REDESIGN OF COMMERCIAL VEGETABLE PROCESSOR

Industrial Design Project II

MPR-465

By

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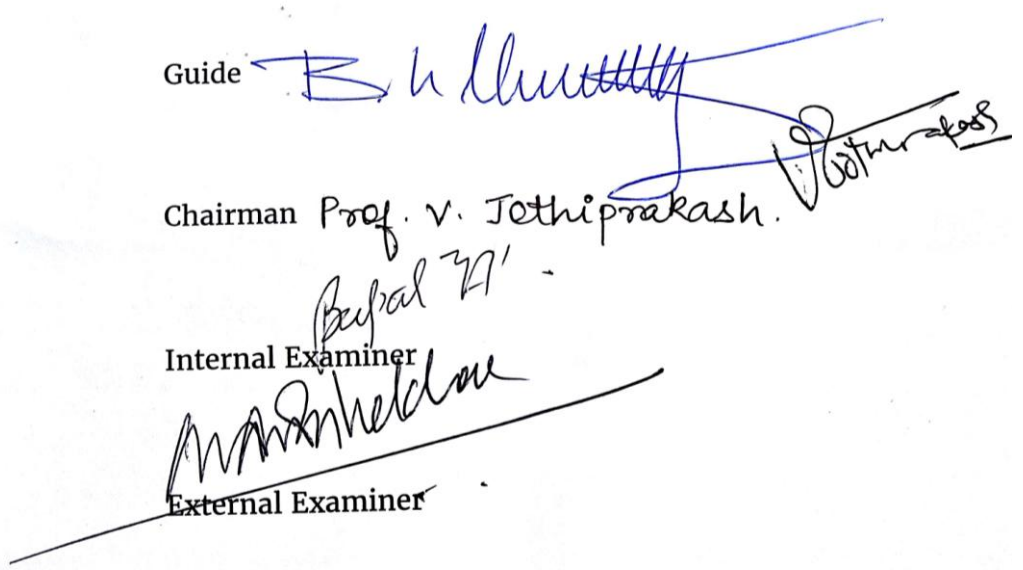
2017

Approval

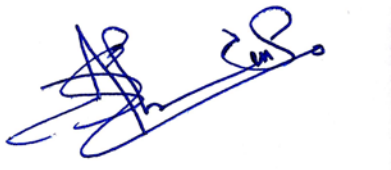
This project titled "Redesign of Commercial Vegetable Processor" is prepared and submitted by 'Aswin S' in partial fulfilment of the requirement for the degree of 'Masters in Design' in Industrial Design. It has been examined and is recommended for approval and acceptance.



Declaration

The work done as a part of the written submission under this report "Redesign of Commercial Vegetable Processor" is done as project two for post graduate program in Industrial Design Centre, IIT Bombay, India under the guidance of Prof. B. K. Chakravarthy.

I hereby declare all the content of this project is an original work with appropriate reference information or links provided wherever due. Any violation of the above will be cause for disciplinary action by the institute.



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Acknowledgement

I would like to thank Mr. Thomas of Thomson and Thomson manufacturers for helping me throughout on all aspects of the project. Special thanks to Mr. Cyril, for providing me valuable knowledge base to initiate the project.

I thank Prof. B K Chakravarthy who gave valuable guidance throughout the project. I thank Prof. Sreekumar, Head of the Department, IDC for allowing me to work on the project. I also thank Prof. Kumaresan, Course Coordinator, for the excellent workflow of the project.

A humble thanks to All Product Design faculty, Prof. B. K Chakravarty, Prof. V Bapat, Prof. G.G.Ray , Prof. R. Sandesh, and Prof. Kumaresan and Prof. U Athvankar for their guidance and feedback during the process.

Thanks to Mr. Ashok, for providing guidance on form development at the needed time. Thanks to staffs of Saikripa Catering, Gulmohar cafeteria, and staffs of Sree Sukh Sagar Hospital Services for helping with the user research and study.

Thanks to all staffs in Plastic, Wood and Paint studios for their help. Thanks to staffs in Shenoy Innovation Studio and Product Development Cell.

Thanks to Juwin and all other of PD 2015-17 class, who were a great support in the process. Thanks to my parents who have been a great mental support, who pushed me further at every milestone.

A million thanks to Noa for her passionate support in all activities of the project and for being there at the good and bad times of life.

Abstract

Vegetable processing in commercial kitchens is carried out with the help of machines with a wide range of processing functions and they require extreme durability along with higher productivity and performance. Most of the existing products in Indian market manufactured industrially are an imitation of their international counterparts and exhibits various design flaws. As an Industrial designer, the purpose of redesign is to introduce new and competing products to the current scenario, by optimising the existing design. The final concept addresses the usability, ergonomics and productivity issues considering a set of functional and manufacturing constraints.

Contents

Introduction

Food Preparation

Preparation of food starts with preparing vegetables in all types of cuisines. 'Culinary art' as it is termed, the art of cooking food is a vast field which involves skill and technology and varying scales of preparation of food for eating. As a primary need for us, it requires selection, measurement and combination of ingredients in an ordered procedure so as to achieve desired results.

Although the term food preparation brings the image of cooking in our mind, it's not just limited to cooking. As an art, it involves the chef- a person who cooks food professionally for other people, a person who is proficient in all aspects of food preparation. The act of cooking encompasses a vast range of methods, tools and combinations of ingredients to improve the flavour or digestibility of food. It generally requires the selection, measurement and combining of ingredients in an ordered procedure in an effort to achieve the desired result. There are many cooking practices and traditions associated with different culture, often named after the region or place where it originated since these are primarily influenced by the ingredients that are locally available or through trade over a long period of time and are termed as cuisines.

The process of food preparation has evolved by the development of technology. Moreover, as commercialisation of different sectors happened, the food preparation industry is a huge market which besides the raw materials, includes complex machinery and tools to easily produce food in large quantities.

The process of food preparation includes different chemical techniques and mechanical techniques besides the common techniques like baking, grilling, frying, microwaving, roasting etc. The chemical techniques are mostly secondary which are done after the mechanical techniques. A lot of machines are in the market for all these techniques whether it is to cater the need of a home or for food preparing factory.

The various mechanical techniques include Basting, Cutting, Kneading, Milling, Mixing, Vacuum filling etc. Out of this, cutting is a very common procedure which is subdivided into sub categories.

Commercial Kitchens

Figure 1: A typical commercial kitchen

Commercial kitchens can be described as cooking spaces which are designed to prepare food for selling purposes. However, a wide range of cooking areas in schools, prisons, and nursing homes, colleges, canteens are also referred as commercial kitchens. The basics of all these kitchens remain the same, which is bulk preparation of food. Customisation of kitchen is done according to the requirement of the institute. These kitchens usually have cooking stations and equipment that would be needed to operate the stations. Depending on the cuisine of the restaurant and preparation techniques of the head chef, these are designed. The physical space available is taken into consideration when various equipment and appliances are being chosen for the kitchen. These are usually bigger than the normal residential kitchen and adhere to rules and regulations. The cuisine being served in the restaurant would determine the total number of food preparation and cooking stations. The stations would include baking, grilling, sautéing, and catering areas, etc. The stations are developed to fulfil its purpose and therefore all the equipment, serving dishes and everything on offer would cater to these requirements. These kitchens are easily identified by the big equipment that are devised to handle huge amount of food. They are comparatively durable for the mass food production and adhere to the industrial safety practices.

When it comes to commercial food preparation there are specific products which does mechanical cutting or products that combine the cutting mechanism with other similar food preparation processes. There are a wide variety of food processing appliances used in commercial kitchens based on the cuisines they deal with and also the quantity.

Commercial Food Processors

Preparation of ingredients for the recipes is one of the most time-consuming processes in a commercial kitchen.

Productivity using human labour decreases over time when it comes to process like cutting vegetables because of the monotonous nature of the job. Hence, food processors are used in commercial kitchen to reduce the work load on chefs.

Figure 2: Robot Coupe Commercial Food Processor

As mentioned earlier, unlike home food processors, an ideal commercial food processor is designed for durability to withstand the conditions of mass food preparation. At present, there are wide ranges of processing machines with a wide scope of processing abilities in the market. Most of these are based on the same mechanism of processing similar to the home mixer grinders, but with increased performance and productivity.

Manufacturers, according to their ability and expertise in the field have been developing products for processing ingredients. Thus, Vegetable processors in the market belong to two basic categories; one that comes specifically for vegetable processing, and the one which is part of a food processor in which, a modular approach helps in converting the food processor into a vegetable processor.

This project deals with redesign of vegetable processors which is used in commercial kitchens.

Background Study

Figure 3: Vegetable Cutting at a canteen

An initial discussion was done with few catering team and restaurants and canteens inside IIT campus to understand the usage of vegetable procesor and the possible target users. It was understood that not all the restaurants and canteens use vegetable processors. Only specific restaurants which were doing catering business in a large scale along with the restaurant business housed a commercial machine

There are several reasons for this. The main factor being the cost of the machine. Small catering teams were not able to afford such a machine either because of the cost or because labour was cheaper than the machine. The machine also worked on power which is not predictable at the site of catering. Also the cuts from the machine are not suitable for all cusines. Basically the machine is ideal for the preparation of North Indian dishes.

On discussion with the manager of Sree Sukh Sagar Catering services, it was understood that these machines are also used for catering services when they provide on site catering to customers.

Existing Vegetable processors

Commercial Vegetable Processors are motor based appliances which can perform the functions of cutting vegetables in a variety of ways with the help of blades.

On a discussion with the Chief Chef of Saikripa Catering which managed the Gulmohar restaurant in IIT campus, it was understood that the machine is not useful even for large restaurants since the amount of vegetables cut is less compared to commercial kitchens. According to him, these machines are used in restaurants mostly abroad. In india, labour is cheap and hence people are used for this intensive task even for catering or weddings. “ We have trained our people to do vegetable cutting efficiently than these cutting machines.”

Now, since it was clear that the target customer is large institutions with commercial kitchens, a discussion was done with a dealer to understand the market and the manufacture.

Study of existing machines in IIT hostels were done. Hostel 15 with a capacity of 1100 occupants uses a single Vegetable processor. There was a pair of 2 older machines which had degraded in performance over time. The specification of these two machines are shown in the table below. These are the two basic models still available in Local market.

These two machines were studied to understand the basic parts and working environment of the machine. To have a deeper understand on how the market works a discussion was done with the dealer who supplied the products to IIT hostels. Both the models were supplied to hostels by the same dealer over a period of two years. One of the machines were said to be manufactured in Coimbatore.

When another dealer was approached, he refused on grounds of disclosure of the mechanism and detail of the parts of the machine. It was undersood that all the products in the market uses the similiar dye for the blades as well as for the aluminium casting. The products vary very little in their form.

Figure 4: a-Model 1, b- Model 2;

Another product belonging to the same category is the potato peeling machine. This was also provided by the same dealer. It has a stainless steel build with minimal interventions done other than to its function.

Figure 5: a, b – Potato Peeler in Hostel 15 Mess, IIT Bombay

Market

Figure 6: a – Model 1, b – Model 2

Specification of existing Products		
	Model 1	Model 2
Power	.5 hp	.75 hp
Material	Stainless Steel	Aluminum and Stainless steel
Cost	Rs 30000	Rs 45000

Table 1

Target Customers

The major customers of this product are 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.

End User

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

Environment

These machines are used in commercial kitchens of restaurants or catering company or institutions which cater large quantity of food preparation on a daily basis.

Relevance

The primary objective of the course is to work on a redesign project with or without intervening in the technology used. The idea of design for food preparation has been the primary reason for choosing the topic. The topic was relooked on the basis of understanding fundamental technologies and manufacturing processes in design and to coordinate with the different people in the manufacturing chain.

Though the initial topic chosen was redesign of vegetable processor, a new perspective of designing for a new manufacturer was brought in to give constraints to the project. This was on the understanding that all the products for vegetable processing in the local market were a mere mimic of the international products and followed the same fabricated form without innovation.

A new manufacturer who was into the development of motor based products was identified along with the process of understanding the technology used in the product. As an Industrial designer, this purpose of redesign is to bring new and competing products to the Indian market, by helping small industries in the area of 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.

Scope

Design of table top commercial vegetable processors which work on electric power alone is considered for design. The design is strictly limited to commercial vegetable processors of small power capacities and not the ones designed to cater industrial food preparation.

Limitations

Manufacturing and making of a working prototype will require high cost since the process will be either fabrication in steel or casting in aluminium.

Research

Operation and Mechanism

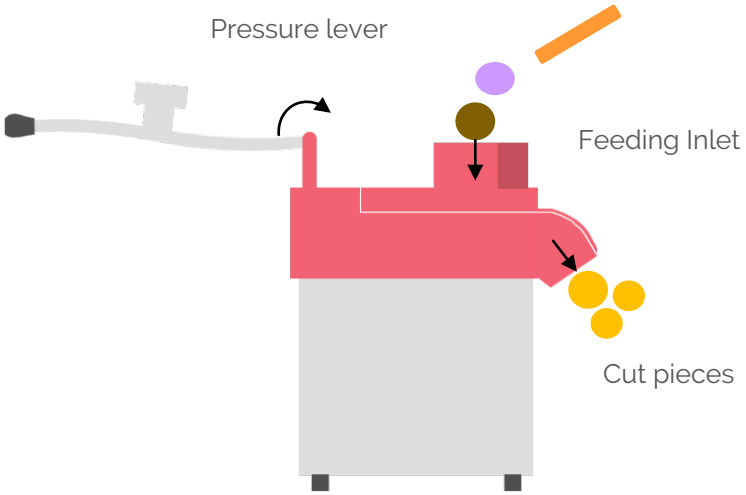


Figure 7: Illustration showing the process of cutting in existing vegetable cutter

Figure 8: Existing product in Hostel 15, IIT Bombay

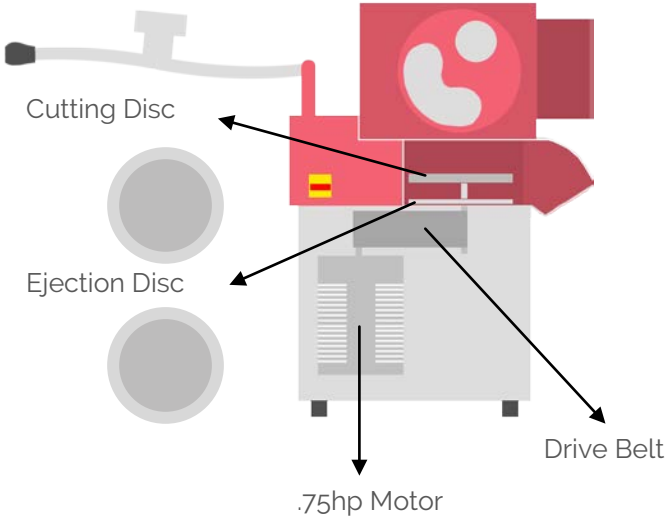


Figure 9: Illustration showing the internal configuration of the existing product

The vegetable processor works with the help of an induction motor. The existing machine used a power of .75 hp. The motor is connected to a belt drive which transmit the torque to the cutting blades. The driven pulley is relatively of larger diameter to reduce the speed of rotation. The pulley is attached to the shaft to which the cutting blade is loaded. The vegetables are fed from the top through a small hopper which is forced into the cutting chamber using a feeding lever. This is done manually.

