A product to help arthritis sufferers in the kitchen

Process report AD10-ID

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Title Page

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Title
DUO: A product to help arthritis sufferers in the kitchen

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DUO: A product to help arthritis sufferers in the kitchen, is an industrial design project based on the development of a product to help opening different kind of lid based containers. The product has been developed considering that has to be suitable for a person that has arthritis, but is directed to a broader consumer area, since this is a problem that also people that do not have arthritis face. Taking care of aesthetics, an aspect missing in the market directed for arthritis, the objective has been to design a functional and handy but at the same time attractive looking product, creating a product inside the inclusive market.

Naroa Luque Ruiz de Eguilaz

Reading Guidance

The project is described in three reports, a product report, a process report and a report containing the conclusion and reflection.
The process report that you have on your hands, documents the working process followed during the project, while the product report present this final result. The last report contains the conclusions and reflections obtained after finishing the project.
At the back of the report can be found a DVD containing digital versions of the three reports, the Appendix an additional material to get a better understanding of the project.

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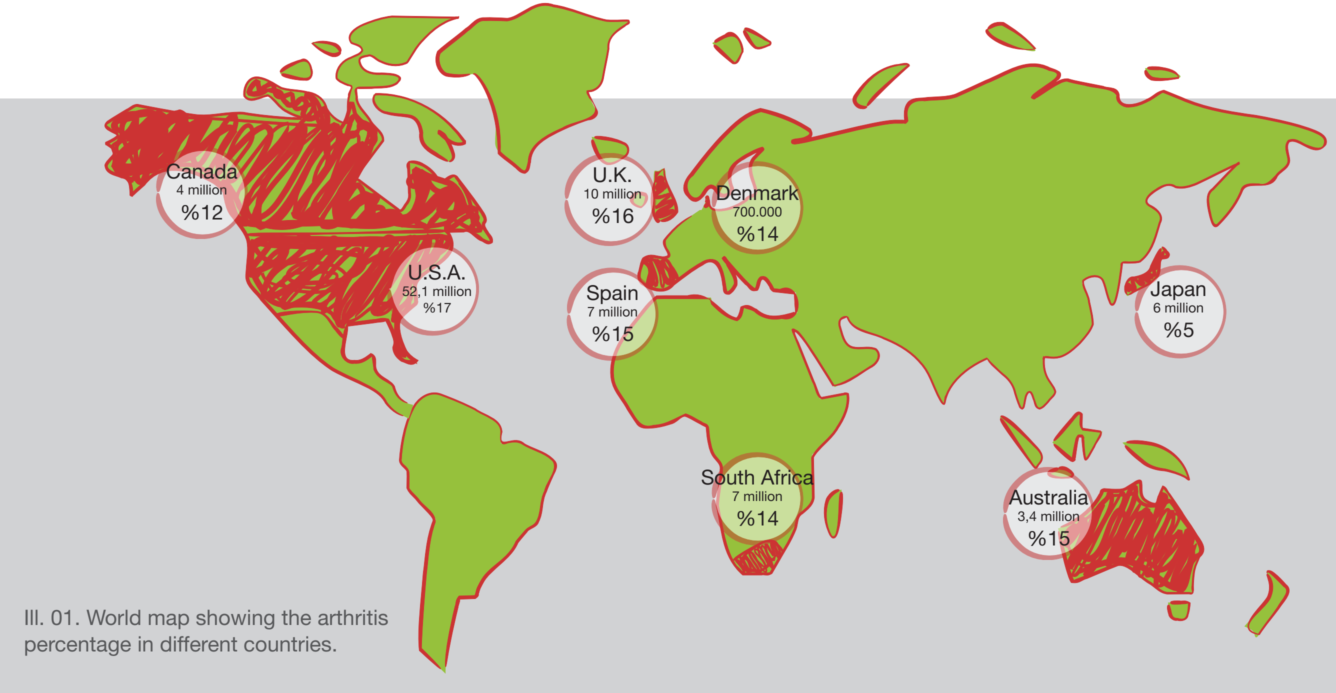
Arthritis, a worldwide illness

More than 300 million people worldwide suffer arthritis. The most common form of arthritis, osteoarthritis, affects mainly people aged 60 an higher. However, people of any age can develop arthritis, even children (Bjorklund, 2010).
Arthritis can arise in many articulations of the body, but commonly affected joints are: knees, spine, hips, feet and hands. It provokes pain and mobility loss, which decreases the affected person's self-sufficiency level. The well-being reduction grade depends on the arthritis type and its severity, but, usually, daily life tasks as getting dressed, cooking or taking a shower, become tougher -sometimes impossible without external help- to carry out. Quantitative data about the limitations that people suffers due to arthritis are provided in chapter *Scale of the Problem* and *Lifestyle Effects*, page 15.

According to the Arthritis Association from Denmark, Gigt Foreningen, around 700.000 Danish suffer arthritis, which equals to the 14% of the population. The older we get, the chance to contract this disease increases. Since the average age of the population is growing, on time this percentage will be even higher.

Distance between design and products for disabled people

People affected by arthritis find trouble performing everyday life actions, like tiding oneself up, cleaning or cooking. There are products in the market designed to make their life easier, but these products are merely functional, with no considerations on aesthetics. Designers (industrial, product, fashion, graphic…) are not totally implicated yet in the development of products for disabled people; the people involved have usually a clinical or engineering background (Graham, 2009). They are limited to solve the problem, without considering on how to do it in an appealing or playful way. Examples of this kind of products can be seen in the chapter *Exclusive Market for Arthritis Sufferers*, page 22.
In certain circumstances, the needs of a person suffering arthritis, match with the needs of one that does not. But the products directed to arthritic people become exclusive for them, since a so-called able bodied person would never buy a product that looks like for disabled people. Similar happens the other way around: a person that has arthritis cannot buy many products in the market because is not able to use them; the usability and ergonomic level are not enough. The difference between the two cases is that an arthritic person cannot choose what to buy, is forced to buy the "special" utensils if wants to be able to fend for himself or herself.
It is possible to find the balance between an effective, efficient and comfortable functionality and a clean, catchy and playful aesthetic; there are companies that are good examples of it, whose products are shown in chapter *Inclusive Design*, page 24. This companies are focused on inclusive or universal design: design for the whole population, trying to reach the broadest users' group as possible.
This has also been the goal of the project: design a product that can be useful for the largest population area as possible; included people that suffer arthritis, without making them feel disabled because they need to use exclusive products.



Ill. 01. World map showing the arthritis percentage in different countries.

"People are disabled by the society they live in, not directly by their impairment."
(Graham, 2009)

Focus on the kitchen

In the Danish culture food and cooking has a great importance. That is why in Denmark there is a large product variety related to the kitchen, many of them designed in Scandinavia. Functionality is a very important parameter in Scandinavian design, but still a person that has arthritis can hardly use most of the products that are sold in current stores.

Cooking is a daily basic task that we do for ourselves and for the people around us. Loosing independence in the kitchen in simple and insignificant tasks as opening a can, lifting a pot or cutting some vegetables, bounds independence and self-esteem. To keep doing them without external help, it is necessary to buy exclusive utensils designed for disabled people, instead of going to a common shop and finding a suitable product. The ground of the project was set in designing universally for the kitchen, so people suffering arthritis can keep on cooking as they did before, using the same tools that a person that does not have arthritis.

Ill. 02. Different kind of people in the kitchen.

Target Group

The product is not directed to a specific target group, between a specific age range, with particular skills or life style. The objective has been to design an utensil that suits as much users as possible. A product that can be used by anybody who cooks, for fun or for obligation.
The functionality and interaction with the product have been defined considering the worse case scenario: a person suffering arthritis has to be able to use it comfortably.
Regarding aesthetics, simplicity and cleanliness have been core values, in order to adapt the design to the broadest are of consumers possible.

