P2 COMMERCIAL VEGETABLE PROCESSOR

REDESIGN

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Commercial Vegetable Processor

Processing involves Cutting or/and Peeling
Separate Machines for Both
Different Types of Vegetables – Onion, Potato
Different Types of Cutting

Commercial Kitchens

Existing Vegetable Processor

Context

- Type – Based on quantity of preparation
- Table top product

Hotels & Banquet Halls

- Infrastructure and resources for mass processing of vegetables. Smaller – Manual Cutting
- On site catering (in the hotel itself) facilities for Meetings, Conferences and even weddings based on their capability.

Hostels & Institutions

- Number of Occupants is high
- Quick and mass production – Continuously

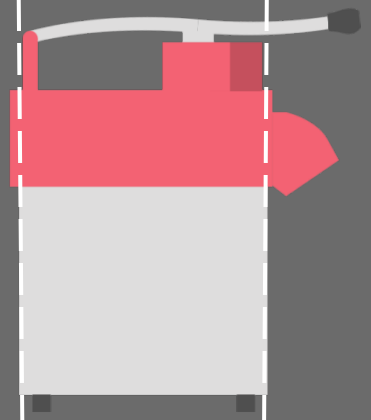
FOOD PREOCESSORS - International

EXISTING PROCESSORS - Indian

Background Study

Why is it used?

1 person – 5 minutes



Storing | Peeling | Cutting | Preparing | Cooking

3 person – 15 to 20 minutes

Preparing

Background Study

Why is it used? - Variety

Slicing

Julienning

Grating

Dicing

French Fry

END USER

These machines will be operated by professional chefs who will be trained to use the product.

RELEVANCE

Redesign project

Fundamental technologies & Manufacturing processes

Indian Market – Scenario

Small Industries - Design

PROBLEM STATEMENT

Aim

To redesign of Vegetable Processor for using in commercial kitchens.

Objectives

- To understand and rethink on possibilities in redesigning existing process of working of Commercial Vegetable Processors.
- To design a Commercial Vegetable processor based on given material and manufacturing constraints.
- To solve existing issues in the process of cutting and other associated functions in the product.

RESEARCH

MARKET

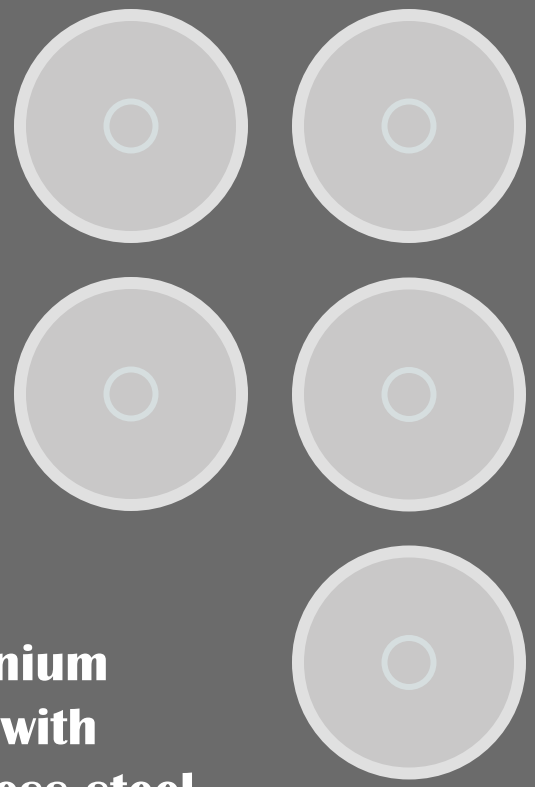
TARGET CUSTOMERS

- Private and Government institutions having a commercial kitchen intended for mass preparation of culinary items.

- Other customers will also include large Restaurants or Catering service providers.

Situation Study

Parts and Assembly



Cast Aluminium Discs with Stainless steel blades

Stainless steel Dicing Disc

PVC Disc

Steel Handle

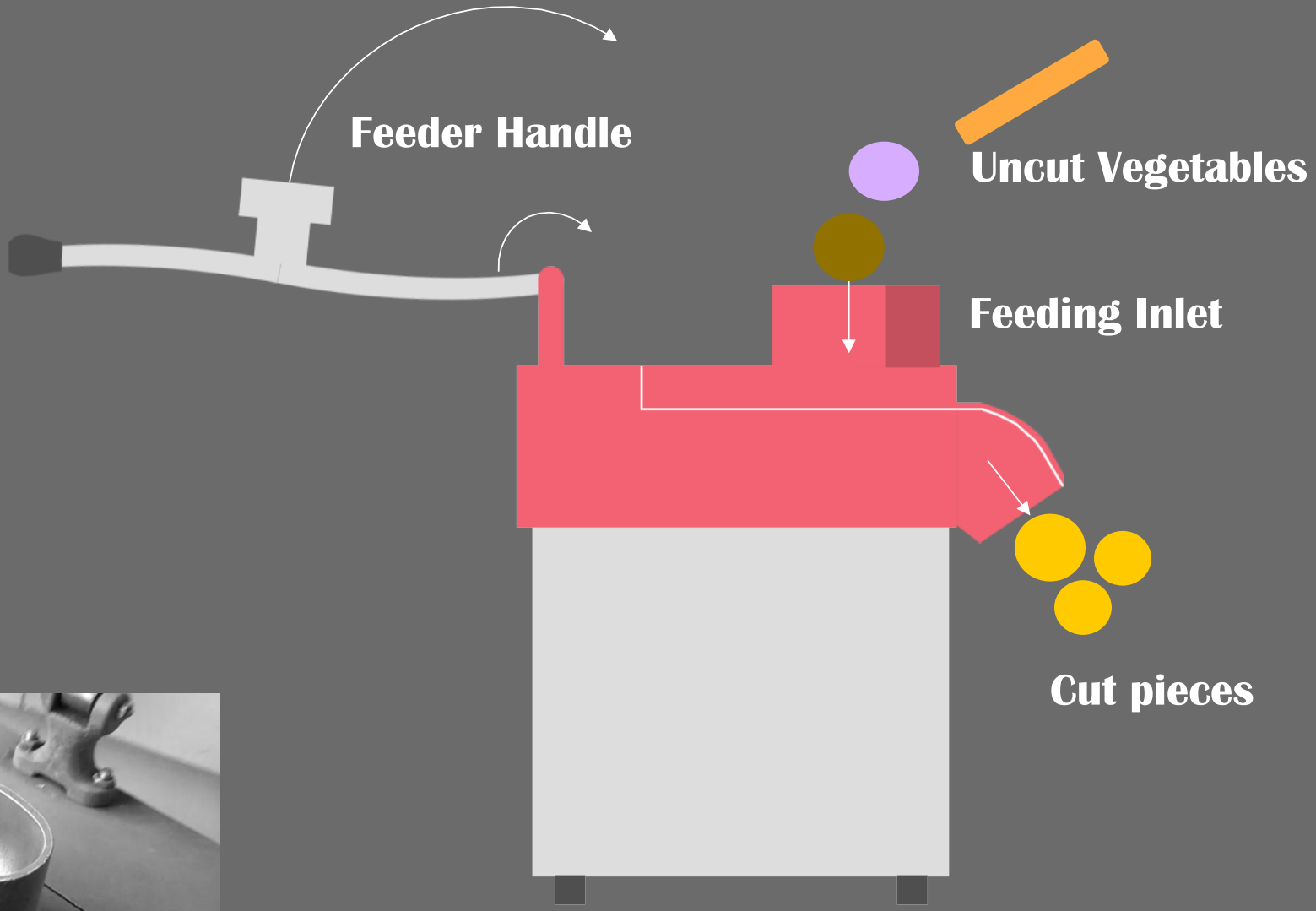
Cast Aluminium

Stainless Steel Casing

Rubber Bush

Situation Study

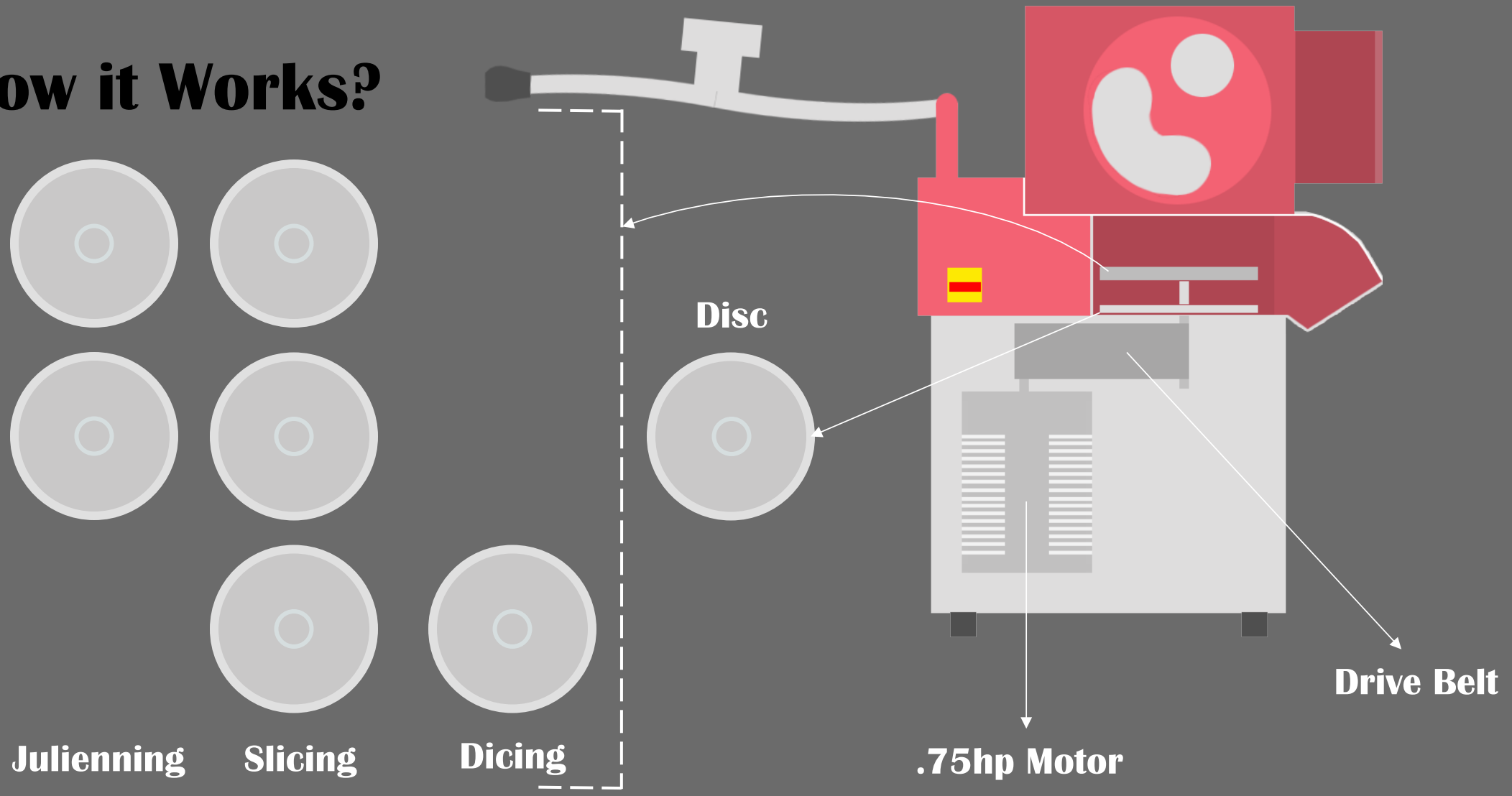
How it Works?



Vegetable Feeder on top

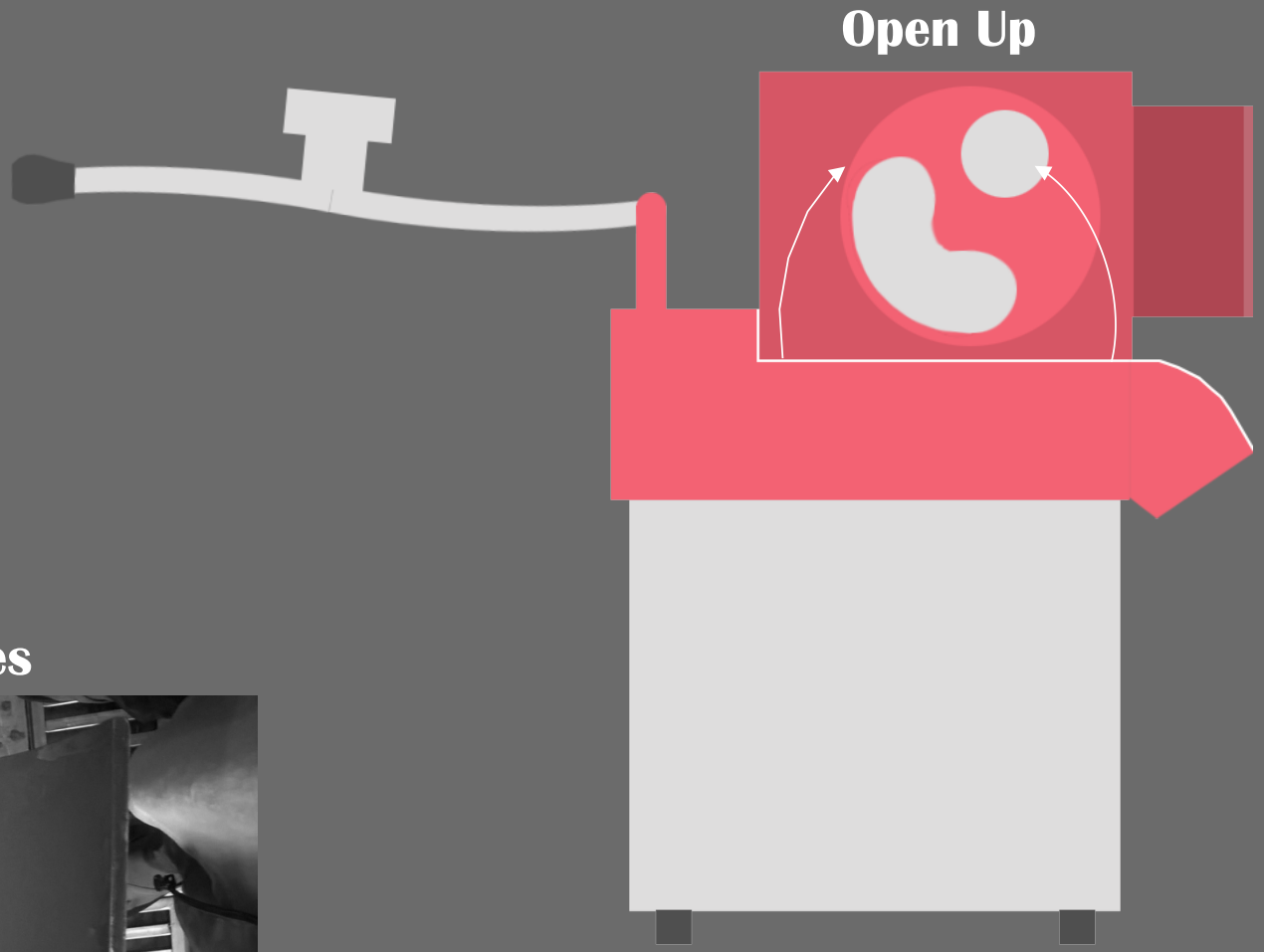
Situation Study

How it Works?

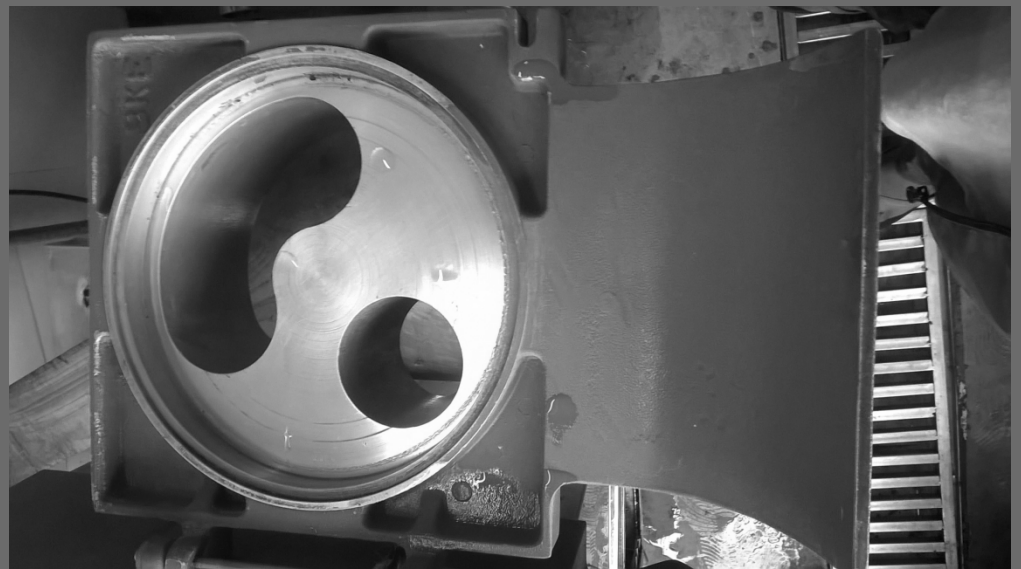


Situation Study

How it Works?

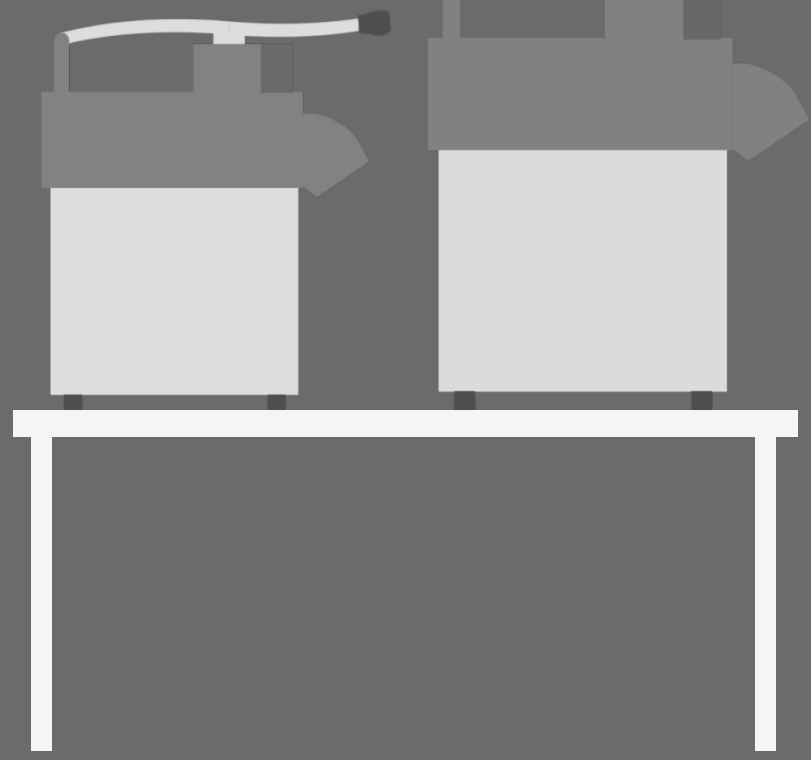
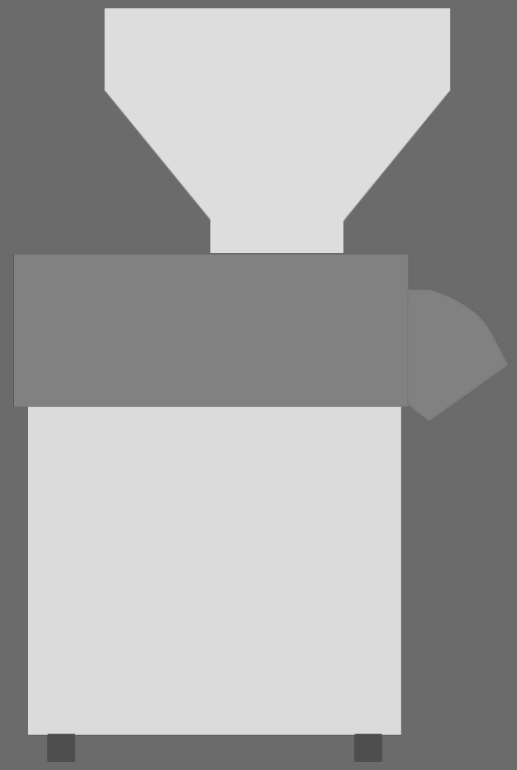


Top lid opened to change blades



Product Variants

Rs. 48000/-

Performance	50-65 Kg/hr.	75-100 Kg/hr.	150-200 Kg/hr.
Relative Size			
Power	0.5 hp.	0.75 hp.	1.0 hp.

Situation Analysis

Performance Issues

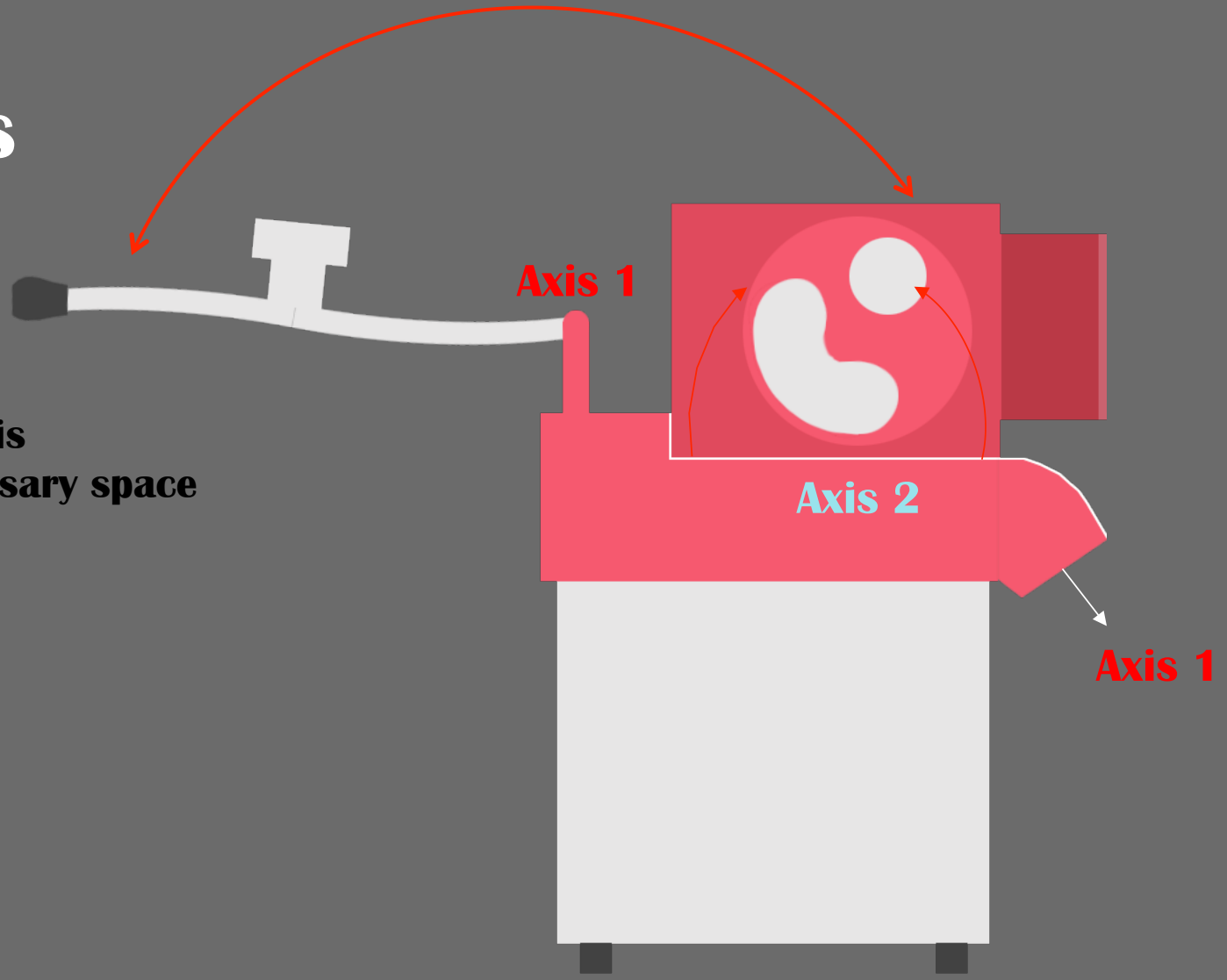
Improper Use & Lack of awareness cause damage of blades.
Frequent Change of blades, Less options in blades.

Rs. 2300/-

Situation Analysis

Usability Issues

Manual Operations in different axis
Feeder handle occupying unnecessary space



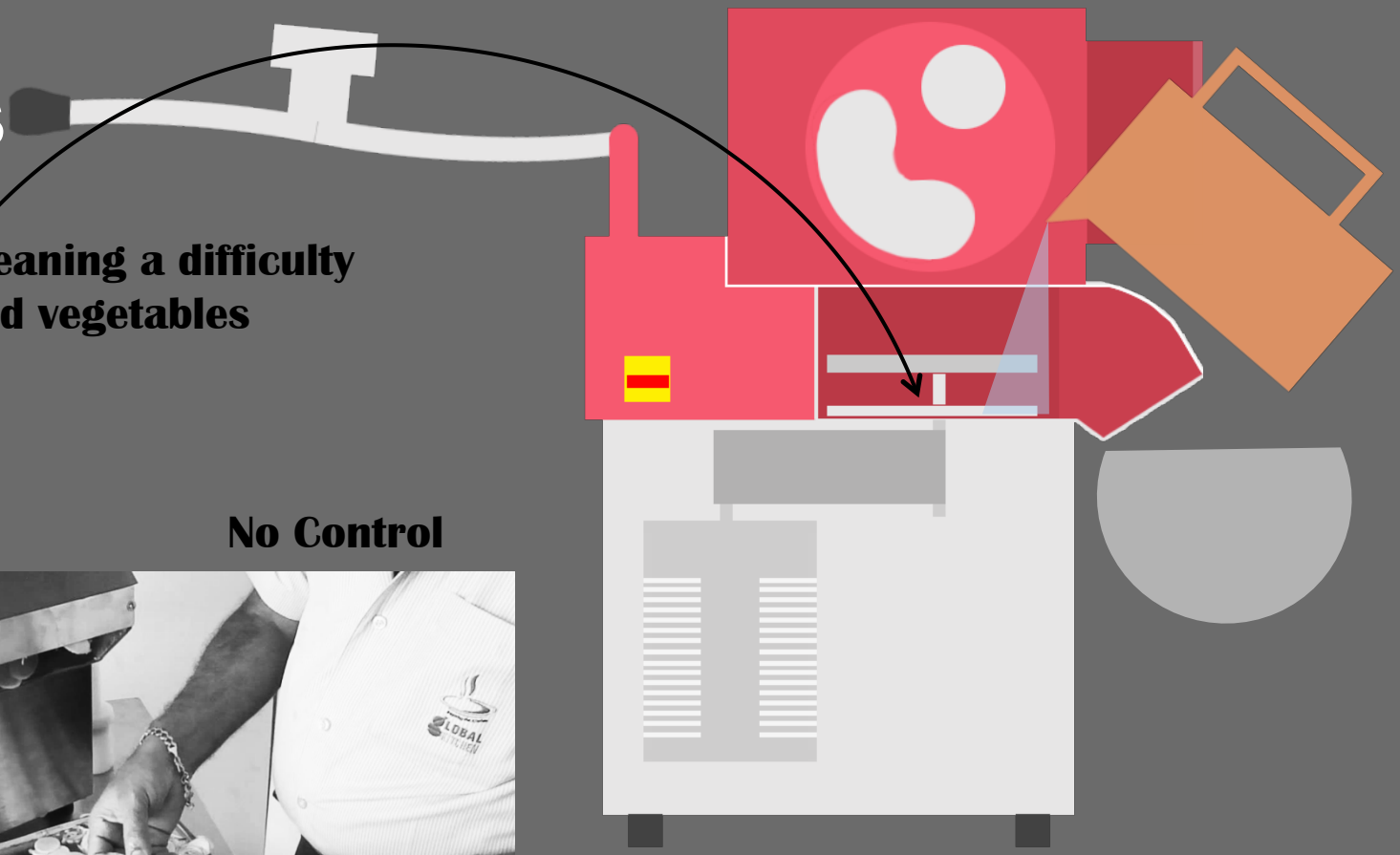
Situation Analysis

Functional Issues

Cutting area being fixed makes cleaning a difficulty
No collecting unit/Area for finished vegetables

over collecting.

