



Multifunctional Unit for Cooking in Small Spaces



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Ana Maria Leal Yepes
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To all my family in Colombia and United States, whose support has given incentive to this endeavor, and has encouraged me to proudly and successfully complete my thesis project and industrial design advanced studies.

Approvals

School of Design

Patti Lachance

Chair, School of Design
College of Imaging Arts and Science
Rochester Institute of Technology
Rochester, NY

Approvals

Chief Advisor

David Morgan, Assistant Professor
School of Design, College of Imaging Arts and Science

_____ Date _____

Associate Advisor

Kathleen Kaminski, Adjunct Faculty
School of Design, College of Imaging Arts and Science

_____ Date _____

Associate Advisor

Alan Reddig, Lecturer
School of Design, College of Imaging Arts and Science

_____ Date _____

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ABSTRACT

This thesis project is a proposal to improve student's life living at college dorms in USA. To accomplish this, a more functional and practical object and also meaningful for students will be design. The main purpose of the object is to meet student's desires and needs of having a fully functional appliance that allows a safe and easy cooking while living at the college dorms. During studies made to students living at college dorms, it was revealed that most of the students struggled cooking and had difficulty assimilating the new eating habits, ending in eating disorders. Despite the fact colleges strove for supplying nutritive food, it was difficult to please every student eating habits. Moreover, cultural differences made even harder that a menu offered by cafeterias at the dorms could supply eating desires from students of other countries.

In addition to the results from on campus living studies, this project will also take into account regulations and policies of on campus living that restrict and regulate the use of electric powered or any other type of appliances inside the dorms due to the dangers of fire ignition by appliances. Policies are necessary to protect student's life but are also an opportunity for this project of exploring solutions that provide a safe way for cooking at the dorms. Foreign countries and students in an outside the US are taking advantage of existing appliances that by adapting technology into house ware, are making goods more efficient and safer and then meeting students' needs. US colleges should start revising how to better furnish dorms or even

create areas to allow students using appliances safely, so that forbidden objects are not illegally brought inside the dorms, as it is happening now.

Besides the practical and safety issues, social affairs are also an important aim for this project. While living at the dorms, students develop strong bonds with roommates, friends, and neighbors. College is the new home for students who almost become a family. The way students furnish their rooms allow them socializing and creating an ambience to feel like at home. Whatever students own and bring inside their rooms is key to foster integration with people around. Thus, the final outcome of this project is meant to ease students' interaction through cooking and sharing exquisite meals with friends and roomies while improving their eating and nutritional habits.

I believe the market offers great stuff for students but there is nothing specific to meet the need I am addressing in my thesis project. By means of implementing an existing and efficient technology already developed for other appliances, I can focus on the design and the experience I want to create around it. Using magnetic induction for the cooking section of the appliance, I can ensure there won't be any risk of fire or burned food because of the shut-off system and non-heating surface this technology uses. In addition, students will find within the case, a complete set of all the basic cooking utensils. Therefore, there won't be any loose pieces all around the dorm. On top of the case, the lid also works as a surface area for cutting and getting food ready prior to cooking. The good thing about the system is the

fact that it can be carried around, used and accommodated wherever it fits on the room, freeing up the space for other objects or activities.

Lastly, the design language is appealing to the target, the sleek and simple design makes the object an elegant appliance that perfectly hides its content and seems a decorative element of the dorm. It comes in three color choices to match the user color preferences. An easy to carry, easy to clean and easy to store design that houses cooking and serving pieces is a perfect complementary appliance that students can acquire by themselves or colleges can provide to be shared by the dorm community in specific areas where they would enjoy it.

INTRODUCTION

The human habitat and its surrounding context are changing at an accelerating pace. Among the factors affecting the context are: available living space, population growth, income levels and climate. If the context changes, so do the objects in the habitat, in order to meet space requirements and users' needs. Objects may become furniture or equipment designed to supply a demanding user living in a constrained space. Thus, the role of the object (furniture or equipment) is to mediate the relationship of inhabitant to habitat, avoiding uncomfortable living conditions even in the smallest areas.

This thesis project proposes that the dorms, no matter its size, will provide inhabitants with the necessary equipment, optimizing the space and improving living conditions. In addition, the project will invite inhabitants to do more social activities thanks to the broad services the final outcome will supply. This project also uses a cutting-edge technology for the final product, which not only reduces the risks of accidents while using the design solution but also the amount of energy consumption.

Ideally, the final product designed here could be adopted by any habitat, but its primary focus is for use in a small space, and its design is specifically suited for college student dormitories (dorms). After some preliminary studies, analysis, and research, student dorms at RIT and elsewhere were found to lack equipment specially designed for small spaces that were functional for its inhabitants.

Therefore, this project was conceived as a broadened opportunity to fulfill some of the dorm residents' basic needs and provide them with a product flexible enough to be used by more than one user, whenever or wherever in the residence.

The advantages, then, are not only to the user, but also to the space, which, now free of stationary equipment, allows the inhabitants to have a more comfortable space that still meets their basic needs and requirements.

Problem Statement

It is believed that a student living in a college dorm will be always limited to the use of a minimum of goods and equipment, but the situation can be improved if there were specially-designed equipment for this type of small space. Despite the fact that colleges provide most of the necessary equipment for a pleasant stay in a dorm, there is still a need for supplies that would improve the experience of dorm living. For instance, when it comes to cooking facilities, the typical college solution is a cafeteria with a limited selection of foods that does not always match students' food preferences. Food seems to be a low priority when in college, but it is, in fact, one of the most important issues for parents, students, and the college, since a well-nourished person can concentrate and perform better academically and socially.

The solution, then, will be to increase habitat functions through new equipment that meet the needs of more students and make them live more comfortably. Once the product integrates within the context, the student will associate even more a dorm with his/her home, which is one of the intentions of the equipment. After

enhancing the habitat services and supplying basic human needs, the product will also be an instrument to foster social interaction, while increasing user expectation and satisfaction. Even if the product is used only with roommates, the student will significantly improve his or her living conditions while in college.

Thesis Proposal

My thesis project's specific objective is to supply inhabitants of small spaces with a convenient cooking and eating unit. I will design a system capable of performing more than one task that incorporates the minimum needed pieces and space for preparing, cooking, and eating within the system.

Goals

- Target is a college dorm, a small space where occupants strive to make the most of the space to live comfortably.
- Mediate the relationship between environment and the occupant, in order to make inhabitants feel more comfortable in the space in which they live.
- Provide an incentive to get together and share time with roommates and friends while using the system.
- Design equipment to be used when needed and stored when not in use, in order to free up the habitable space.
- Take better advantage of the space by building up a system that performs several tasks to accomplish one main objective, and allows the users to make their eating time an enjoyable, anticipated experience.

- Design a flexible object that can be portable and placed anywhere in the space.
- Evoke the feeling of home cooking through the design of the system and its elements.
- Incorporate cutting-edge technologies in the mechanism, which will reduce electric consumption and avoid fire or user injuries.
- Demonstrate through characteristics that the object belongs in a small space.
- Introduce a breakthrough product into the college student market.

DORMITORY AS THE SMALL SPACE

First of all, it is important to introduce the target context of this project.

Dormitories, or dorms, shall be defined as a place on campus where students live while attending college. Dorms can have single, double, or even triple occupancy rooms. There are dorms with quad occupancy, but these are usually considered apartments. In a traditional dorm, there are community showers and shared common areas with kitchen equipment or televisions.

Student residences are intended to make the student feel at home, with a wide variety of academic, cultural and social activities. Living on campus encourages students to meet and share with many people and make new friends. There is a great advantage to having all the facilities and classrooms close by. It positively impacts academic performance by allowing the students to focus full-time on their studies. As the on-campus population grows, so does the demand on equipment

and supplies needed by dorm inhabitants.

Colleges are becoming increasingly aware that helping students accommodate in is reflected in more successful academic performance. As stated by Reslife¹, an online housing resource in the USA, students who live on campus tend to be more actively involved in college activities and achieve higher grades than those who opt to live off campus. Therefore, more and more colleges are striving to build more accessible, functional, and comfortable facilities that motivate students to pursue their academic goals as well as develop a social life. After a year or two on campus, students may investigate off-campus living, as they will have established fairly strong social networks and solid study habits by this time.

Major cultural exchanges occur on a college campus where differences become opportunities to broaden one's skills. Dorms are among the best places to have experiences and opportunities to learn and be exposed to several cultures. For instance, cooking may be the thing students want to do least. However, if there are students from many cultures, they might get together to share a meal made of varied dishes, giving an incentive to socialize.

It is quite important for students to find not only facilities but also the right equipment to facilitate academic, social and personal activities.

¹ Life on a College Campus, a Guide for New College Students, October 2006, <http://www.reslife.net/>.

Chapter I

Target Context and its Impact on the User

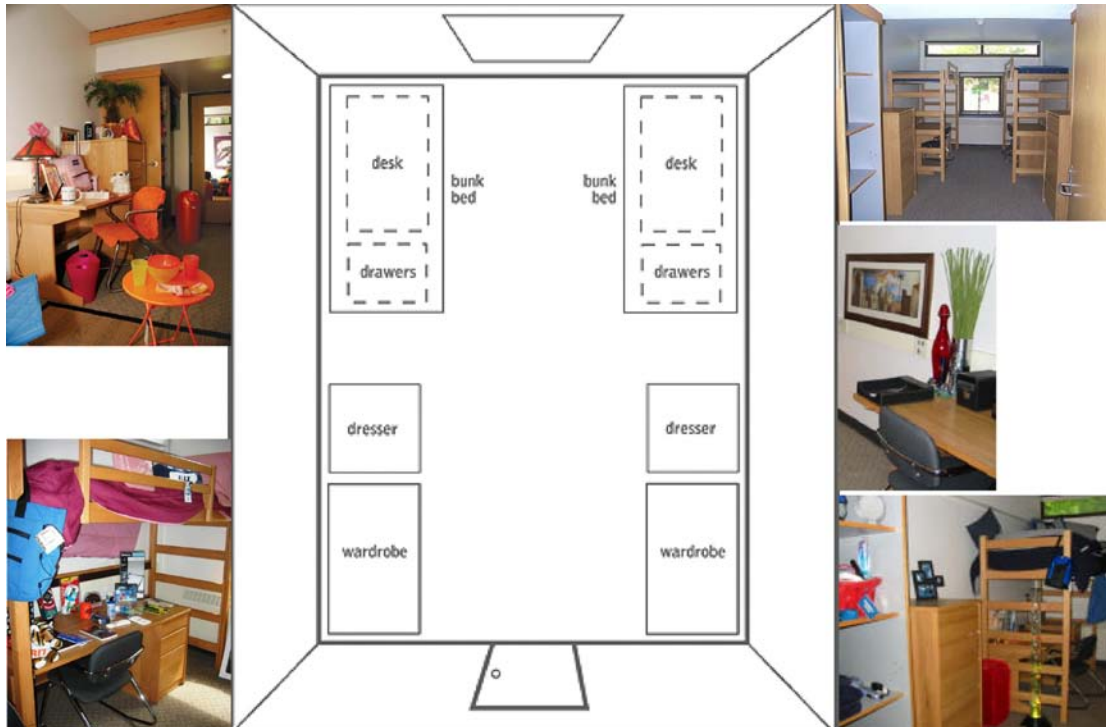


Fig. 1-1 RIT Residence Halls

Rooms range between 12'x14' to 10'x18'

Single, double or triple rooms can house from one to four college students.



Fig.1-2 Double dormitory, Residence Halls² at Rochester Institute of Technology. Amenities include 2 cabin beds, 2 movable desks, 2 dressers, 2 chairs, and a closet.



Fig. 1-3 Communal areas are provided with a small dining table, 1 sofa, 2 arm chairs, 2 long tables, 1 microwave oven, sink, faucet and television.

Living in campus residences (Fig.1-2) is an experience that allows one to exchange ideas, thoughts, customs, cultures, etc. Whether students come from the same country or not, there are always differences between family upbringing, backgrounds, and cultures. However, these variations foster learning from each other and contribute to social interaction. (Fig. 1-3) The transition from home to college is always an anticipated but sometimes difficult step. Therefore, students expect to create a kind of home-like environment so that they may fulfill some of their needs as they used to do at home.

² <http://reslife.rit.edu/photogallery/>
<http://finweb.rit.edu/housing/residence/>



Fig. 1-4 Students in the Residence Halls at RIT. Parallel to academic duties, they play table games, video games, watch TV, and share meals.

(Fig. 1-4) One of those vital needs is eating, depending where students come from, their meals and the way they are prepared varies. Due to different preferences, it might take a time to find the perfect meal for everyone, especially on campus, where menus are not always well-balanced and nutritious, and fast food is a frequent, easy choice.

Searching for the appropriate meal is an important process, because students need to be well-nourished and healthy in order to concentrate and have enough energy to support the heavy work study load and succeed in school. Most students living in a dorm have no choice other than the dining halls on campus because cooking in residential rooms is restricted, as a way to prevent injuries or fire. Thus, it is less likely that they cook at the residences. Despite the restrictions, forbidden equipment is illegally used and, even worse, these goods are designed for other contexts, making the space dangerous.