Operating Environment

Figure 10: Vegetable cutter and table in Hostel 14, IIT Bombay

Figure 11: Vegetable Cutter – lid opened

Figure 12: Vegetable cutter in the Service Area of Hostel 12, IIT Bombay

The tables though designed for the machines, does not tend to satisfy all the needs. Usability of the product is difficult since it is difficult to reach the handle of the product from around the table. So, the user is forced to use the machine from the side. The uncut vegetables are placed in crates after peeling. The cut vegetables are collected in the vessel. There is no adequate space for keeping the vessels since there is no standard sizes of these vessels.

Cutting Disks

The blades of the product vary with respect to the capacity of the product. This product uses 8” (200mm) cutting disks for getting the different type of cuts.

Figure 13: a, b – Demonstration of existing products in Hostel 15, IIT Bombay

A basic set of blades come along with the product which includes, one for slicing, one each for slicing and dicing, one for julienning, one for grating and one for French fries. These are stored in a tray provided along with the product.

Figure 14: Types of Cutting Disks, from top – Slicing, Dicing, Chopping, Grating, ejecting plate

Process

Before cutting, the peeling of vegetables is mostly done by hand except potatoes for which peeling machines are used. These peeled vegetables are then taken in vessels depending on the quantity and taken to the cutting area. The vegetables are then fed into machine through the feeder continuously and pushed by the lever. The cut vegetables get ejected out of the cutting chamber and get collected in the vessel kept in front of the machine. The Feeding part incorporates the lid of the machine which opens to help in changing blades and cleaning the cutting chamber.

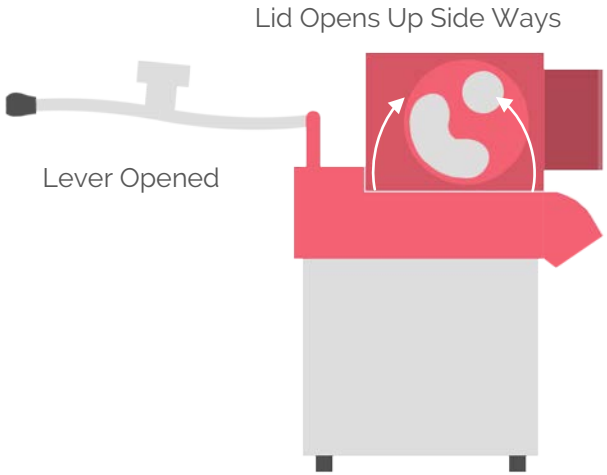


Figure 15: Illustration showing how the lid is opened to change disk and to clean

Figure 16: Cast Aluminium Lid of the Vegetable processor showing the inbuilt hopper

Figure 17: View of the lid from top showing the feeding hopper of two sizes

The lid has two feeding areas, the larger area for bulk feeding and the smaller one for smaller quantity and to assist feeding slender vegetables vertically, like Cucumber, Carrot, etc.

Product Variants

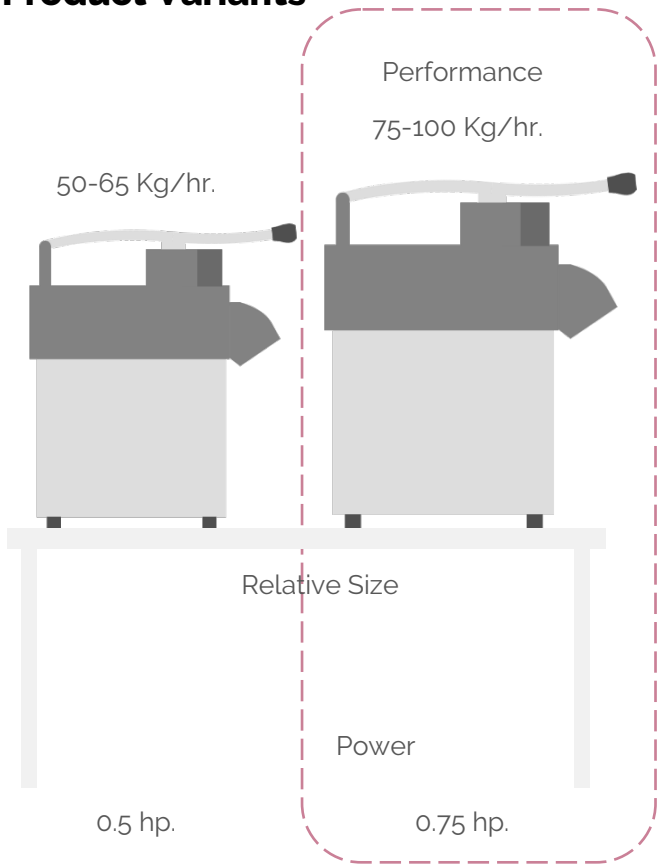


Figure 18: Illustration showing the varying capacities of products of the processor

One of the basic difference between a food processor and a vegetable processor is that the former one has a container for processing food with a specific capacity, whereas the latter one has a cutting chamber, and hence the performance is measured by the rate of cutting, rather than the volume.

Materials used

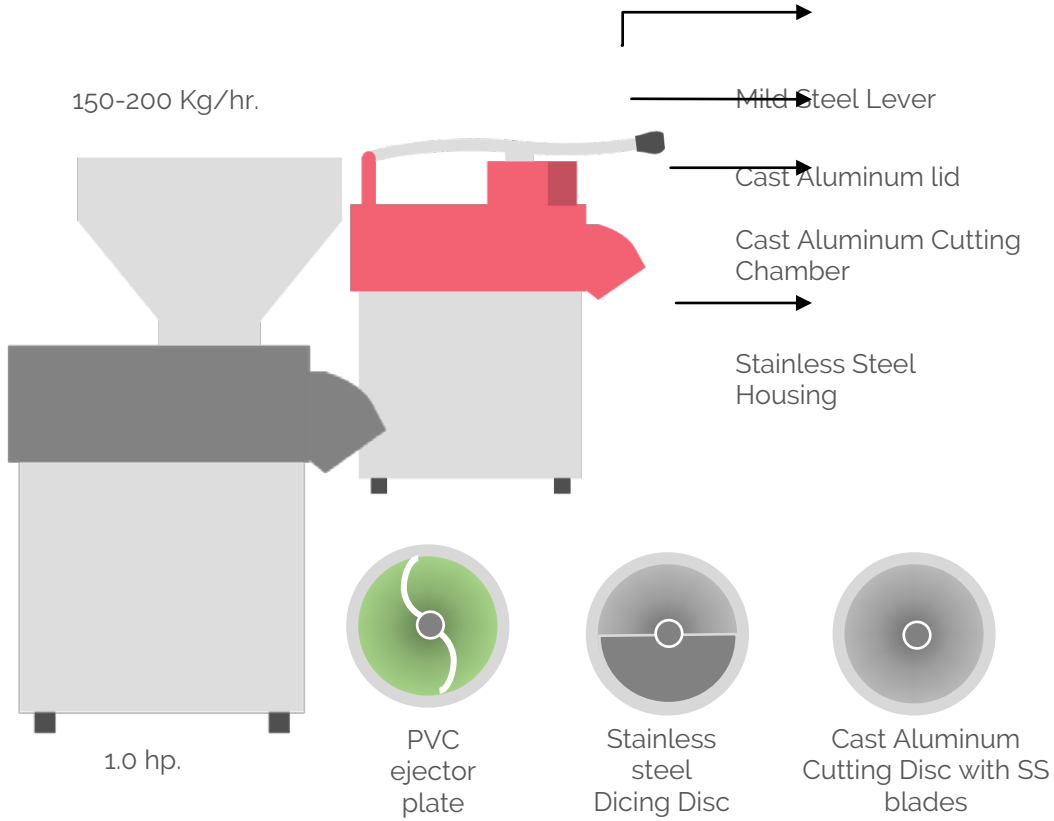


Figure 19: Illustration showing the materials used in the product

Other materials used in the product are Teflon gaskets for water proofing, Brass oil seals. The shaft is made of stainless steel. The internals parts are made according to the manufacturer. Rubber bushes are used in the bottom plate to prevent vibration and to provide grip.

Technology Input

Motor

Type of motor to be used depends on the application of the product. Cutting and grinding machines require high starting torque for the process:

Single phase Vs Three phase – Single phase motors are not self-starting, so they are used with capacitor start or running capacitor Induction Motors. Three phase motors are self-starting motors but they have higher cost.

AC Induction Motor Vs Stepper Motor – Universal Stepper motors are used where control of Speed is required. This is required in case of food processors. In case of vegetable cutters, a single speed motor is required.

Direction of rotation - The direction of rotation can be reversed by interchanging any two of the three conductors connected to the starter switch or motor. This property could be used to redesign the processor.

Speed of rotation - 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:

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

2 poles – 3000 rpm

4 poles – 1440 rpm

6 poles – 960 rpm

- 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.

- The amount of torque loading on the motor.

Takeaway:

The type of motor to be used for the product is identified, although the motor will be provided by the manufacturer (shown below). The motor is 165mm in diameter having a length of 130mm. The shaft size is 75mm. The size of the pulleys is to be calculated from the required speed of rotation of blades for cutting.

Manufacturing Constraints:

Figure 20: Sample motor shown by the manufacturer, 0.25 hp. AC induction motor

Figure 21: Sample motor shown for dimensional purposes, 0.5 hp. AC induction motor

Figure 22: 0.5 hp. AC induction motor

Figure 23: A motor based hand drying machine being assembled by the manufacturer

Material Comparison

	Which material?			Where?
Weight	Aluminium	1/3 rd of	Steel	Parts and body
Corrosion resitence	Aluminium	<	Steel	Exposed parts
Fatigue strength	Aluminium alloys	<	Steel	Cutting, moving parts
Welding	Aluminium	Not good as	Steel	Manufacturing
Hardness	Aluminium	<	Steel	Abrasion, scratch
Cost	Raw aluminium	Varies	Raw steel	Alloy steel< aluminium alloy (42%)< stainless steel
Machining	Aluminium alloys	Faster	Steel	Alloy steel< sluminium alloy (42%)< stainless steel

Table 2: Comparison of Stainless Steel and Aluminium Alloys

Takeaway:

Food grade Aluminium alloys or Food Grade Stainless steels (304, 316) should be used for the manufacturing of the body of the product or wherever vegetables come in contact appropriately. This is to avoid poisoning. According to this constraint, parts like feeding chamber, feeding plates, cutting chamber, cutting blades, shaft etc. should be designed in SS.

The housing of motor can be fabricated in mild steel. But it is recommended to use stainless steel to prevent rust in future. Use of plastic should be avoided in main body parts to avoid vibration. Mechanism if any, can be done in steel or aluminium as per situation requirement.

Problem Identification

Figure 24: Images representing the issues identifies in the existing product

- 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

An initial study of the product and environment was done as a part of the research process which shows that's few areas in the existing design has to be redesigned.

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.

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 Methodology

A methodology was developed to study, analyse the situation and then design in a systematic manner. This was initiated by studying the existing product in detail. Then it was required to know what all were the requirements to design a new product. Study of existing products help to understand the different functions required in the product. This will help to develop the functional structure for the new product.

It is required to know the different manufacturing constraints since that will influence the use of current tools and technology in the product. A visit to a small Industry unit was done to understand what are the different products made in the factory and assembly area. Dimensions of the components will be obtained from the manufacturer.

Functional structure is developed based on the basic functions of the product. It will help in developing the different organisations possible for the product. A design basis with hierarchy will help to analyse organisations and choose the ideal configuration or design direction.

Input from technology study will help in assembling the parts and obtaining the remaining dimensions of parts. It will also help in developing new ideas in mechanisms.

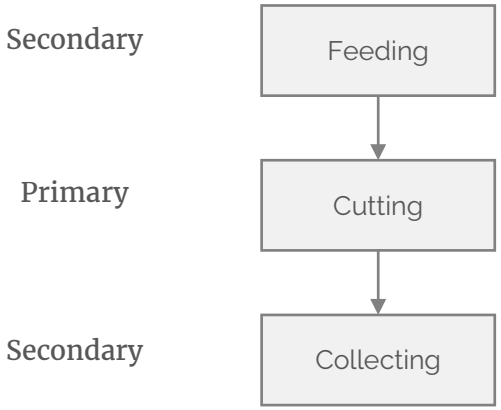
Synchronic study is done to study the similar products in market and explore their features. This will help in understanding variants in products in the market. It will also help to decide some criteria required to proceed the project. Ideation is done based on brainstorming and decided configuration which will help to develop concepts.

Design

Understanding Basic Functions:

Basic functions of the product are identified by studying existing product, its parts and functions. An overall idea about the mechanism has to be generated along with it.

Functional structure is made based on the existing function of the product. Other sub functions associated with the product are listed down and are linked with these functions. These functions are identified based on how user interacts with the product and thus



Design Basis

The primary design direction for the design process is termed as design basis. Certain criteria for developing the product are identified based on the basic problems associated with the products.

1. Durability, Choice of material
2. Novel Concept and Ease of Manufacturing
3. Ergonomic Consideration
    a. Ease of operation
    b. Less Maintenance
    c. Less Effort
4. Environment of Use
5. Affordability

Hierarchy

Performance of the machine is given primary importance. During design, better productivity and usability is given the next level of importance. Then comes ergonomic issues. After this, the maintenance and hygiene issues are to be given preference. Then the micro environment issues should be taken care of.

