INTERNATIONAL HELLENIC UNIVERSITY

“Cookware for elderly persons, following the principles of Universal Design”

Konstantina Vasiliki Iakovou

SCHOOL OF ECONOMICS, BUSINESS ADMINISTRATION & LEGAL STUDIES

A thesis submitted for the degree of

Master of Science (MSc) in Strategic Product Design

02/2016
Thessaloniki – Greece

Dimitrios Nathanael

Digitally signed by Dimitrios Nathanael
Date: 2016.04.13 18:33:19 +03'00'

Student Name: Konstantina Vasiliki Iakovou
SID: 1106140005
Supervisor: Athanasios Babalis

I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

February 2016
Thessaloniki - Greece

Table of contents

TABLE OF FIGURES

TABLE OF TABLES

ABSTRACT

This dissertation was written as part of the MSc in Strategic Product Design at the International Hellenic University. Its subject is redesigning a type of cookware by following the principles of Universal Design. The focus user group are elderly users. They represent a continuously increasing market share, since the global demographics are changing. Many of the existing products are stigmatizing them. So, more effective products should be introduced in order to enhance their independent living without marginalizing them. Universal Design offers a very fruitful approach in succeeding this goal. By promoting the equitable and easy use of the product, this approach takes into account its intuitive use of a product by using perceptible stimuli. Their design promotes tolerance of error and various safety factors. Products designed with this approach are certainly suitable not only for elderly, but for every potential user, no matter the status of her/his ability.

Elderly users are a group with a very large span of capabilities resulting from physical and mental decline. In order to understand thoroughly their needs, contextual interviews with elderly people cooking in their own house were held. After analyzing the data collected, the oven tray was selected as the type of cookware that was the most problematic, as was considered the most difficult cookware to use due to bending posture, lifting and carrying weight. A very intensive research for the most suitable handles was conducted in order to define handles with the best possible functionality and to impose them on the existing oven tray design resulting to the final proposal.

Keywords: (cookware, elderly, Universal Design, handles)

Konstantina Vasiliki Iakovou

20/02/2016

INTRODUCTION

This dissertation aims to examine the potential improvement of existing cookware inspired by the needs of the elderly. More precisely it will focus on the redesign of the oven tray taking into account all the data collected from contextual research, as well as bibliographic research, concerning the implementation of Universal Design principles into product development processes.

Given the fact that the ageing population increases, the need to reexamine some daily used products is urgent. By creating functional products as cookware for any possible given context, the independent living of the elderly is supported. The shift of focus from other, younger groups to them could transform the range of needs that such products have to satisfy, creating more usable products for everybody, without marginalizing any user in relation to her/his span of ability.

This proposal may interest first of all cookware industries, so as to expand to markets that can afford to buy a new product if they truly believe it will be easy to use. Also, this kind of methodological approach that was followed by contextual research until the final definition of the product, is a very interesting instrument for product designers. Therefore this research could be followed for furtherly improving cookware or kitchenware. But what are the contents of this research?

First of all, in Chapter 1, the origins of the phenomenon of the population ageing worldwide will be explained along with possible opportunities, that arise mainly in household related products.

Chapter 2 contains all the literature review regarding the Universal Design approach. Its principles can be used as a strategy aiming to introduce successful products deriving also from seniors.

In Chapter 3, the specific characteristics and dexterities of the focus group are examined based on relative bibliographic research. How do the needs and capabilities of a human being transform as the time goes by?

The methodology with which the redesign of cookware is approached is described in Chapter 4. Which were the specific characteristics of each of the participants of the contextual research, which conclusions were deducted by the brainstorming sessions, and which of the

cookware proves were the most difficult to use? Which dysfunctions should the redesign of it should correct? Taking into account that this project is considered to be an experimental one, the improvement of the oven trays was chosen. At this stage, the initial product design brief was created.

The Concept Generation process described thoroughly in Chapter 5 is divided into three discrete steps. First of all, deconstructing the character of existing products in order to understand their deficiencies and find ways to improve them. The major focus of this experimental dissertation is to combine the results of contextual research with the characteristics of existing products, so as to improve existing products following the principles of Universal Design. After having defined a general module for oven trays, the second part of the concept generation process focused mainly in experimentations in various handles designs. The third part of this process was the refinement of the most promising concepts in order to result to one solution.

Chapter 6 presents the final product, analyzing all the design decisions behind it, finalizing its design brief, the material selection and final technical drawings.

1 CHARACTERISTICS OF SENIOR MARKET POPULATION, CONNECTION WITH COOKING AND CURRENT TRENDS IN COOKWARE.

1.1 ORIGINS OF AGEING SOCIETIES

Changes in demographics is one of the sources for innovation since the last 30 years (Kohlbacher, Herstatt, and Levsen, 2015).The phenomenon of the vast aging of the global population is based mainly on three factors: the increase of the life expectancy, the decline of the birth rate and the enhanced medical care (Imrhan, 1994). As Juarez et al. (2015) point out, this trend has no signs of change and it will be intensified. It will also definitely affect the economic development in the long run (Štefánik and Al, 2013). Among its various implications it affects the sectors of technology, product markets and other branches of economy (Congleton, Jurmain, and Koppa, 1989). In such a context the patterns of consumption as well as the percentages of the potential buyers of certain products are rearranged. But which are the forecasts for this growth and which are the specific characteristics that define this specific consumer group?

1.2 POPULATION OF ELDERLY TRENDS, CATEGORIZATION AND MARKET OPPORTUNITIES

People aged over 60 years belong to the silver's economy spectrum. According to United Nations report "World Population Ageing 2013" (United Nations, 2013) there is a significant increase of the population ageing worldwide. To be more specific, "the global share of older people (aged 60 years or over) increased from 9.2 percent in 1990 to 11.7 percent in 2013 and will reach 21.1 percent by 2050" (United Nations, 2013). According to UN Census on World Population Prospect (United Nations, 2015), the life expectancy at birth is projected to rise from 70 years in 2010-2015 to 77 years in 2045- 2050 and to 83 years in 2095-2100. Gender aggregation within the last century, the average life span grew even further; according to 2005 data from the U.S. Census Bureau, in 2003 it was 80.1 years for females and 74.8 years for males.

Since an interesting share of the potential purchasing power belongs to seniors, many companies will have to “react to this change” (Universal design in an era of global demographic change, 2008) and readapt their product design strategies in order to face the current demographic reality (Schewe, 1991). Older people are a more different group than younger groups due to their unique individual differences. As Schewe (1991) points out, positioning products on comfort is a very effective strategy for the elderly.

In order to categorize this large but homogeneous part of population, three different age groups (subpopulations) have to come up (IuFoST 2014):

- The "Young - Old" ageing among 65-74 years old
- The "Old or Middle - Old" ageing among 75-84 years old
- “Oldest-Old or Old - Old" being 85+years old

1.3 CHALLENGES AND CONTEXT OF AGEING POPULATION

The challenges of the ageing phenomenon are categorized in three main levels:

- national
- communal and
- individual level

In the framework of this current dissertation the challenges into individual level are of minor importance. These challenges are highly correlated with changes - deterioration of their physical and/or psychological status seniors face. But how these changes can be transformed into a market opportunity for releasing relative products?

It is not only this age group that becomes stronger, but the family relationships among a family members have been transformed. In the realm of the current economic crisis, their children have either immigrated to find better job (fragmentation of family that reduces the number of person a senior can count on) or have returned to a state of dependency of their

parents (Hirzel, 2015). So, either the grandparents have more time to spend on their own and to be more independent or must return to protection (Bloom, Canning, and Fink, 2010).

1.4 AGEING AND COOKING: A NEW OPPORTUNITY ARISES?

As far as cooking is concerned there are varied needs among senior consumers living on their own. Many of them are very active and are capable of buying all the needed supplies for preparing their meals on their own, despite having some minor difficulties that exist because of the ageing (decreased motor skills or memory). On the other hand, another group of seniors is incapable of cooking and they require home delivery of food (from children or acquaintances that are willing to do so or restaurants). Both of these groups are advised to go on a healthy diet.

Also, an attitude that characterizes “young - old” seniors, is that they are used to own high quality products, a habit that they will definitely keep as consumers throughout their life. They also strive for functional and easy to use products (Probst et al., 2015Seniors tend to spend more time at home. So it is estimated that expenditure on housing will rise (Štefánik and Al, 2013). Compared to the past, seniors are healthier today (Bloom, Canning, and Fink, 2010).

Seidel et al. (2011) argue that one of the most necessary activities for independent living is to be able to prepare her/his own meals and do her/his laundry. So, one product group that could be influenced is the cookware industry. The opportunity that arises in the current market is that as there is a need to ensure the independent living of the seniors, there is the need for developing or redesigning existing products inspired from their needs. Those products should also be aligned to current cookware market trends, so as to appealing to every possible buyer.

1.5 COOKWARE TRENDS

The current growing trends in general in the cookware industry can be summarized as follows (Insider, 2015), (Editors and Smith, 2015), (Glink, 2015), (Editors and Smith, 2015), (Reiter, 2015), (Posts about cookware trends on trend bible, 2011), (Cooking trends for 2014? 2008) (Six alternatives to traditional non-stick cookware), (TRENDS in kitchenware):

- Bright colored cookware. Trending colors, though, may vary in different areas. There is also a specific preference for retro-inspired palettes too.
- Search for simple design changes that can make previously released products more successful and worth buying.
- Dishwasher, fridge, oven, microwave safe
- They must have an attractive design
- Convenience in use is an asset.
- Promote safe use by incorporating silicone parts.
- Versatility is an important factor and refers to replacing many cookware with one piece whenever this is possible.
- Quality materials that ensure also durability (e.g. stainless steel). Also copper has a significant share in the market.
- Regarding their main body, there is a turn to ceramics and copper.
- Detachable handles
- Strive to a healthier and simple living low-fat cooking that is highly linked to the coating of the material of the cookware itself.
- Consumers prefer buying individual pieces (open stock) rather than sets of cookware that are mostly preferred as gifts.
- Downsizing when the family gets smaller (e.g. children leaving)
- Cookware that are easy to carry.

Having in mind all the aforementioned characteristics of the ageing population Universal Design seems to be the most effective strategy for senior oriented products.

2 PRINCIPLES OF UNIVERSAL DESIGN

Ageing is a normal process in life. Nowadays all the past stereotypes of rigidity and fixity of elderly people's behavior are eliminated, as we are introduced to an incrementing silver market. This phenomenon could influence the design process. As Greg Panther points out, "the challenge to design is to envisage no less than an ageless society, that incorporates later life in the same way that design now "naturally" embraces the needs of previously excluded categories, such as women and children" (Blaikie, 1993). This can be accomplished by incorporating the Universal Design approach in product design development process.

Universal Design is a term coined by the architect Donald Mace in the 1980s. It is defined as "the design of products and environments to be usable by all people, to the greatest extent possible, without adaption or specialized design" (Christophersen, 2004).It provides, in other words, a foundation not only for more accessible products but also for more usable ones.

Its origins lie to the earlier barrier-free movement in architecture (Christophersen, 2004) after the World War II. This movement aimed to create accessible environments for soldiers in their own house after exiting the rehabilitation centers, in order to continue living independently to the greatest extent. Later it was also expanded in other fields e.g. design.

Universal Design, as a descendant movement, can be characterized as a more holistic approach, not only a barrier removal one. It is a human centered approach but also as cross generational - transgenerational method of designing (Universal design in an era of global demographic change, 2008). It can also be considered as a bottom up approach, as its aim is to provide products and environments in larger audiences without creating any specific adaptations. It could also be regarded as a sustainable approach (Kadir and Jamaludin, 2013), in the way it "meets the needs of the present entailing also inclusivity for the generations to come". After all, a product with improved function can benefit everybody (Christophersen, 2004) and simplify her/his life (Universal design in an era of global demographic change, 2008).

What universal design points out, is that the standardization concerning human beings (and also their sex aggregation) in designing products and/or environments cannot exist. Abilities and characteristics change with the flow of time, transforming the human beings, adding or lessening abilities in a temporary or permanent manner. Every person may not be able to

perform certain tasks for a short period of time (child, pregnant women, injury) or for the whole flow of her/his rest of life. In other words, the Universal Design is a manifestation of the human diversity, by promoting the inclusion of all the people no matter what their specific characteristics may be (Christophersen, 2004). Moreover, it aims to find a balance between products for mass markets targeted to average healthy users and to specialized products targeted for disabled people. In this way, a more democratized market is created (Batch job440, 2011).

The Universal Design's principles are the following (Beecher and Paquet, 2005):

- Equitable use: a product or environment can be used with people with a large span of abilities. It should not stigmatize its user and at the same time it is easy and appealing to use.
- Flexibility in use: the design of the product may accommodate more ways in which to be used without losing accuracy of performing certain tasks that the product is addressed to. Also, it must not restrict the users to perform such tasks in a certain period of time, but is adapted to their own time of perception and reaction. For example, it is used from both left and right-handed people even, only when one hand is used.
- Simple and intuitive use: It should be designed in a simple manner, which leads the user to use it intuitively, providing essential feedback in order to understand the start and the end of the performance of a certain task. Also, users, regardless their level of literacy, must be able to use a product.
- Perceptible information: Every user of a certain product must be provided with a certain amount of information in order to be able to use the product, no matter what the surrounding conditions or the user's sensory abilities may be. In other words, the product has to be "legible", it should contain elements and relationships among them, which are so clear that no instructions have to be given in order to use the product. In case of sensory disability, it should provide enough stimuli with varying techniques.
- Tolerance of error: the product's design should minimize potential hazards and prevent as much as possible consequences of inappropriate use. Some interesting strategies for that, is to have direct access to most used elements of a product conceal at

the same time potentially hazardous elements of it. Also, to warn the user of existing errors and hazards. It is encouraged to contain features that are failure safe (e.g. undo buttons).

- Low physical effort: The use of a product must discourage harming postures as much as possible. Moreover, it may contain reasonable operating forces without including many repetitions of the same actions.
- Size and space for approach and use: the size of the product but also the context of use should be appropriate for reaching, manipulating and using, no matter what the user's posture, physical characteristics (e.g. body size) or mobility status may be. The important elements of a product must be visible and reachable for either standing or seated users. Variations of hand and grip size must be taken into account too.

What should be pointed out is that even if the design product meets all these principles to the greatest possible extent, does not mean that it could be a successful one. A designer should also take into considerations other dimensions, such as cost (little or no extra cost), durability (easy to use products without failing), aesthetics (attractive at first glance products) and cultural appropriateness (harmonized with the social context if that is crucial for a buying decision).

The principles presented above can be used to design a product "inspired" by senior's needs, but in the same time satisfying needs of younger age groups (Woudhuysen and Woudhuysen, 1993). Older consumers are not any more passive research subjects, but they actively participate in the design. So, what are the specific characteristics of this age groups and which is the span of their abilities?

3 EFFECTS OF AGEING IN THE ELDERLY

Aging is characterized by a steady decline of a person's physical and cognitive abilities. Although human beings face decline of capabilities throughout their whole life, in particular period these changes are more obvious. As Fisk (1993) points out, individuals may vary greatly in their rate of decline. Various diseases or disabilities may influence this skill decline too. In order to be able to design a product that satisfies primarily the needs of the elderly, a designer must be aware of the whole span of their capabilities.

Physical decadence is related to problems in (Pinto et al., 2000):

- Posture: a sitting posture is preferred rather than standing. In this way the body is better supported.
- Muscular mass and strength are reduced. Joints become less flexible with age, making it extremely difficult to use upper and low extremities (Kirvesoja, Väyrynen, and Häikiö, 2000)
- Certain movements are executed with less speed. For example lifting – carrying an object is a very difficult task to perform. Moreover, by pulling – pushing excess stress is exerted on the arms, the shoulders and the back.
- Deceased visual and auditory abilities (McDonagh, Bruseberg, and Haslam, 2002)
- The coordination of movements may be looser.

Mental decease is normally expressed in the following ways:

- Some of the perceptual abilities e.g. orientation, problem solving abilities are lost (Lunau et al., 1988)
- Their memory is weaker.

While the ageing progresses elderly people are fully aware of the deterioration of their physical and mental status, a fact that has a direct negative impact on their psychological status. As a consequence:

- Many of them tend to get anxious and are not confident that they can lead an independent living.
- They feel embarrassed for seeking help, either from other people or by using mechanical devices (Imrhan, 1994).
- Their self-esteem is damaged due to their isolation and their role change in the family environment (Lee and You, 2006)
- Some of them may suffer from depression.

Products used on a daily basis must encourage independent living by acting within the realm of the users' capabilities, though. Imrhan (1994) proposes that a healthy senior must use her/his muscular strength preventing in such a way the muscle loss. A person's functional autonomy results to increased life expectancy (Allen et al., 2013) and restored self-esteem.

Cooking is one of the most important activities for autonomous living, especially for those who live alone or away from relatives or acquaintances. Cooking habits are closely related to one's family status. For example, cohabiting with someone else transforms the preparation of a meal to a social activity, due to sharing the result of the cooking activity (Daniels et al., no date). Also, cooking sometimes for somebody you are attached to, is a pleasurable task. On the contrary, if one leaves on her/his one, it is merely a necessity that it turns to be less pleasurable.

Kitchen environment contains many possibilities for domestic accidents as scalds, falls and posture-related problems. Preparing a meal contains the tasks of lifting (e.g. oven trays), carrying (e.g. cookware, ingredients etc.) and lowering the trunk (storage of cookware in lower cabinets, checking the food in the oven etc. retrieving ingredients form refrigerator), three of the most stressful physical tasks (Imrhan, 1994) and critical posture (Seidel et al., 2011). Scalds may occur by accidentally touching an oven tray or with naked hands, or by knocking off the frying pan from the stove. Poor design of kitchen environments and products may reduce and restrain cooking activities.

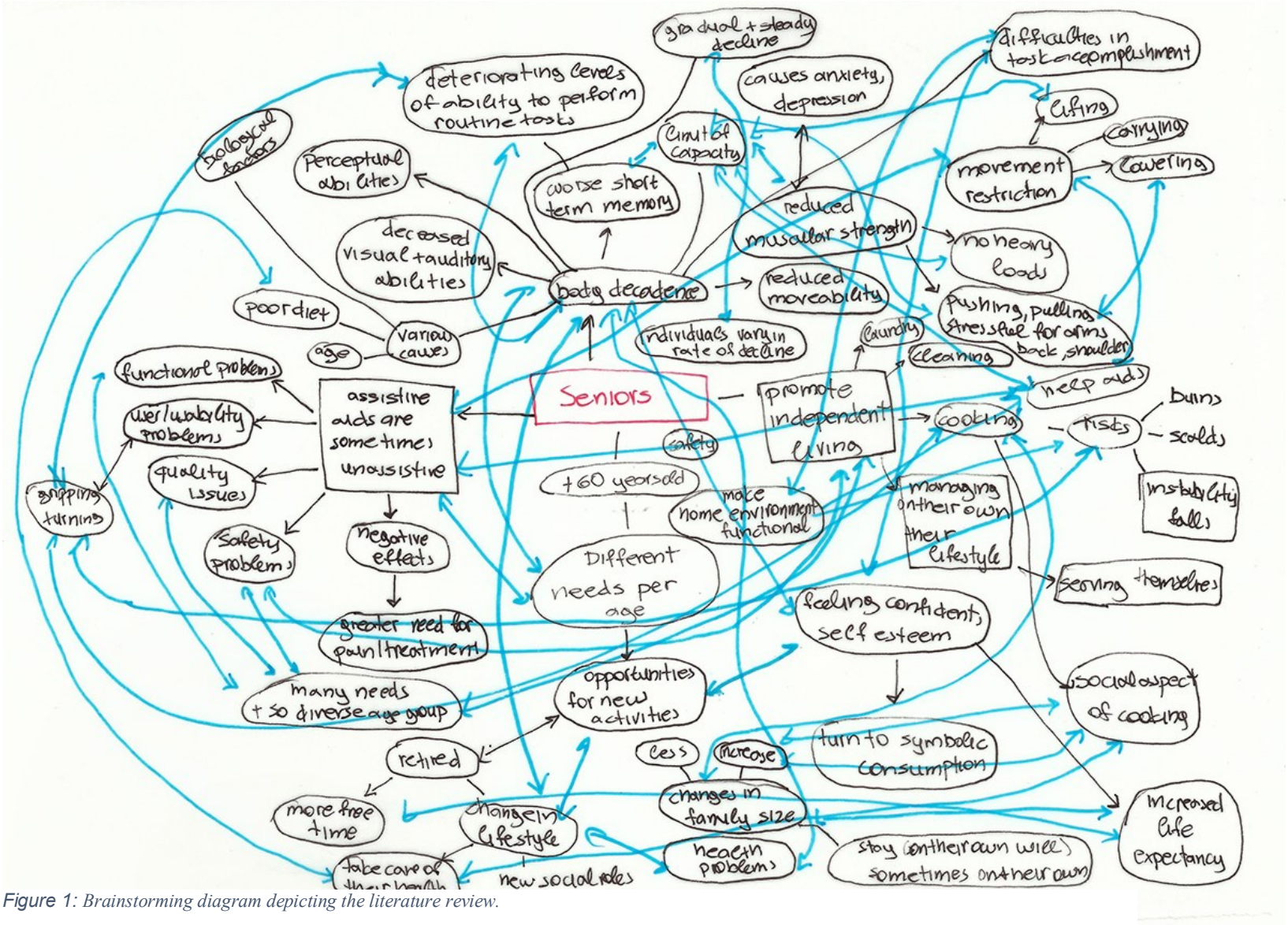


Figure 1: Brainstorming diagram depicting the literature review.

4 CONTEXTUAL INTERVIEWS DEFINING CUSTOMER NEEDS

4.1 METHODOLOGY

A very important step is to understand how seniors use their own kitchen and try to elicit their needs, worries and desires by simply observing them. After having conducted literature review regarding Universal Design, but also the general characteristics of the status of the elderly, a qualitative observational research took place. It involved on site interviews.

The subjects selected for this study met the following criteria:

- Adults aged above 60 years
- They live independently (they are capable of cooking, shopping cleaning the house and personal care)
- It was preferable to cook lunch, but an alternative of breakfast was offered if they seemed unwilling
- Since the interviews were going to be arranged at the interviewees' houses, the population of those who would agree to do so could not be estimated beforehand. From an invitation to 20 people, only seven responded affirmatively and all of them were interviewed.

Contextual interviews aim to understand how the user's needs are fulfilled with a certain product, while being used in its context-of-use. These observations and the conclusions that were derived from them, help the designer develop concepts suitable for the users' needs (Sangelkar, 2016). The context- of –use - in this case the kitchen – "*refers to the relationship between the use-activity-situation during people's interaction with products."* (Chamorro-Koc, Popovic, and Emmison, 2009). Given that elderly is a very special population group, it is crucial to understand the diversity of this group and design responsibly (Waller et al., 2015).

This method is more preferable than questionnaire-based interviews since it unveils more information about what people really need. As Waller et al. (2015), point out "it complements observations of real world behavior with opinions elicited by the interview.

The contextual interviews were conducted with a method similar to “A day in the life” method that Milton and Rodgers (2013) propose. The researcher has to follow the user while she/he cooks and to catalogue all the activities that take place by observing the user in relation to her/his context and the examined product. Some questions are asked too, but mainly the user is free to perform all her/his usual related to the examined task activities. In this particular research, regarding the documentation of the interviews, the whole procedure has been video recorded. Also, photographs of various moments were captured to ensure the whole documentation process.

After the interview, the interviewer had to organize the data collected into coherent categories and to try to find systems and patterns of behaviors that can give an opportunity for a new product.

The task that was observed was the preparation of a meal, in the users “natural” environment, the kitchen of her/his house. The task was divided in subtasks conducted in a sequence that the interviewee was used to. After confirming their participation, they chose which meal they were willing to prepare. Most of them chose to prepare a lunch, except from two who chose to prepare breakfast. As far as their physical status is concerned, they do not suffer from any severe disease, having only the typical age related problems.

The main focus of these interviews was to explore how they grasp several types of cookware and kitchen utensils, see how they organized the context of their kitchen and their overall behavior during cooking.

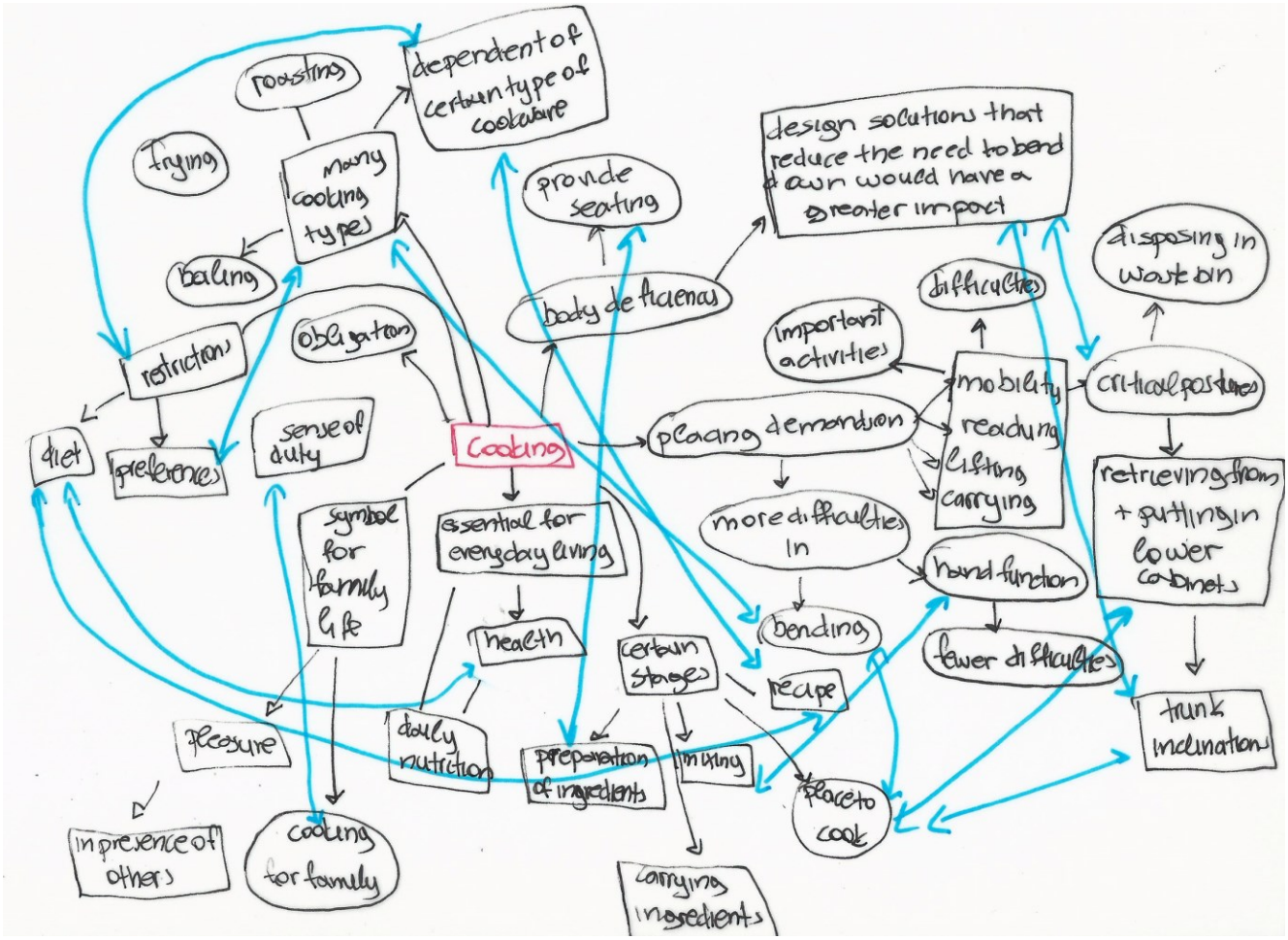


Figure 2: Brainstorming diagrams regarding the cooking activity

4.2 DATA COLLECTED FROM CONTEXTUAL RESEARCH

	Number of participants	60-75	75+
Male	1	1	-
Female	6	4	2

Table 1: Characteristics of population

The population of the first stage of this research was seven people. As seen in table 1, the 2/3 of the examined population is aged between 60-75 years old. They are living with their families (mainly husband or wife and possibly one adult child) and are cooking almost every day. The women belonging in the second age group 75+ years old, are widows and cook for themselves except from some times (family gatherings, helping their children etc).

Since the interviews were conducted at the users' house, they were asked which type of meal they were willing to prepare. Five of them prepared lunch and two of them offered to prepare breakfast.

In the tables that follow are included the observations made for each one of the interviewees. They are described analytically in order to understand more accurately the characteristics of the subjects and the conclusions that follow.

Interviewee Number		**1**		**Lunch: Stuffed peppers and tomatoes**		
Age: 86		**Gender: Female**				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Widow / lives alone	Washing and chopping vegetables Preparation of the stuffing Filling the vegetables Cooking in the oven	She claims to be dizzy when standing trembling hands, cannot keep her arms away from her trunk – minimizing the working area of upper extremities bending posture is painful but obligatory	Even though she feels dizzy, she prefers to do all the chopping and filling of the vegetables standing, even when prompted to sit down. She does not have a dishwasher, so she prefers to use the minimum size of trays, spoons, knives. She does not pay attention to where the handle of the frying pan is put – usually she puts it perpendicularly to the oven – danger of spill over. She holds utensils and vegetables very tightly When cutting with knife she holds it very very close to the other hand – claims to be afraid of fall of the vegetables if she does not do so. She has cut herself sometimes	2-3 times a weeks	She either cooks larger quantities in order not to cook every day or her children cook for her She arranges family gatherings (1 per month), a very pleasant reason to cook. She prefers cooking in a kettle or frying pan. She has stopped making pies, cakes and many demanding recipes because it is a tiring procedure.	She does not own a dishwasher so she uses as little kitchenware and cookware as possible. Prefers not to use specific kitchen utensils and aids, as she feels that they fill up her space. The cookware she uses are not stored but are placed on the working area of the kitchen.

Table 2: Interviewee No1

Interviewee Number:		**2**	**Lunch: Fried potatoes**			
Age: 61		**Gender: Female**				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Married, lives with husband and daughter	Washing and peeling potatoes Cutting the potatoes into small pieces Putting the potatoes into the kettle	She has vision related problems (has lost 50% of her vision in both eyes)	When she was peeling off the potatoes, she held both and the knife and the potatoes very closely to her face in order to be able to see clearly. She had no difficulties in lifting the kettle that was filled with water. She holds loosely all the handles (kettle, knife etc) The only problem she claimed that she had, was during chopping some specific ingredients (e.g. onions) her eyes are irritated. It is a common issue for everybody, but it might be dangerous for her sight. As an alternative she buys these ingredients precut.	She cooks once or twice per day	She enjoys cooking very much. She uses the most basic utensils as she wants to be able to see clearly what happens and control everything She fasts twice a week so she has to prepare more than one meal for her and her family.	Large kitchen with a large working area She uses only the area close to the oven and auxiliary the large table that is close to it. All the cookware are stored into cupboards.

Table 3: Interviewee No2

Interviewee Number:		**3**	**Breakfast**			
Age: 81		**Gender: Female**				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Widow, lives on her own	Brewing filter coffee and Greek coffee	Even though physically she has no problems at all, the pace of the movements is slowed down	She stores her kitchen utensil on the wall and the oven trays are underneath. Since she exercises every day, there were no limitations of her extremities. She grasps loosely the handles of the brewers There is no particular difficulty in executing various tasks. She uses the cookware she had since she was younger and stores them on a shelf on the wall	She cooks every day for her and her son who lives next door.	She enjoys cooking very much. Whenever there is utensil that can be used (e.g. jar opener, electric knife for finer cuts of bread) she uses it. The utensils are stored in drawers all over the kitchen. She considers it no trouble retrieving them. She always uses separate pan for each ingredients (e.g. cooking the meat separately, vegetables etc.) as she does not like to mix the taste of the various ingredients.	Large kitchen with a large working area Even though she has enough storage space for various kitchen utensils, cookware and appliances, she prefers to place them outside the storage area, filing up a lot of the kitchen's available working area. Even cutlery is stored in a construction on the wall.

Table 4: Interviewee No3

Interviewee Number:		**4**	**Breakfast**			
Age: 75		Gender: Female				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Widow, lives with her 2 sons and her grandchild	Coffee: Carrying the ingredients Stirring the coffee Sandwich Picking the ingredients from the fridge, Toasting	She cannot stand still for a lot of time, as she has problems with her knees.	Her upper extremities function very well. She grasps loosely the handles of the brewers. There is no particular difficulty in performing lifting, grasping and stirring actions.	Everyday	She enjoys cooking very much. She uses only the utensils that are necessary. She uses her knife sharpener and a tin opener.	Large cabinets overhead, since all the electric appliances are placed in lower cabinets. The oven is reachable with bending as well as dishwasher.

Table 5:Interviewee No4

Interviewee Number:		**5**	**Lunch : French fries**			
Age: 60		Gender: Female				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Married, Lives with her husband and their daughter	Peeling potatoes Cutting in equally sized small piece with a special cutter Frying	She feels dizzy when looking downwards, or in a bended posture.	While peeling, and cooking she wears gloves because of very sensitive skin and allergies. The cutter she uses demands the exposure of a lot physical strength, something she finds unpleasant. She grasps loosely the knife and the handle of the frying pan. It is easier to use the knife than the peeler.	Everyday	Occasionally she cooks for the rest of her family. She uses utensils only when they are worth using and she is willing to pay for better quality products	There is a very small working area She cannot use a lot of kitchen utensils, as there is no space to use them. There is a lot of storage area. Kitchenware that are mostly used are those reachable with upper extremities. Only cookware is stored in a place that requires bending (oven, cupboards)

Table 6: Interviewee No5

Interviewee Number:		**6**	**Lunch : Omelet**			
Age: 65		Gender: Male				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Married, Lives with his wife and their daughter	Chopping vegetables Cracking eggs Stirring eggs Mixing all ingredients	He has trembling hands. Diabetes, He has pain on the waist when bending	He uses a non-stick frying pan in order to fry without using oil – healthier approach He grasps loosely the handles of cookware and various utensils While cooking, he always holds the handle of the pan.	1 time per week	Cooks occasionally and specific recipes.	There is a very small working area Cookware are stocke into the oven or cupboards

Table 7: Interviewee No6

Interviewee Number:		**7**	**Lunch : Green beans**			
Age: 65		**Gender: Female**				
Family status	**Stages for preparation**	**Ageing deficiencies**	**What is being observed**	**Frequency of cooking**	**Cooking Habits**	**Context of kitchen**
Married, Lives with her husband	Washing the green beans Chopping some of the ingredients Mixing and stirring all the ingredients in the kettle	Not anything particular, only some difficulties in upper extremities.	She holds loosely the handles of utensils - cookware Although she is right handed, she mainly uses the utensils with the left hand	Everyday	Every weekend she cooks for the family /friend gatherings	She has a lot of storage area She uses hand tools meticulously. The oven trays are stackedinside the oven.

Table 8: Interviewee No7

4.3 ASSUMPTIONS FROM THE CONTEXTUAL RESEARCH

Figure 3:Grasping handles

The exact behavior of the users was described thoroughly in the previous section (see tables 2-8). The comparison of their behavior based on photographic documentation is a fruitful process, which will result on the common needs and habits of the elderly people examined.

What in my opinion is the most interesting part for adjusting is the handle part because it is associated with many actions: holding and lifting and in some cases guarding the cook's safety.

The documentation proved a huge variety of grasping handles (See figure 2). When safety was not a major issue, they were holding cookware or kitchenware loosely.

The only common kitchenware regarding safety was the knife.

Figure 4: Cutting with a knife

When the object is hard to cut, the users tended to grasp both the vegetable / fruit and the knife firmly. In one case as you can see, there is a possibility of accident (due to arthritis problems she was feeling insecure, if she held it a little further away). A good alternative is chopping on a cutting board, but the majority of them is not kin of it.

Figure 5: Unconscious turn of the handle of the frying pan.

The possible turnover of the frying pan due to false positioning of its handle is depicted on figure 4. She turns tha handle so as to control the frying pan while stirring but she leaves it in this position afterwards. She claimed to have somescalds due to this habit.

Figure 6:Kitchen aids - Utensils

The use of kitchen utensil – aids (e.g. peeler, lid opener, electric knife, knife sharpener, fruit cutter, and potato cutter) relies upon the user's needs, working and storage area of the kitchen, but primarily to her/his habits acquired through 30+ years of cooking. Some of the interviewees consider these aids inseparable. On the contrary, others replace them with more simple solutions (knife instead of peeler, fruit and potato cutter, cloth instead of lid opener) no matter if by using them, they are safer and less tired.

Concerning the kitchen workspace and storage area, there is also a variety of spatial environments there. One kitchen may have very limited working area (e.g. 50 cm long) and others may have vast working areas. Cookware are stacked mostly in the oven (eg oven trays).

Figure 7: Kitchen arrangement related problems.

To sum up, the assumptions deducted from this first stage are the following:

- The way of cooking is complete a personal issue. In the age of 60+ cooking has become a habit, so the behavioral changes due to deficiencies are very common and unconscious sometimes. The way one cooks is based and limited on her/his own capabilities and/or deficiencies. Another important factor that influences it, is the kitchen context.