Fig. 1-5 Home-like room
In order to live in a home-like room, students stock them with all the necessary food to cook some type of home-made meals.

(Fig. 1-5) With the use of the right equipment and a safe cooking area, students might enjoy cooking healthy meals for themselves, and share with roommates and friends.

The study done by psychologists Kelly Straw and Christina Gerhard, “The Food Voice: Connecting Cultures and Combining Cuisines: Adapting to Eating with Diverse Female Roommates in College Dorms,” describes the main limitations, needs and desires of students living on college campuses. For instance, they mention two of the most difficult issues in dorms: the fact that everybody needs to abandon food preferences and stick to what is available and new feeding habits resulting from the exchange of food among roommates. Students complain about the imposed eating choices and how the new context affects their food opinions, habits and preferences. Whether they get along with roommates or not, the space constraints limit them to separate their food and belongings. Thus, students yield to new food choices, and share goods and supplies as a means of saving space and living in community.

Even though students' personal food choices are altered, they see it as positive in some aspects. For instance, the exchange of food and cuisine habits is, in the end, a way to enjoy dining with roommates and friends. Following is a fragment of the article *The Food Voice*, describing some of the experiences of college students:

By observing students, such as Pamela Kuemmerle, we were able to discover how their new living arrangements, in which they are forced to spatially and culturally accommodate each other, affect their relationships with one another through social bonds and the dismissal of traditional norms, as well as personal choices that are formed through each individual's food identity. Pamela has been stressed about finding the perfect restaurant to carry on her family tradition. Pamela has been successful in creating a sense of family and community within her dorm:

"I really like coming back to the room after a long day of classes and relaxing with my roommates. Typically, a different snack is passed around as we talk about funny things that happened that day, and it reminds me of what my siblings and I used to do after school. The only bad part about this is that I feel like I've been eating a lot more. With five girls in one room, someone is always hungry."

As shown in the example, students enjoy sharing a meal, either small or large, but a meal nonetheless. However, some are conscious of the poor quality of what they are consuming and try to find more nourishing ingredients and prepare meals by themselves.



Fig. 1-6 Plastic pot

In this figure, a plastic heating pot has been adapted to cook some sort of home-made food, even though it is not really safe, and the variety of meals is still limited. Whether for time, space, budget, housing policies, or other reasons, eating during college years can be a radical change in someone's life. Usually food is provided by the school cafeteria and is not always tasty or healthy, but assuages hunger. The college cafeteria does not always please students, and they may look for ways to make their own meals. The options for cooking are limited, and so are the tools allowed in a dorm or provided by the colleges because of the danger it would represent.

As revealed in The Food Voice study, interviewed students missed home-cooked, balance meals, and admitted that their emphasis on nutritional value is often sacrificed due to accessibility, price, time and overall convenience.” (Fig. 1-6)

From this study the impact of dorm life on some aspects of a student's habits is confirm.

Although students keep attachments to their home-like life and are persistent in preserving culinary habits from home, or at least trying to make them as similar as possible to home, it is the most difficult time to preserve good eating habits. It is in college where they are careless about the importance of eating well and where often they fail to do it well. Therefore, this project gives students an opportunity to have something of home and it encourages them to make healthy food choices.

One of the most rewarding experiences for students in dorms is the social role. Using meal preparation, students will attract roommates and friends and expand their social circle, which will foment cultural exchange. Meal preparation can encourage individuals to show their skills, strengthen personalities, learn from each other and enhance experiences.

Although it can be difficult to live within a tiny area, dorm living teaches inhabitants to live with only the items necessary to meet their basic needs, take better advantage of the space, and fit objects that allow others to have their space too, all in addition to developing a proactive personality and respect for the boundaries and limits of others.

Undoubtedly, the list of needs from college inhabitants will be an opportunity for this project to tackle, especially the issues that seem least important but in the end strongly affect students while in college.

Objects for Small Spaces

It is a myth that you cannot use big things in small spaces. Oversized objects - as long as they do not stop you from moving around freely- make the atmosphere seem bigger. (Helen Ellery, Interior Designer)

The debate about the correct size of objects for use in small spaces never ends.

Whether smaller is better, or bigger can be fitted, the truth is that, more than the size of an object, its function and the interaction within the space make it appropriate for a small space. Functionality shall be defined as the frequency of use and efficiency of an object to accomplish tasks demanded by the inhabitant. Interaction is the capacity and flexibility of the object to adapt itself within the room and allow the user to adjust it.

Unlike Helen Ellery, Joe Colombo places more importance on the integration of the object on a space rather than in its size. When there is good match between a niche and an object, the object's profile changes from being another element inside the space to an extension of it. This enhances the human habitat and provides more livable conditions to the inhabitant.

All objects needed in a house should be integrated with the usable spaces; hence they no longer ought to be called furnishings but "equipment".
(Joe Colombo³, Inventing the Future 1970)

³ Joe Cesare Colombo (1930-1971) was an Italian industrial designer. By experimenting with new materials and using the most advanced technologies, he created a kind of "machine for living," habitat of the future: multi-function mobile units, like "**VISIONA 1**", "**TOTAL FURNISHING**", "**ROTO-LIVING**", "**CABRIOLET-BED**" and "**MINI-KITCHEN**".

Objects are not only providers of services but also modifiers of the small space. To do so, objects should be versatile, by allowing the user to accomplish a diversity of activities, almost becoming multifunctional. In addition, flexibility is an important quality of objects for small spaces, so that the resident can move objects within the space.

Despite an area being very small, objects do not have to be small as well. In fact, filling up the space with “mini-stuff” might clutter it more than having just the necessary practical pieces in a regular size. Thus, taking better advantage of a small room is simply a matter of choosing the appropriate equipment or practical solutions that avoid unnecessary furnishings. Such solutions are objects that follow one or more of the following principles⁴:

- Vertical stackability: To line up objects allow storage of more pieces.
- Movable furnishing: Non-stationary object, free to move around, adapting in several contexts.
- Multifunctional: Objects useful for more than one room.
- Versatile: Capable of doing two jobs at once.
- Collapsible: The object’s size can be reduced when not in use, in order to free up the space for other activities.
- Modular: integration of similarly-shaped pieces, becoming a compact object.

If at least some of these features are applied when designing and choosing goods for small spaces, in this case college dorms, there may be more free space for inhabitants and their activities without clutter.

⁴ Small Spaces: Making the most of the space you have. New York, NY: Rylan Peters & Small, 2003.

Existing Objects for Cooking in a Small Space

The housewares market has grown in response to different scenarios in the human habitat. As long as the human habitat changes, so do the furnishings. More specific needs are being met and the range of goods broadens at an astonishing rate. One of the scenarios that have experienced enormous growth is student dorms; indeed a whole culture has arisen from this type of life. Every day, the market focuses its efforts in providing discriminating students with items that mimic a home-like life in college.

Although settling in a dorm that is like home would be ideal, it is imperative to furnish only the necessary equipment due to constraints in space. Also, the purpose of living with roommates is to learn how to share goods as well as respect each other's space. Having that in mind, students can narrow down the list of desired belongings to what is required for living in college residences. One way to choose the type of objects one might need is sorting by importance and impact on a student's life. For instance, eating is mandatory; therefore, there must be some sort of cooking equipment. Studying is a primary purpose for going to college, thus, good conditions for this activity and a comfortable space is required. Rest is as important as eating, and socializing helps students develop their personality and recharge energy for study time.

Eating is one of the most basic and important human needs. Consuming healthy and well-balanced meals can ameliorate the physical and mental capacity of a student, making a great difference in his or her academic and social performance. Thus, it would be a benefit colleges could provide more opportunities for students to fulfill this basic need.

Although there are some cooking units that have been developed for small contexts, what is already available does not perform more than a single function. Therefore, cooking needs are met by other units or devices, requiring more goods and overcrowding the room. There is no product on the market today that adequately fulfills the needs of college students cooking in dorm rooms.

The existing products found in the market may be classified as movable or stationary. Movable is defined as those products capable of being stored when not in use and carried about within spaces, allowing the user to freely move and still enjoy the service of the object. In contrast, stationary are those products with a prominent volume and a much heavier weight, which are not meant to be moved but rather fixed in a given place for routine use. This category might be the least convenient for dorms and restricts the user from utilizing the object in more than one room, since it cannot be carried around.



Fig. 2-1 Lean Fat Grilling Machine

A compact grill, the perfect size that fits in any room, is a good option to cook some healthy, quick meals, although not much variety of meals can be made on it, e.g., not soups, rice or pasta. After being used, it can be stored, freeing up space. This is a convenient option in terms of volume and portability, but undoubtedly is not multifunctional. Therefore some additional cooking units would be needed.



Fig. 2-2 Plastic Cooktop

A lightweight plastic cooktop works with magnetic induction that minimizes the heating period. Time and temperature can be set across a wide range. The unit shuts off by itself after the chosen heating time ends, avoiding burned food. Its flat and wide surface supports several sizes of pans, which allows cooking a variety of dishes. This unit is safe, quick, relatively light, and portable. However, this

simple design, as a practical solution for small spaces, still lacks additional pieces to provide more than one service; therefore, it is not multifunctional.



Fig. 2-3 Rice Cooker

In a rice cooker one just adds the ingredients, closes it up and let it cook. It is quick, safe, small, portable, but its function is limited to cooking and heating only specific food, limiting variety of meals. Cooking time and functions can be set as needed; it shuts off by itself when cooking is complete

These are some examples of the current products the market offers for small spaces. However, these solutions each provide a service limited to one function, leaving aside valuable elements that would enhance product performance and avoid the need for additional objects. Thus, the goal of supplying a student with an all-in-one or multifunctional item that contains most of the required elements to prepare a healthy meal is only partially accomplished and underdeveloped. Yet, this is the type of product a student living in a small space should have, ideally with added convenience in configuration and flexibility in movement.



Fig. 2-4 Mini-Kitchen

“Designed by Joe Cesare Colombo in 1963 and produced by Boffi in 1964.

This small one-piece kitchen on wheels contains all the electrical appliances and necessary features one needs to cook for and accommodate six people, in just one half of a cubic meter. Electrically powered, it is made of wood, steel and plastic.

On the other hand, stationary or permanent objects, almost always prominent in volume and size, do provide a wide variety of services since their big areas (in contrast to the portable unit’s size) are fragmented in parts in order to use each compartment for a specific purpose. As figure 2-4 (above) shows, this multifunctional, almost-a-gadget object provides all the services gathered in one compact volume. Refrigerator, cutting surface, storage compartments, and stove are well-integrated in a fairly complete unit. In addition, the wheels allow moving the object throughout the space and placing it in a convenient area to clear the room for the user, rather than being always fixed in the same location. From a functional perspective, this might seem to be the best choice to furnish the majority of the spaces, especially a small area. However, for this target context, a college dorm, it seems less convenient since it will take a significant portion of the already constrained room space and it cannot be accommodated within the room’s furniture.

Undoubtedly dorms are not as easy to furnish as one may think, and even existing products, though cleverly designed and quite functional, are not fully-equipped choices to fulfill all student cooking and eating needs. More functional and appropriate equipment still needs to be designed to develop an innovative product in the gap between the two previously-described categories. In other words, a convenient solution should be created, enhancing functionality of products for small spaces, and avoiding limitations of current equipment.

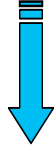
Chapter II**Design Scope**

Fig. 3-1 RIT Dorms (Residence Halls)

When designing a product to meet the demands of students living in constrained spaces, the outcome must be an extension of the habitat. In other words, the product must be appropriate for the context it is design for so that enhances it and improves the services the space gives to the inhabitant.

Factors such as type of space, its size, distribution of furnishing and equipment and amenities strongly impact inhabitants. This project will strive for evoking positive feelings in the user, parallel to providing a practical solution. When in use, the product will encourage new ventures that positively impact student mood.

Project Scope



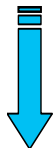
Reduce physical and emotional impact on the user by providing appropriate equipment for the human habitat

Major goals

Take better advantage of the small area.

Translate needs into a system that meets these.

Mediate in the relation of human to habitat



Dorm area 100 sq. ft
155 sq. ft must house furniture, equipment and inhabitants.



Object engenders reactions in the user during and after the interface.