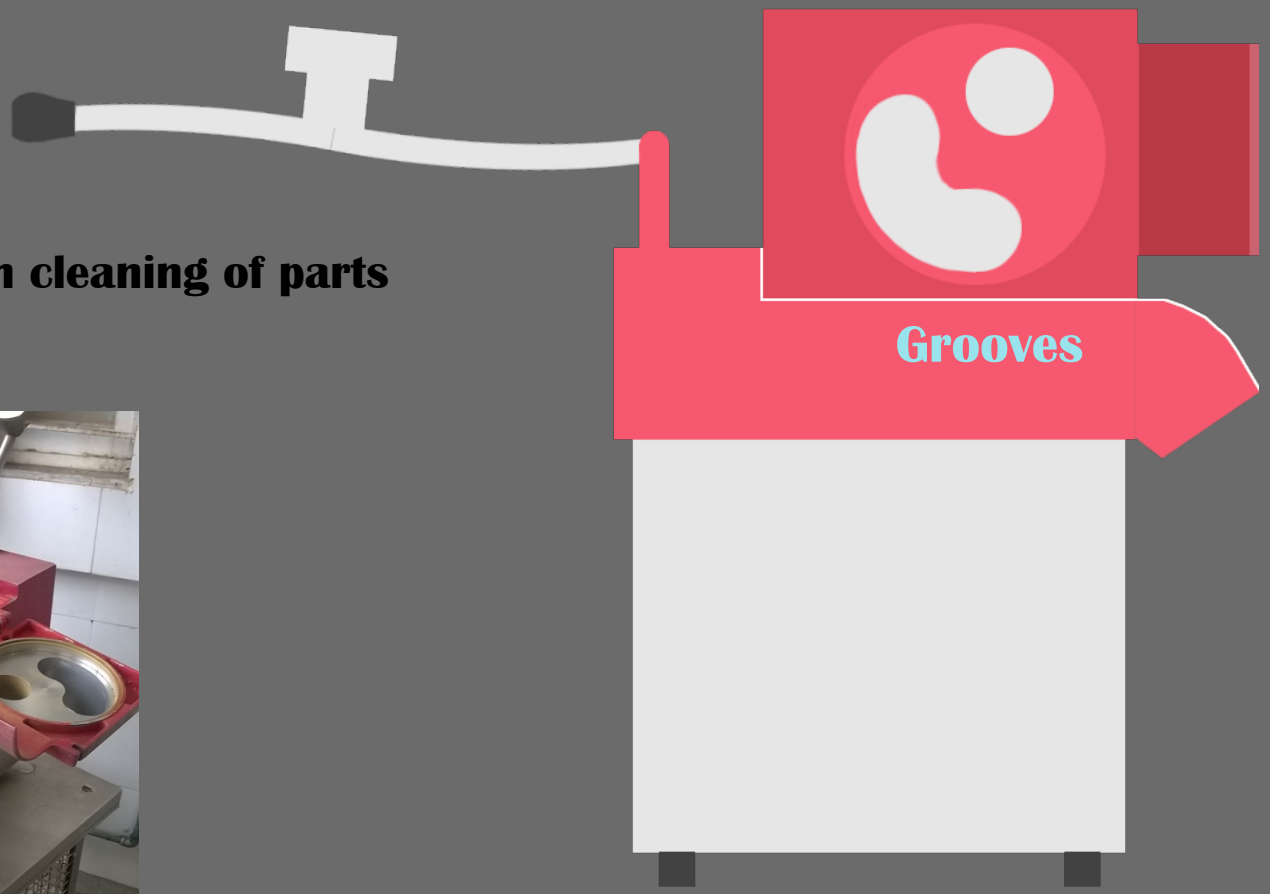
No Control



Situation Analysis

Quality Issues

Lack of Hygiene due to difficulty in cleaning of parts
Lack of Hygiene due to way of use



Situation Analysis

Environment

Lack of Hygiene due to difficulty in cleaning of parts
Lack of Hygiene due to way of use

TECHNOLOGY INPUT

Type of motor to be used:

Type of motor to be used depends on the application.

Cutting and grinding machines require high starting torque for the process:

Single phase – not self starting, so used with capacitor start Induction Motor (or capacitor start, capacitor run Induction Motor)

Three phase – self starting, at higher cost

Speed control is required only if more than cutting function is there

Direction of rotation:

Direction of rotation, with the exception of certain larger 2-pole motors. The direction of rotation can be reversed by interchanging any two of the three conductors connected to the starter switch or motor.

TECHNOLOGY INPUT

Speed of the vegetable cutter :
Speed of the cutter is to be obtained from a study of similar existing products.

Ac motors are overwhelmingly preferred for fixed speed applications. The speed of the AC motor depends only on three variables:

1.The fixed number of winding sets (known as poles) which determines the motor's base speed.

a) **2 poles – 3000 rpm**
b) **4 poles – 1440 rpm**
c) **6 poles – 960 rpm**

2.The frequency of the ac line voltage.

- **In india input ac standard is 50hz, ~240v**
- **Variable speed drives change this frequency to change the speed of the motor.**

3. The amount of torque loading on the motor, which causes slip.

MATERIAL COMPARISON

	WHICH MATERIAL?			WHERE?
WEIGHT	ALUMINIUM	1/3rd of	STEEL	PARTS AND BODY
CORROSION RESITENCE	ALUMINIUM	<	STEEL	EXPOSED PARTS
FATIGUE STRENGTH	ALUMINIUM ALLOYS	<	STEEL	CUTTING, MOVING PARTS (Blades)
WELDING	ALUMINIUM	NOT GOOD AS	STEEL	MANUFACTURING
HARDNESS	ALUMINIUM	<	STEEL	ABRASION, SCRATCH
COST	RAW ALUMINIUM	VARIES WITH TYPE	RAW STEEL	Alloy steel < Aluminium Alloys (42%) < Stainless Steel
MACHINING	ALUMINIUM ALLOYS	FASTER	STEEL	Alloy steel < Aluminium Alloys (42%) < Stainless Steel

PROBLEM IDENTIFICATION

- **Performance issues**: The products tend to lose efficiency by time. This is due to lack of power of the motor. Improper use of blades and carelessness results in wearing of blades.
- **Productivity issues**: The inappropriate positioning of the feeding mechanism results in less productivity. Other associated functions beside cutting is not taken care of.
- **Usability issues**: Position of control panel is away from view of the user.
- **Ergonomic Issues**: position of feeding handle is given less importance to ergonomics
- **Maintenance Issues**: During applying high pressure jet, the product is difficult to clean when lid is closed and spills water when lid is open.
- **Hygiene issues**: Crevices in the cutting chamber, lid and blades create left overs which is difficult to clean.
- **Environment Issues**: Environment does not integrate well to the product

PROJECT BRIEF

DESIGN BRIEF

Design a commercial vegetable processor for a new manufacturer who wants to enter into the business of kitchen products

DESIGN DIRECTIVES

Manufacturing Constraints

Product is designed with manufacturing constraints like:

- Use of Aluminium Casting or Stainless steel
- Use of limited amount of plastic
- Use of Motor and related parts with the manufacturer.

Process

Design for cutting all vegetables commonly processed in commercial kitchen.

Design for slicing, julienning, dicing, cutting

Design for collecting vegetables processed.

DESIGN DIRECTIVES

Business

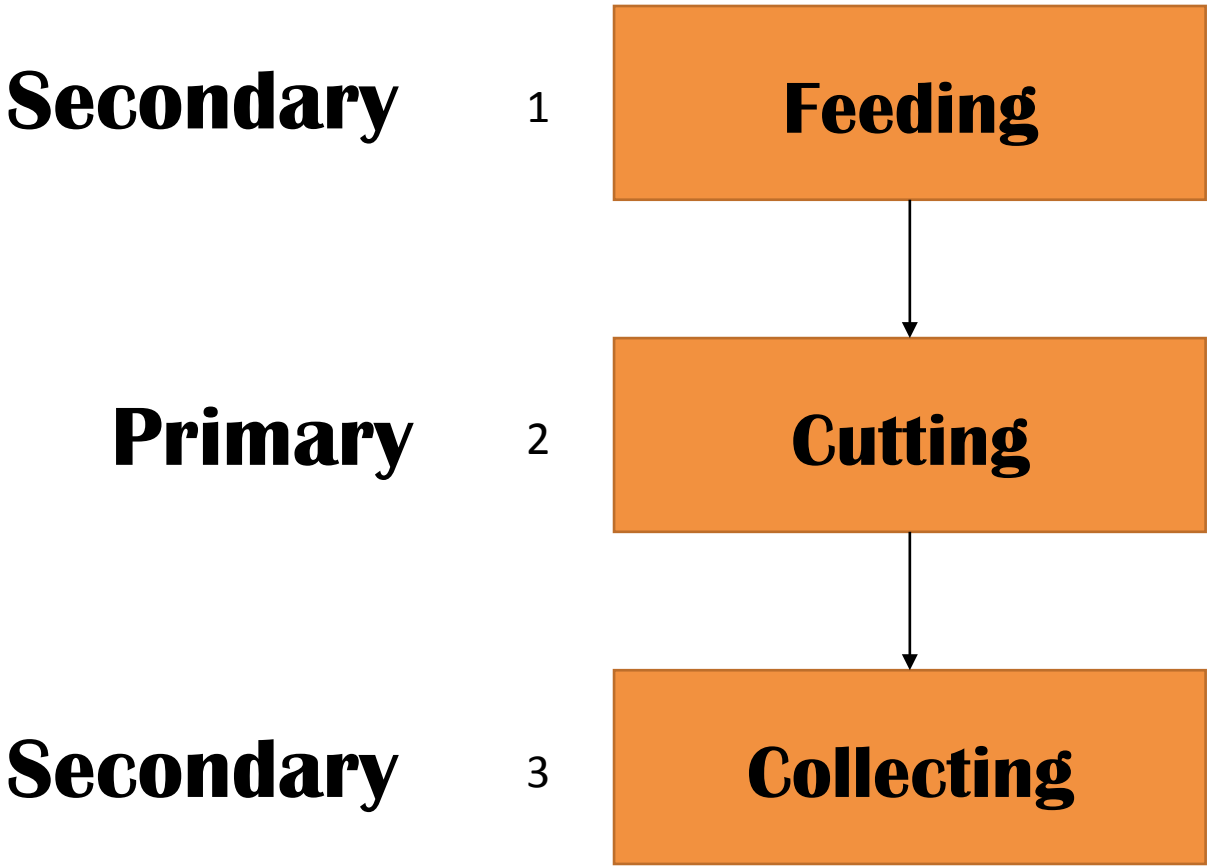
Product should exhibit form and **aesthetics** which is unique compared to similar products in the market. It should address issues in existing products.

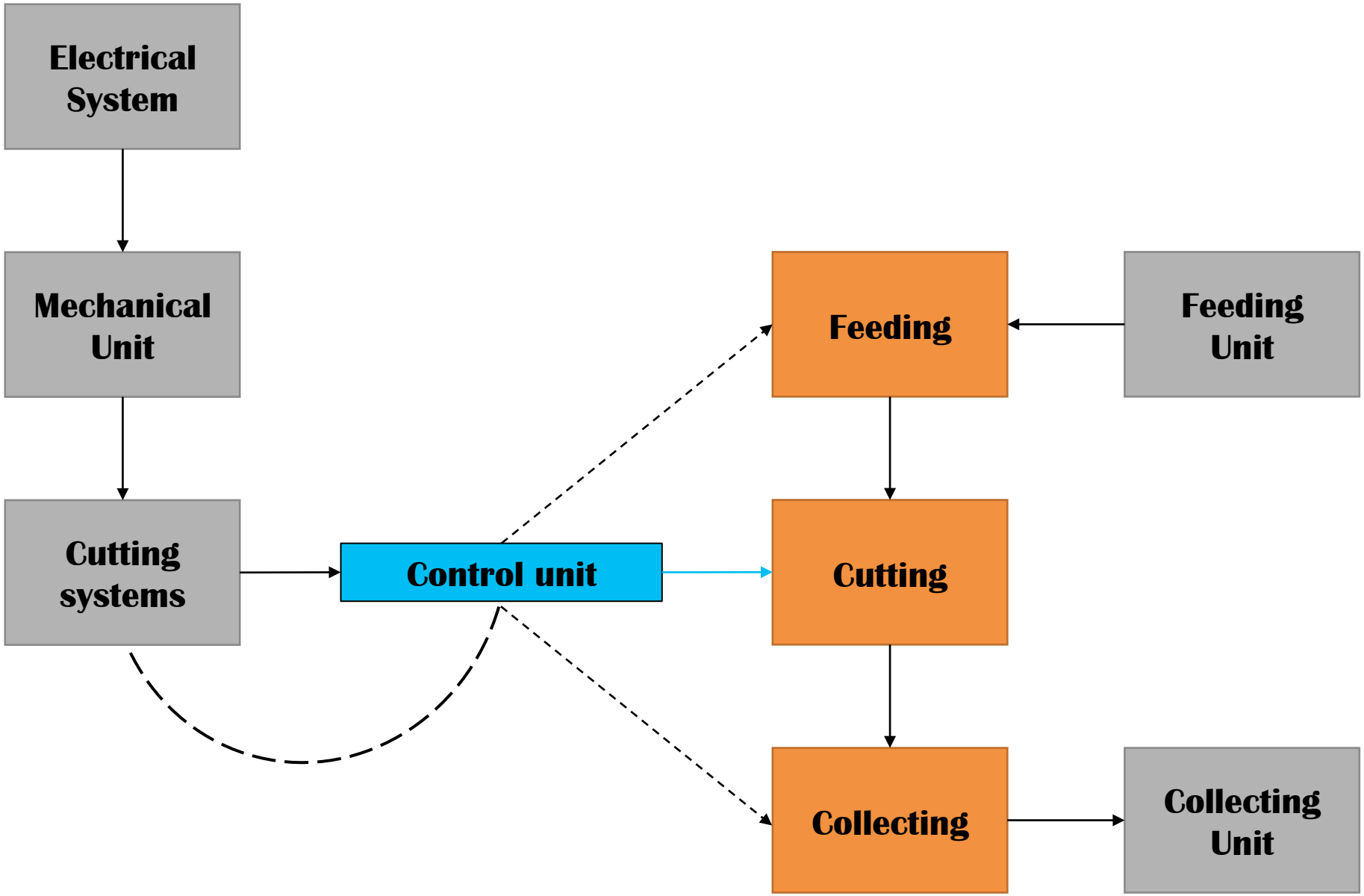
A design that can make use of the expertise of the manufacturer in products utilising motors. (Eg: Air curtain, Hand drier, Shoe polisher).

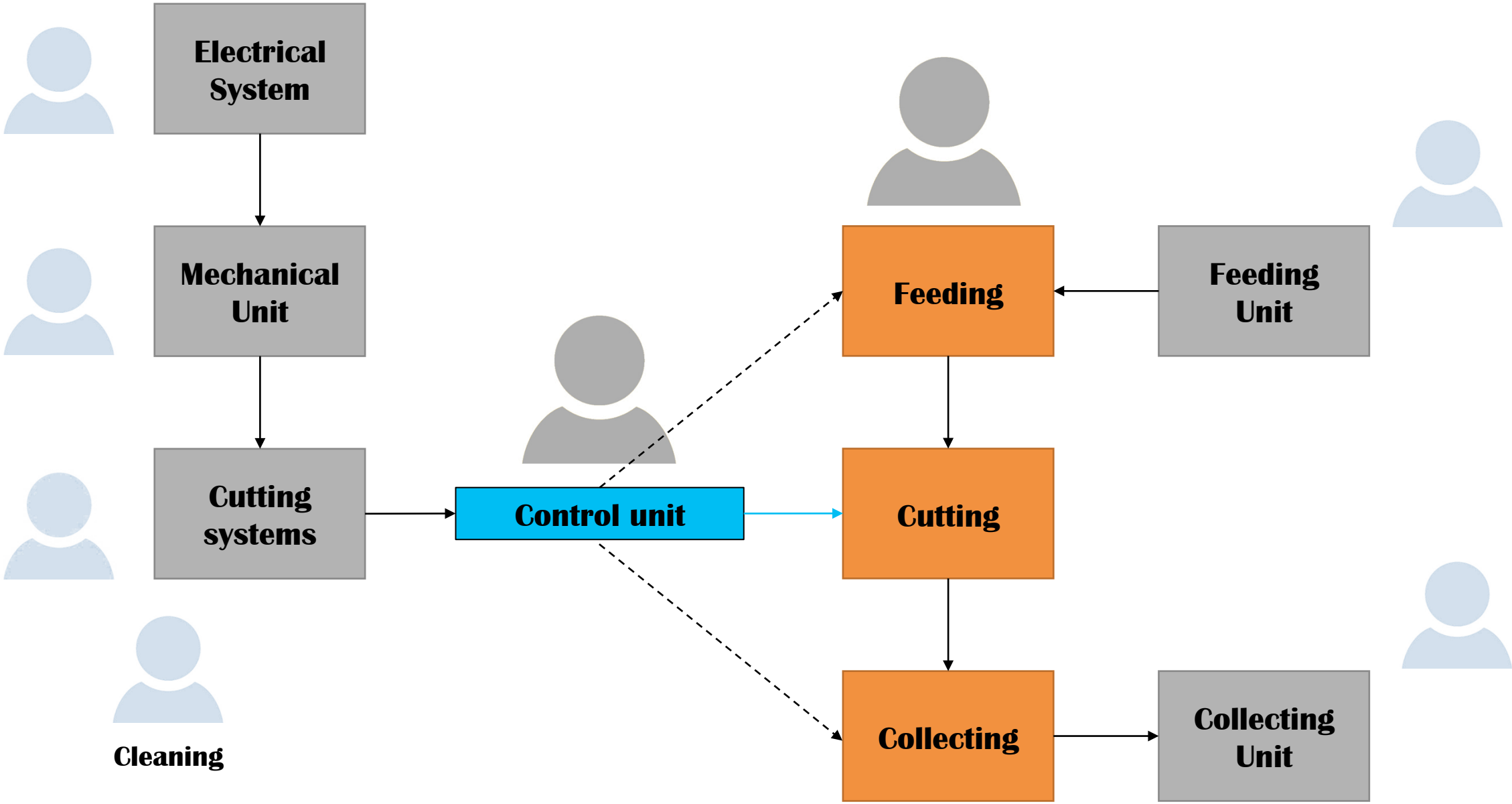
A design that reduces tooling and material cost such that it can compete in the present market.

DESIGN

FUNCTION STRUCTURE




Electrical System
Mechanical Unit
Cutting systems
Control unit
Feeding
Feeding Unit
Cutting
Collecting
Collecting Unit


Electrical System
Mechanical Unit
Cutting systems
Control unit
Feeding
Feeding Unit
Cutting
Collecting
Collecting Unit
Cleaning

DESIGN BASIS

- Performance:
- Productivity
- Ergonomics
- Maintenance
- Materials and Manufacturing
- Cost
- Market

SYNCHRONIC STUDY

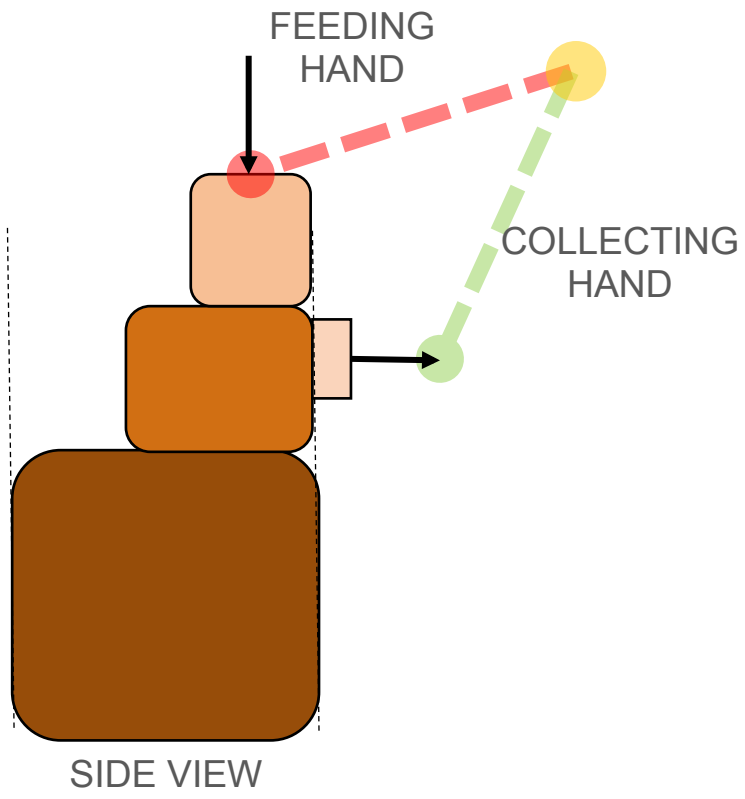
SYNCHRONIC STUDY

Product		Power (w)	Voltage (phase)	Load (kg/hr)	Feeding	Ejection	Interface	Blade dia. (mm)	Speed (rpm)
Robot coupe		750	Single	300	Top	Side	Normal	200	Fixed 375
Santos		450	Single		Front	Front	Normal	170	Fixed 1000
Electrolux		370	Single		Top	Front	Touch	178	Fixed 360
Minigreen		250	Single	200	Top	Front	Normal	175	Fixed 1000
Aurea		750	Single, 3	<200	Front	Front	Normal		Fixed 350
Metcalfe		750	Single		Front	Front	Normal		
Bartscher		550	Single		Front	Front	Normal		

Bulk Feeding, Continuous Feeding.

Typical Organisation of Parts.

ORGANISATION



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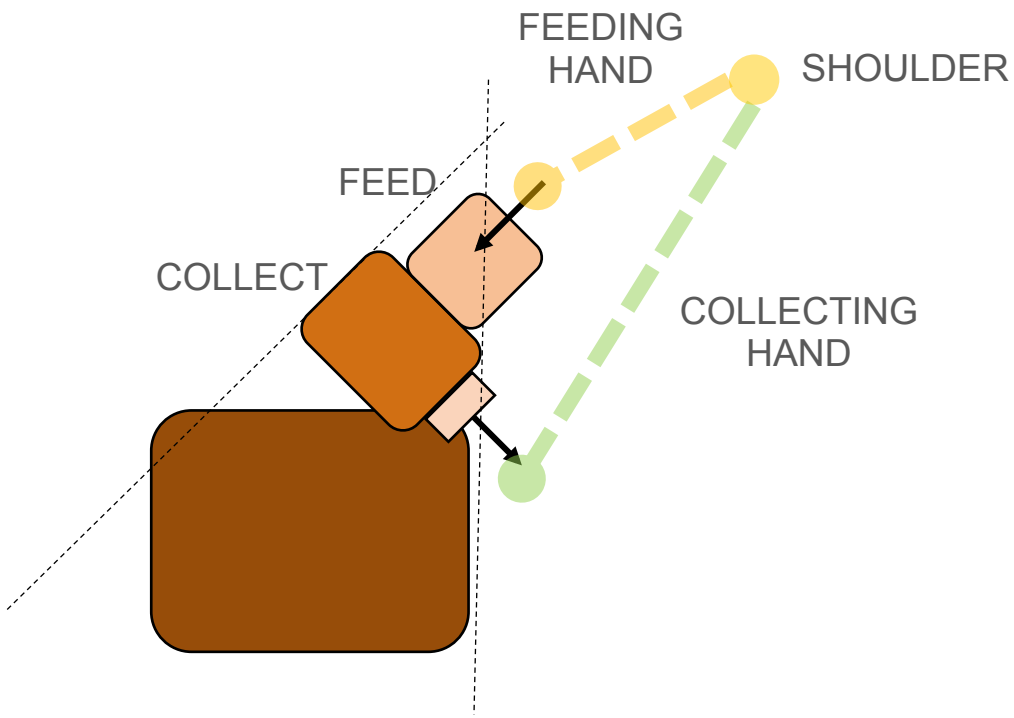

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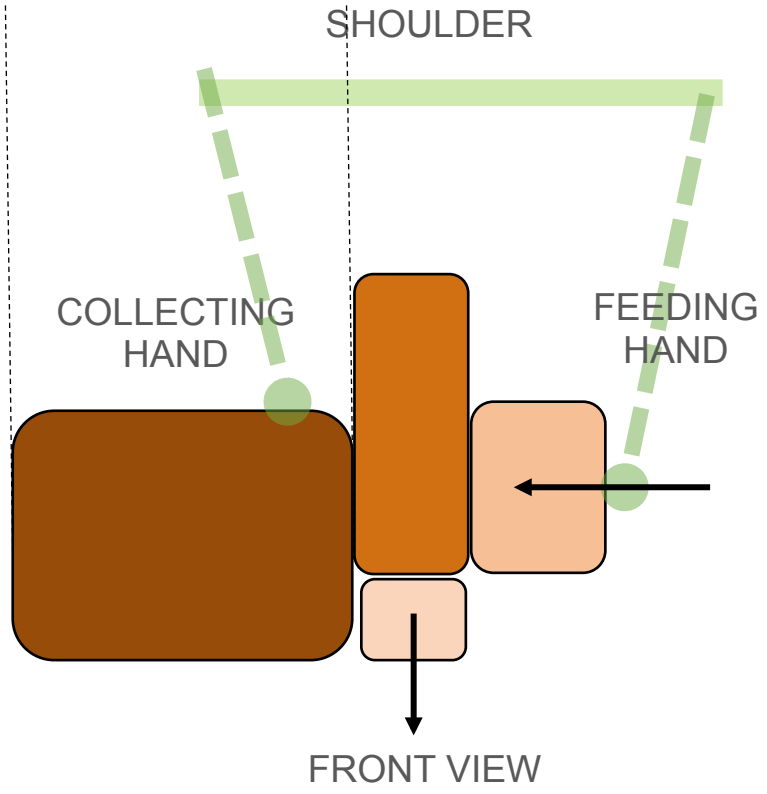


BRAINSTORMING AND IDEA SELECTION

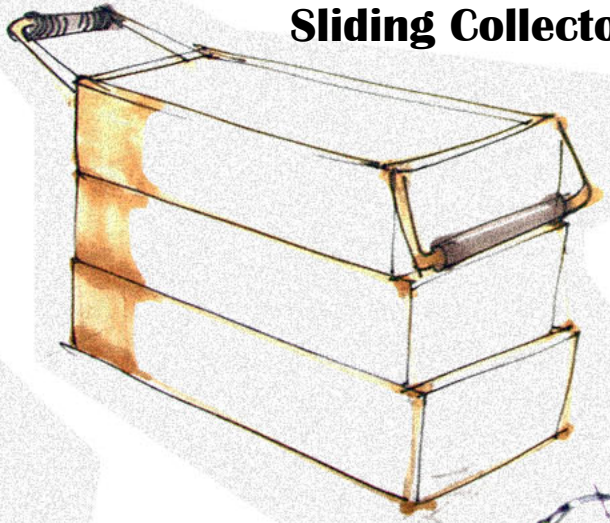
Ejection method
Gravity ejection
Centrifugal ejection
Blade ejects
Splitting vessel ejection
Falls down
Water pressure ejection
Ejection by Side holes
Continous ejection
ejection inside machine
Fixed Vessel ejection
Separate Vessel ejection
Side way trays
Throw away ejection
Explode sideways ejection
Ejection into Central Chamber
Bulk Ejection
No ejection

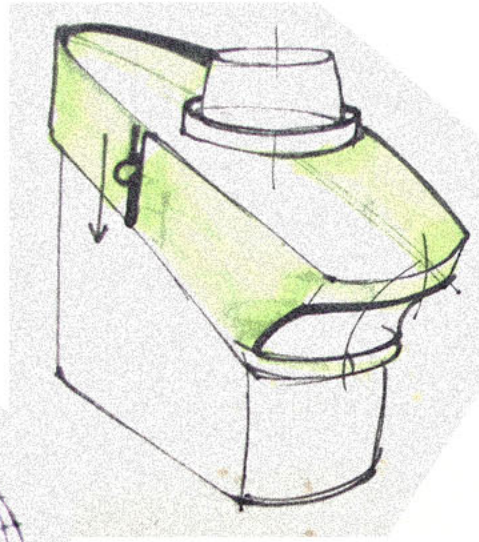
Cutting chamber
Fixed Chamber
Movable Chamber
Rotating Chamber
Sliding Chamber
Fixed blades, chamber moves
Detachable Chamber
Chamber with vessel
Modular Chamber
Cutting and Collecting is same vessel
Side Cutting, Central Collecting
Cutting Outside Unit
Horizontal Chamber
Pivoted Chamber
Folding Chamber
Funnel Shaped chamber

Collection method
Gravity collection
Centrifugal collection
Blade ejects collection
Splitting vessel collection
Falls down collection
Water pressure collection
Side holes collection
Continous collection
Inside machine
Fixed Vessel
Separate Vessel
Side way trays
Throw away
Explode sideways
Central Chamber
Rectangular Chamber

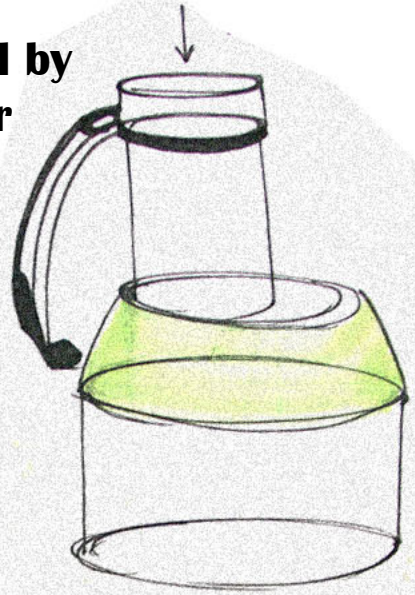
Ideas Based on Objects with different functions