Function Structure

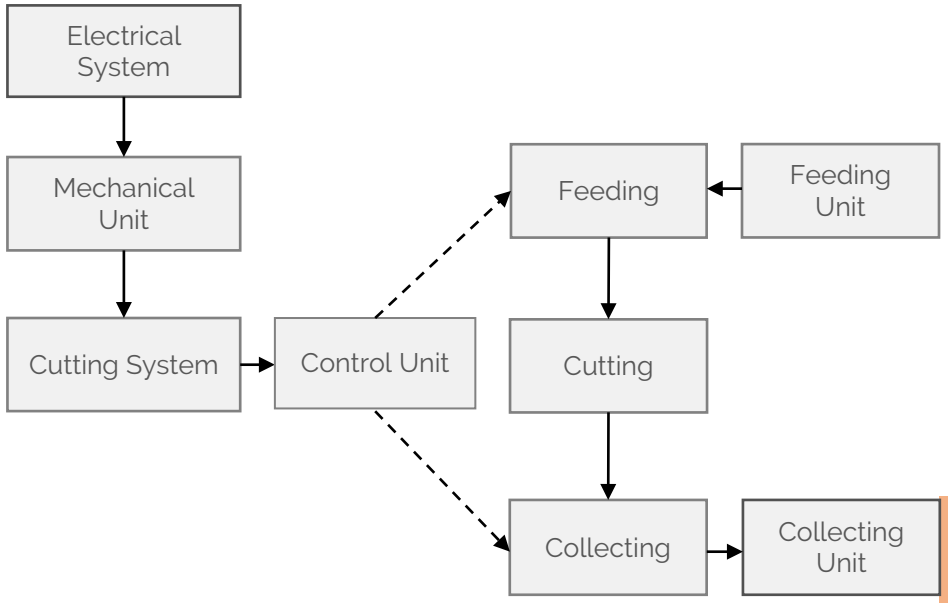


Figure 25: Functional Structure

Feeding, Cutting and Collecting are identified as primary and secondary functions. Hence, Feeding Unit, Collecting Unit and a cutting system forms the functional core of the product. Control Unit, Electrical and Mechanical unit form the Technical core of the product. Changing blade, Cleaning are identified as associated functions which are related to the core functions of the product.

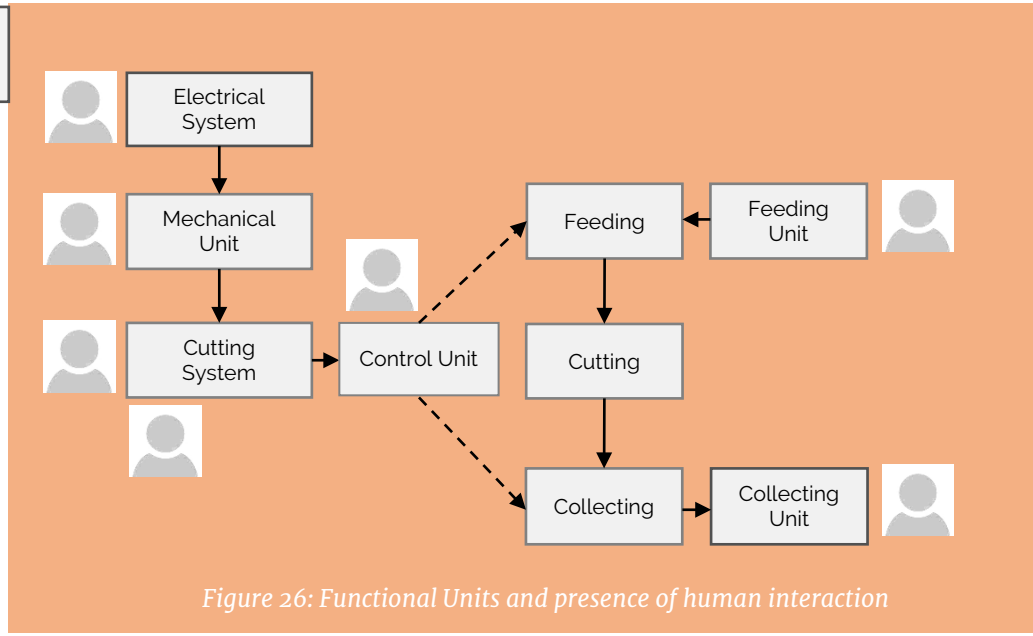


Figure 26: Functional Units and presence of human interaction

Synchronic Study

Figure 27: Some of the Products used for synchronous study, From top left - Robot Coupe, Santos, Electrolux, Minigreen, Sammic, Aurea,

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		

Table 3: Comparison of similar products

Takeaway

Study of similar products helped to understand the variants like Bulk Feeding, Continuous Feeding. It also helped to understand the typical configuration of parts.

Organisation

After understanding the basic functions, various organisations of these functions were explored to give directions to concepts. Here the identified important function (Parts) are represented as blocks (Brown shade). Dashed Lines represent the working position of the user.

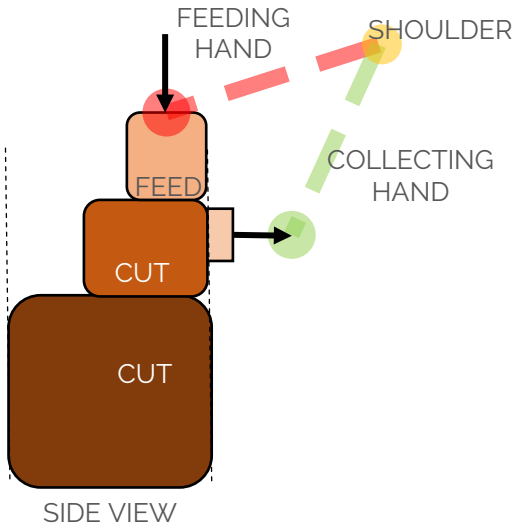


Figure 28: Illustration showing vertical organisation of functions

Takeaway:

All the three configurations have their own benefits.

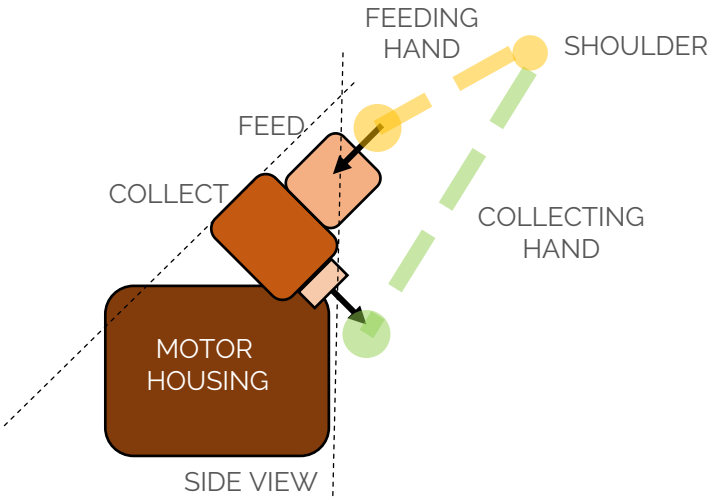


Figure 29: Illustration showing inclined organisation of functions

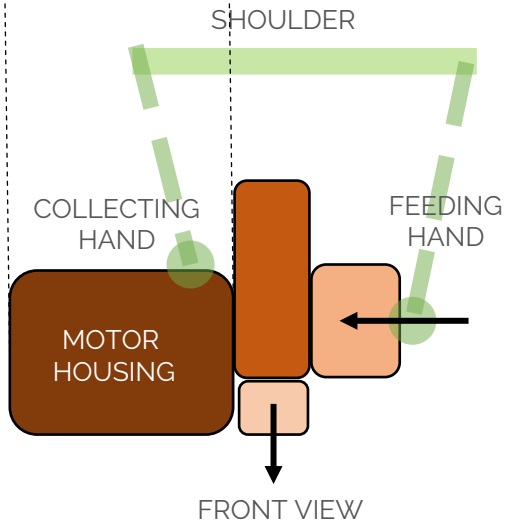


Figure 30: Illustration showing horizontal organisation of functions

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
Feeding Mechanism
Spring Action feeding
Vibration Feeding
Loaded weight feeds
Pulling Feeder
Vaccum Suction
Rotating Feeder
Pushing feeder
Whirlpool Feeding
Sharp pins for feeding
Open and Close feeding
Different for each vegetable
Crush first
Hold from side
Grabbing hands
Lock Vegetables
Catch Vegetables

Pressure feeding
Different holes
Thread mill method
Lever handle
Side feeding
Push and rotate
Funnel shape
Large drum
Continious feeding
Bulk Feeding
Tube feeding
Spiral Rings for feeding
Valve or door
Bottle type
Modular vessel
Detachable

Table 4: Brainstorming

Ideation based on configuration

Table 5: Exploration of vertical Configurations

Table 6: Exploration of horizontal configuration

Idea generation based on brainstorming

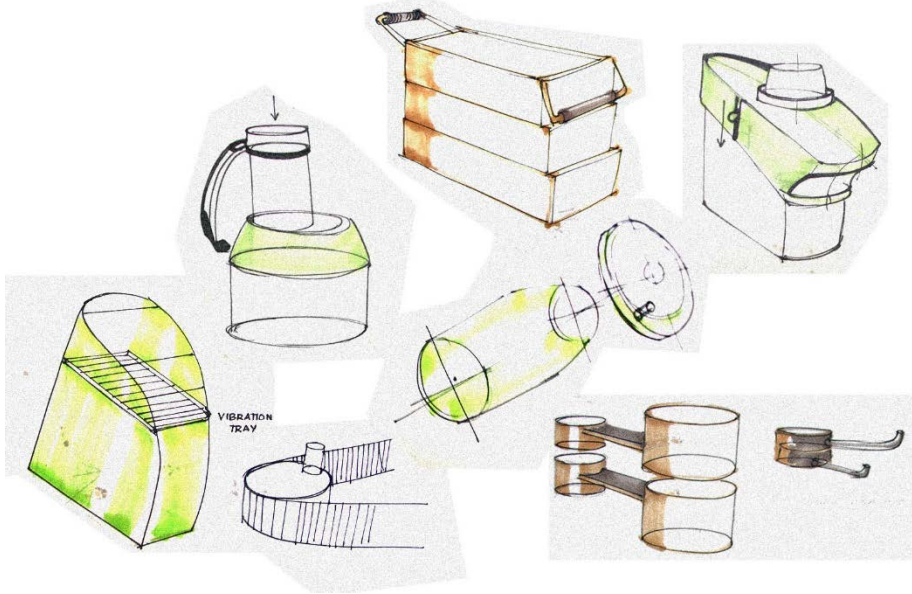


Figure 31: Idea sketches

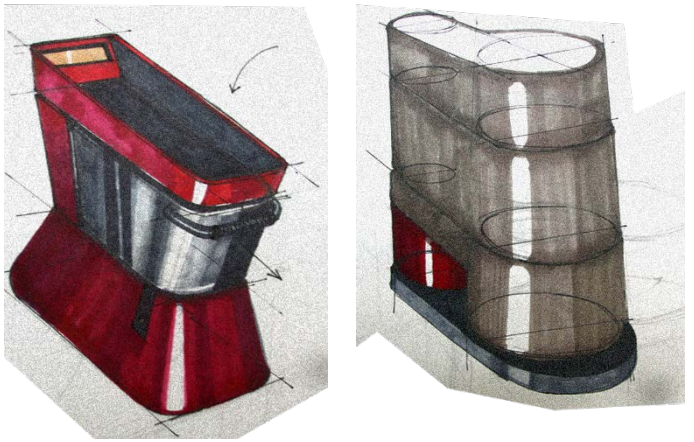


Figure 32: Idea sketches

Concept 1

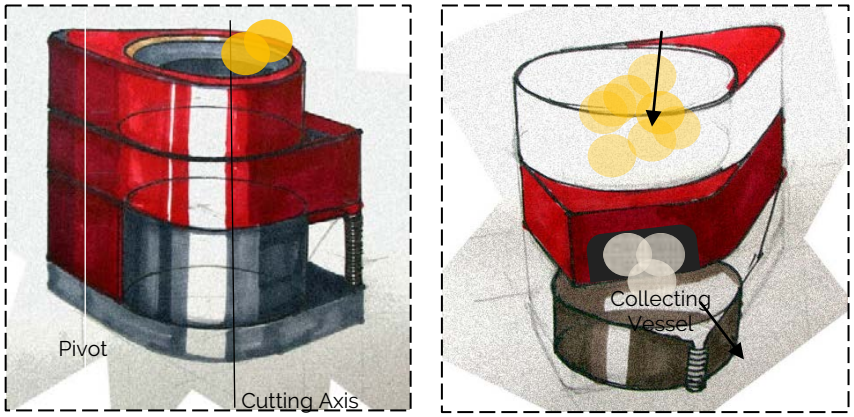


Figure 33: Concept 1

This concept is based on a vertical configuration of parts. Here the motor is aligned vertically with its foot mounted to the inside frame. This configuration makes the cutting and ejection plates mounted vertically.

The main features of this concept are the bulk feeding mechanism with a rotating feed. Here the feeding is done manually with the help of a handle from the top hopper. The collecting chamber is pivoted movable or detachable for easy cleaning. The ejection of cut vegetables is to the side. The vessel can rotated along the pivot during the process.