Human — **Object** (medium) — Context

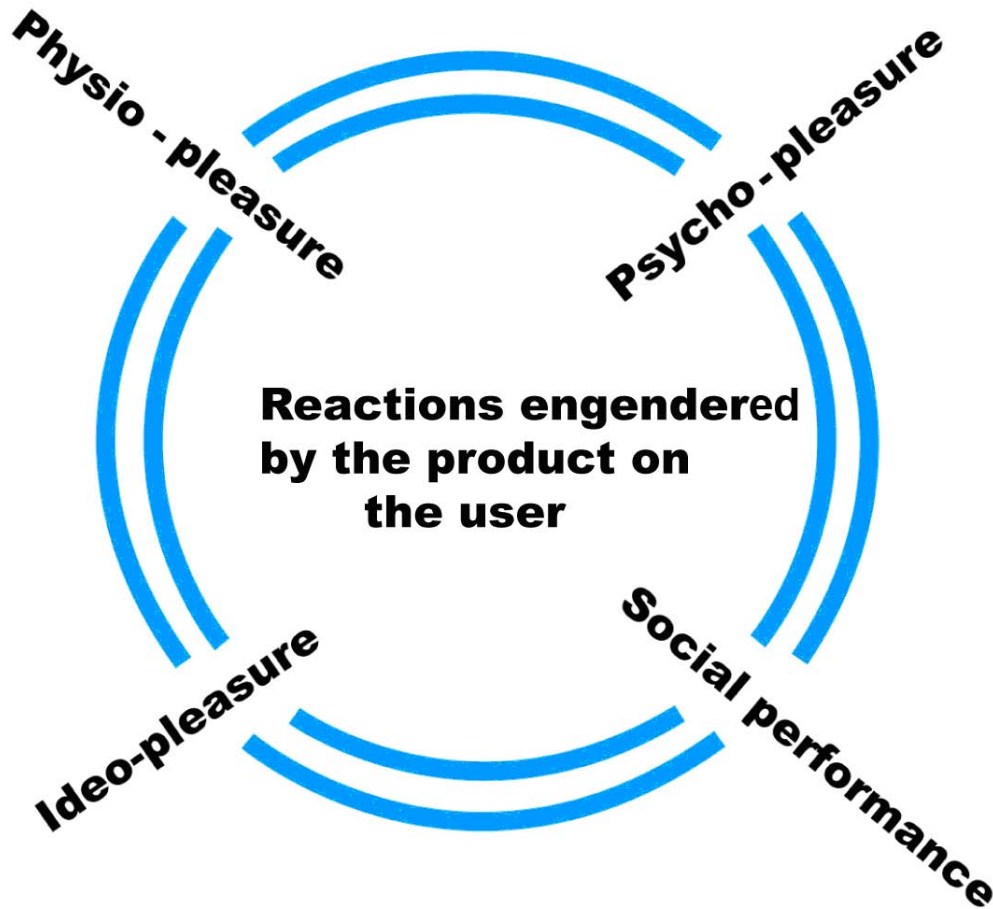
(Physic - Psycho - Idea – Socio)⁵
Type of reaction reflects satisfaction⁶ or rejection when interacting⁷ with the product.

Comfortable Living

⁵ The Four Pleasures, Lionel Tiger.

⁶ Pleasure with Products. William Green and Patrick Jordan. Taylor & Francis, NY 2002.

⁷ Respect: Human-Machine interaction. Kees Overbeeke and Tom Djangadiningrat.



The product will be designed to answer needs in these four areas:

- **Physio – Pleasure:** Physical gratification derived from the sensory receptors, e.g. touching a soft or rough surface evokes positive or negative feelings, influences mood and user's behavior.
- **Psycho – Pleasure:** Satisfactory outcome and relevant feelings engendered from accomplishing a task, e.g., fulfillment of the task using the object, brings tranquility and satisfaction to the user.

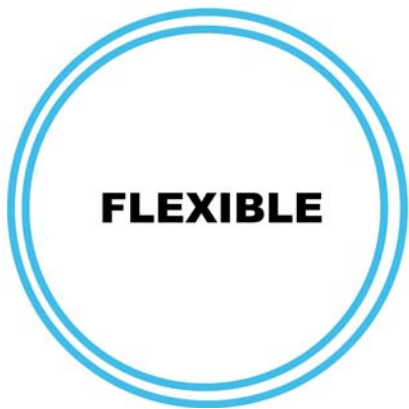
- **Ideo - Pleasure:** Features aesthetically appealing to the user and the system is easy to read and operate. Also the degree of impact on the context (out of context or suitable within it) e.g., shape, color, material, and ease of use make the user identify him or herself with the object.
- **Social - Performance:** Facilitates social interaction with roommates and friends and eases object-user contact, e.g., during spare time, friends gather in student dorms to cook using the object, and play some table games.

As mentioned previously, it is imperative to meet the main goal of enabling college students to make and consume nourishing food. To pursue this, the unit intends to draw student's attention, being a break-through product for small spaces with all the necessary elements to cook well. In addition, an eye-catching geometry and pleasant aesthetic appearance makes this unit a highly desirable must-have product for dorm inhabitants.

Object's Main Characteristics



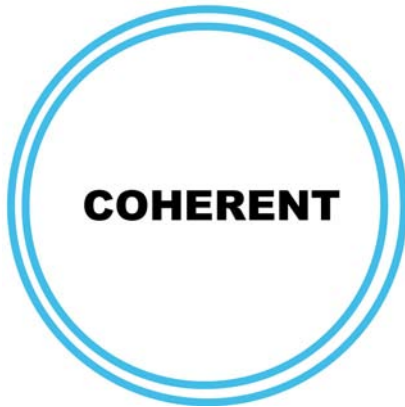
A versatile product is that with additional functions to accomplish more than one task, fulfilling more needs with only one system. Therefore, the more it efficiently serves daily activities, the more meaningful it becomes for the user and the better it suits the dwelling.



Thanks to its versatility, the object is multifunctional and remains open to be adapted in any place the student wants to take it. It is also capable of transforming and accommodating in different situations in the habitat. Mobility and freedom are characteristics of this design.

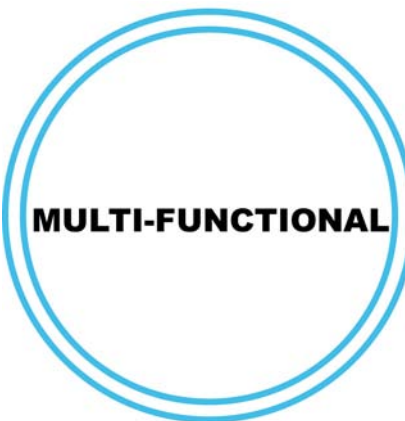


This unit is sustainable in that it is built with minimum necessary parts that divide the overall cooking activity into small steps. The system also uses cutting-edge technology to maximize functionality and reduce energy consumption, which substantially decreases the impact on the environment, the user, and the unit itself. Also, the architecture of the object allows easy replacement of components when needed, without affecting the whole function or product. Each piece is standard and can be found in typical sources like markets, so that the user does not have difficulty purchasing the part.



Coherence in the unit can be defined as the physical coordination or good matching of all the components.

Coherence refers to how well they interplay and engage to fulfill the main objective. Hence, coherence evokes harmony during the interface of the user to the object, and better integrates the equipment within the context.



Versatility and multifunctional are some of the qualities of this product because it supports cooking, preparation and storage. Also the product gives an incentive for social encounters through its use, fostering new experiences for the user and a broadened usability for the object.

Thus, the object not only performs its function well, but it is also an efficient community connection.

Design Process

Design Evolution

Early concepts show a divided volume whose sections are conceived as the space for each activity from the identified user demands: preparing, cooking, and eating. These actions drive the design solution and every idea evolves into a compact object that houses several components when not in use.

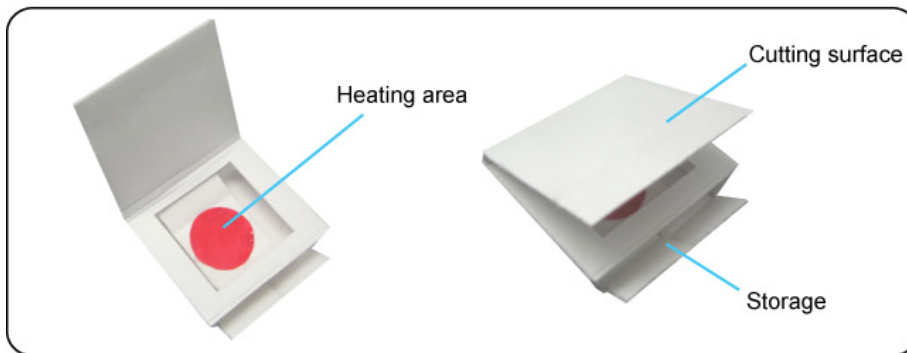


Fig. 3-2 First concepts conceived as volumes with sections for preparing, cooking and eating.

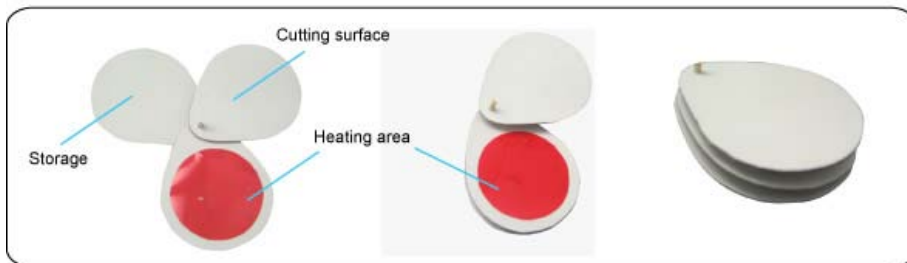


Fig. 3-3 Attached at one side, the object is spread out to access every level and perform the assigned functions.

These ideas explore the relationship of the cutting board and the heating surface:



Fig. 3-4 Spin core: The next sequence of concepts explores the idea of turning the flat cutting surface at the center of the structure to become a hot surface on the other side. Also it can be that both faces are used as cutting boards and then removed to reveal the heating zone underneath.



Fig. 3-5 Hot zone at center: For this concept the flat, movable surface has dual functions. The anterior face is the cutting zone and the posterior is the heating zone (red dot).



Fig. 3-6 Bendable sides: In this case the hot zone is at the center of the unit and the bendable sides serve as the cutting surfaces.

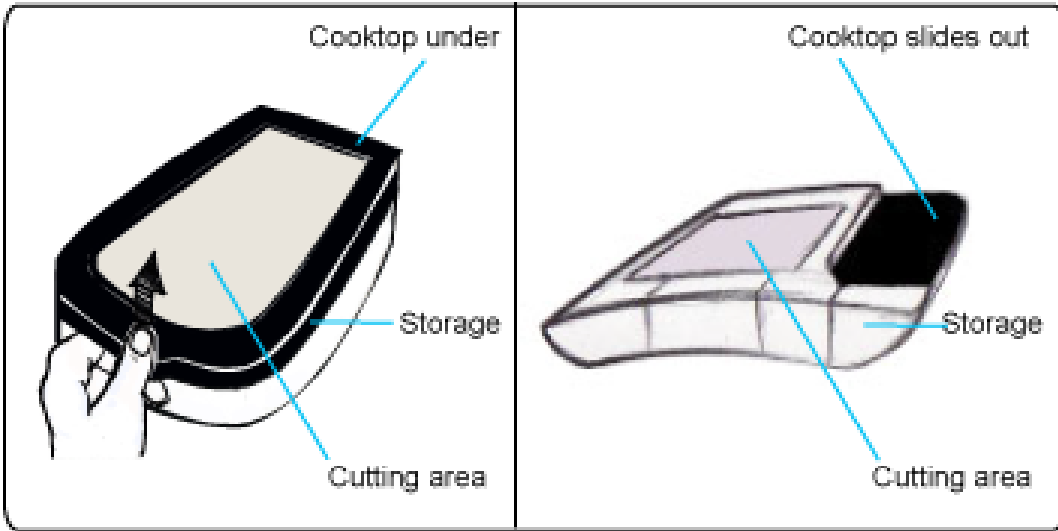


Fig. 3-7 Single Body: These concepts explore a single, compact volume dividing the top into areas for each activity. The cutting, heating and storage zones are integrated, making a compact unit, but the object is oversized. Therefore, flexibility to relocate to other areas is limited.

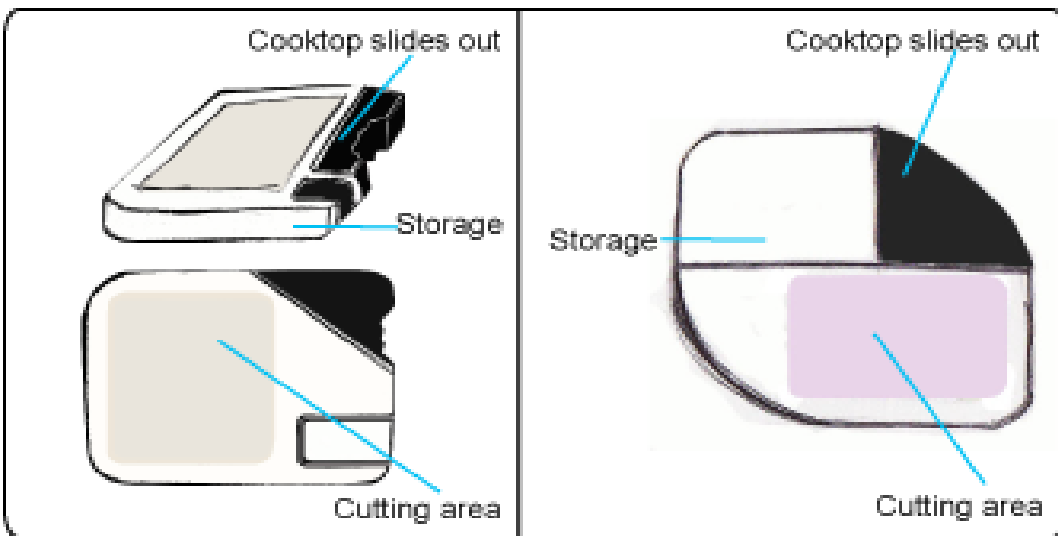


Fig. 3-8 Rectangular one level unit in different configurations: left top explores side heating area; left bottom, on the corner heating area slides out and last configuration on the right, storage cooking and cutting zones are all exposed, non slide out parts.