Sliding Collectors

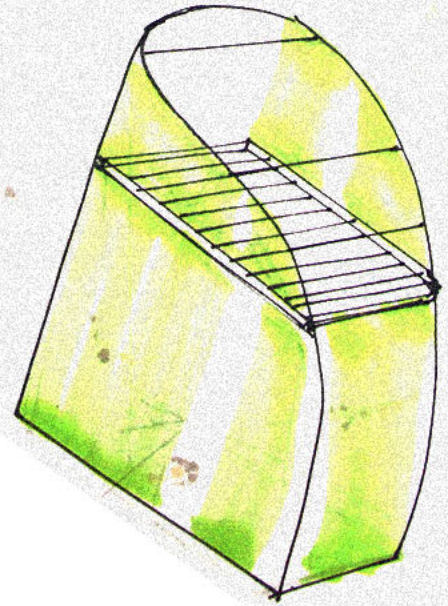




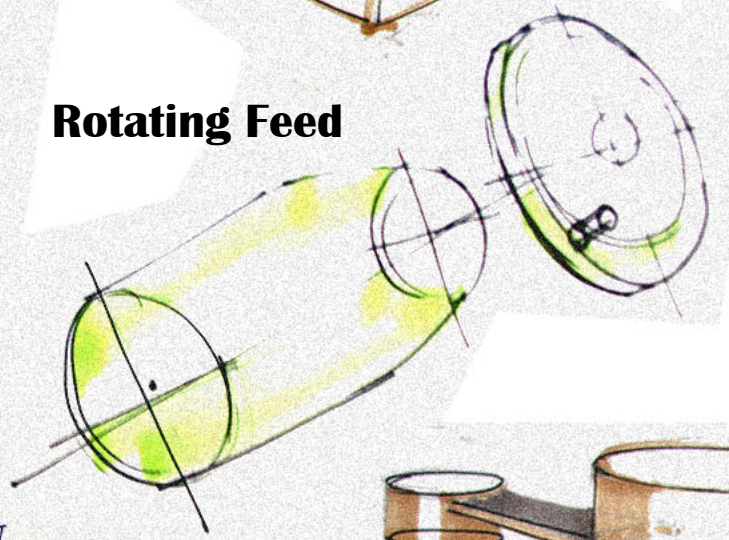
Manual Feed by Container



Feed by Vibration

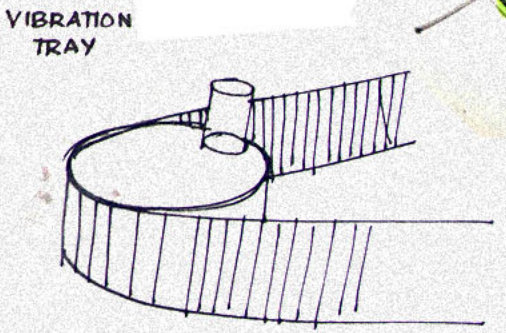


Rotating Feed

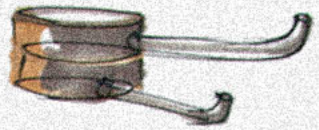


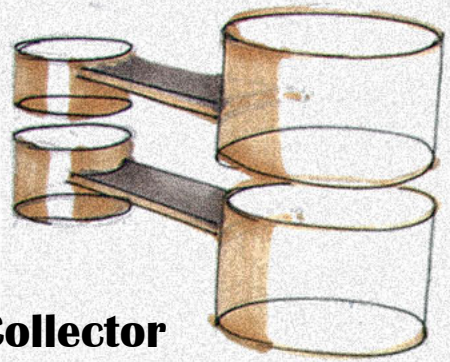
Tension Feed by Spring

Eccentric Axis



Pivoted Hook

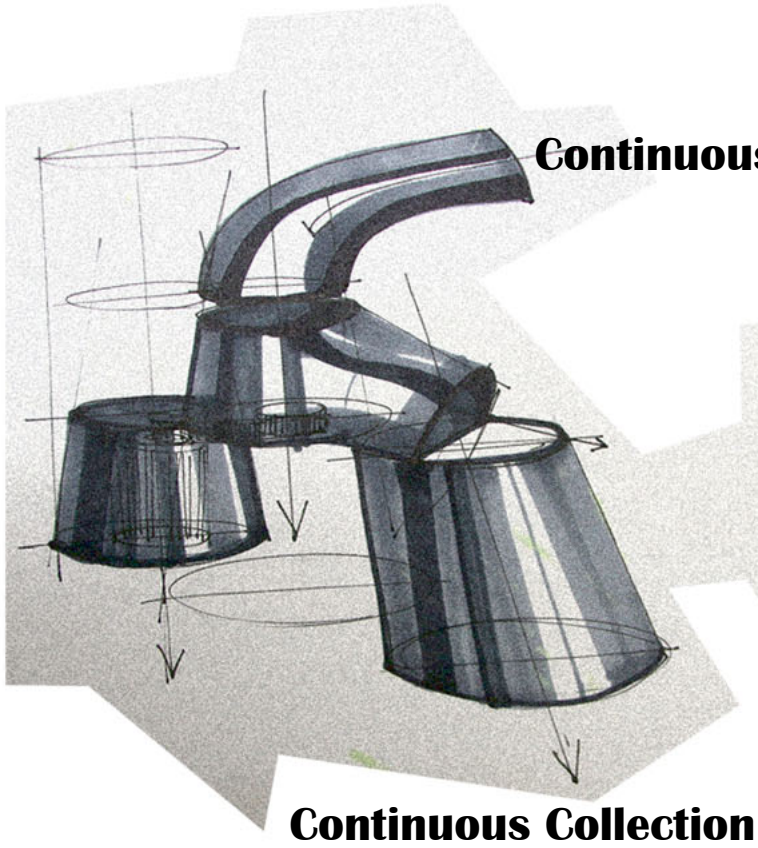




Pivoted Collector

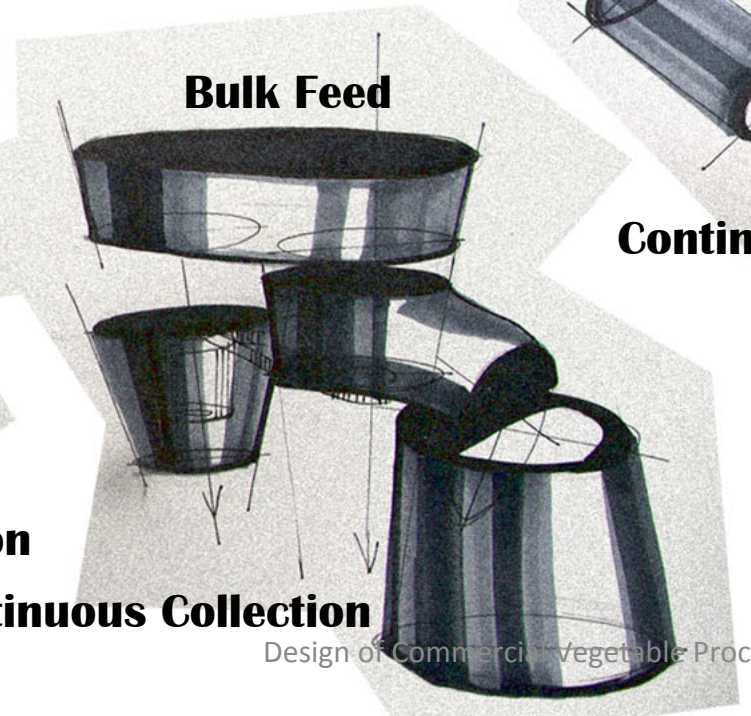
Configuration

Continuous Collection



Continuous Feed

Continuous Collection

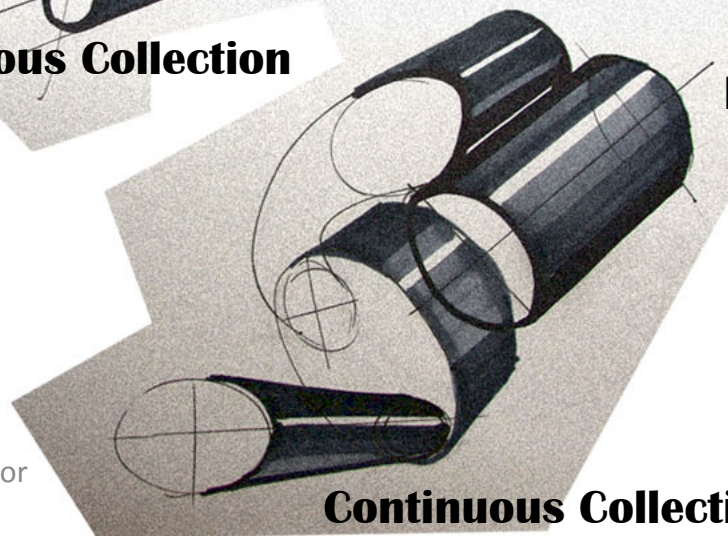


Bulk Feed

Continuous Collection

Continuous Feed

Continuous Collection

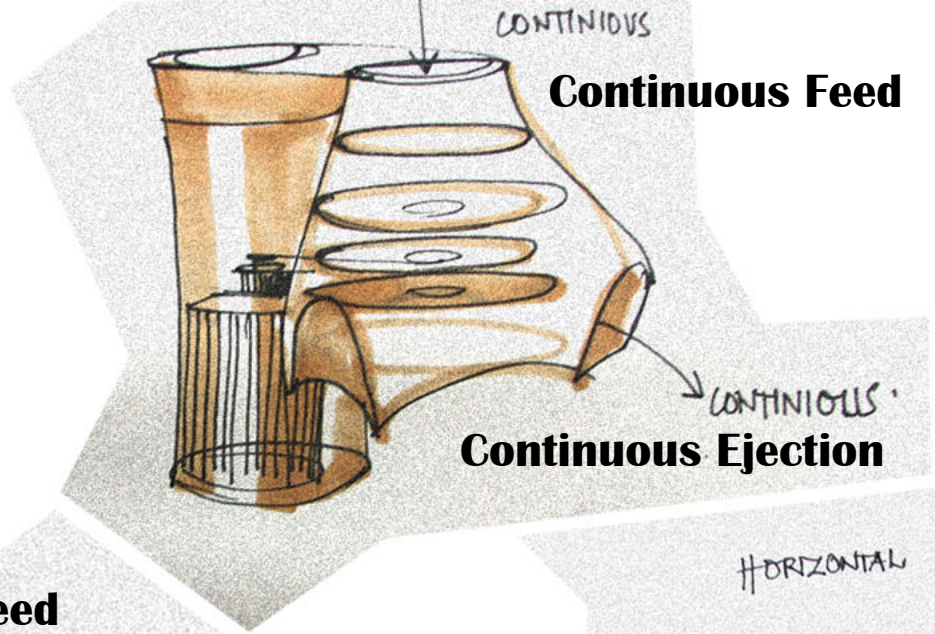


Bulk Feed

Continuous Collection

Configuration

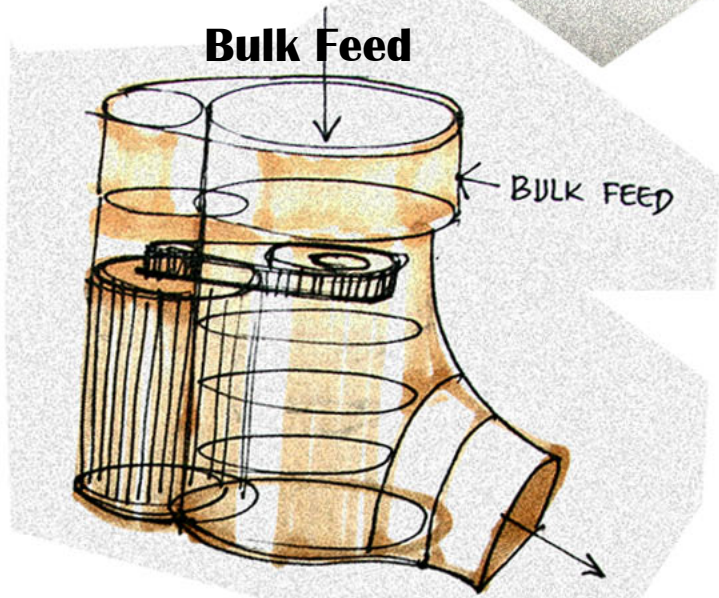
Continuous Ejection



Continuous Feed

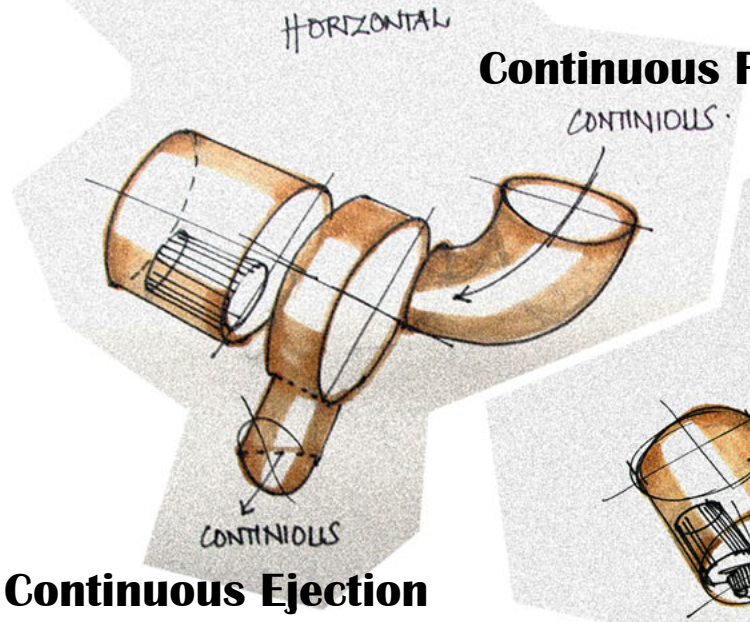
Continuous Ejection

Bulk Feed

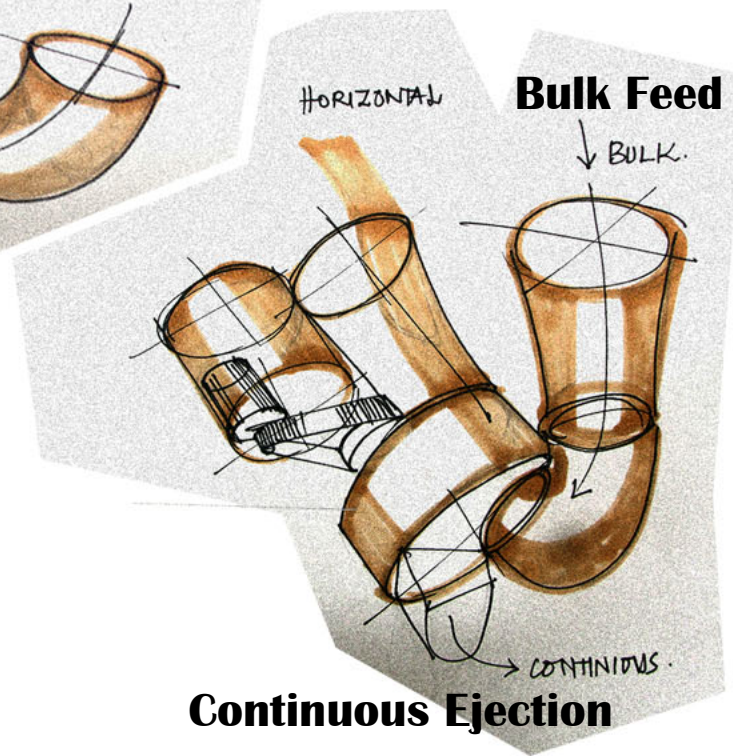


Continuous Ejection

Continuous Feed



Continuous Ejection

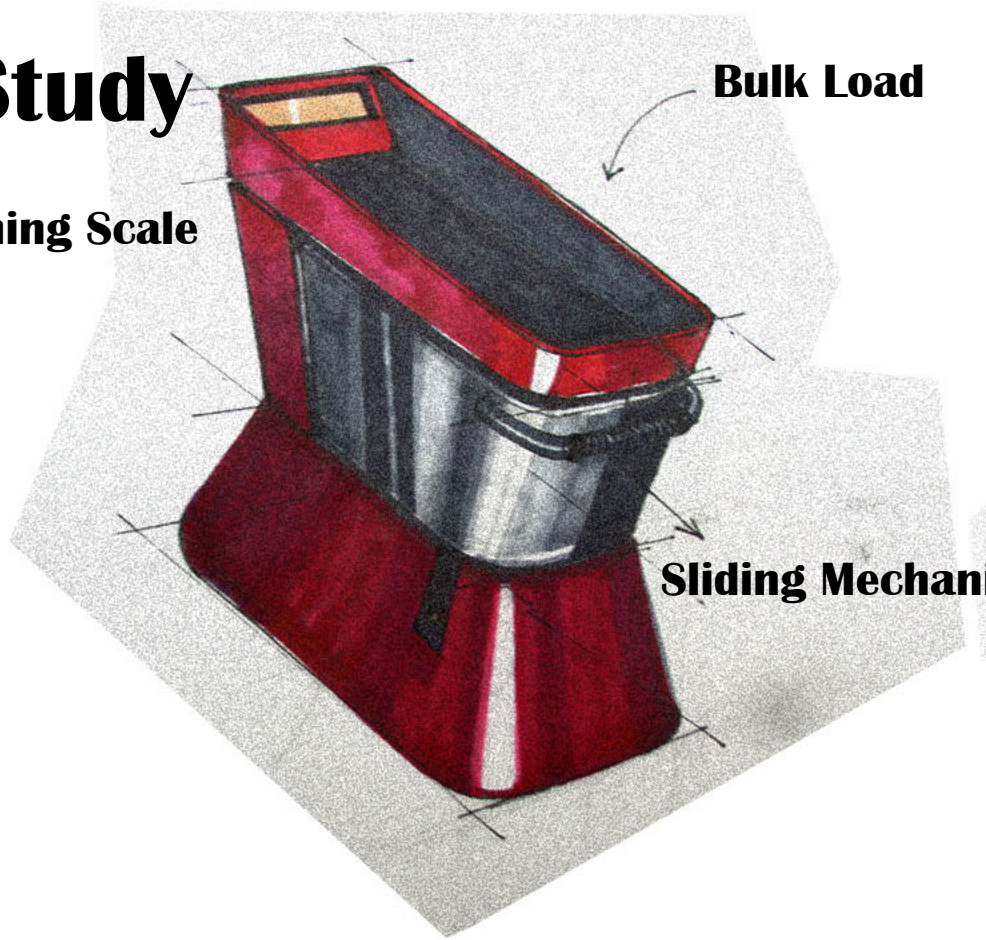


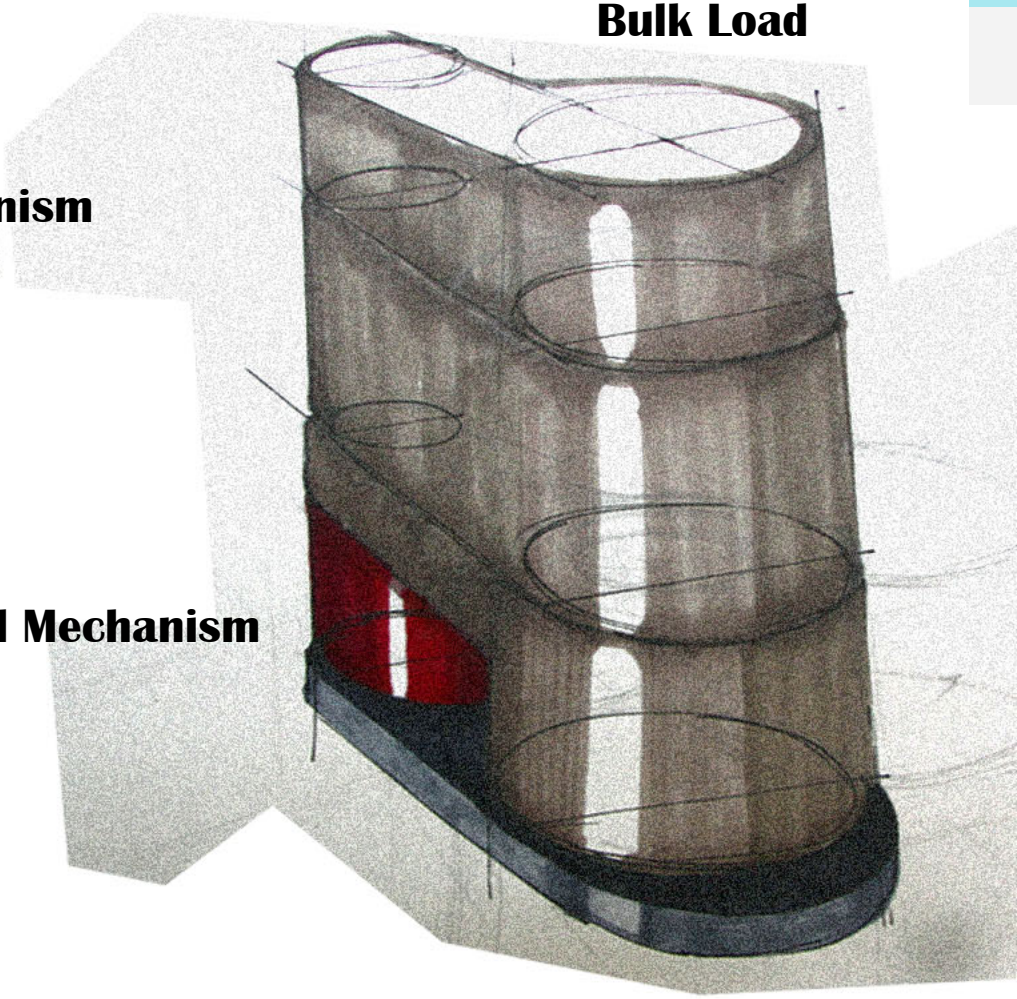
Bulk Feed

