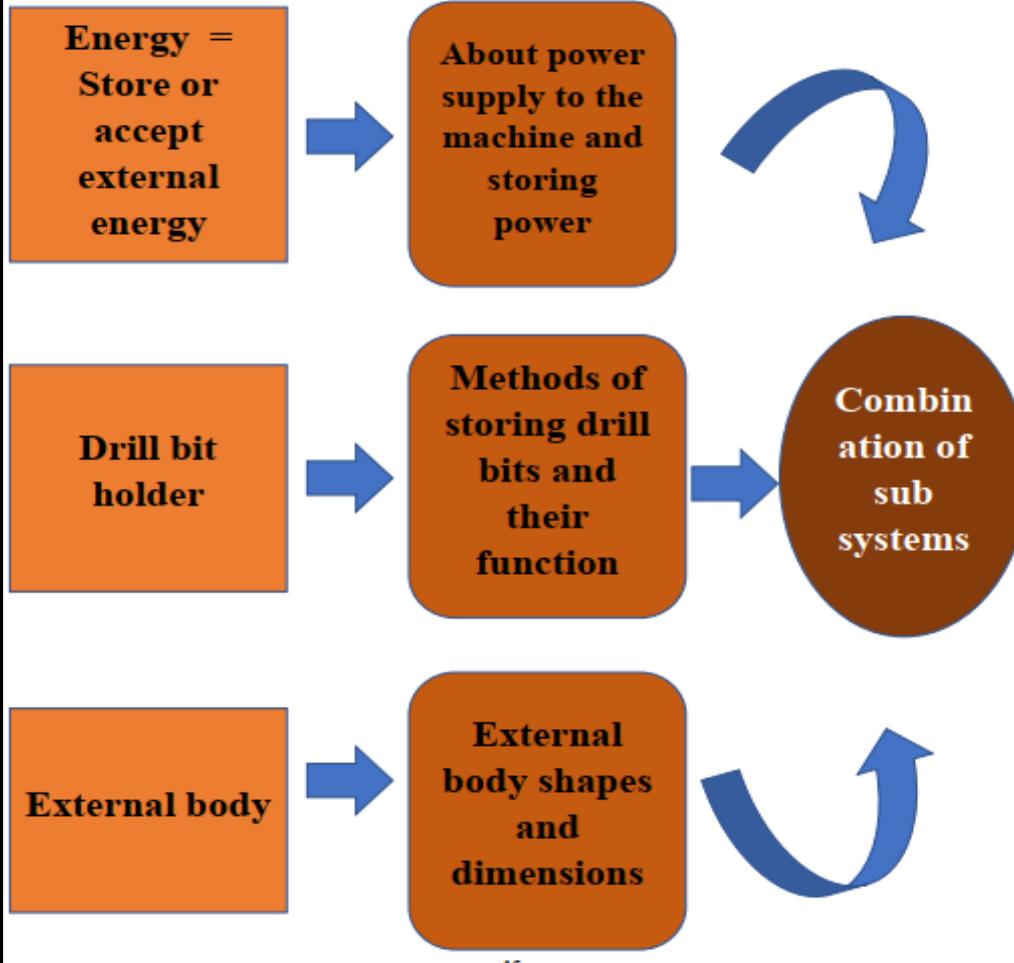
A product concept is an approximate description of the technology, working principles, and form of the product. It is a concise description of how the product will satisfy the customer needs.