- Each type of cookware is not always difficult to use for all of them. Some prefer not to use any of these due to diet reasons, others because they find it difficult to move around the context of the kitchen due to body deficiencies.
- They tend to use smaller cookware as the number of the member of the family decreases.
- Awareness for accidents is mainly habit aware. Some tend to be more attentive while cooking others are in a hurry.
- One could claim though, that as the age progresses they tend to look for more easy solutions
- They tend to hold the handles with the most convenient way, in order to control safely the cookware and/or the utensils.
- They prefer to prepare their meals (or some of them) on their own.

4.4 COMPLEMENTARY RESEARCH

A second stage of research, but of minor importance were face to face or telephone interviews with old women that denied the invitation for the on-site interview. The questions asked where typically based on the structure of the onsite questionnaire (See Appendix). The population examined was 28 old women over 60 years old. Those interviews mainly confirmed the information derived from contextual interviews and the previous literature research too.

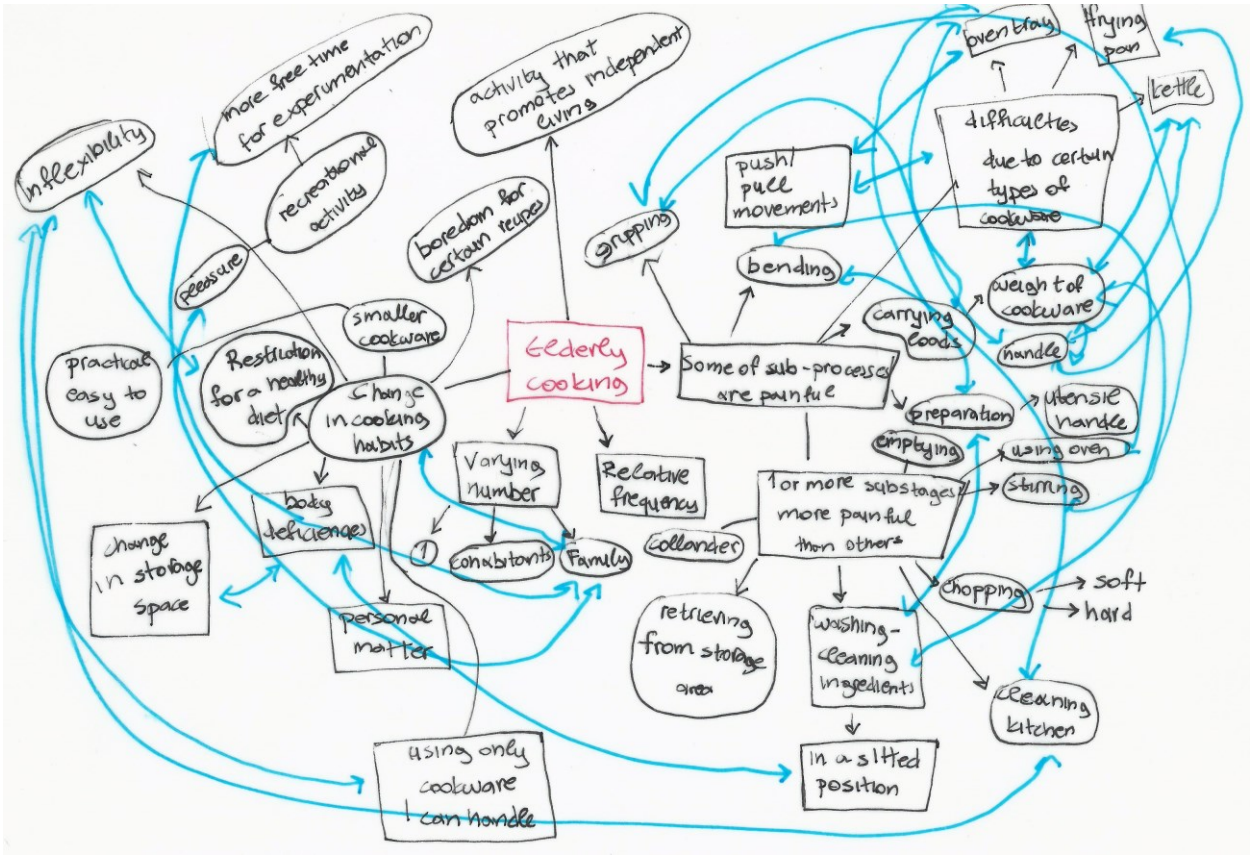


Figure 8: Brainstorming diagram depicting the results of the interviews (both contextual and on site)

Regarding the level of difficulty of the cookware, oven tray was regarded the most difficult to uses whereas casseroles (saucepans, kettles) the most easy ones. So, I decided to examine the possibility of redefining either the casserole or the oven tray.

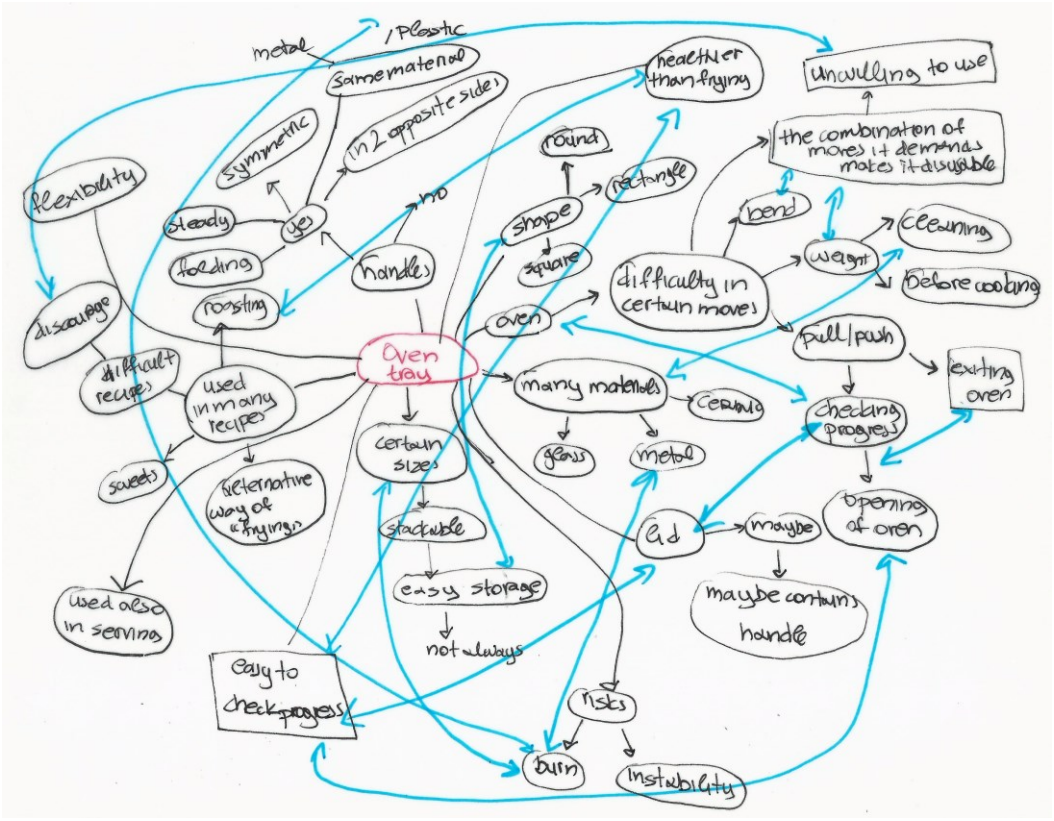


Figure 10:Brainstorming diagram exploring the attributes of the oven tray

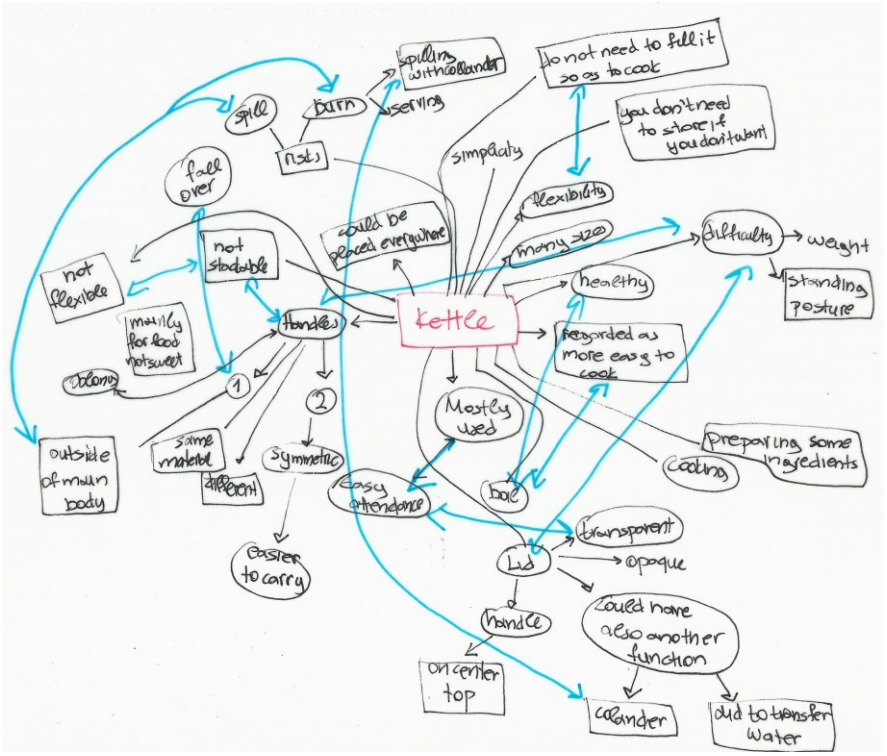


Figure 9: Brainstorming diagram regarding the properties of the casserole - kettle

4.5 RATING OF FINAL CONCLUSIONS

From both the contextual interviews and the analysis of face to face or telephone interviews, the following conclusions were deducted:

12	They usually cook for themselves or for 2 persons. Sometimes they cook for friends and / or family. As they grow older, they tend to cook only for themselves.
9	They either have not changed the cookware they used or tend to use smaller cookware.
6	The age related physical deficiencies, discourage elderly people from performing certain movements, leading to a deteriorating situation. They do not feel confident or able enough to perform certain tasks if they do not have any solutions.
7	The extent that every person finds it difficult to perform certain tasks varies.
4	The products they use, expose them to risk since they may be inappropriate due to their different specific needs (risk of turn over, flipping, spilling, burning, fall due to excess weight etc).
3	Even though they rated all the cookware proposed (oven tray, frying pan, and kettle) of the same difficulty to use, when asked separately they rated all the pan related activities and movements more difficult to perform.
1	The most irritating task was the bending movement in order to retrieve stored items or ingredients, or to place a tray into the oven.
2	The way they grasped the various handles was very different, depending on the physical status of each participant.
8	They tend to adopt more simple solutions and are not fond of many kitchen gadgets, unless they have learned to do so.
10	Cooking has moved from pleasure to obligation and necessity.

11	Tasty foods are considered unhealthy and sometimes difficult to cook. Since there are no alternatives, one could think that elderly are “excluded” from tasteful recipes.
5	Storage of cookware is of high importance too.

Table 9: Rating of needs

Both casserole and oven tray are the two types of cookware that I found interesting. Since kettle performs certain cooking activities and it is considered easier to use, I see the opportunity to improve some elements of the oven tray, in order to make it more attractive first to older people.

4.6 INITIAL DESIGN BRIEF

The proposed design brief for the oven tray is the following:

- Target audience: Since the product has to follow the principles of Universal design, it will be addressed to every person that cooks in spite of her/his span of ability. Some of its features are inspired and will try to serve firstly the needs of the elderly.
- The main focus of tray's redesign will be its handle.
- The design of the handle has to ensure safety while using the oven tray (easy to carry, steady grip, prevents user form burn and excess bending).
- It can be available in one or two sizes but not as a set.
- It will promote healthy cooking (an alternative for frying)
- Its design has to be flexible. It may change its size or offer multiple placement for handles.
- The design of the handle could be used to other cookware too.
- It must be at the same cost or at a little more cost compared to existing products.
- It has to be bright colored not only because of current trends but also as a sensory sign.

After the redefinition of the oven tray during the concept generation process, the aforementioned design brief will be transformed in order to incorporate all the attributes that will derive from this process.

5 CONCEPT GENERATION

In this chapter, I will describe the whole Concept Generation process. This description involves:

- An attempt to redefine the oven tray by changing some of its attributes
- different types of handles in general and how they could be used in order to refine the oven tray
- Concentration into some types of handles and refinement of the new type of oven tray.

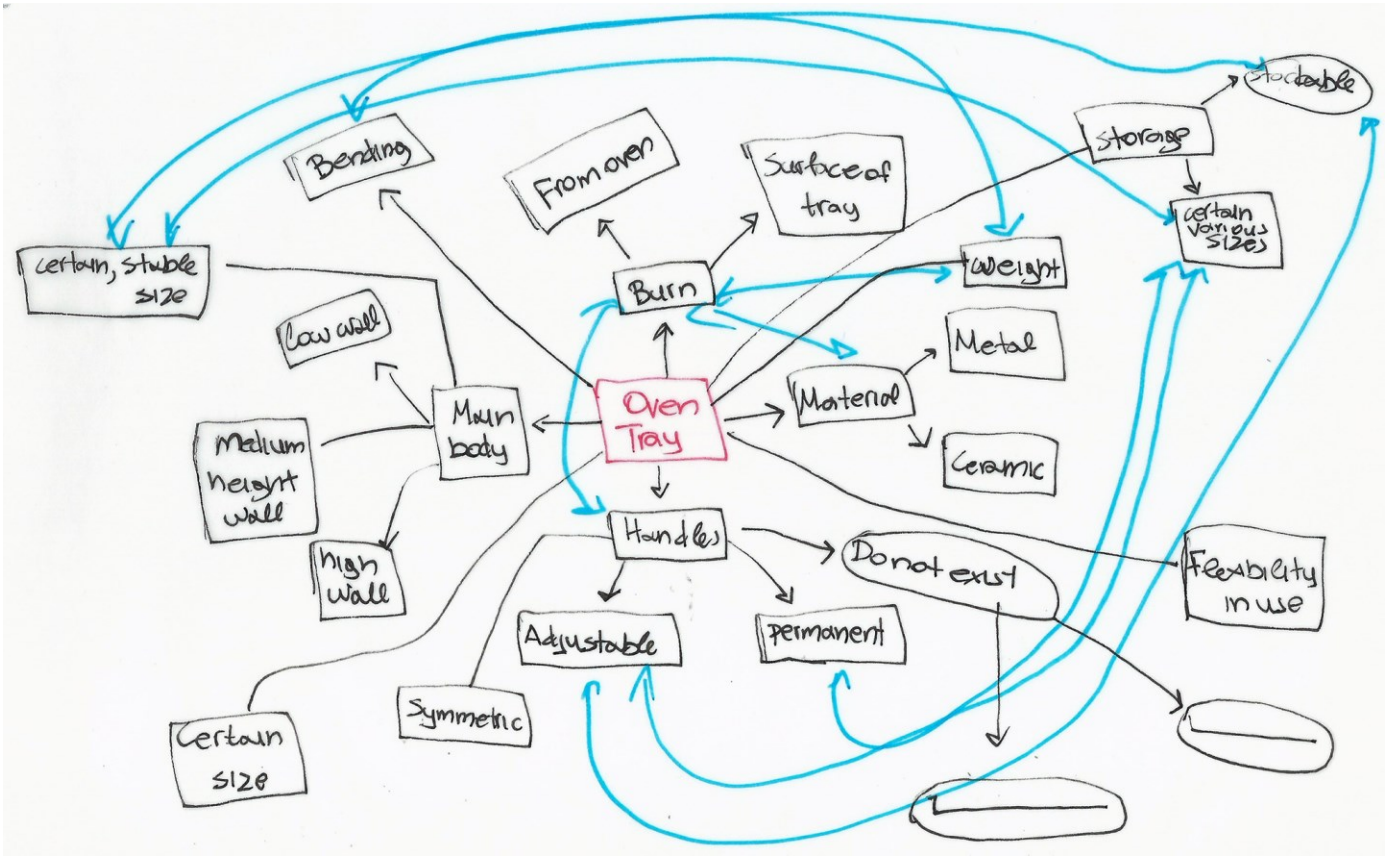


Figure 11: Brainstorming for the general characteristics of the oven tray

The handle properties regarding existing products are depicted in the following diagram.

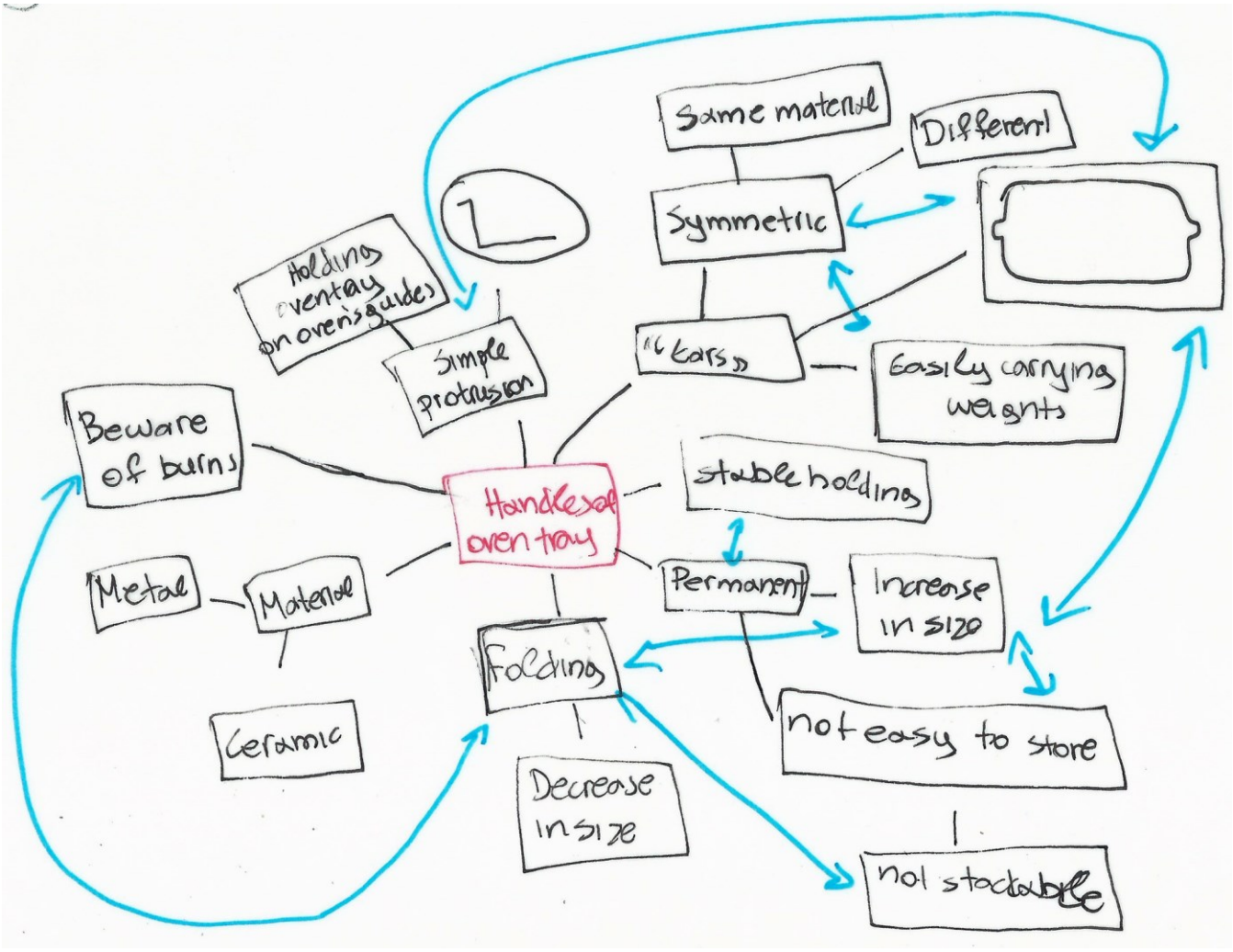


Figure 12: Brainstorming for handles

5.1 INITIAL CONCEPTS GENERATION FOR THE REDEFINITION OF OVEN TRAY

5.1.1 Concept No 1

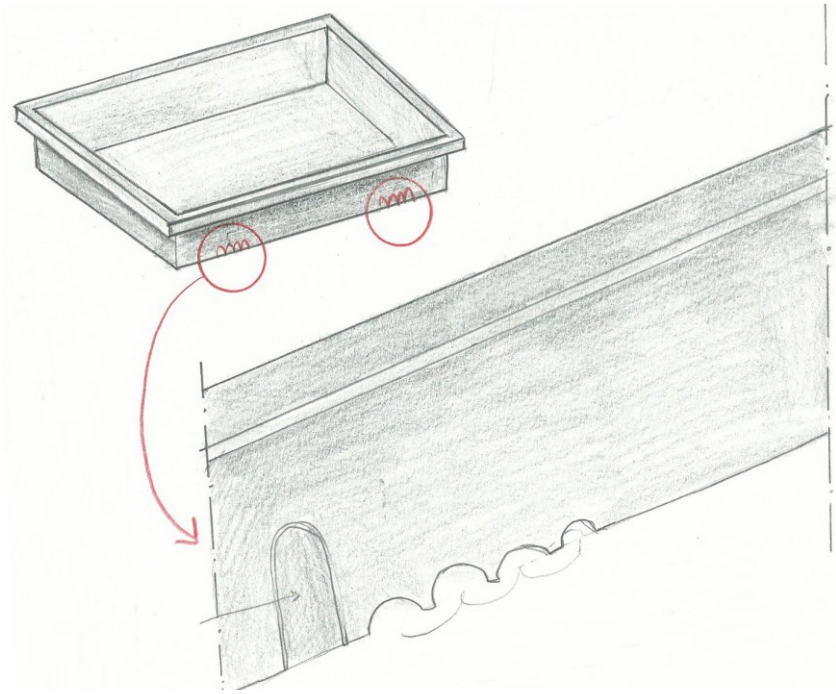


Figure 1: Sketch of concept 1

This concept aims to create “embossed” touching areas on the oven tray covered with silicone in order to prevent scalds. It is hanged on the side runners of the oven.

Advantage: No need of thermal proof as it is applied on the surface of the oven tray.

Disadvantage: It can only be used hanged.

5.1.2 Concept No 2

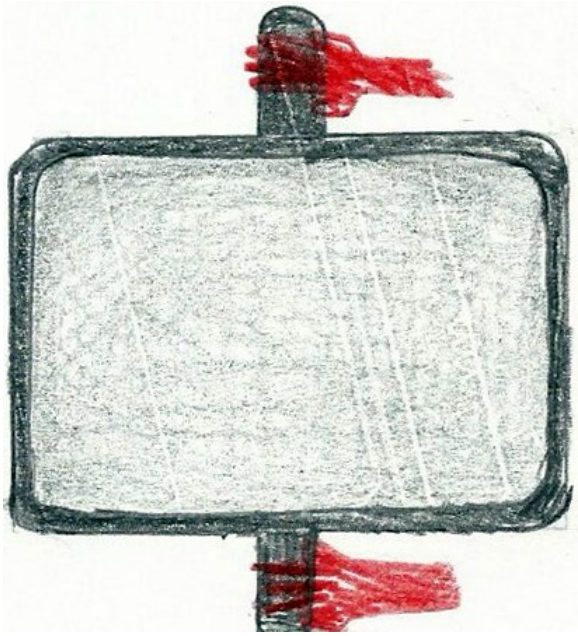


Figure 13: Concept 2_first alternative (top view)

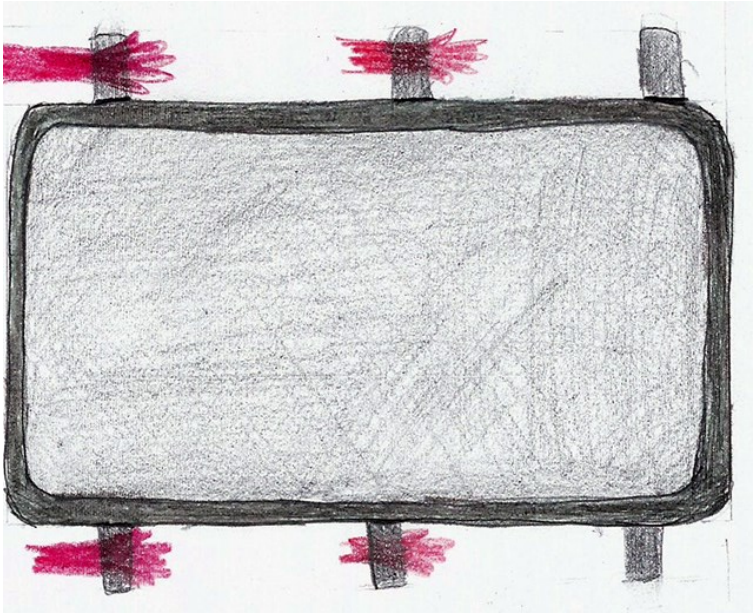
This proposal involves the creation of large lateral handles placed symmetrically on the longest sides of the oven tray, so as to offer more surface to hold it.

Advantages:

It offers a steadier grip for people that may have trembling hands or need a larger surface to hold firmly.

Disadvantages:

- It may roll over due to weight.
- The user has to bend a lot in order to get the oven tray



.

This alternative offers more handles that can offer “diagonal” holding in order to stabilize better the user’s grip and prevent simultaneously the rollover of the oven tray.

Figure 2: Concept _second alternative (top view)

5.1.3 Concept No 3

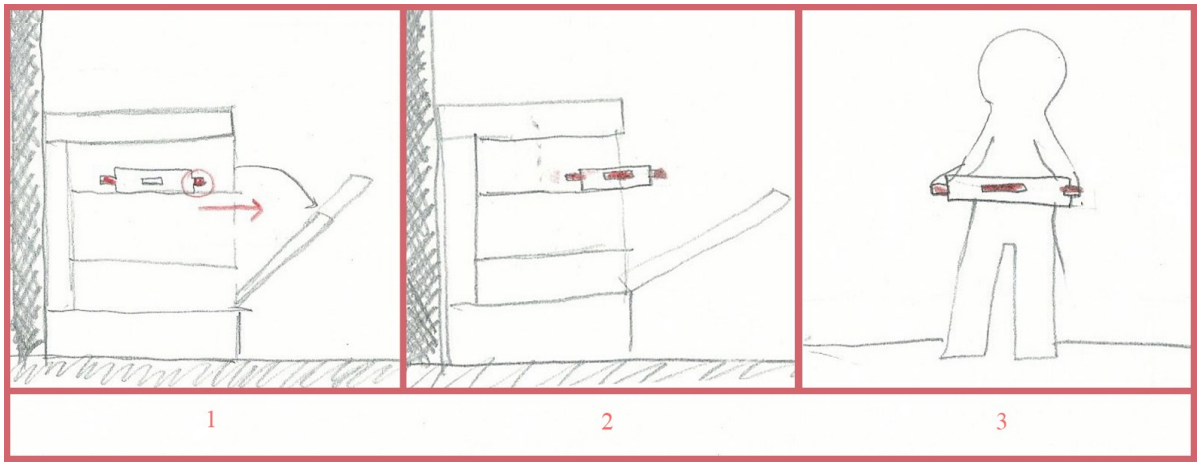


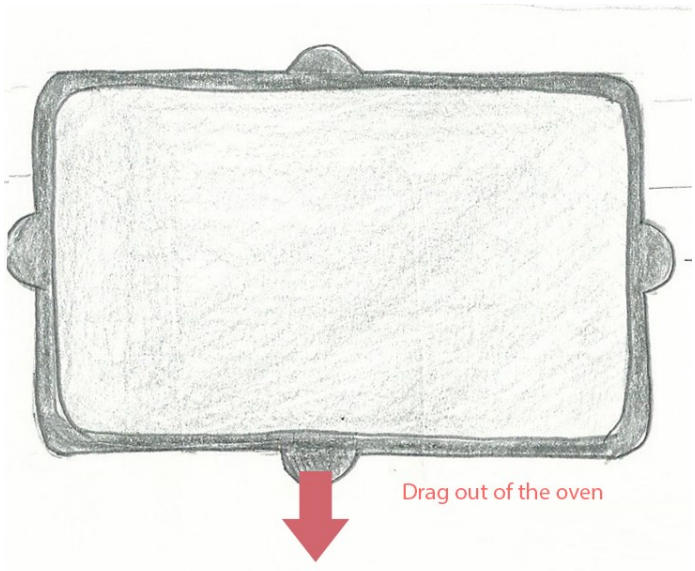
Figure 14: Storyboard of concept 3

Concept 3 aims to offer two handles for aiding the process of taking the tray out of the oven.

- Handles that help the safe grip while dragging the oven tray outwards. The dragging handles are placed symmetrically on the longest sides of the oven tray. There has to be at least one dragging handle.
- A lifting handle which responsible for helping the user carrying the oven tray safely.

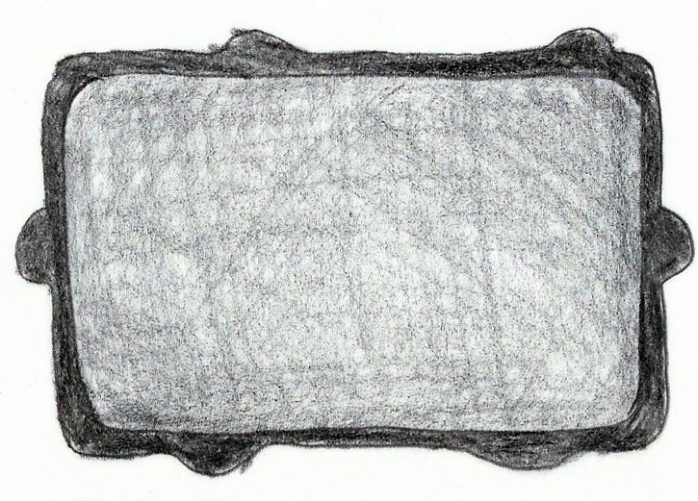
The dragging handle can secondarily serve as a lifting handle too, enabling the diagonal grip referenced on Concept No2.

There are three different alternatives for this concept.



This alternative incorporates 2 dragging handles for being able to drag the oven tray, without having to remember the right side for placing it into the oven.

Figure 15: Concept 3 alternative 1 (top view)



This alternative offers more dragging handles. Since the user may not be able to access the dragging handle if it is placed in the middle (due to disabilities of flexibility of hands, not enough space etc.), she/he can drag it from other reachable points. These handles can assist the "diagonal" holding explained in Concept 2.

Figure 16: Concept 3 alternative 1 (top view

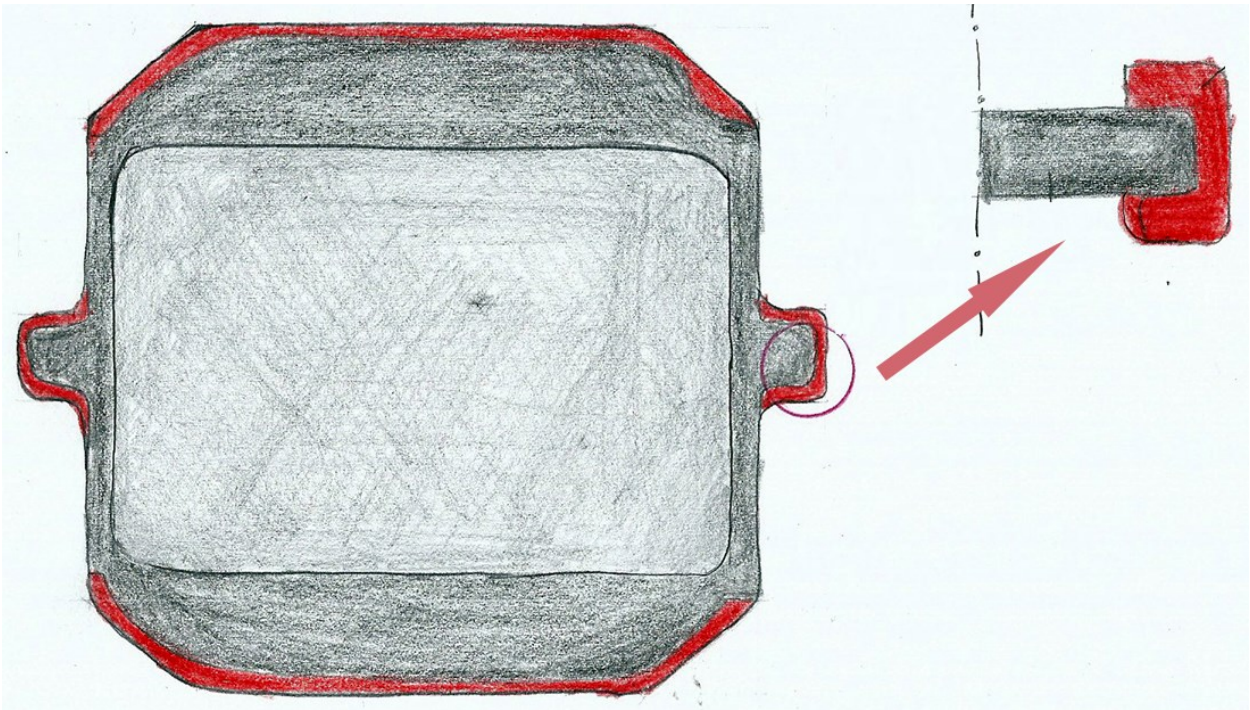


Figure 17: Concept 3_Alternative 2 (top view and section detail)

In this alternative, the lips of the oven tray at its longest sides are protruded in order to form a uniform surface which the user can touch and drag the oven tray out of the oven. The user is not obliged to grasp at certain reach points, but can touch at the most convenient place. A percentage of this surface can be silicone coated (see section detail, figure 17). Also, the lifting handles are silicone coated so as to be heat proof.

The advantage of all the alternatives of Concept 3 is the use of the dragging handle that makes it easier to pull out the oven tray. What it fails to accomplish, though, is the elimination of bending posture.

5.1.4 Concept No 4

Figure 18: Arthirtis handle. Available at: https://s-media-cache-ak0.pinimg.com/564x/81/ad/3a/81ad3a6904cb0959b59bf176b5580d1a.jpg

Concept 4 is inspired by this type of door handle that is aimed for users with arthritis. The users are able to use handles without holding them tight. It is an alternative solution for lifting handles.

It cannot be easily manipulated, though, from users. The have to pull out the oven and then try to put their hands into the handles, an action that can result to a rollover of the oven tray.

Its main drawback is that it does not decrease the bending posture, but it also makes its user stand more than she/ he usually does in bending posture.

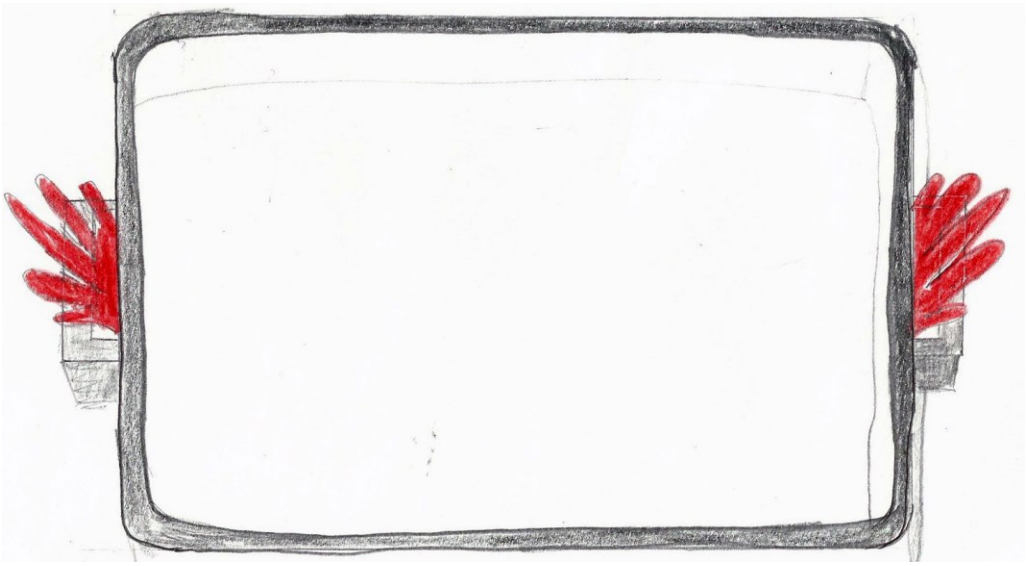


Figure 19: Concept 4 (perspective from top view)

5.1.5 Concept No 5

This concept aims to explore how the size of the oven tray can be altered. It proposes two smaller oven trays (modules) which can be fastened together and create a larger cooking area. They can also be used separately. The notion of modularity is selected in order to serve the need of cooking for different number of persons not at a certain manner (E.g. people who live alone but once or twice a month organize family dinners).