Continuous Ejection

Formal Study

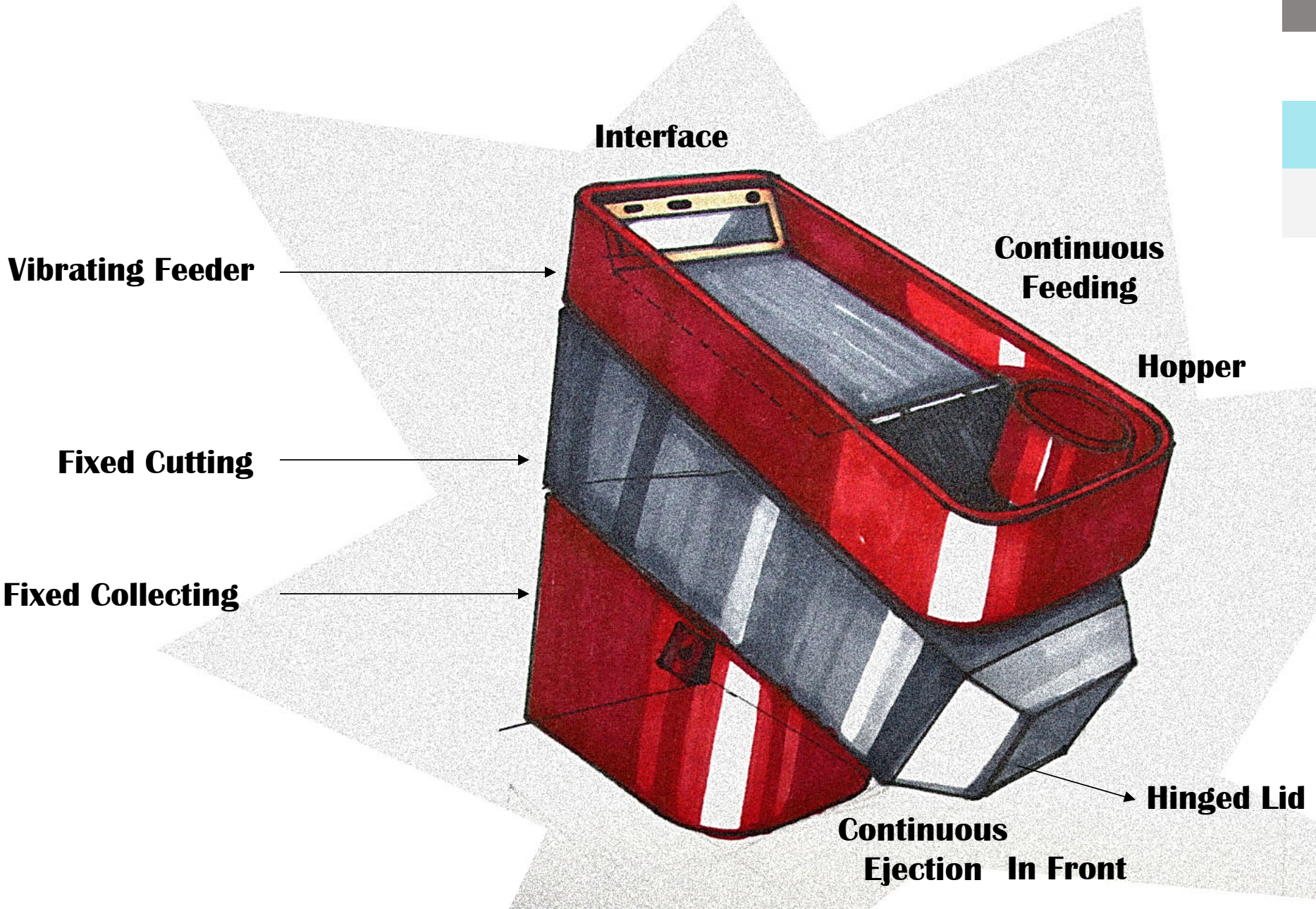
Idea of Weighing Scale

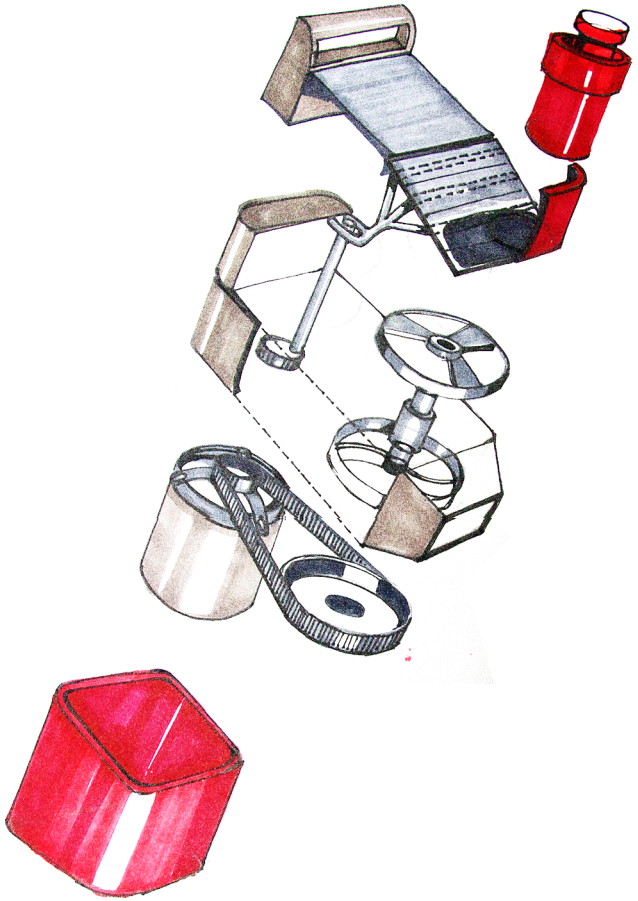


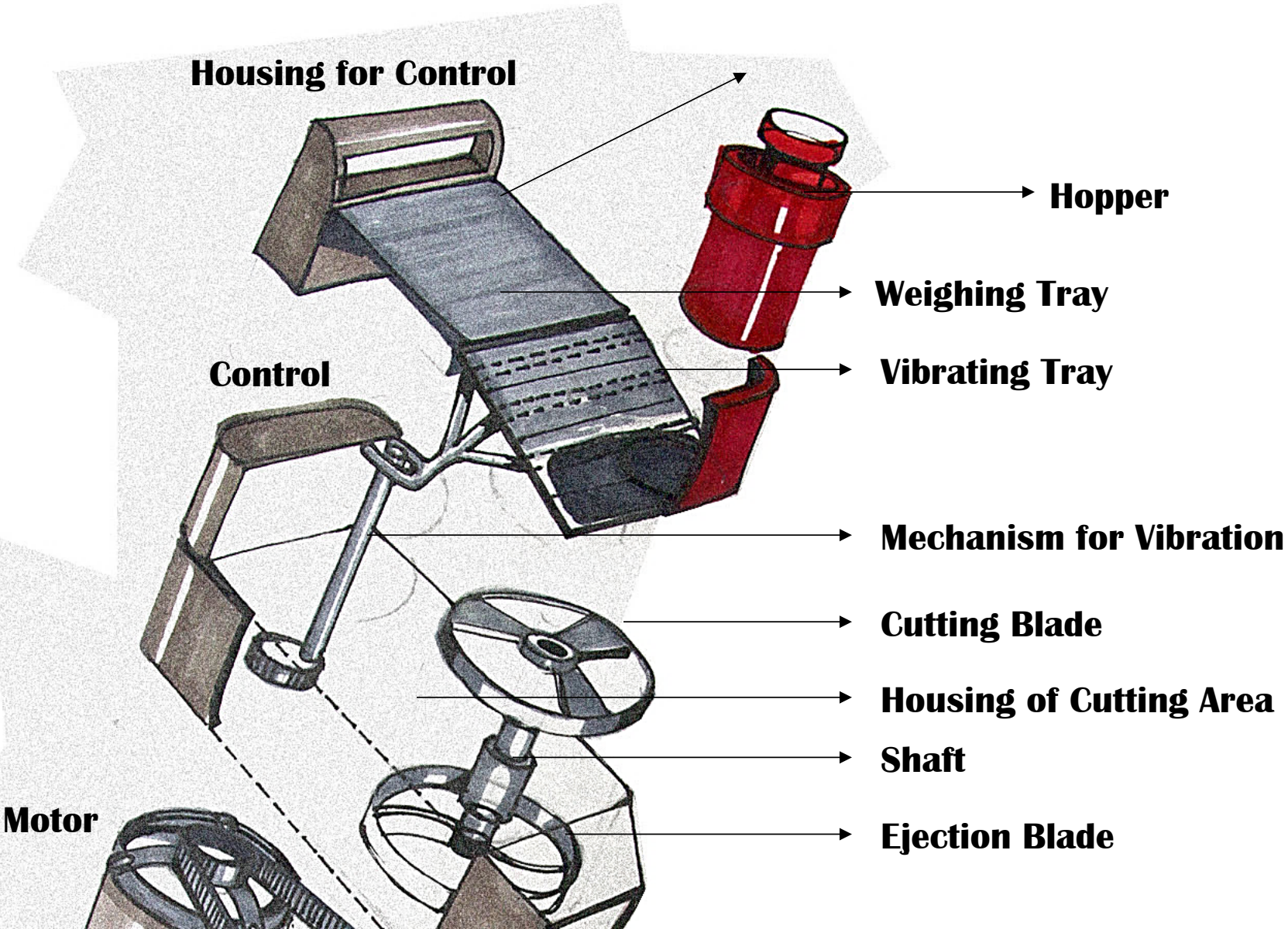


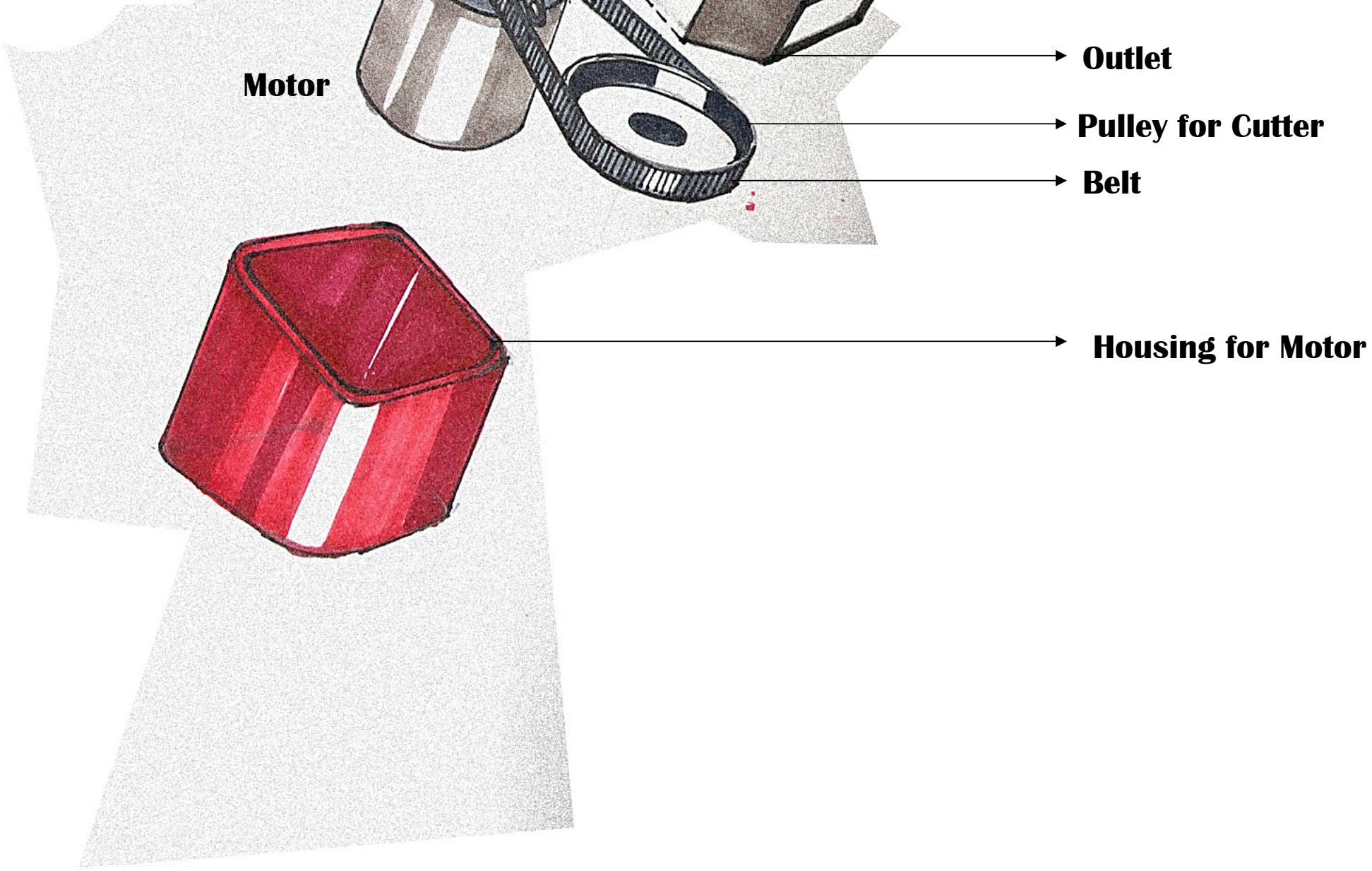
Concept 1

Inclined Layout






Housing for Control
Hopper
Weighing Tray
Vibrating Tray
Control
Mechanism for Vibration
Cutting Blade
Housing of Cutting Area
Shaft
Motor
Ejection Blade


Motor
Outlet
Pulley for Cutter
Belt
Housing for Motor

Concept 2

Horizontal Layout

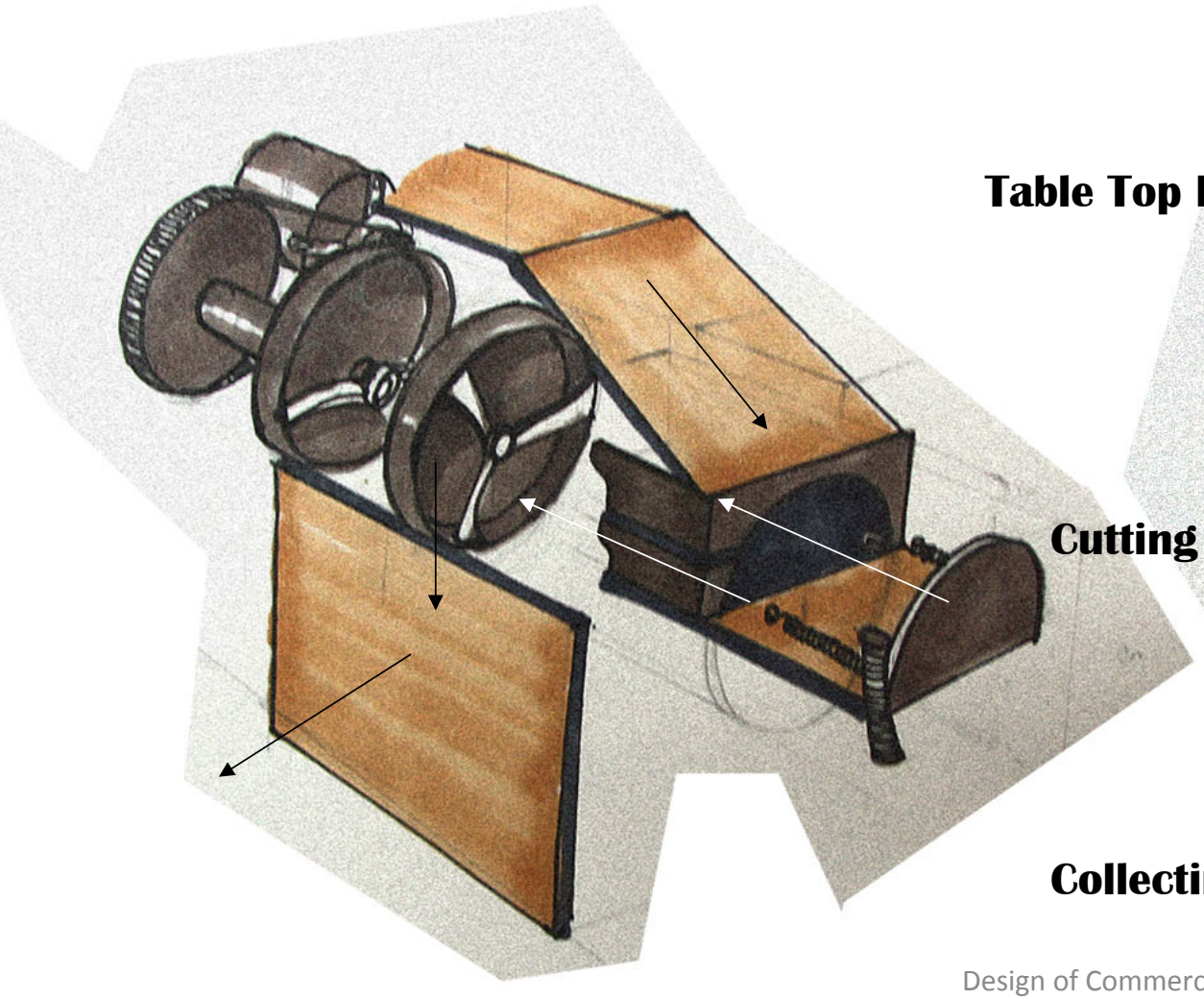
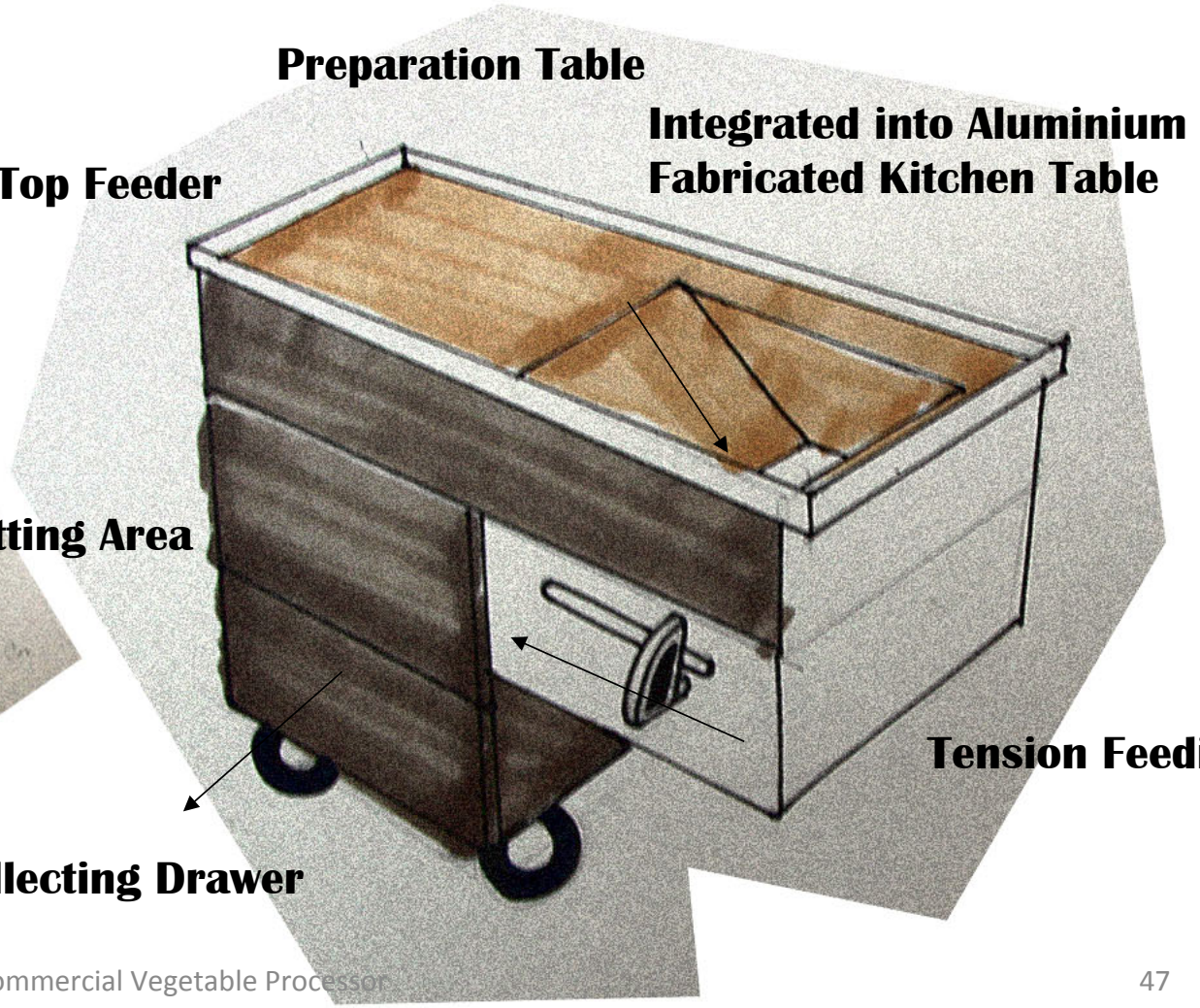


Table Top Feeder

Cutting Area

Collecting Drawer



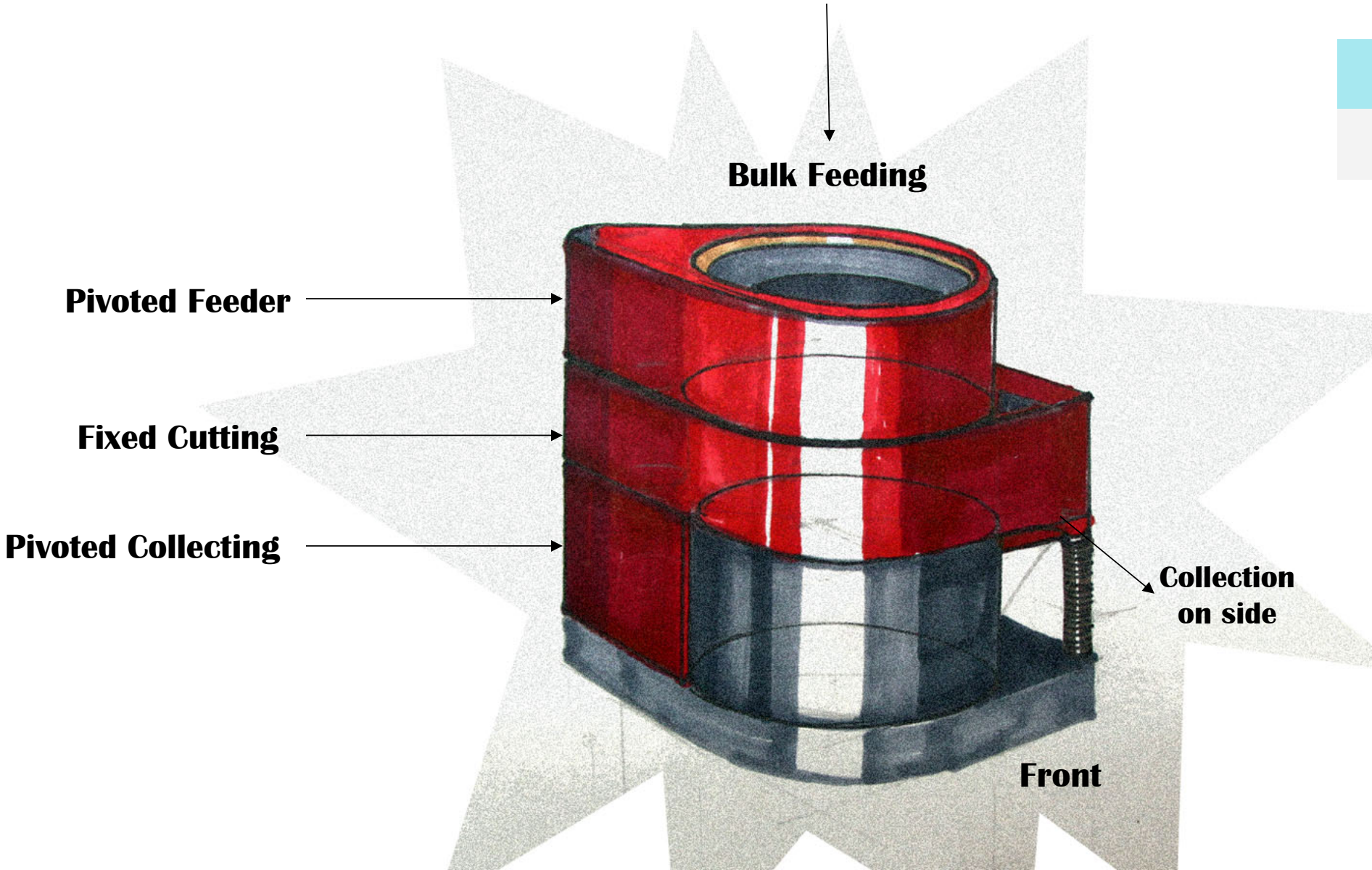
Preparation Table

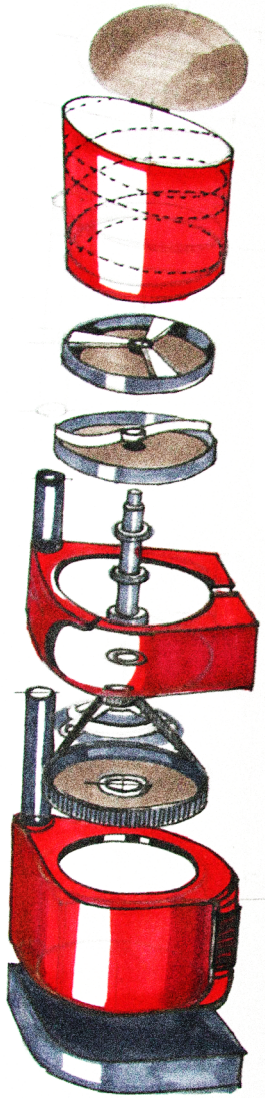
Integrated into Aluminium Fabricated Kitchen Table

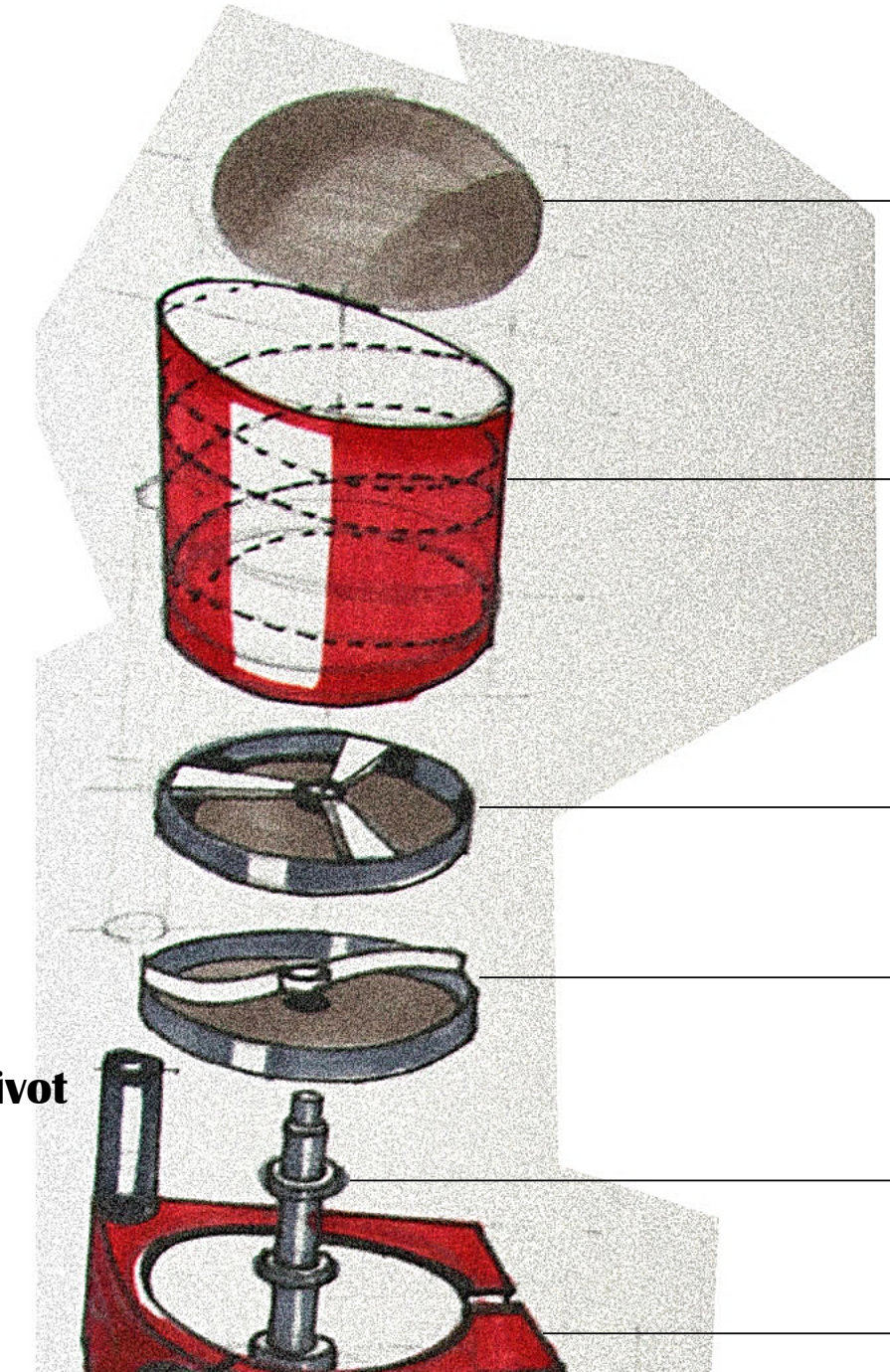
Tension Feeding

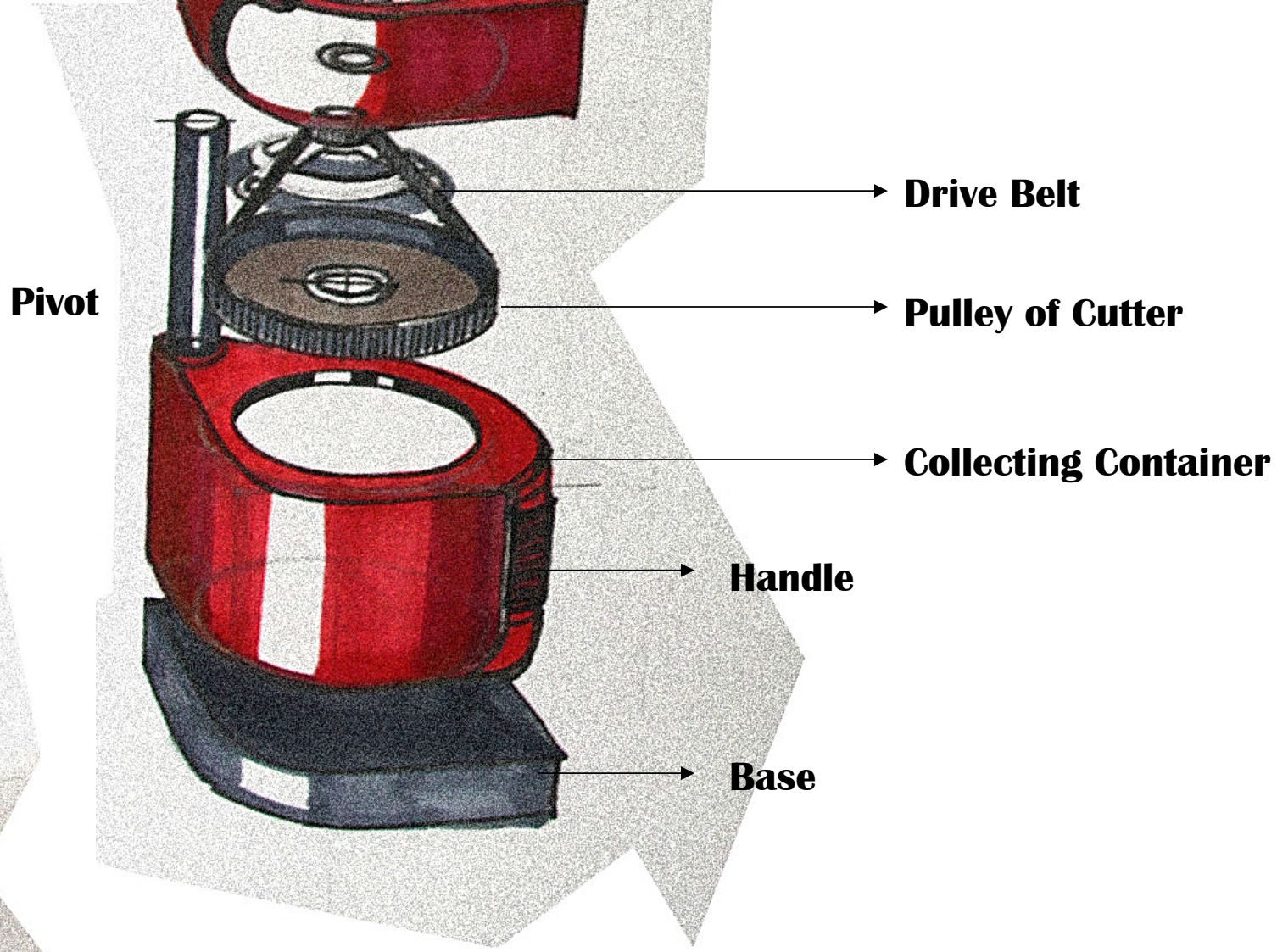
Concept 3

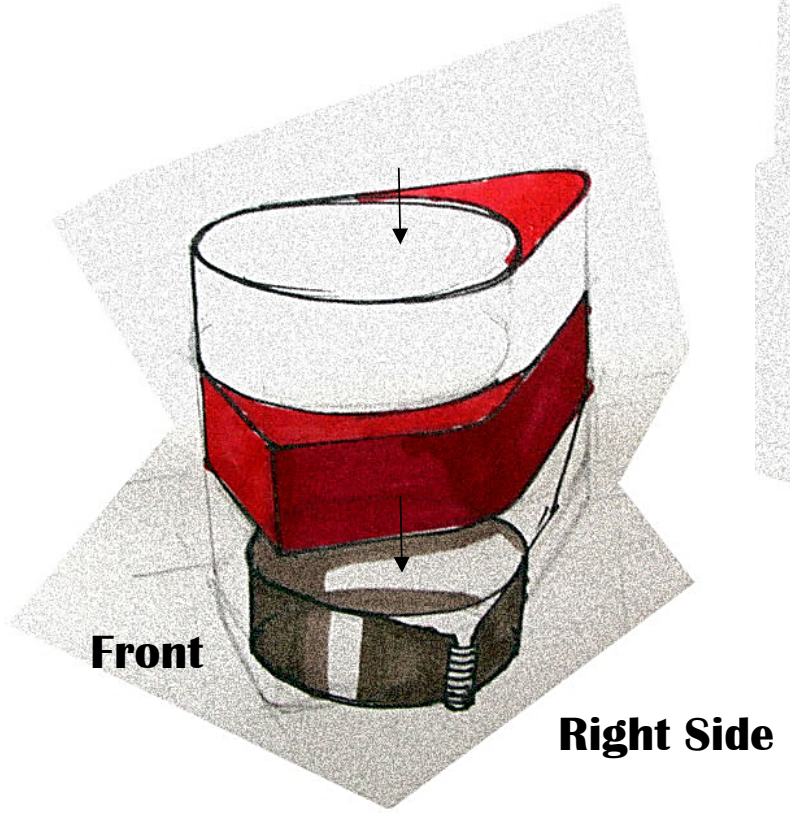
Vertical Layout



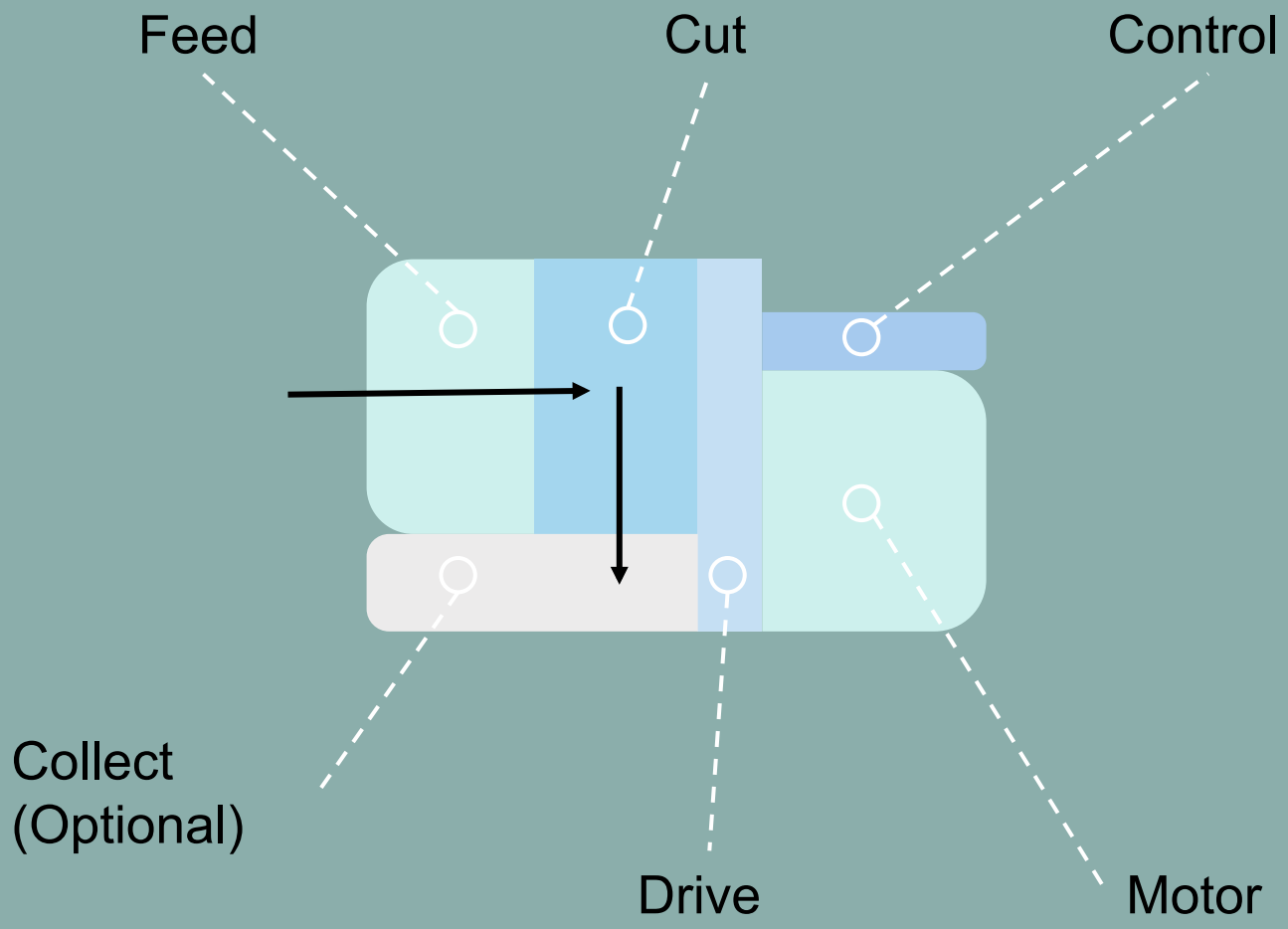



Hinged Lid
Bulk Loading Bowl
Cutting Blade
Ejection Blade
Pivot
Shaft
Housing of Cutting Area