Sectioned and lined-up designs are a way to achieve a compact volume that allows easy storage and transport of the unit. To operate the cooktop or hot zone, the cutting board (lid) slides out to the right side and the storage compartment underneath slides to the left side.

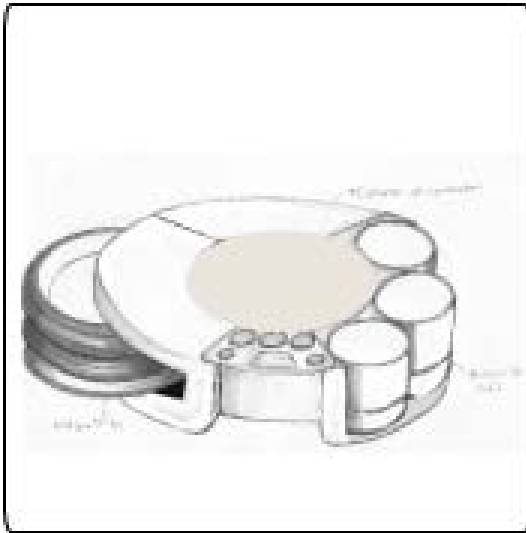


Fig. 3-9 Open unit

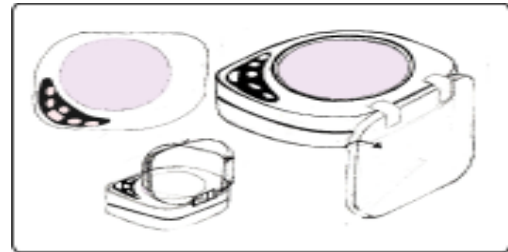


Fig. 3-11 Live-hinge, lid as cutting mat opens up revealing cooking surface; underneath storage space for cooking and eating pieces.

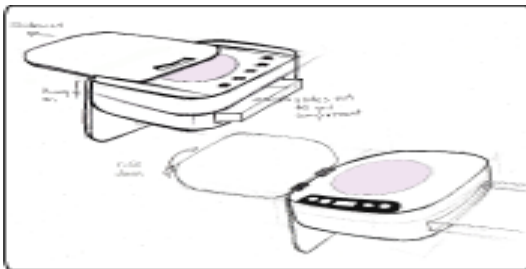


Fig. 3-10 Slide out parts, cutting board and storage slides in and out but cooking zone without motion remains as axis of object.

The idea of a round open unit is to keep the hot zone at the center for safety and accommodate other easily accessible elements such as dinnerware around it. On top of it, as a lid, is the cutting board. Some of the side elements fit well, but some others remain as though floating in space. There is not yet enough storage area for additional pieces.

The next models explore motion of the components to access aligned compartments. These two prototypes show similar deep volumes with the hot surface under the cutting board, which also functions as unit lid. They differ in how

the lid is removed. One idea is to slide out the cutting board and let it hang from the left side. Fig. 4-3, a hinge allows swiveling and hanging the lid to the side while the hot surface is in use.



Fig. 4-1 Compactness



Fig. 4-3 Slide-out cooktop

Half of the unit must be removed because the compartment under the hot zone stores the dinnerware pieces.



Fig. 4-2 Spin cutting board

On the left, a small body, deep enough to accommodate collapsible dinnerware pieces. It is divided into three aligned sections that interact to support and distribute the weight. The order of the parts is assigned by their use and volume.

Sitting on the cooktop, the cutting board spins on an axis to reveal the hot zone (figures 4-1 to 4-3).



Fig. 4-4 Two halves design



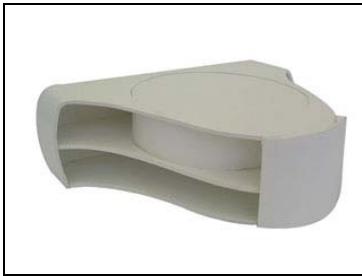
Fig. 4-5 Bottom half



Fig. 4-6 Compartments

This idea shows a deep volume divided into two sections. The upper part is the cooktop and the lower, bigger section is the storage area. The empty round area is to accommodate plates and access them fast.

Inside the storage, there is plenty of space to accommodate collapsible dinnerware pieces, such as cups, forks, knives, spoons and plates. In addition to being multifunctional, the vertical configuration and compactness of the volume saves space when not in use.

**Fig. 5-1** Open sides**Fig. 5-2** Upper cooktop**Fig. 5-3** Higher volume

Disadvantages are the large size and the requirement for collapsible pieces, which might be complicated to find and replace, affecting the lifetime of the product.

Similar to previous prototypes, figure 5-3 is a compact volume with sections and just the lid movable. The dinnerware pieces are taken in and out of the storage area.

The cooktop is on top of the storage space, and is protected by the cutting board that sits upon it. When not in use, the board slides in under the storage.

Advantages of figure 5-4 are the small area occupied by the object, integration of the levels, absence of mechanism to move the parts, open storage area, and prominent corners that work as handles. The cooktop's heavy part needs to be supported by an underlying strong structure, making the unit oversized and heavy.



Fig. 5-4 Two slide out trays



Fig. 5-5 Wide Open sides

The idea on figure 5-5 is an evolution from figure 5-3. The addition is two movable trays on the storage zone, which hold dinnerware pieces. These trays open outward so that the dinnerware pieces are easily accessible.

Cooktop on the upper area and an amplified, underneath storage compartment make this design another step in unifying the object as a means of building a portable unit.

However, its large size makes it difficult to carry around and accommodate in the dorm.

Moveable parts as the lid or cutting board changed the way dinnerware pieces would be accessed, but it also makes these trays weak because they could break if support many pieces and limited in space because dividers organize but constrain the tray' space.

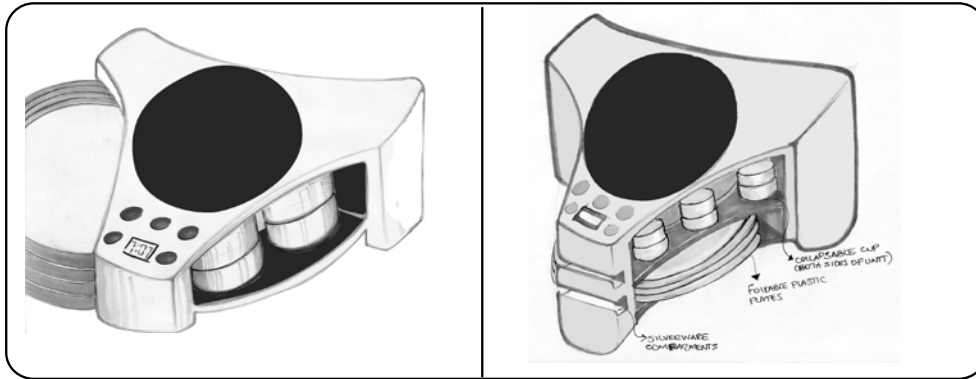


Fig. 6-1 Triangular architecture

These sketches refer to the previous 3D models. They showed how dinnerware pieces might be accommodated. Open sides made it difficult to carry the object around.

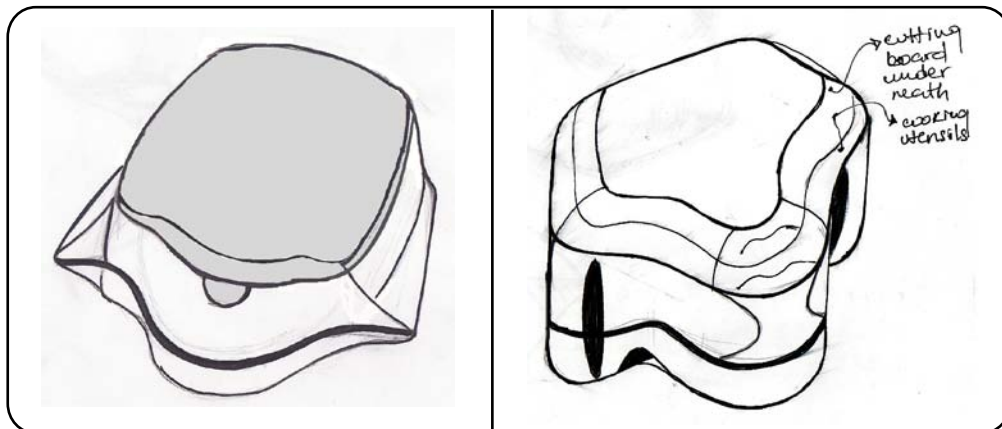


Fig. 6-2 Shells

After the previous opened unit proved difficulty to move about the space, the volume was closed again to ease mobility. A better distribution of the weight was achieved by moving the cooktop under the storage area. This enhanced capacity and moved the heavy part to the bottom. The cutting board remained on top of the whole system as the lid of the storage compartment.

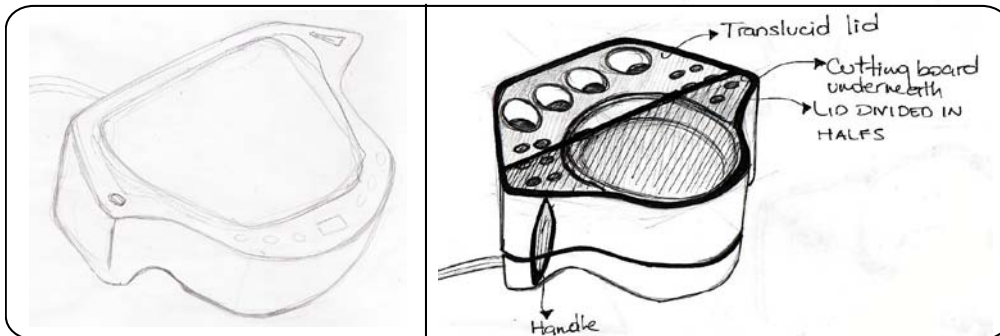


Fig. 6-3 Two Levels: Bottom cooktop and top storage area with cutting board on top.

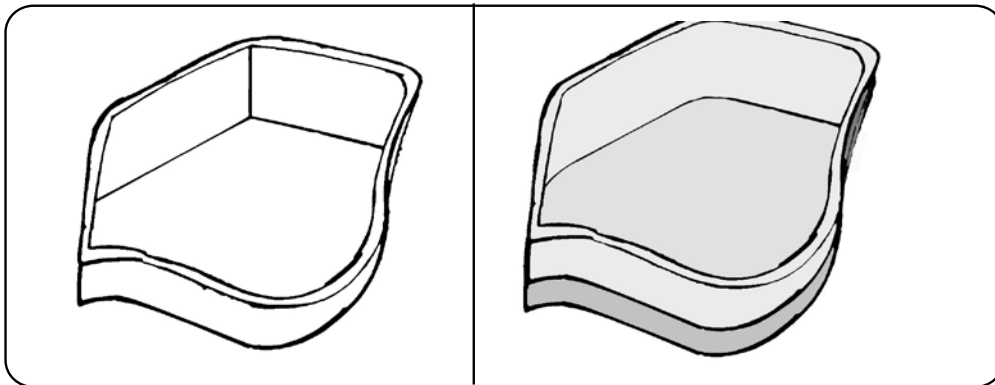


Fig. 6-4 Case

These four ideas explore variations of height, and play with the organization of the pieces within the storage, defining the width of the object. Also, the body geometry is modified so that the prominent sides work as handles for lifting the unit, and enlarges the interior for large-piece additional storage.

3D Evolution

Concepts explained in detail in previous pages.



Fig. 7-1 First mock-ups

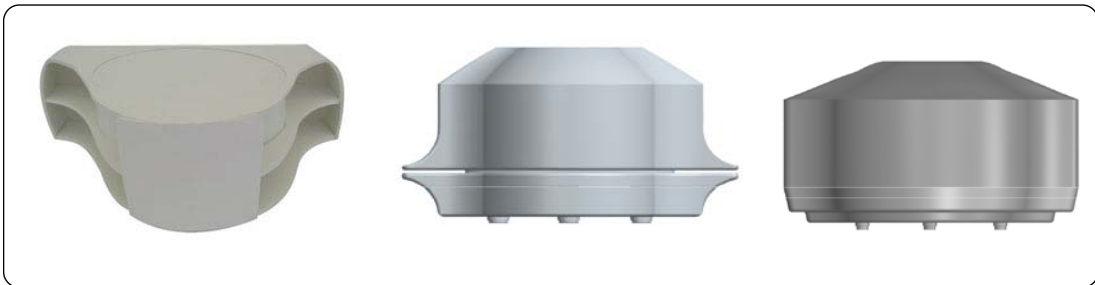


Fig. 7-2 Later mock-ups



Fig. 7-3 Final solution

Design Solution



Fig. 7-4 Product

Gather is a multifunctional unit for cooking in small spaces. This compact volume houses most of the pieces necessary to prepare, cook and eat nutritious, homemade meals.