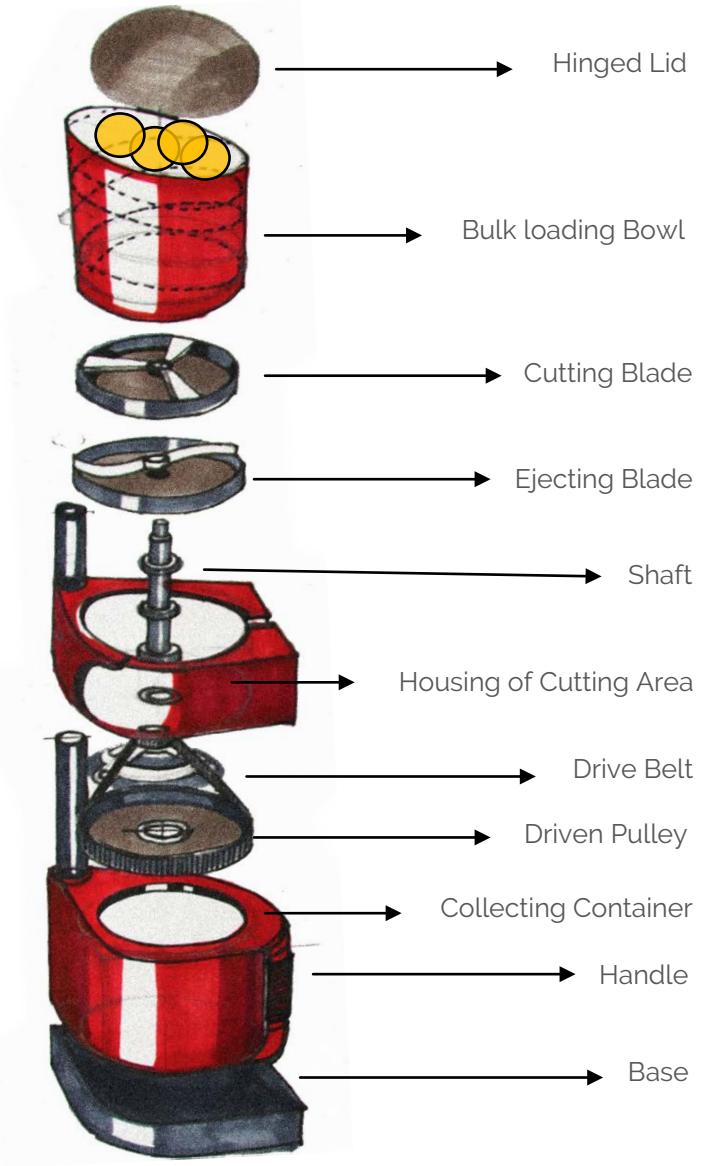


Figure 34: Concept 1– Arrangement of parts

Concept 2

Figure 35: Concept 2

This concept is based on an inclined configuration of parts. Here the motor is mounted vertically with its foot to an inclined frame. This configuration makes the cutting and ejection plates to be mounted at an angle.

The main feature of this concept is the vibration feeding mechanism connected to the motor. Here the feeding can be done manually or using the vibration at an inclined angle. Here both continuous or bulk feeding is possible. This option may or may not have a collecting vessel. The ejection of cut vegetables is to the front which can be collected to a vessel.

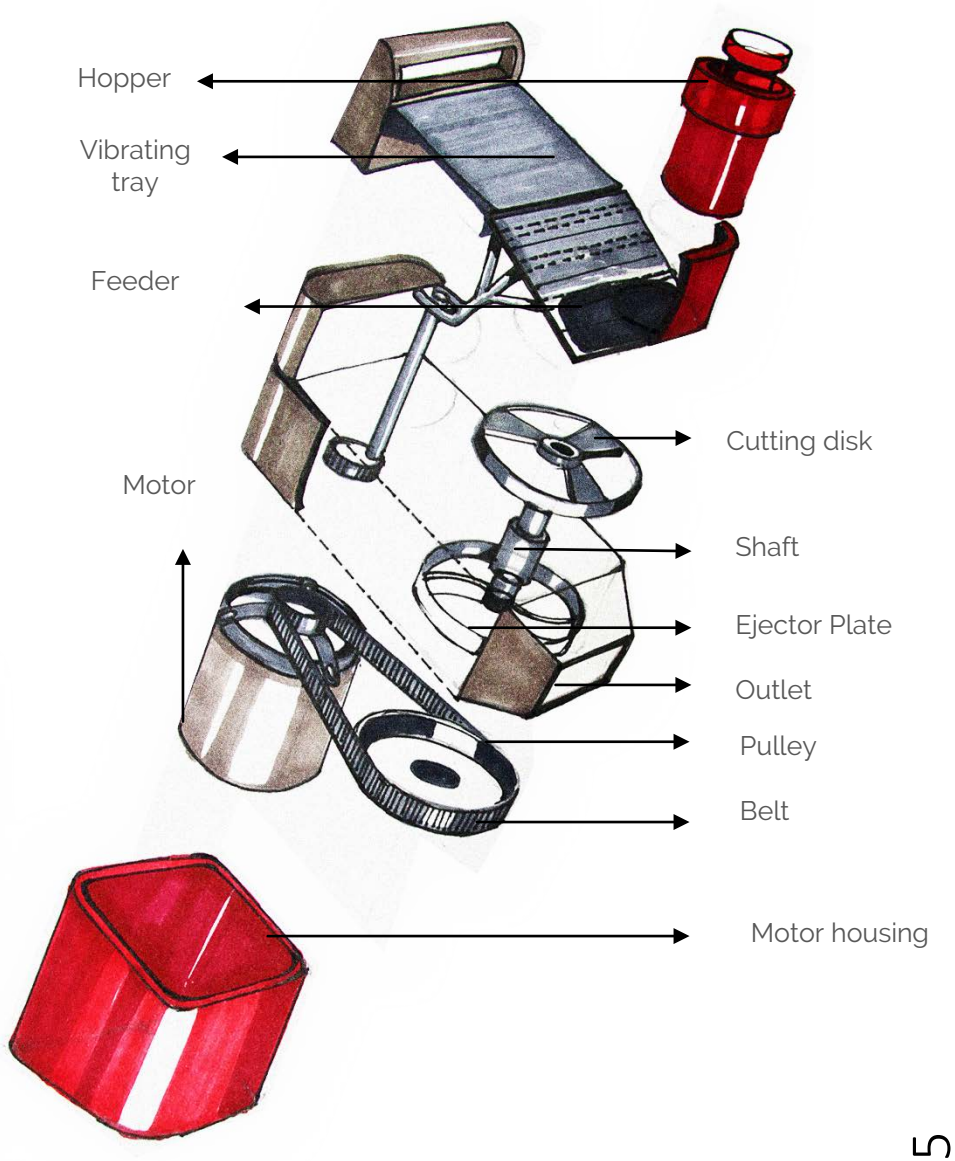


Figure 36: Arrangement of parts – Concept 2

Concept 3

Figure 37: Concept 3

This concept is based on a horizontal configuration of parts. Here the motor is mounted is foot mounted to the bottom frame of the machine. This configuration makes the cutting and ejection plates to be mounted in a horizontal way.

The main feature of this concept is the tension feeding mechanism using springs. Here the feeding is done manually or semi manually in a horizontal way. Here both continuous or bulk feeding is possible depending on the parts. This option can have a collecting tray or even the drawer can be used as the vessel. The ejection of cut vegetables is to the bottom which can be collected through a tray.

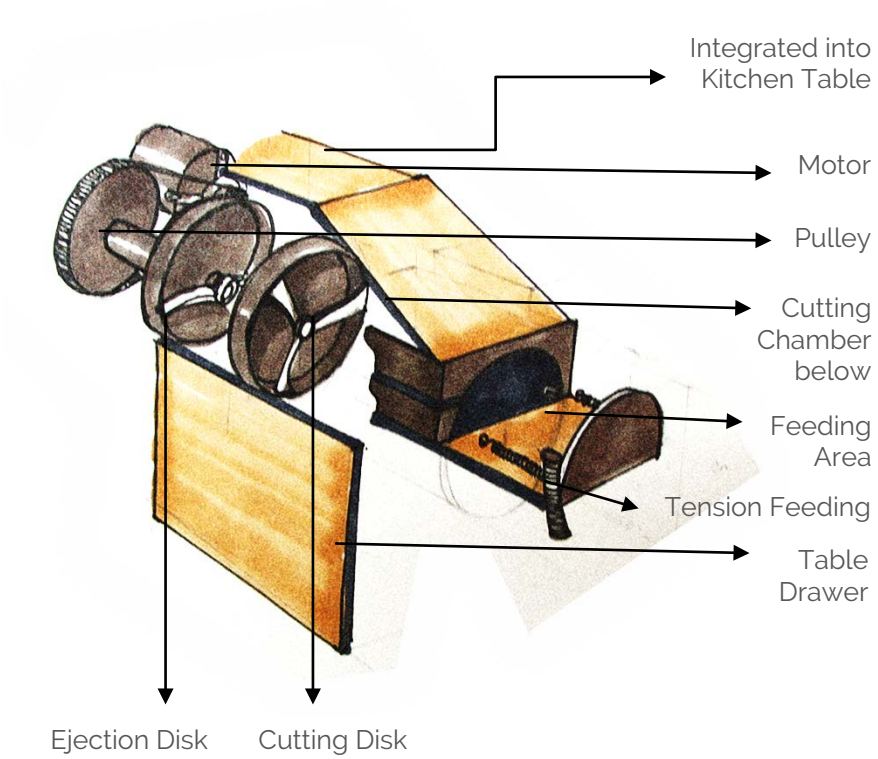


Figure 38: Arrangement of parts – Concept 3

Design Direction

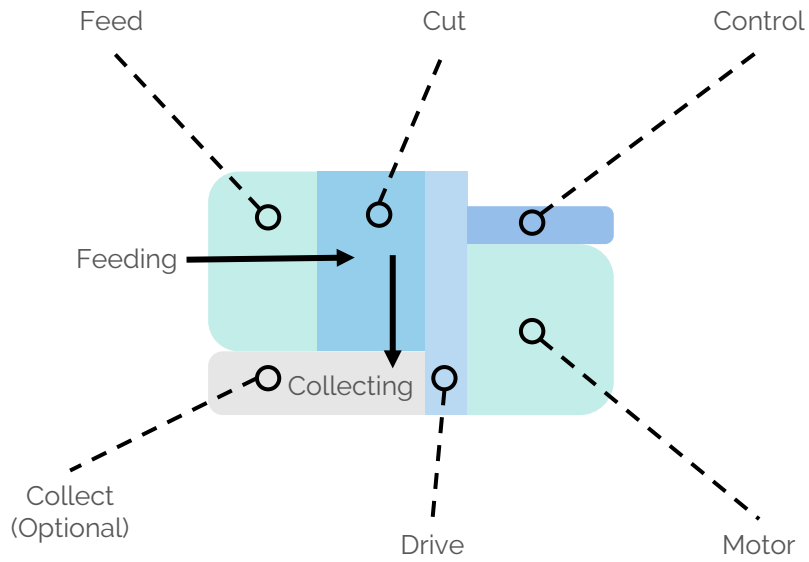


Figure 39: Illustration – Selected Configuration

The three-concept varied fundamentally in their configuration of parts. All other feature can be added according to the feasibility of that particular feature. The issues to be attended in the design was considered in the order of hierarchy for selection of concept. The configuration effected all the functions of the product. So, choosing the configuration is crucial.

The selection of concept will also decide which direction the design will proceed. The criteria of selection of concept is shown below.

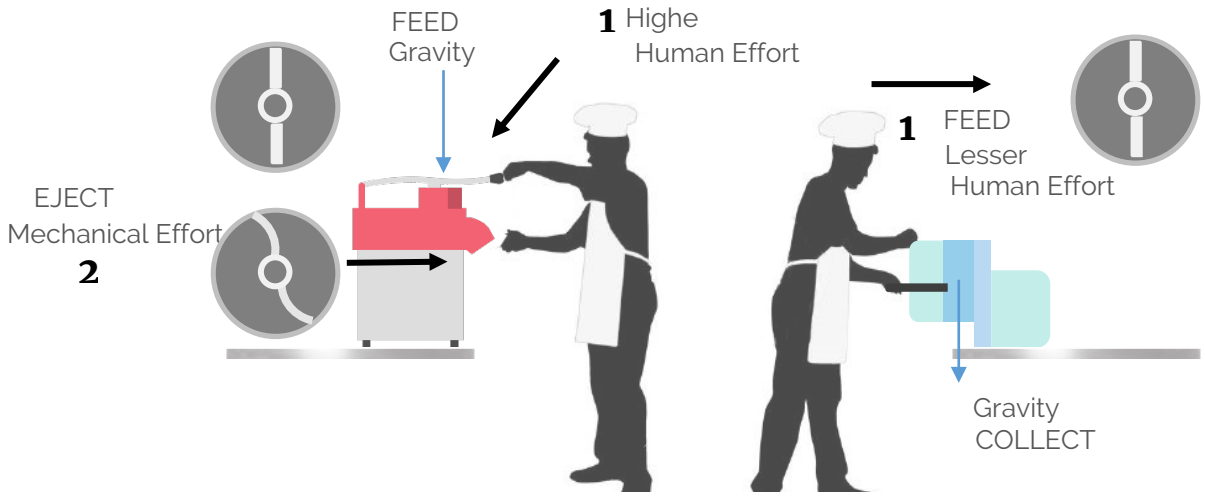
Criteria for concept selection

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

Choosing the configuration

The major reasons for choosing the particular configuration is shown below in four illustrations.