Motivation

With this thesis I wanted to apply the knowledge I got through my Bachelor in Mondragon Unibertsitatea (Basque Country, Spain) and the Master at Aalborg University, to identify real problems in people's everyday life and solve them; during the education, we get the ability to detect problems, develop creative solutions, based on: improving the users' experience, designing suitable interactions and functionalities, giving to the product an appealing look and, combining the designer's role with the engineering skills, detail a realistic product that can be produced. During this final thesis, I have applied this knowledge to make arthritic people's life a bit easier, using my skills to develop a product that can improve their self-sufficiency level.

Being a person that likes cooking, draws my attention the huge amount of kitchenware that is on the market: many brands, many product-lines, many styles... Unfortunately, despite the variety is so big, most of them are difficult or impossible to use for people that has hand mobility problems, the main part of the body involved on cooking. My challenge in this project has been to identify the problems that, specifically, people suffering arthritis face while they cook and design an utensil to make their cooking process less tough.

Choosing the topic of the project, it also has been considered to select an area that allows me to demonstrate, put in practice and develop further on the skills acquired in: user research, functional design, ergonomics, engineering, styling and business strategy development.
Developing a product for a market that is so crowded was considered a challenge that I wanted to face to test my ability on finding problems and solving them in a innovative and more user-friendly way.

Since the kitchenware market is a large business area, with so many companies involved on it all over the world, I was interested on developing the product in collaboration with a design firm, because of the information source that this can be according to competitors, new tendencies, production techniques or new materials. However, it was not possible to find a suitable collaborator company at the early stage of the project (see Appendix 1), so another approach was taken: sell the product to a company after is developed and detailed. The staging of this approach will be described further on during the project.

Learning objectives

The following learning objectives were defined considering what I wanted to put in practice during the semester and the knowledge I wanted to achieve by the end of it.

User research

- Carry out fluent and productive communication with the users, taking out the maximum as possible from every contact that is established.
- Know how to analyze the data in order to identify real and important problems.

Functionality, interaction and ergonomics

- Train the ability to think about smart and, at the same time, simple solutions that make the use of a product easier and more comfortable.
- Be able to prioritize the problems that need to be solved, in order to avoid making a design more complex because of trying to solve too many issues.
- Identify products that are example of simplicity, handiness and style and find inspiration on them.
- Use anthropometric and byomechanical data to define dimensions.
- Create physical models to evaluate ergonomics in the users.

Technical specifications

- Design inside-out; define the internal components first and after design a housing that fits them.
- Use reverse-engineering to develop the mechanism of the product.
- Use 3-D modeling as a tool to develop the construction, to have a better understanding of dimensions and how things are mounted together.
- Be able to develop into detail a mechanism for the chosen product. This means identifying different parts, dimensioning them, defining materials and production techniques.
- Think efficiently about production. Design trying to save parts and have simple molds.
- Calculate an approximate cost of the product.

Styling

- Create different concepts for the outer shape in a fast way, having always in mind that the functionality and interaction with the product defines how it looks.
- Use 3-D modeling for styling in order to get a high visual feedback of shapes, dimensions and proportions.
- Make mock-ups to text dimensions and proportions.

Communication

- Develop the ability to communicate ideas, concepts and the process followed during the design in a clear, understandable and pleasant way.

Business plan

- Define the staging of introducing the product into the market.

During the whole project, 3-D modeling, sketching and rapid prototyping skills wanted to be improved.

Structure

	Framework	Research	Concept development	Product detailing	Reflection
Objectives	Define the learning objectives. Describe the problem area. Structure the project. Plan the time line of the project.	Have a better understanding of what arthritis is. Choose a product to redesign according to the problems and needs the users have. Research the movements of the hand that are less painful and harmful. Find a market-place and define the direction I want to follow.	Generate a diversity of concepts, but always down to the earth. Present a 3-D modeled idea for the Status Seminar. Test the dimensions and functionality of them.	Detail the product until production level: define materials, joints and technical drawings. Calculate approximate cost of the product. Present the use of the product in a clear way. Create a Logo for the product.	Write a conclusion and reflection upon the followed process and the result
Activities	Try to contact a company to design closer from the real world. Reflect upon what I want to learn or improve at the final semester of my education. Make a structure of the project and place it in a time line in order to have an overview of the time I have to spent in the different activities.	Read information about arthritis: the parts of the body that are affected by it, the percentage of the population suffering it, the reasons why happens, etc. Contact people suffering arthritis and interview them. Look into the market concerning products for people suffering arthritis.	Get inspiration from the objects/ world around me. Make mock-ups and tests them. Use Solid Works for 3-D modeling. Discuss the concepts at the Status Seminar.	Use Solid Works to make a detailed model and define technical drawings. Make a material scan in order to choose the most suitable. Present a exploded view to show how it is going to be mounted. Make use cases of the product.	Go back to the beginning of the process and think about what could be done in a different or better way.
Output	Learning objectives draft. Scheme of the different project phases and main activities within them. Description of the problem area for the reader's understanding.	More knowledge about arthritis. Selection of a kitchen utensil to start developing concepts on. Knowledge about the ergonomics of the product to make it suitable for arthritic people. List of problems that need to be solved.	Selection of concept to develop further on.	A final product detailed product.	A reflection and conclusion that can be found in the *Conclusion and Reflection Report*.

PROBLEM IDENTIFICATION

In this preliminary phase of the project, arthritis and the problems that this illness brings when cooking were analyzed, in order to see the different directions that the project could follow. Interviews with people that have arthritis were carried out, to prioritize the problems and find out which is the biggest challenge in the kitchen for them.
After deciding the project focus, the existing market was researched and, gathering the findings that were done during the whole phase, the problems that needed to be solved were defined, which was the outcome of the problem identification phase.

Understanding Arthritis

The first step of the analysis was to obtain generic knowledge about arthritis: the different types, who is affected by it, what are the causes, the symptoms, the influences on everyday life, etc. In this chapter this information is presented, so the reader has a ground that will help on the understanding of the report.

A disease that affects the joints

Arthritis is disease that impairs the joints of the body; the word arthritis literally means ''joint inflammation''. Before facilitating information about arthritis and its consequences, it is important to understand what a joint is:

A joint is the connection between two or more bones, with the purpose of allowing repeated and efficient movements between them. In a joint, the ends of the bones are covered with cartilage (ill. 03), a spongy and smooth material that cushions the bones and protects them from wear and tear.

Joints are covered in a capsule called synovial lining (ill. 03). The lining releases a thick fluid called synovial fluid, which fills the joint space (ill. 03). The synovial fluid and the cartilage work together, to ensure the smooth movement of the bones against each other (Bjorklund, 2010).

The most common types: Osteoarthritis and Rheumatoid Arthritis

There are more than a 100 types of arthritis; the most common, by far, is osteoarthritis. About 210,000 Danes have been diagnosed with osteoarthritis in hospitals or by a specialist, but experts say that this is just the tip of the iceberg (ill. 04). It is estimated that the total number of people suffering osteoarthritis is far higher (www.gigtforeningen.dkA).