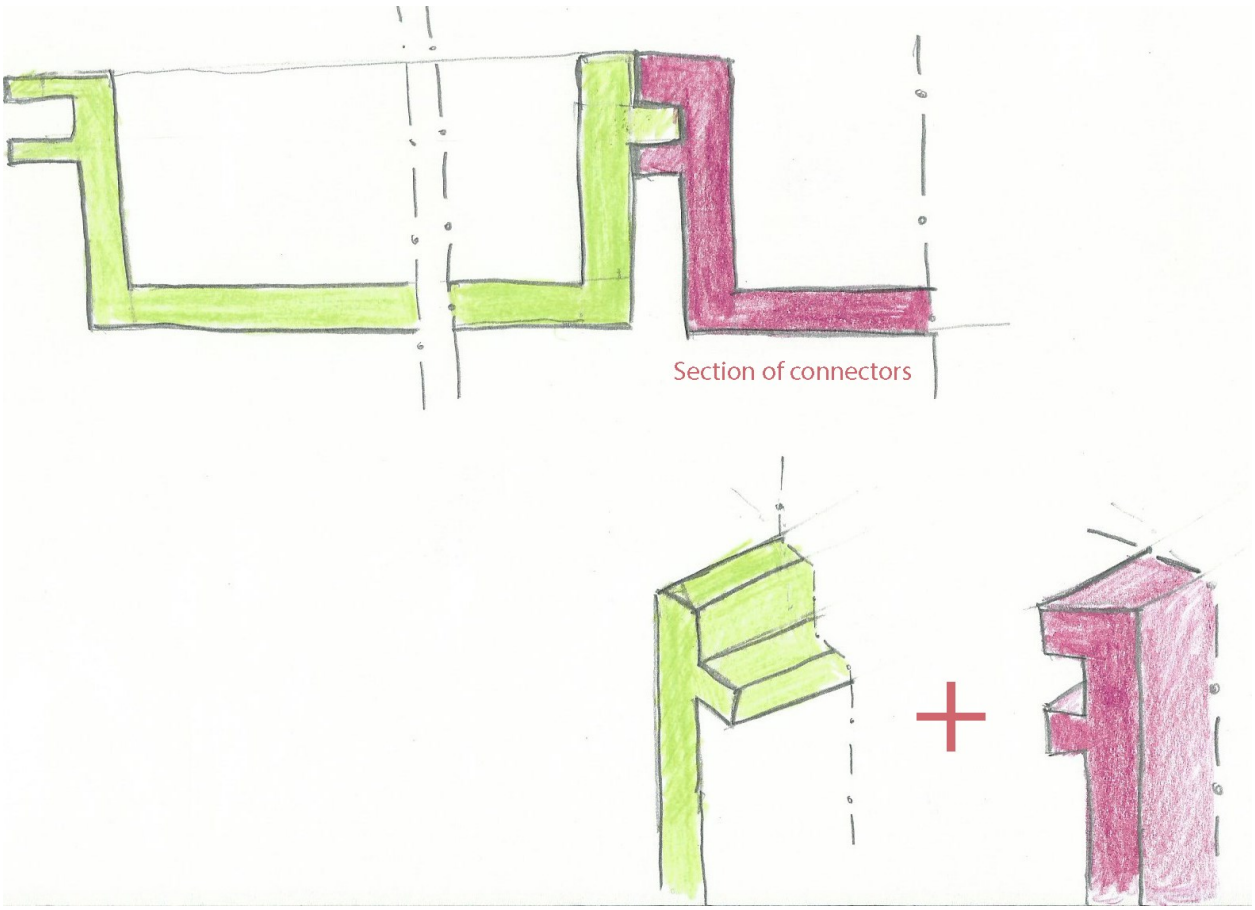


Figure 20: Concept 5 alternative 1 (section view and a perspective detail)

In this alternative, the connection may be unstable as it could move while carrying. So, a different solution has to be proposed in order to ensure a safest connection of the modules and its safe carrying. Also, it discourages stackability.

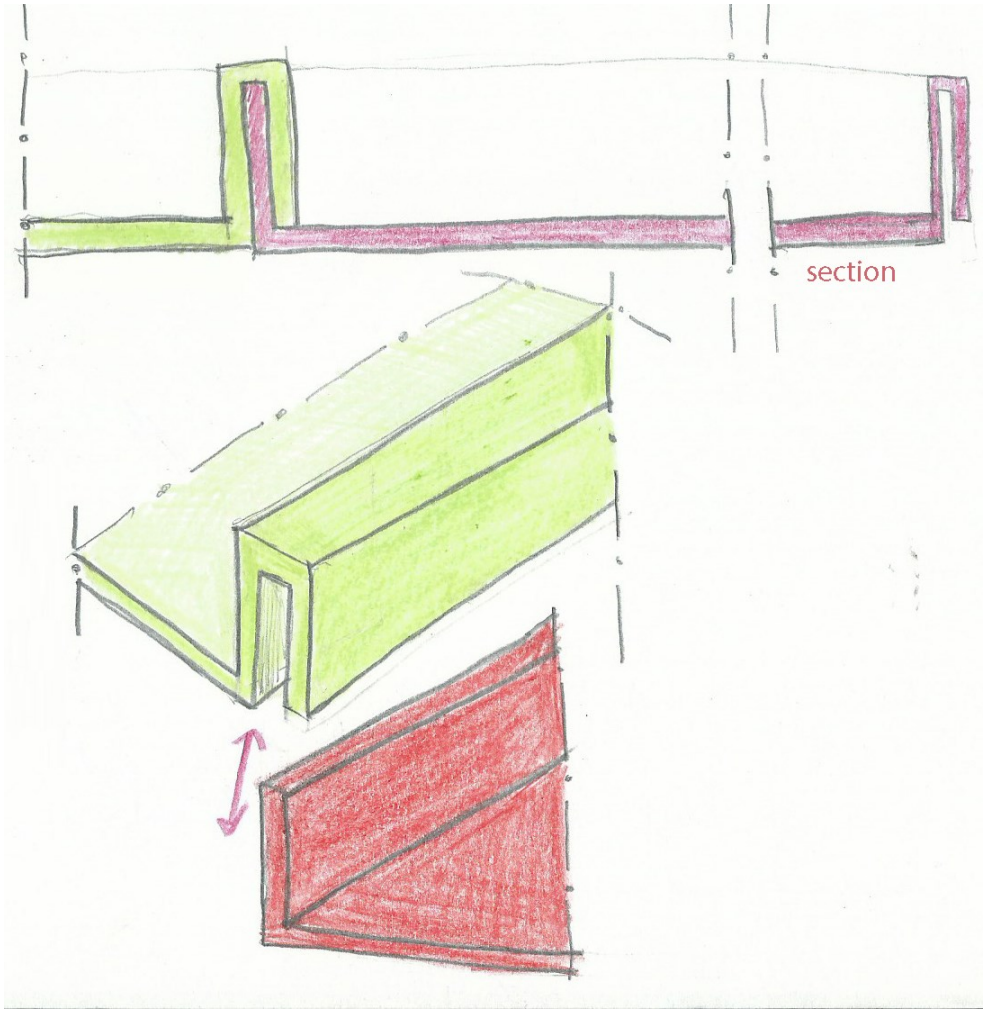


Figure 21: Concept 5 alternative 2 (section view and perspective detail)

This concept has a more stable interlocking of the two modules. It also encourages stackability.

5.1.6 Concept No 6

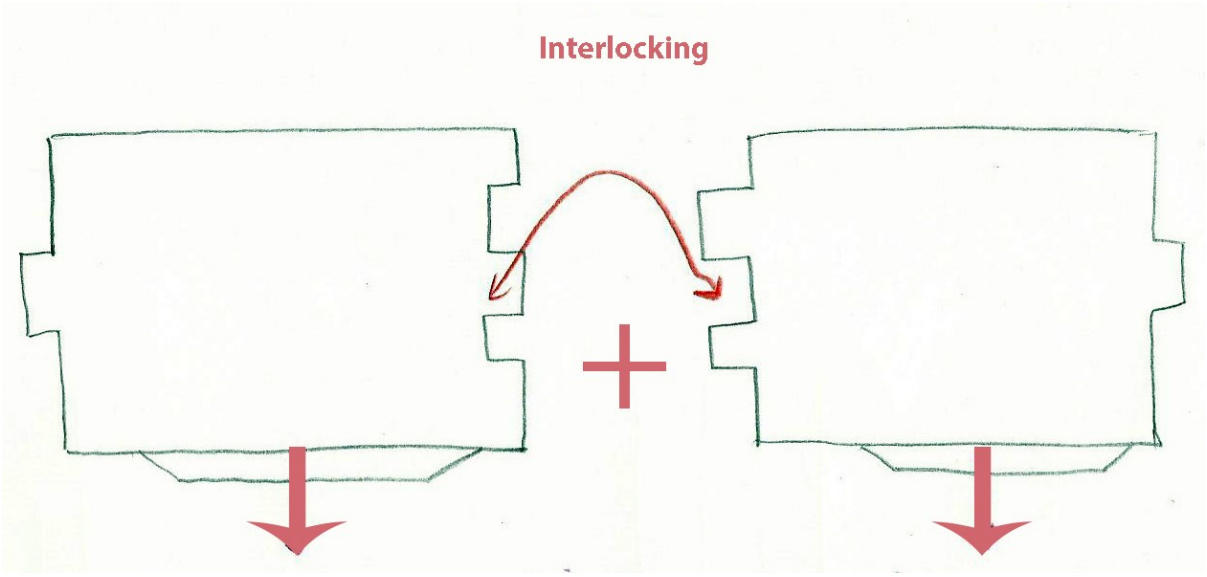


Figure 22: Concept 6 (top view)

This concept also explores the notion of modularity. The interlocking is puzzle-shaped. They are created by protrusions of oven tray lips at certain points. They can serve also as lifting handles. This solution also has a dragging handle.

This kind of interlocking is not so safe, though.

5.1.7 Concept No 7

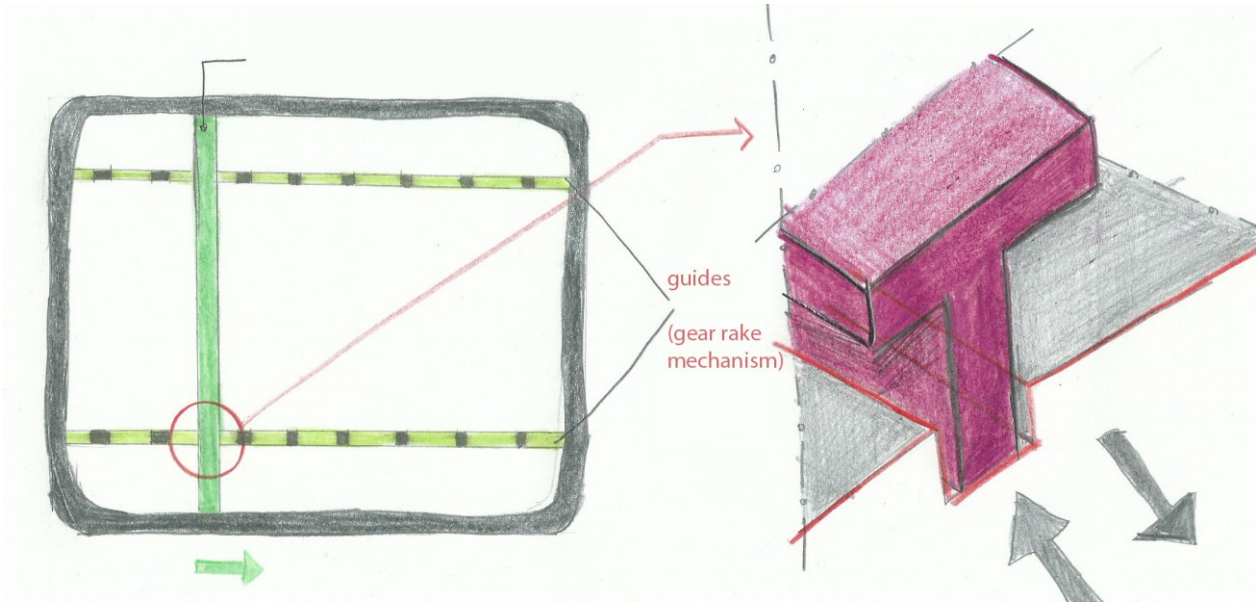


Figure 23: Flexibility in the cooking area

This concept aims to create a cooking surface with varying size in its interior. This is achieved by adding a “wall” that moves with the help of gear- rake mechanism onto suitable

guides. The movements of the wall is controlled manually. Its advantage is that it satisfies the need to cook varying number of portions. Its drawback is that it is not impermeable and also the guide area is difficult to clean. So, this proposal seems to be very impractical despite the fact that it gives the best adaptability of the cooking surface.

5.1.8 Assumptions of first stage of the Concept Generation

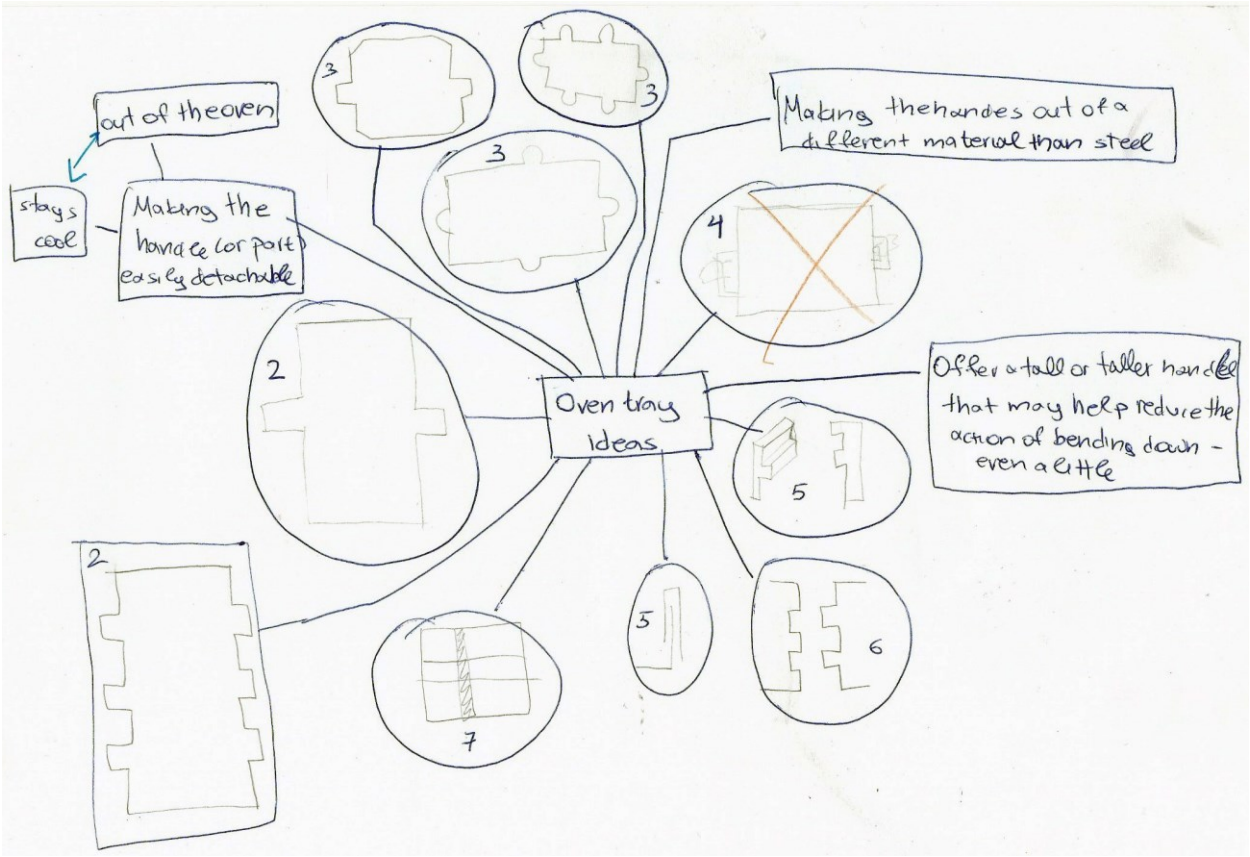


Figure 24: Results of initial Concept Generation process, and further proposals

The most interesting parts of this first stage of this research is the proposal of a dragging handle as a means of adding more comfort in the use of oven tray. What it fails to do is to accomplish the decrease of bending posture at a certain extent in a convenient way.
From this process Concepts 2, 3, 4, are going to be further explored in terms of materiality (handles having the same or different material from the oven tray), detachability and height so as to prevent bending. Concepts 5, 6 are developed furtherly in case any interesting proposal derives.

5.2 FURTHER CONCEPT GENERATION FOR THE REDEFINITION OF OVEN TRAY

5.2.1 Concept No 1

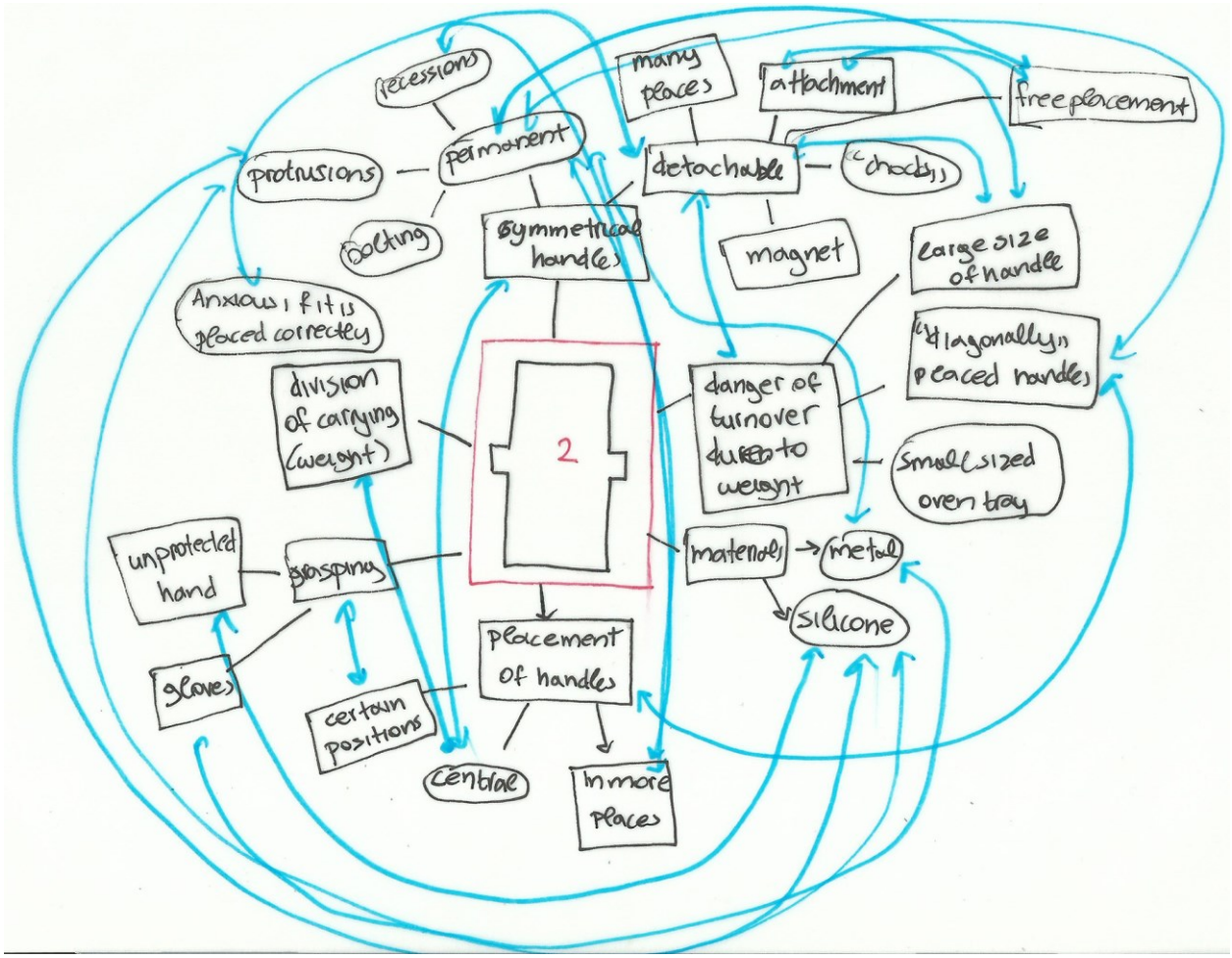


Figure 25: Brainstorming for searching options for improvement

The main idea is to support the easy carrying of the content of the tray with larger or easy to grip handles. It should also protect user from possible scalds. This may result to the narrowing of the cooking area.

In the following pages sketches of variations of lifting handles types will be presented.

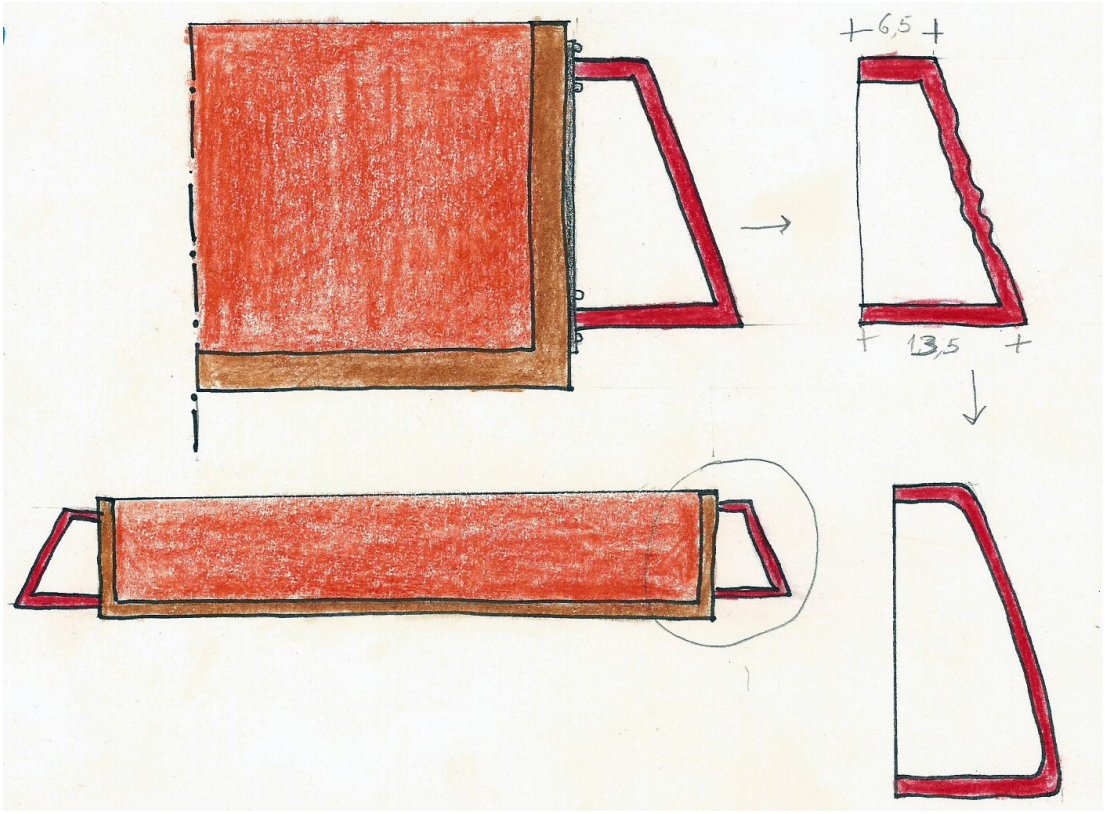


Figure 27: Variation of permanent handles

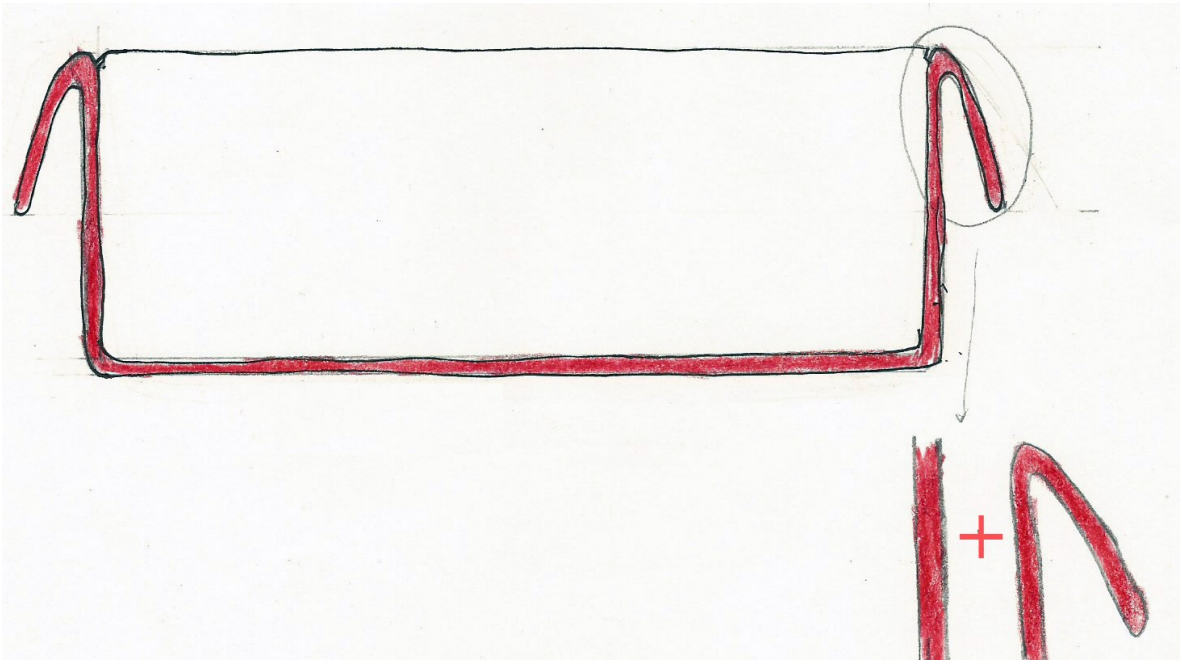


Figure 26: Variation of permanent handles

Permanent handles can be bolted on the inner surface of the oven tray. In this case, the materials must be stainless.

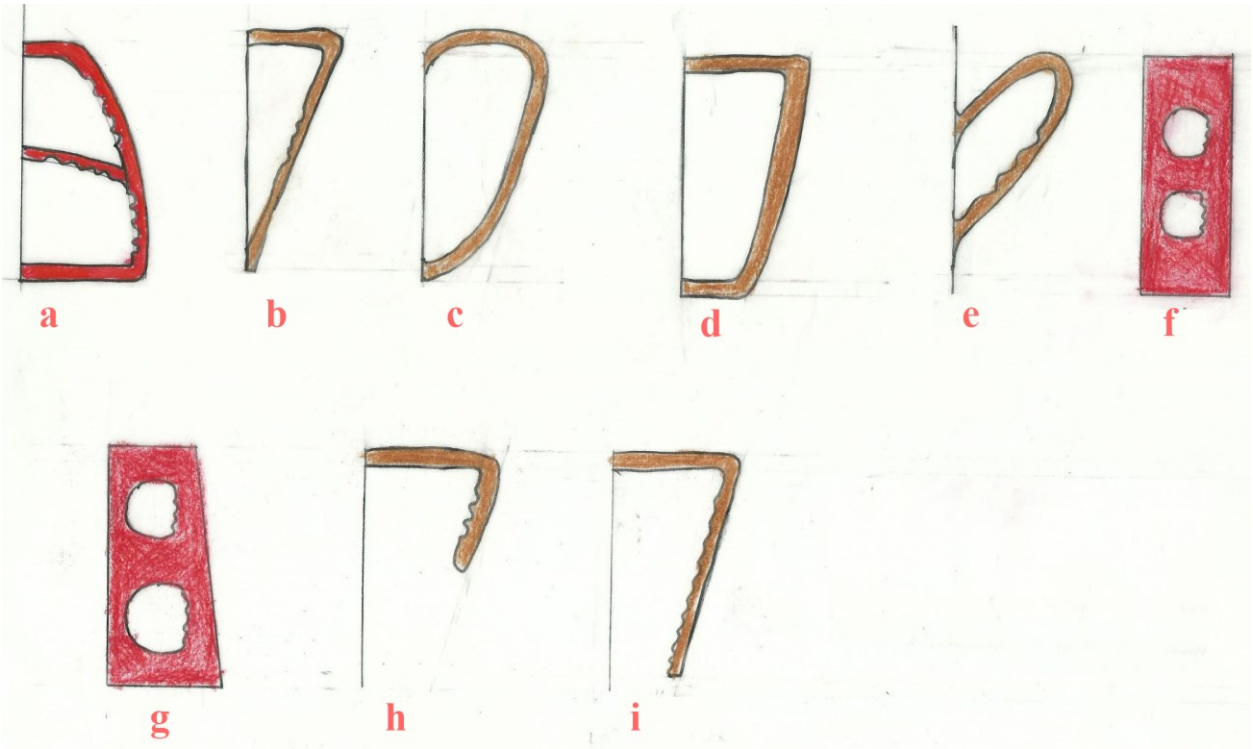
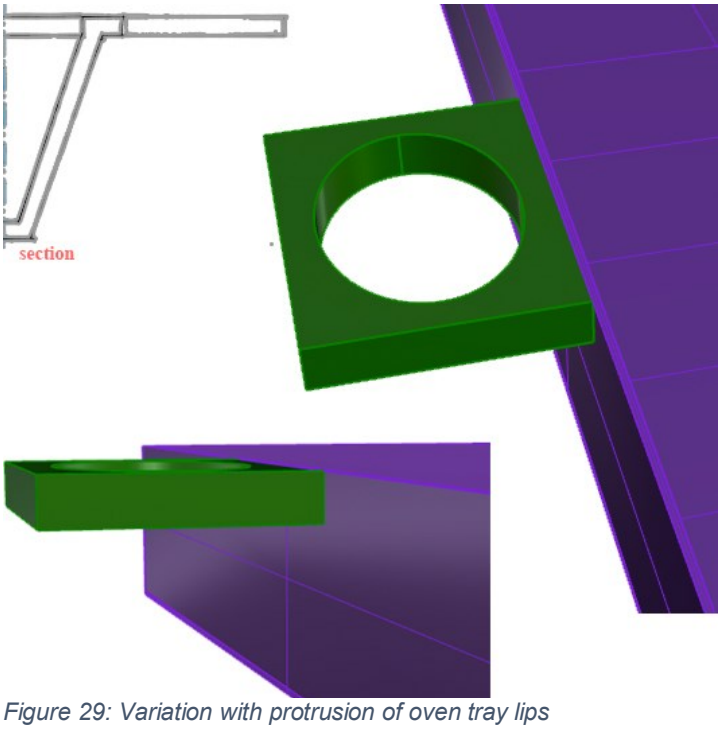


Figure 28: Variations of different types of lifting handles

All the handles being presented in picture a are bolted on holes punched on the walls of the oven tray. They offer a number of possible solutions from tight grips (variation a, b, c, d, e, h, i) to using handles without holding (concept 4 of previous stage). Most of them offer embossments for a better finger and palm accommodation.



Another way of accommodating lifting handles is to cut out shapes from protrusions of the oven trays lips.

Figure 29: Variation with protrusion of oven tray lips

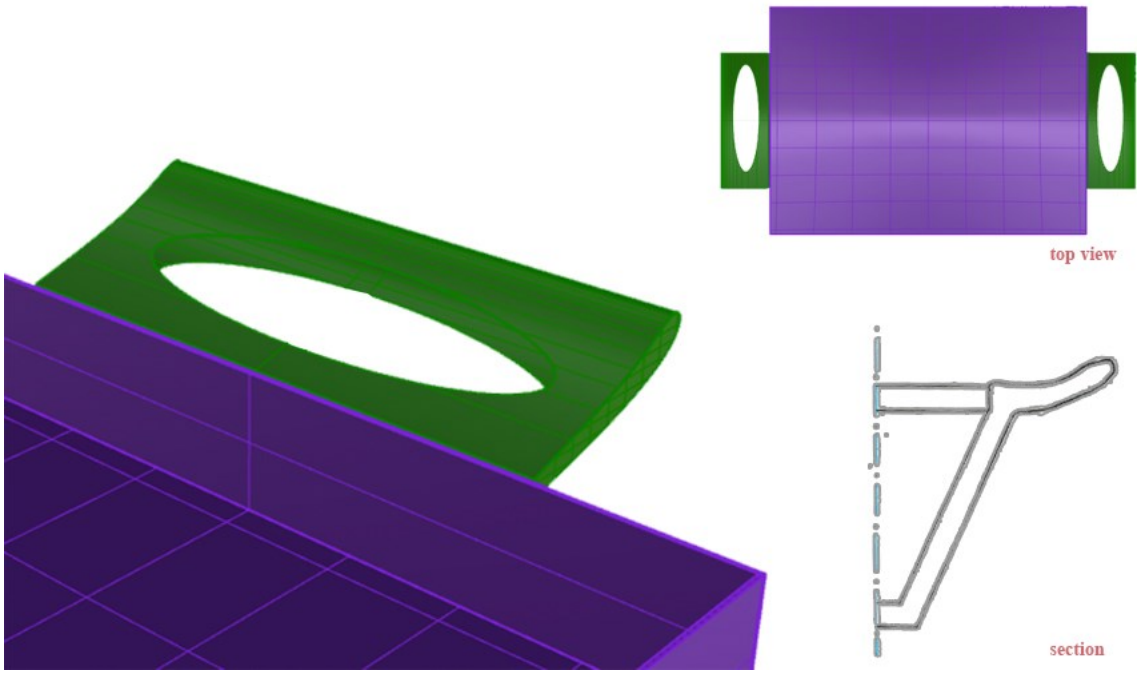


Figure 30: Variation with slightly inclines protrusion of oven tray lips

The inclination of the lifting handles may reduce the bending posture.

5.2.2 Concept No 2

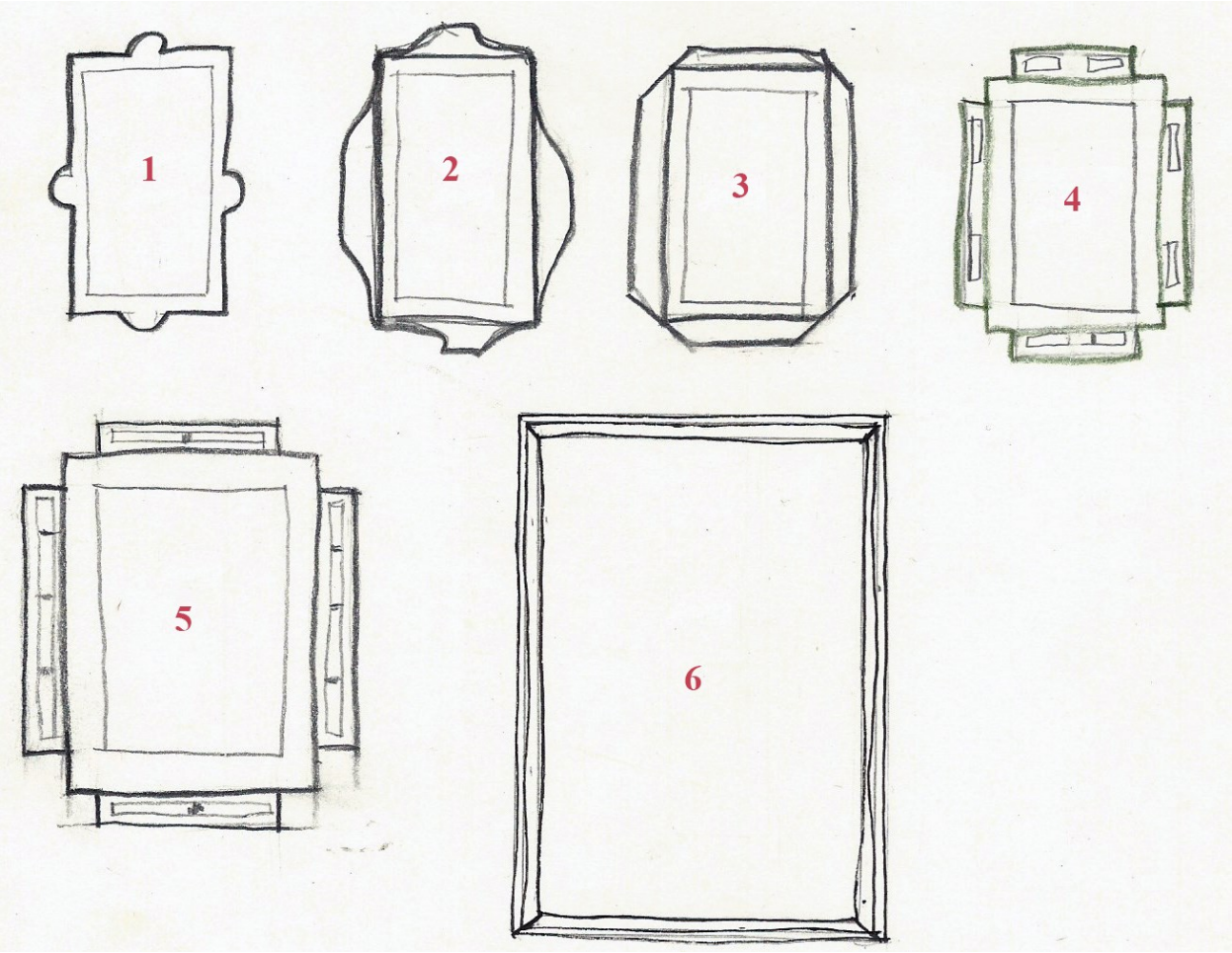


Figure 31: Possible arrangements of dragging handles (top view)

This concept explores various positions and types of the dragging handle(s) in relation to the lifting handles. The dragging handles are located in the longest sides of the oven tray. The lifting handles are placed on the shortest sides. All the handles are placed in protrusions of the oven tray's lips in the same height with them, without any inclination too. This arrangement could be accommodated at elevated handles in order to reduce bending posture.