Drive Belt
Pivot
Pulley of Cutter
Collecting Container
Handle
Base


Front
Right Side

CONCEPT



Final Configuration after assessment

Performance -

Productivity -

Ergonomics -

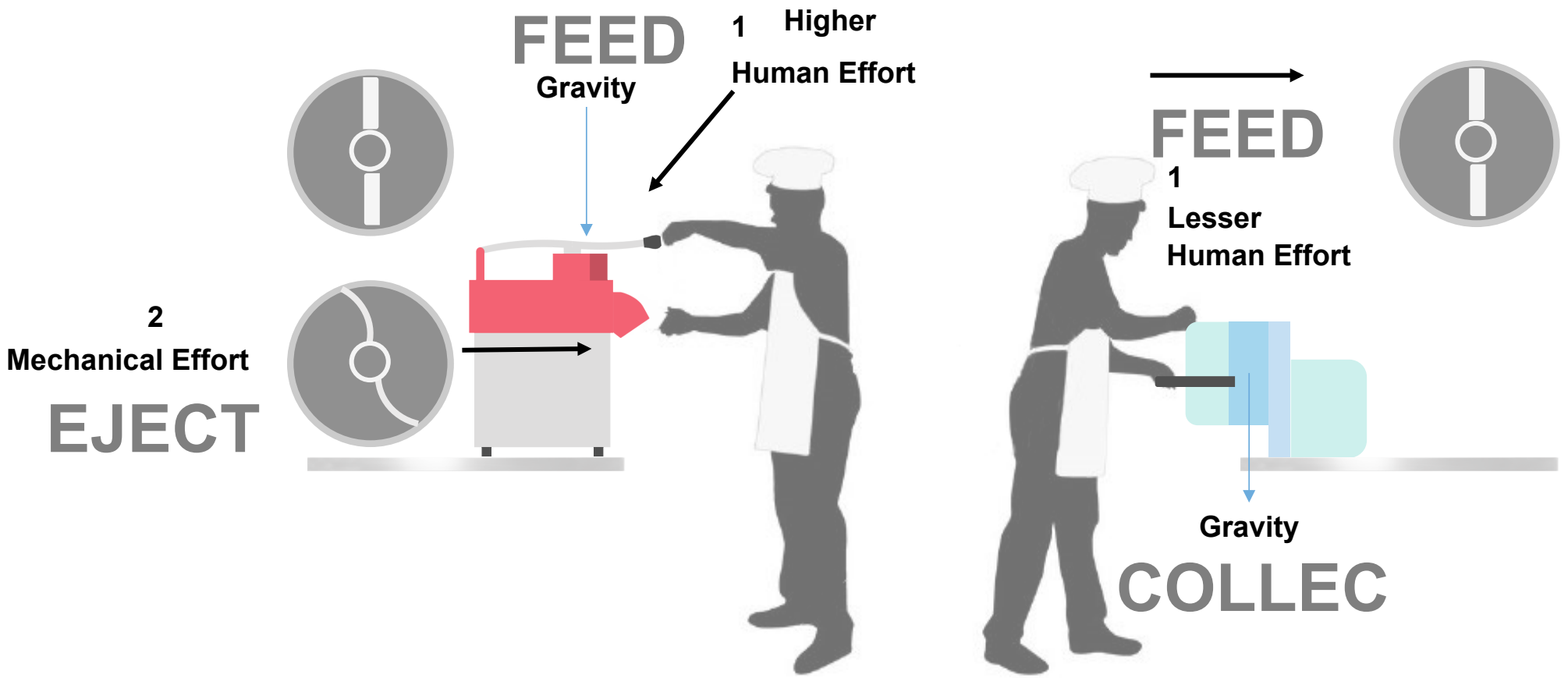
Maintenance -

Materials & Manufacturing - Similar

Cost – *“ Cannot say because of lack of detail” - Manufacturer*

Market – Unique Product

Choosing the concept

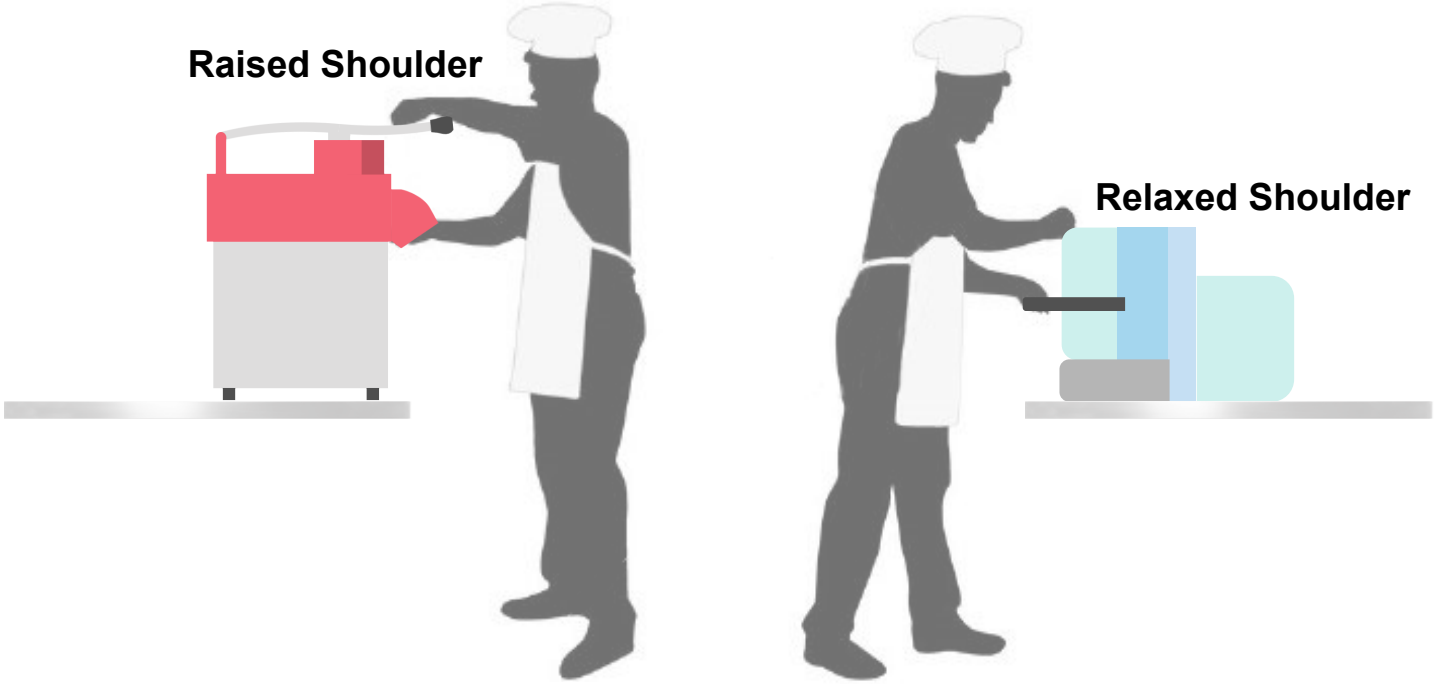


Torque used on 2 blades with loads

Only 1 blade with Less Load

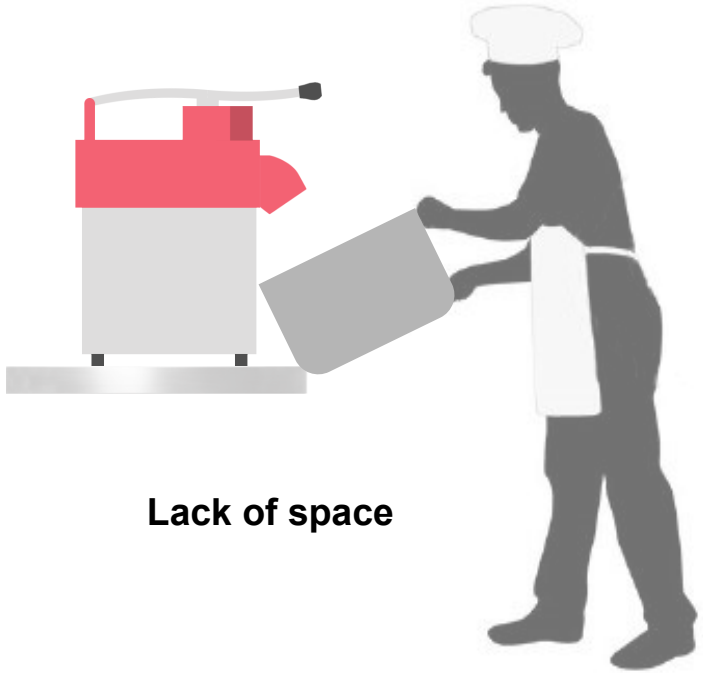
Comparison – Efficiency for the same power

“2 hours for Lunch, 2 hours for Dinner, 45 minutes for Salad”



Relaxed shoulders effect the productivity drastically

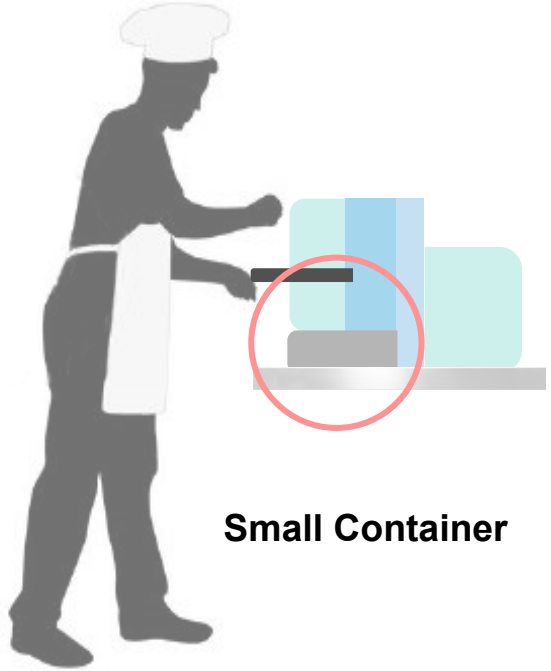
Designed for large containers



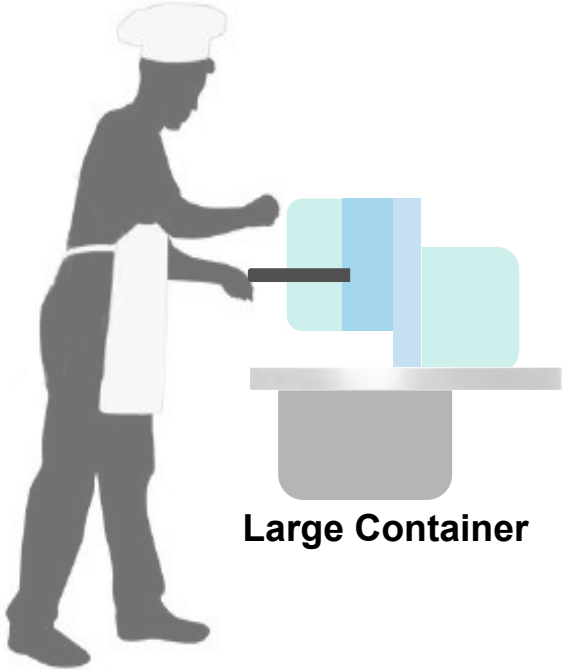
Lack of space

But, Not table

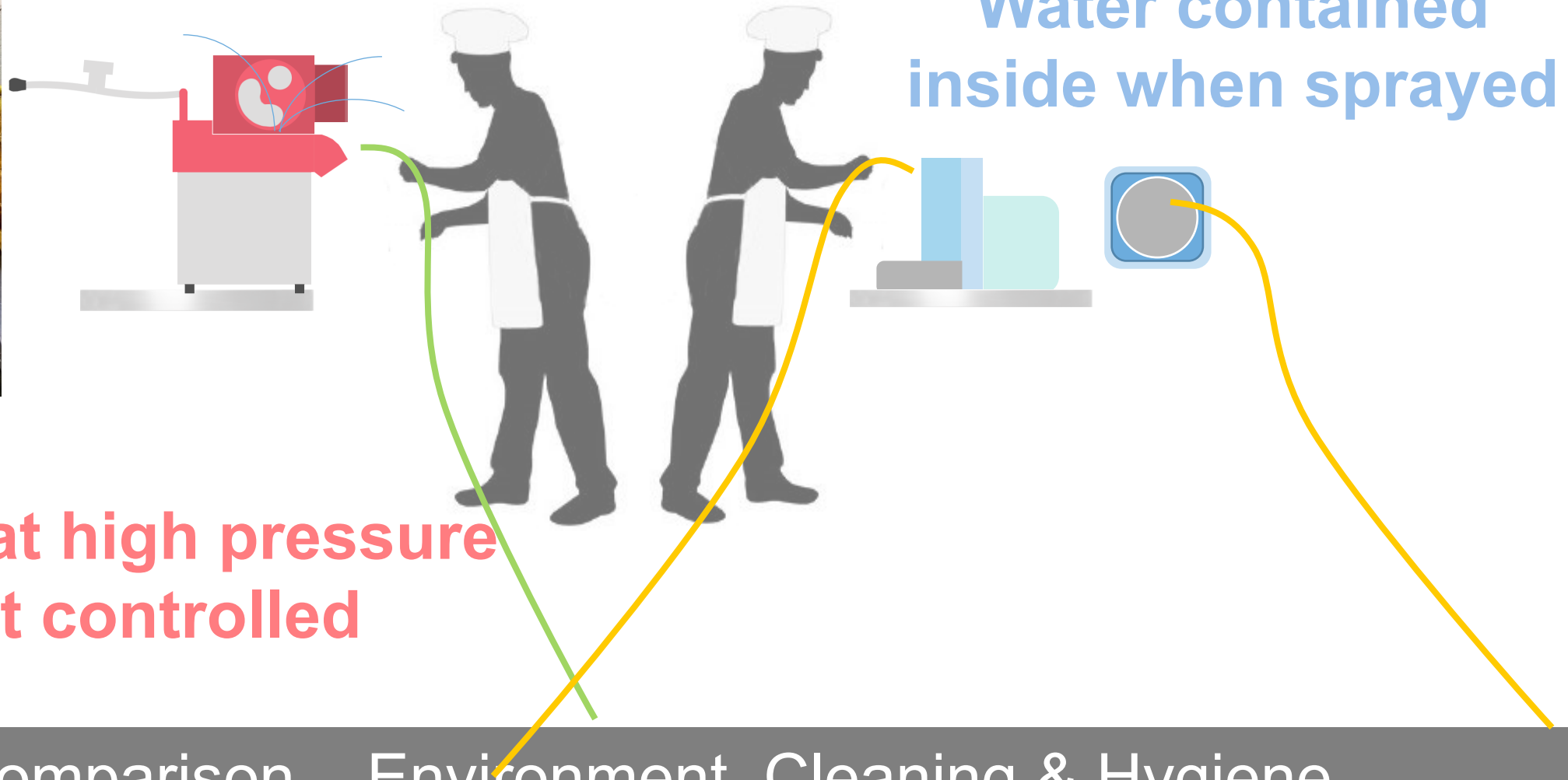
Machine and table should be compatible

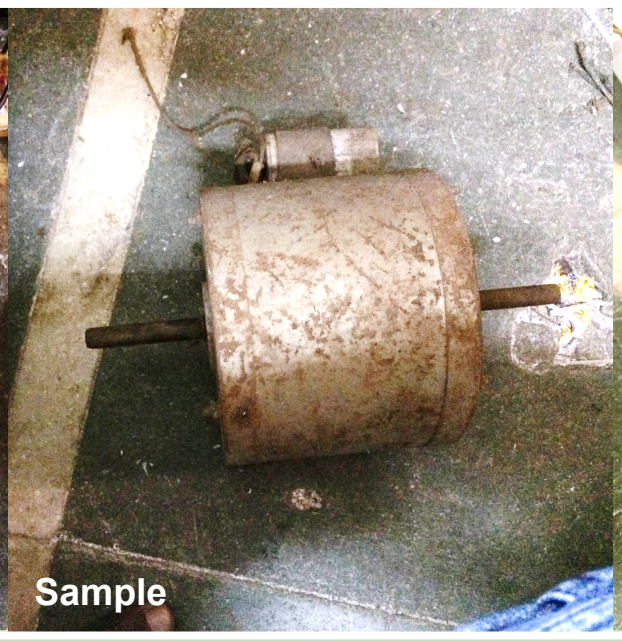


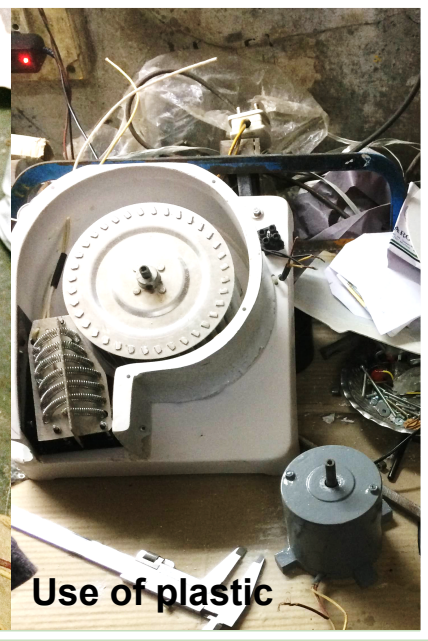
Small Container



Large Container


Water contained
inside when sprayed
Water at high pressure
not controlled





MOTOR: 1hp single phase induction @1500 rpm with running capacitor

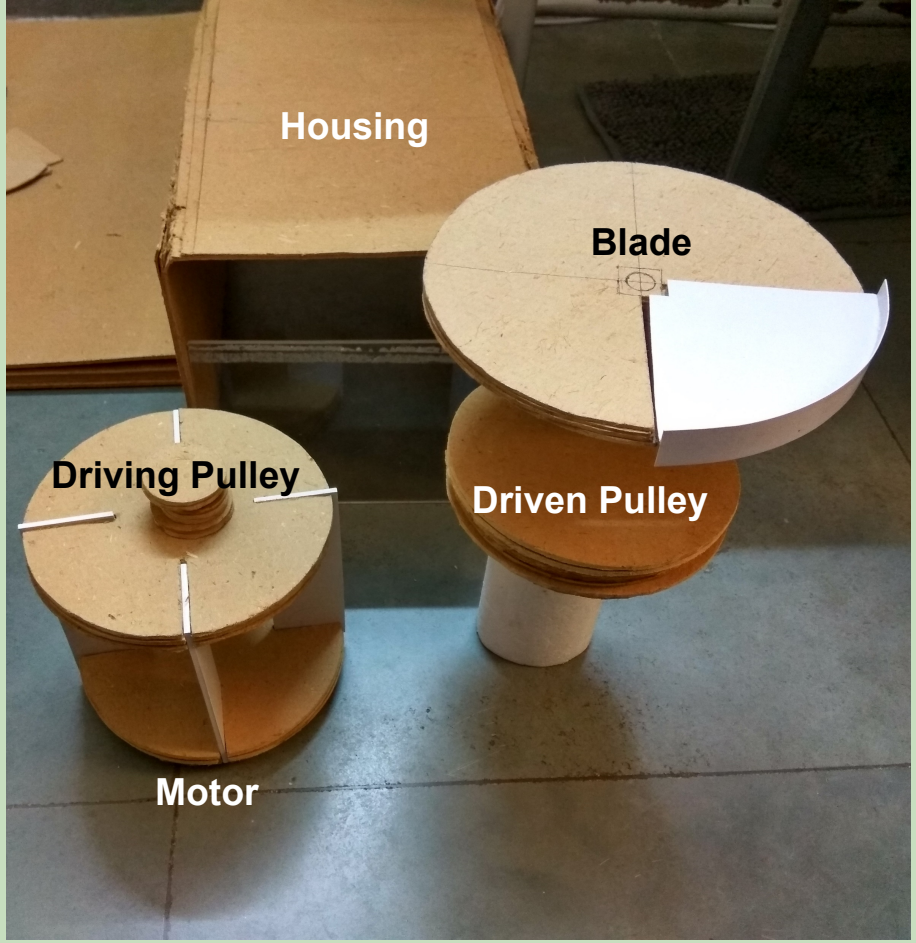
DRIVE: Belt drive, to reduce speed to ~400-500 rpm

SHAFT: ½” Food grade (304, 316) steel

BLADE: 200mm (or 8 inch) diameter

To develop product volume

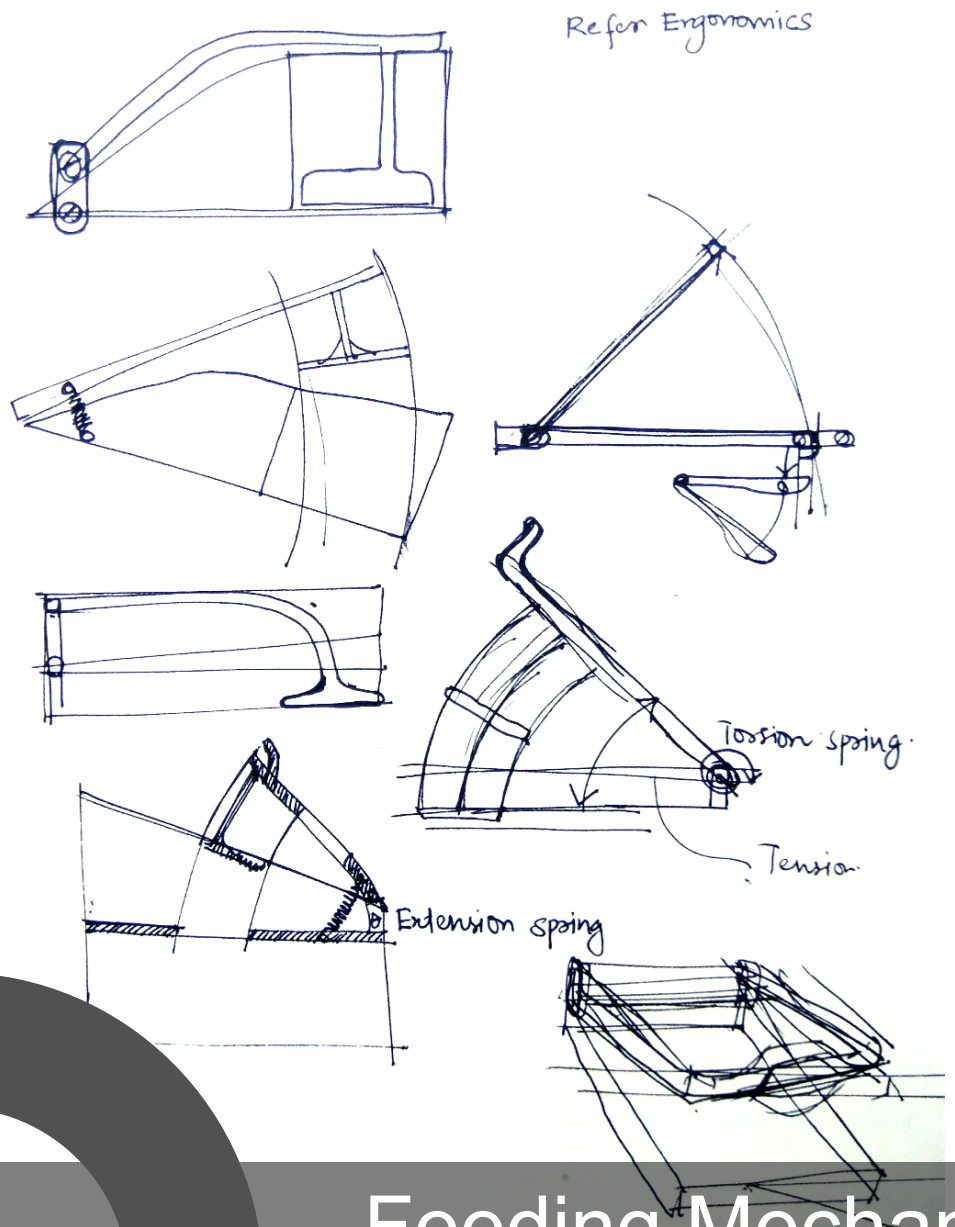
Manufacturing Constrains - Dimensions



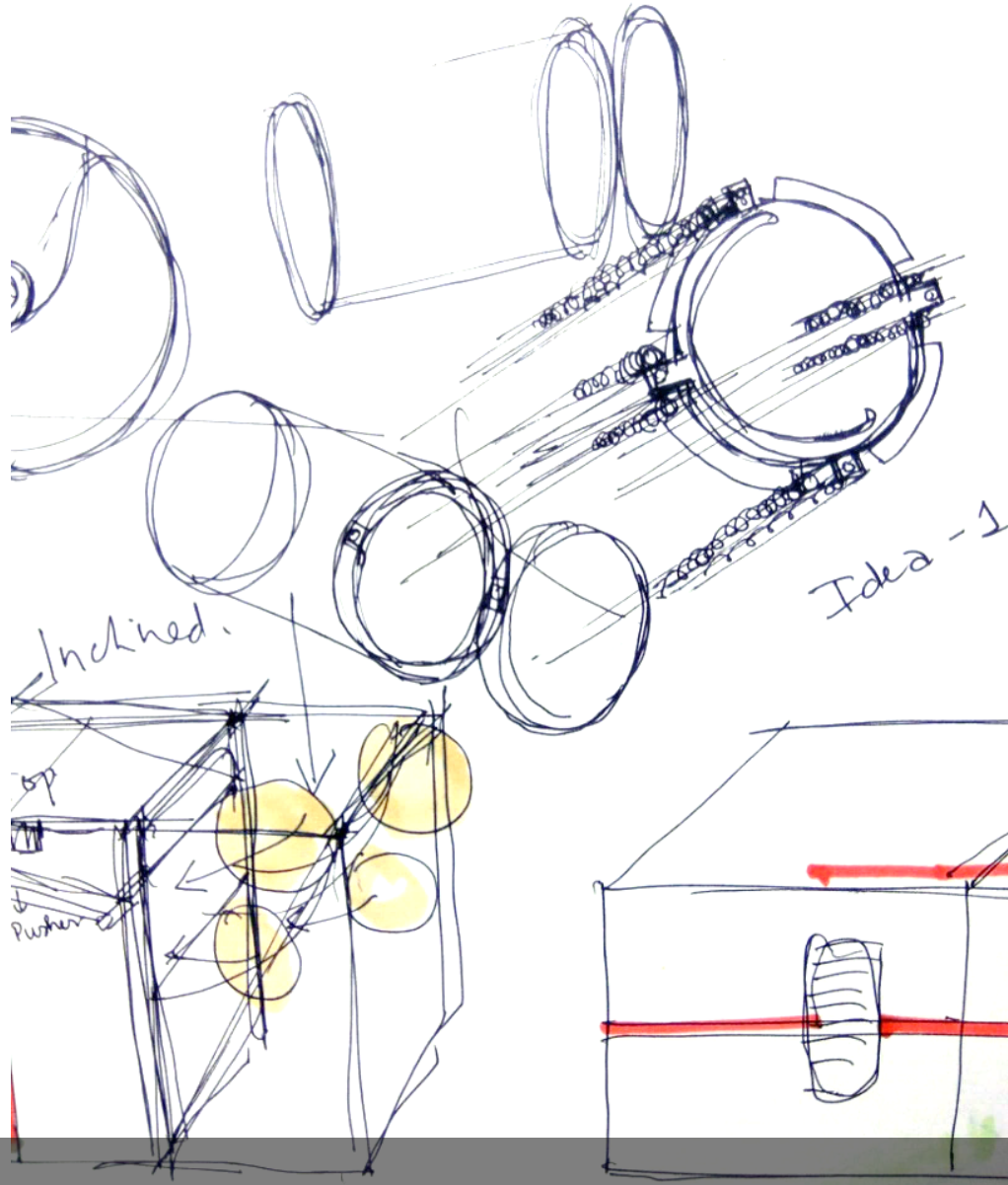
To develop dimensions and understand design possibilities