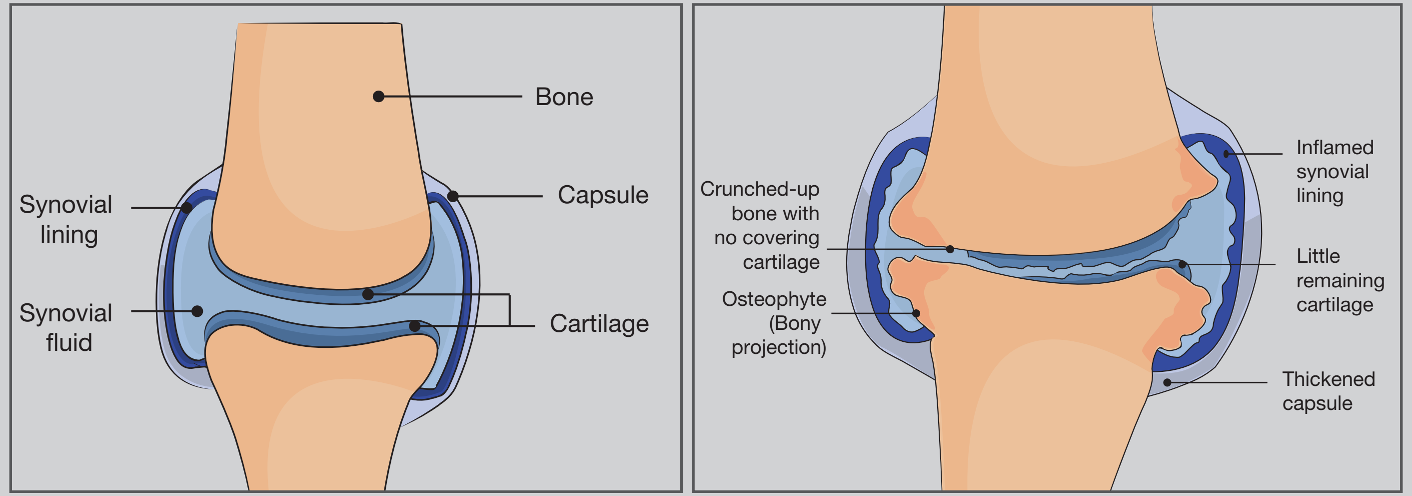
Next, osteoarthritis and rheumatoid arthritis are introduced. The reason of having analyzed this two types deeper than the rest, is because they affect harshly the hand and wrist, which are essential for cooking. Furthermore, they are the two most common arthritis types in Denmark (ill. 04). More information about other common arthritis types can be found in Appendix 2.

As a brief introduction, mention that osteoarthritis and rheumatoid arthritis are quite different from each other. Osteoarthritis occurs when the cartilage covering the ends of the bones wears away. Rheumatoid arthritis is a fail of the immune system, which, instead of protecting our health, attacks the body's tissues, specially the synovial membrane (ill. 03) (Bjorklund, 2010).

Osteoarthritis(OA)

OA is the consequence of the wearing of the cartilage. The cartilage works as shock absorber between the bones so, when this is damaged, the bones rub against each other, causing pain.

The body tries to replace the lost cartilage producing more synovial fluid in the joint, which tries to act like a cushion. But it also swells the joint, restricting the motion. The swelling causes the stretching of the synovial lining (ill. 03), which also creates pain.



Ill. 03. Comparison between a healthy joint and a joint affected by arthritis.

It is a progressive disease; the cartilage deteriorates little by little. Over time, if the osteoarthritis is not treated, the bones can be deformed, causing even more pain and making the motion more difficult (orthoinfo.aaos.org).

Almost any joint of the body can develop osteoarthritis, however, usually occurs in the hands and feet, and weight-bearing joints as the hips,knees and spine (osteoarthritis.about.comB).

Primary symptoms

Pain is the main symptom of OA and develops gradually, together with the illness. With mild to moderate OA, pain typically gets worse with the use of the joint, and is relieved with rest. As the disease progresses and becomes more severe, medication might be necessary to calm down the pain (osteoarthritis.about.comB).

Often the joint appears swollen, due to hard bony osteophytes - bony projections formed by the body around joints, to increase the surface area of the joint- or extra synovial fluid in the joint (ill. 03).

Consequence of swelling and pain is joint stiffness, which limits the range of motion. The joint does not move smoothly and often 'creaks' when moved. Joint stiffness, together with pain, is the main reason for osteoarthritis patients' impairment. (clinicaltrialsmgt.com).

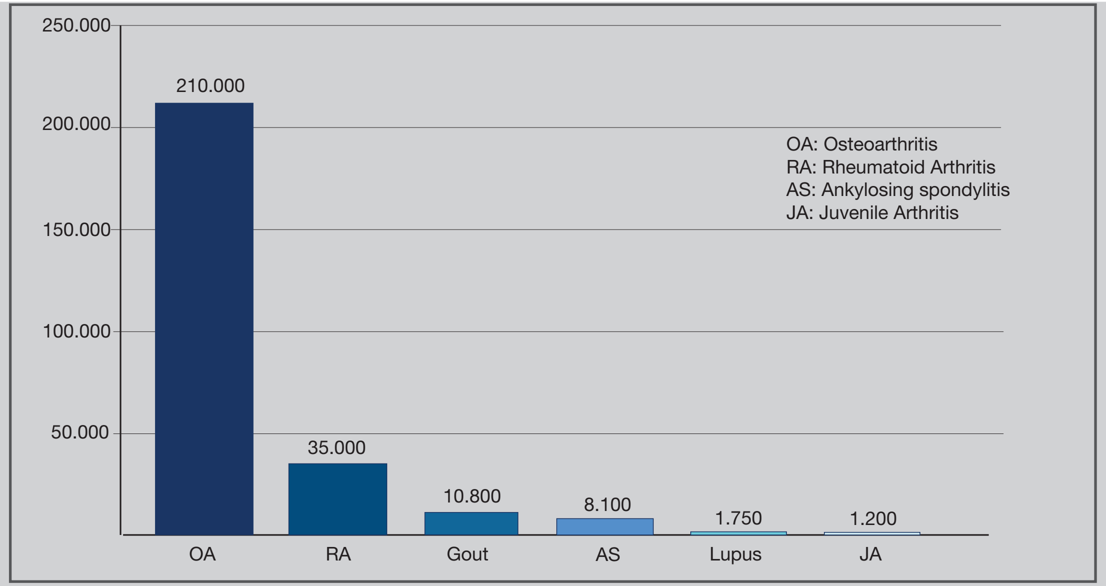
Causes of OA development

OA can be differentiates in two types: primary and secondary.

The primary OA is related to aging. It is more common to contract OA as our age increases, since is a disease that results from wear and tear. But is not a disease that affects only those considered elderly (age 65+ in most developed countries); the incidence of osteoarthritis increases after age 40 in women and after age 50 in men. More women than men develop osteoarthritis, particularly OA of the hand and, in a minor extent, OA of the knee.

Secondary OA is derived from other diseases or factors, such us:

- Overweight. Increases the chances to develop OA because more stress is applied in the weight-bearing joints. After aging, is the most common factor for OA of the knees.
- Previous injuries near a joint. The chance to have OA in that joint increases, as the joint is weakened.
- Overuse of joints. This might be consequence of having a job that requires repetitive movements, since wearing out is accelerated.
- Inheriting a defective cartilage. People born with joint abnormalities have also more chances to develop OA, caused by early degeneration and loss of joint cartilage (www.pdrhealth.com).



Ill. 04. Chart showing the amount of people affected by different arthritis types in Denmark (www. gigtforeningenB, C, D, E, F & G).

Rheumatoid Arthritis (RA)

RA differs mainly from osteoarthritis in the cause of it. It is not an effect of wear and tear, it is referred as an autoimmune disease because RA is a consequence of having a defective immune system. The failure consists on, being its function to protect the body from foreign threaths, attacks the healthy tissue confusing it with an invader.

The disease progresses in three stages. The first stage is the inflammation of the synovial membrane (ill. 03), causing pain, warmth, stiffness, redness and swelling around the joint. The second is growth of cells, which causes the synovial membrane to thicken. In the third stage, the inflamed cells release enzymes that may dissolve bone and cartilage, causing deformation of the joint and, consequently, more pain and loss of movement (www.livestrong.com).

RA is a symmetric disorder, which means that if the right wrist is affected, the left one will be affected too. It can arise in any joint of the body, but commonly begins in the smaller joints of the fingers, hands and wrists (www.metrohealth.org).