It is designed for students living in college dorms. It provides an incentive for social interaction, gathering roommates and friends to share meals when using the unit. Gather creates a feeling of home.

Design Components

Main parts

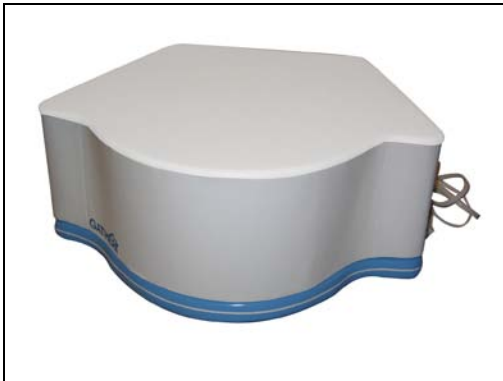


Fig. 8-1 Main Assembly



Fig. 8-2 Cutting board



Fig. 8-3 Magnetic Induction Cooktop



Fig. 8-4 Storage Case

Components:

Section	No.	Part	Name	Qt'y.
Top Level Assembly	1	Body Assembly	Cutting Board	1
	2	Body Assembly	Storage Case	1
Lower Assembly	3	Body Assembly	Cooktop Device	1
	4	Body Assembly	Cooktop Surface	1
Auxiliary Pieces	5	Cooking tools	Knives	2
	6	Cooking tools	Utensils	2
	7	Cooking tools	Spatulas	2
	8	Dinnerware	Plates	4
	9	Dinnerware	Bowls	4
	10	Dinnerware	Cups	4
	11	Dinnerware	Silverware set: knife, spoon, fork	9
	12	* Cutting Board aux. ⁸	Plastic mat	2
TOTAL PARTS				33
Unit Total weight: 15.14lb				

Auxiliary pieces:



Fig. 8-5 Utensils



Fig. 8-6 Plates and bowls



Fig. 8-7 Plastic cups



Fig. 8-8 Silverware

⁸ Auxiliary plastic mats for cutting different kinds of food, e.g., meat, poultry, vegetables.

Product Description

Cutting Board



Fig. 8-9 Polypropylene cutting board

Anterior and posterior faces are used as a surface to cut different types of food. This cutting board second function is to be the storage case's lid. This is the surface for transforming the food and preparing to cook.



Fig. 8-10 Polyethylene bendable cutting board

These two 2mm (.080") thick polyethylene cutting mat are auxiliary pieces for the cutting board because some users prefer to cut different types of food on different boards. One can be used to cut veggies and the other poultry. These additional flexible mats help to move chopped food without spilling. The two faces of the lid or cutting board can be used to cut meat or something else.

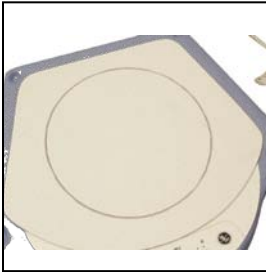
Storage Case**Fig. 8-11** Polypropylene case

The deep middle body of the unit houses several auxiliary plastic dinnerware pieces such as cups, silverware, utensils and plates. The interior dividers keep pieces organized and in place. The bottom of this compartment was perforated so that it functions as a drain for drying the pieces when washed.

Fig. 8-12 Drilled bottom case to drain

The prominent side geometry provides handles. To lift and carry the unit, the front rests on the user's body while the fingers grasp the sides underneath. To use the cooking area, remove the storage case by grasping it from side handles.

Fig. 8-13 Inside detail

Magnetic Induction Cooktop**Fig. 8-14** Ceramic Glass Surface

function is to conduct magnetic induction directly to the steel or ferrous pan.

Fig. 8-15 Cooktop Device

Polypropylene magnetic induction cooktop device supports the ceramic glass surface. This part induces magnetism to a ceramic glass surface, focusing the heat only on the pan.

This is a safe solution for college residents, because it heats quickly, without risk of overheating and fire. It provides several heating options, is portable, lightweight, and needs minimum care and attention to operate.

This is the top surface of the cooktop device. Made of ceramic glass, its

Magnetic Induction

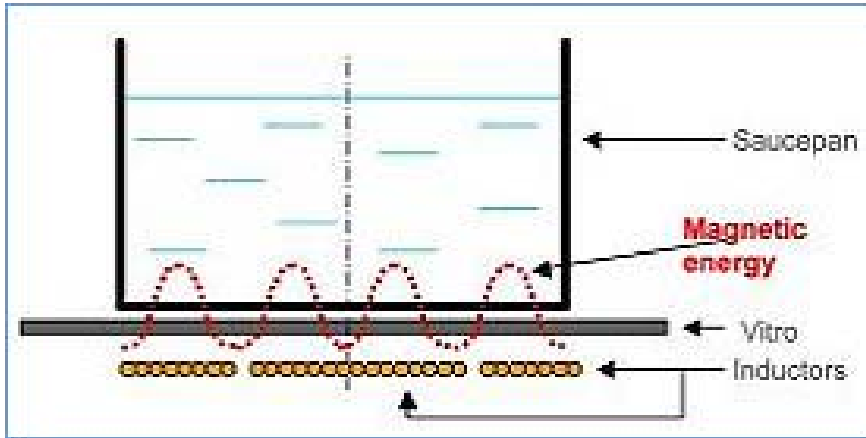


Fig. 9-1 Magnetic field

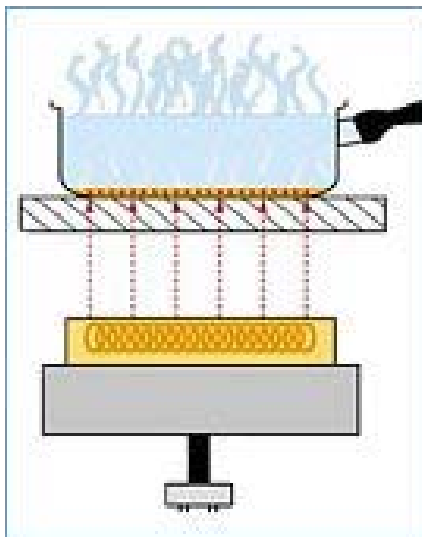


Fig. 9-2 Induction

This efficient technology is a heat source for cooking that is neither gas nor electric; it is induction heating. When the cooktop is turned on, a high frequency induction coil creates an alternating magnetic field. When the bottom of a ferrous metal pan (steel - iron) comes in contact with this field, heat is created. This means the pan, not the cooktop, actually supplies the heat. Thus, the ceramic surface would never be hot.

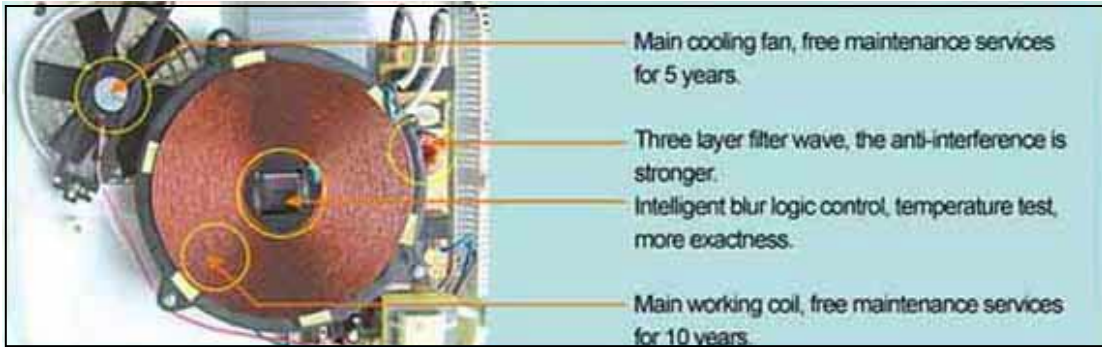


Fig. 9-3 Mechanism

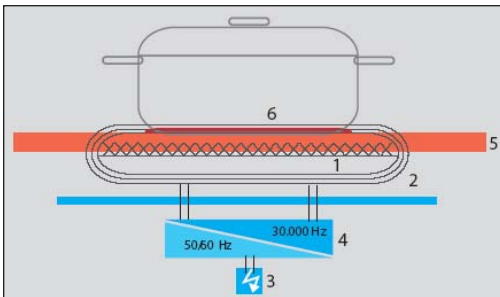


Fig. 9-4 Induction range

Safety

With no open flame or hot coil, the induction cook surface cannot generate heat on its own. Heat is produced solely when the magnetic cookware is placed on the cook surface.

The cook surface remains only slightly warm to the touch, reducing the risk of burns and spilled-grease fires.

Energy Efficiency

While gas provides approximately 55% efficiency and traditional electric coils about 65%, an induction device delivers 85% to 90% efficiency.

When the cooking vessel is removed from the cooking surface, the automatic shut-off immediately begins the cool-down process, reducing heat and lowering room cooling costs.

Full Scale Model Construction**Fig. 9-5** Sculpting the base**Fig. 9-6** Building up case**Fig. 9-7** House of pieces

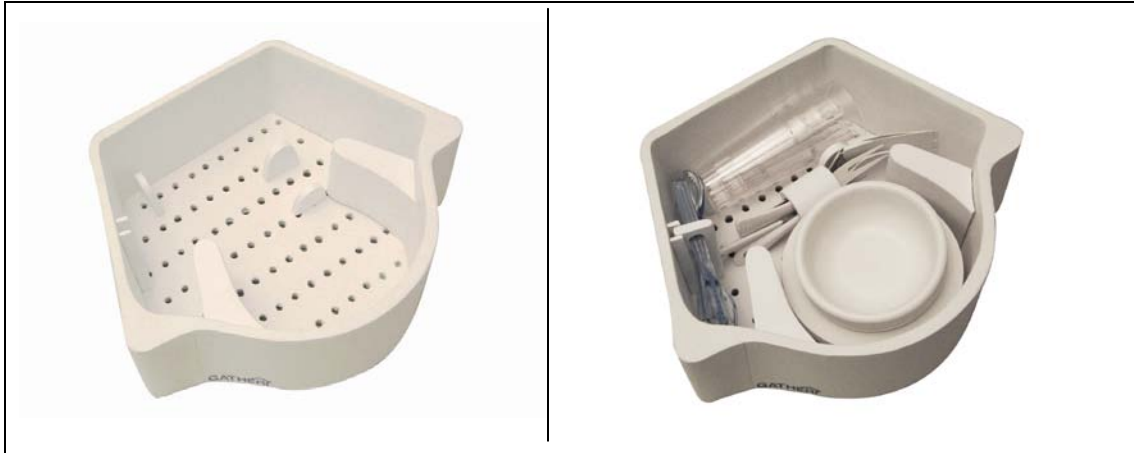
In the model, the cooktop (bottom) and the storage case (middle body) were made of extruded polystyrene, commonly known as Styrofoam. This blue foam was cut, carved and sculpted to build up walls, dividers, and vents. Styrofoam was chosen for the main body of the model because of its properties such as light weight, tough, durable, and mainly for its ease for crafting and modeling.



Fig. 9-8 Cooktop model

To achieve a smooth-finished device, the cooktop was cut from a piece of acrylic, simulating the ceramic glass material. The five legs were made of Styrofoam and wrapped with black foamy (soft, flexible foam). The fan was made of foam core board to recreate the refrigerant system. There are four shallow holes carved on the top face of the cooktop (two larger at front and two smaller on the back). These are axis for aligning the storage case and cooktop.

A wide range of temperatures and functions are provided in the digital controls, which automatically shut off when the cook time is over. Even though the cool down is displayed by a thermometer on the digital control, the top surface will never be hot, but the inside coils will be cooling down.

**Fig. 9-9** Filled case

The main body, walls, base and dividers are made of Styrofoam, wrapped with white styrene for a clean and smooth finished appearance. Holes were drilled at the bottom to drain water when the auxiliary pieces are left drying in the unit.

**Fig. 9-10** Utensils' holder

Utensil holder is made of Styrofoam and wrapped with styrene to strengthen the structure that holds together all the cooking utensils. It has a flat side (bottom) which will sit on a surface next to the cooktop and be used with the utensils while cooking.



Fig. 9-11 Silverware set & holder

Four sets of plastic silverware were adapted to the product. A spoon, knife and fork, joined by the handle, can be detached when in use. They were the best space saver, innovative and already on the market. To hold the silverware, there is a perforated rack that slides in between two ribs on the left side wall of the case. The rack can be taken from the case to put in the silverware and can lie on the table to keep the silverware in place. Bowls and plates can be purchased at any housewares store because the dividers accommodate two different, standard sizes of plates. The cups' storage location houses four medium-size plastic cups, readily available in the market.