5.2.3 Concept No 3

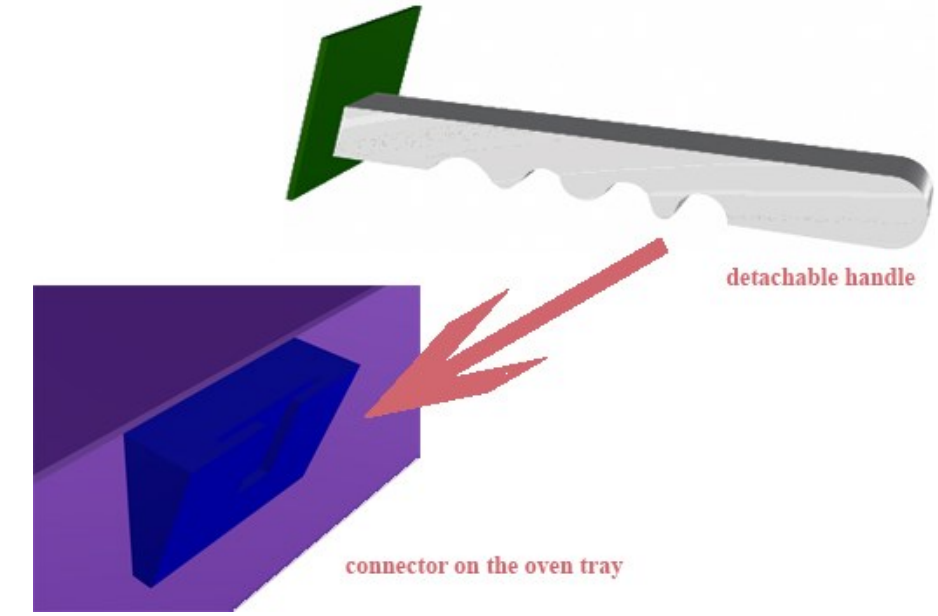


Figure 32: Detachable handle and connector's (perspective view)

The main idea is to diminish the movement of bending as little as possible. This is achieved by creating dragging handles in the front side of the oven tray, or by creating higher handles generally. The dragging handles are thought to be mainly detachable, but constructed in such a material that will not wear when gets in touch with heated surfaces.

Another alternative for detachable dragging handle and its connector is the following:

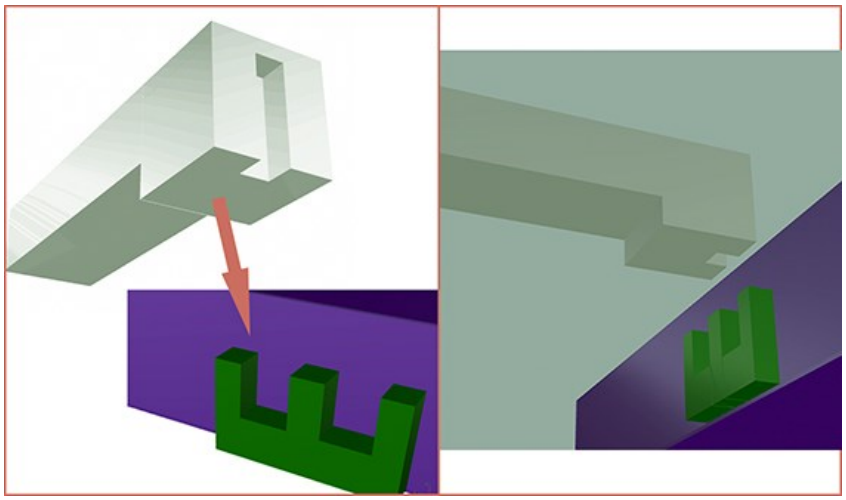


Figure 33: Detachable handle and connector's (perspective view)

Figure 34: Source: https://s-media-cache-ak0.pin-img.com/564x/6e/00/e6/6e00e606c9fd0201bbd2c961a87e3a02.jpg

This concept involves a wooden permanent drag handle inspired by this kettle. Due to the properties of this material, it could not be used in the oven above certain temperatures. The creation of a longer dragging handle is interesting.

Figure 35: Section of the handle

5.2.4 Concept No 4

Figure 36: Casserole with a detachable handle (source https://s-media-cache-ak0.pinimg.com/564x/93/de/f8/93def8b99ea69165318f5e4aea4dfdd2.jpg)

In this concept, the idea of the wooden detachable handle is introduced. It involves the design of one "receptor" on one of the longest sides of the oven trays, on which the handle is attached and then the oven tray is pulled out of the oven.

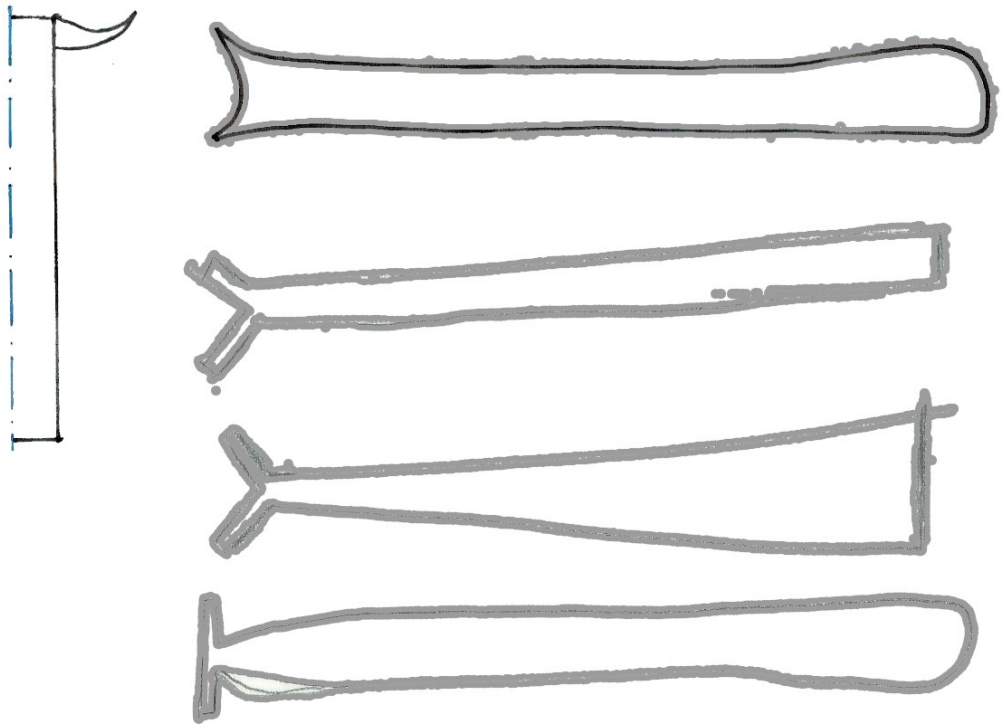


Figure 37: Different types of detachable wooden handles (front view)

5.2.5 Concept No 5

This concept involves detachable handles that are attached to the oven tray's connectors with magnetic locks. This minimizes the effort to interlock the handle to the connector. Since the handle remains out of the oven, for the time being there is no concern about its material.

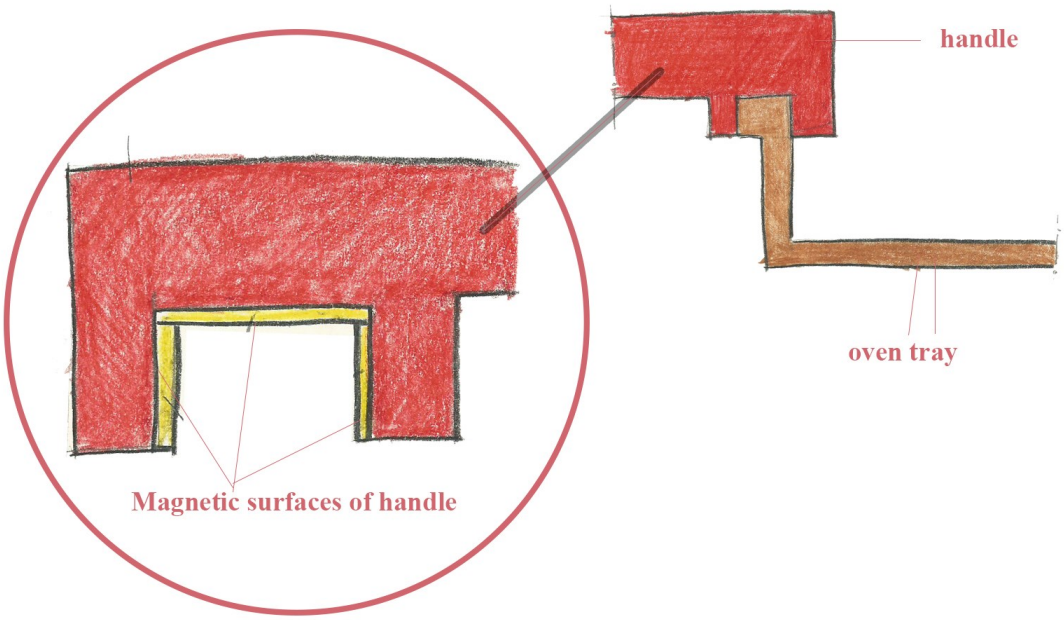


Figure 38: Handle with a magnetic interlock (section)

5.2.6 Concept No 6

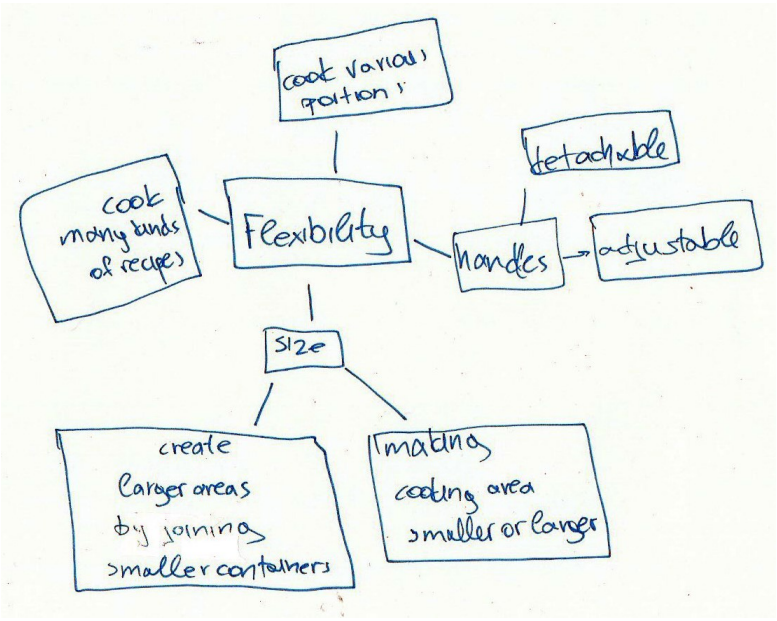


Figure 39: Brainstorming diagram depicting the notions of flexibility

The main idea is the notion of flexibility and how could it could be translated to the oven tray's function. One way is to diminish or increase the cooking area by connecting multiple "cells" –smaller oven trays. Smaller modules that can be interconnected are easier to clean and use.

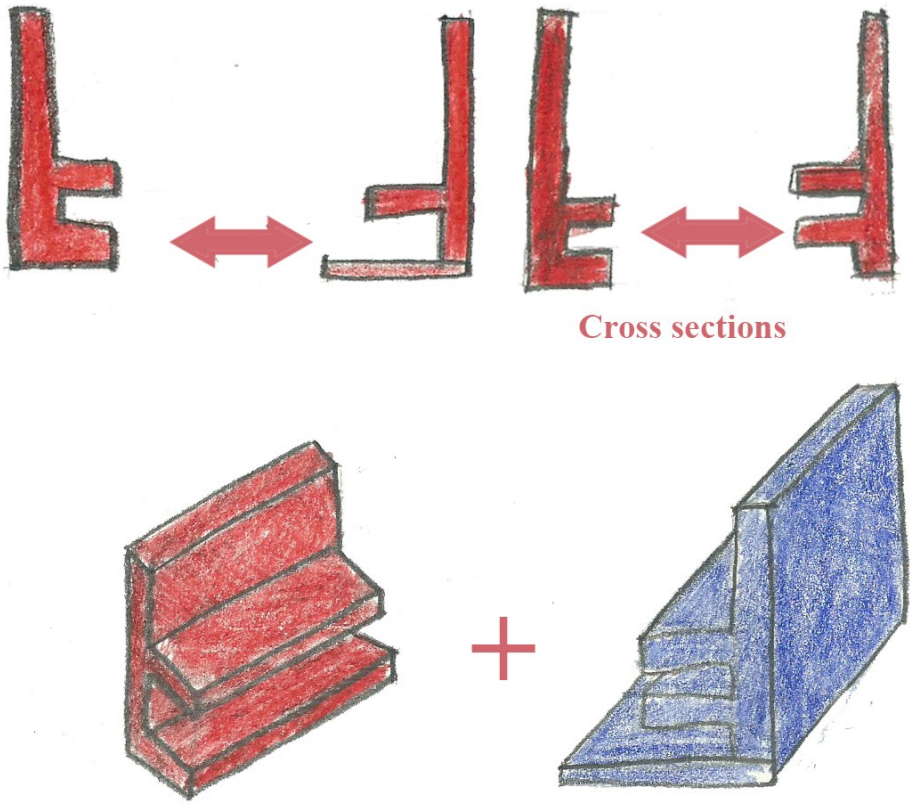


Figure 40: First variation of interlocking of modular oven trays

This kind of interlocking is safer than the previous ones, but there is still enough space for improvement. It is not stackable, though. This solution offers a great interlocking because it is stable too. The connecting element of the module is “locked” into a very small void area created by two walls. It is also stackable.

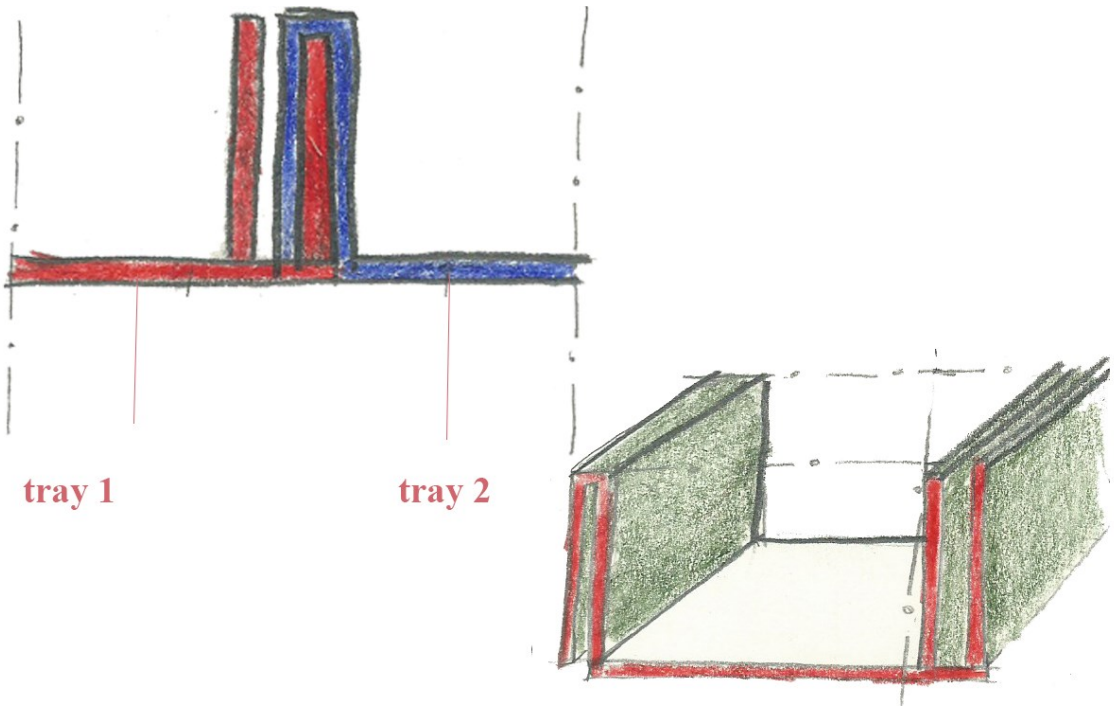


Figure 41: Second variation of interlocking of modular oven trays

5.2.7 Assumptions of the further concept generation

The further concepts that are going to be developed must incorporate the following characteristics:

- Sizing approximately 40cm x 50cm (handles included)
- One long handle placed perpendicular to longer side of the oven tray, assisting to pull it easily. This is the dragging handle that will diminish to a great extent the bending position (see Fig.42).
- Two symmetrical handles to the shortest sides of the tray, designed adequately for lifting the oven tray easily.

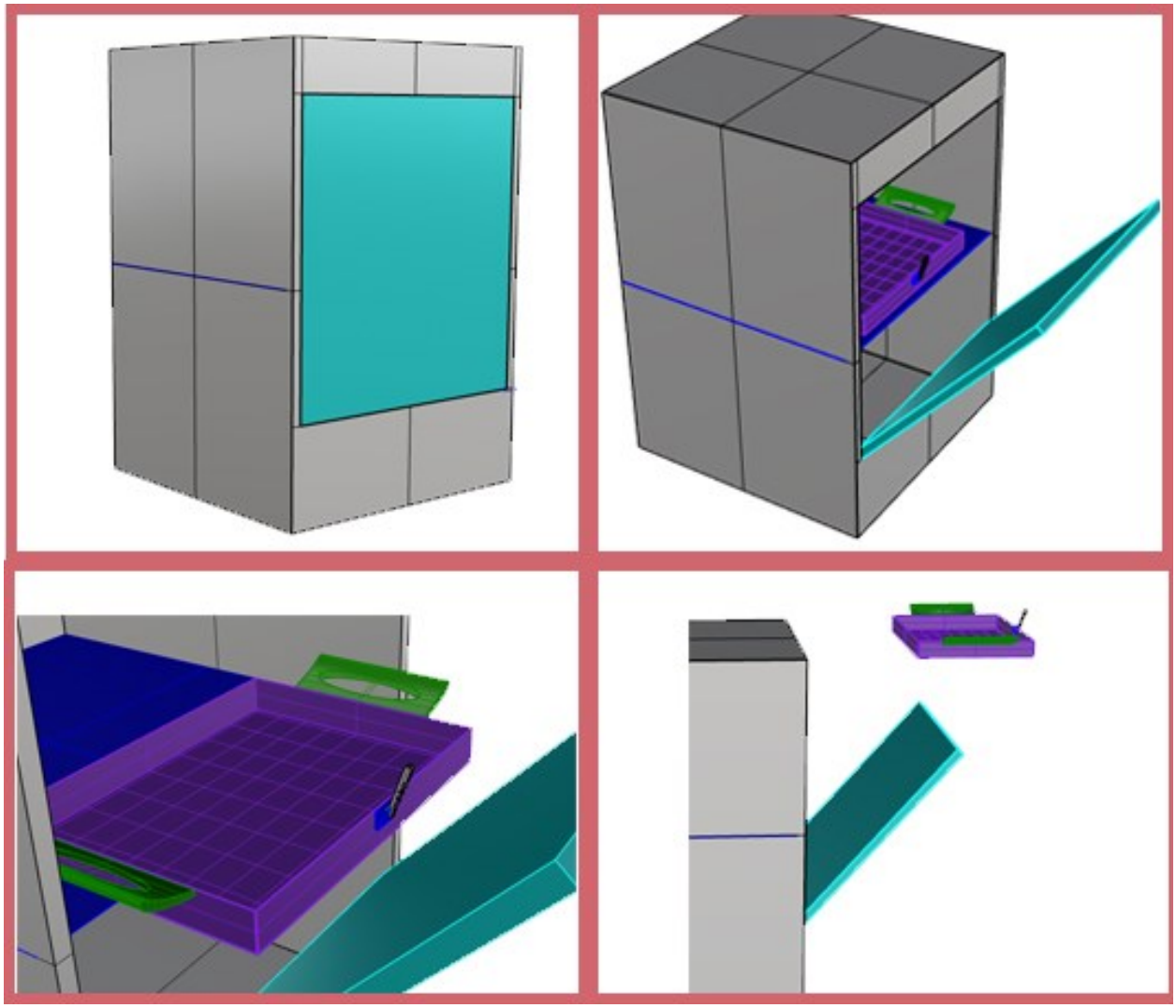


Figure 42: Storyboard of the concept to be further explored

The concept of modular oven tray will not be furtherly developed. The combination proposed above is the most adequately to

5.3 FURTHER CONCEPT GENERATION FOR THE DRAGGING HANDLES

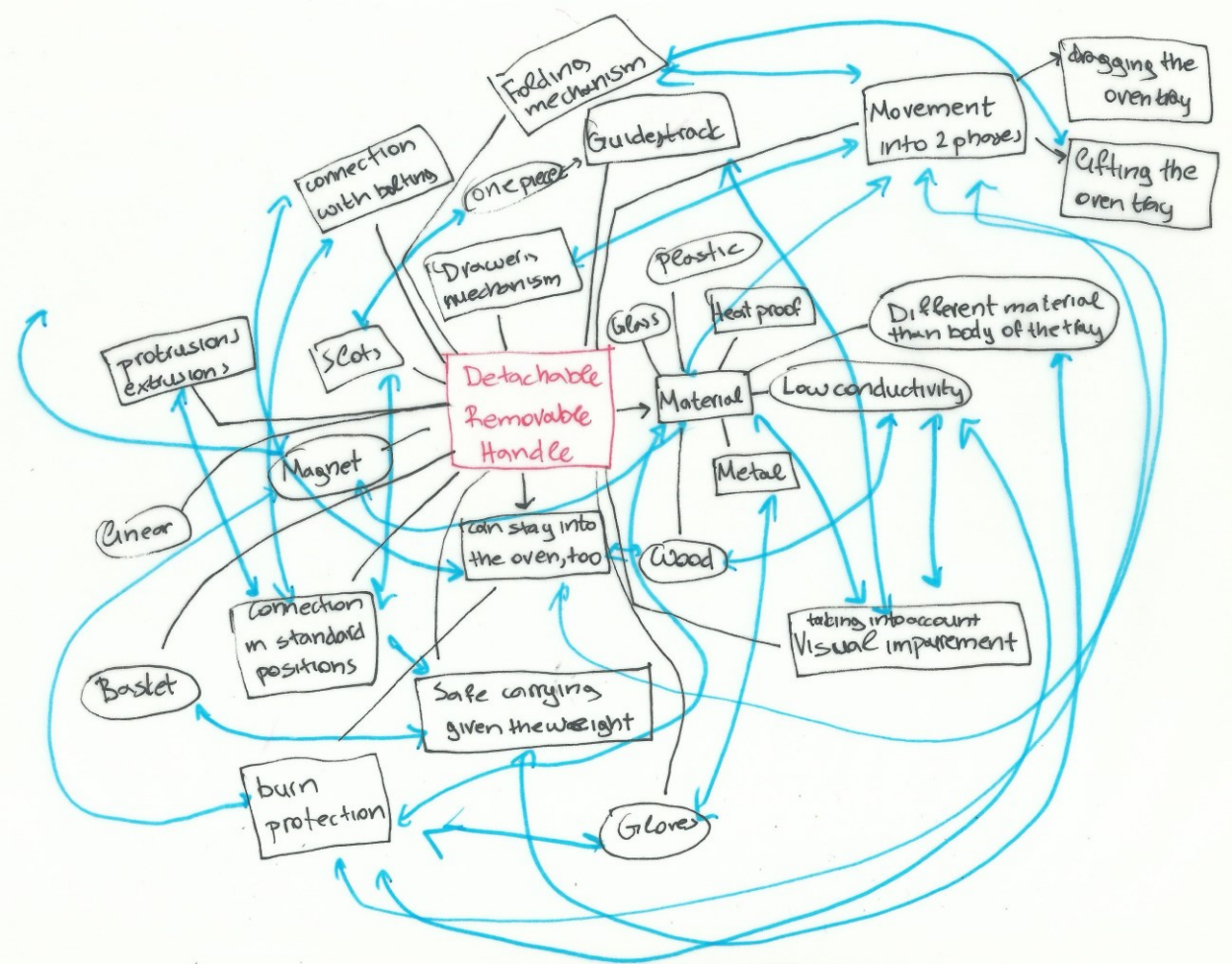
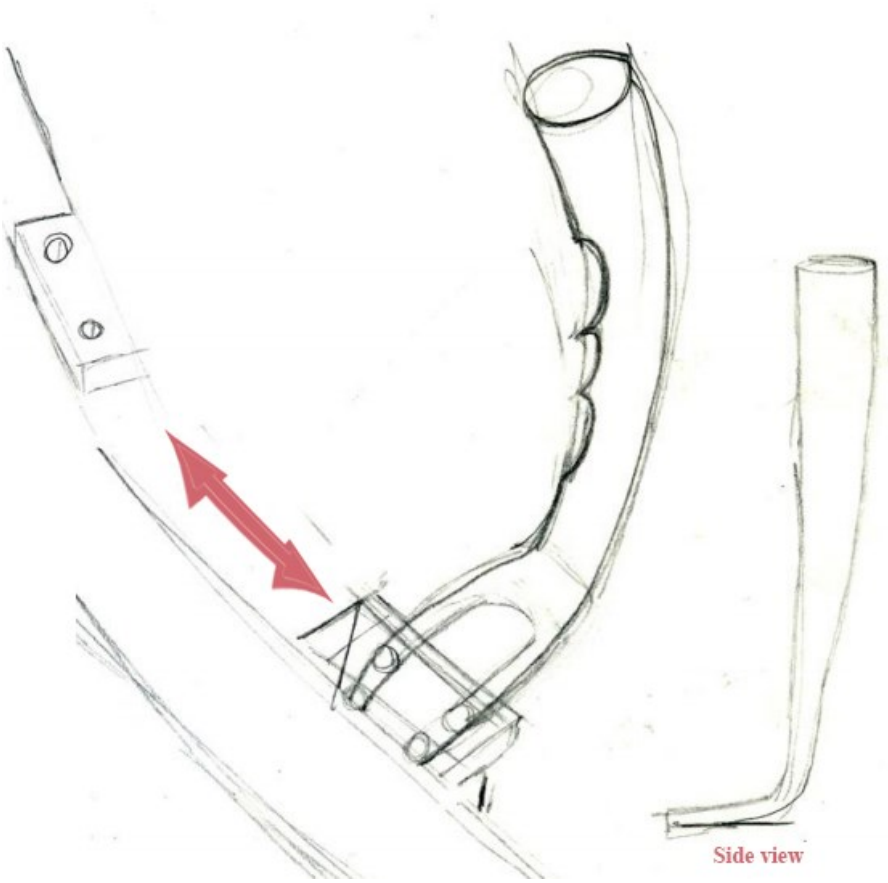


Figure 43: Brainstorming regarding the properties of the dragging handle

5.3.1 Concept No 1

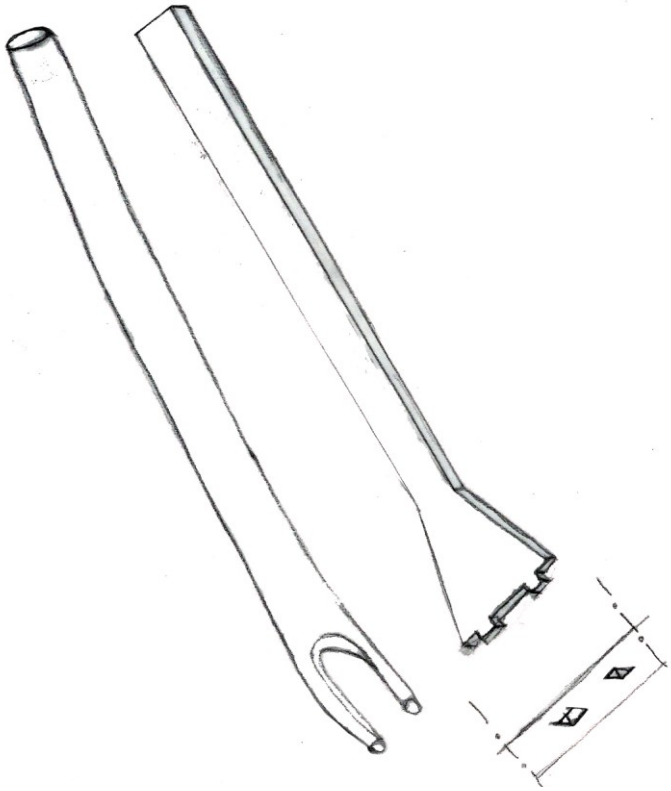
Generally the concept of the detachable handle has to follow these rules:

- It has to be detached from the main body of the oven tray.
- Manufactured with a materials that is a poor heat conductor
- Its safe interlocking had to be ensured.
- Since it should minimize the bending posture it is recommended to focus on designing oblong handles
- It can have a magnetic interlocking. In this case the material properties should be investigated.



The fork shaped end of the dragging handles inserts two slots that are attached to the oven tray. The shape of the connector demands accuracy in order to interlock it together, a requirement that might be unpleasant.

Figure 44: First variation



This second type of interlocking is easier to lock, but it still remains problematic.

Figure 45: Second variation

This variation has a hook-shaped connector and the interlocking element on the handle is just a hole adequate large to pass through the hook.

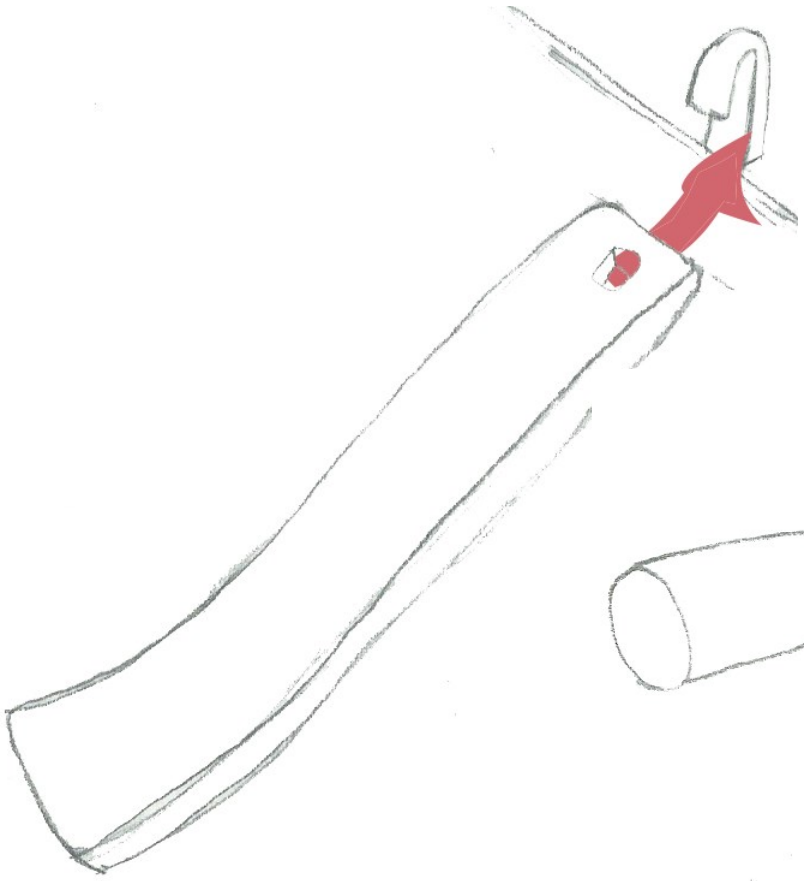


Figure 47: Third variation

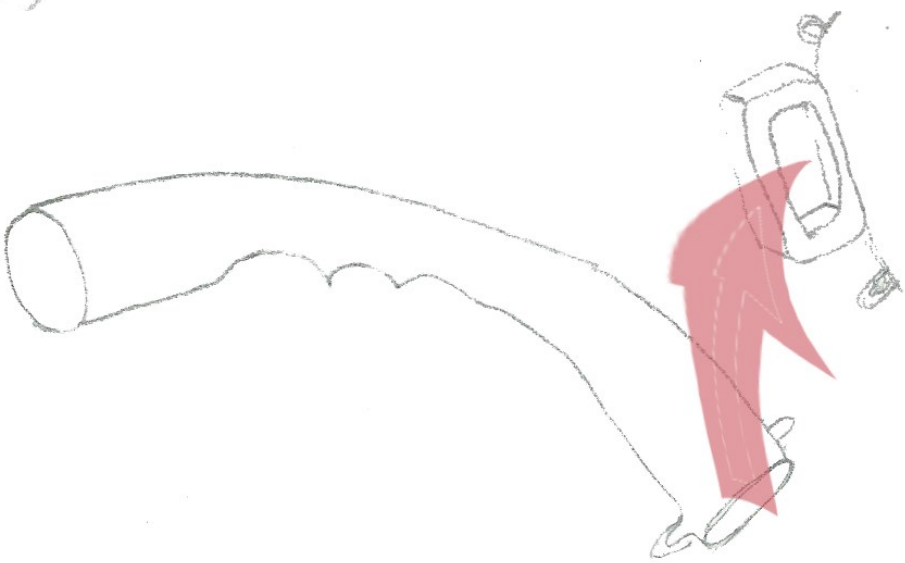


Figure 46: Fourth variation

This variation is more linked to the first and second variation presented earlier in this section.

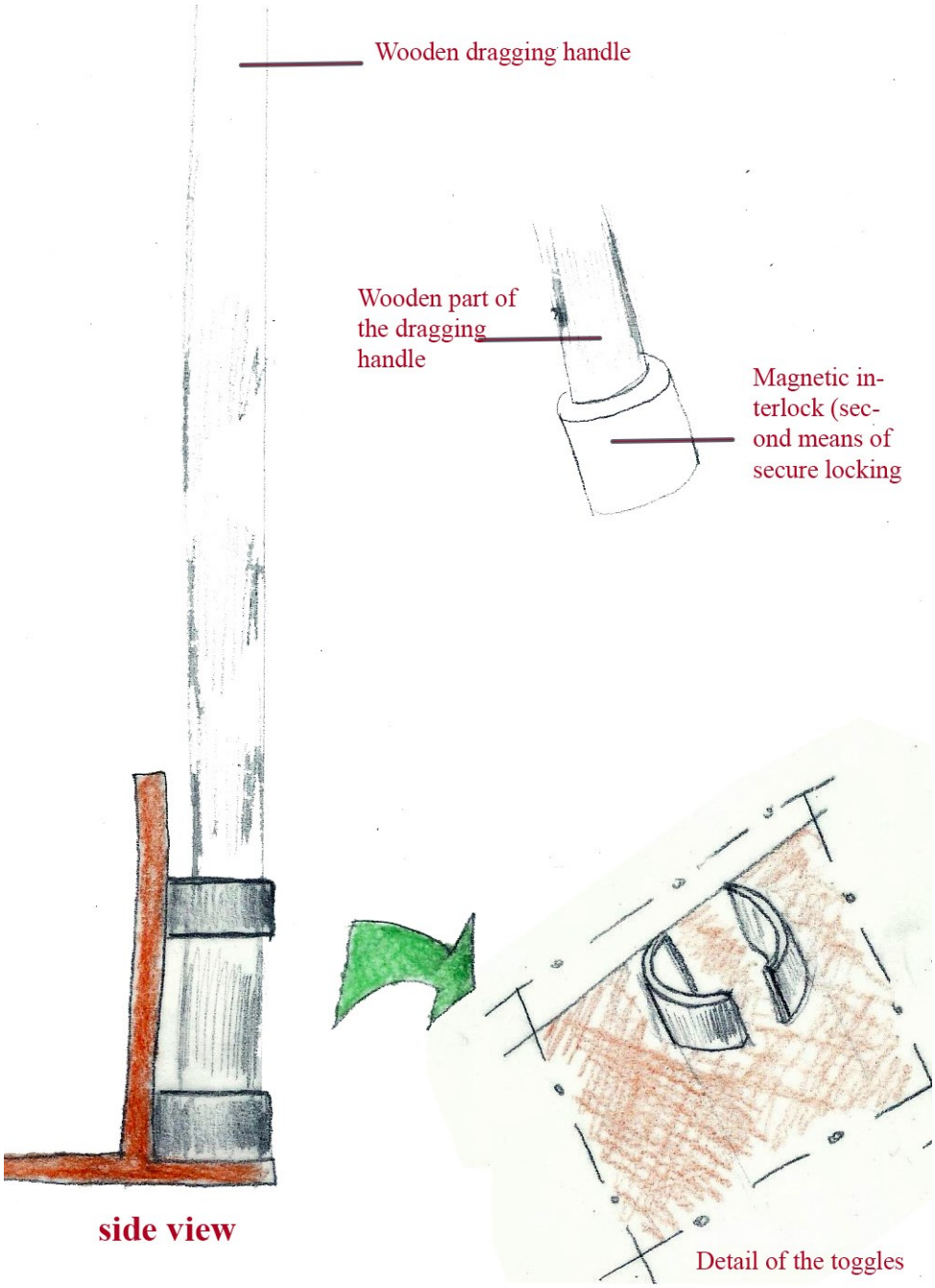


Figure 48: Detail of concept with toggles

This concept consists of a wooden cylindrical dragging handle that is inserted through two cylindrical toggles. On the bottom of the dragging handle a magnet is attached. This magnet acts as a secondary mean of safe interlocking.