Causes of RA development

The cause for contracting RA is unknown. There are different hypothesis: external infectious agents, genetics, infections, environmental factors... However, any of them has been proved to be real (www.metrohealth.org).

Age prevalence

Rheumatoid arthritis can affect anyone, even children; however, usually occurs between age 30 and 50. 70% of people having RA are women, but men tend to be more severely affected when they get it (www.metrohealth.org).

Primary symptoms

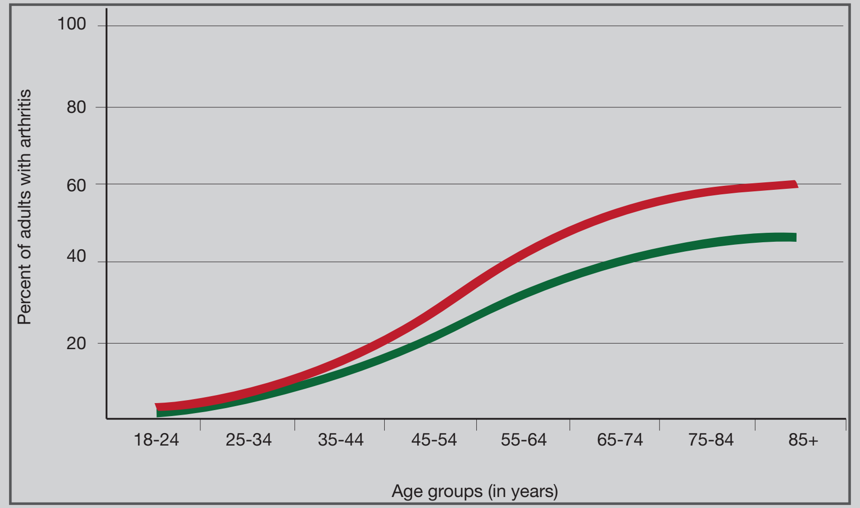
The symptoms of rheumatoid arthritis come and go, depending on the tissue inflammation degree. When the body tissues are inflamed, the disease is active. When the tissue inflammation subsides, spontaneously or by treatment, the disease is inactive.

Joint inflammation is the primary symptom of RA, which, in turn, creates joint stiffness, limiting motion, and pain. The swelling inside the joint makes it sensitive and tender.

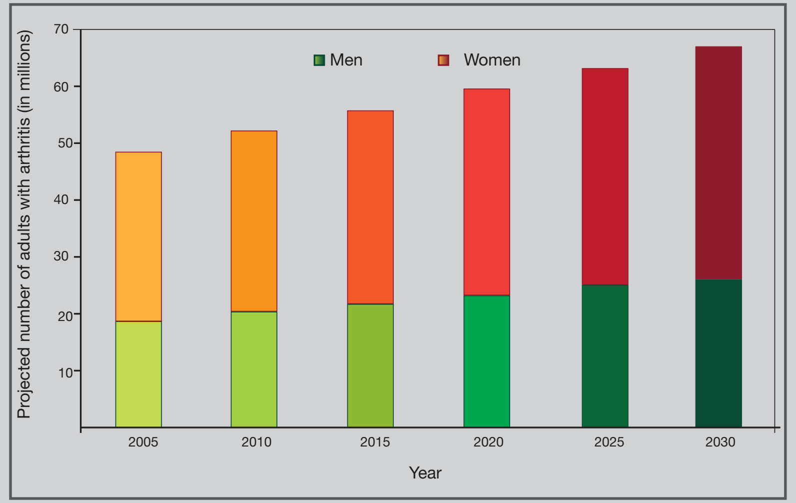
The joints also might be warmer and more pink or red than the skin around.

Fatigue, energy loss, lack of appetite and low-grade fever are also RA symptoms (www.metrohealth.org).

Ill. 05. Chart showing the prevalence of adults with arthritis in the US, according to age and gender.



Ill. 06. Arthritis development in the next twenty years.



Scale of the Problem

The data in this section belongs to United States inhabitants and it was gathered between the years 2002 and 2005. It is considered beneficial because provides awareness of the considerable prevalence of arthritis this days and how is going to evolve on time. The arthritis percentage is higher in the United States than in Denmark, possibly influenced by the generally unhealthier lifestyle of the first ones. However, arthritis is also a common illness in Denmark, the difference between both countries being low: 17% vs. 14%. So, is interesting to contemplate this data as reference, as it helps comprehending the scale of the problem.

Influence of age and gender

52 million people suffer arthritis in the U.S.A., which represents around the 17% of the population. As mentioned previously, the predominance increases with age and this increment is higher in women than in men (ill. 05).

Evolution

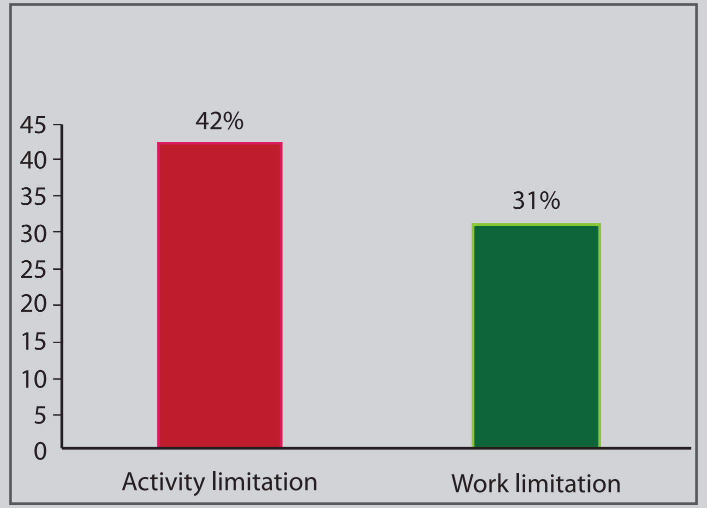
The data according to the development of arthritis is quite scary. From the 52 millions at 2010, to the 67 millions at 2030, that means an increment of the 28.8% (ill. 06).

Lifestyle Effects

The impact that arthritis has in the daily life, depends on the type of arthritis and severity of it. According to the The National Health Interview Survey (NHIS) from the United States, 42.4% (21.1 million) of the 50 million adults with doctor-diagnosed arthritis in the USA, report limitations in their usual activities due to arthritis (ill. 07).

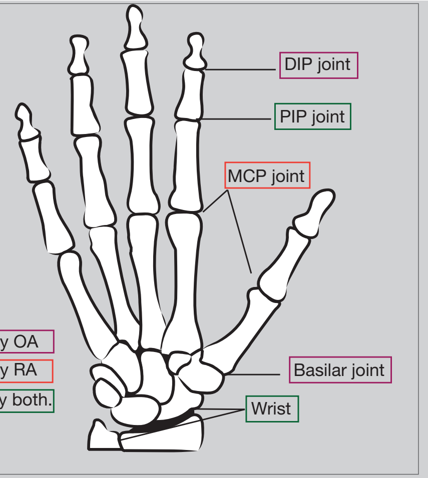
The limitations can go from having problems grasping things caused by arthritis of the hand, to stand up from a chair because of damaged knees. The illustration 08 shows limitations defined as "very difficult" or "cannot do" by the interviewed for the following activities: grasp small objects; reach above ones head; sit more than 2 hours; lift or carry 10 pounds; climb a flight of stairs; push a heavy object; walk a 1/4 mile; stand more than 2 hours; stoop, bend, or kneel (www.cdc.govB).

Ill. 07. Activity and work limitation due to arthritis in the US.



Ill. 08. Number of adults -in millions- in the US that reported limitations in specific functional activities in 2002.

Arthritis of the Hand and Wrist



Ill. 09. Joints affected by OA and RA in the hand.

Ill. 10. Activities where the joints of the hand are involved. From top to bottom and left to right: write, pinch, turn, grip, again grip and lift).