Comparison of Performance

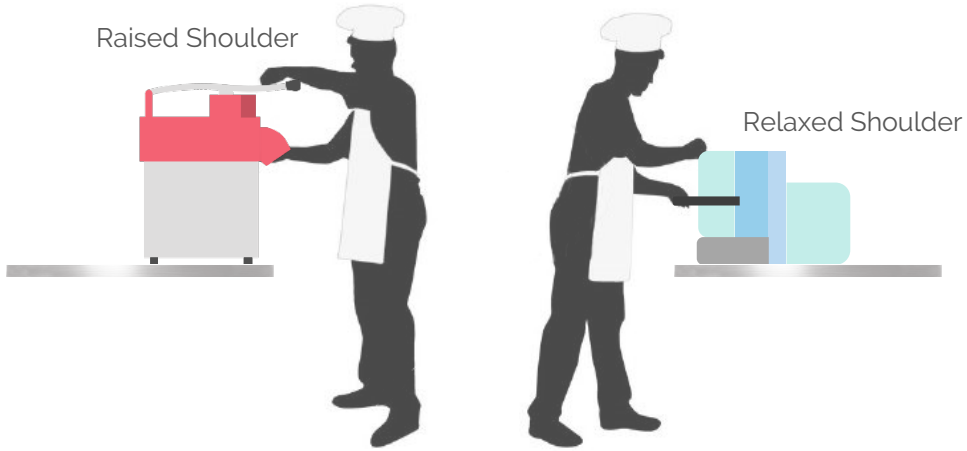


Reason 1:

In the new configuration, the load can be reduced by avoiding the ejection disk thus increasing performance

Figure 40

Comparison of Productivity, Ergonomics



Reason 2: Ergonomics, thus Productivity

Here, the shoulders of the user are relaxed when using the product compared to the existing product

Figure 41

Comparison of Usability

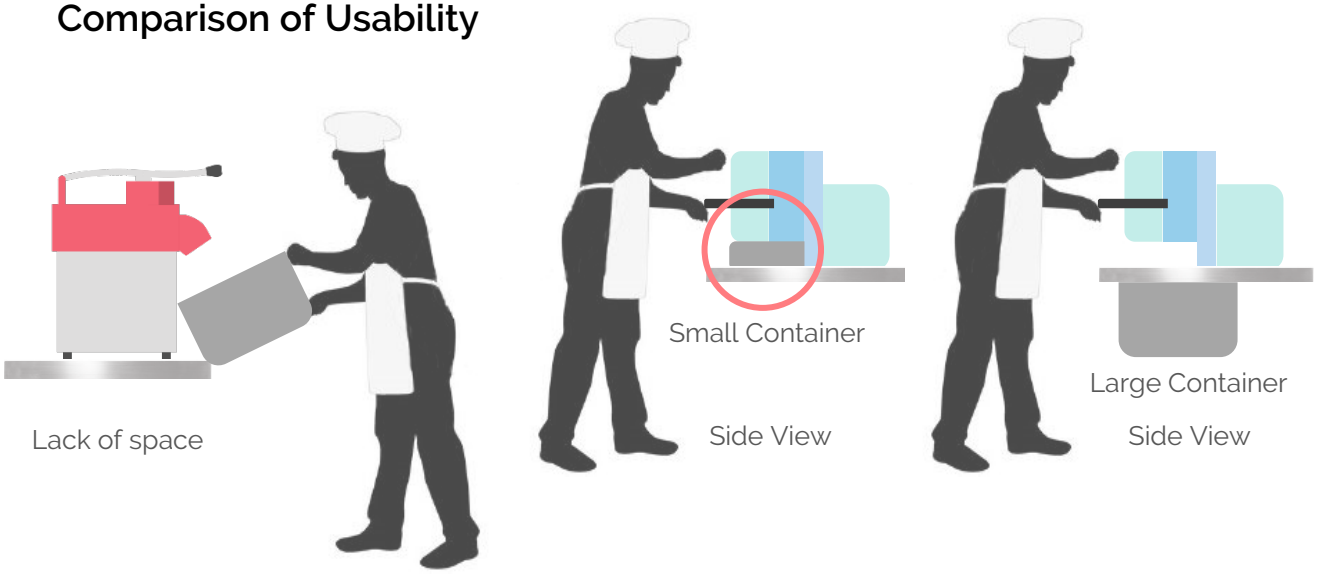
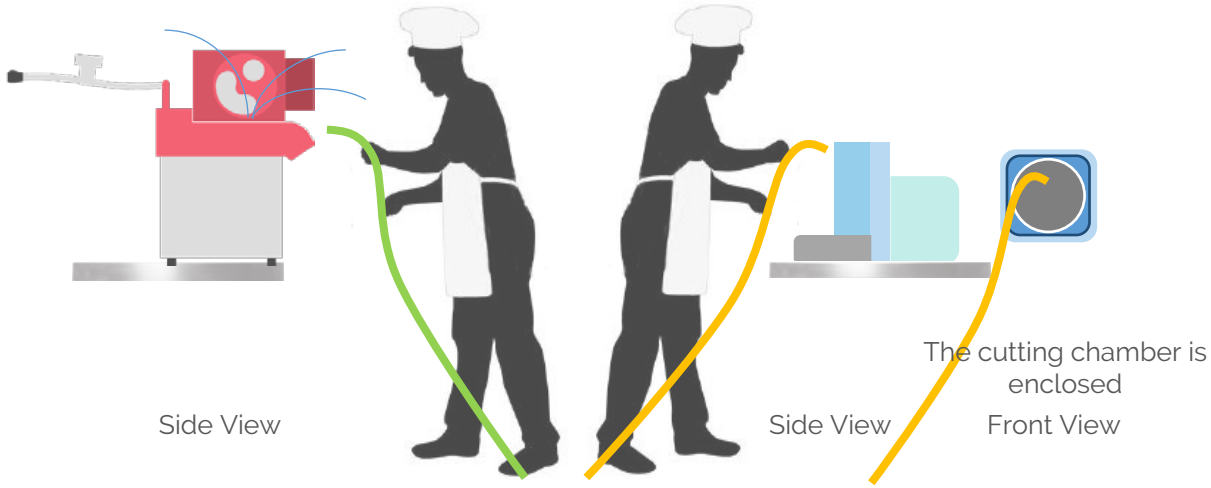


Figure 42

Comparison of maintenance



Reason 3: Usability

Here, the configuration has a possibility of incorporating collecting vessel into the product. There is also a possibility of integrating vessel to the table.

Reason 4: Maintenance

The new configuration helps in cleaning the cutting chamber without spilling water unlike the existing product.

Concept Development

Deriving Volume from mock-up

The diameter of the blades is fixed initially as 200mm.

After having the rough dimensions of the internal parts, the volume of the product was to be derived. The size of the pulleys was calculated for 500 rpm. The length of the belt was obtained as 30”. These parts were arranged to get the size of the product.

Based on this, the dimensions of other parts like, sliding channel for feeder, Feeding chamber, cutting chamber was derived.

Figure 44: Mock up model for Concept development

Deriving Mechanisms –

Option 1- Spring assisted slider feed

Many Ideations were done to understand the working of the spring mechanism and how it can be used. This idea uses the same sliding technique of drawers of tables to act as the mechanism of the feeding part.

An extension spring is used to slide between channels that run one inside the other using ball bearing. A similar mechanism is used to simulate the feeding mechanism for the cutter.

The details of the mechanism are then model to derive the dimensions of the parts. Variations of this mechanism is shown in the succeeding pages.

Figure 45 a, b – Sliding Mechanism in drawers with spring

Figure 46 a, b – Spring mechanism tried on mock up model

Variations of Mechanisms

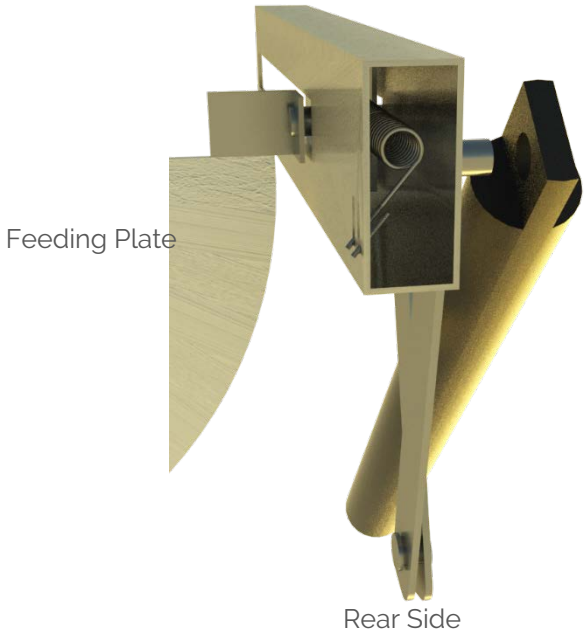


Figure 47: Rear side of the sliding mechanism showing spring attached to channels

Ideations were done to understand the working of the spring mechanism and how it can be used.

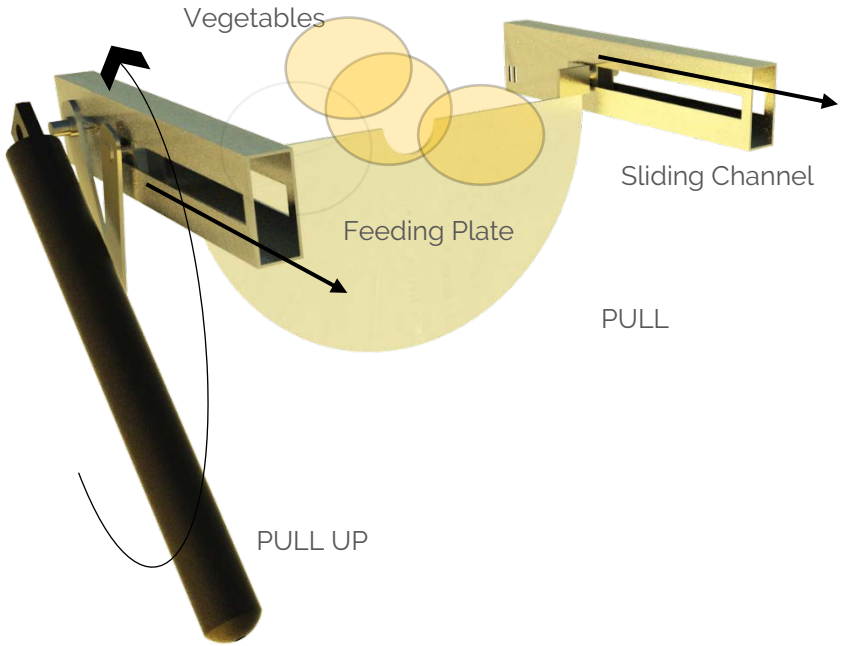


Figure 48: Sliding mechanism showing the lever and feeding plate

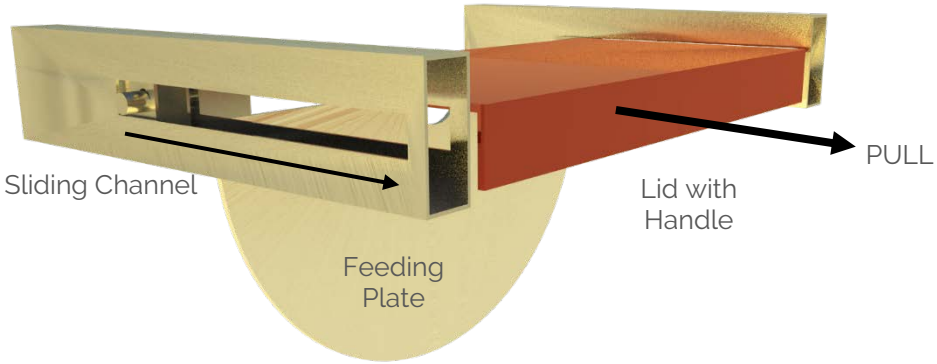


Figure 49: Sliding mechanism showing the sliding lid with handle

Option 2 – Spring assisted Lever feeding

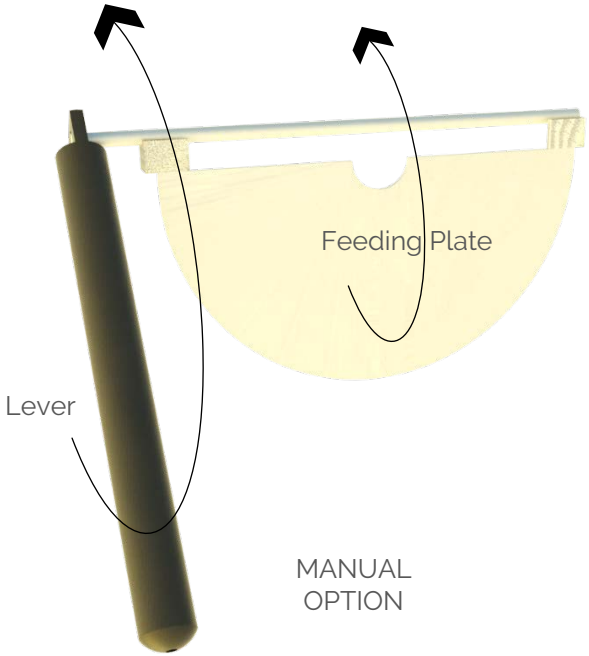


Figure 50: Manual lever mechanism

The spring assisted lever feeding mechanism make use of the existing lever in the product. It has a similar feed plate attached to the lever. On rotating the lever, the plate feeds the vegetable into the blade in a rotational motion.

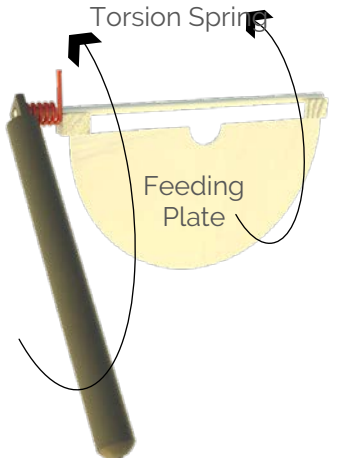


Figure 51: Spring assisted lever using Torsion spring

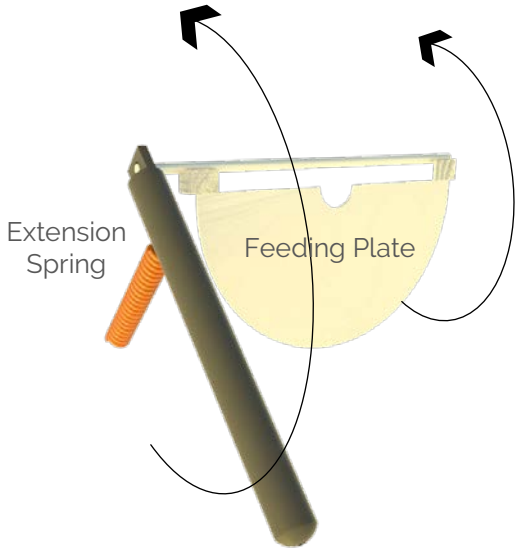


Figure 52: Spring assisted lever using Extension Spring

Parts based on Mechanism

Figure 53: Feeding bowl design for lever

Sphere shaped feeding bowl can be used with spring assisted lever mechanism since it is easy to use and cheap to manufacture because of less parts involved. This is a primitive design form which is similar to the lever in the existing product.