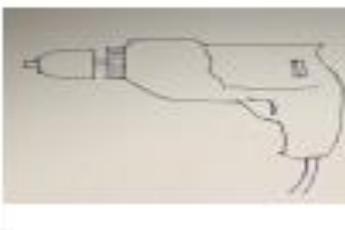
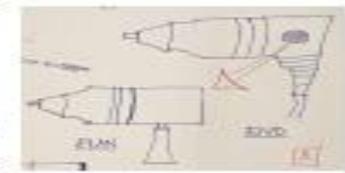
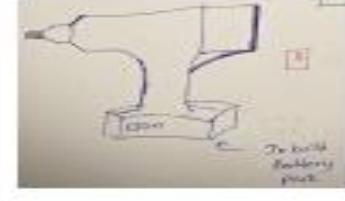
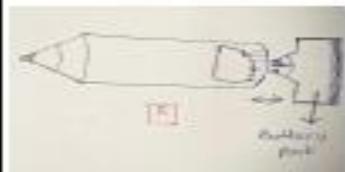
Mission statement  
Customer Needs  
Target Specifications

Concept Generation

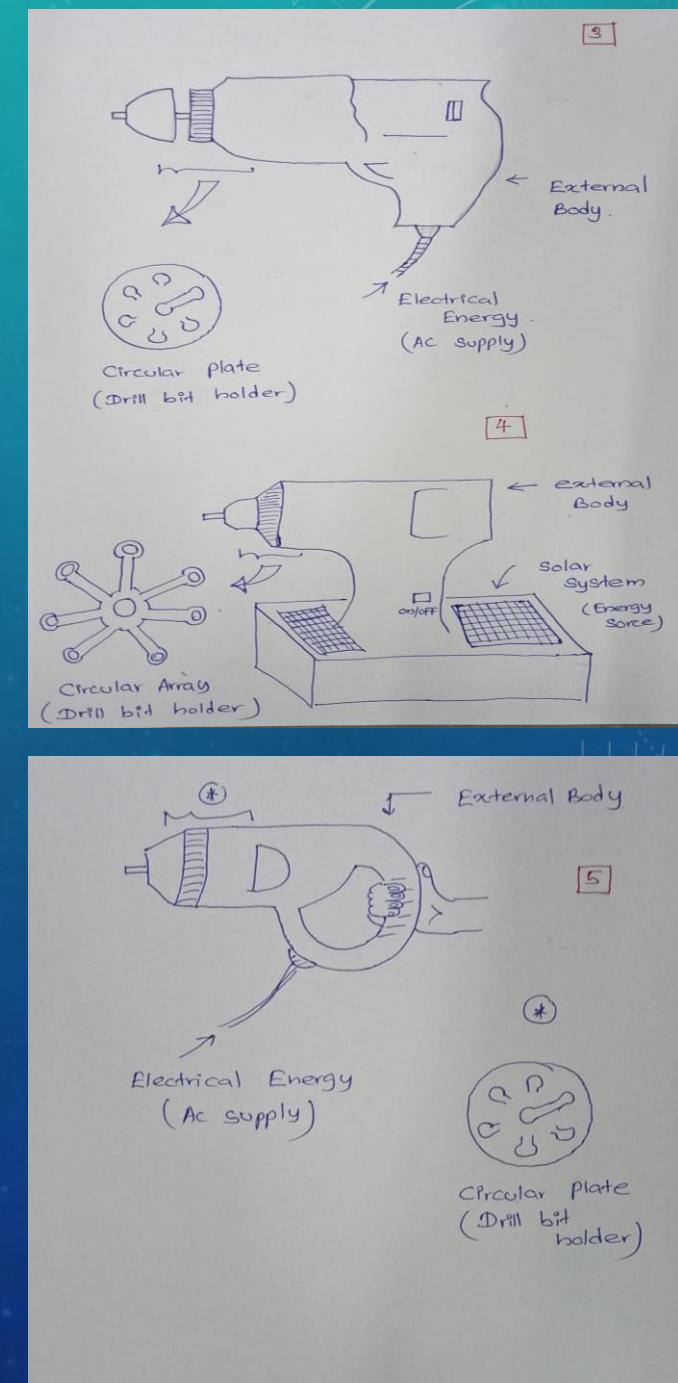
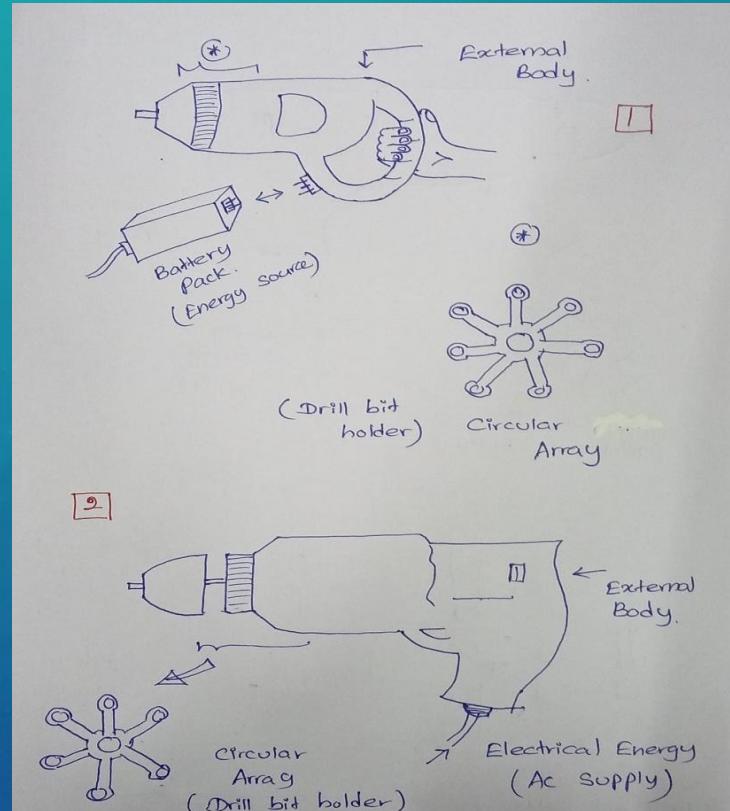
Set of Possible Concepts