**Fig. 9-12** Standard plates**Fig. 9-13** Stackable glasses

Plates and cups are some of the auxiliary pieces included in the system; they were the main factor in defining the storage case shape. These two kinds of plates, plastic silverware, cooking utensils and auxiliary cutting boards are housed in the case. Four pieces of each dinnerware were included to support the idea of fostering encounters and social interaction through sharing nourishing meals with friends and roommates.

Two different types of plates are used to enhance the service and allow users to make and serve any kind of meal. Additionally, the shape of the plates is appropriate for stackability, reducing the space occupied. The plate size is appropriate for normal portions of food, made of a lightweight and impact-resistant material. Cups are large, but stack one into the other, building a long row that fits at the back of the case. Impact resistant and lightweight, they can be found easily on the market if replacements are needed.



Fig. 9-14 Lid & cutting board

The last but not least piece of equipment is the ¼” polypropylene (pp) cutting board. The process used to produce this board for the model was sawing the plastic board to the desired geometry, and partially routing about 1” of the edge, forming a lip to rest the board on top of the case (middle body). The board needed only to be sanded with light grain sandpaper to achieve a smooth and even surface.

Both sides of the board can be used for different foods, and it can be easily replaced if needed, without affecting the general function of the unit.

Chapter 3

Product Development & Manufacturing

Customer Requirements

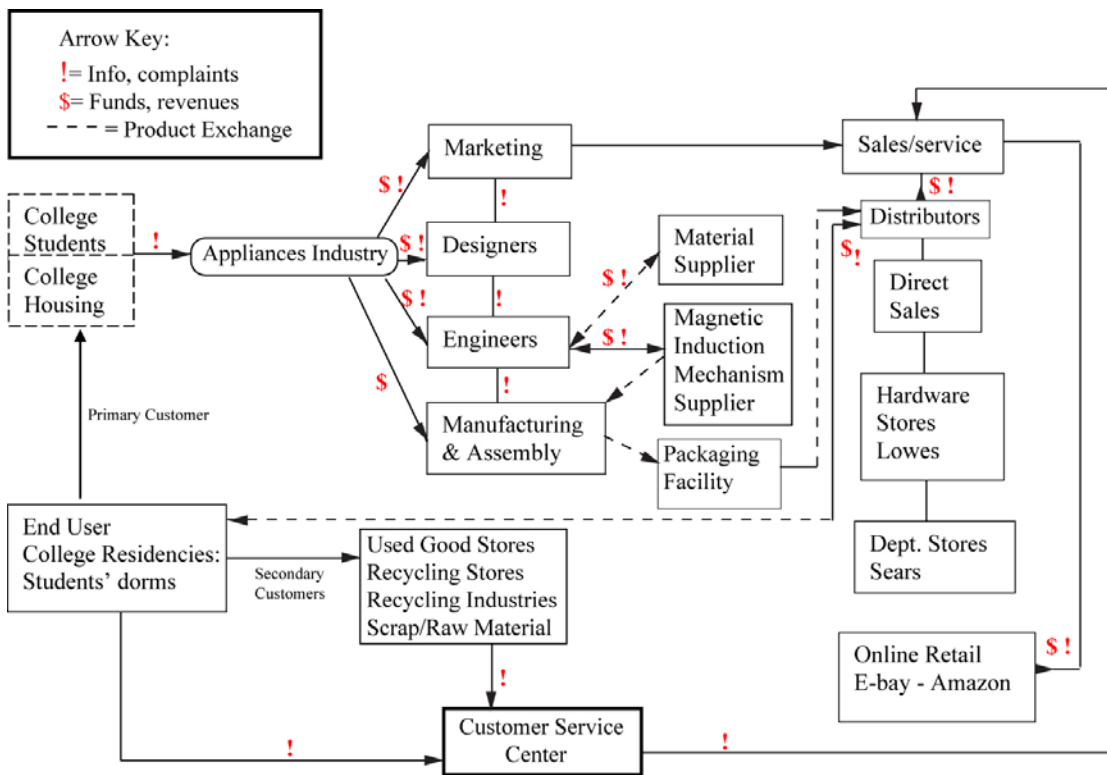
- Portable
- Useful
- Easy to carry
- Easy to clean
- Auxiliary accessories to perform different tasks
- Durable material that makes the product last longer
- Affordable (price between \$70-150)
- User-friendly (ergonomics and human factors)
- Easy assembly and disassembly of parts
- Enough case capacity to house dinnerware pieces
- Cooks in less time than electric or gas stoves
- Safe cooking mechanism to avoid user injuries, burned food, and fire
- Reliable
- Detachable parts
- Compact size
- Different cutting surfaces for different foods
- More than one service or function
- Standard auxiliary pieces that can be replaced
- Area to grasp each part
- Aesthetically attractive
- Replacement main body parts, if needed, available from manufacturer

Engineering Metrics

- Incorporate magnetic induction system
- Storage for auxiliary pieces
- Self-cooling down cooktop surface
- Protect auxiliary pieces and interior of case from spills
- Heat in less time
- Avoid hot surfaces
- Impact-resistant material

Customer Value Chain Analysis (CVCA)⁹

This analysis seeks to identify the phases (ideation, processes, distribution, etc.) and the exchange between all the parties involved during the development of the new product.

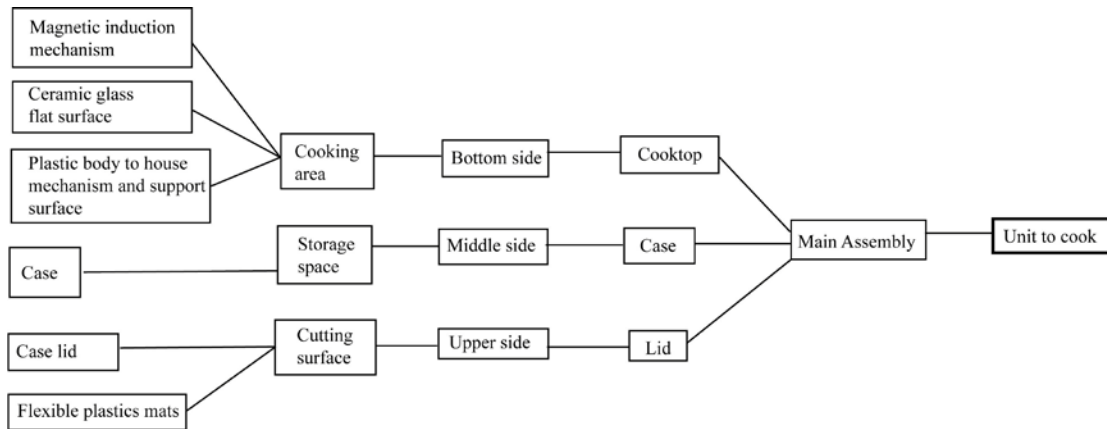


⁹ Product Definition, Customer Value Chain Analysis, K. Ishii, January 2004.

Product Analysis

Structural Tree of KosDri¹⁰

This diagram analyzes the product by expanding and detailing its structure. This also clarifies the role of every part of the assembly. It provides a handy tool to define the product, to envision how the object might be better structured and to decide the components needed to build the product.

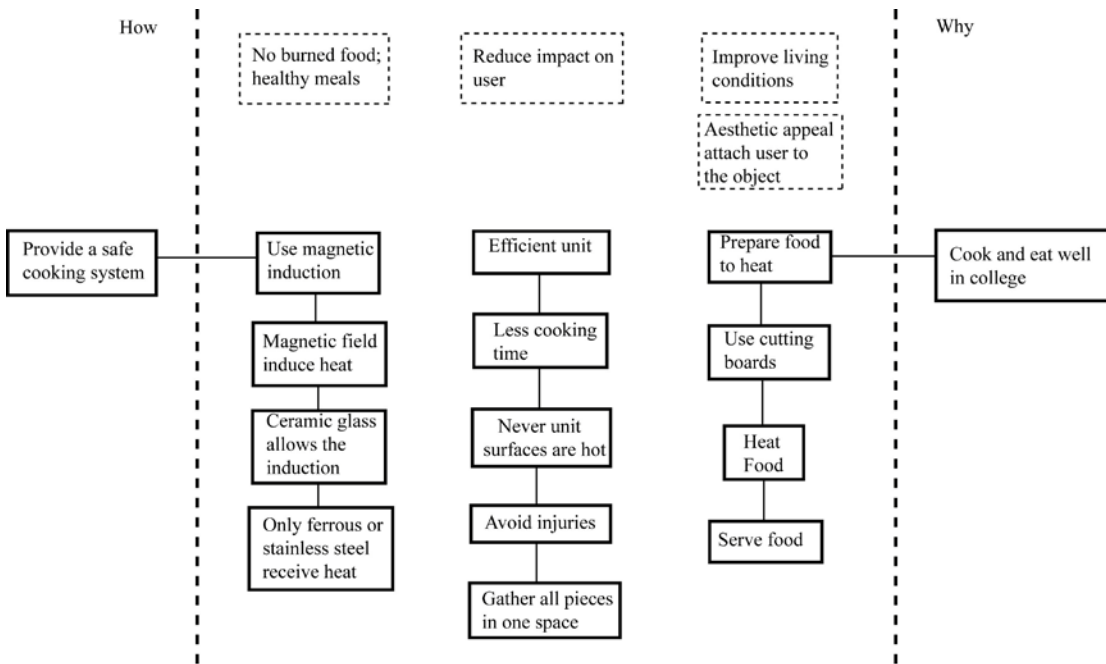


¹⁰ Ishii, KosDri, "Introduction to Design for Manufacturability (DFM)", ME317A DFM: Product Definition, Stanford University, Lecture 1/7/2004.

Functional Analysis

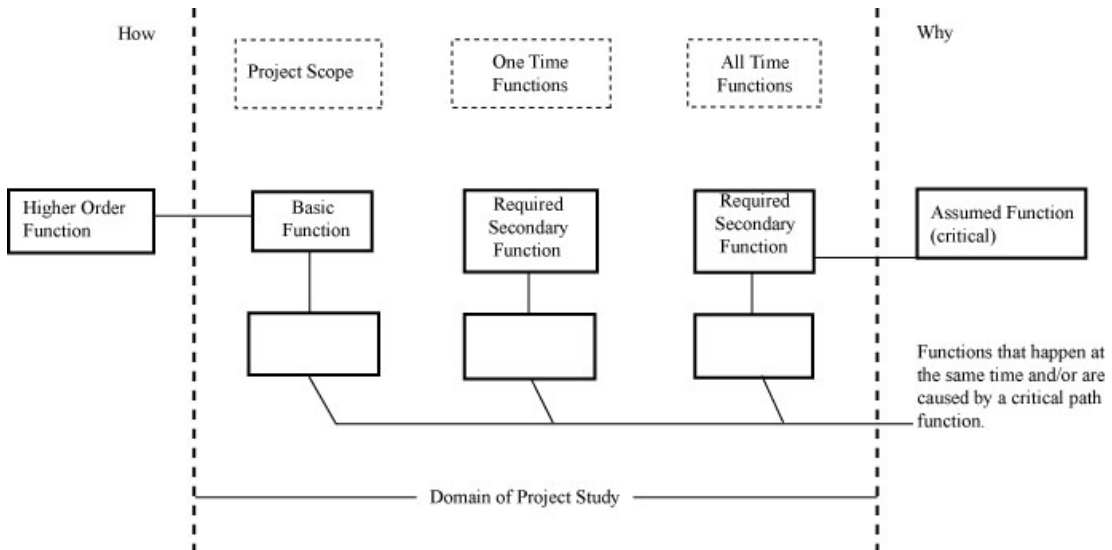
Function Tree of KosDri¹¹

This functional diagram emphasizes the main goal of the product (section called “why” on chart) and defines how this statement might be better approached and fulfilled. It also reveals the minimum set of elements needed to accomplish the object purpose. Additionally, it shows the scope of the product (information delimited by dotted squares) in three major goals.



¹¹ Ishii, K., “Introduction to Design for Manufacturability (DFM)”, ME317A DFM: Product Definition, Stanford University, Lecture 1/7/2004.

The following a general basic structure of a Function Tree of KosDri diagrams¹³:



The structural tree and the functional tree/analysis can be mapped to build a functional structural analysis, connecting each function with its equivalent part on the structure. The interesting aspect of this map is how relations (function-structure) back up the existence of the chosen elements and reveal strong connections between every part. Even though parts are assigned with different functions and are at different sections of the product, they remain linked by the main product objective. All the previous diagrams were used as strategies to develop the product to better meets customer requirements and market expectations.

¹³ Otto, K., Wood, Kristin L., "Product Design: Techniques in Reverse Engineering and New Product Development", Prentice Hall, Upper Saddle, NJ 2001, pg 155.

Unit Manufacturing Processes

Materials Use to Build the Unit

The unit is made of thermoplastics, one of the most common plastics used for houseware products. Thermoplastics are those softened by increases in temperature and hardened by decreases in temperature. When the material is processed, its change is primarily physical and its original chemical features remain.