5.3.2 Concept No 2

This concept refers to the design of the lifting handles. A basket-like approach is adopted. What I plan to achieve with this proposal is to accommodate a handle in the center of the oven tray, which allows the even weight distribution. Moreover, there is a greater surface for holding it. With this type of handle the roll-over of the oven tray is prevented.
Two sub concepts were developed.

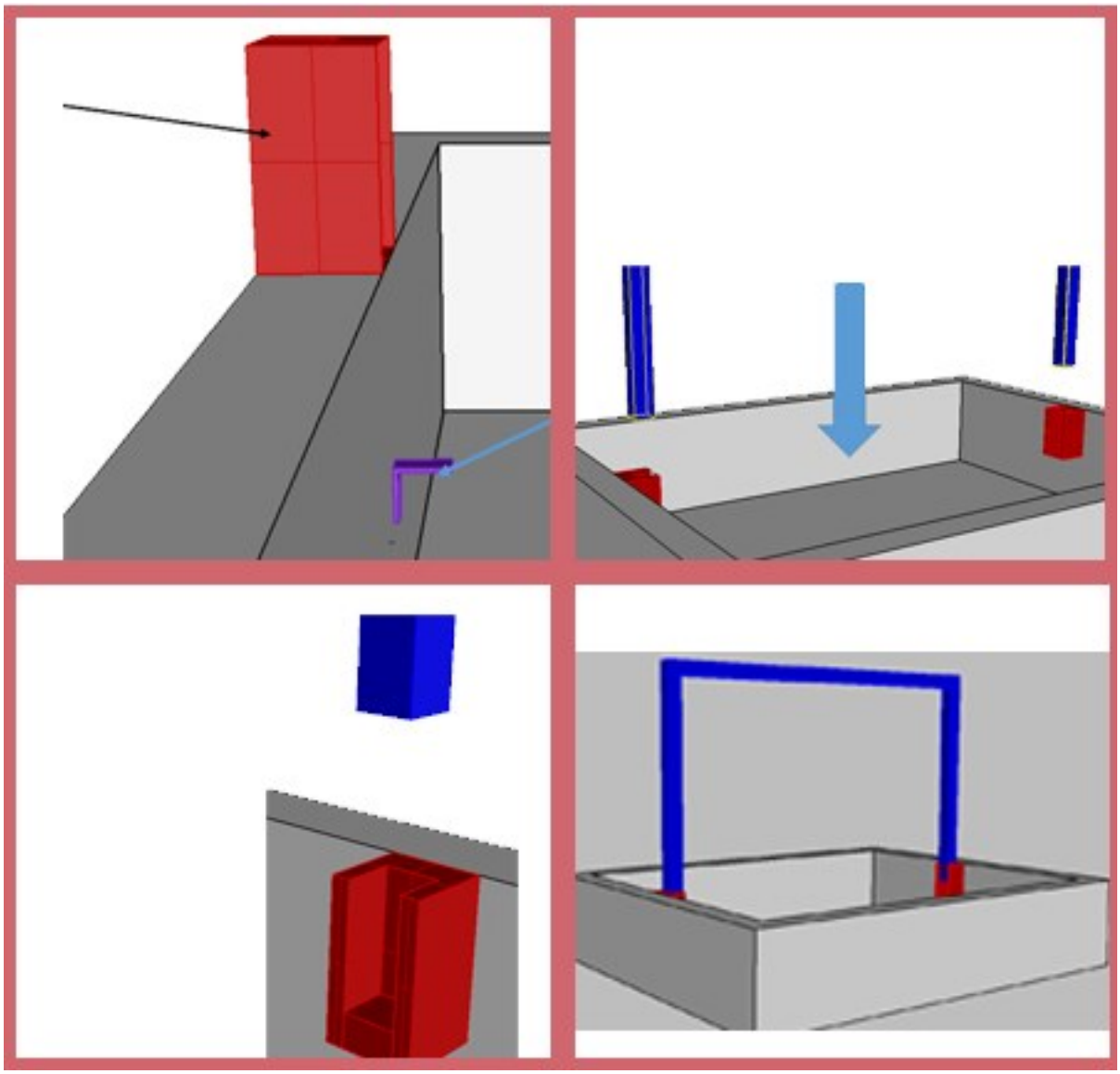


Figure 49: first sub concept

In this variation, the lifting handle is detachable and interlocked into special openings which are already installed in the interior of the oven tray's walls. This method has a major disadvantage; while pulling the tray out of the oven, the user has to interlock the handle, a movement that requires bending.

Figure 51: Basket (Source: https://0.s3.envato.com/files/12100076/shopping%20basket%20590x590.jpg)

This second alternative is inspired by the shopping basket. The lifting handle is detachable. It is attached to the exterior of the walls of the oven tray. When in right position, it interlocks and rotates 90 degrees up. Then, the user can lift the tray. Also, this solution requires bending posture, not only in order to lift the tray but to lock the handle.

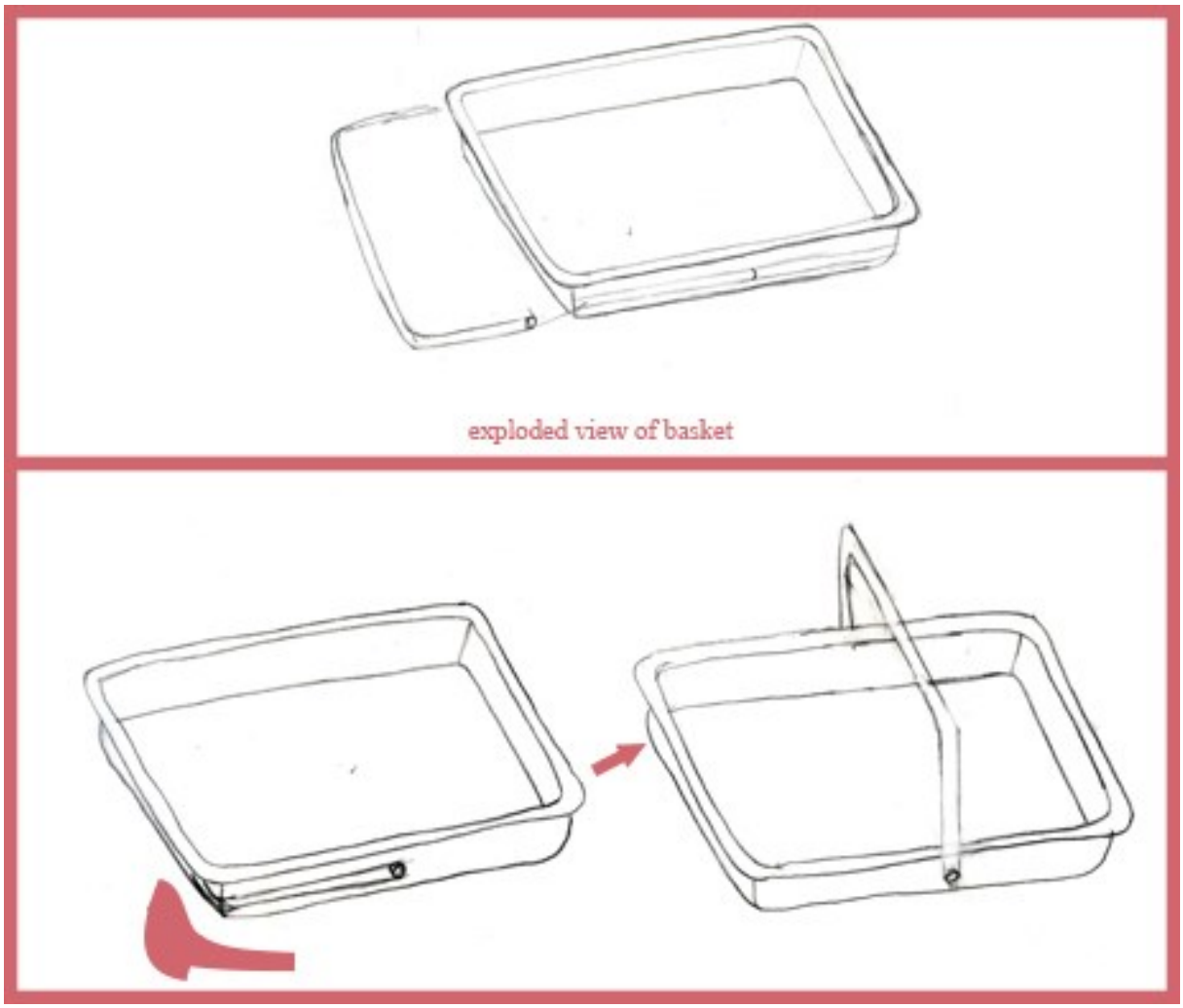


Figure 50: Shopping basket concept

5.3.3 Further progress for the next stage

The geometry of the oven tray has to be refined having a softer shape with drafted walls. Some of the handles (the lifting handles most probably) have to evolve from the main body of the oven tray. In doing so, considerations about their production technique have to be made.

Generally, a parameter that has to be taken onto account for the next step is that whatever the solution it might be, is use must be intuitive to the user.

5.4 INITIAL ASSOCIATIONS OF PLACING DRAGGING AND LIFTING HANDLES

5.4.1 General principles followed in this proposal

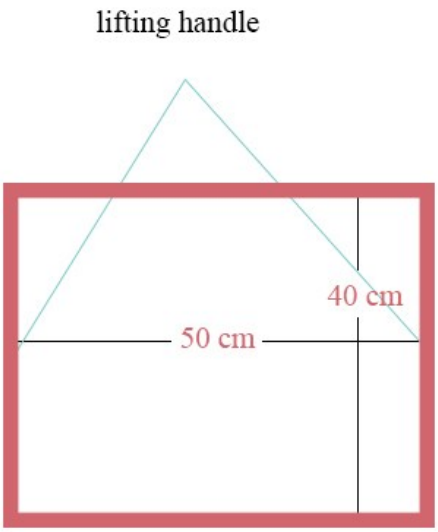


Figure 52: General dimensions of the oven tray

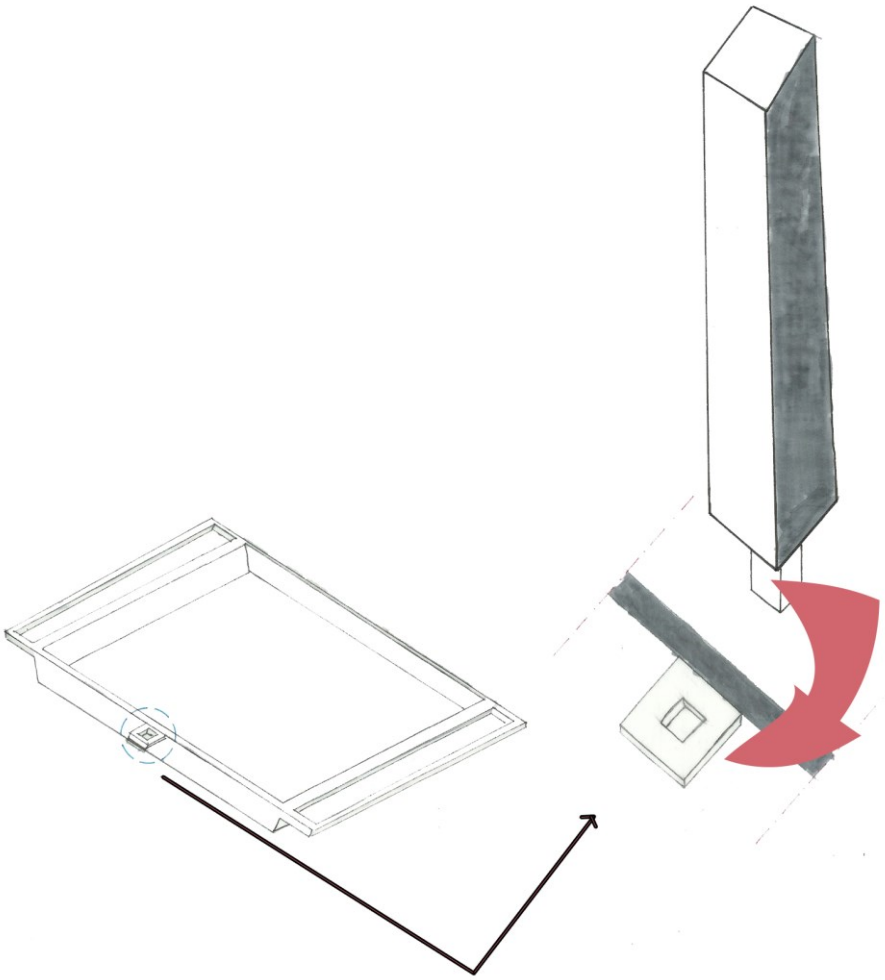
The overall dimensions of the oven tray are 50cm x 40cm (main body and lifting handles included). The main production technique for oven trays is deep drawing. The manufacturing material of the oven tray might be a stainless steel sheet. It is advisable that no welding takes place.

As for the handles they have to be as high as possible to limit bending. So, the concepts that will be developed will have:

- 2 “points” for dragging with 1 detachable handle. This detachable handle will be oblong, most likely 25-30 cm tall.
- 2 handles are required for lifting.

In this section various combinations of dragging and lifting handles will be presented. The sketches now are not so conceptual but are on scale.

5.4.2 Concept 1



Concept 1 consists two long lifting handles that span across the total length of the shortest sides of the oven tray. These handles provide a better hand accommodation when the user wants to lift the oven tray. They can be manufactured by punching rectangular holes from protruded lips of the oven tray. Concerning the dragging handle, its shape in the interlocking area is easier to manipulate but there is still need some effort in assembling. Therefore another type of interlocking must be created.

Figure 53: Concept 1

5.4.3 Concept 2

This concept involves the exploration of potential easy to interlock the dragging handles.

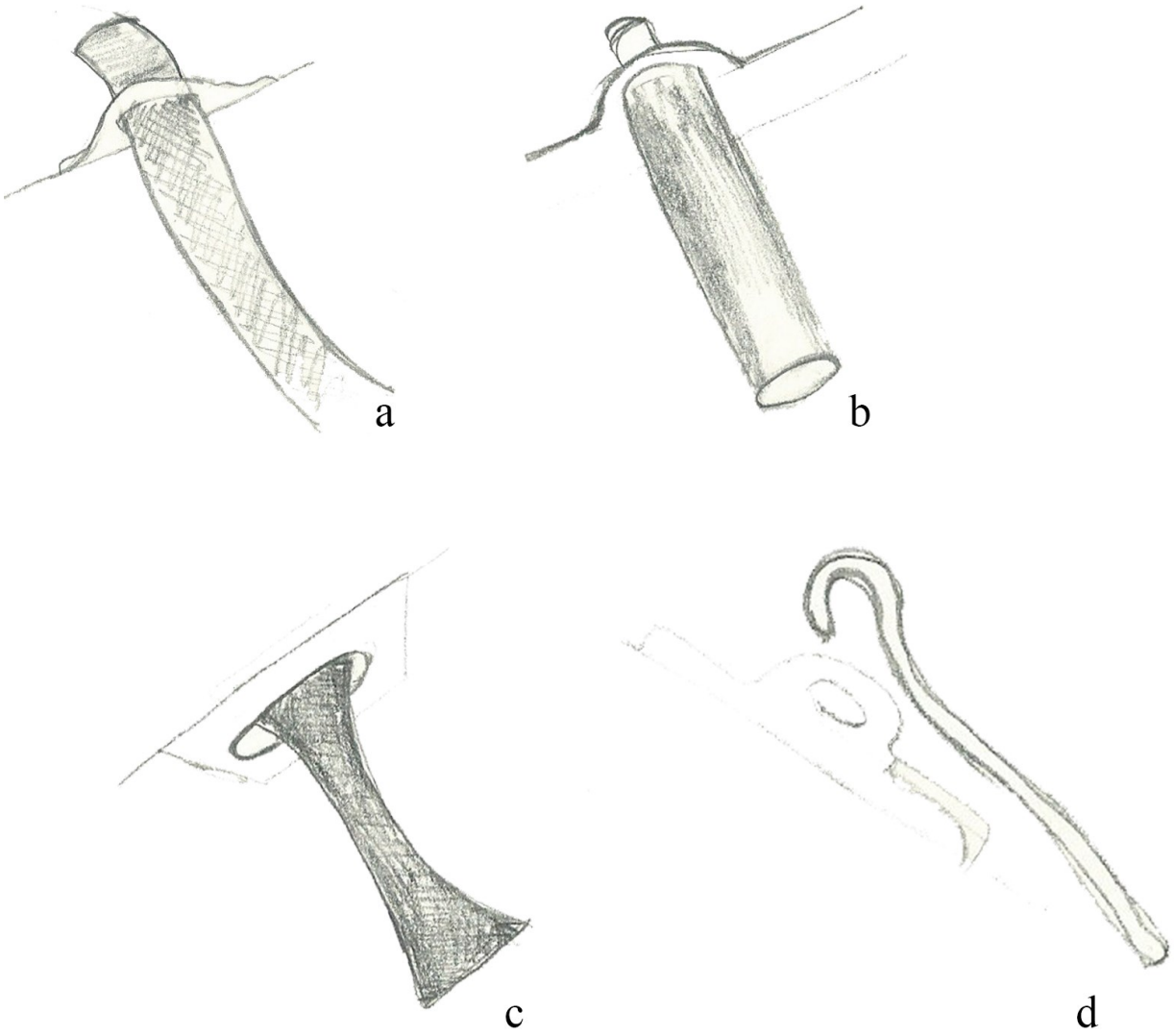


Figure 54: Different types of dragging handles

Some of these alternatives seem to function very well (a and d). Version b is problematic since it needs a lot of attention to interlock and version c is of intermediate difficulty. The hook-shaped handle seems the most promising of all. They are mainly wood crafted. They could be also manufactured with silicone.

5.4.4 General models of oven tray

In this section some sketches regarding the relationships between the dragging handle and the lifting handles are presented.

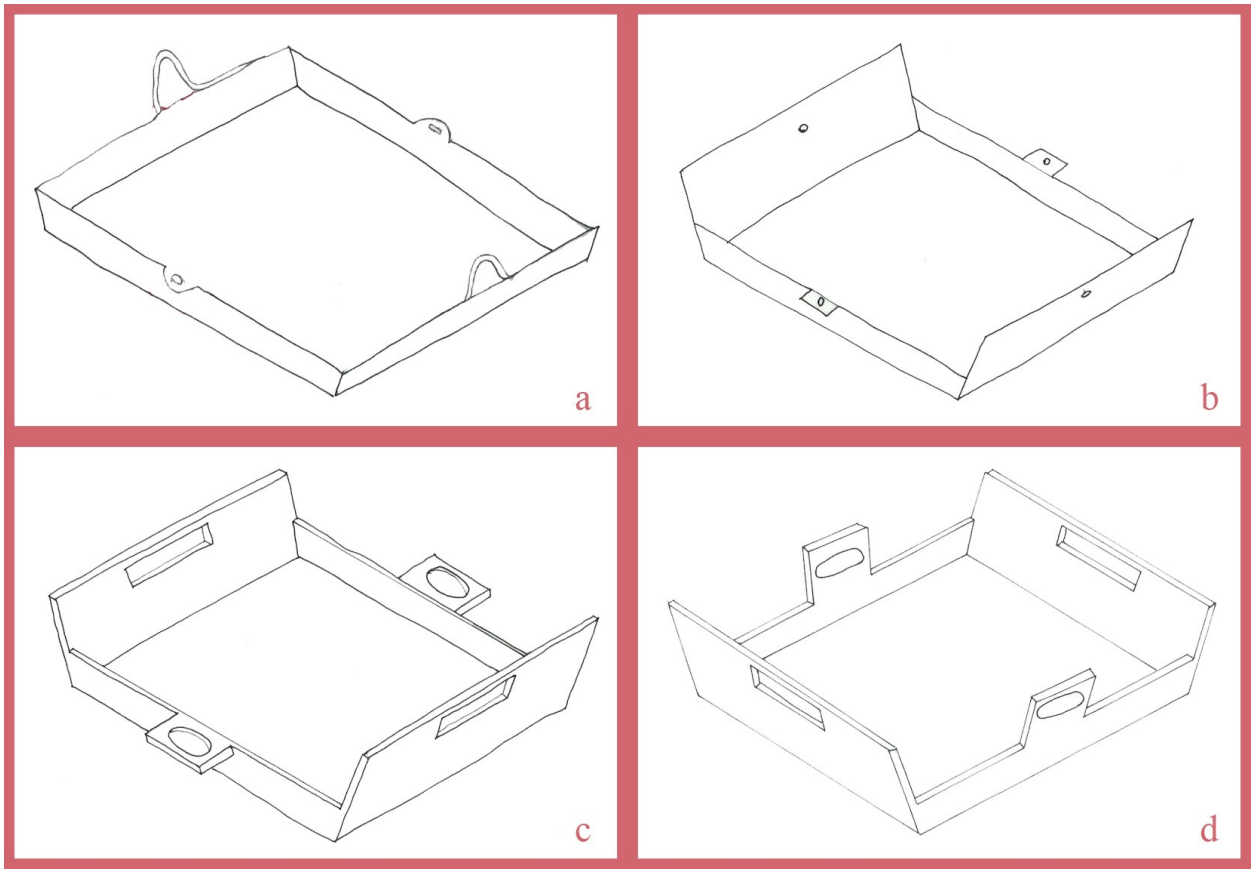


Figure 55: Carious concepts examining the relationships of dragging and lifting handles.

The higher lifting handles facilitate the easy carrying of the oven tray. They can be manufactured by punching rectangular holes to the protruded lips of the oven tray. As far as the dragging handles are concerned, the shapes appearing in the sketches are mainly the receptors for the interlocking. The elevated receptor aims to eliminate more the bending posture.

5.4.5 Further progress

As far as the dragging handle is concerned, the concepts proposed here must be developed thoroughly. The concept of permanent or detachable dragging handle has to be fatherly explored, applying also the efficient geometry for it (soft surfaces ergonomic for a human hand).

5.5 FURTHER CONCEPT GENERATION CONCERNING THE DRAGGING HANDLES

5.5.1 General design of the oven tray

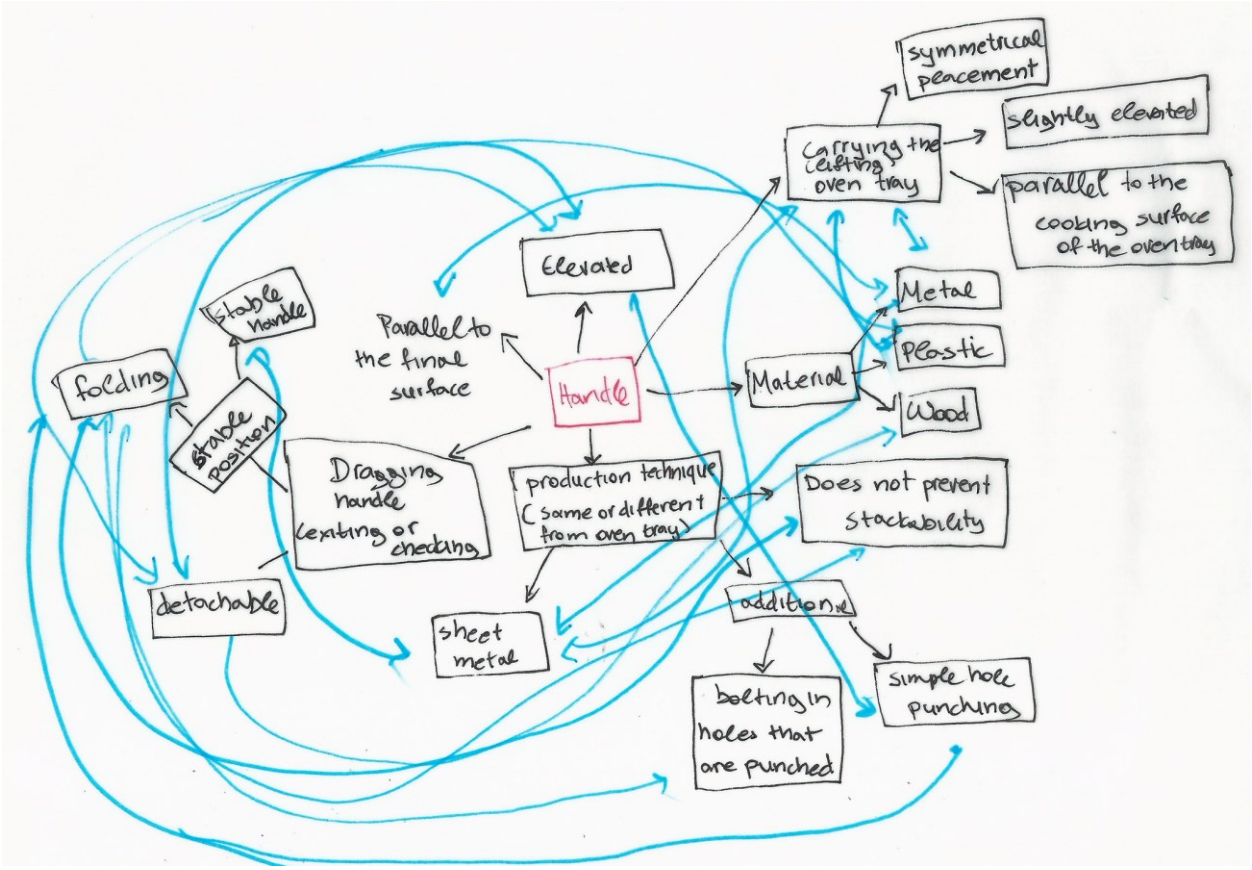


Figure 56: Brainstorming diagram concerning the dragging handle properties

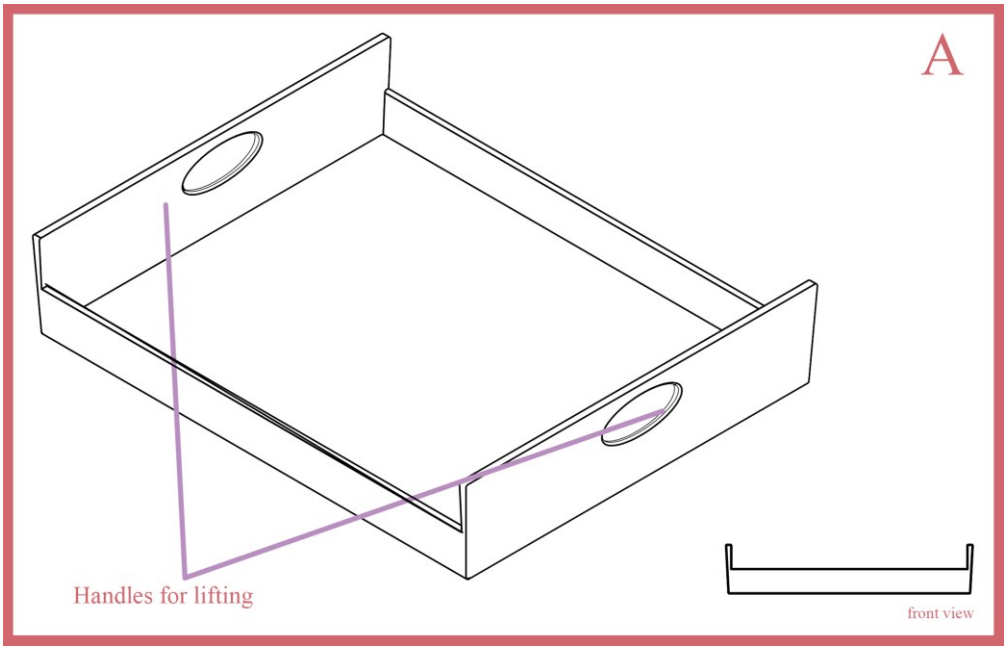


Figure 57: General sketch of oven tray

The oven tray has two handles for lifting. Those can be constructed with the deep drawing production technique. Afterwards, the ellipse shaped parts can be cut out with punching. All the walls of the oven tray are slightly angular (3-4 degrees with outward slope).

The handles for checking and dragging out of the oven will be located to the other sides that in this sketch contain only the walls of the tray. The various solutions for these handles will be presented in the next pages.

5.5.2 Handle 1

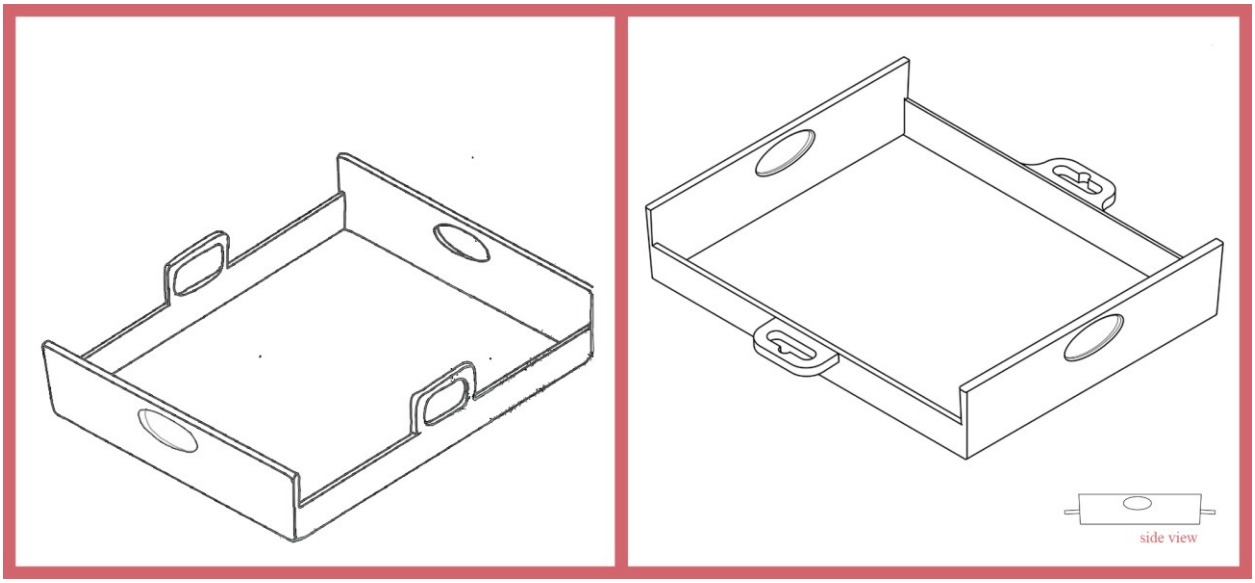


Figure 58: Receptors for the dragging handles

Figure 59: Source: https://s-media-cache-ak0.pin-img.com/564x/c7/c7/29/c7c729b3a8024c7daba33821ba59f3e3.jpg

The handle that is proposed is this solution is inspired by this kitchen utensil (can opener). It is hooked shaped but having enough aperture to ease the positioning into the interlocker.

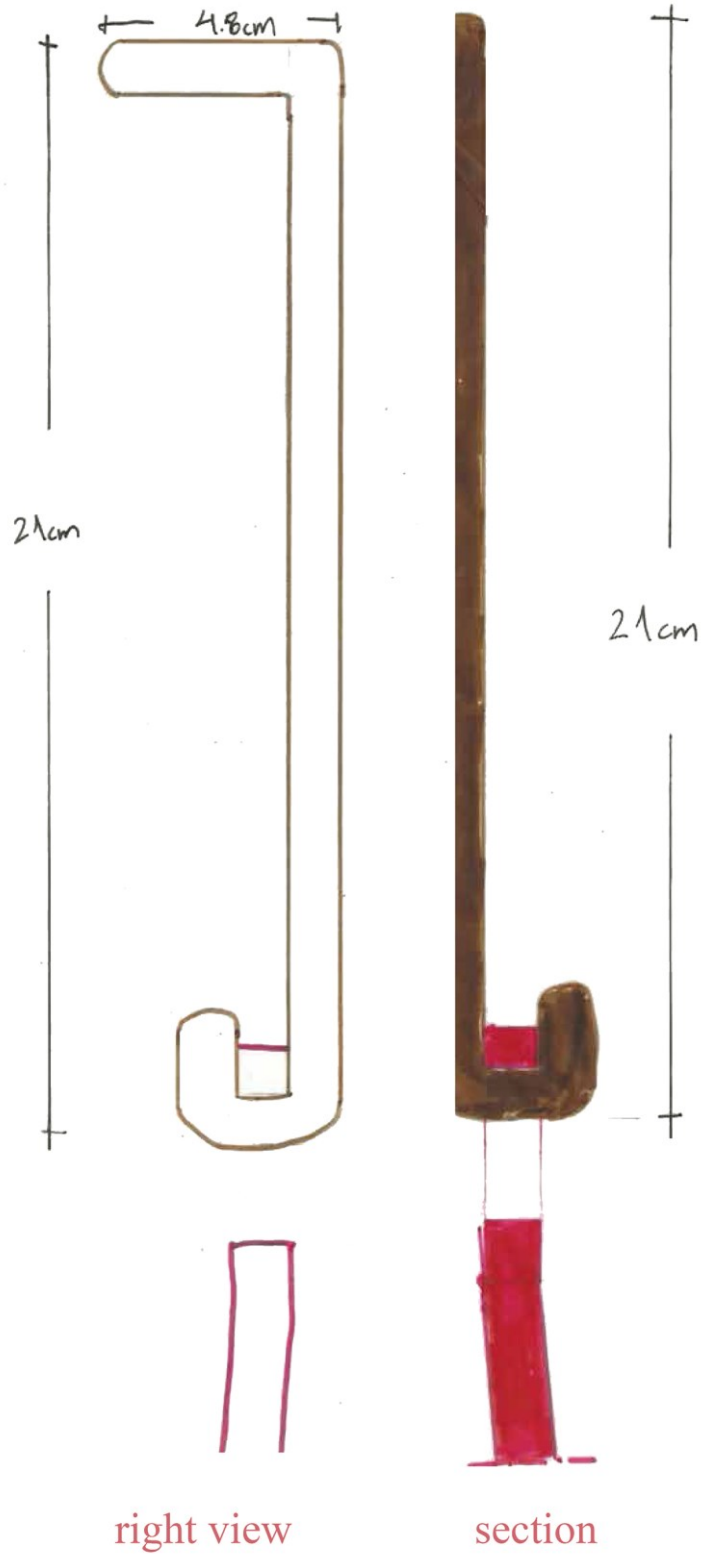


Figure 60: Right view and section of Handle 1

5.5.3 Handle 2

In this particular solution, the dragging handles are permanent and positioned in a parallel way to the walls of the oven tray and are made of metal. They are manufactured in the same manner as the lifting handles. They could also be metal parts that are bolted to the walls in punched holes.