This chapter contains information the effect arthritis has in the main parts of the body involved in cooking: the hand and wrist. As mentioned in the previous chapter, the joints in the hand and wrist are usual targets of osteoarthritis and rheumatoid arthritis.

The repercussion of arthritis in hands and wrists varies from one person to another. Some patients do not have a high level of discomfort and do not experience big changes in their daily life, while others suffer severe pain and loose motor skills; the ability to perform everyday simple tasks, such as opening jars, griping objects or lifting pots can become difficult or even impossible.

Affected joints in the hand

Both Osteoarthritis and Rheumatoid Arthritis affect the fingers' and wrist's joints, but the joints that, usually, each of the types damages vary.

Osteoarthritis mostly develops in three places (Ill. 09):

- At the base of the thumb, where the thumb meets the wrist (the trapezio-metacarpal, or basilar, joint). The thumb provides the ability to pinch in multiple positions. Tip pinch describes the ability to grasp an object between the tip of the thumb and another fingertip, most commonly the index finger. This is used when writing or picking up objects, for example. The thumb is also used to hold an object between the thumb and the side of the hand. This pinch is required for turning, like holding and turning a key, for example.
- At the joint at the end of the finger, closest to the finger tip (the distal interphalangeal or DIP joint).
- At the middle joint of the finger (the proximal interphalangeal or PIP joint). The DIP and PIP joints allow the fingers to bend and straighten. They are used to grasp and any object, working together with the MCP. The PIP and MCP are under more stress when grasping than the DIP, the DIP takes part when the object is large.
- At the wrist. The wrist allows the motion of the hand, turning, flexing or stretching and bending to the sides. At the same time, it has to provide strength for griping and lifting or moving heavy objects.

(www.ehow.com, www.assh.orgA).

On the other hand, Rheumatoid Arthritis arises in (ill. 09):

- At the wrist.
- At the joints between the hand and the bottom of each finger, commonly referred us knuckles (metacarpophalangeal joints or MCP). These joints bend and straighten, which allows a person to hold different objects, like a glass when drinking or the phone when we are talking. The MCP joints work together with other finger joints to make a tight fist.
- At the middle joint of the finger (the proximal interphalangeal or PIP joint)

(www.ehow.com, www.assh.orgB)

Symptoms

Stiffness, swelling, and pain are symptoms common to every form of arthritis in the hand and wrist.

With osteoarthritis, bony nodules may grow at the middle and at the end-joints of the finger (PIP and DIP). The joint at the base of the thumb is, usually, hardly affected by OA, originating a deep, aching pain. A bump can appear at the joint between the base of the thumb and the wrist. Grip and pinch strength may decrease.

The same symptoms -pain, swelling, stiffness, and weakness- are also seen with osteoarthritis of the wrist (www.assh.orgA).

Regarding Rheumatoid Arthritis, the symptoms above are also consequence of this arthritis type. Plus, there are some symptoms that are classic features of rheumatoid arthritis, like nodules and deformity of the hands. Prominent bones in the wrist might appear. Furthermore, RA patients often suffer numbness and tingling in their hand because the swelling of the tendons causes pressure on the nerves. They may make cracking sound as they move joints (crepitus) and sometimes the joints snap or lock because of the swelling (www.assh.orgB).

Treatment

The treatment of arthritic hands and wrists varies depending on the severity of the symptoms.

Resting an affected joint will decrease symptoms and slow down he progression. This means that, if a certain activity cause overuse of the joint, it might be necessary to stop doing it, modify the way to do it or delegate it to another person. It is hard to assume that we are not able to perform an activity that we have done all our life anymore but, if the joints are forced, inflammation and joint wear can be increased.

Splints are effective to prevent movement when the joints are stressed. However, some joints are hard to immobilize without compromising significantly the range of motion and, once more, limiting the autonomy.

There are many aids to help arthritic people in everyday life tasks as opening lids and jars or cutting. These products are analyzed in chapter *Exclusive Market for Arthritis Sufferers*, page 22.

Physiotherapy is not as effective in the hand's joints as it is, for example, in the knee; the joints in the hand are not dependent on muscle tone for stability. Nevertheless, exercising the joints moderately and appropriately can improve the range of motion.

To relief the main symptom of OA, pain, medication is necessary often. Surgery is performed when the rest of the methods of relieving pain do not work (www.pncl.co.uk).

Recap

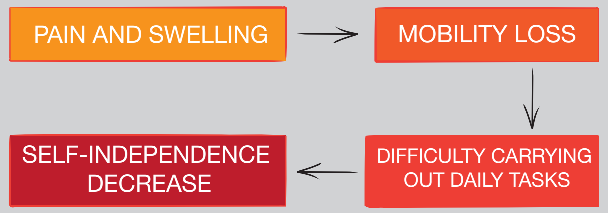
Arthritis is a disease that strikes quite strongly the population, specially the middle adults (40-65) and elderly (65+), which are a high percentage of it and will be higher on time.

Arthritis is a painful disease that bounds the range of motion and diminishes strength. This represent a cut down to self sufficiency, as every day tasks become tougher. Hands are affected harshly by arthritis,and loosing hand function means loosing capacity for essential daily living activities, work duties and leisure activities.

Is a natural process to stop being able to do certain activities as we get old. But, when this activities involve basic daily tasks for self-care, becomes hard to accept and lows down self-confidence and self-esteem level.

Furthermore, arthritis can appear at any age, and the earlier it comes the less prepared we are for finding difficulties performing every day simple actions.

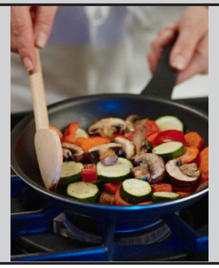
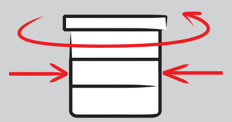
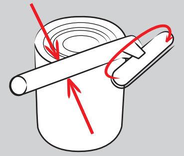
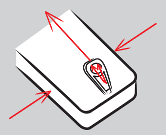
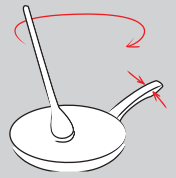
An important fact to bear in mind during the design process, is that the pain increases with the overuse of the joints, and the arthritis can get worse. During the use of the product, bending and stretching the fingers should be avoided.

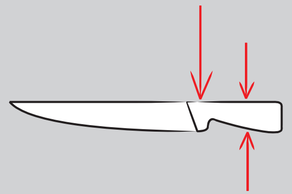
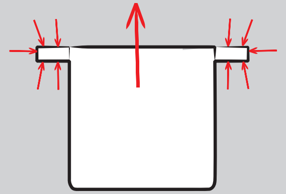
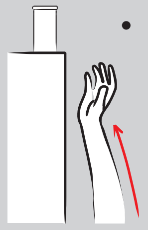
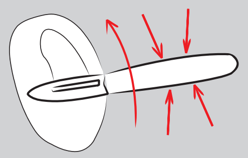


Ill. 11. Illustration showing the consequences of arthritis symptoms.