## FUNCTION DIAGRAM

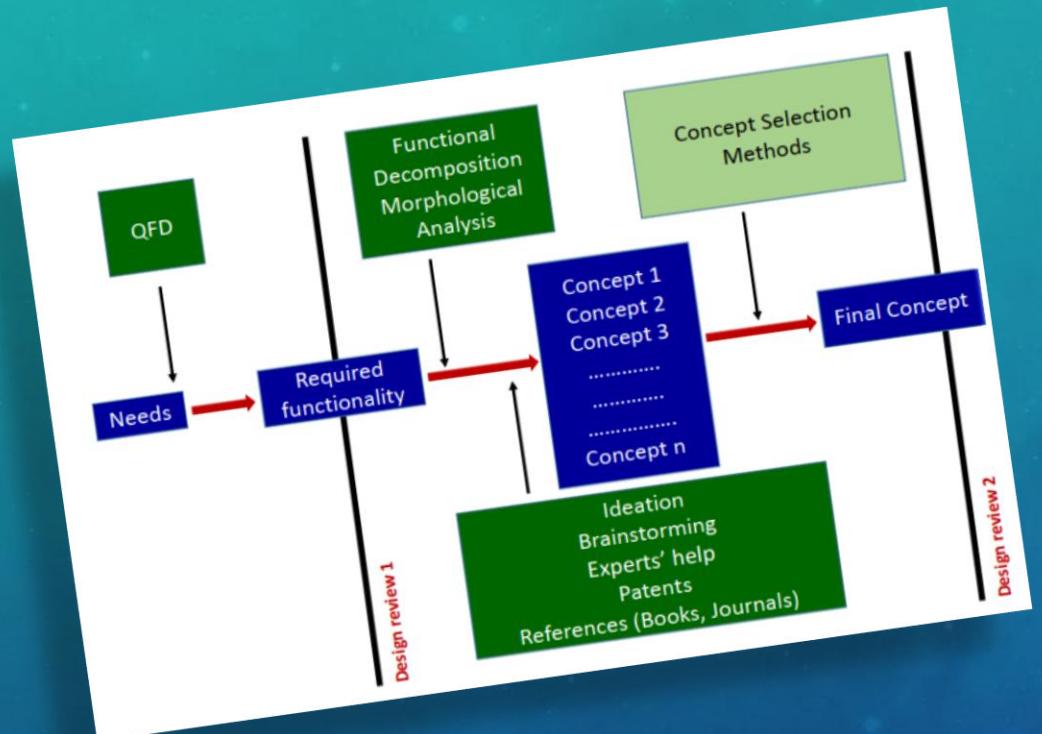


<b>Energy =</b> Store or accept external energy	<b>Drill bit holder</b>	<b>External body</b>
<b>Electrical</b>		
<b>Battery Pack</b>		
<b>Solar system</b>		
		