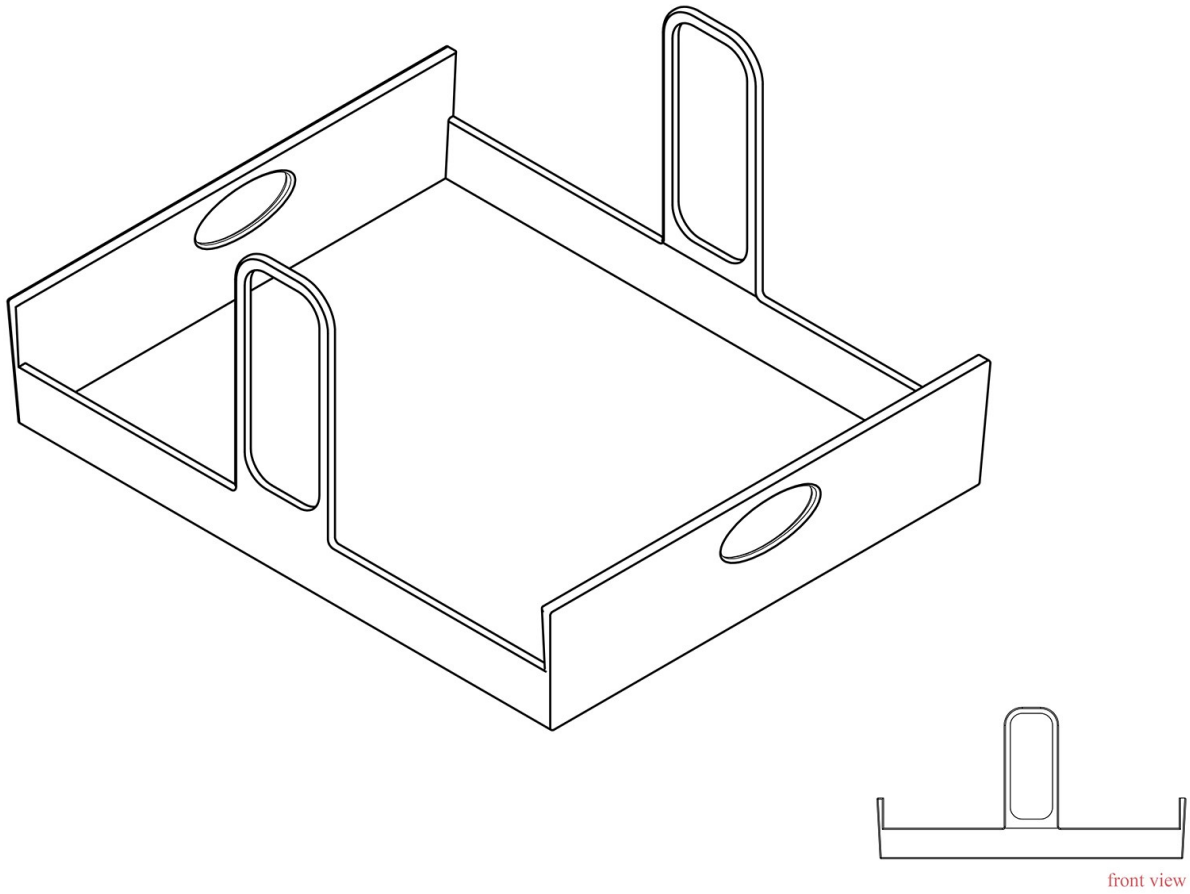


Figure 61: Handle 2 (perspective and frond view)

5.5.4 Handle 3

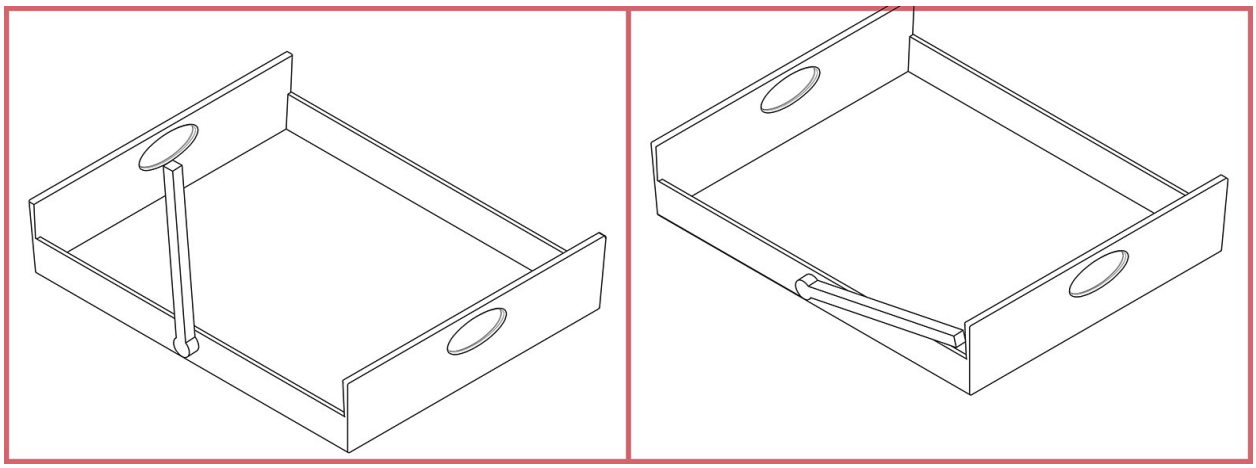
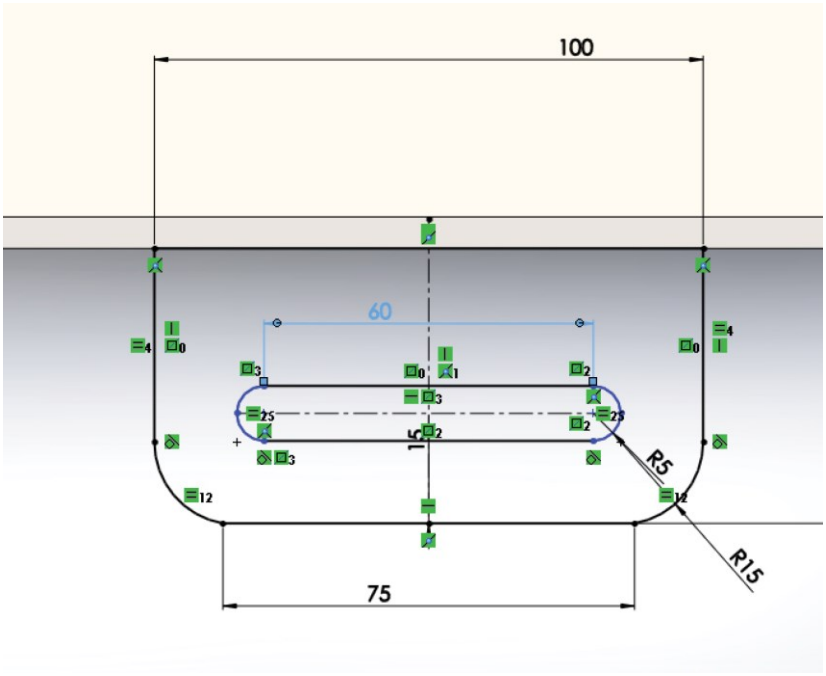


Figure 62: Handle 3 rotation frames

In this particular solution, the dragging handles can rotate. The handle is positioned in a void created by punching. Then, it is locked by its rotating mechanism. This solution could also have two rotating handles to be used from both sides. They consist of a metal skeleton covered up with silicone (or other heat resistant polymer).

5.5.5 Handle 4



The dragging handles' receptors are permanent. The void area needed for the interlocking (connector) of the handle is created with punching. The dragging handle is wooden. It is safe for use as it remains out of the oven.

Figure 63: Sketch of the connector on the oven tray (top view)

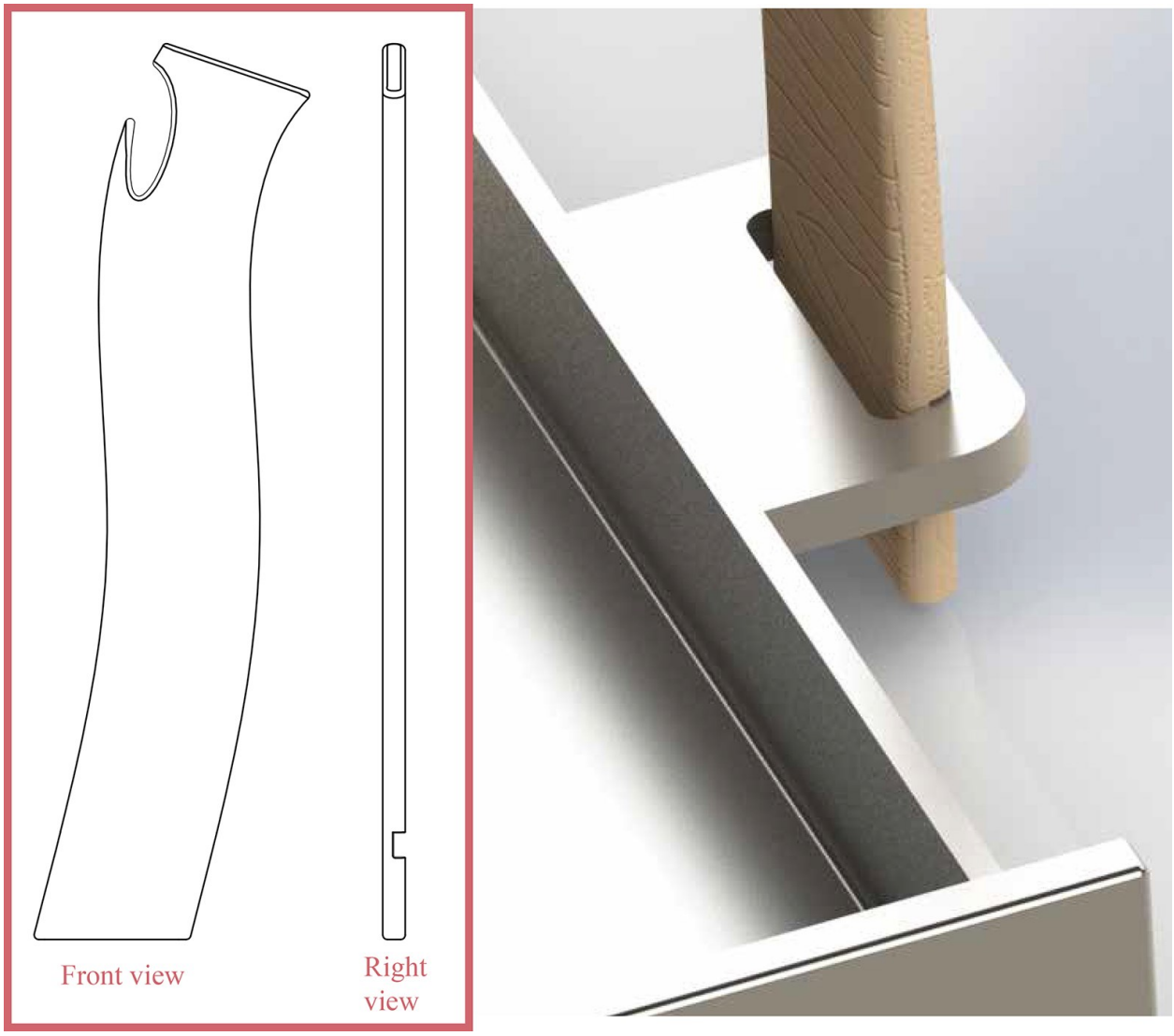


Figure 64: Views and perspective detail of the handle

The handle is curved aiming to create a better feeling when held. It has also a slot in order to accommodate the thumb.

5.5.6 Handle 5

Figure 65: Frying pan of IKEA© (Source: Personal archive)

In this particular solution, the dragging handles is positioned perpendicularly to the walls of the oven tray. They are made from wood which does not withstand the working temperatures of the oven. So, a different material must be reviewed. Since it is a permanent handle it could also help for lifting, if needed. The oven tray could contain one or two dragging handles of this type.

Having such rotatable handles also ensures stackability.

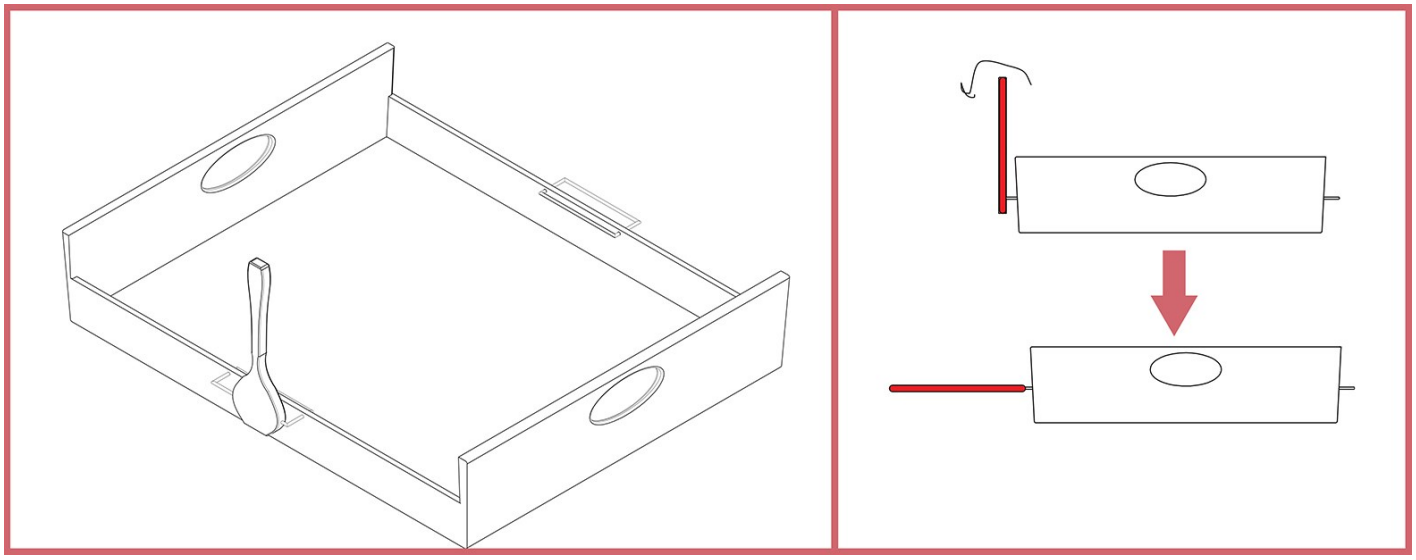


Figure 66: Perspective view and sections showing the rotation of the handle

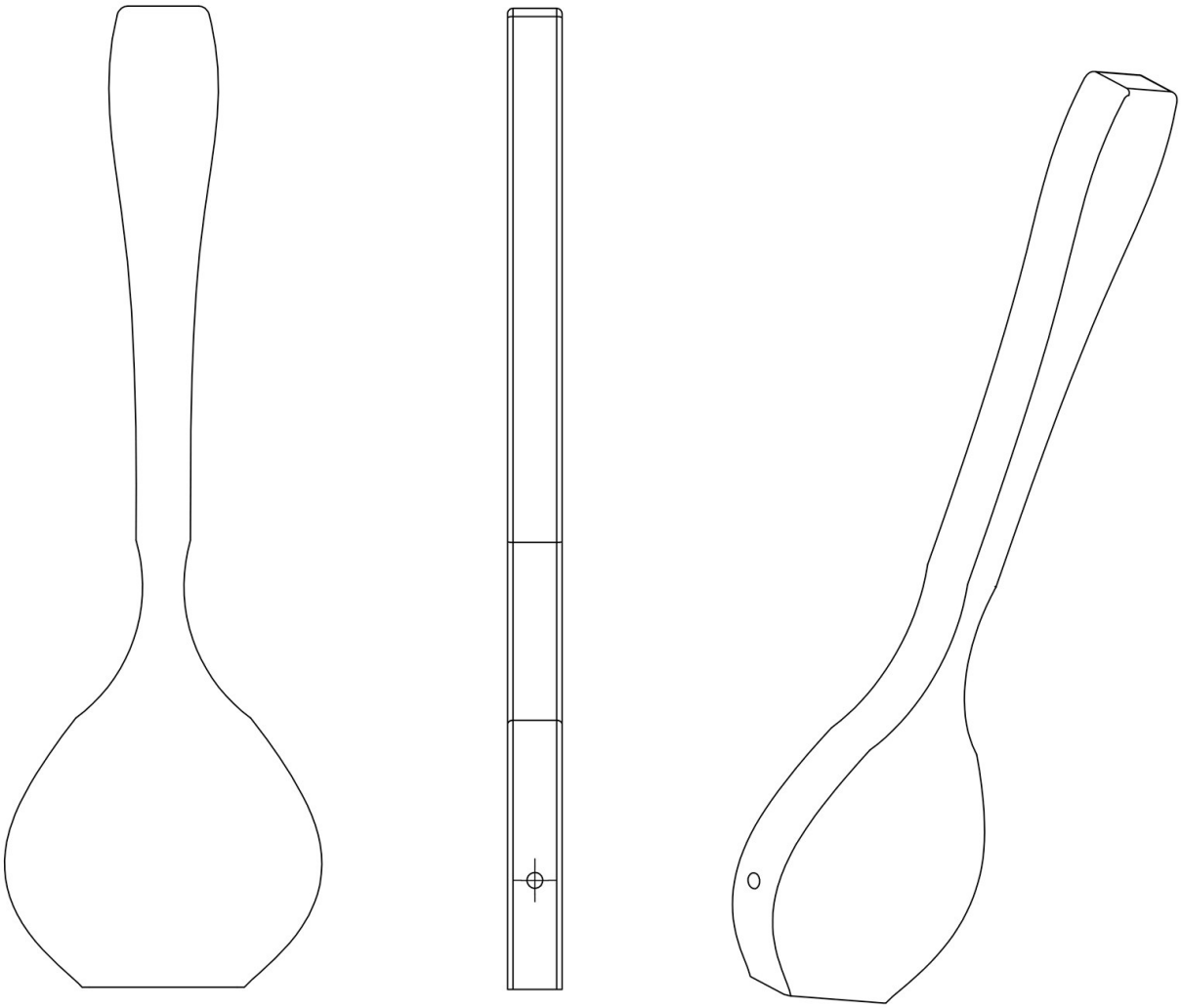


Figure 67: Perspective view and sections showing the rotation of the handle

5.5.7 Handle 6

The dragging handle's receptors are permanent. The handle is detachable though and manufactured with plastic. The void area needed for the interlocking of the handle is created with punching. Its interlocking requires a lot of effort.

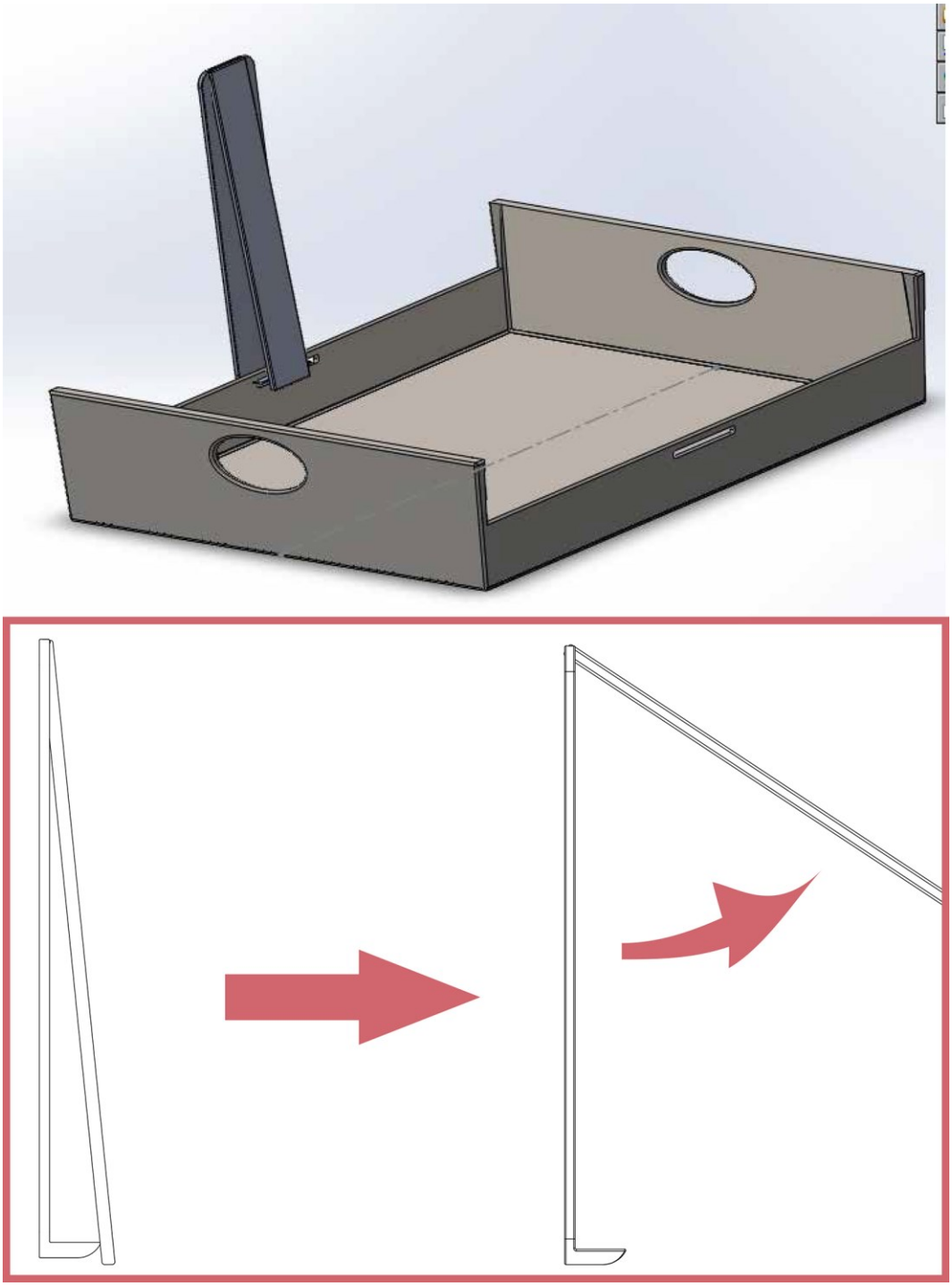


Figure 68: Perspective view and working mode of the handle

5.5.8 Handle 7

This solution is an alternative solution for hook shaped handles. Its “receptors” are positioned perpendicularly to the walls of the oven tray and they are manufactured with metal, the same as the oven tray. The dragging handles can be wooden or plastic.

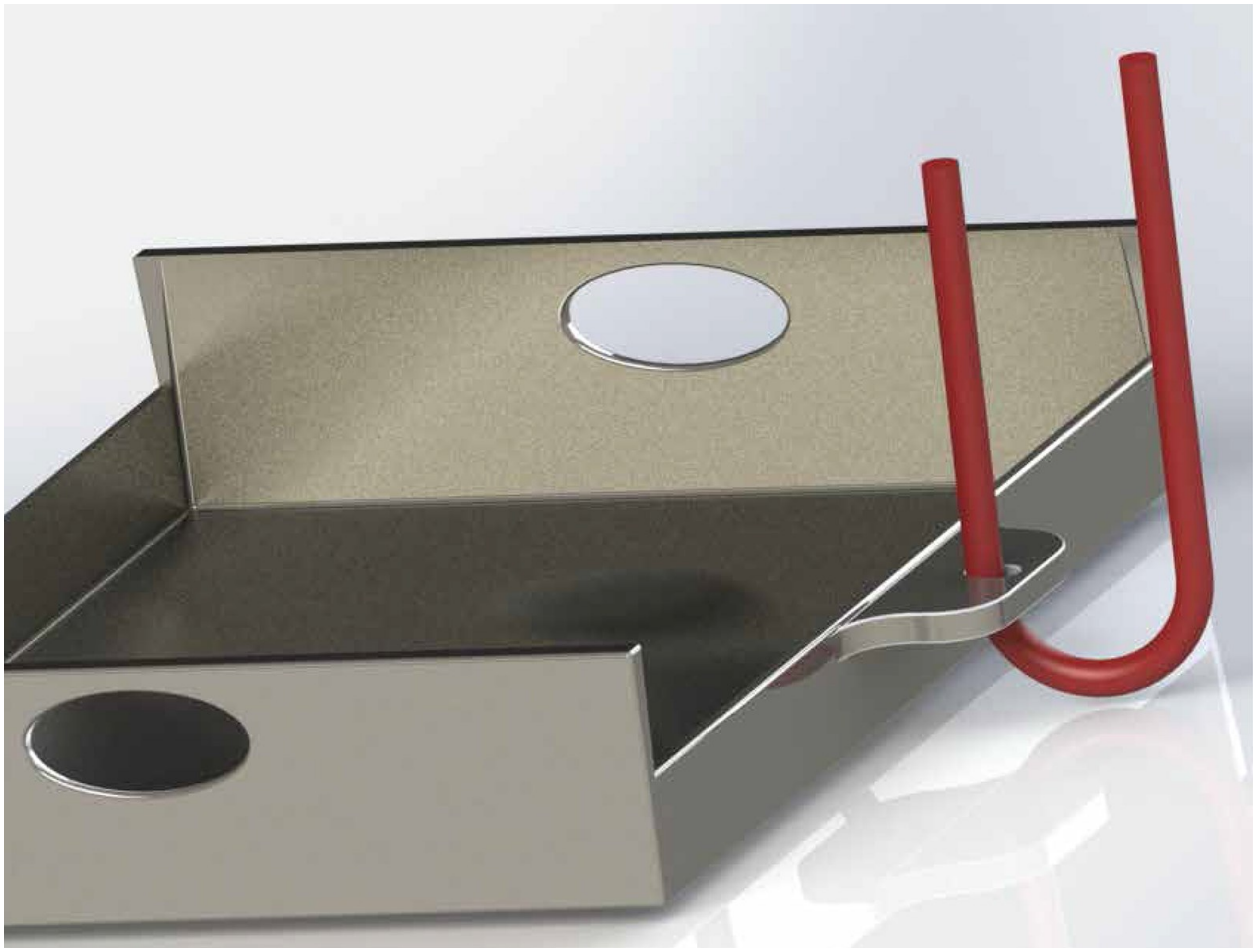


Figure 69: Perspective view of the handle assembled with the oven tray

5.5.9 Handle 8

In this sketch, the dragging handle serves also as an auxiliary lifting one, “giving” to the oven tray the function of the basket.

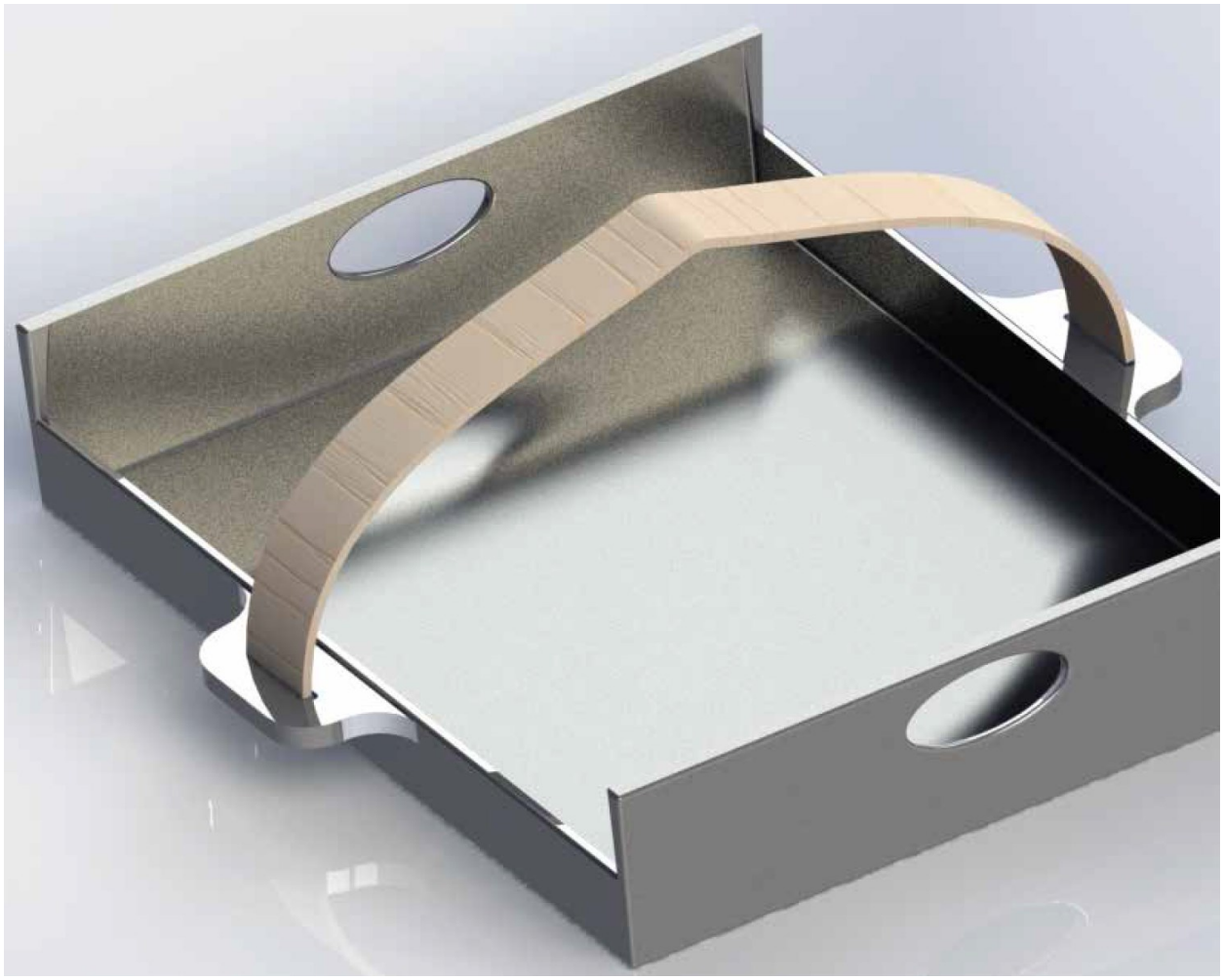


Figure 70: Perspective view of the oven tray

The fact that the dragging handle can be used as a secondary lifting handle gives to this solution a certain flexibility. But attaching, detaching and reattaching again the handle can be a very painful procedure for the user. This kind of positioning of the handles may make the oven tray unstable (possible turn over).

5.5.10 Handle 9

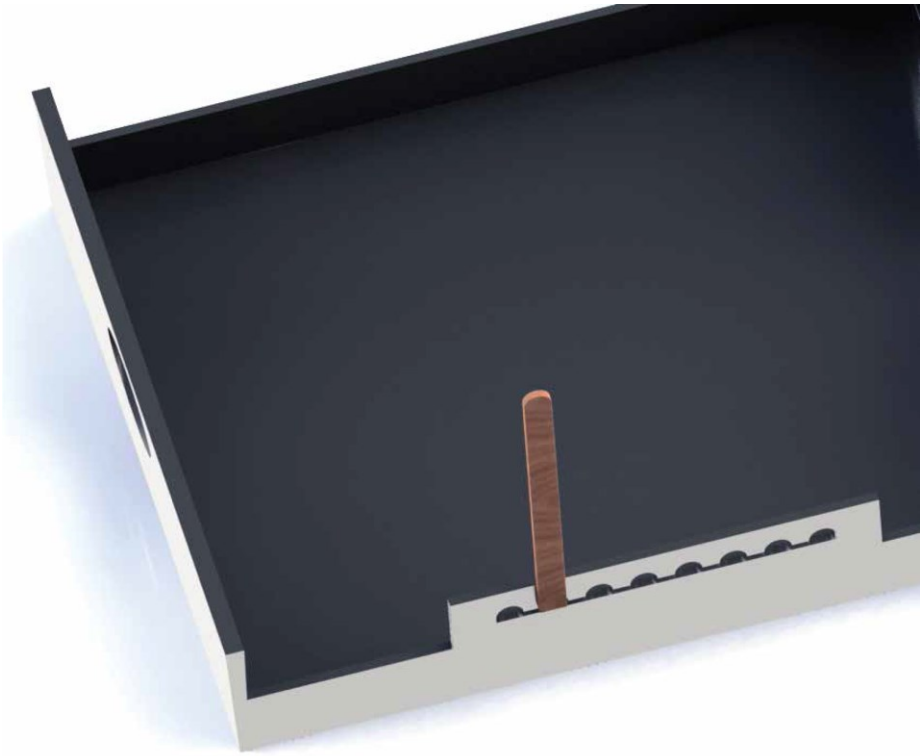


Figure 71: Perspective view of the oven tray

In this proposal, the detachable handle is attached to a connector having voids that could interlock the handle as a manual rake and gear system. This particular interlocking aims to offer more possible places for the handle to be attached. They are punched.

5.5.11 Concept Generation results and further development suggestions for the next stage

As far as the oven tray geometry is concerned, it still needs to be refined in order to be based to the need to be safe at use, having rounded edges and sloped walls. Concerning the handles. Handle 3, 5, 6 and 8 are proposed to be fatherly explored having also a geometry that is friendly to hands.

5.6 LAST PHASE OF CONCEPT GENERATION

This phase aims to refine all of the details missed in the previous stage and to end up in the selection of a system of dragging and lifting handles that is usable.

Figure 72: Variations of the oven tray

5.6.1 Refining the body of the oven tray and the lifting handles

This final stage aimed firstly at refining the geometry of the oven tray. As it is obvious it has acquired the soft geometry needed (no sharp but rounded edges).

As for the lifting handle position the three last versions could be either the actual lifting handles or, by being transformed, though be the connectors on which a detachable handle would interlock (e.g. creating a new variation of the "basket" solution presented in previous stages).

Their manufacturing technique and material remains the same punching holes after a stainless steel metal sheet has been deep drawn.

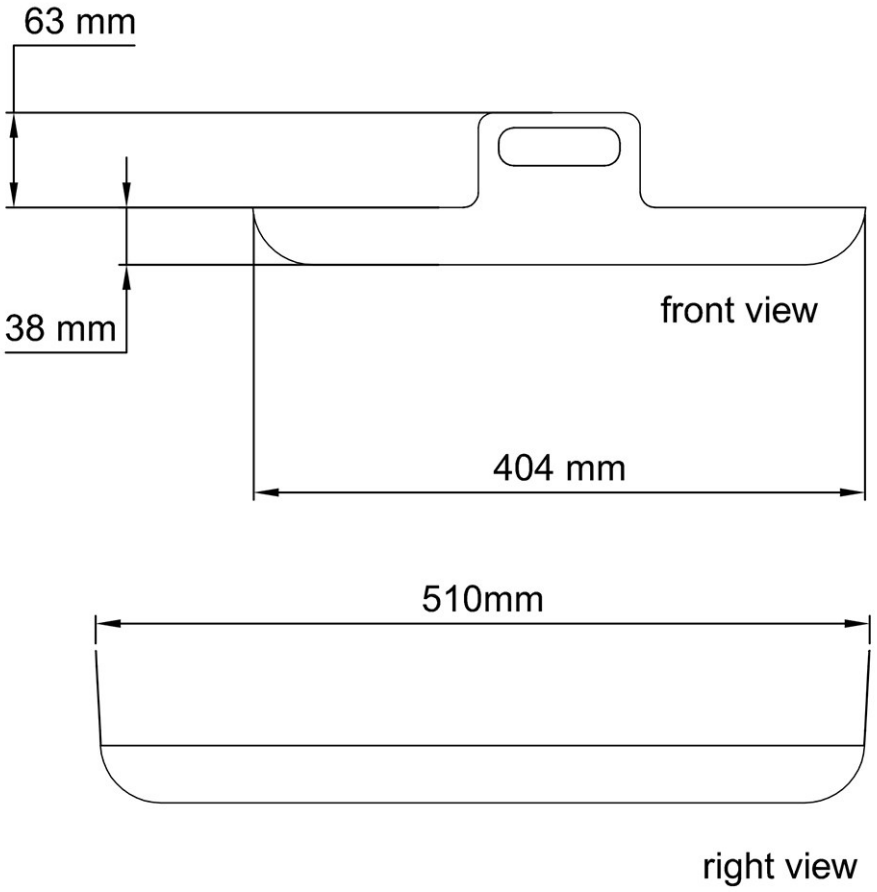


Figure 73: Technical drawings

5.6.2 Refining the dragging handles

The general guidelines and thoughts behind the proposals that will be presented are the following:

- They are used for dragging the tray from the oven at an adequate distance in order afterwards to be able to lift the tray by hand and remove it out of the oven.
- It is not a lifting mechanism although it could be used as a secondary lifting handle (diagonal holding).
- The main focus for rotating handles will be towards solutions that can be rotated 180 degrees or until 90 degrees depending on their positions on the oven trays walls. From my point of view, this is the safest solution, demanding the least effort for using it, as it is always attached to the tray and does not

have to be attached and detached, a movement that could be difficult for some of the users or unsafe.

- The handles are manufactured with plastic or with a combination of plastic and metal skeleton.
- The handle is attached parallel to the side wall of the oven tray by punching a small hole on it.
- It is possible that the user could easily forget from which side she/he placed the tray into the oven. So, I think that the best solution is to place dragging handles on both longest sides of the oven tray.

5.6.2.1 Alternative 1

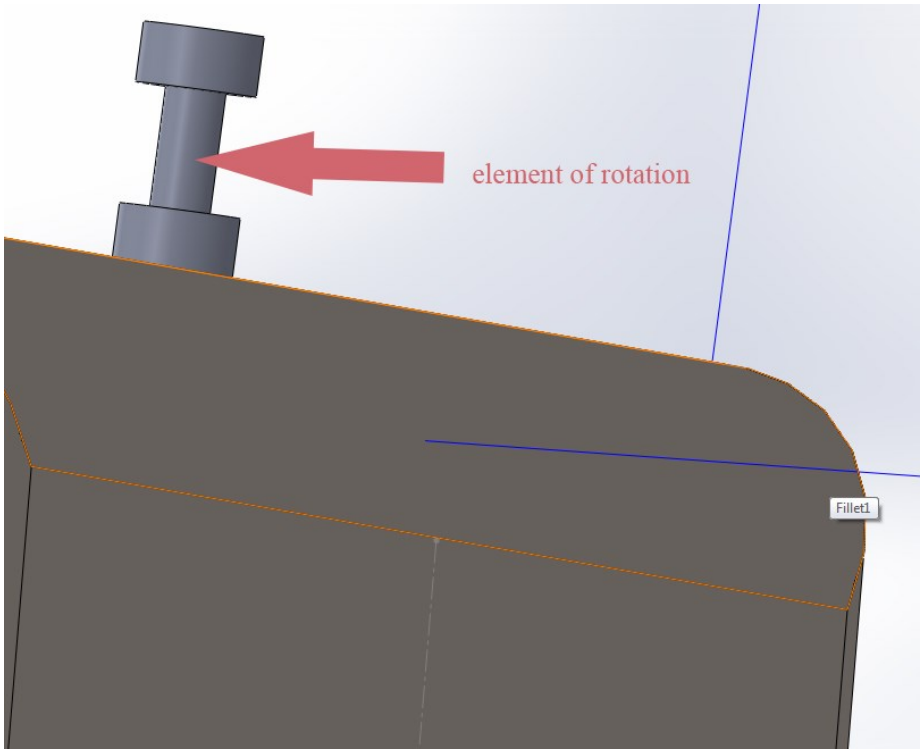


Figure 74: Element of rotation

In this section, further concepts for this type of handle will be presented. It involves a 180 degrees rotating permanent dragging handle. The connectors on which the handle rotates are welded on the exterior of the oven tray's walls.

The lifting handles are simple protrusions of stainless steel metal sheet, having punched holes to certain points in order to eliminate bending.