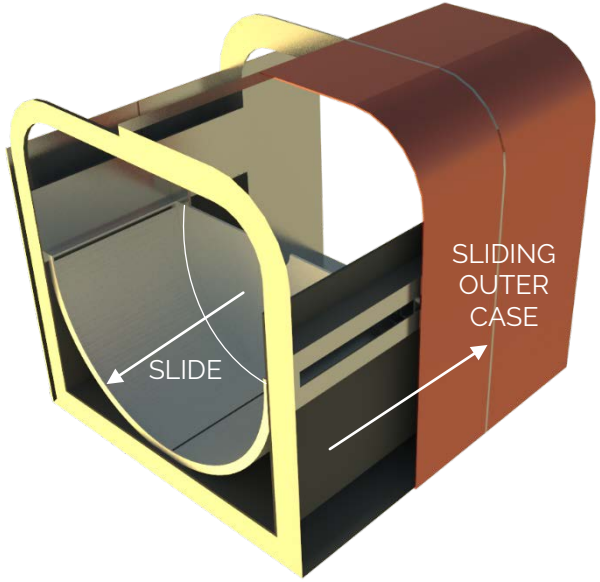


Figure 54: Sliding feed mechanism showing outer case

The form shown above is developed in order to hide the mechanism which help in sliding of feeding plate. This form is manufacturing friendly and helps in giving a form different from industrial fabricated products. The outer case slides to help in maintenance of the mechanism inside.

Concept

Form Generation based on Parts developed

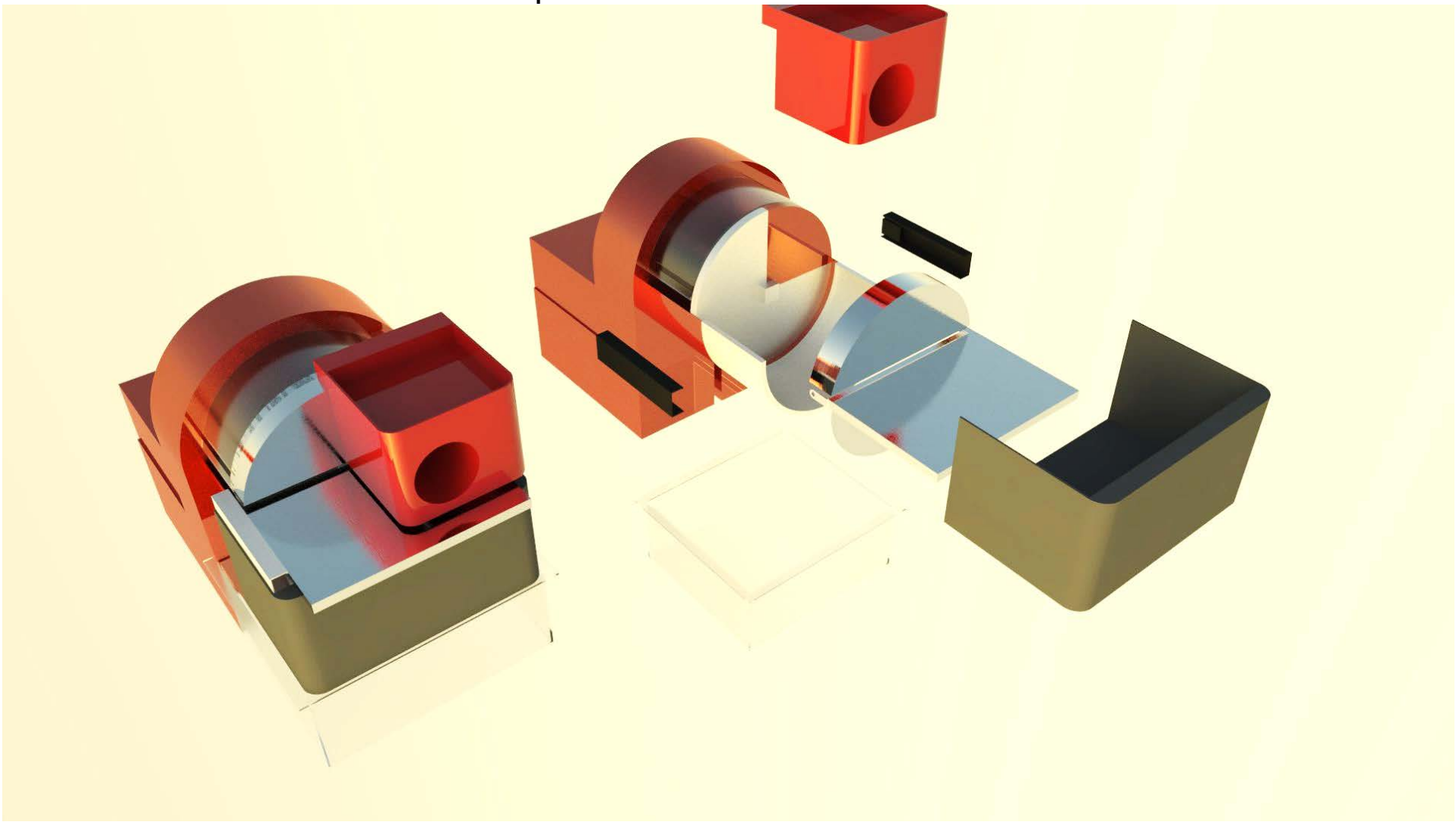


Figure 55: Rendering showing the arrangement of parts to derive form

Variation of Feeding Lid

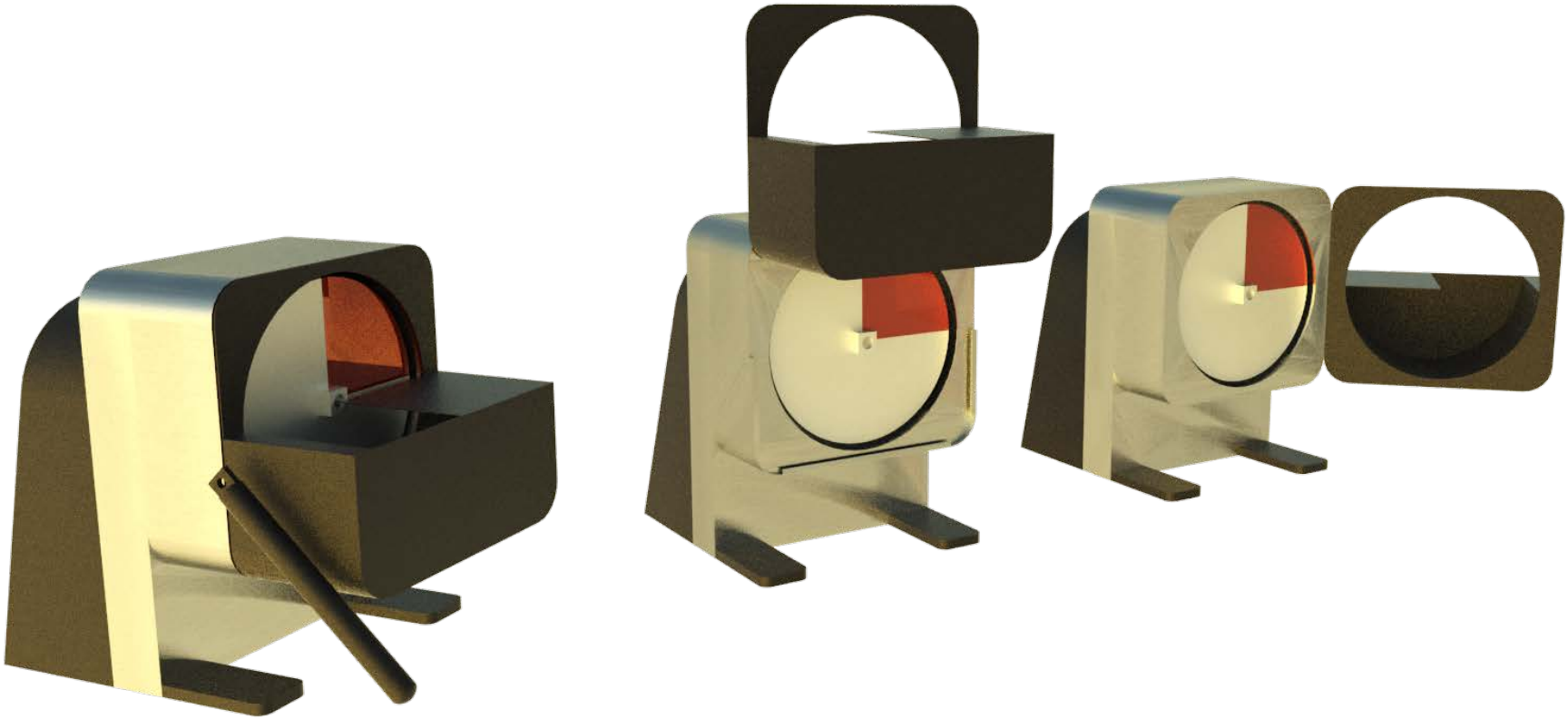


Figure 56: Initial Conceptual Model based on derived parts showing possibilities of feeding chamber types

The feeding unit also act as the lid for the cutting chamber. This is for easy access to the cutting chamber for changing blades. Two options were derived to attach the feeding part to the cutting chamber. In the first one it can be slide from the top of the machine. In the second it is hinged on one side. The type is to be chosen based on the mechanism.

With and without Container

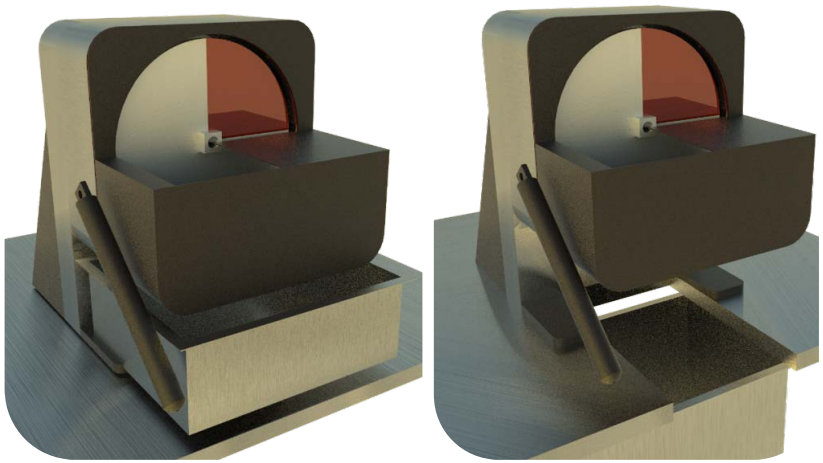


Figure 57: rendering showing possibilities of usage of collecting vessel

These two options are the derivative of incorporating the environment also with the product. Here the table is designed in such a way that the product can be integrated into the table.

This is possible with a table design in which the drawer is designed to collect vegetables which is cut and fed directly from the machine.

Figure 58: Mock up model

Mock up model

A full-scale mock up model was made to understand the scale and volume of the product. The internal parts were also made in full scale to understand the fixing details.

The form of the cutting chamber and feeding chamber developed is completely based on form and ease of manufacturing using stainless steel.

Figure 59: mock up model of collecting and cutting chamber

In this option the cutting chamber is hinged to the feeding chamber so that it can be opened to change disk.

User review

A review of concept was done with users in kitchen. The intention was to mainly know the effect of spring action in cutting vegetables. According to them pushing using lever is necessary for most vegetables except tomato because of their hardness. According to them, both the bulk and narrow hoppers need not be on the lid together, because they are not used together.

The main disadvantage of this product is that it will be difficult to collect the vegetables in the small tray. Hence they asked to make the tray larger. It is good to have cut vegetables directly in the large tray than using a small tray to avoid overwork.

The position of feeding vegetables is ideal according to the user. Since the mechanism was in the crude stage of development, they couldnot comment on what effect it will have in the cutting process.