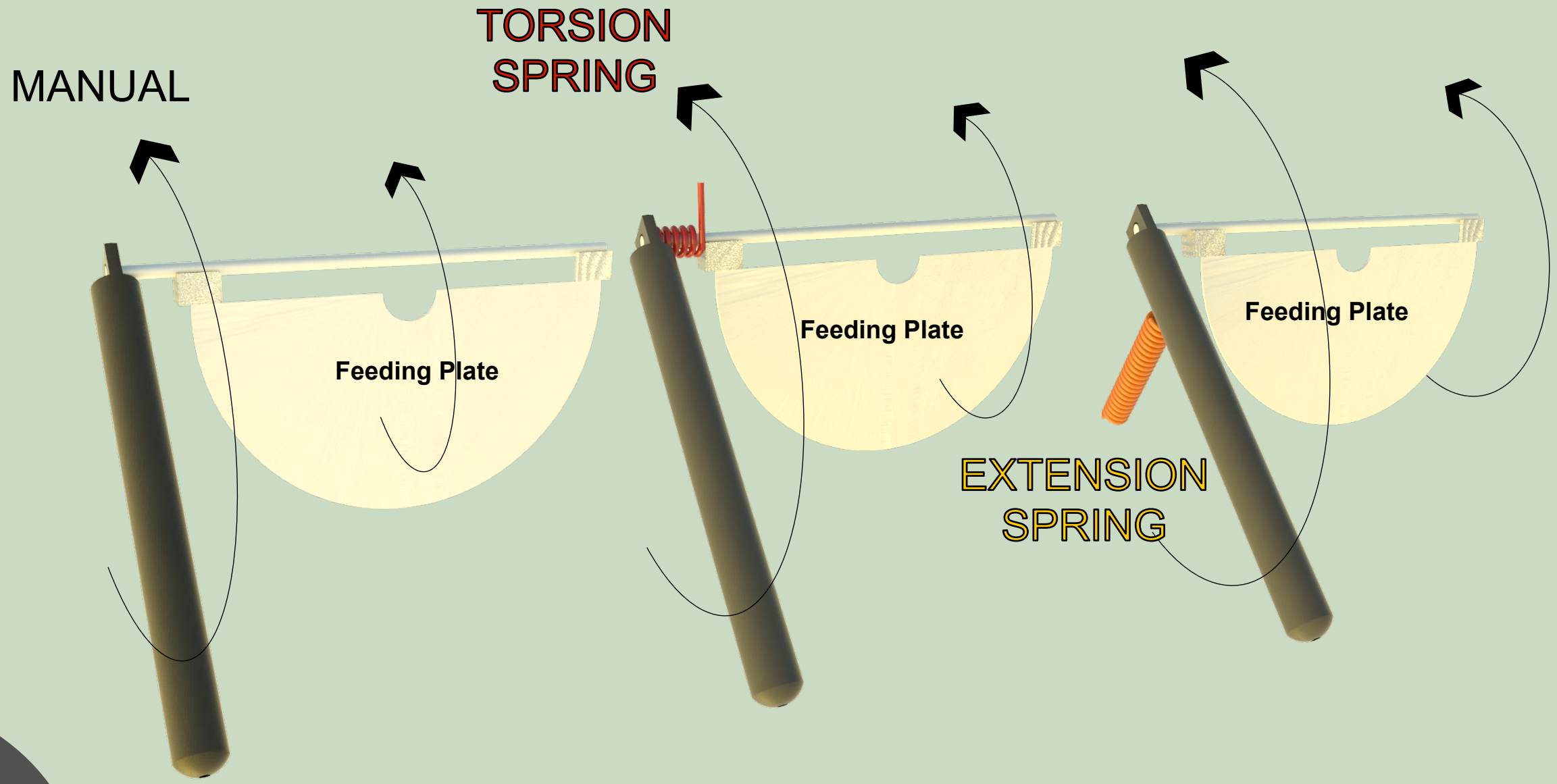
Full scale Mock up of parts and housing

Spring Assisted Lever



Spring Assisted Slider

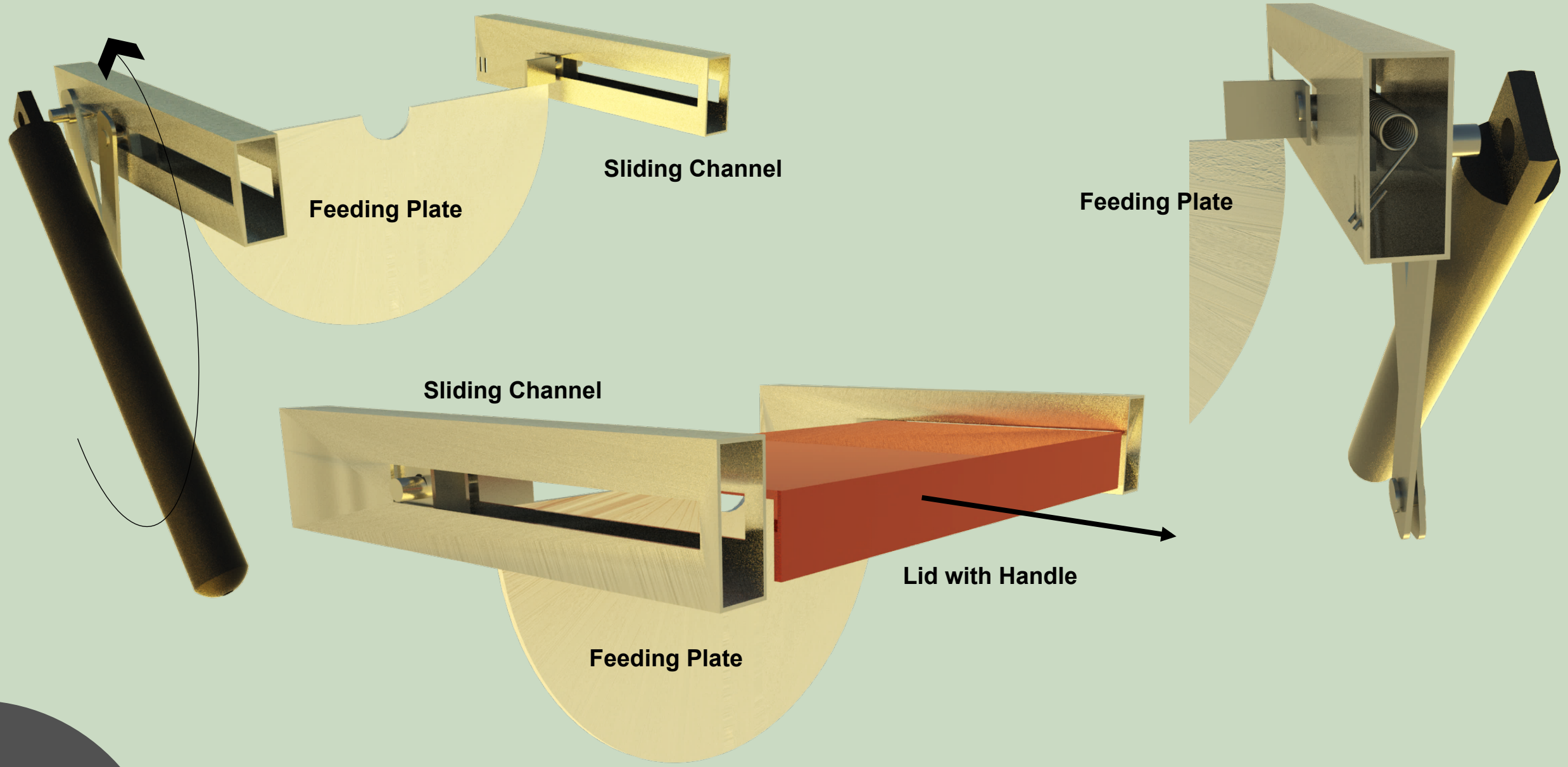




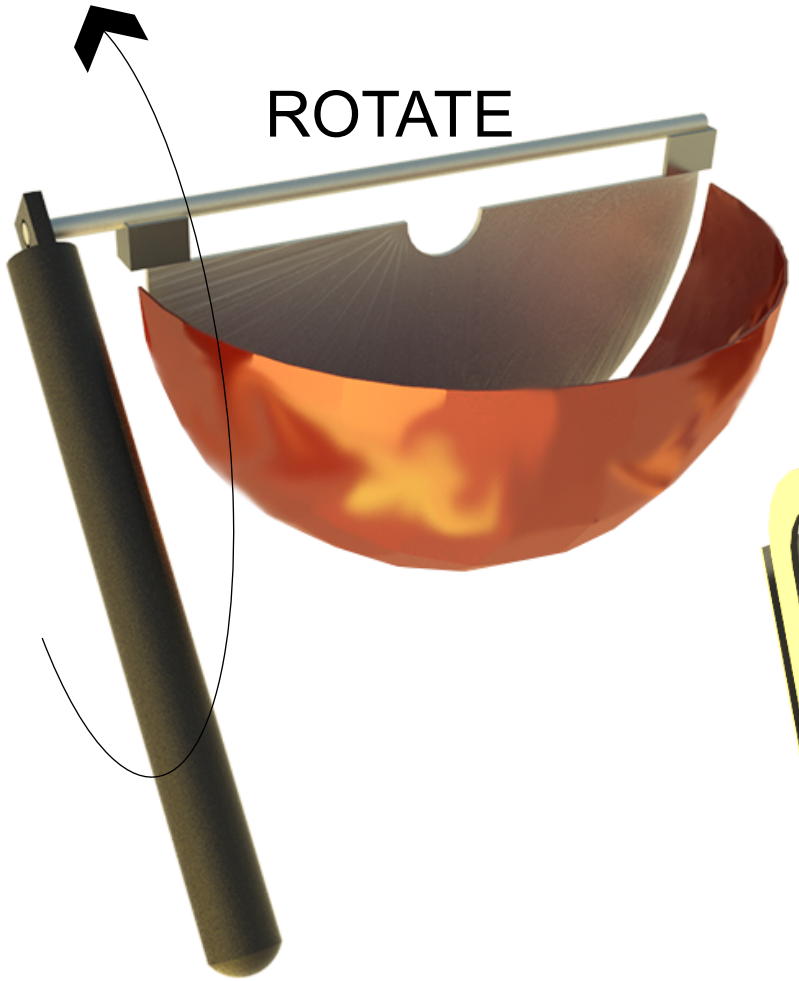
Feeding Mechanism – Spring assisted lever

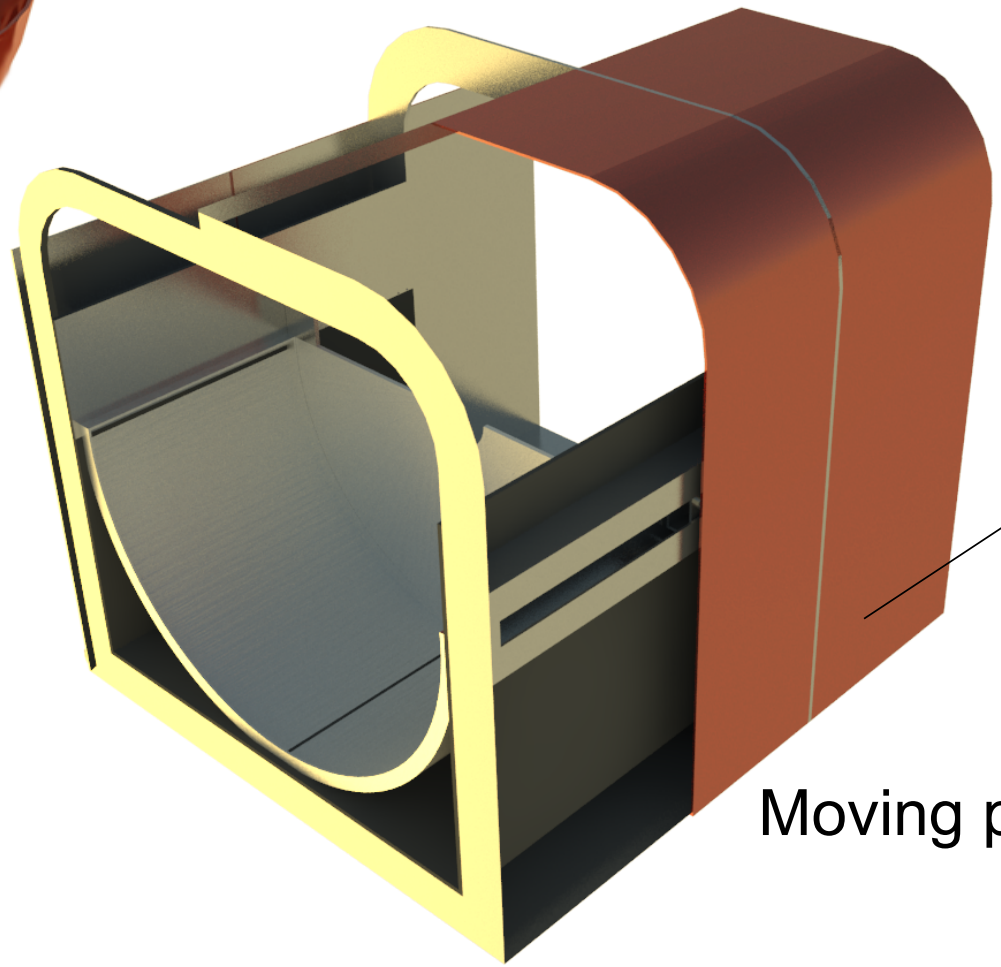
Extension springs are used assist the feeding of vegetables

Feeding Mechanism – Testing Using Mockup



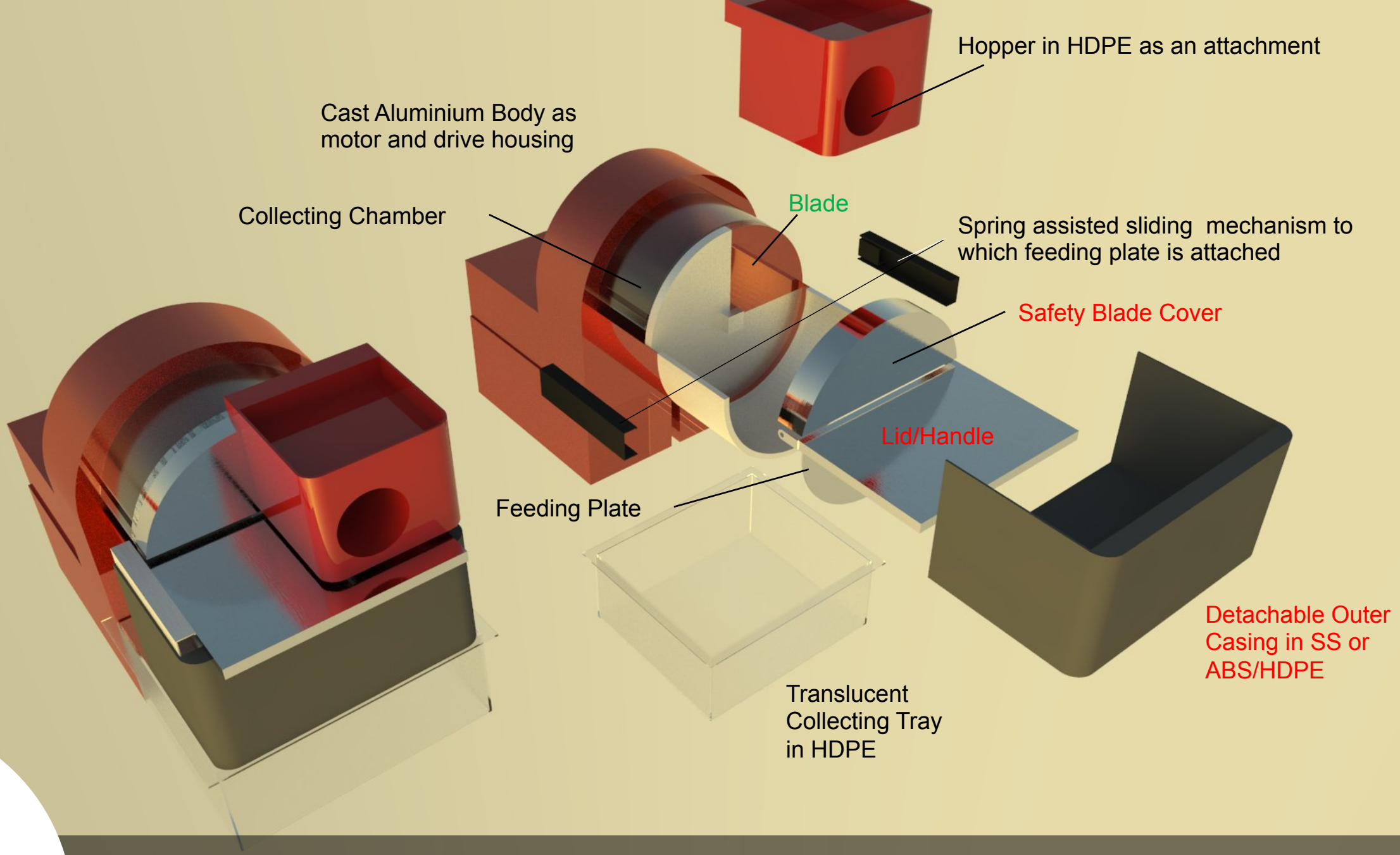
Feeding Mechanism – Spring assisted Slider



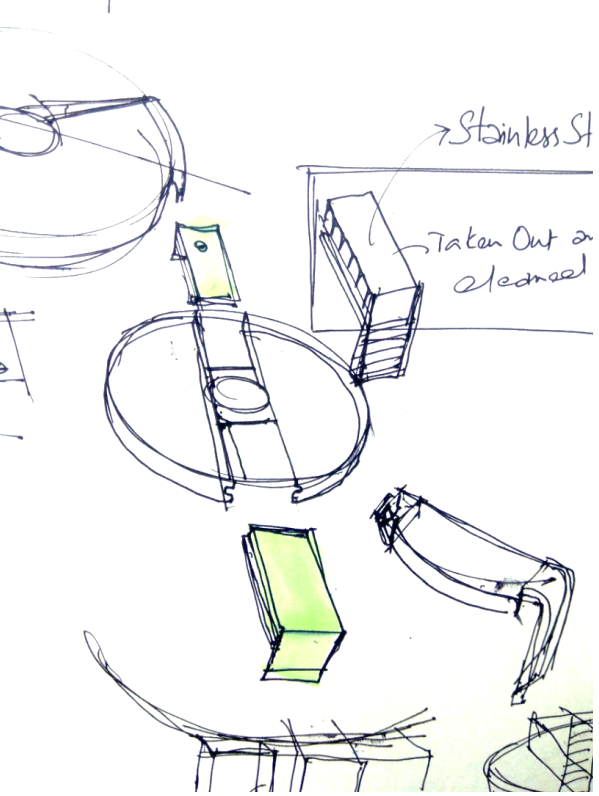


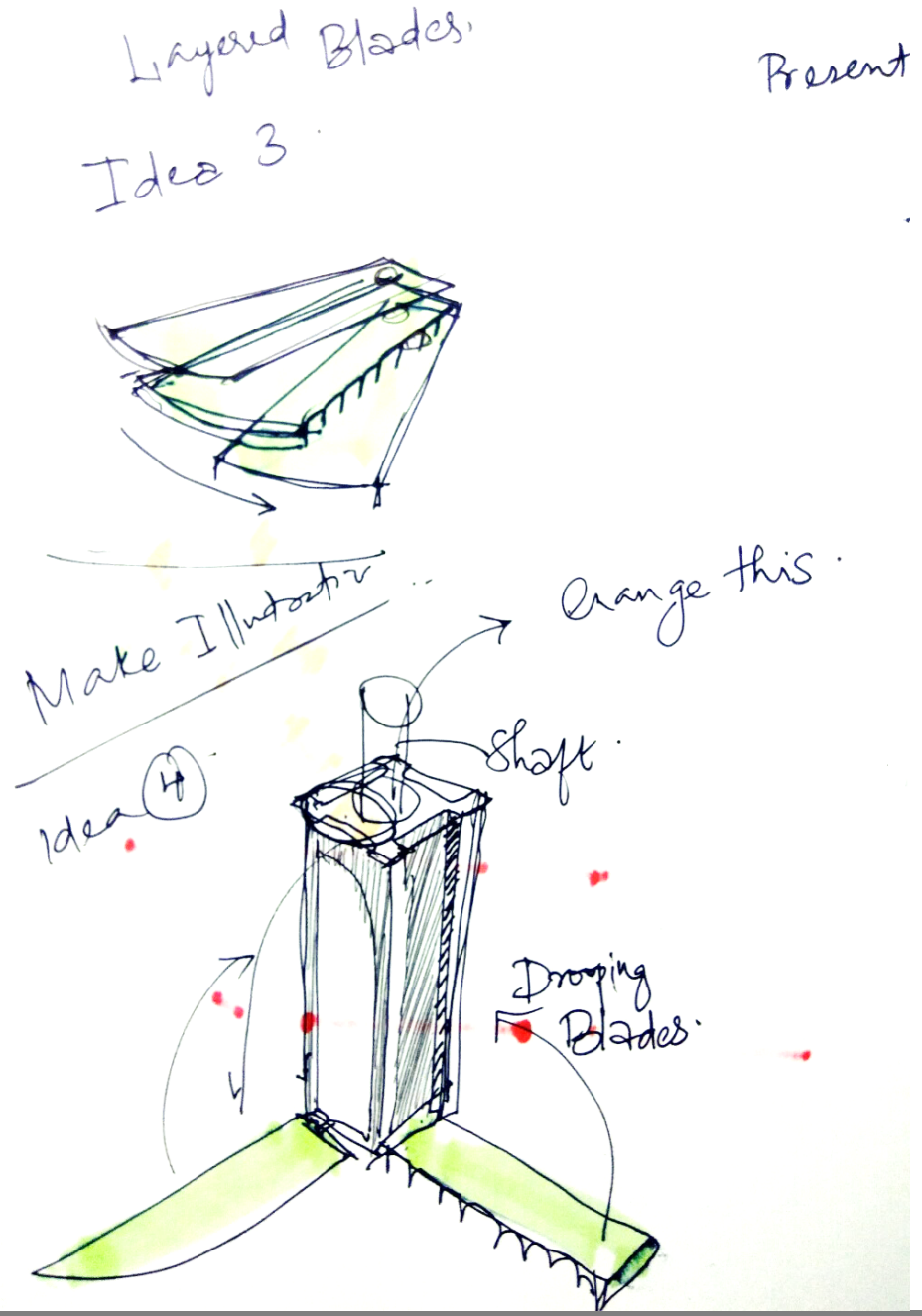
Moving parts can be lubricated by sliding the case

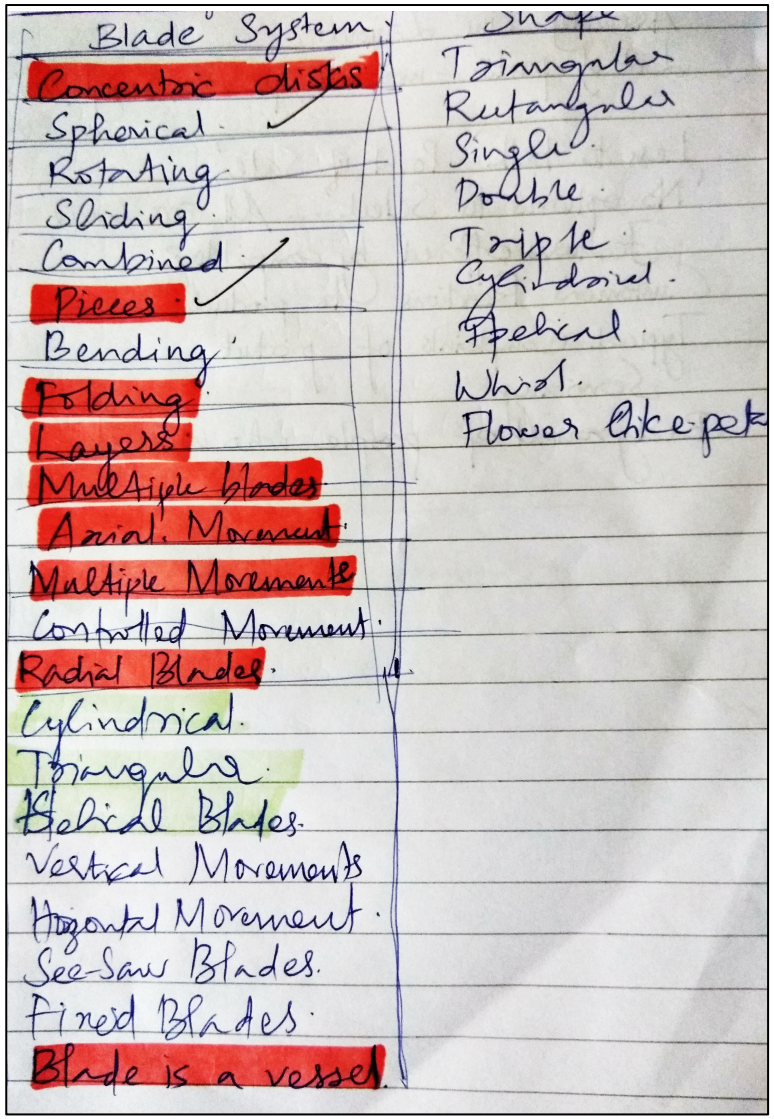
Hopper –


Hopper in HDPE as an attachment
Cast Aluminium Body as motor and drive housing
Collecting Chamber
Blade
Spring assisted sliding mechanism to which feeding plate is attached
Safety Blade Cover
Lid/Handle
Feeding Plate
Detachable Outer Casing in SS or ABS/HDPE
Translucent Collecting Tray in HDPE