		

## CONCEPT GENERATION CHART



# Concept Selection



Product concept would be based:

- Ease of handling.
- Ease of use.
- Readability of dose settings.
- Dose metering accuracy.
- Durability.
- Ease of manufacture.
- Portability.

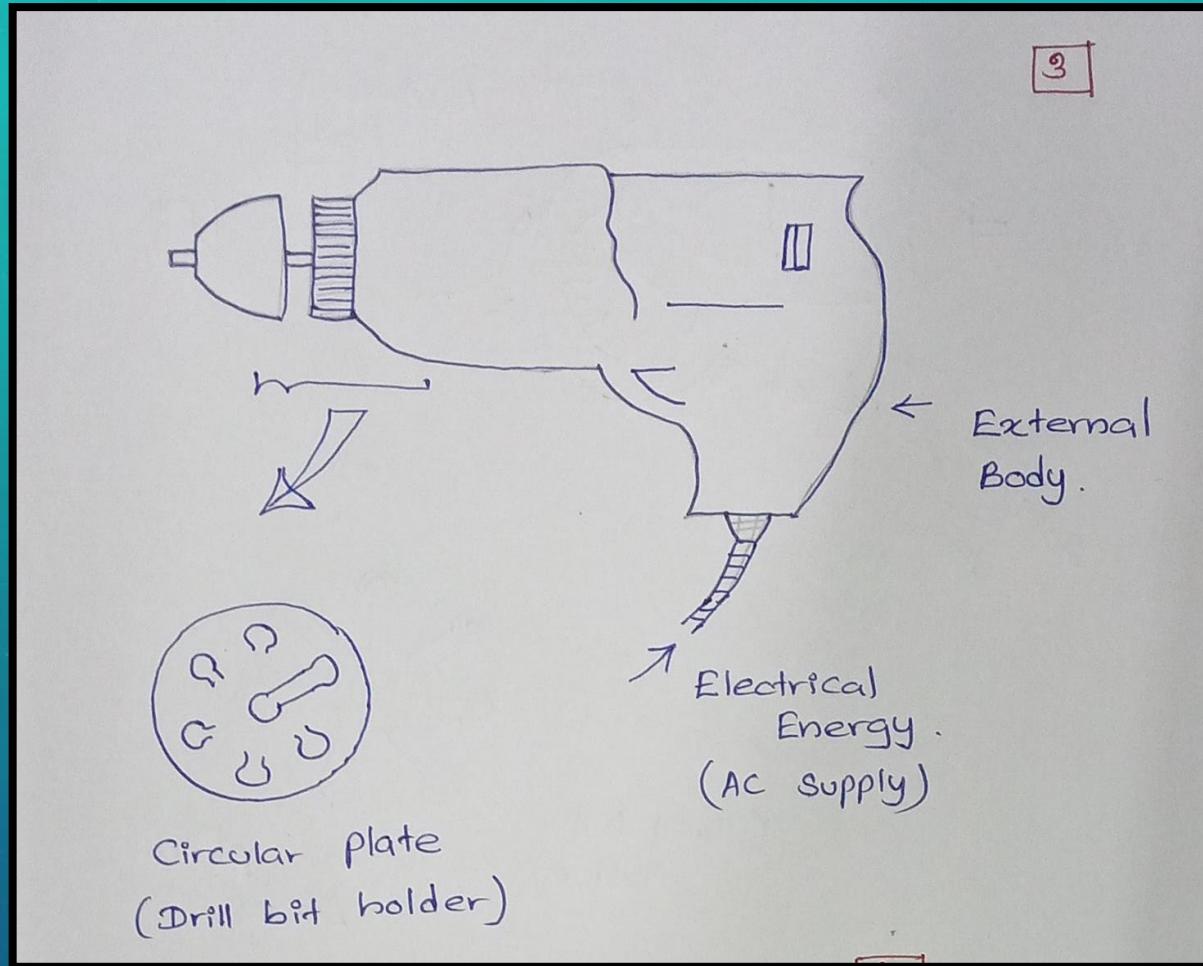
# **CONCEPT SCREENING**

			<b>CONCEPTS</b>		
<b>Selecting criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
			<b>( Reference )</b>		
Easy to use	+	-	0	-	+
Light weight	-	0	0	-	+
Time Saving	0	-	0	+	0
Appearance	+	0	0	-	+
User Friendly	+	-	0	-	+
Easy to manufacture	-	-	0	-	-
Profitable Machine	-	0	0	+	0
Durability	-	-	0	-	-
Sum +'s	3	0	0	2	4
Sum 0's	1	3	8	0	2
Sum -'s	4	5	0	6	2
Net Score	-1	-5	0	-4	2