Looking for Design Possibilities

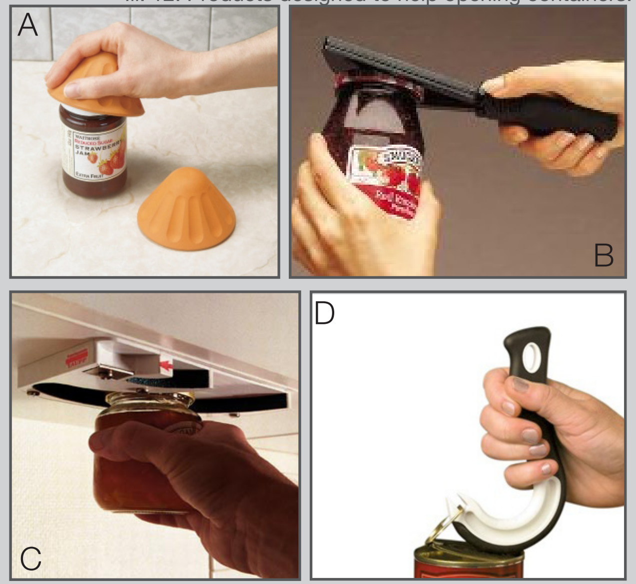
The different actions that are carried out cooking were listed and analyzed, in order to find the possible directions that the project could take. The activities analyzed are involved in daily cooking, since the purpose was to solve a problem that presents frequently when preparing meals.
In this chapter is shown a chart gathering the analyzed aspects, which are: the movements that are made while carrying out each of the actions, the joints involved on it and, finally, the problems that arthritis sufferers meet while doing them.
The understanding of this problems was achieved by interviewing arthritis sufferers and reading articles about arthritis in relation with cooking. To get more awareness of the difficulties they face, it was important to keep thinking while I was cooking and using different kitchen utensils, how it must be to accomplish those actions without having a good manual dexterity. These thoughts were brought to the interviews with arthritis patients.

	Open containers			Stir
ACTION				
MOVEMENTS	• Grasp • Twist 	• Grasp • Twist 	• Grasp • Pull 	• Grasp • Rotate 
JOINTS INVOLVED	• Fingers, specially thumb • Wrist	• Fingers, specially thumb • Wrist	• Fingers • Wrist	• Fingers • Wrist
PROBLEMS	Opening a jar requires a high a amount of effort with both hands; one of the hands has to hold the container strongly, while the other twists the lid to open it, using mainly the thumb and wrist. Besides strength, manual dexterity is needed; the smaller the container is, the more precision is required grasping. Milk cartons, which have small lids, are particularly difficult for people suffering arthritis. The cans where a can needs to be pulled are also difficult to open for arthritic, people, due to the high accuracy is needed.			Stirring is an ample movement of the elbow and doesn't need a strong grip. Furthermore,the elbow is not affected by arthritis as fingers or wrists are, so this action is not supposed to be a problem.

Cut & chop	Move pots,pans and trays		Reach	Peel
				
• Grasp • Push 		• Grasp • Lift	 • Stretch	• Twist 
• Fingers • Wrist • Elbow		• Fingers • Wrist • Elbow	• Shoulder	• Wrist
Cutting requires high grasping effort, in a position where the wrist is under high stress. Repetitive up and down movements need to be done using the wrist, until the cutting is accomplished. Furthermore, not only the knife needs to be griped, also the food we are cutting. The smaller it is (e.g., garlic) the more accurate we need to be, both grasping and cutting.	When lifting a pan, the handles need to be gripped strongly. To make the gripping easier is important that the pots, pans and trays have big and comfortable handles. The wrists are the main joints making the effort of lifting. If the pot, pan or tray is very heavy, might be impossible to lift it for a person with very weakened joints.		If the movement of the shoulder is limited by arthritis, it gets difficult to reach shelves that are above our head. Besides, when the object is reached, lifting effort is required.	The wrist is constantly twisting while we are peeling. It is very important to have the right utensil that makes this easier, with a curved blade that turns following the shape of the food.

Exclusive Market for Arthritis Sufferers

Ill. 12. Products designed to help opening containers.



Ill. 13. Products designed for cutting.

A research on products developed for arthritis sufferers was carried out. The objective was to see existing solutions and how ergonomics and motion are approached.
This products specifically designed for arthritic people are not available in current kitchenware shops and supermarkets, they have to be bought online at special sites directed to arthritis patients or contacting a local distributor. The products shown in this chapter can be found in online shops like *www.arthritissupplies.com* or in the catalogue provided by a interviewed local distributor, belonging to the international brand *Etac*.

The products have been classified according to the problem they solve. The parameters considered in the analysis were the motion that requires the tool, the shape of it and the material. This aspects were analyzed in each product-area.

Jar and can openers.

A typical example of openers in the market are rubber utensils that surround the lid (ill. 12, A), making the twist easier because the gripping surface is wider and the material more rough. Also utensils that take the pressure out from the jar (ill. 12, B), easing the turning of the lid. Mounted openers (ill. 12, C) allow to the user to open the jar using only one hand, with the inconvenience of having it outside all the time. It can be set up on walls, work tops or under tables. The last example (ill. 12, D) helps pulling rings of the cans so the movement that needs to be done is not that narrow.
Rubber is used both for holding the lid and in the handles, for an easier grip.

Knifes, boards and other cutting utensils

The knifes with the handle at a distance of 90º from the saw (ill. 13, A and C), dispose the hand and wrist in a stress-free position. Furthermore, they have big and ergonomic handles to make the grip easier. This knife are not exclusive for the arthritis market anymore, they are sold in many common shops. Ikea has a bread knife that follows this shape.
Coming back to the products specialized in arthritis, we can also find cutting boards where the food can be fixed, so only one hand is needed for cutting (ill. 13, B). Scissor with a spring integrated (ill. 13, D), makes the scissor open automatically, saving this movement.
Another common characteristic that can be perceived, generally, in products for arthritis is that the number of interactions that the user needs to do aimed to be reduced. Save grasping the jar to open it, the food when cutting it, or opening the scissors.

Kettles and mugs that are easier to lift

The structure supporting the kettle facilitates pouring the beverage inside, since instead of lifting and turning the kettle, we only have to turn it (ill. 14). There are also different kind of mugs with handles designed to low down the stress of the hand and wrist when lifting (ill. 14).

Peelers

The two examples show, again, the principal of saving the effort of one of the hands (ill. 15). Furthermore, the second example transforms the peeling movement in a broad movement, reducing the accuracy and manual dexterity level required. However, this implies the big increment of the dimensions from an usual peeler.

Other products related to the kitchen

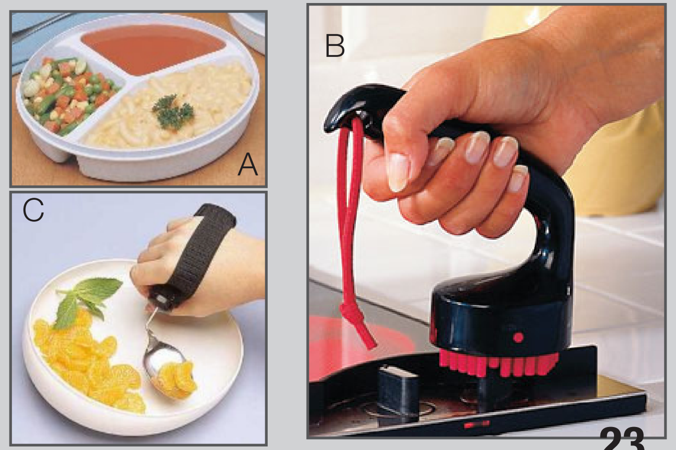
Adapted eating utensils and plates are also a common product in arthritis supplies. The plates have high edges, so gathering the food becomes easier (ill. 16, A). The eating utensils are bent, so there is no need of bending the wrist to put the food in the mouth (ill. 16, B). The last example is an utensil that helps turning the stove, door handles, water taps, etc., by adapting the shape to what is required (ill. 16, C).