For this type of handle, the following alternatives are generated:

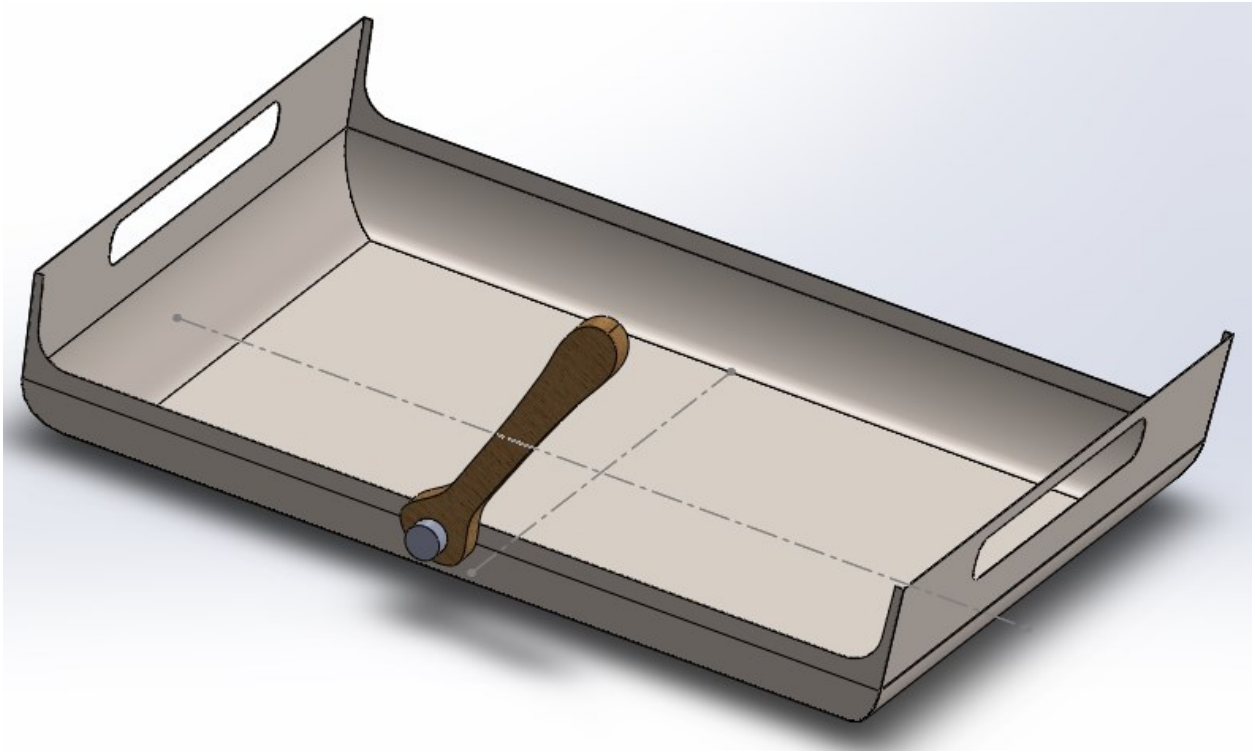


Figure 75: Perspective of the oven tray with one of the alternatives

Figure 76: Alternative a

Figure 77: Alternatives of rotating dragging handle.

The rotating handle, as easy and intuitive its use may seem, has a serious drawback: its rotation can prevent the easy dragging of the oven tray.

5.6.2.2 Alternative 2

This second alternative is mainly a “basket” like type of solution. Both dragging and lifting handles are detachable.

Such a solution should have the following characteristics:

- The locking movement of both dragging and lifting handles must be intuitive.
- Uncomfortable postures during locking and unlocking the handles may also be very difficult.

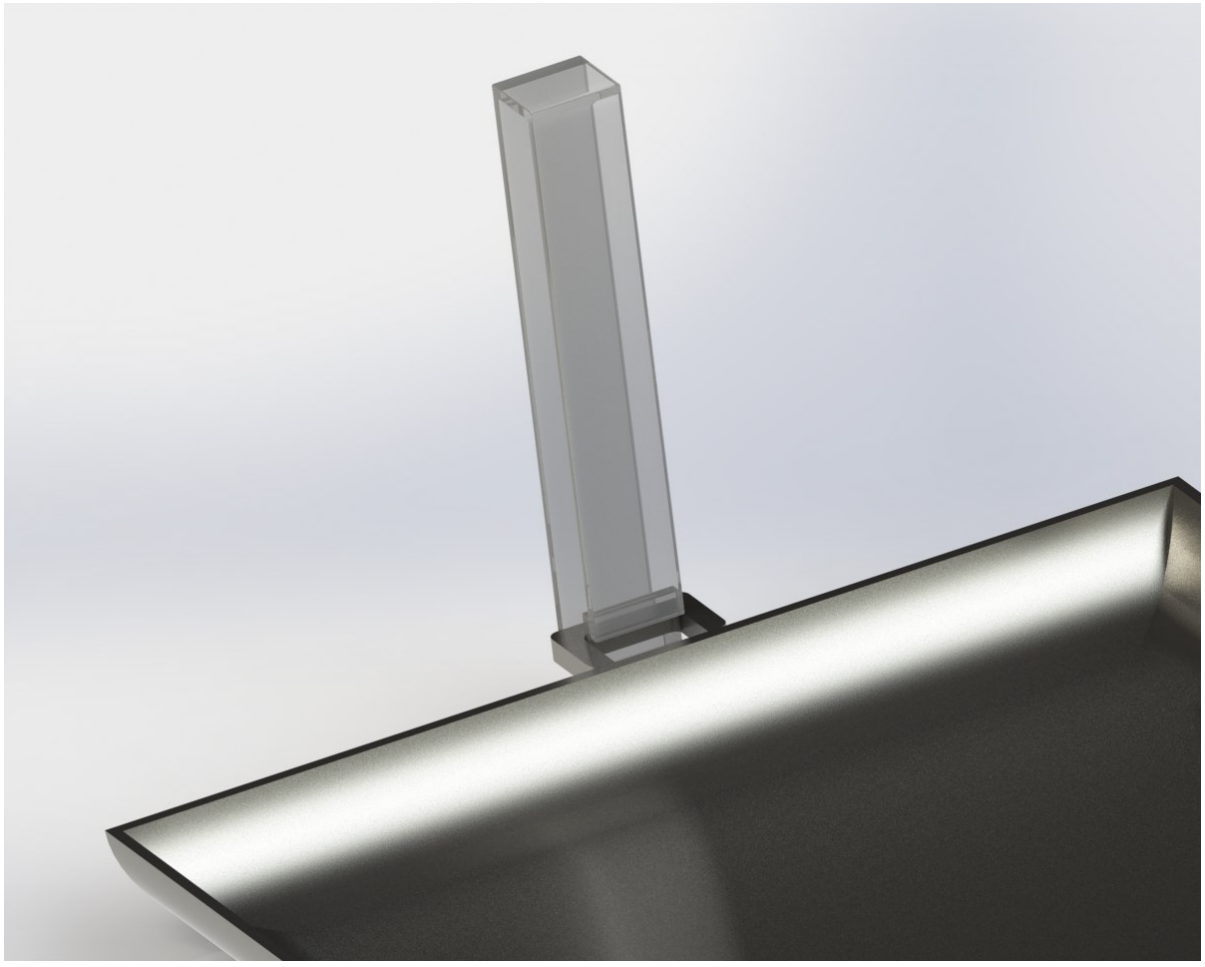


Figure 78: Dragging handle detail

This type of dragging handle has been presented also before. It is like a clipping handle attached to a connection area of the protrusion of the oven tray’s lips. It can be manufactured with silicone or other heat resistant polymer.

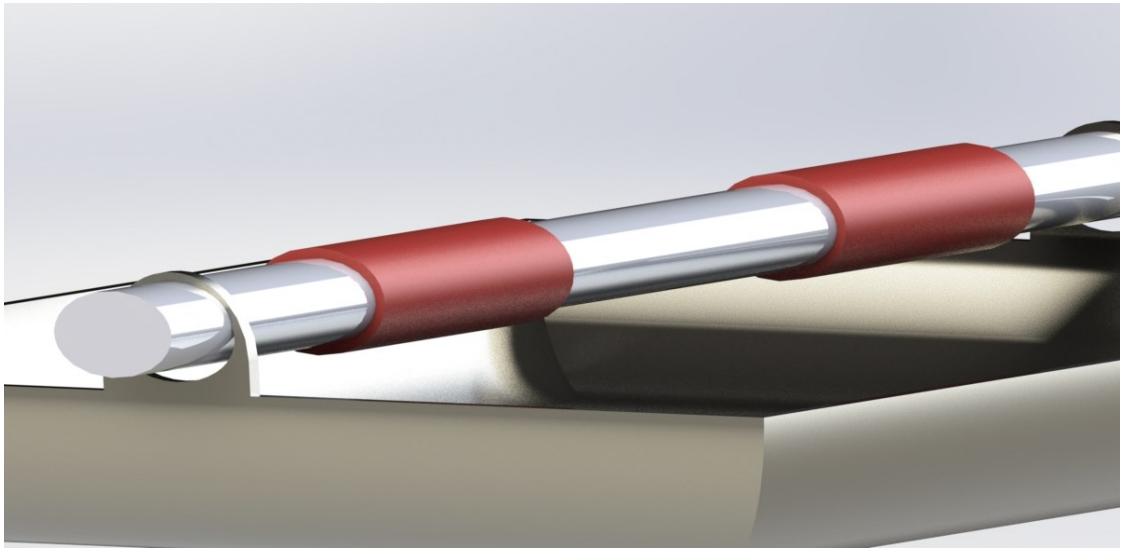


Figure 79: Lifting handle detail

The lifting handle of this version is a metal rod with ellipsoid section which is interlocked into protrusions of the wall of the oven tray. Some parts of the rod's surface are covered with silicone in order to be touched safely. It provides stable lifting and carrying of the oven tray. It can be detached while preparing the food and re-attached before putting the tray into the oven. What it fails to succeed is the diminishing of bending.

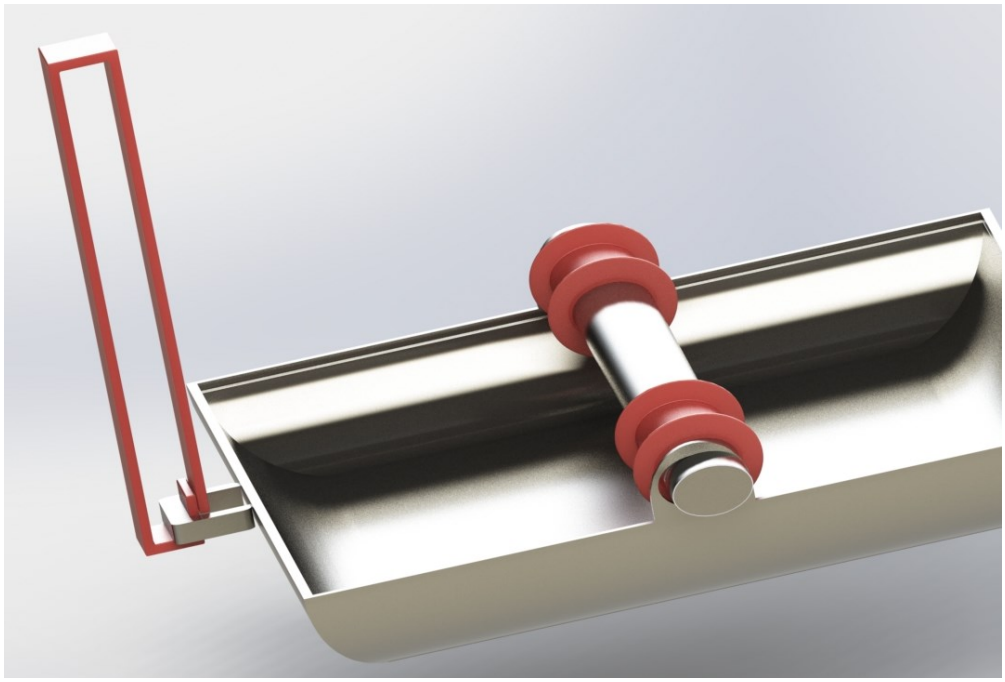


Figure 80: Assembly of alternative 2

6 FINAL CONCEPT - CONCLUSIONS

In this chapter, the final characteristics of the product are defined.

6.1 PRODUCT STATEMENT

Following all the assumptions from Concept Generation process, the product statement for the oven tray is the following:

- Target audience: The product is inspired by the special needs of the elderly, but it is user-friendly for any person regardless status ability.
- The primary goal of its design is to offer an easy-to-carry oven tray, with steady grip that prevents its user from excess bending.
- The oven tray will contain two types of handles different in function: a dragging handle, that is detachable and a lifting handle that is permanent.
- Both handles ensure safety by preventing from burnings or roll over of the oven tray.
- It can be cleaned easily.
- Promotes healthy cooking (using oven tray for alternative recipes minimizing the use of frying pan)
- It might have a slight extra cost compared to other oven trays.
- It has to be bright colored not only because of current trends but also as a sensory sign.

6.2 IMPROVEMENTS REGARDING POSTURE

The following diagrams depict posture related improvements of this concept.

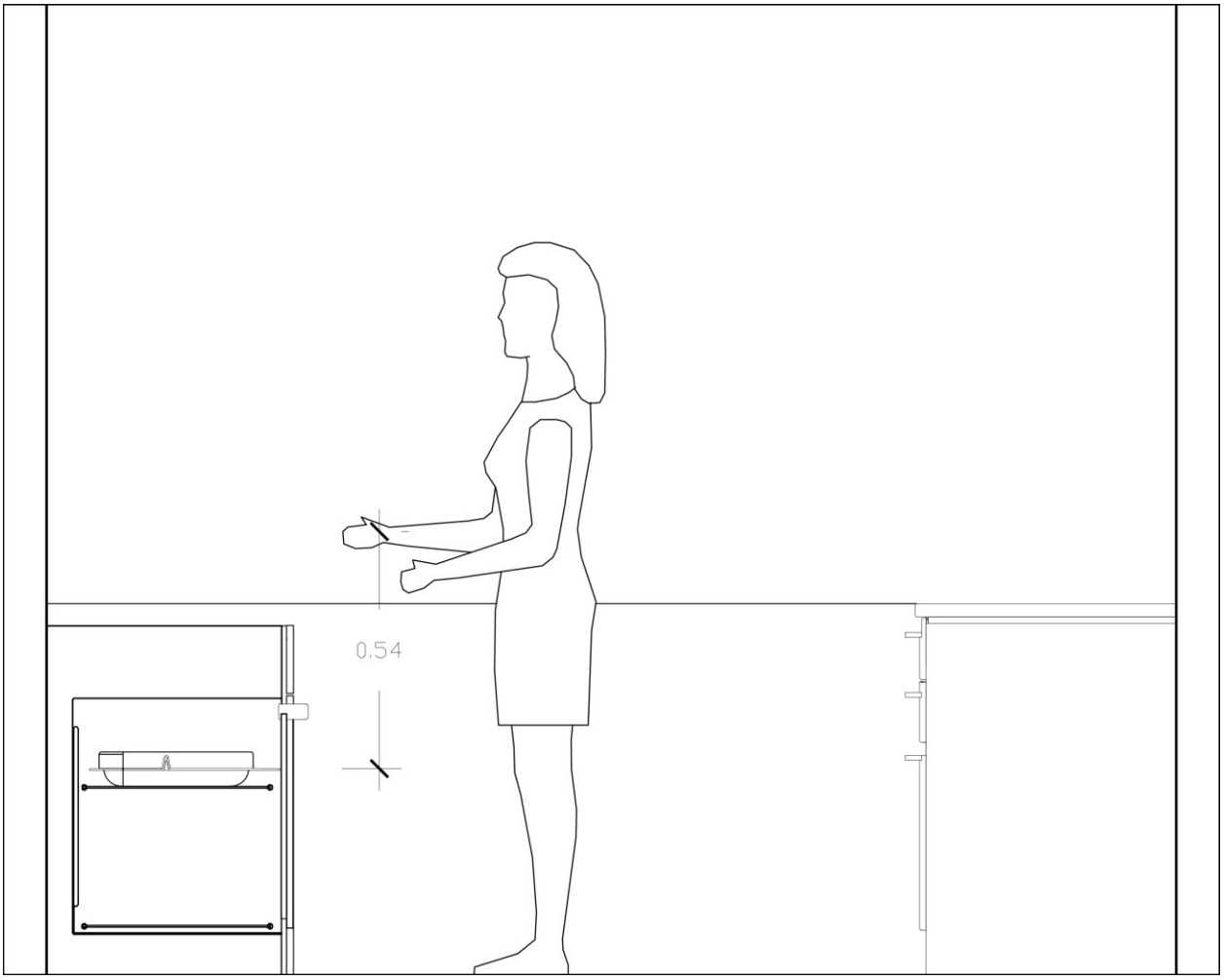


Figure 81: Distance reduction

The less distance one has to cover in order to pick up the oven tray is 25 cm and the maximum distance is about 50 cm. It refers mainly to the tasks of checking the progress of cooking and, in this case) the distance it is needed to drag the oven tray out of the oven. In order to minimize the bending, an oblong dragging handle is used.

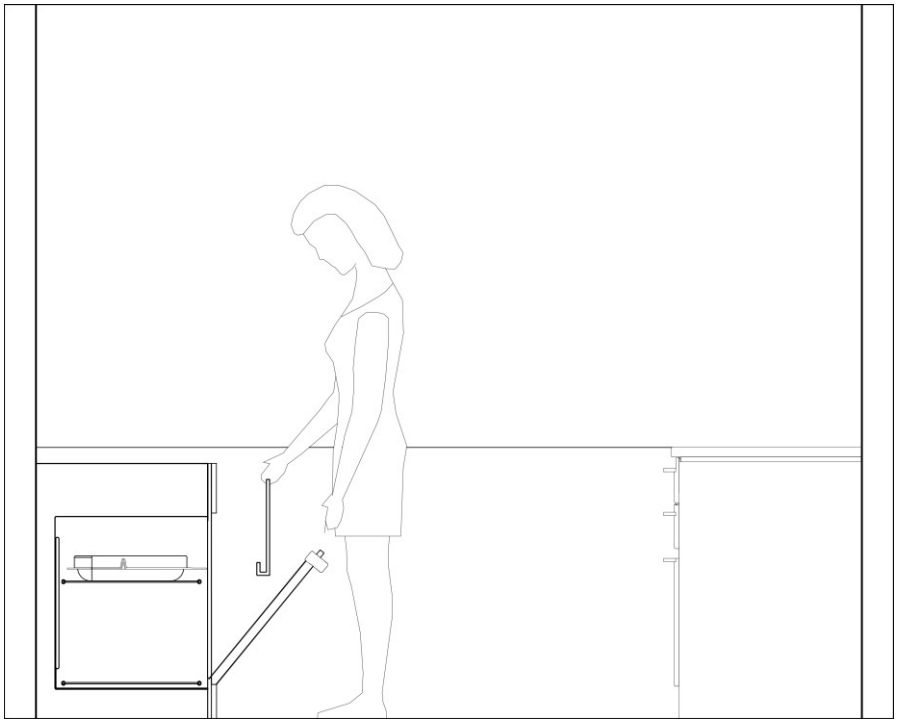


Figure 82: Opening the oven in order to attach the dragging handle to the tray

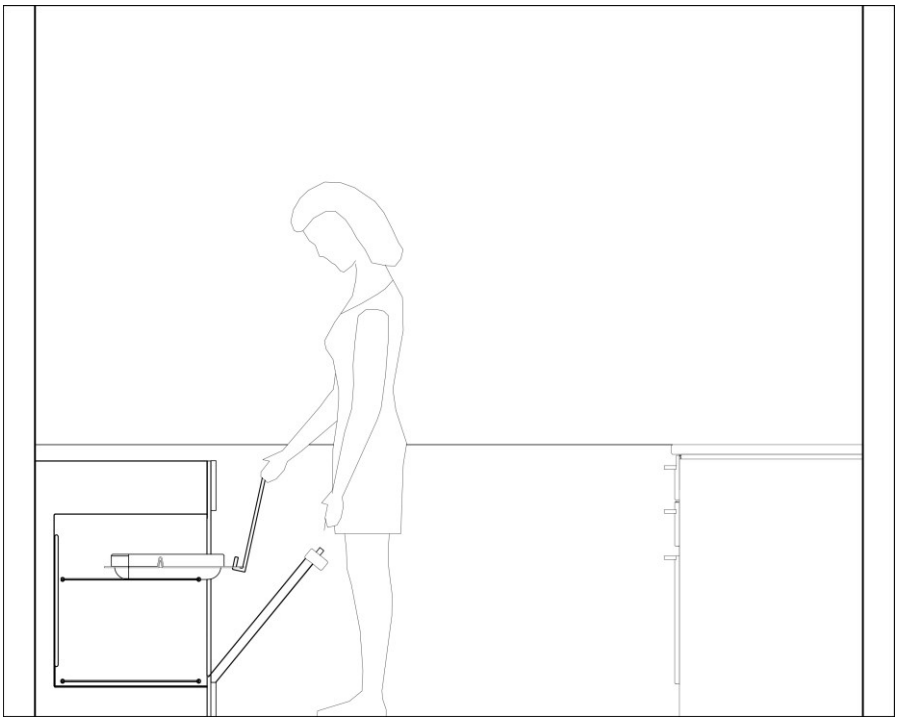


Figure 83: Attaching the dragging handle to the oven tray

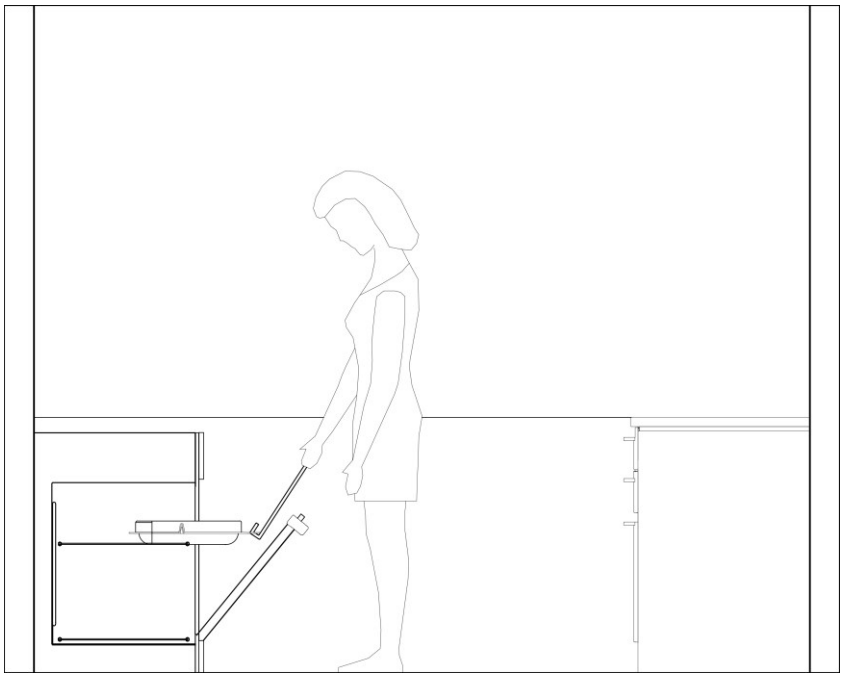


Figure 84: Dragging the try out from the oven

The last three images prove that in order to drag the tray with this kind of handle almost vanishes the bending posture (it may depend on the person's height of course). So, for almost half the procedure, the goal is succeeded.

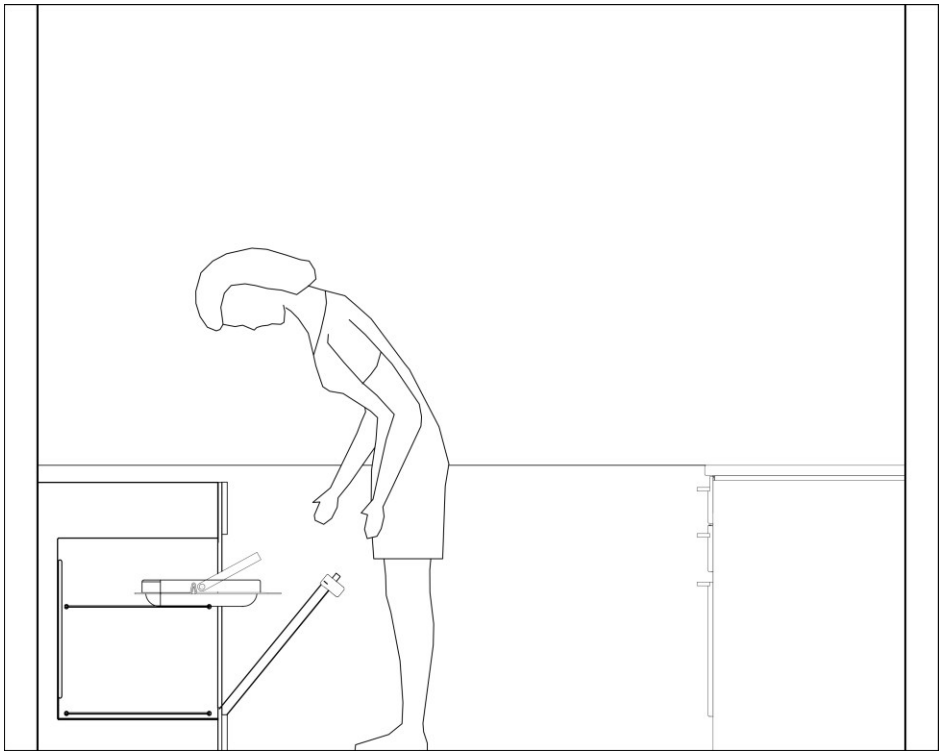


Figure 85: Bending in order to rotate the lifting handle

The bending at this stage could not be avoided. But with a rotating lifting handle that ensures the holding of the oven tray with both hands the duration of bending is minimized (see attached animation).

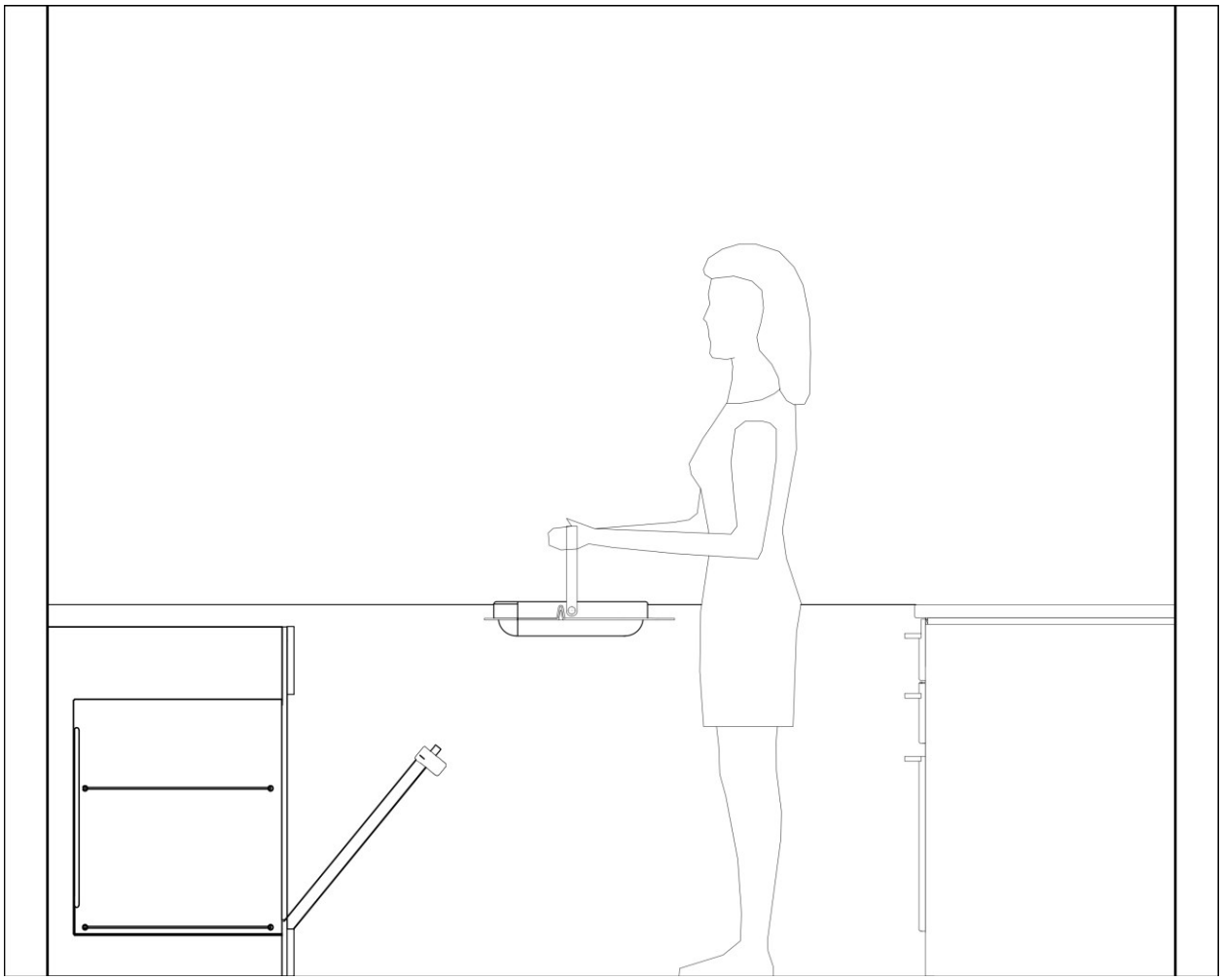


Figure 86: Holding the basket-like oven tray - end of the task analyzed.

6.3 FINAL PRODUCT CONCEPT

The final concept of the oven tray is inspired from the shopping basket concept described previously. It consists of the following parts:

- Main body of the oven tray
- Detachable dragging handle
- Rotating lifting handle
- Fasteners
- Heatproof covering

6.3.1 Main body of the oven tray

The design of the main body has a very soft geometry, with filleted edges. It has high walls (10cm tall). Its wide lips serve as a placement of the lifting handles. On one of its longest sides, the lips of the oven wall are protruded so as to incorporate the dragging handle's receptor. It contains also rotation barriers (the triangular protrusions) in order to stop the rotation of the oven tray at a certain point (90 degrees).

Figure 87: Isometric view of the oven tray

The receptor of the dragging handles, as well as the barriers of rotation serve as a reminder for the user to place the oven tray from the right side. This reminding aims at eliminating the possible bending in case of false positioning in the oven.

Regarding its material, it is advised to use stainless steel sheet 5mm thick with aluminum core. Stainless steel is a resistant to scratch, corrosion and rust material. It does not react with food. It is of high endurance and can be cleaned very easily. Its main disadvantage is that it does not conduct heat evenly, a property that is very crucial for a cookware. That is the

reason why an aluminum core is proposed. Copper can also be used as an inner core but is more expensive.

6.3.2 Rotating lifting handle

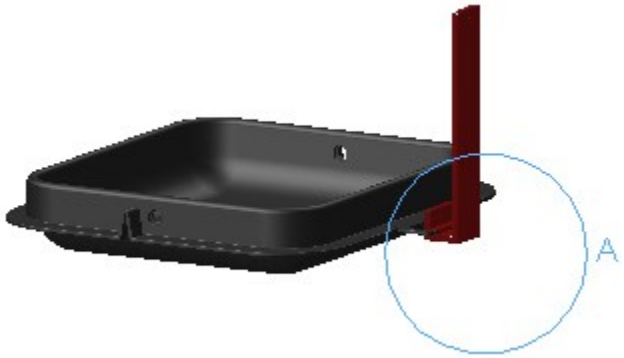
The lifting handle is the component for which the shopping basket is an inspiration. It is located centrally to the smallest sides of the oven tray. Its 180 degree rotation is inhibited by a stopping element on the lips of the oven tray. This design aims at reminding the user to place it properly to achieve full function.

Figure 88: Lifting rotating handle (perspective view)

It will be manufactured with hard silicone. As silicone is high heat resistant and also is a good insulator, it can be used for the handles that remain in the oven while cooking.

6.3.3 Detachable dragging handle

The dragging handle derives from hook-shaped handle concepts referred previously. It is tall enough to eliminate as much bending as possible and it is also very easy to be attached to the oven tray.



a

Figure 90: Perspective view of dragging handle attached to the oven tray.

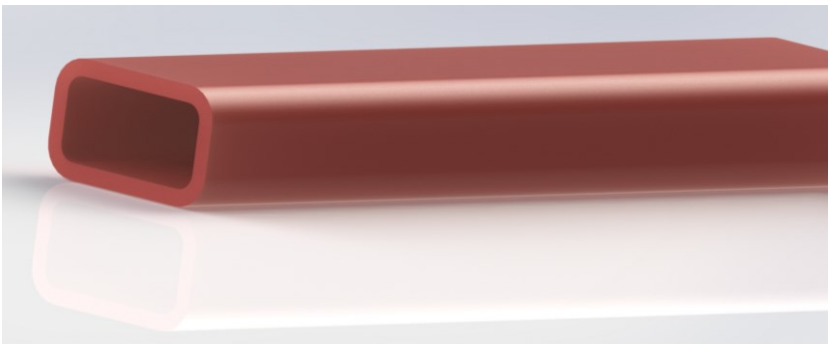


Figure 89: Silicone insulation of the dragging handle's receptor

It is attached to a hole punched on the protrusion of the lips of the dragging handle. This protrusion may serve as a secondary handle in case of difficulty, using only the lifting handle (not enough space, feeling of insecurity, and need for diagonal grip). Therefore it is covered with silicone rubber.

The dragging handle is made by silicone, in order to avoid heat transference to the hand of the user during the dragging process.

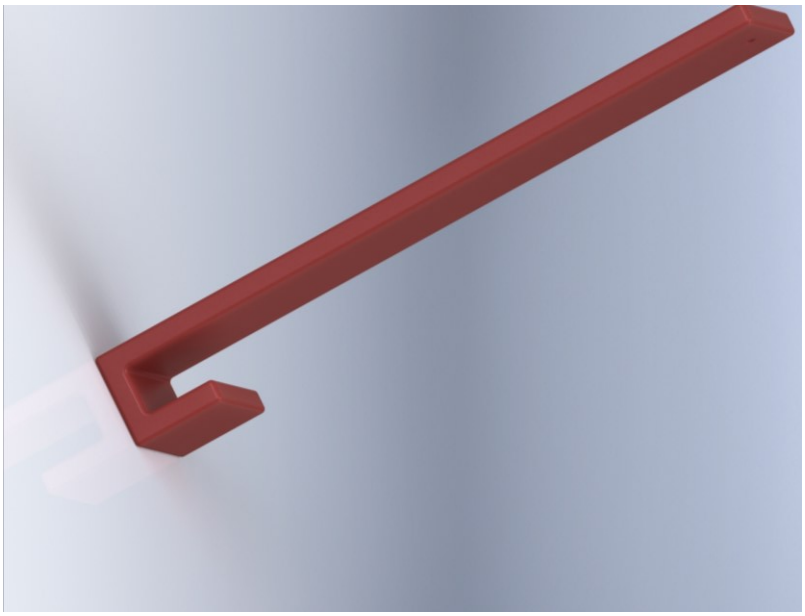


Figure 91: Perspective view of the dragging handle

6.3.4. Fasteners

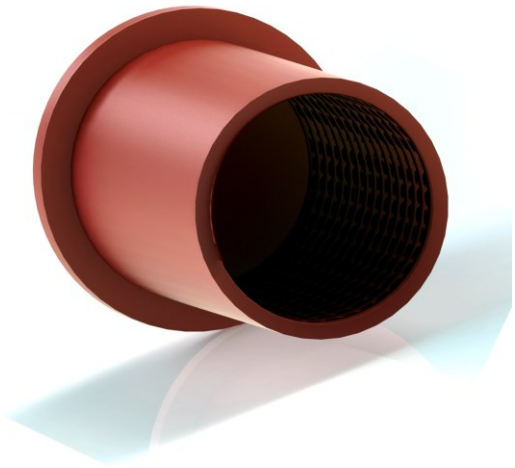


Figure 92: Connector No1

There are two types of fasteners that connect the rotating lifting handle with the walls of the oven tray. They interlock one another.