Rank	3	5	2	4	1

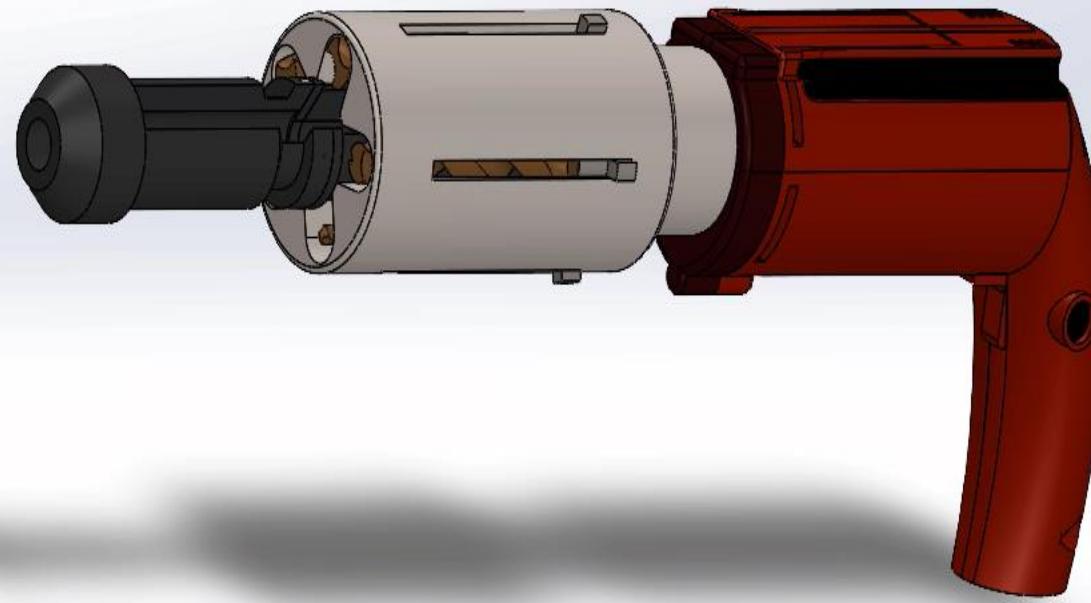
# CONCEPT SCORING

			CONCEPTS								
			1	2	3	4	5				
Selecting criteria	Weight	Rating	weighted scoree	weighted rating	weighted score	weighted rating	Weighted score	Weighted rating		Weighted score	
			%			REF					
Easy to use	15	4	0.6	2	0.3	3	0.45	1	0.15	5	0.75
Light weight	15	2	0.3	3	0.45	3	0.45	1	0.15	4	0.6
Time Saving	25	3	0.75	2	0.5	3	0.75	4	1		0
Appearance	5	4	0.2	3	0.15	3	0.15	1	0.05	4	0.2
User Friendly	15	4	0.6	2	0.3	3	0.45	1	0.15	5	0.75
Easy to manufacture	10	2	0.2	1	0.1	3	0.3	1	0.1	2	0.2
Profitable Machine	5	2	0.1	3	0.15	3	0.15	4	0.2	3	0.15
Durability	10	1	0.1	2	0.2	3	0.3	2	0.2	1	0.1
TOTAL SCORE			2.85		2.15		3		2		2.75