Figure 60: mock up model of collecting and cutting chamber

Figure 61: mock up model of collecting and cutting chamber

Final form development

Figure 62: Refinement of form based on ideations

Visual perception matrix

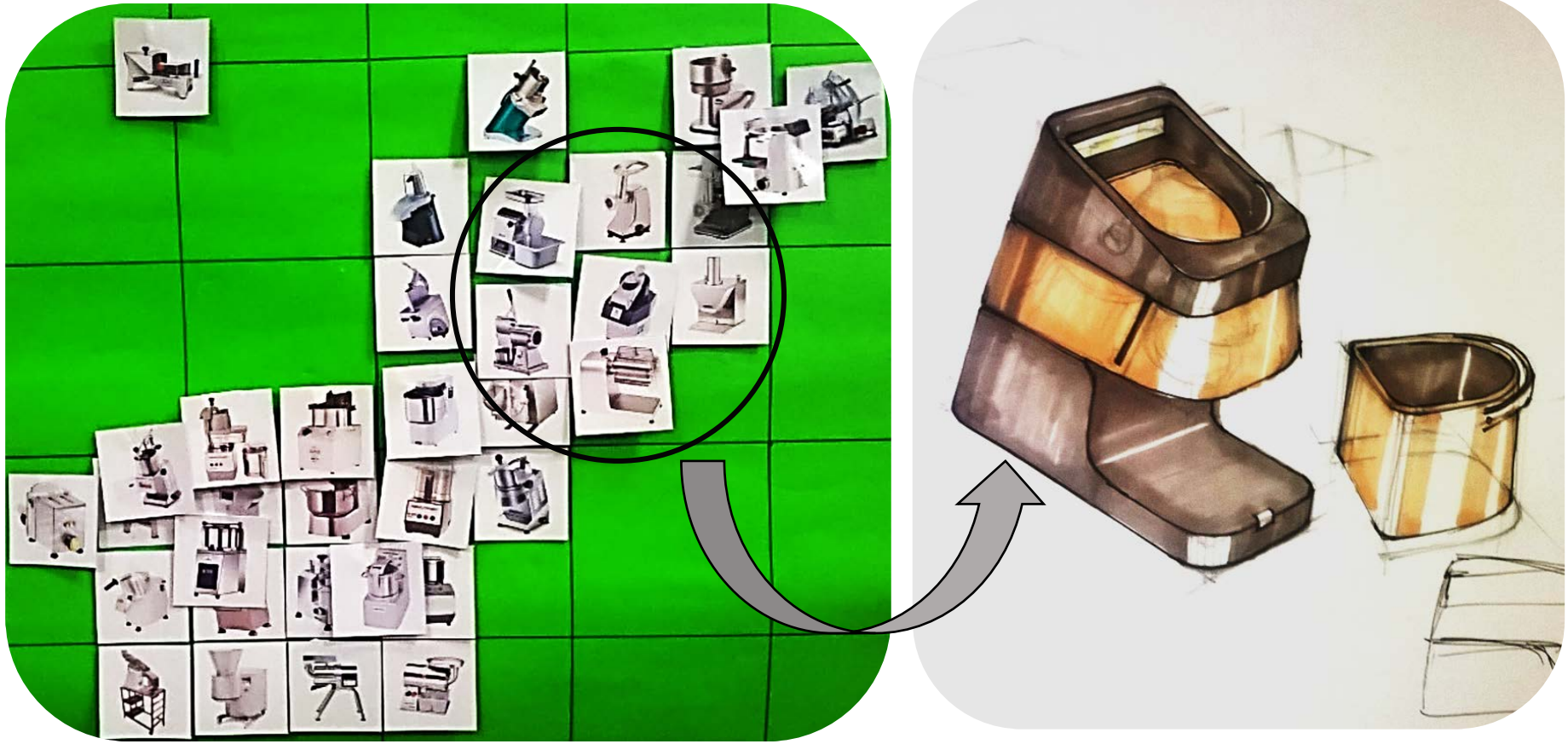
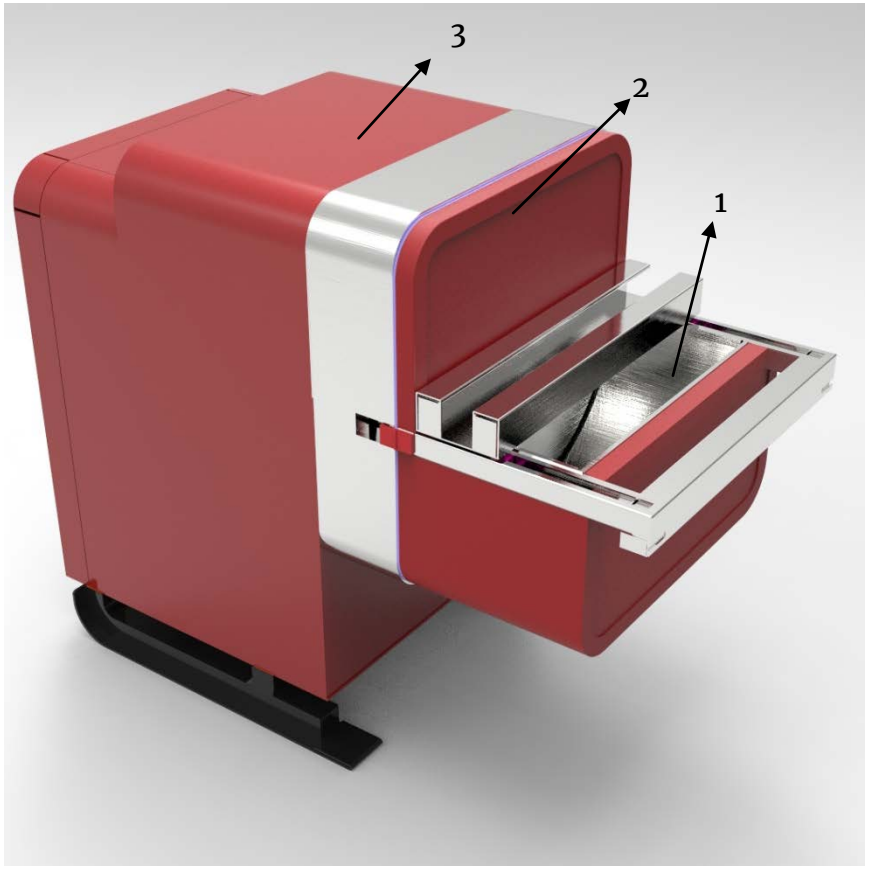


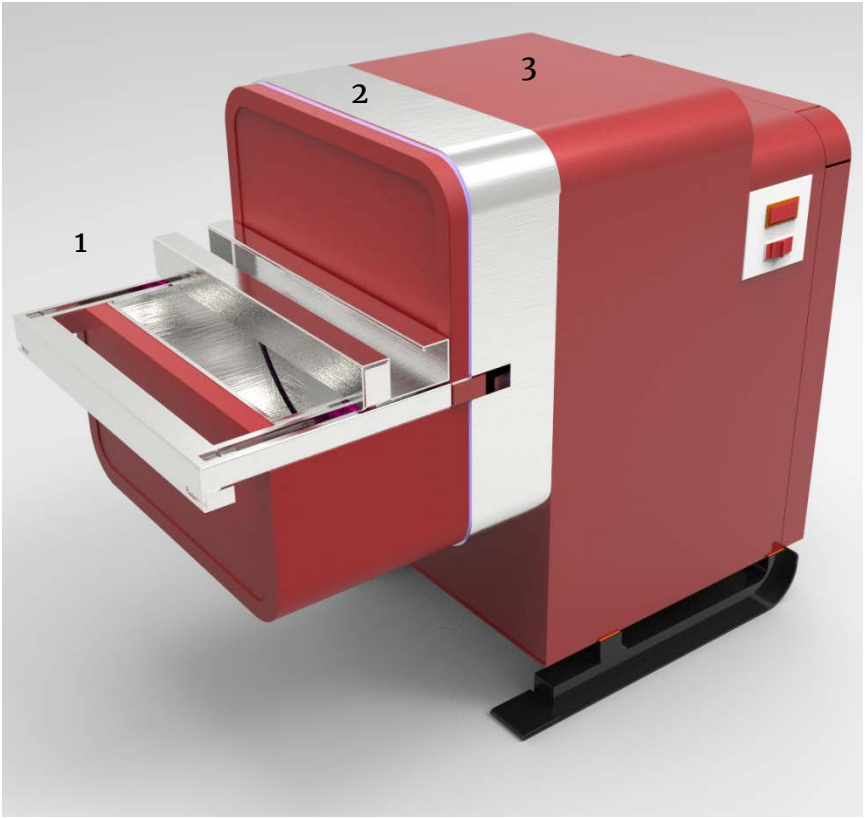
Figure 64: Visual identity developed earlier

Figure 63: Visual Perception Matrix developed as part of product planning course

Final Product

Design Refinement

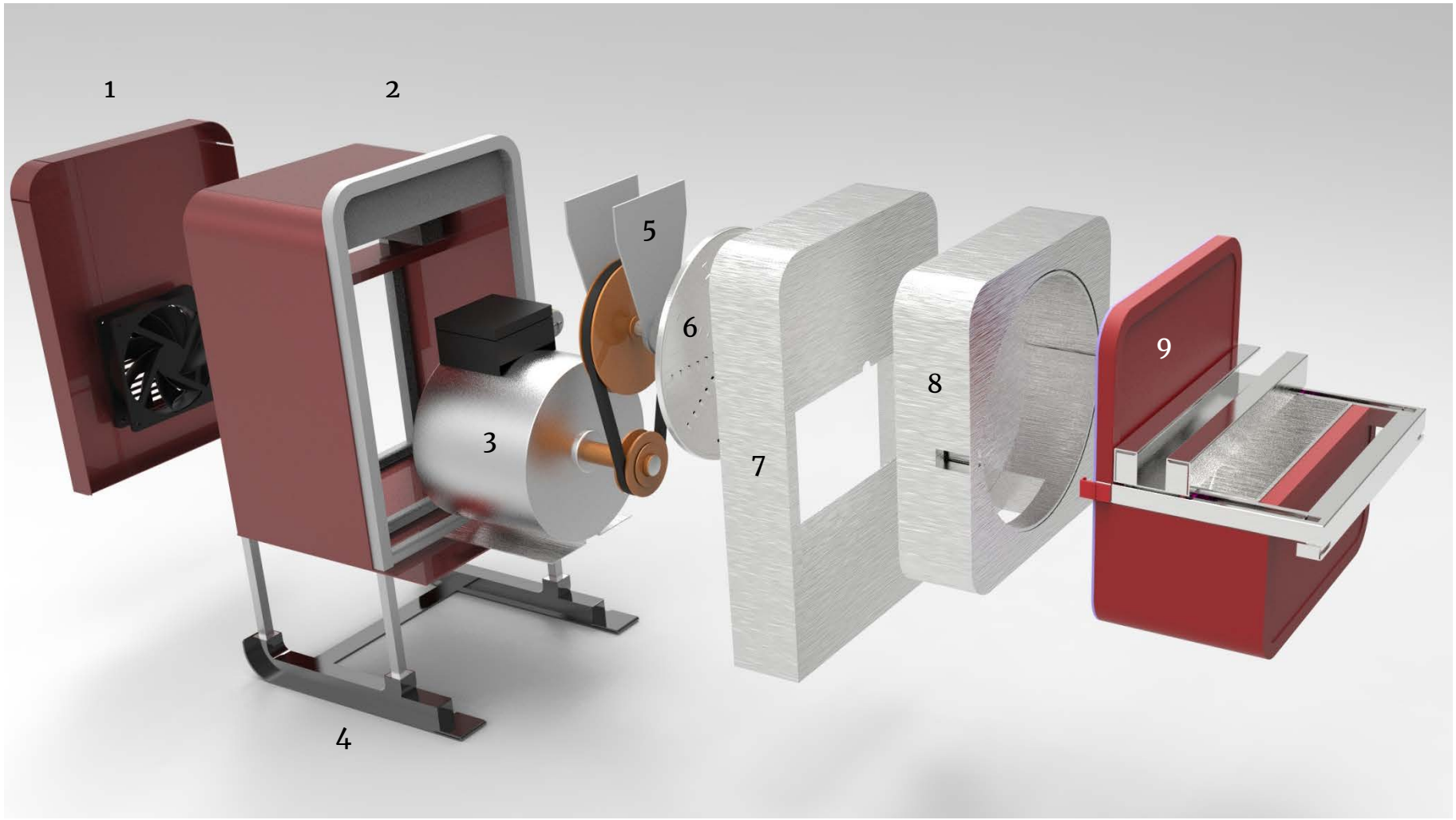




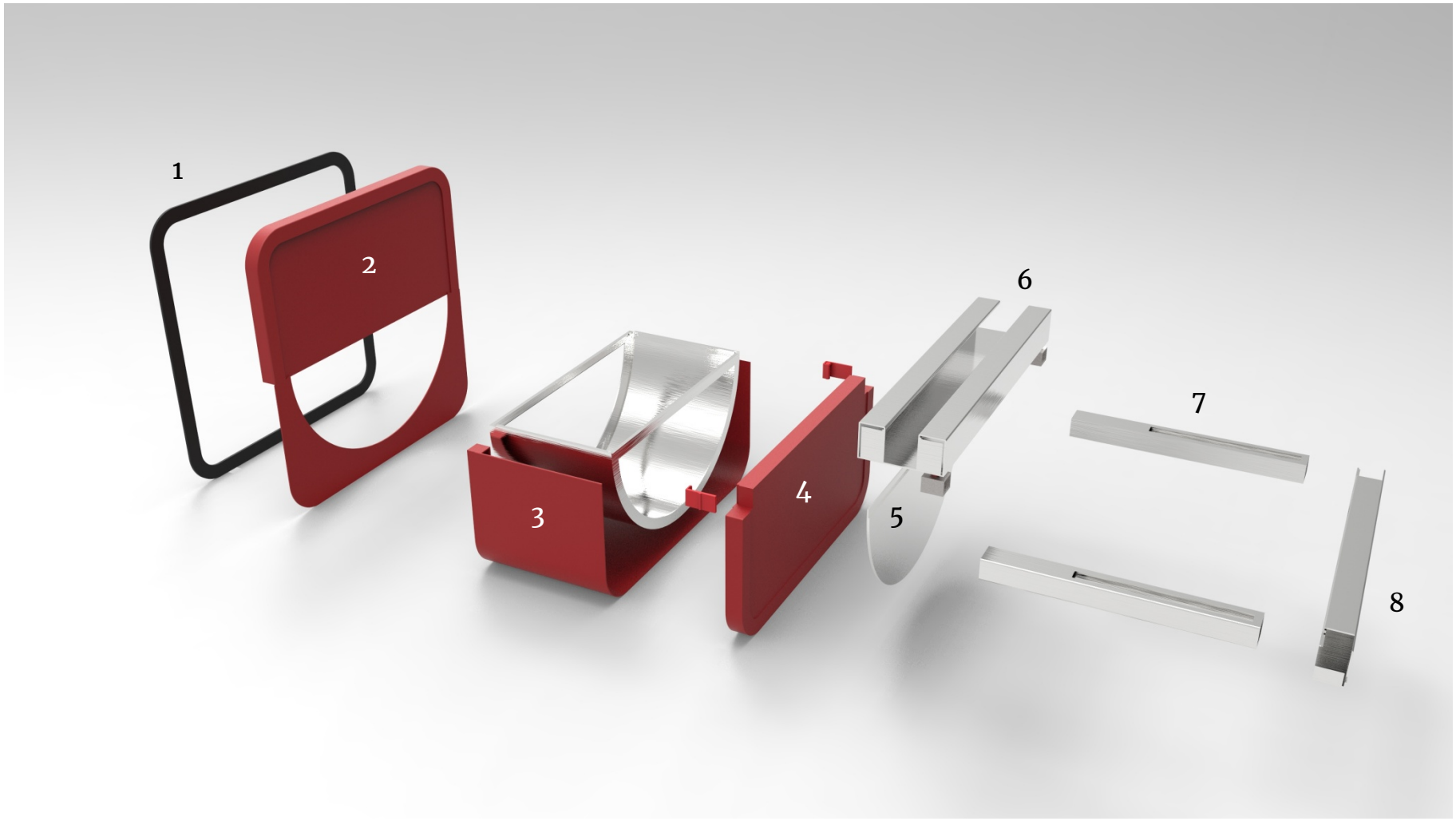
The refined design consists of basically 1) the feeding area 2) Cutting area 3) The body which covers all mechanical parts of the machine

The feeding area acts as a lid which is connected with a hinge to the cutting area. This is closed and locked when the machine is working.