Functional, but not attractive

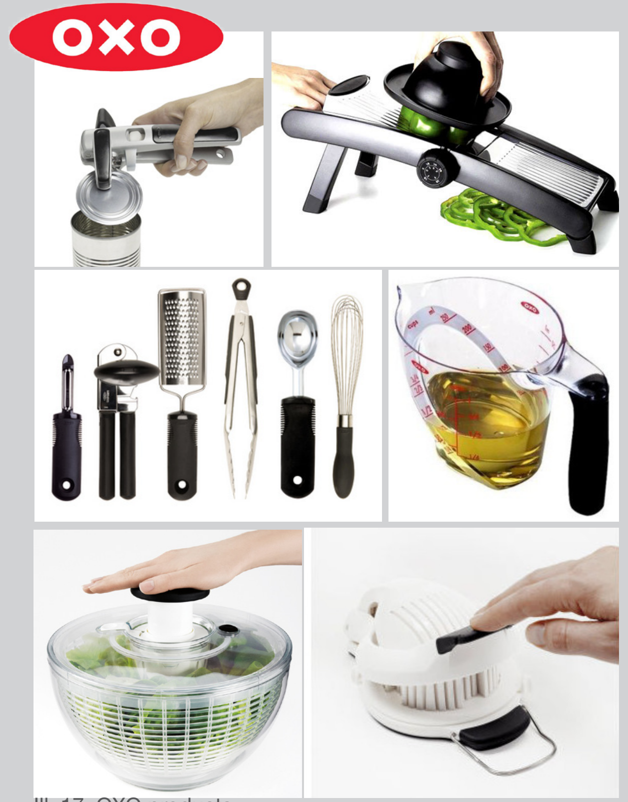
The products shown in this chapter are examples of ergonomic design, they have big grips, with handles meant to be comfortable to hold and manipulate and non-slippery materials. They can make easier the daily life in the kitchen, since they reduce the stress that needs to be applied and the accuracy of the movements; not only for a person that has arthritis, some of the products in this chapter can also be helpful for a person with healthy hands. However, the lack of considerations in aesthetics, makes them exclusive for arthritic people. They are designed for disabled people, and they look like it. People that does not have problems in their hands and/or wrists are not even going to consider buying them, because of their orthopedic look. Besides, they are not easily accessible products.
This market is inspiring regarding functionality and comfort for the user, but the aesthetics need to be approached in a completely different way. They need to be in harmony with the kitchen and the rest of the utensils in it. Arthritis people should not feel disabled because they need to buy special products that look so unappealing. Additionally, increasing the aesthetic value, a broader area of consumers is reached.

Ill. 14. Products that are easier to lift.

Ill. 15. Peelers with the food fixed.



Ill. 16. Products that help in different aspects.



Ill. 17. OXO products.

Ill. 18. Rösle products.

Ill. 19. JosephJoseph products.

Inclusive Design

Inclusive design -universal design in American English- is the type of design that adapts to a board and diverse range of users. Products, services or buildings grounded on inclusive design are usable for people of all ages and abilities, therefore are more universal. Consequently, there is no need of special or adapted products for older or disabled people.

Next, principles that inclusive design should follow are listed, developed by the *Center for Universal Design*:

- **Equitable use**. The design has to be useful for people with diverse abilities.
- **Flexibility in use**. The design has to be suitable for a wide range of individual preferences and abilities.
- **Simple and intuitive to use**. The design has to be easy to understand, regardless of the user's experience, knowledge or skills.
- **Perceptible information.** The design communicates the necessary information to the user in an effective way, despite the user's sensory abilities.
- **Tolerance for error.** The design has to have minimal adverse consequences after accidental or unintended actions.
- **Low physical effort**. The design can be used efficiently and effectively applying minimum strength.
- **Size and space for approach and use.** Appropriate size and space have to be provided according to approach, reach, manipulation and use, being able to adapt to different users' body size, posture or mobility.

(Clarkson, Keates, Coleman and Lebbon, 2003)

In this chapter brands that design kitchenware conforming to inclusive design are presented; examples of products that I consider good example of design for the whole population and have inspired me. To see products and companies that design universally in other areas than kitchenware, see Appendix 3.

OXO, United States

The company founder, Sam Farber, launched the current universal design strategy after watching his wife, who had severe arthritis in her hands, struggling to peel a potato. Their *Good Grips* product line offers a broad range of kitchen utensils with the mission of adapting to as many user types as possible. Examples of their universally designed products are, according to the company, the salad spinner that requires the use of only one hand, liquid measuring cups that can be read from above and tools with pressure absorbing and non-slip handles that make them more efficient (www.oxo.com).

Rösle, Germany

Rösle considers ease and ergonomic utility as top priorities in their designs. One of their style characteristic is the use of stainless steel as main material in their products, providing them with a robust and resistant but, at the same time, elegant look (ill. 19).

JosephJoseph

JosephJoseph are excellent solving problems in a technically and aesthetically simple way. Having simple features, their products make daily cooking easier. Regarding the style of the products, their use vivid colors and rubbery materials to provide them with a playful aesthetic.

Fiskars, Finland

According to Fiskars, Great design combines beauty, form, and function. They are focused on understanding the user and they say this helps them to develop solutions offer more and are easy to use.

Besides the home, they are also focused on the garden and outdoor activities like fishing and hunting (www.fiskarsgroup.com). Their products can be recognizable due to their ergonomic and sporty look.

Alessi, Italy

Alessi's mission is to transform a gadget in an opportunity for consumer to improve their perception of the world (www.alessi.com). To reach this goal, they are very focused on the style of the products, making their designs playful, funny and catchy. But they are not only centred in the outer look of the product, they also improve the user's experience providing their products with functionality, simplicity on the use and comfort. Examples of this are: the bottle opener that removes the caps pushing it, a table vacuum with an ergonomic and big handle and a whipping bawl with two compartments.

Lékué, Spain

Lékué's challenge is to surprise the user and facilitate them a greater enjoyment of their homes. To reach that goal, they keep a close relationship with their end users and with the professionals of the industry sector, in order to innovate constantly in materials and design. They want their products to stand out because of their attractive look, ergonomic and usability (www.lekue.es).

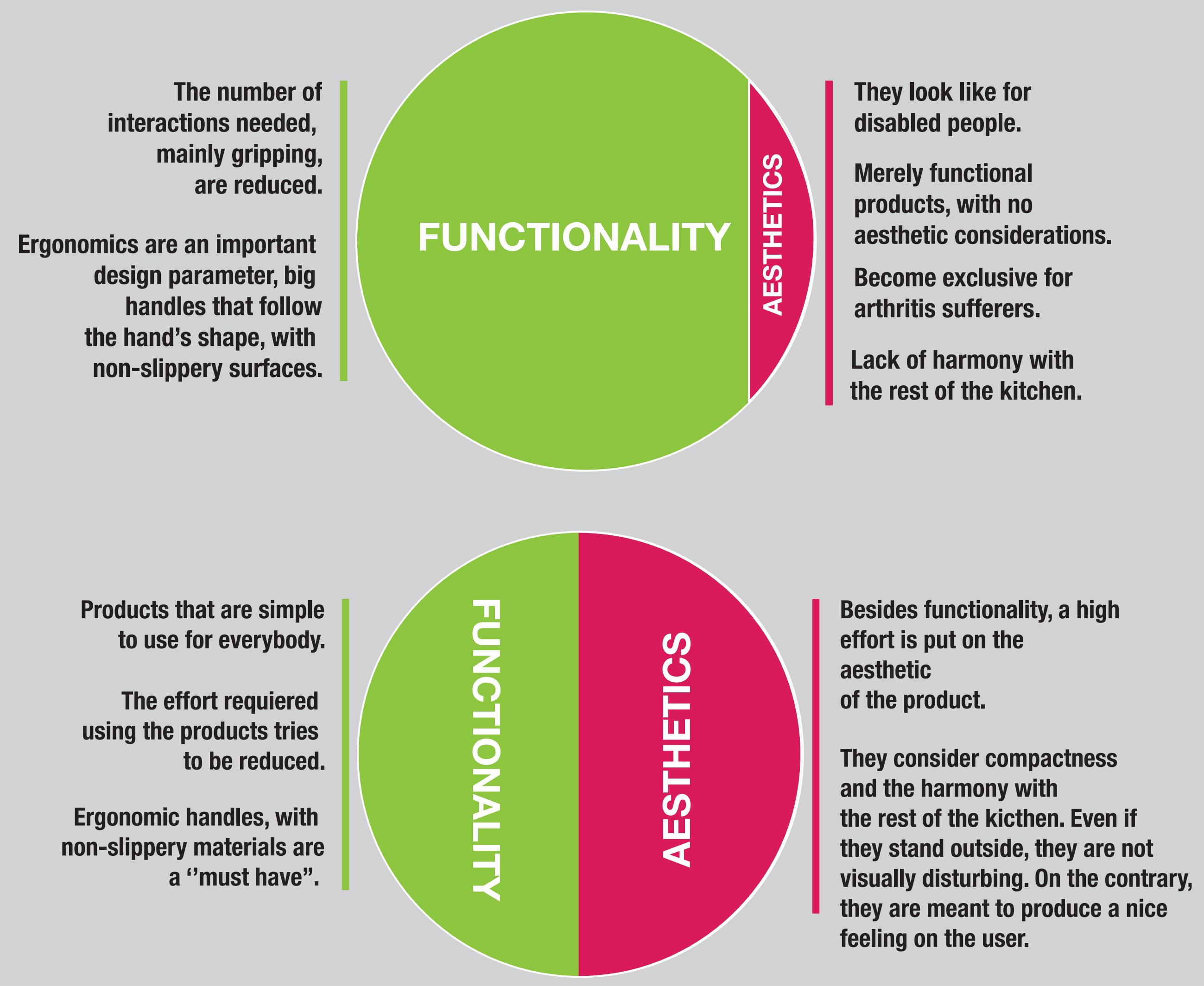
The use of rubber as their main material and the colorful products make their products look like toys rather than tools, making them very inviting to try out.