## FINALIZED CONCEPT



# 3D MODEL ASSEMBLE & VIDEO





PRODUCT CHARTER &  
PRODUCT MISSION



OPPORTUNITY  
IDENTIFICATION PROCESS



CUSTOMER NEEDS  
ANALYSIS



QUESTIONNAIRE  
AFFINITY WORKSHEET  
AHP

PRODUCT  
SPECIFICATION



SUSPENSION FORK  
SPECIFICATIONS TABLE  
METRICS FOR THE  
SUSPENSION  
QFD

CONCEPT GENERATION



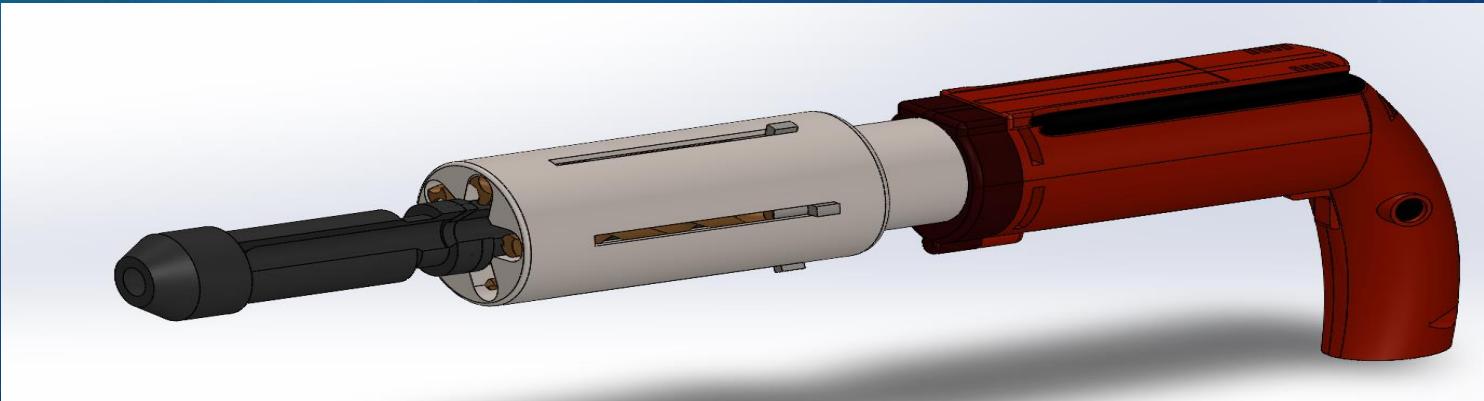
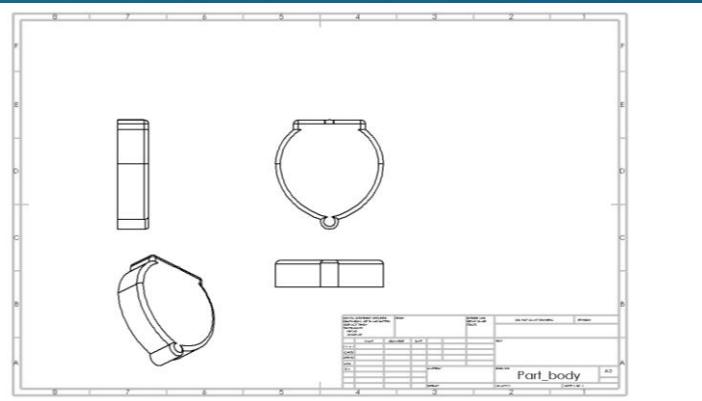
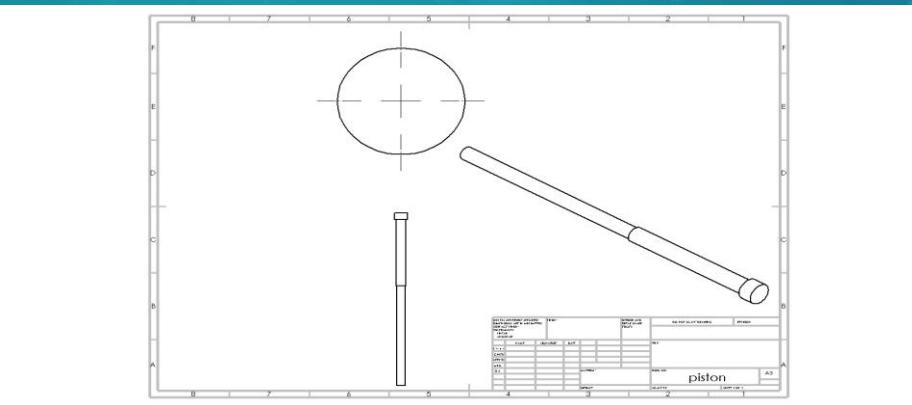
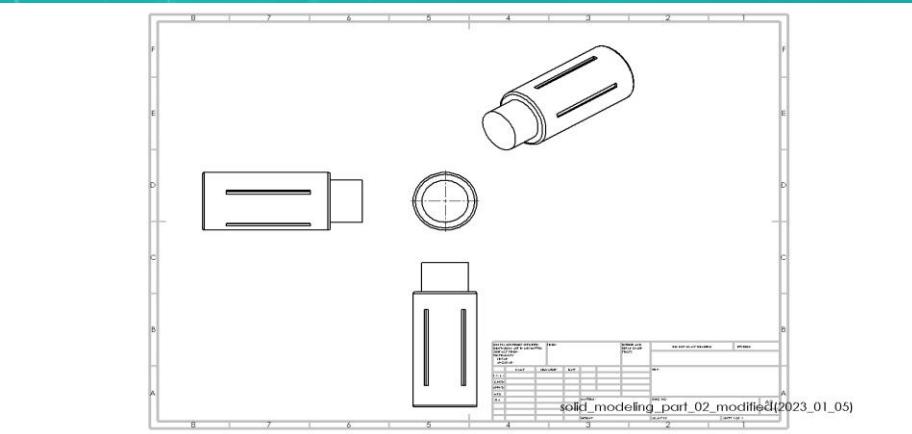
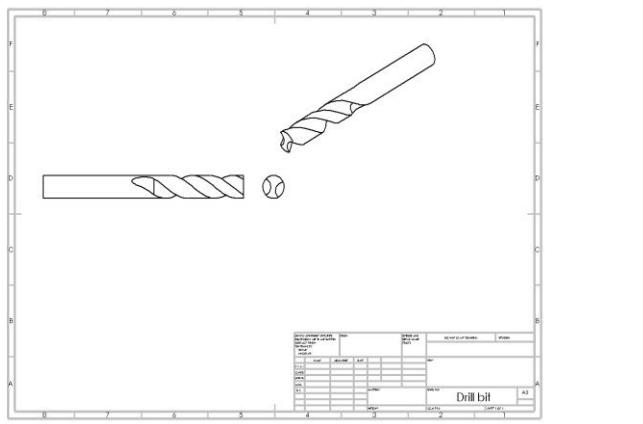
FUNCTION DIAGRAM  
CONCEPT GENERATION CHART

CONCEPT  
SELECTION



CONCEPEENIT SCRNG  
CONCEPT SCORING

# Conclusion



## 2D DRAWINGS AND 3D MODEL

# THANK YOU !