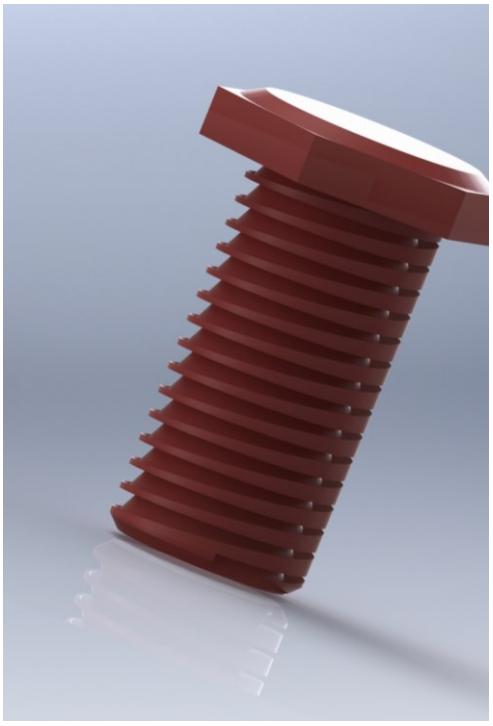
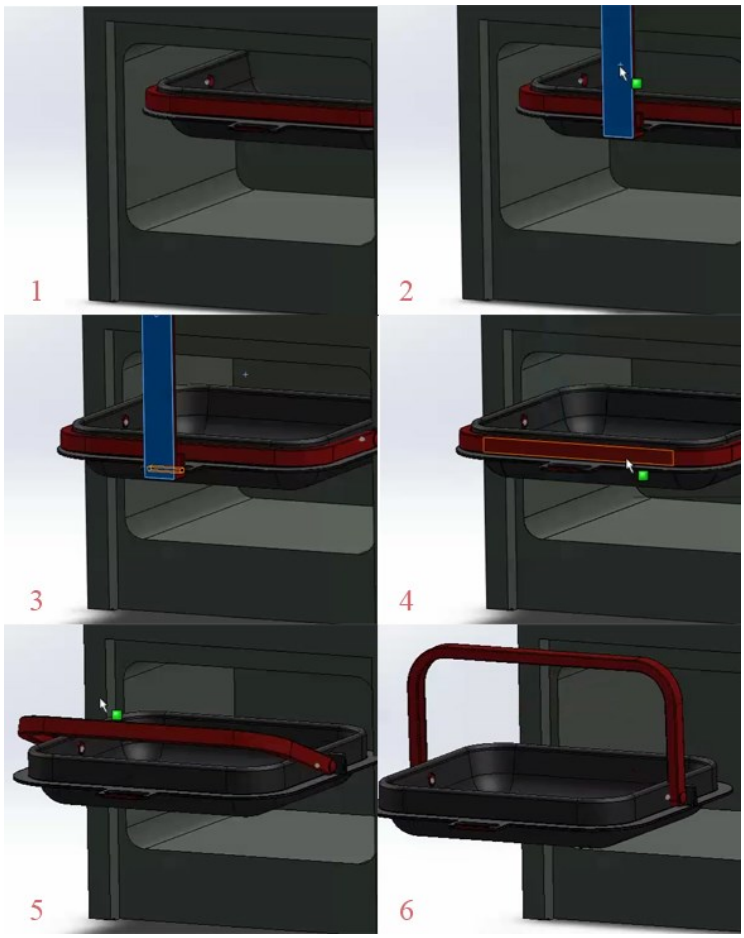


Figure 93: Connector No 2

6.3.5. Storyboard



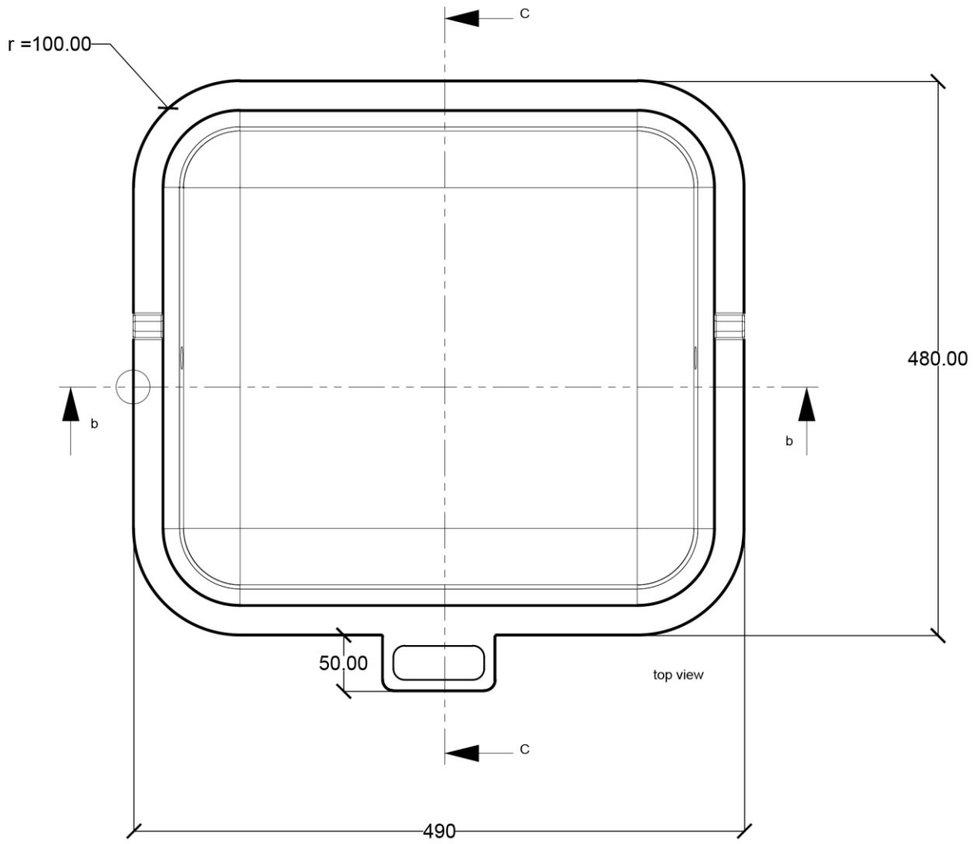
This storyboard depicts captured videos of the animation attached.

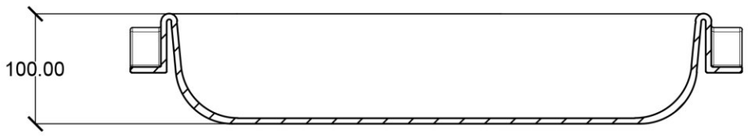
Figure 94: Story board of the oven tray

6.4 TECHNICAL DRAWINGS AND RENDERINGS OF THE FINAL PRODUCT

6.4.1 Main body of the oven tray

(Scale 1:5)





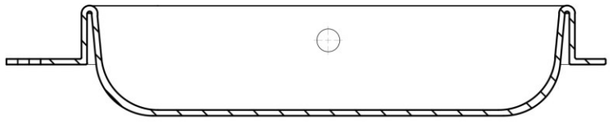
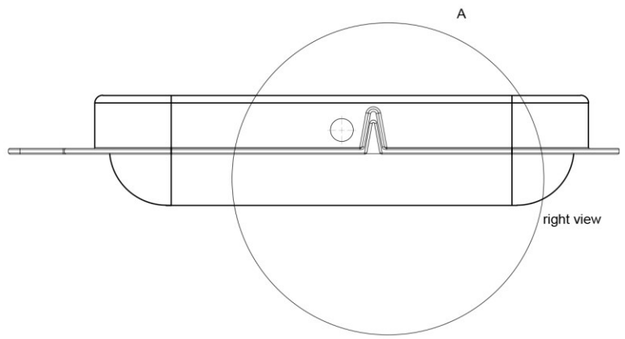
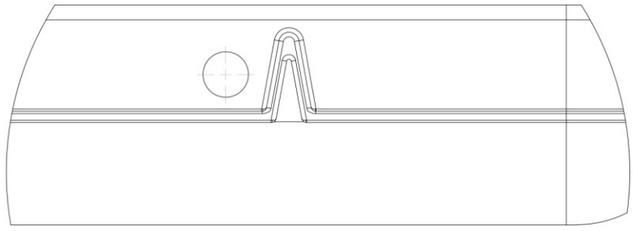
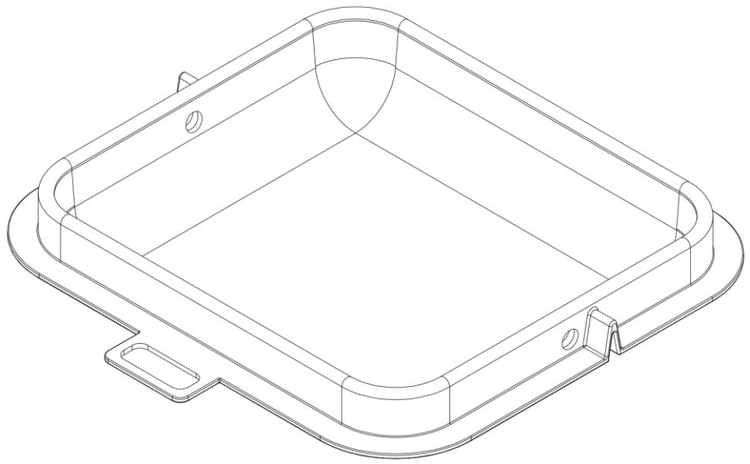


Figure 95: Technical drawing of the main body





Detail A
scale 2:5



isometric view

6.4.2 Rotating lifting handle (scale 1:5)

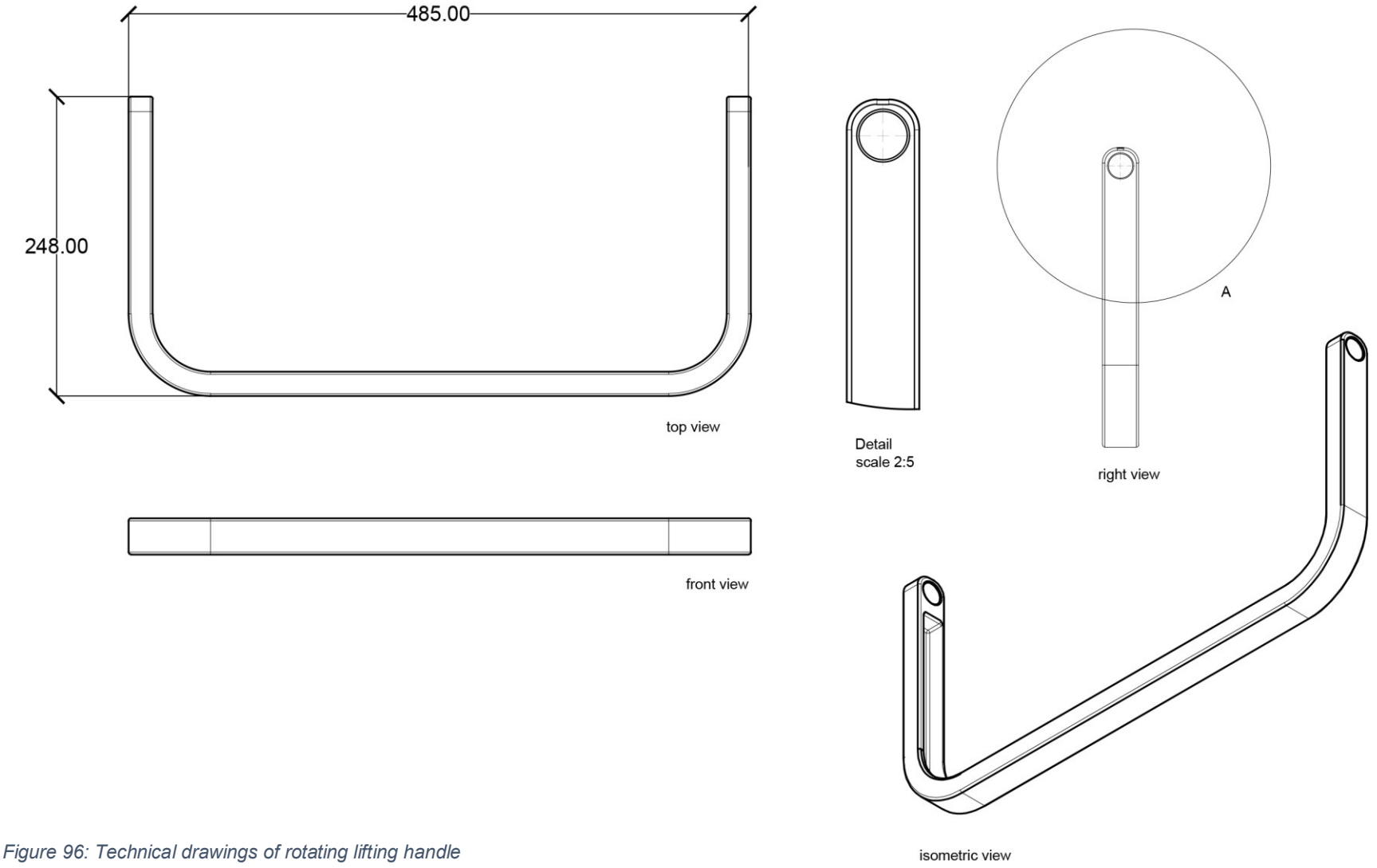


Figure 96: Technical drawings of rotating lifting handle

6.4.3 Detachable dragging handle (scale 1:2)

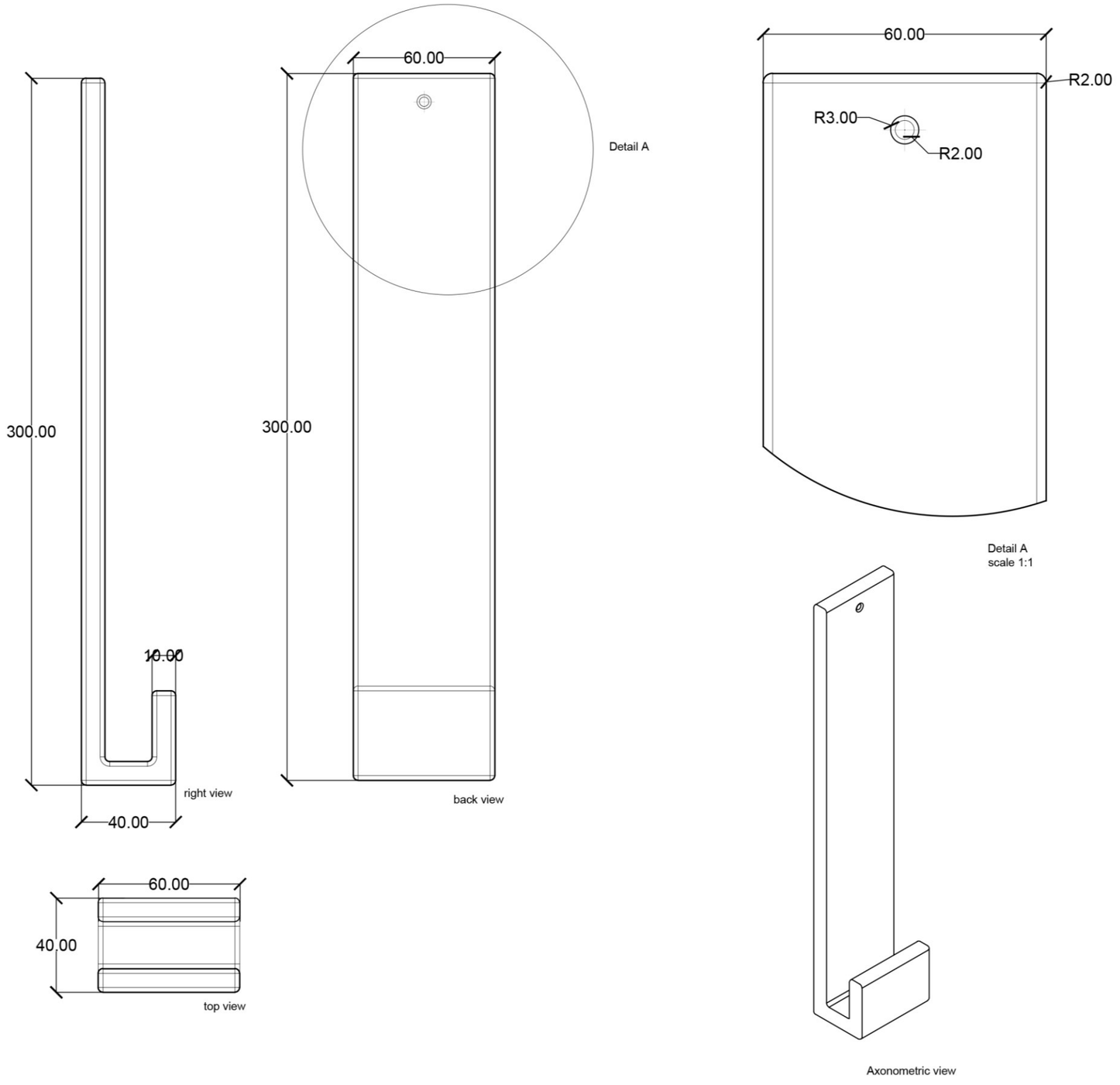


Figure 97: Technical drawing of detachable dragging handle

6.4.4 Fastener No1 (scale 1:1)

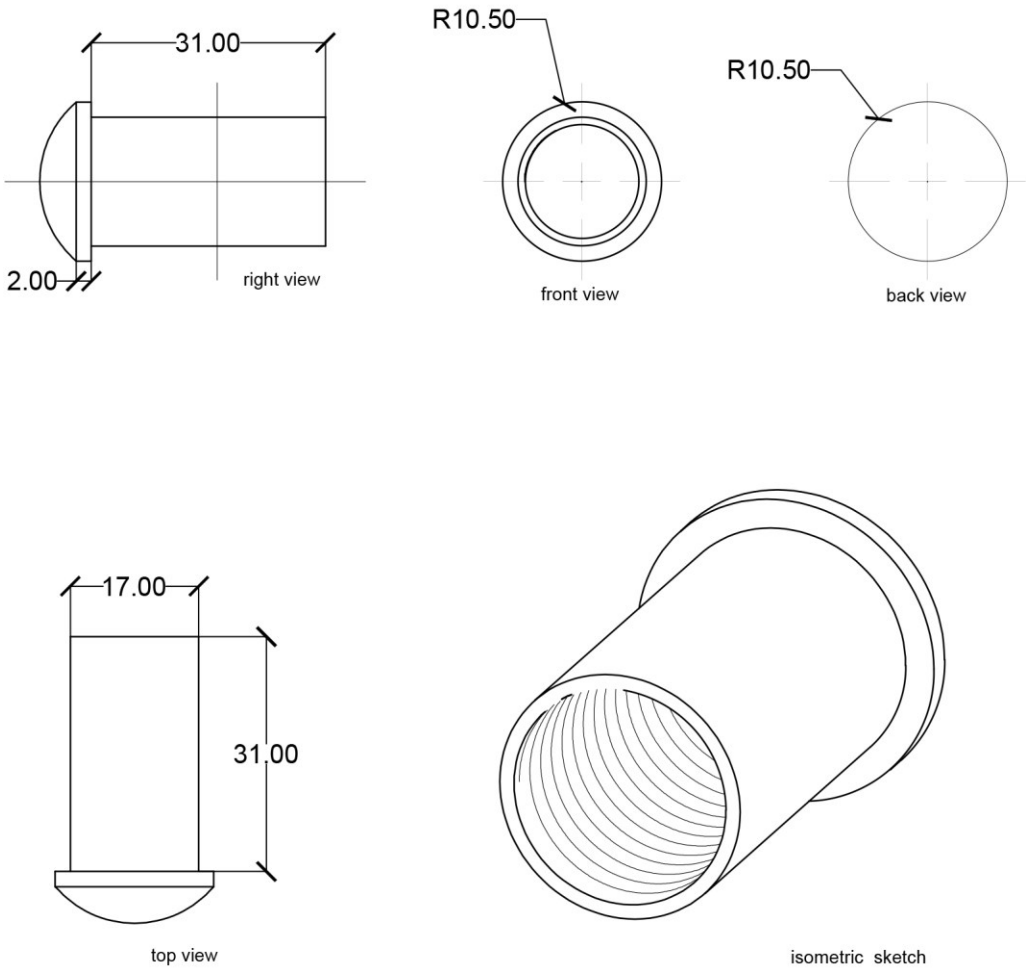


Figure 98: Technical drawings of fastener No1

6.4.5 Fastener No2 (scale 1:1)

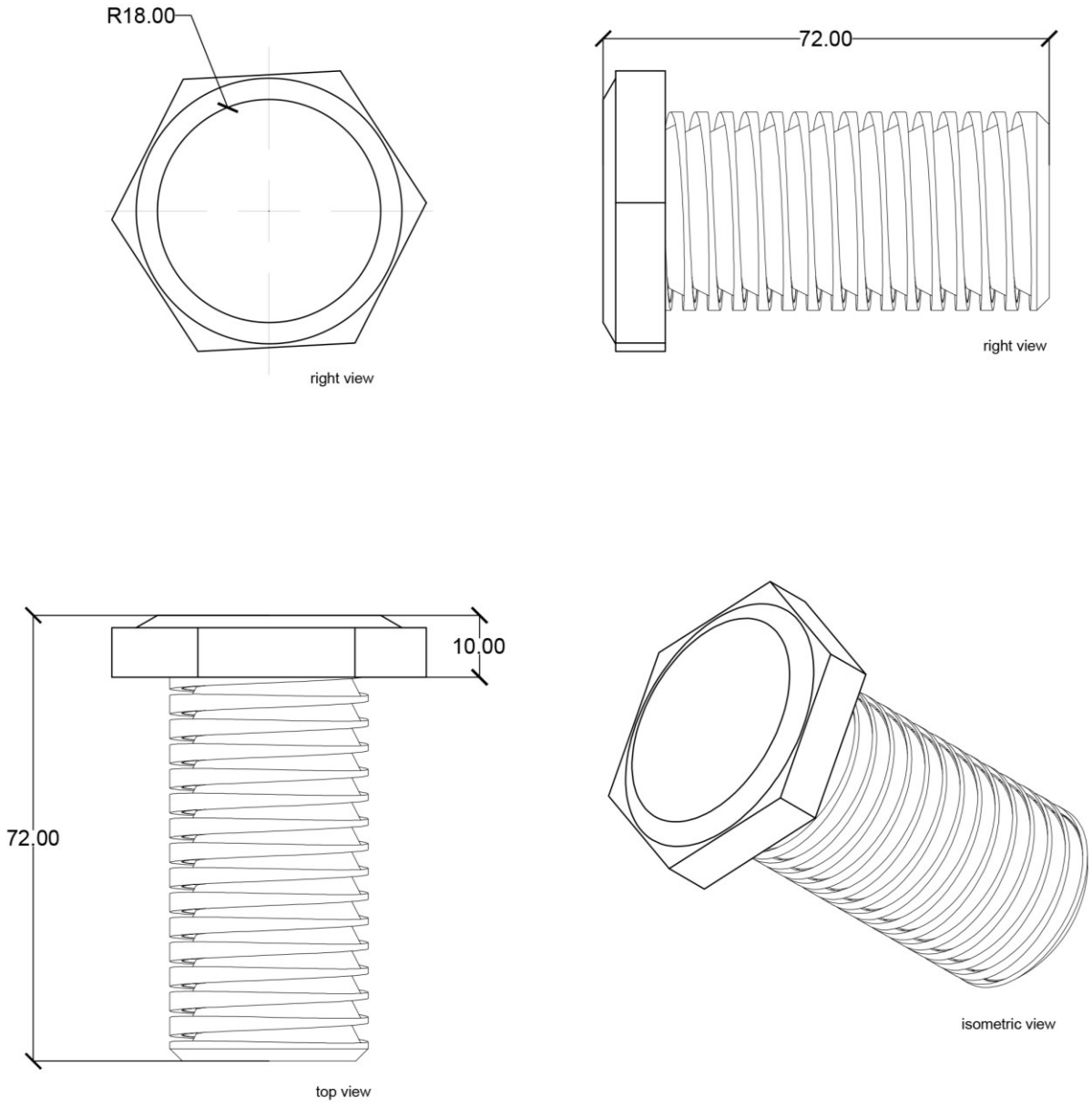


Figure 99: Technical drawings of fastener No1

6.4.6 Silicone covering (scale 1:1)

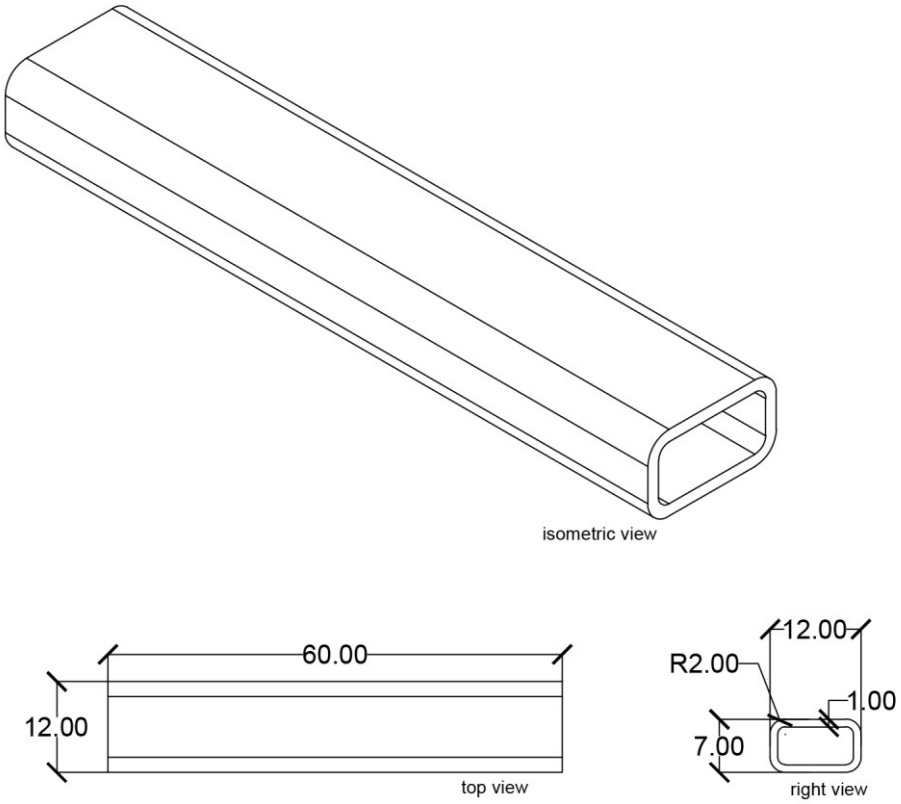


Figure 100: Technical drawings

6.4.6 Renderings

Figure 101: Rendering with the dragging handle attached.

Figure 102: Rendering of the oven tray

Figure 103: In context rendering (top view)

Figure 104: In context rendering (perspective view)

7 APPENDIX

The questions that follow are the framework within each interviewee was observed.

Part 1: Cooking tasks

- Do you live on your own?

- Do you cook?

- If no, why?

- If yes, how many persons do you cook for?

- Is the number of persons for whom you cook stable or not (cooking for friends family etc)?

- Do you

- Which meals do you prepare by yourselves?

- (In case one meal is omitted) why do you omit this meal? Is it difficult for you to prepare or you prefer to eat something else at that time?

- Rate meal preparing tasks in terms of physical difficulty

1. taking plates, utensils, oven dishes out of their storage area
2. cleaning /washing ingredients (eg vegetables, meat etc)
3. chopping/ cutting/grating ingredients (eg vegetables, meat etc)
4. kneading (flour, meat)
5. stirring
6. whisking
7. cleaning up
8. using the oven (Bending, pulling, pushing)

- What is the most irritating task for you when preparing a meal

- What tasks have become harder for you now compared to 10-20 years ago?

- Do you have adequate space for the preparation tasks to take place? (Large working area)

- If not, how do you organize your space in order to be efficient

Part 2: kitchen tools

- Do you use kitchen tools?

- If yes, which kitchen tools are the most helpful and which seem the least - and why?

If not, why?

- Has your use of kitchen tools changed as the years pass by?

-Have you acquired an alternative solution when you find something difficult?

Part three: cooking with others

- Do you cook with somebody else (eg grandchildren?)

- If yes, please specify the number and approximate ages of family members:

- Do you change any of your cooking habits when cooking with others?

Part four: other questions

- Do you have a dishwasher?

- How is your kitchen?

___ Cooktop with separate oven ___ slide-in/drop-in ___ freestanding

- Do you have adequate storage area for your kitchenware?

- What type of storage do you prefer?

___ shelves ___ sliding shelves ___ drawers ___ specialty

- Have you changed the position of storing your kitchenware over the years (due to physical difficulty)
- If yes, how do you arrange them?

- Does any other activity take place in the kitchen?- Does it bother you while cooking?

Other information

Sex

Age: +60 +70 +80

left handed - right handed?

8 BIBLIOGRAPHY

Books

- Ashby, M.F. and Johnson, K. (2004) Materials and design: The art and science of material selection in product design. Oxford: A Butterworth-Heinemann Title.
- Bridger, R.S.S. (2008) Introduction to ergonomics, Third edition. 3rd edn. Boca Raton: CRC Press.
- Milton, A. and Rodgers, P. (2011) Product design. United Kingdom: Laurence King Publishing.
- Milton, A. and Rodgers, P. (2013) Research methods for product design. United Kingdom: Laurence King Publishing.

Papers

- Beecher, V. and Paquet, V. (2005) 'Survey instrument for the universal design of consumer products', Applied Ergonomics, 36(3), pp. 363–372. doi: 10.1016/j.apergo.2004.10.014.
- Bloom, D.E., Canning, D. and Fink, G.N. (2010) 'Implications of population ageing for economic growth', Oxford Review of Economic Policy, 26(4), pp. 583–612. doi: 10.1093/oxrep/grq038.
- Chamorro-Koc, M., Popovic, V. and Emmison, M. (2009) 'Human experience and product usability: Principles to assist the design of user–product interactions', Applied Ergonomics, 40(4), pp. 648–656. doi: 10.1016/j.apergo.2008.05.004.
- Daniels, S., Glorieux, I., Minnen, J. and van Tienoven, T.P. (no date) 'More than preparing a meal? Concerning the meanings of home cooking', Appetite, 58(3), pp. 1050–1056. doi: 10.1016/j.appet.2012.02.040.
- Congleton, J.J., Jurmain, M.M. and Koppa, R.J. (1989) 'An ergonomics approach to refrigerator design for the elderly person', Applied Ergonomics, 20(2), pp. 123–130. doi: 10.1016/0003-6870(89)90134-8.
- Fisk, J. (1993) 'Design for the elderly: A biological perspective', Applied Ergonomics, 24(1), pp. 47–50. doi: 10.1016/0003-6870(93)90161-2.
- Imrhan, S.N. (1994) 'Muscular strength in the elderly - implications for ergonomic design', International Journal of Industrial Ergonomics, 13(2), pp. 125–138. doi: 10.1016/0169-8141(94)90079-5.
- Juarez, J.M., Ochotorena, J.M., Campos, M. and Combi, C. (2015) 'Spatiotemporal data visualisation for homecare monitoring of elderly people', Artificial Intelligence in Medicine, 65(2), pp. 97–111. doi: 10.1016/j.artmed.2015.05.008.
- Kadir, S.A. and Jamaludin, M. (2013) 'Universal design as a significant component for sustainable life and social development', Procedia - Social and Behavioral Sciences, 85, pp. 179–190. doi: 10.1016/j.sbspro.2013.08.349.

- Kirvesoja, H., Väyrynen, S. and Häikiö, A. (2000) 'Three evaluations of task-surface heights in elderly people's homes', Applied Ergonomics, 31(2), pp. 109–119. doi: 10.1016/S0003-6870(99)00044-7.
- Kohlbacher, F., Herstatt, C. and Levsen, N. (2015) 'Golden opportunities for silver innovation: How demographic changes give rise to entrepreneurial opportunities to meet the needs of older people', Technovation, s 39–40, pp. 73–82. doi: 10.1016/j.technovation.2014.05.002.
- Lunau, K., Fernie, G., Holden, J.M., Fernie, O. overlay G. and Lunau, O. overlay K. (1988) 'Chairs for the elderly — design considerations', Applied Ergonomics, 19(4), pp. 281–288. doi: 10.1016/0003-6870(88)90075-0.
- McDonagh, D., Bruseberg, A. and Haslam, C. (2002) 'Visual product evaluation: Exploring users' emotional relationships with products', Applied Ergonomics, 33(3), pp. 231–240. doi: 10.1016/S0003-6870(02)00008-X.
- Pinto, M.R., De Medici, S., Van Sant, C., Bianchi, A., Zlotnicki, A. and Napoli, C. (2000) 'Technical note', Applied Ergonomics, 31(3), pp. 317–322. doi: 10.1016/S0003-6870(99)00058-7.
- Schewe, C.D. (1991) Strategically positioning your way into the aging marketplace. Available at: http://connection.ebscohost.com/c/articles/9707080010/strategically-positioning-your-way-aging-marketplace (Accessed: 1 November 2015).
- Seidel, D., Hjalmarson, J., Freitag, S., Larsson, T.J., Brayne, C. and Clarkson, J.P. (2011) 'Measurement of stressful postures during daily activities: An observational study with older people', Gait & Posture, 34(3), pp. 397–401. doi: 10.1016/j.gaitpost.2011.06.009.
- Waller, S., Bradley, M., Hosking, I. and Clarkson, J.P. (2015) 'Making the case for inclusive design', Applied Ergonomics, 46, pp. 297–303. doi: 10.1016/j.apergo.2013.03.012.
- Woudhuysen, J. and Woudhuysen, O. overlay J. (1993) 'A call for transgenerational design', Applied Ergonomics, 24(1), pp. 44–46. doi: 10.1016/0003-6870(93)90160-B.

Reports, ebooks etc

- BrandView (2014) Kitchen and cookware: High-end sales up 2.8 percent. Available at: http://www.brandview.com/2014/06/kitchen-and-cookware-high-end-sales-up-2-8-percent/ (Accessed: 23 January 2016).
- Christophersen, J. (2004) UNIVERSAL DESIGN 17 ways of thinking and teaching. Available at: http://nedlasting.husbanken.no/Filer/7f34e.pdf (Accessed: 19 October 2015).
- Cooking trends for 2014? (2008) Available at: http://www.beka-cookware.com/blog/what-are-the-cooking-trends-for-2014 (Accessed: 9 February 2016).

- Editors, T. and Smith, L. (2015) 7 cool trends that will hit your kitchen in 2016. Available at: http://www.housebeautiful.com/room-decorating/kitchens/g2664/kitchen-trends/ (Accessed: 9 February 2016).
- Glink, I. (2015) Top 5 kitchen trends of 2015. Available at: http://www.cbsnews.com/media/top-5-kitchen-trends-of-2015/ (Accessed: 9 February 2016).
- Hirzel, H. (2015) Ageing: How family offices can invest in the 'silver economy'. Available at: http://www.campdenfb.com/article/ageing-how-family-offices-can-invest-silver-economy (Accessed: 23 January 2016).
- IUFoST, Iuf. (2014) Meeting the food needs of the Ageing population – implications for food science and technology over 65 year olds – an overlooked segment of the population. Available at: http://www.iufost.org/iufostftp/IUF.SIB.Meeting%20the%20Food%20Needs%20of%20the%20Ageing%20Population.pdf (Accessed: 23 January 2016).
- Insider, G. (2015) Retailers offer an inside look at cookware trends. Available at: http://www.gourmetinsider.com/retailers-offer-an-inside-look-at-cookware-trends/ (Accessed: 9 February 2016).
- Lee, H. and You, K.S. (2006) The physical, mental, and emotional health of older people who are living alone or with relatives. Available at: http://www.psychiatricnursing.org/article/S0883-9417(06)00032-X/abstract (Accessed: 12 February 2016).
- Posts about cookware trends on trend bible (2011) Available at: https://trendbible.wordpress.com/tag/cookware-trends/ (Accessed: 9 February 2016).
- Probst, L., Frideres, L., Pedersen, B., Bolanowska, J., Marchive, C. and Luxembourg, P. (2015) Business innovation observatory silver economy active aging. Available at: http://ec.europa.eu/DocsRoom/documents/13420/attachments/1/translations/en/renditions/native (Accessed: 24 January 2016).
- Reiter, A. (2015) The food trends to look for in 2016, according to food network kitchen | FN dish – food network Blog. Available at: http://blog.foodnetwork.com/fndish/2015/12/the-food-trends-to-look-for-in-2016-according-to-food-network-kitchen/ (Accessed: 9 February 2016).
- Sangelkar, S. (2016) 'User activity-product function association based design rules for universal products'
- Six alternatives to traditional non-stick cookware (no date) Available at: http://www.divinecaroline.com/life-etc/home-food/six-alternatives-traditional-non-stick-cookware (Accessed: 9 February 2016).
- TRENDS in kitchenware , cookware, cast iron cookware, cooking (no date) Available at: http://www.kmpfurniture.com/Newsletter/trends-in-kitchenware_59.html (Accessed: 9 February 2016).
- United Nations (2013) World Population Ageing 2013. Available at: http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf (Accessed: 9 February 2016).

- United Nations (2015) World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. Available at: http://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf (Accessed: 10 December 2015).
- Universal Design (2011) Available at: http://www.uc.edu/cdc/urban_database/aging/NY_universal_design.pdf (Accessed: 20 October 2015).
- Universal design in an era of global demographic change (2008) Available at: http://if-universaldesign.eu/resources/ud-igdW_english.pdf (Accessed: 30 December 2015).
- Štefánik, M. and Al, E. (2013) MODELLING THE ECONOMIC POTENTIAL OF THE SILVER ECONOMY. Available at: http://www.neujobs.eu/sites/default/files/NEUJOBS%20Working%20Paper_Modelling%20Silver%20Economy_12.3.pdf (Accessed: 23 January 2016).

Images

Picture 9: Arthritis handle (no date) Available at: https://s-media-cache-ak0.pinimg.com/564x/81/ad/3a/81ad3a6904cb0959b59bf176b5580d1a.jpg (Accessed: 20 September 2015).

Wooden handle (no date) Available at: https://s-media-cache-ak0.pinimg.com/564x/6e/00/e6/6e00e606c9fd0201bbd2c961a87e3a02.jpg (Accessed: 1 December 2015).

(no date) Available at: https://s-media-cache-ak0.pinimg.com/564x/93/de/f8/93def8b99ea69165318f5e4aea4dfdd2.jpg (Accessed: 2 December 2015).