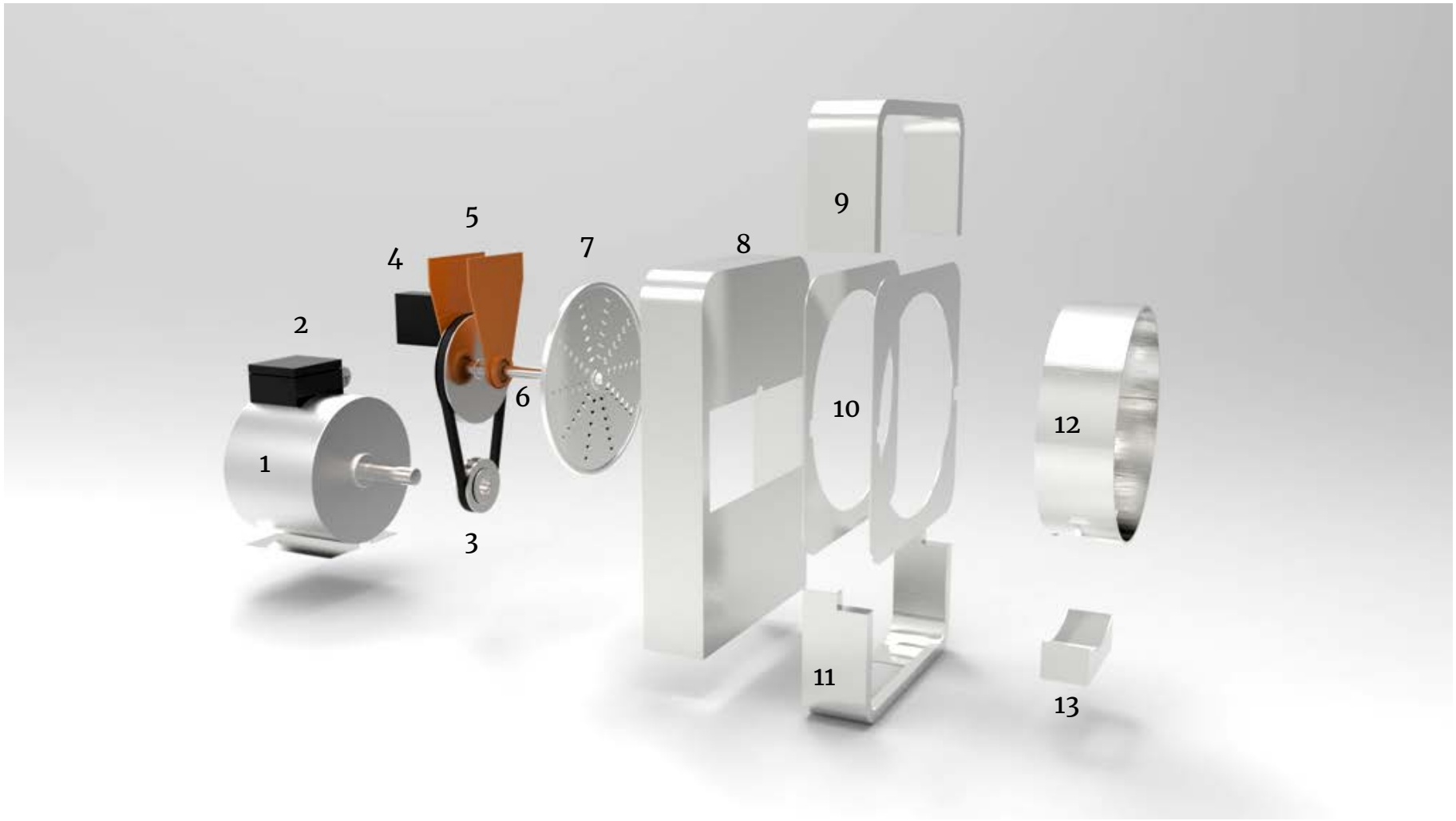
The legs of can be extended for height adjustment according to the work environment. This is made possible by using telescopic movement of the legs through the body frame made in M S Square tubes.



An exploded view showing the internal parts and assembling of the body: 1. Back Cover 2.Body Enclosure 3. Motor 4.Legs 5.Pulley Mechanism 6.Cutting disk 7.Front Cover 8.Cutting Area 9.Feeding Area



An exploded view of the feeding area showing the different parts of the lid. 1. Rubber Gasket 2.Safety Cover 3.Cutting Chamber 4. Front Cover 5.Feeding Plate 6.Handle for Slider 7.Sliding component with spring mechanism



An exploded view of the parts of the processor: 1. Motor 2. Terminal Box 3. Driving Pulley 4.Power Controller 5.Steel parts for supporting bearing 6.Shaft 7. Cutting blade 8,9,10,11,12. Exploded view of enclosure 13.Ejecting area

An exploded view showing the Frame work and the enclosure of the processor. The view shows how the height adjustment can be done using the frame.

Product Planning

Elevator Pitch

The new ‘Target Series’ of commercial vegetable cutters from ‘Thomson and Thomson Industrials’ bring raw processing power into commercial kitchens an in all segments of food preparation. It provides all types of cut variety and exhibits extreme productivity with less effort to keep your kitchen clean and organised, opening the door to a whole new culinary world.

Brief Description of the product

Target series is a versatile vegetable cutting machine designed to meet your professional needs in the kitchen. It can perform a wide number of cuts as well as save much in time and labour. The target series is supplied with a wide range of cutting plates and grids to satisfy even the most demanding chefs when it comes to cutting up fruits and vegetables; i.e., slicing, grating, dicing, julienning, French fry.

Target series is characterised by durable stainless steel construction which enhances the lifetime of the product. The ergonomic and smooth surface design ensures easy cleaning. The compact horizontal configuration helps in easy loading and collection of vegetables.

Target 401 comes with an ergonomic handle designed for easy feeding of vegetables. The hopper is designed to complement the feeding activity. Target 411 comes with spring assisted mechanism which makes it easier to feed vegetables.

The unique side feeding is chosen to help reduce the feeding height in the vegetable cutter. This has resulted in a contemporary form compared to other primitive products in the market. This has also increased the performance of the product by avoiding ejection blades.

Target 501 is the sliding version of the same product which features an enhanced feeding mechanism of vegetables. It has a linear feeding arrangement which automatically feeds vegetables using spring assisted mechanism. This is the under counter version of the same product.

The anti-spill cutting chamber directs water into the tray and avoids spillage of water to keep the kitchen environment clean and dry.

Food grade stainless steel is used for the manufacture of most of the parts of the product considering health and toxicity of traditional aluminium casting methods for body of the product.

SWOT Analysis of the product

Strength:

- The technical and service background of the manufacturer.
- Support of designer and dealer for the new product.
- Existing Customers of the products in other categories.
- Food grade material for fabrication of parts and housing.

Weakness:

- Lesser human resource of manufacturer.
- Abrupt high demand not tolerable.
- Narrow product line. Multiple products are made by competing manufacturers.

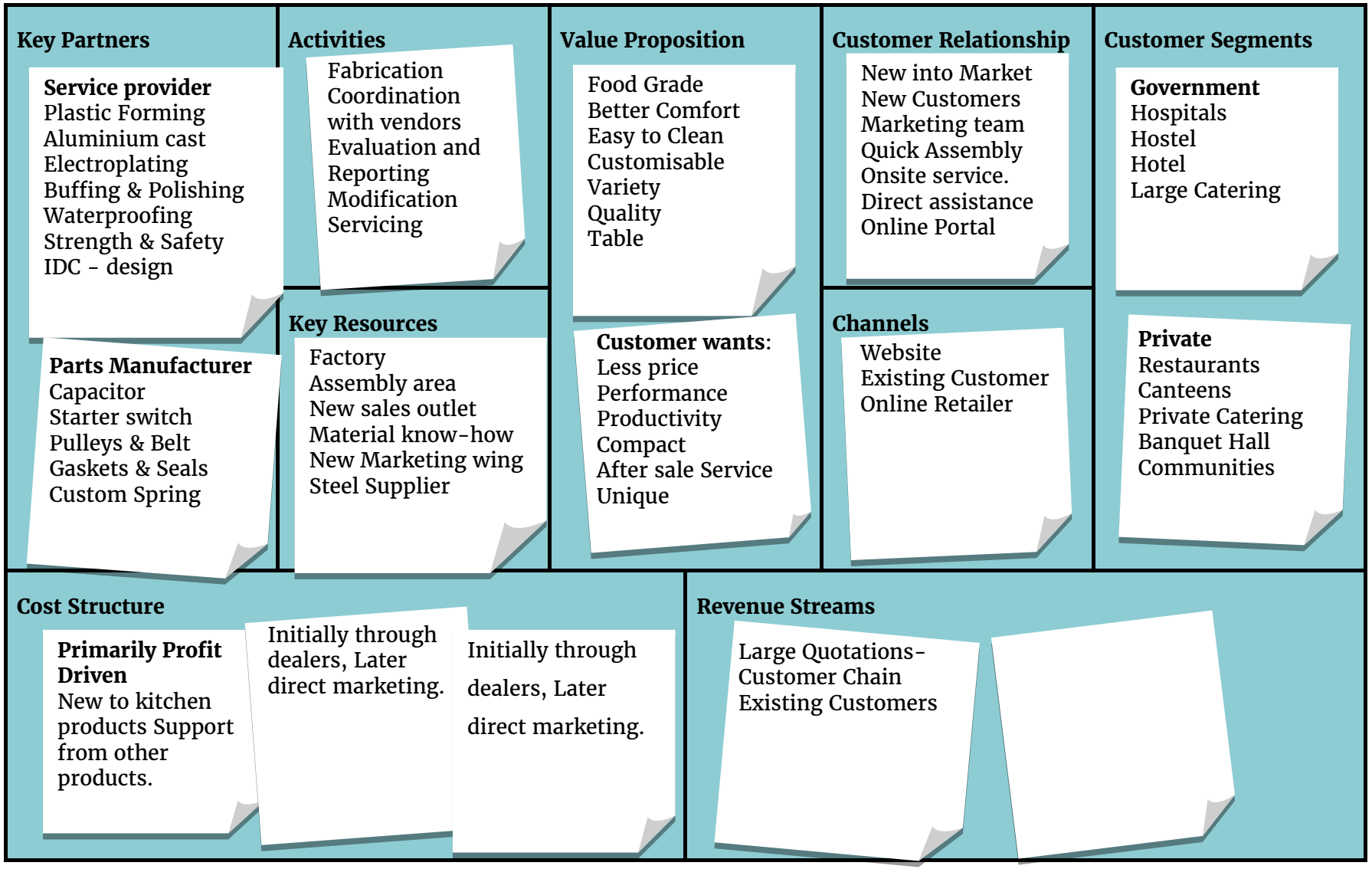
Opportunity:

- Star Hotels looking for cheaper products.
- Comparatively better design

Threat:

- New design platform or configuration compared to other products in the market.
- International products in the market.
- Competing Product dealers in the market.
- Government look for least quoted products and not better features
-

Business Model Canvas - New manufacturer


Key Partners
Service provider
Plastic Forming
Aluminium cast
Electroplating
Buffing & Polishing
Waterproofing
Strength & Safety
IDC - design
Parts Manufacturer
Capacitor
Starter switch
Pulleys & Belt
Gaskets & Seals
Custom Spring
Activities
Fabrication
Coordination with vendors
Evaluation and Reporting
Modification
Servicing
Key Resources
Factory
Assembly area
New sales outlet
Material know-how
New Marketing wing
Steel Supplier
Value Proposition
Food Grade
Better Comfort
Easy to Clean
Customisable
Variety
Quality
Table
Customer wants:
Less price
Performance
Productivity
Compact
After sale Service
Unique
Customer Relationship
New into Market
New Customers
Marketing team
Quick Assembly
Onsite service.
Direct assistance
Online Portal
Channels
Website
Existing Customer
Online Retailer
Customer Segments
Government
Hospitals
Hostel
Hotel
Large Catering
Private
Restaurants
Canteens
Private Catering
Banquet Hall
Communities
Cost Structure
Primarily Profit Driven
New to kitchen products Support from other products.
Initially through dealers, Later direct marketing.
Initially through dealers, Later direct marketing.
Revenue Streams
Large Quotations-
Customer Chain
Existing Customers

Value proposition

- Stainless Steel Design is an important feature of the vegetable cutter. Hygiene is ensured by clean and smooth surface finishing. This design also ensures easy maintenance.
- Consideration of user comfort is another important factor of the design. Increase ergonomic standards help in increasing productivity by reducing arm and shoulder fatigue to user. Enhanced feeding mechanism helps in feeding vegetables automatically to the cutting area.
- This vegetable cutter comes in manual as well as semi manual options to enhance productivity in commercial kitchen environment. Thus, the consumer can choose which type of product is suitable for their needs and budget.
- The product can be configured in two different ways – table top and under counter options which will assist in a more process oriented organisation of commercial kitchen.
- An Integrated table design that comes with the product will be useful for the type of preparation environment.
- The new cutting configuration also helps in easy cleaning after continuous usage.
- The anti-spill cutting chamber directs water into the tray and avoids spillage of water to keep the kitchen environment clean and dry.

TARGET

Master your kitchen

Commercial Vegetable Processors

Stainless Steel Design is an important feature of the vegetable cutter. Hygiene is ensured by clean and smooth surface finishing. This design also ensures easy maintenance. Consideration of user comfort is another important factor of the design. Increase ergonomic standards help in increasing productivity by reducing arm and shoulder fatigue to user. Enhanced feeding mechanism helps in feeding vegetables automatically to the cutting area. This vegetable cutter comes in manual as well as semi manual options to enhance productivity in commercial kitchen environment. Thus, the consumer can choose which type of product is suitable for their needs and budget.

The product can be configured in two different ways – table top and under counter options which will assist in a more process oriented organisation of commercial kitchen. An Integrated table design that comes with the product will be useful for the type of preparation environment. The new cutting configuration also helps in easy cleaning after continuous usage. The anti-spill cutting chamber directs water into the tray and avoids spillage of water to keep the kitchen environment clean and dry.

- Stainless Steel Design
- Ergonomic lever
- Enhanced feeding
- Manual and semi manual
- Integrated table design
- All new cutting configuration
- Anti-spill chamber for cleaning

Commercial Vegetable Processor TARGET 411

TARGET

Master your kitchen

Reference

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- https://www.bartscher.de/opencms/opencms/html/en/PrimaryNavigation/Produkte/Bartscher_Katalog/V/0098/120325
- http://www.omas1949.com/en/food-equipment_processing-vegetables/
- http://www.brunner-anliker.com/en/food-industry/vegetable-cutting-machines/vegetable-cutter-gsm-multicut-240-ideal-for-large-quantities/
- http://www.metcalfecatering.com/products
- http://www.sammic.com/catalog/dynamic-preparation/commercial-food-processor/ca-301#specs
- http://www.catering-appliance.com/pantheon-vpm-veg-prep-machine

REFERENCE OF FIGURES, TABLES