Thermoplastics are available as resins and compounds for molding, as sheets, rods, and tubes for fabricating, as liquids for paints and adhesives, and as film and foil for packaging. The wide variety, grade, and combination of thermoplastics make them differ from each other and assign them certain physical, mechanical, serviceable, or visual properties.

One of the advantages of using thermoplastics is their low processing cost. Even if the material is not as effective in cost as other plastics, it can be injection-molded faster, decreasing process time and cost.

It is also important to know the material features so that the treatment applied does not affect the final outcome or its production, making this clean and cost-effective. For this particular product, thermoplastic and its behavior would be the analyzed topic during this production phase.

The manufacturing process is determined not only by the design but also by the properties of the material¹⁴, in this case plastic, whose characteristics might affect and determine machinability. Some of the critical things to know to prevent machinability issues are:

- Plastics do not readily conduct, but are easily affected by heat.
- Some contain abrasive fillers (composites).
- They are mostly soft and yielding.
- Some are quite brittle though soft.
- Thermoplastics can soften, lose shape, become gummy, and clog cutters.
- To cut the plastic, a band saw is preferable to a circular saw because the teeth on a long band have more time to cool.
- Air, water and oil coolants are commonly used for cutting plastics.

¹⁴ Manufacturing Processes and Materials for Engineers, Doyle, Lawrence, Prentice Hall, and Inc.1985 page 239.

The thermoplastics used in this product are polyethylene, polypropylene, and polystyrene.

THERMOPLASTIC	Polyethylene	Polypropylene	Polystyrenes
Trade name	Alathone, Ethylux, Polythene	Escon, Propylux, Tenite	Cerex, Loralin, Lustron, Styron
Maximum service [°C (°F)]	90 (200)	120 (250)	60-80 (140-175)
Average relative cost [\$ /Kg (4/lb)]	0.90 (0.40)	0.85 (0.39)	0.80 (0.36)
Important Properties	Tough to -98°C (-154); good chemical, moisture, and electrical resistance; low friction; most- used plastic; many grades; flexible to rigid	Chemical, moisture, and electrical resistance; special grades for impact strength and high- or low-temperature service	Good electrical and stain resistance
Fabrication Processes	Worked by all processes (resin with additives)	Extrusion, molding, laminating, coating, sintering (resin with additives)	Extrusion, molding, thermoforming, foaming (resin with additives)
Typical Uses	Housings, piping, ducts, bottles, pails, tanks, insulation, housewares, toys, coatings, films, packaging	Electrical equipment, hinges, piping, packaging, luggage, auto trim	Piping, dials, toys, insulation, battery boxes, dental plates, dinnerware, auto and appliance parts, lenses
Use in this Product	Cutting board (lid)	Main assembly: cooktop structure, case	Flexible cutting boards, cups, plates, tableware, utensils

Production Process

Injection molding was the process chosen to manufacture the product because of the geometry requirements, the economics and the automated process making it possible to obtain higher quality for less cost.

As mentioned previously, the design of plastic parts needs certain conditions so that the object can be produced. The more critical design considerations¹⁵ for injection-molding of plastic parts are not always applied to every design. It depends entirely on the type of product and its features, but some are standard and almost imperative for any design. Some of these conditions are solely to strengthen a part, such as ribs; others as bosses and opening formations to aid insertion of joints and parts assembly. To avoid size variations during molding, the plastic's shrinkage characteristics are critical to determining the right amount of material, molding pressures and times. To prepare the material and alleviate processing consequences, vents and potential knit lines must be carefully planned.

Listed here are some recommended features to apply to plastic product design to improve machinability and production processes:

- | | |
|----------------------|--------------------------|
| 1. Parting Lines | 7. Opening Formations |
| 2. Draft Angles | 8. Shrinkage |
| 3. Wall Thickness | 9. Gating |
| 4. Fillets and Radii | 10. Vents |
| 5. Bosses | 11. Potential Knit Lines |
| 6. Ribs | |

¹⁵ Design Consideration for Injection Molded Part, Design Solutions Guide, Helping Make Products Better, BASF, 2003.

Of all the addressed conditions from the Design Solutions Guide of BASF, these are the most relevant and required to prepare the unit for injection – molding:

1. **Parting Line:** This is a line on the object that shows where the two halves of a mold meet when it closes.

2. **Draft Angles:** These are the necessary angles for ejection of the part from the mold; recommended draft angle is 1° with $1/2^\circ$ on ribs.

3. **Wall Thickness¹⁶:** Uniformity is the key. “This not only eases material flow in the mold, reduces the risk of sink marks (depressions), molded-in stresses and differential shrinkage.” (Design Solution Guide, BASF). Thickness variation should be at a maximum of 15%. Corners always need an inner fillet radius recommended to be 50% of the wall thickness and an outer radius at 150% of the wall thickness to preserve uniformity. Adequate plastic wall thickness is generally no less than 1.5 to 2.5 mm (1/16 to 3/32 in). Thick sections should be avoided because they require more material, cool slowly and retard the molding; the thicker the section, the more the shrinkage.



Fig. 10-1 Wall thickness



Fig. 10-2 Wall thickness transition

¹⁶ Design Considerations for Injection Molded Parts, Design Solution Guide, BASF Corporation, New Jersey, 2003.

4. Fillets and Radii: Adequate radii and fillets should be used to eliminate as many sharp edges and corners as possible. “Generally, external radii = internal radii + wall thickness. Sharp corners are the number one cause of part failures, stress concentrations, material flow issues, and tool wear. The maximum fillet and radii depend on what the design allows but large fillets and radii are much more convenient.” Radii or fillet must be at least 25% of wall thickness and never less than 0.8 mm (1/32 inch).

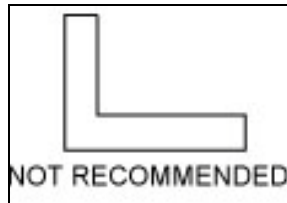


Fig. 10-3 Straight corners

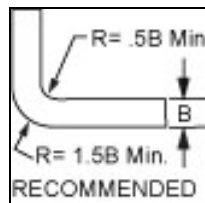


Fig. 10-4 Fillets

- 1-3 degree taper is the standard to remove plastic parts.
- Ribs and flanges are strongly recommended to strengthen areas.
- Uniform wall thickness should be maintained at corners.
- Perforations should be covered during molding, if possible, to avoid machining.
- True holes are better than blind holes in that the pin that creates the hole can be supported at both ends.

Injection Molding Process

As Ticona explained in his book *Designing with Plastics*, the molder receives plastic resin in the form of chopped pellets (usually 1/8 in. long). These are feed into the hopper of an injection molding machine, where they fall into an augur-type screw channel which feeds the pellets forward inside the heated barrel. As the mass of plastic moves toward the front of the barrel, it is plasticized or melted. The screw is allowed to travel back until a sufficient quantity of melted plastic accumulates in front of the screw to fill the cavity in the mold. Once in the mold, the plastic flows through a distribution system called runners and then through gates into the part cavities. As soon as the plastic cools and solidifies in the mold cavity, the mold is opened and the part is removed.

The mold is usually heated or cooled to provide the proper temperature for plastic solidification. The mold also has some type of mechanical assist, called ejection, to help extract the part from the mold. While the part is cooling in the mold, the next shot is being plasticized within the barrel. The mold then closes and the process is repeated. The cooling time in the mold is usually the controlling factor in the total molding cycle time and, thus, a key factor in determining the production rate of the machine. An overly thick wall section, even in just a small portion, can significantly lengthen the cooling time and hurt the overall economics of the part.

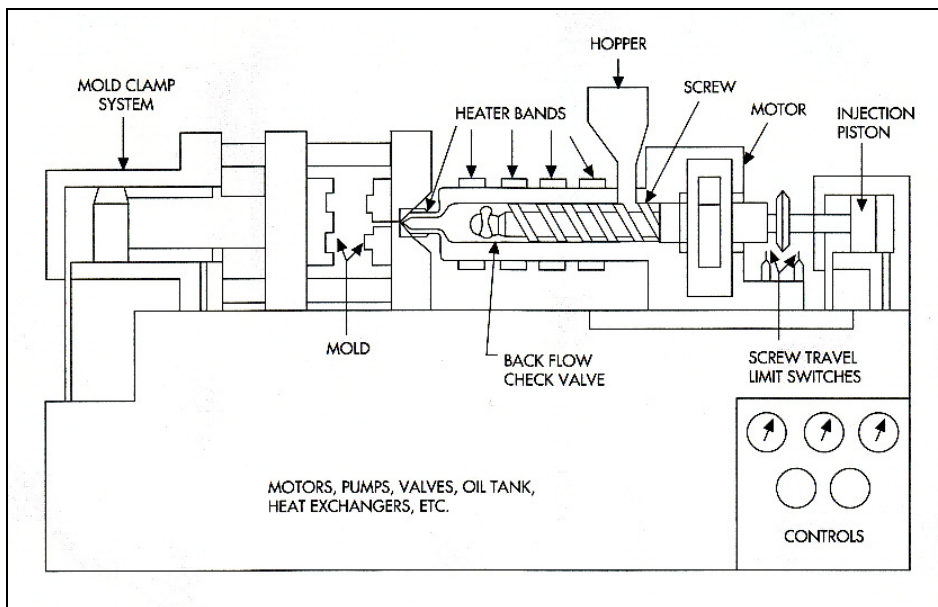


Fig. 10-5 Schematic of reciprocating screw injection molding machine¹⁷

¹⁷ *Designing with Plastic, The fundamentals*, page 55, Ticona, 2005.

Injection-Molding Process



Fig. 10-6 Material

Polypropylene pellets.



Fig. 10-7 Hopper

Hopper, material is feed through this.



Fig. 10-8 Automated control



Fig. 10-9 Injection molding machine clean-up before next loading

Left over material from previous process is heated and purged from the machine.



Fig. 10-10 Injection-molding screen

Phases of an injection molding process.



Fig 10-11 Digital control injection

Digital interface sets the different phases of the entire process.



Fig. 10-12 Injection-molding mold

Stainless steel mold is divided in two halves that meet to start injection.



Fig. 10-13 Cavity and core

The steel mold is made of a core that enters into the other part, the cavity.



Fig. 10-14 Closing mold

Halves meet and cavity core gets.

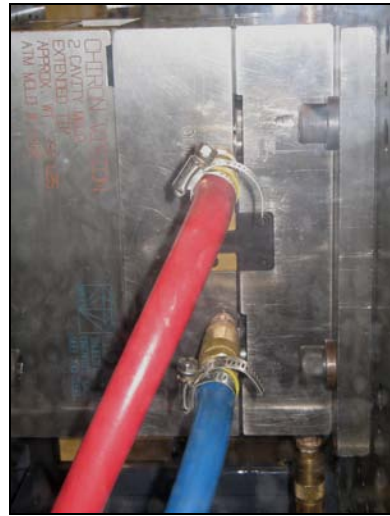


Fig. 10-15 Sealed mold

Completely sealed, the injector starts feeding material into the cavity. The hoses supplies hot and cold water, keeping mold at optimum temperature.

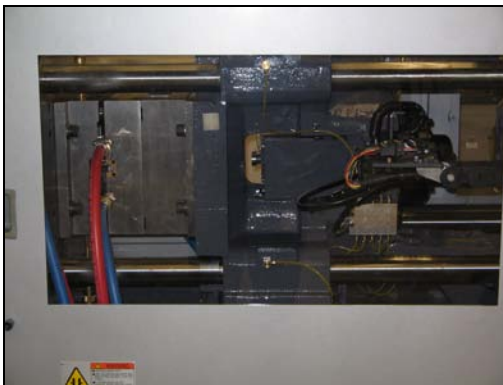


Fig.10-16 Mechanism at work

Mechanism moves forward to push core into cavity.



Fig. 10-17 Controlled motion

Backward motion opens up the mold to release the plastic part.

How to Use the Unit



Fig. 11-1 First step

Place unit on a flat surface



Fig. 11-2 Detach parts



Fig. 11-3 Place case and unit nearby



Fig. 11-4 Preparing the food

Use cutting board to cut and prepare food for cooking. Flexible mats recommended on top of the lid if cutting different types of food.



Fig. 11-5 Plug device

Place the device close to an outlet and avoid moving it when in use.



Fig. 11-6 Set device

Set functions, time and temperature; place steel or ferrous pan on cooking unit.



Fig. 11-7 Cooking

Use utensils to cook.



Fig. 11-8 Set table

Take out plates, cups and silverware.



Fig. 11-9 Serve

Depending on the meal, use plates or bowls.



Fig. 11-9 Eat and share the meal



Fig. 11-10 Clean up

Place all dirty pieces into the unit to wash them.



Fig. 11-11 Take case to sink

Put clean pieces back in the case and let them dry. Case has bottom holes to drain water.



Fig. 11-12 Case sits on cooktop

After cleaned, put away unit.



Fig. 11-13 Accommodate unit

Place in convenient site.



Fig. 11-14 Unit in context

Leave stored until next use.