Parts



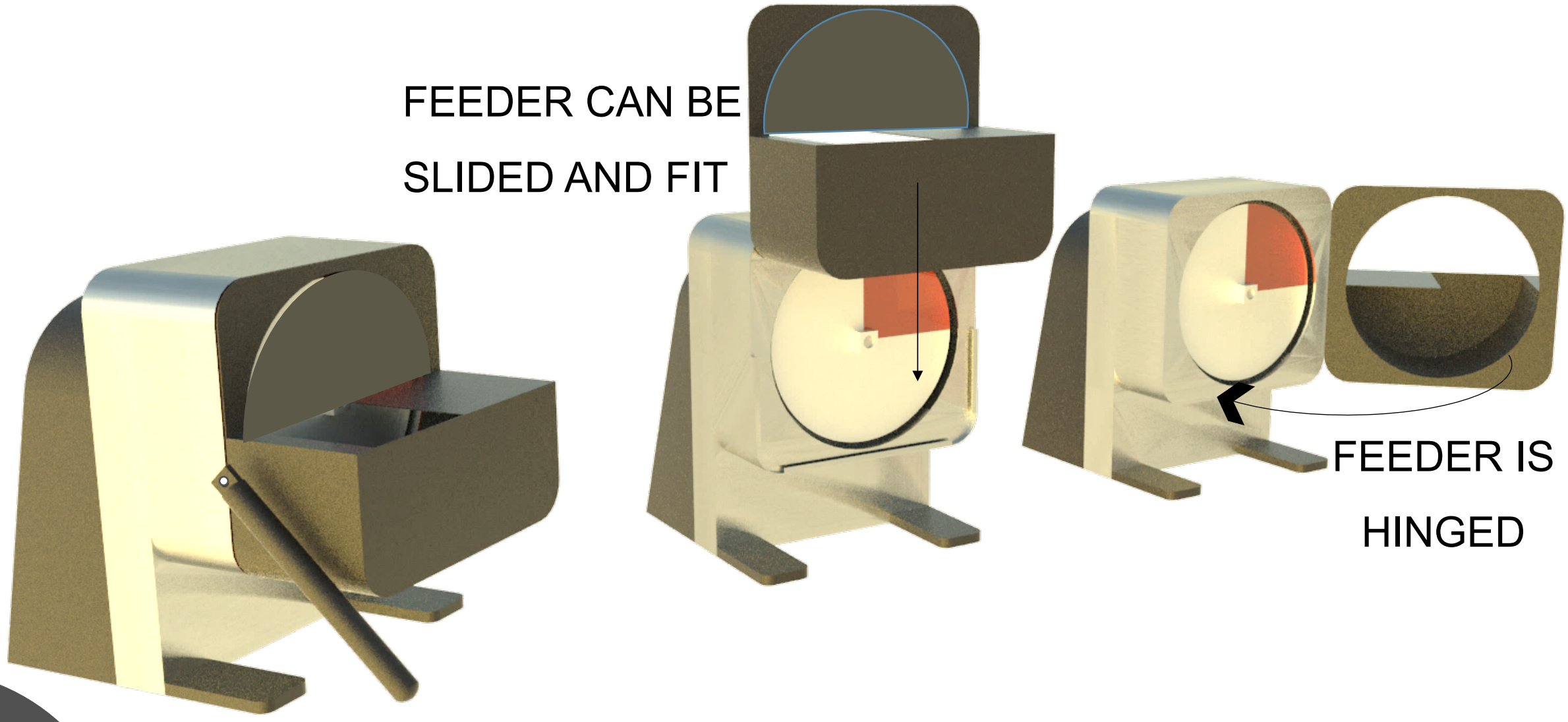




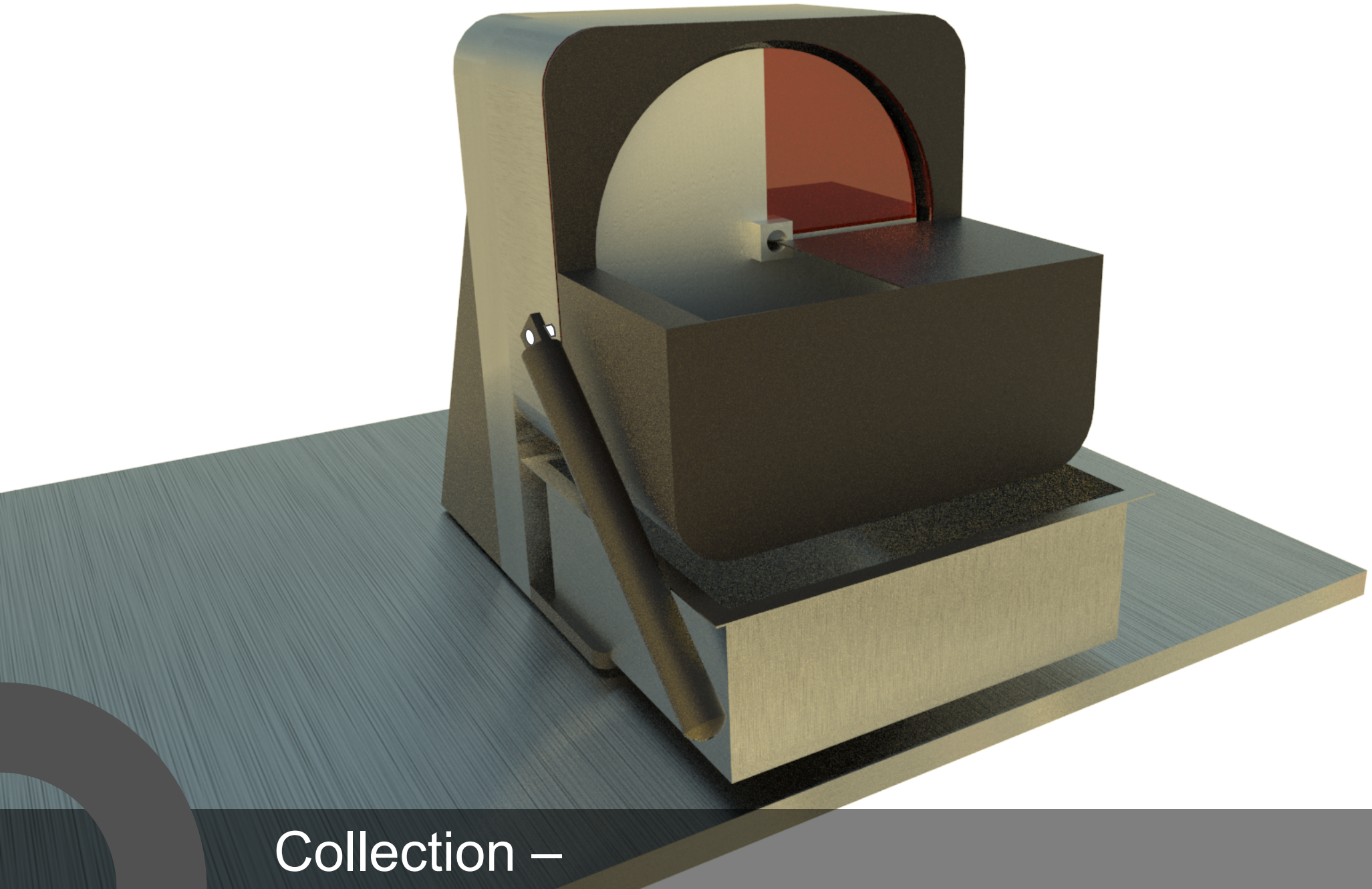
Blade Design – Attempt to reduce cost of product

Different types of blades can be integrated into the disk to get different type of cuts in this way

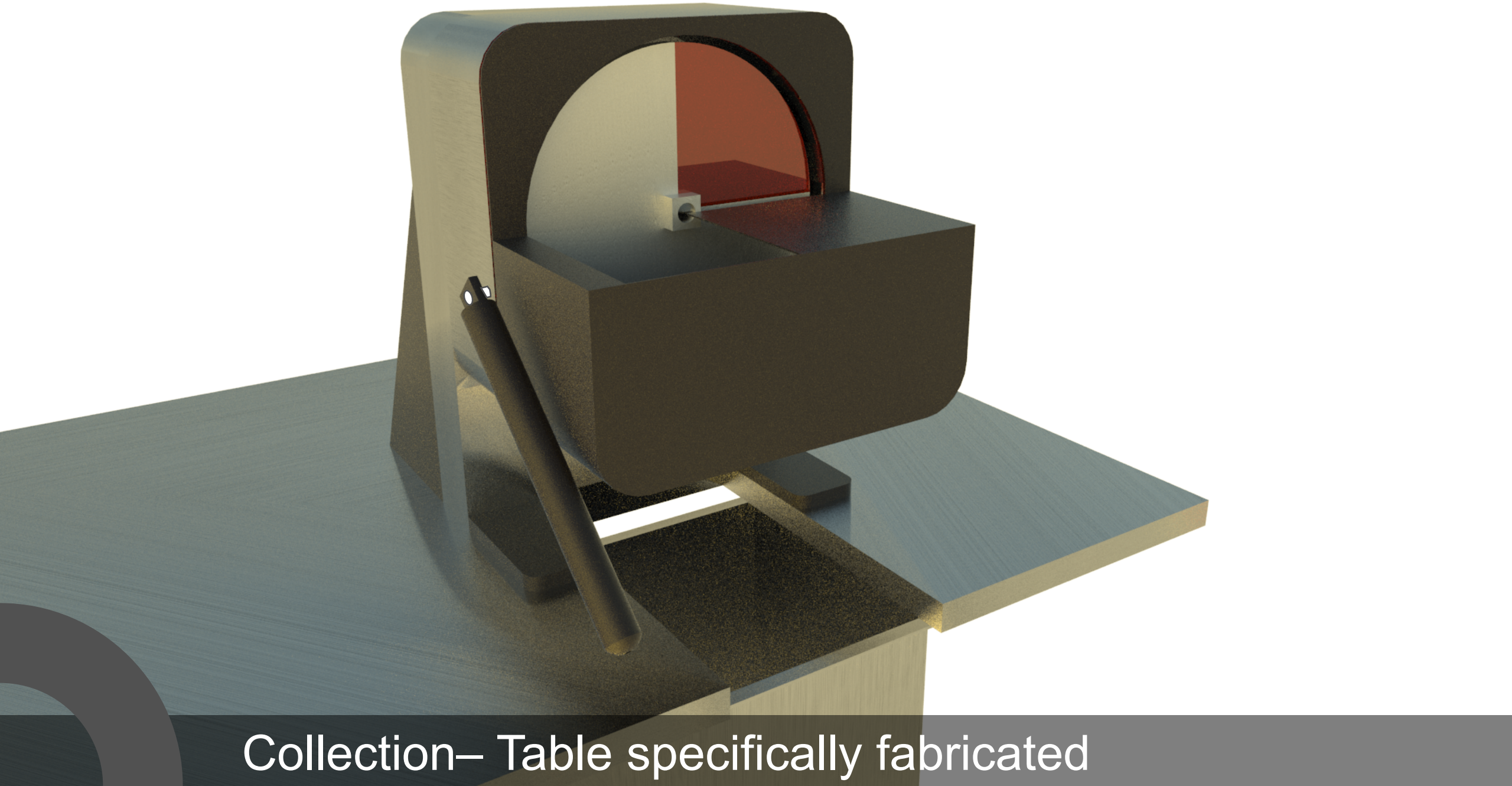
Blade design ideas - Modular



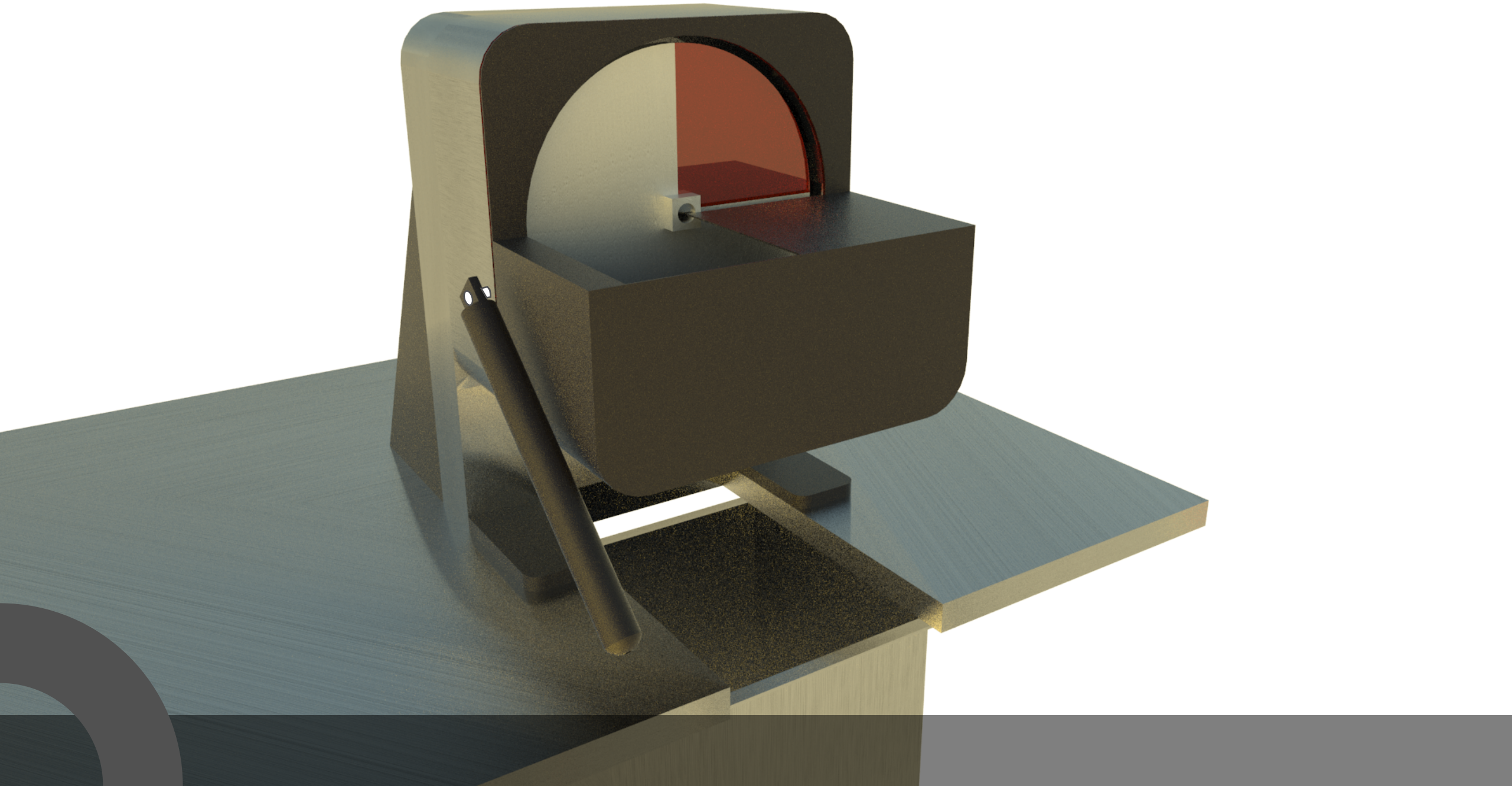
Changing Blades

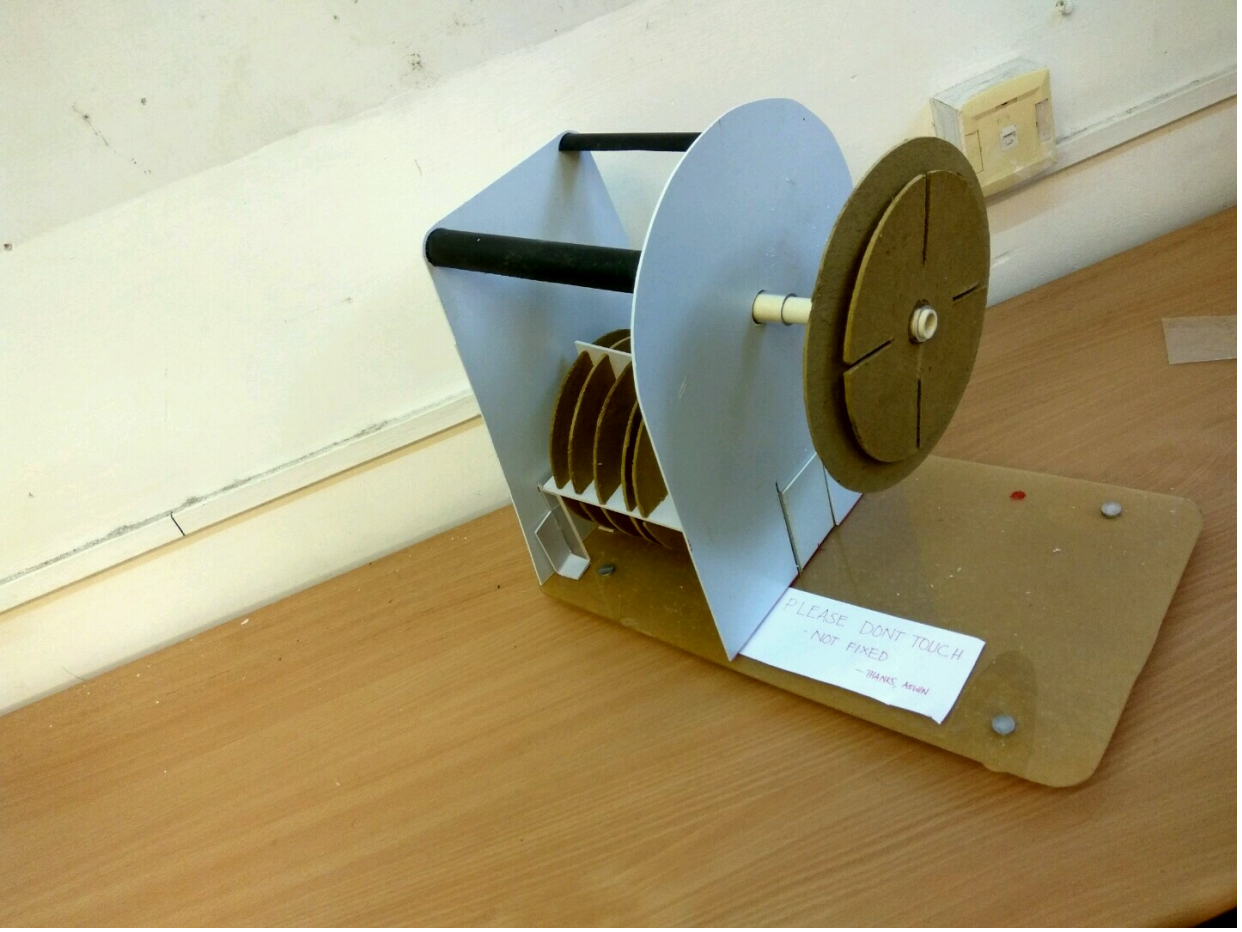


Collection –



Collection– Table specifically fabricated




PLEASE DONT TOUCH
- NOT FIXED
- THANKS, AARON

Manufacturer

Materials

Stabilise

Parts Required

User

Container?

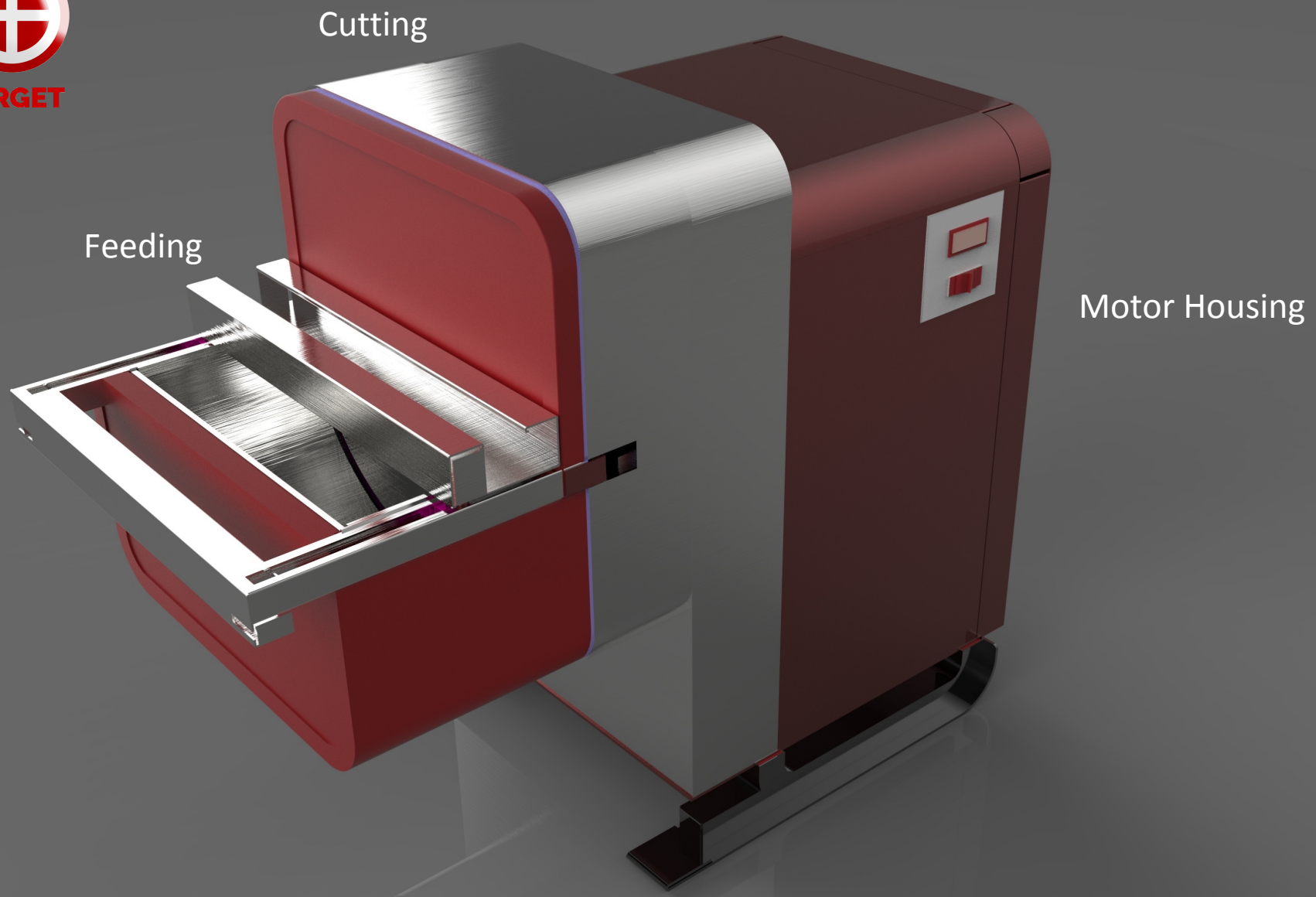
Separate Slender Feeding !

Final Concept

TARGET

Render

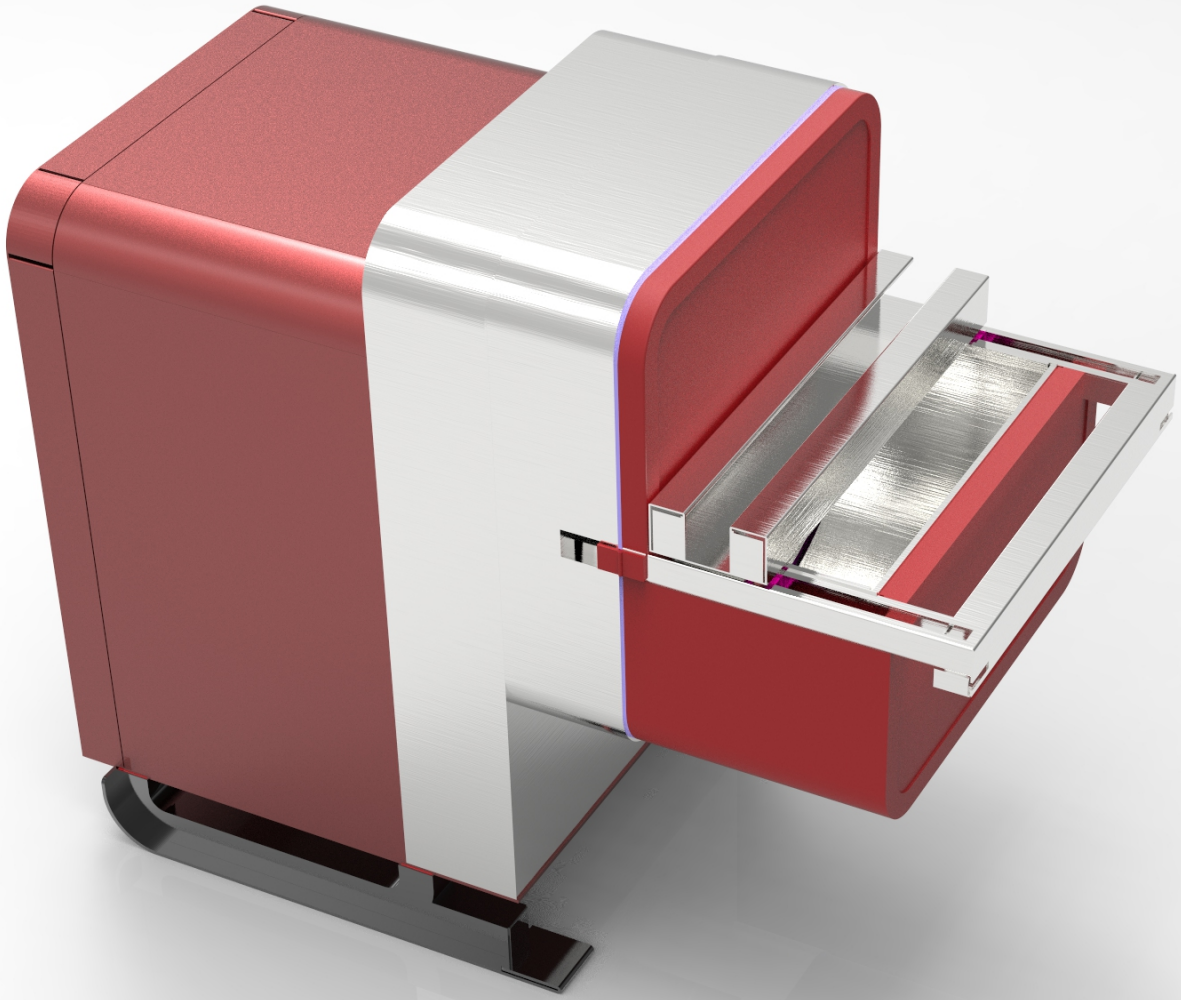
Normal Mode



TARGET

Render

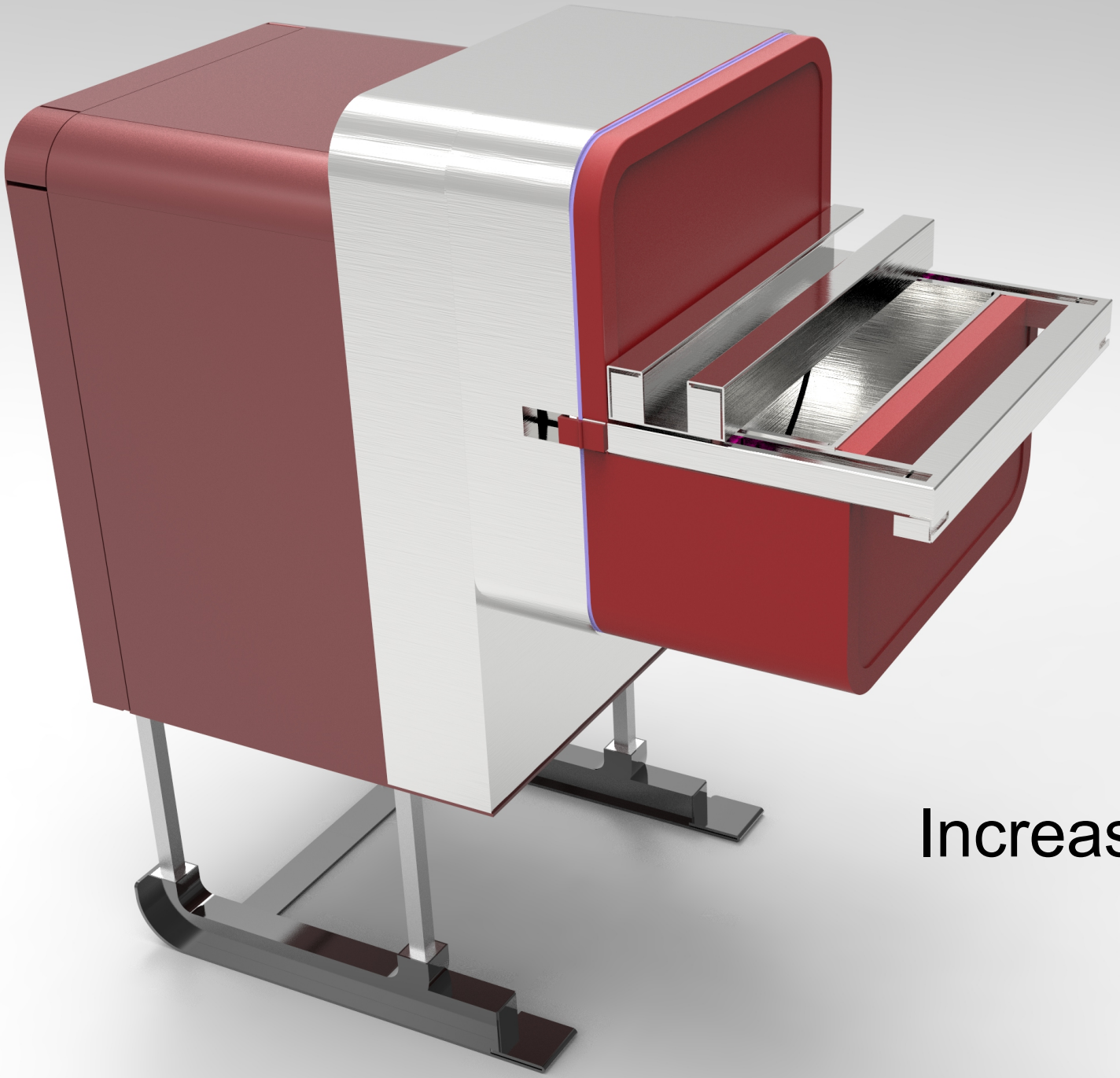
Normal Mode



TARGET

Render

Extended

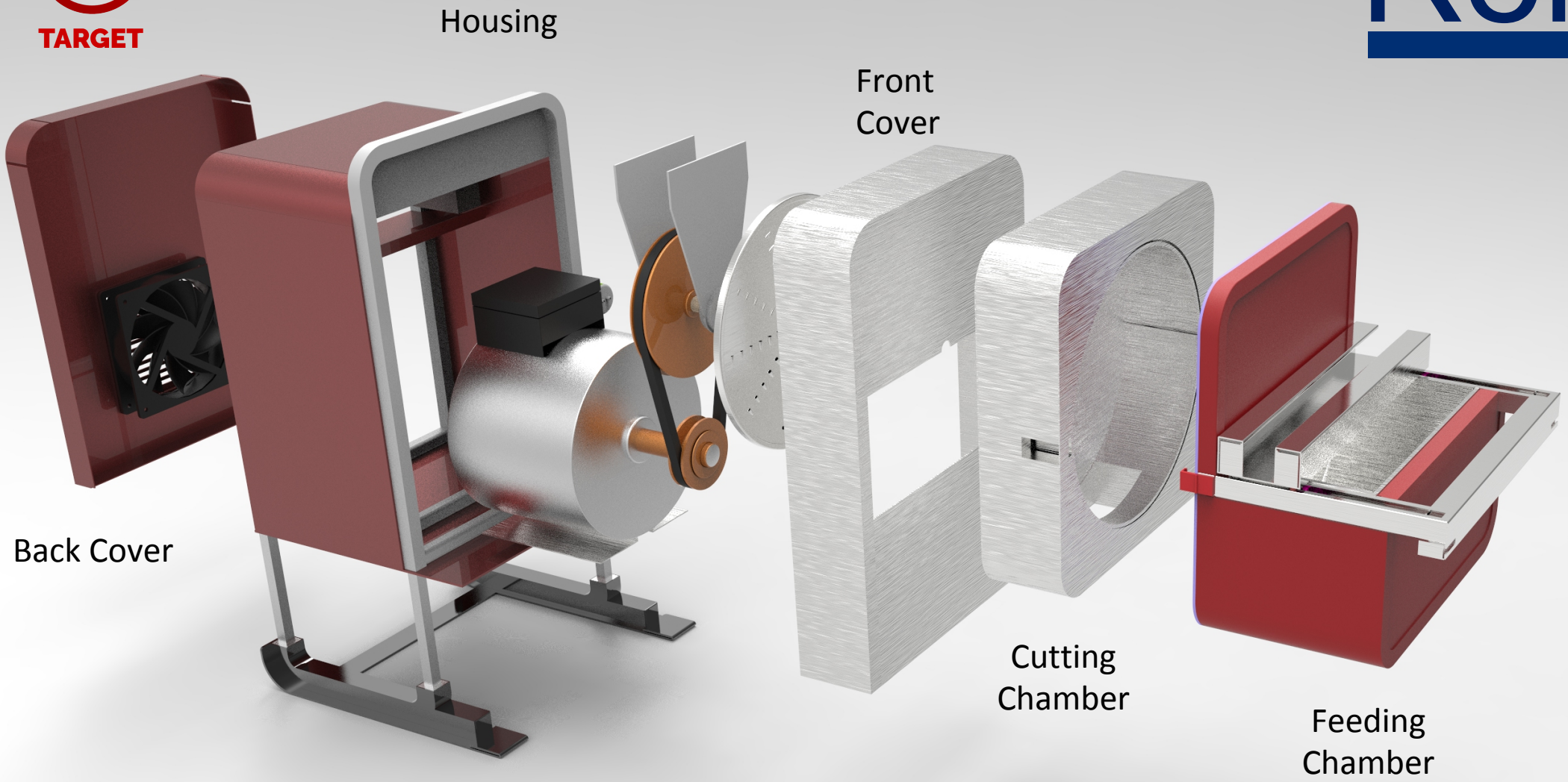


Increase Height

TARGET

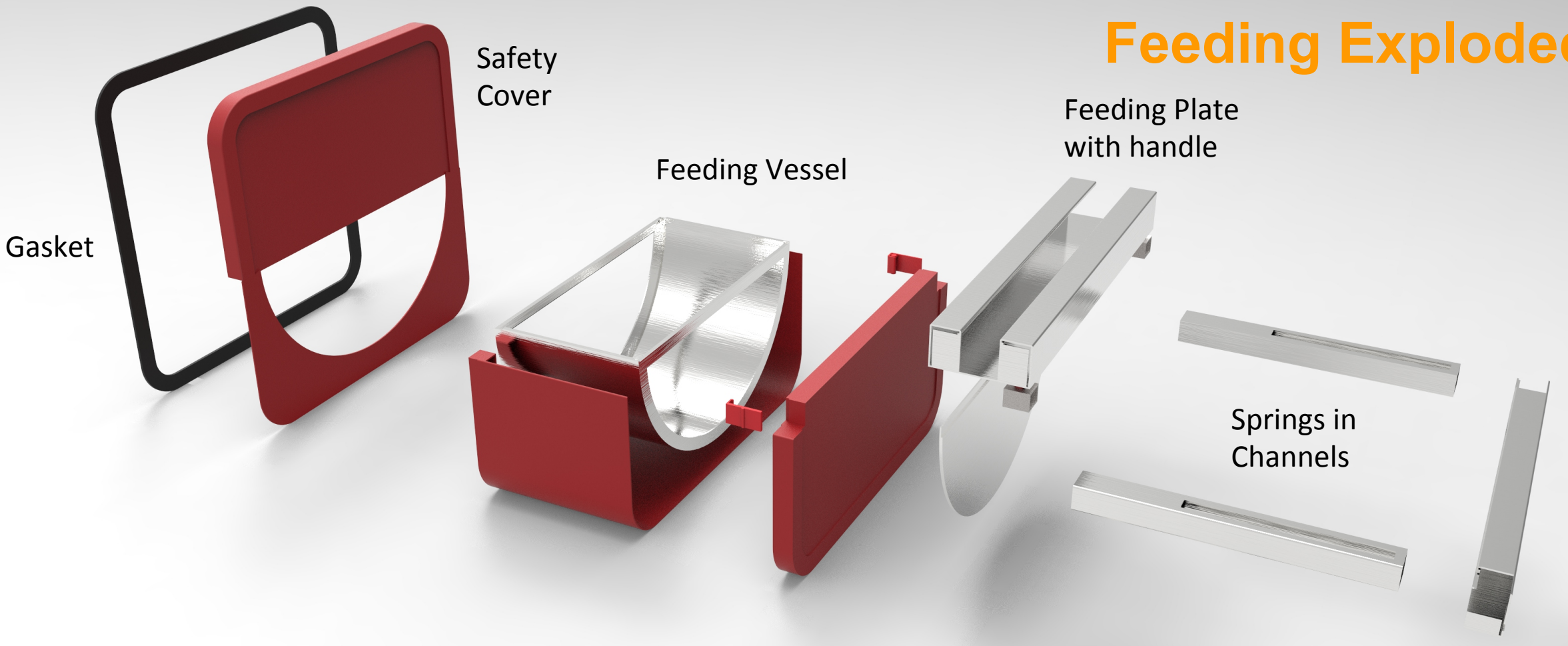
Render

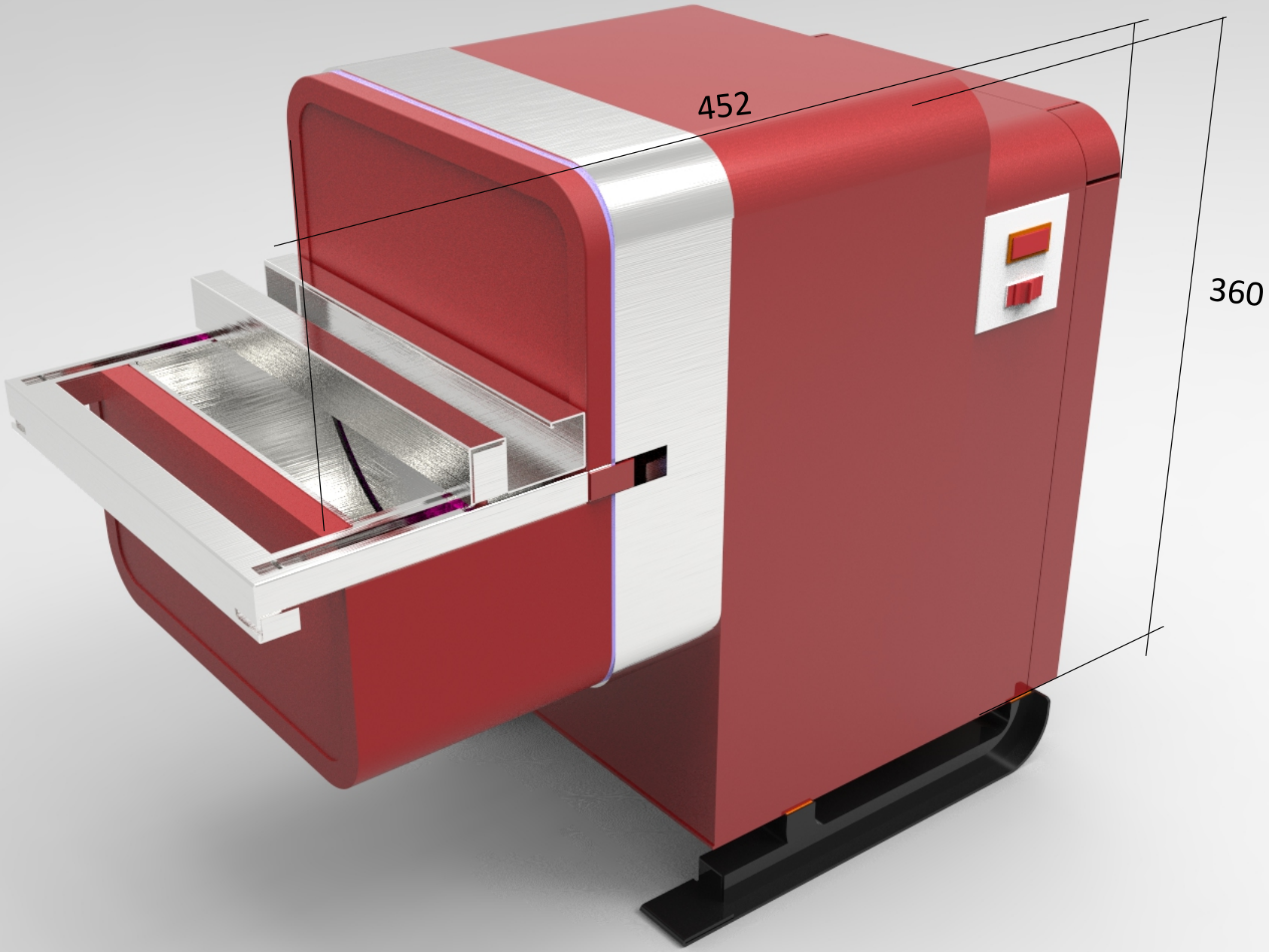
Exploded



Render

Feeding Exploded

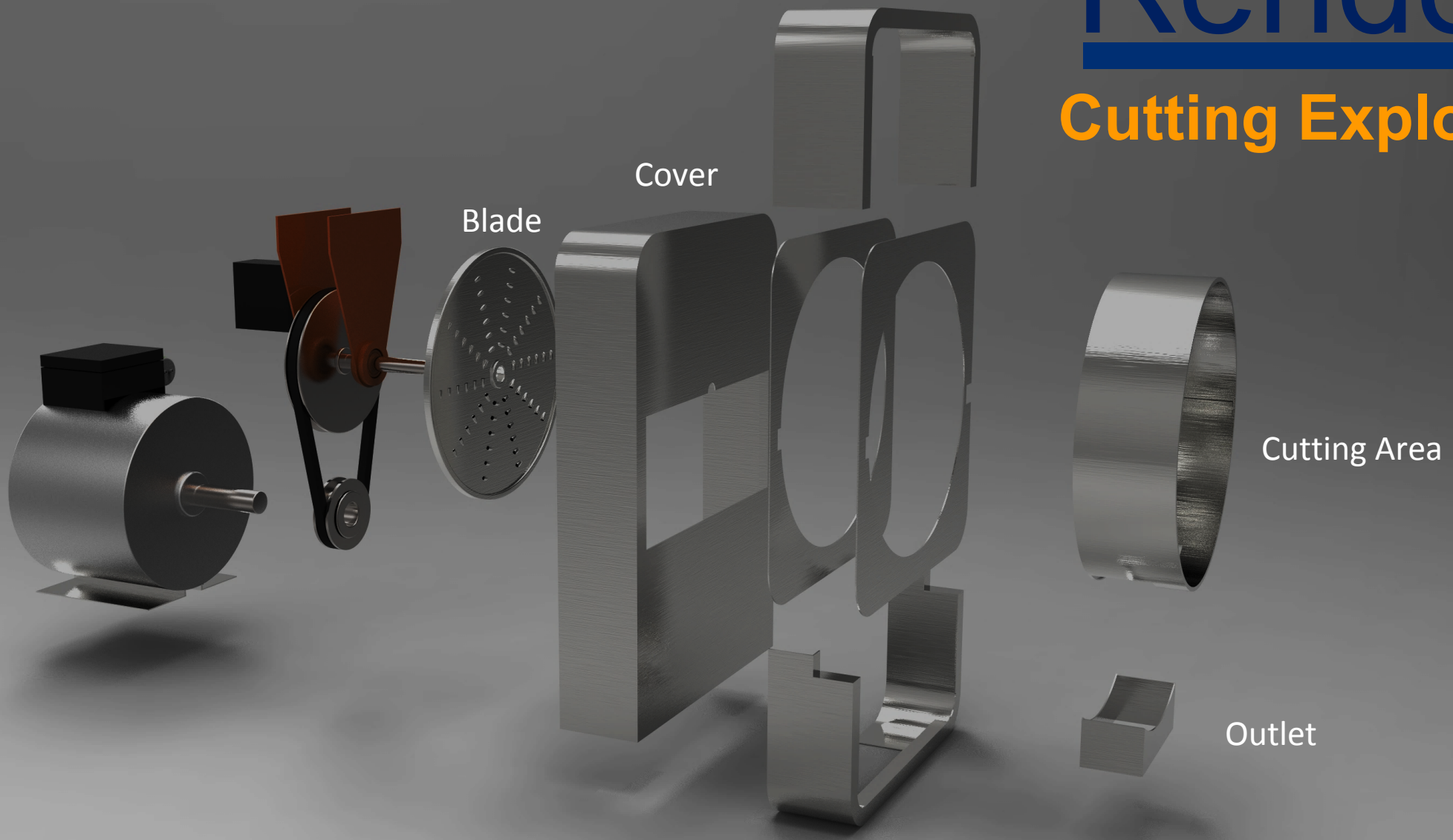


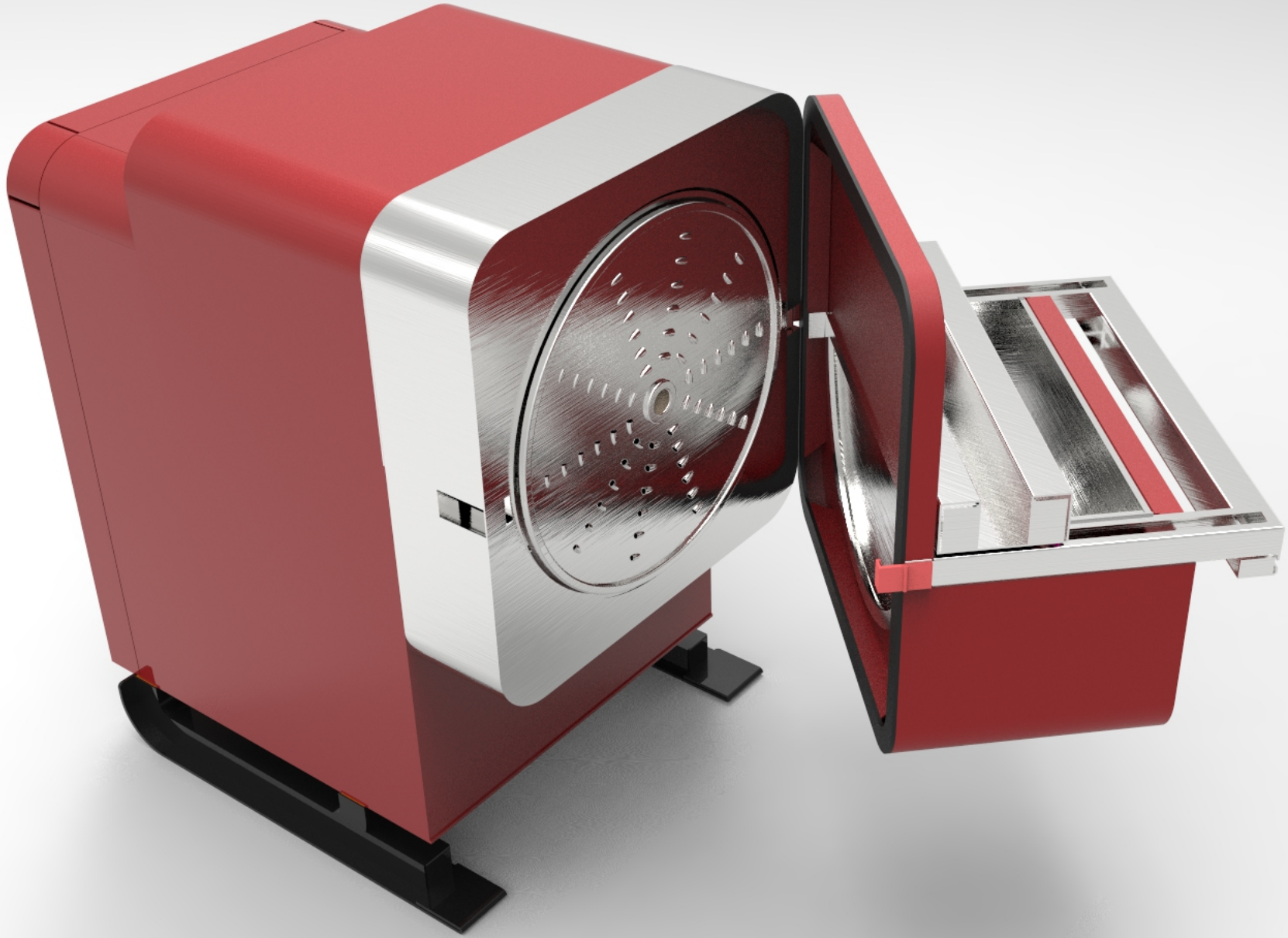

452
360

TARGET

Render

Cutting Exploded

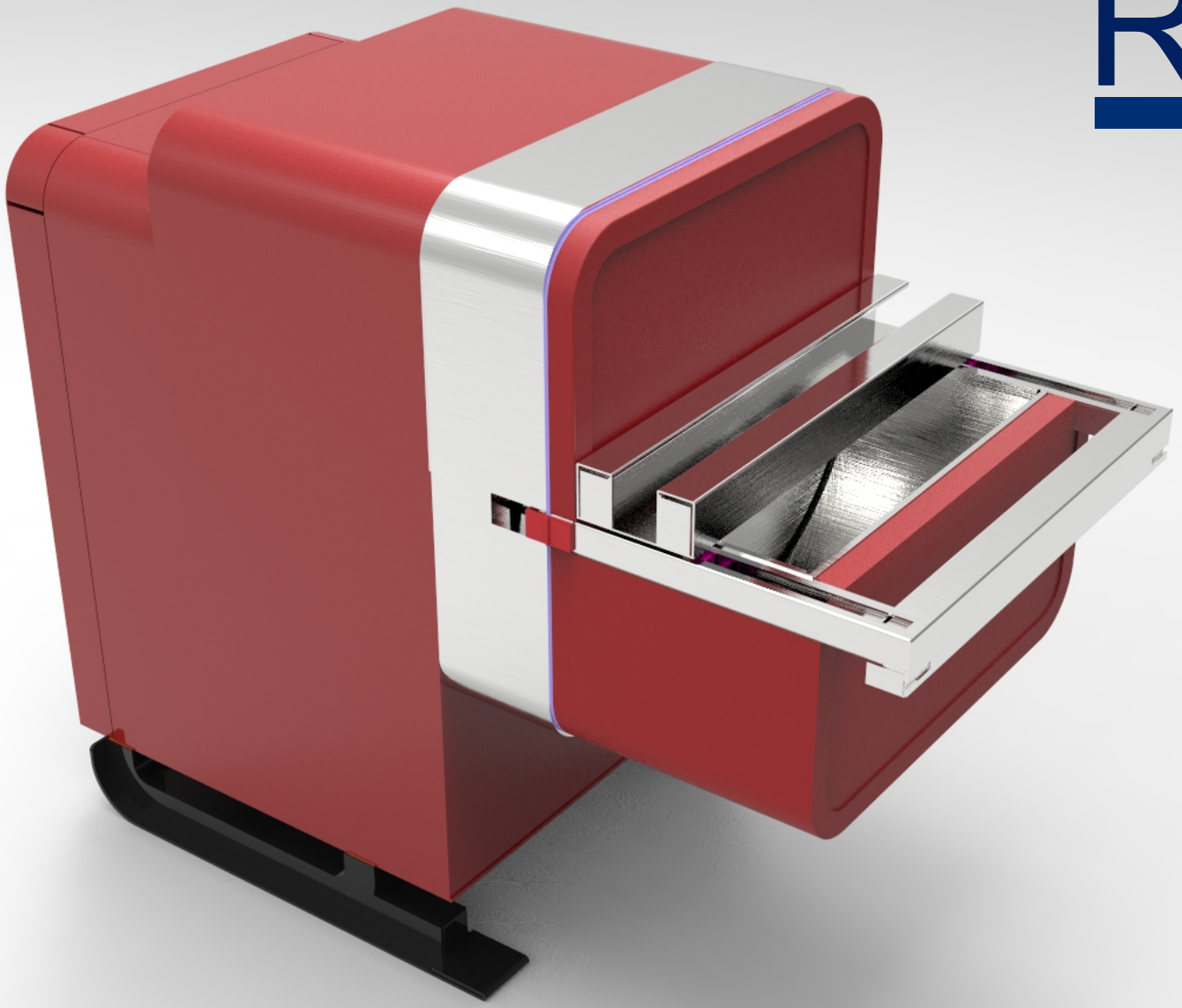




TARGET

Render

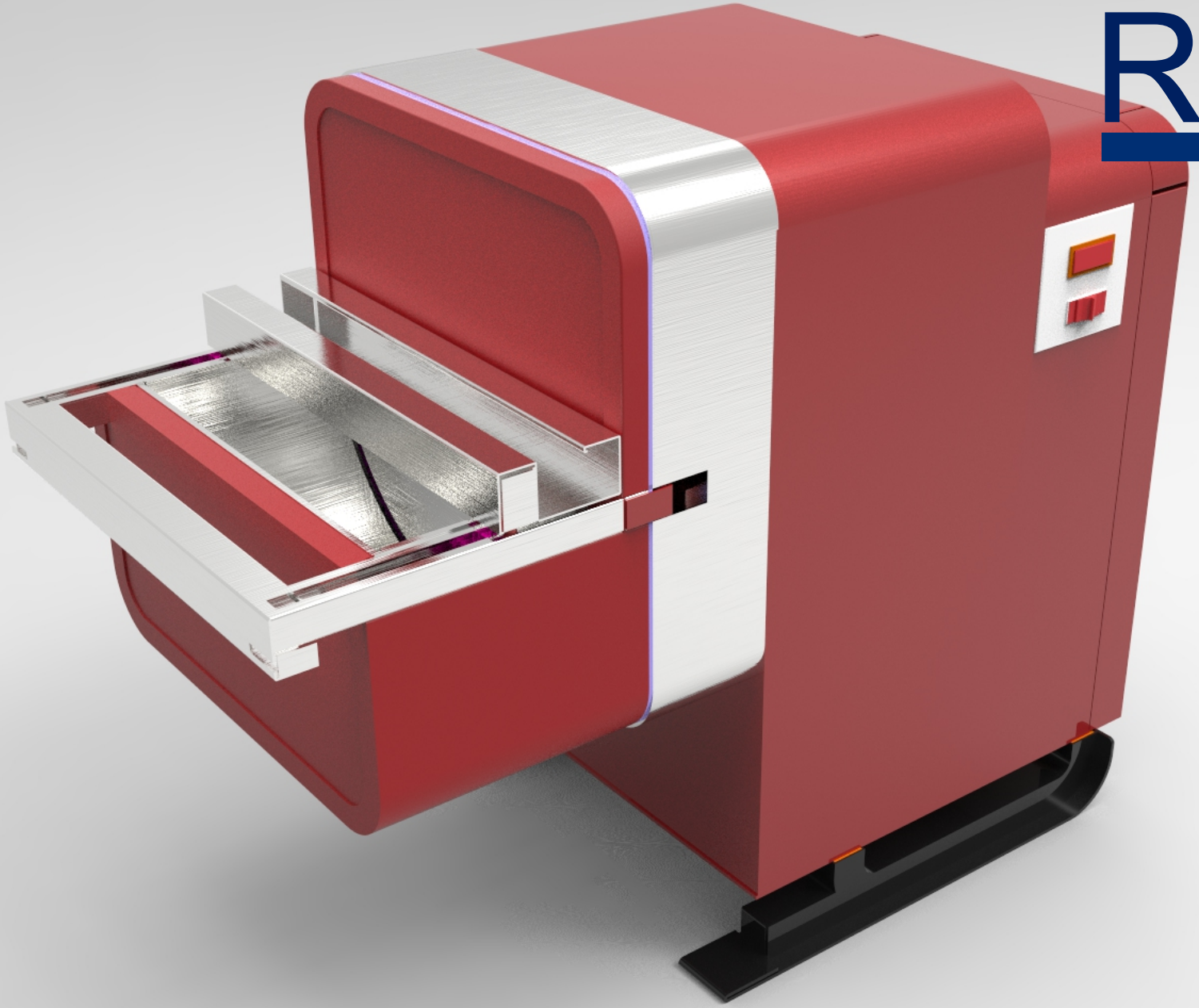
Refinement



TARGET

Render

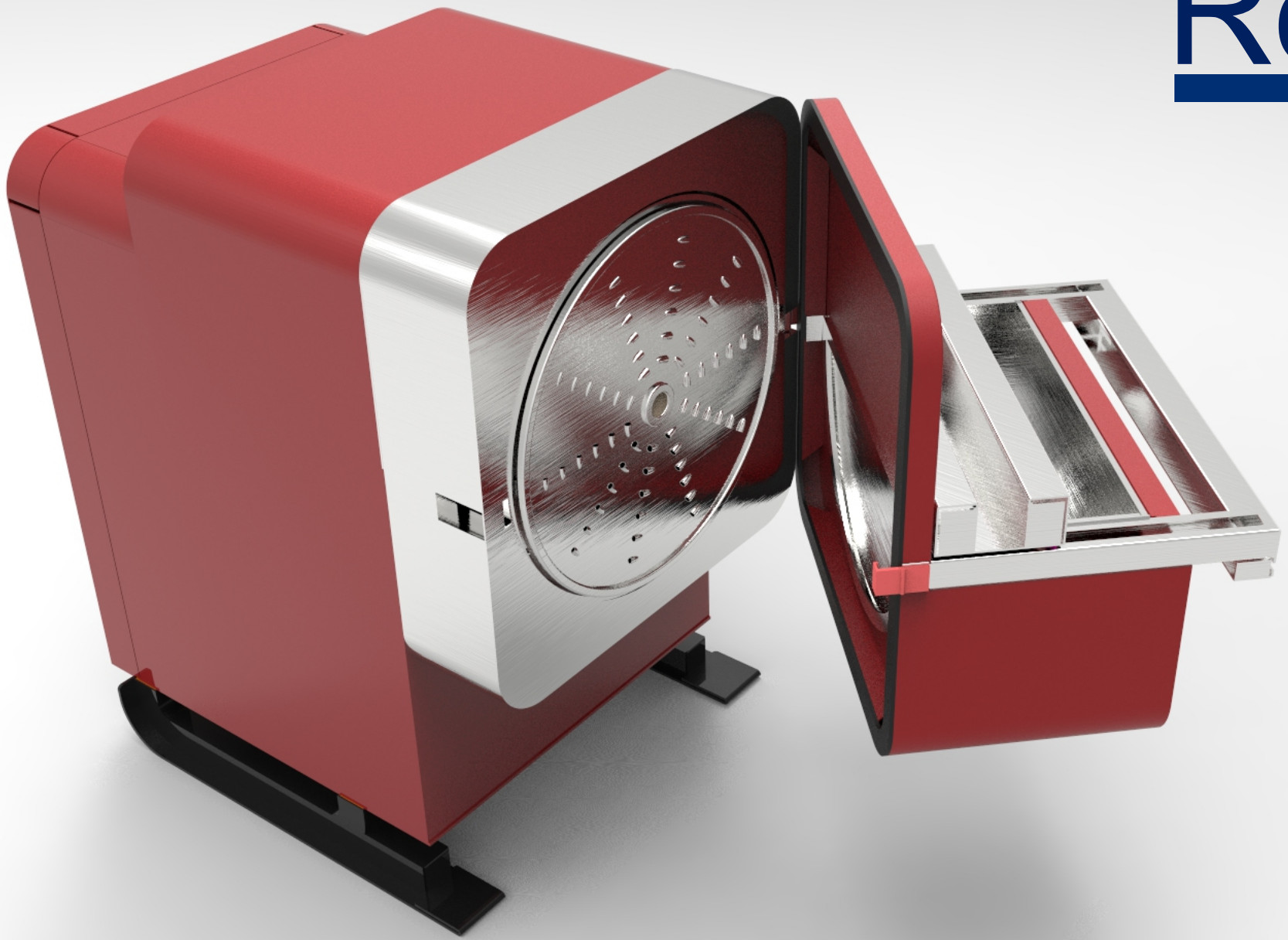
Refinement



TARGET

Render

Refinement



Thank you