Safety Tips

The use of this equipment requires basic safety precautions to assure a better service and protection of the user:

- Read the instructions.
- Use handles or knob; do not touch hot pan surface.
- Use only stainless steel or ferrous pots and pans.
- To protect against electrical shock, do not immerse cord, plug or magnetic induction base in water.
- Unplug from outlet when not in use and before cleaning.
- Do not operate the equipment with a damaged cord or plug or after the device malfunctions or has been damaged in any manner.
- If damaged, do not repair device by yourself; bring it to the store, the distributor, or an authorized service facility.
- Replace auxiliary parts if needed.
- Clean case periodically to avoid bacteria growth.
- Case is dishwasher safe.
- Clean cutting board after every use, even if flexible mats are used on top of it.

Logo



Fig. 12-1 Product Logo

The name and the logo represent the unit's main purpose to gather pieces to interact in different tasks and to get people together to enjoy and share the product. The home abstract figure assigns a home-like, cozy meaning to the product that evokes homemade, healthy food.

Printing Logo on Product

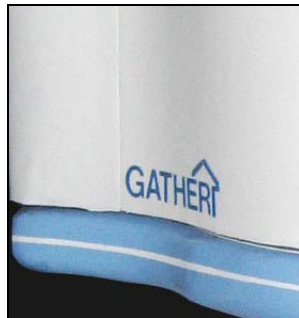


Fig. 12-2 Unit left bottom

Printing on plastic products is a matter of choosing a convenient process according to the geometry of the object. In this case, Laser Printing is the recommended process due to the site of the logo and the topography of the product.

Laser Printing Process

This process amplifies light by stimulating the emission of radiation. Marks are made on surfaces when a CO₂ laser is directed through stencils and a focused optic at set distances from the piece. Basically, the beam vaporizes the target plastic surface changing its colors, pulse power, rate, and marking speed control depth of engraving.

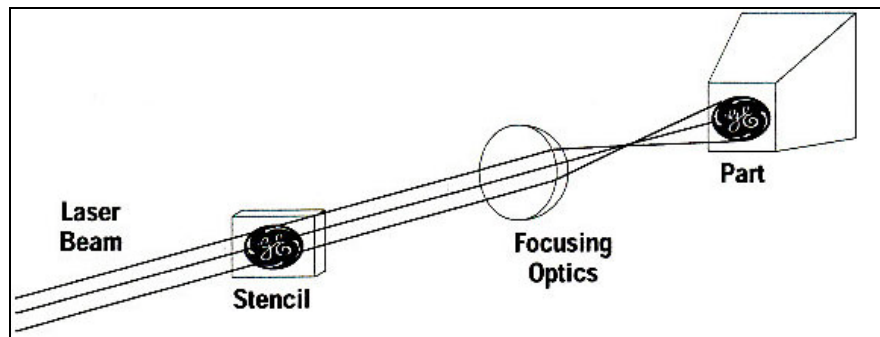


Fig. 12-3 Laser printing process ¹⁸

Laser System Suppliers

Control Laser Corp.
7503 Chancelor Drive
Orlando, FL 32809
407-438-2500

Lumonics/Laserdyne
6690 Shady Oak Road
Eden Prairie, MN 55344
612-941-9530

General Scanning
32 Cobble Hill Road
Somerville, MA 02143
617-625-5200

Laser Fare Ltd., Inc.
1 Industrial Drive South
Smithfield, RI 02917
401-231-4400

Convergen Tenergy
1 Picker Road
Sturbridge, MA 01566
508-347-2681

Lasertechnics
5500 Wilshire Avenue
Albuquerque, NM 87113
505-822-1123

¹⁸ GE Engineering Thermoplastics, Design Guide, Product Assembly, 2004.

Future Design Improvements

After the users have interfaced with the product, some design improvements should be made in order to enhance the service of the unit:

- Include different flexible plastic mats to cut different types of food and avoid bacteria contamination.
- Accentuate the case's topography so that pieces sit better within dividers and design becomes more dynamic.
- Indicate the correct orientation of utensils inside the holder by means of features, graphics such as arrows, and improve geometry of this part to ease utensil placement.
- Make the case wall thickness transition smoother so that material flows better in the mold and material stress is prevented.
- Produce the cooktop device in three different colors to address a broader target audience.

Conclusion

Gather accomplishes its goals by:

- Creating a compact small product that fits in a dorm room.
- Creating a product that can be moved around the space or another space and then returned and stored easily. (Weight 15.14 lb).
- Appealing to a college age market with its choice of function, shape and color choices. "I received a good response from students when tested, they liked the sleek design and how the three color options personalize the product. As far as the function, they like having all in one portable cooking product."
- Evoking a sense of home with its name and its ability to make a variety of type of meals. (Gather can make soup, rice, meat, vegetables, and snacks just use a ferrous or stainless steel pan and everything can be cooked).
- Supporting many tasks from food preparation to serving, eating, cleaning and storage.
- Being small enough to be portable within the room and within the dorm.
- Environmentally friendly because of magnetic induction use in the cooktop.
- Less energy consumption and more quick meals.
- Support gathering around a meal by its size, versatility and dinnerware for four.
- Fulfills all these objectives in a way that no other product on the market currently does.

Additionally, through testing students found it was a pleasure to use. It successfully accomplished its principal purpose of offering an alternative source of good, nutritive food within a campus dorm.

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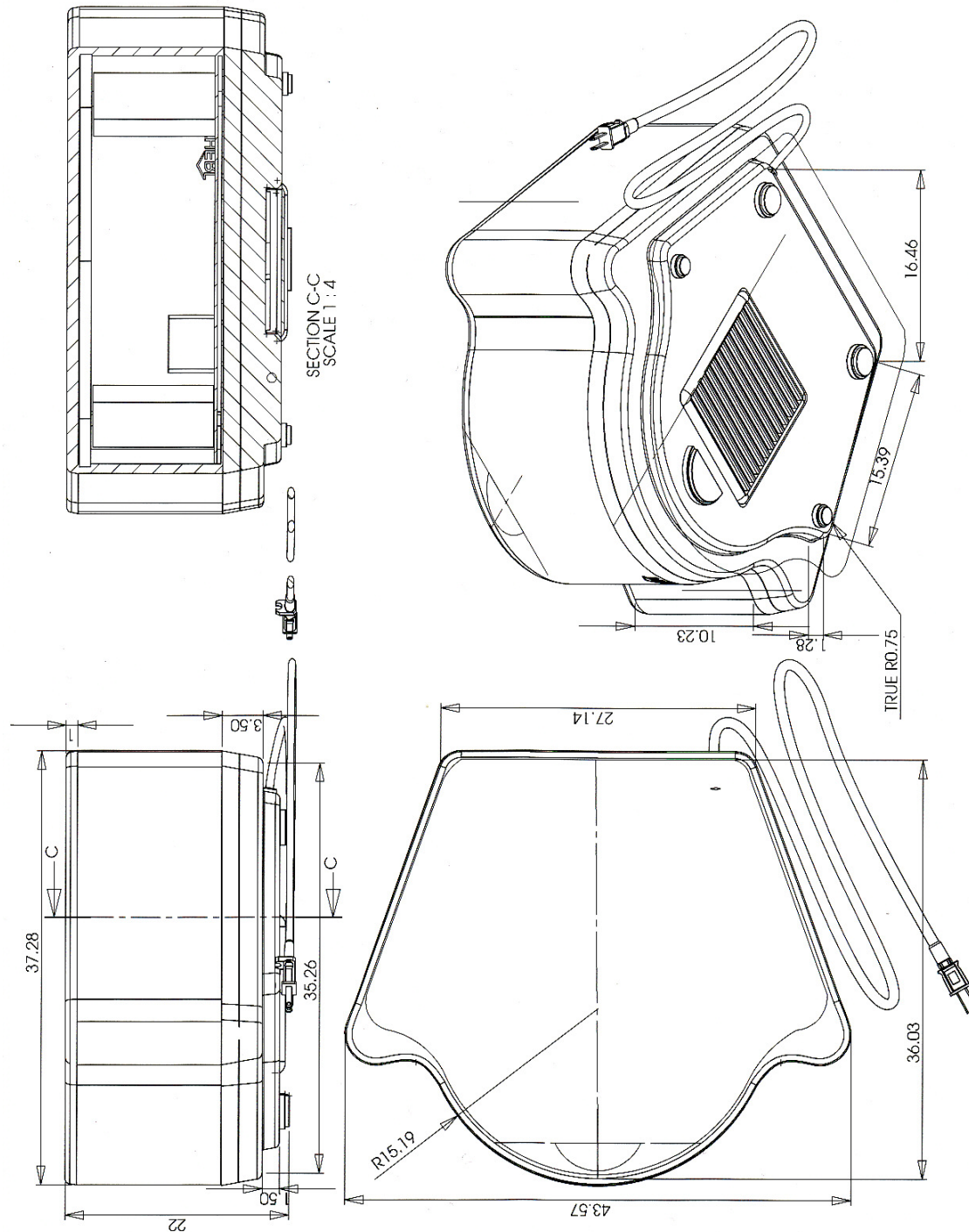
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http://www.NextStopCollegeDormLife-myFootpath_com.htm

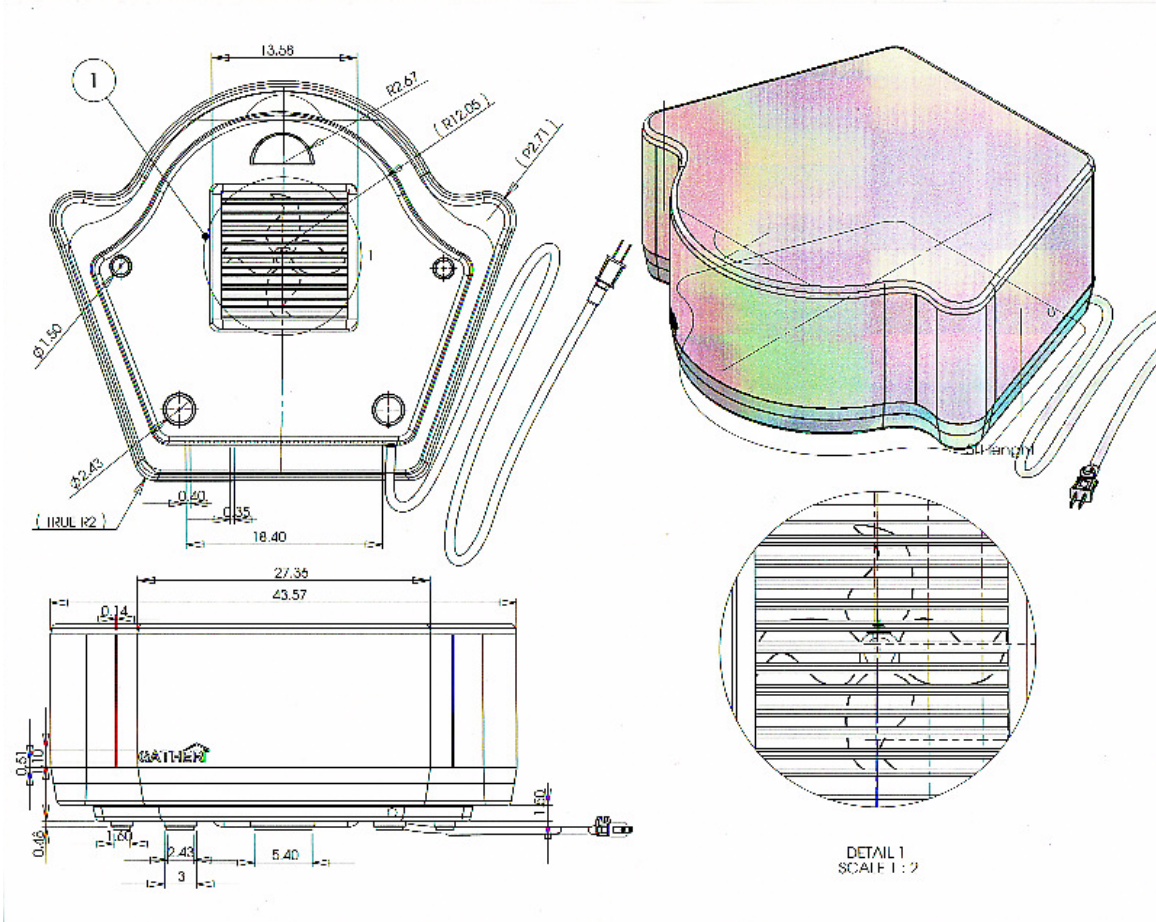
[http://www.TheJournalofHigherEducationVol.62_No.1\(Jan-Feb, 1991\), pp. 44-61.htm](http://www.TheJournalofHigherEducationVol.62_No.1(Jan-Feb,1991),pp.44-61.htm)

<http://www.Collegelifewhatiscollegedormlifelike.htm>

<http://www.HowcanIPrepareforLivinginaCollegeDorm.htm>



Orthogonal and Section Views of Unit



Base general dimensions



Multifunctional Unit to Cook in Small Spaces