Ill. 20. Fiskars products.

Ill. 21. Alessi products.

Ill. 22. Lékué products.

Design for Arthritis Market vs. Inclusive Design



Ill. 23. Chart comparing the exclusive market for arthritis with the inclusive market.

The goal of the project is to brand the product inside the inclusive design market, directing it to the broadest are of users as possible. The exclusive market for arthritic people is also going to be considered, since the products are specially designed for them and are very focused on functionality, so they fulfill the requirements to be used by an arthritic person. The products shown in the previous chapter, are ergonomic, functional and handy, but not all of them could be used by a person suffering severe arthritis. To make real universal design, the functionality and interaction with the product will be defined considering the worse case scenario, which is a person with very reduced hand mobility. To design the functionality and interaction, inspiration will be found in both markets, the exclusive market for arthritis sufferers and the inclusive market. To define the aesthetics of the product, the products for arthritic people will be left apart and focus on the international brands that design inclusively, like the ones in the previous chapter, and other companies that also care about integrating ergonomics on their products (Appendix 4). Because, what makes a product universal, is not only the fact that is useful for a broad area of consumers, is also about pleasing the aesthetic taste of them.

General Parameters for Ergonomic Design

The main ergonomic principle is that the system, product, or else we are designing has to be designed in a way that is suited to every user. So, in order to design a universal product, is essential to follow the ergonomic principals. Examples of user groups that require additional attention, are short or tall people, overweight people, handicapped, elderly, young and pregnant woman. In this project this special attention has been focused on people suffering arthritis (Dul, Weerdmeester, 2008).

Ergonomics involve a large number of factors, not only body posture and movement, but environmental factors (noise, illumination, climate...), information and operation (controls, visual information, relation between displays and control...), as well as work organization (appropriate tasks) (Dul, Weerdmeester, 2008). In this project the focus has been the body posture, precisely the hand and wrist posture.

Posture and movement

Certain postures and movements produce local stress in the muscles and joints. To avoid this postures, some general guidelines were noted, such as:

Biomechanically:

Joints must be in a neutral position when maintaining a posture or making a movement. In this position, the muscles and ligaments that extend around the joints are stretched the least as possible and, therefore, are under less stress. In addition, the muscles are able to apply the maximum force possible.

Raised arms, bent wrists, turned head and, consequently, bent neck, and bent and twisted trunk are examples of poor postures where the joints are not in a neutral position (Dul, Weerdmeester, 2008).

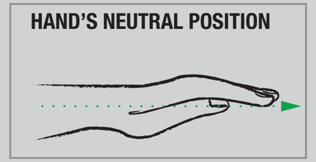
Anthropometrically:

Differences in body sizes of the users must be taken into account. Depending on what is being designing, a certain type of user must be considered. For example, choosing a door height, the tall users are the ones that must determine it (Dul, Weerdmeester, 2008).

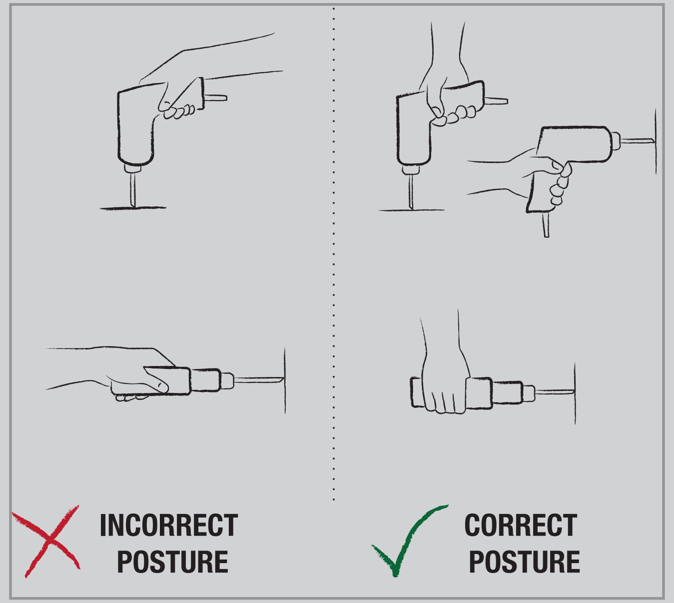
Hand and arm postures

General guidelines to design an ergonomic tool were listed:

- The tool has to allow to keep the joints in a neutral position as much as possible. Ill. 25 shows the correct and incorrect uses of tools.
- Instead of bending the wrist, curved the handle of the tool (ill. 26).
- The tools must not be too heavy, not exceeding the two kilograms.
- The shape and location of hand grips must take into consideration the position of the hands and arms.
- Avoid carrying out tasks above shoulder level (Dul, Weerdmeester, 2008).

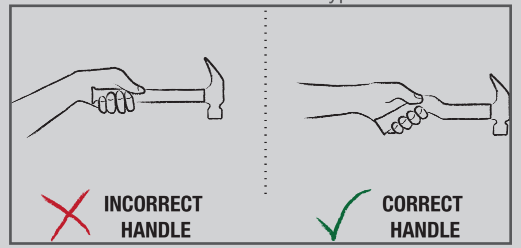


Ill. 24. Neutral position of the hand.



Ill. 25. Correct and incorrect positions of the hand holding a tool.

Ill. 26. Correct and incorrect types of handles.



Interviews with Arthritis Sufferers

Four arthritis patients were interviewed, with two goals: on one hand, have a better understanding of the disease having a personal contact with people suffering it; on the other, find out what they need in order to improve their cooking experiences.
This chapter contains a description of the participants of the interviews and the procedure followed, and a summary of the results.

Participants

Margrit, Inge-Lise, Rud and Rudy

First contact: meeting Margrit and Inge-Lise

Margrit and Inge-Lise assist to the Activity Center Grønlands Torv in Aalborg. After contacting the coordinator of the center and explained what I was doing, Margrit and Inge-Lise offered to help me.
At the interviews were referred general aspects about their disease, the troubles they find cooking and the utensils they use to cook. It turned to be that this first short contact provided me many valuable information and a possible direction to follow.

Margrit, 67; Rheumatoid Arthritis

The articulations in Margrit's hand are deformed, and she can barely move her fingers. Her wrists are also damaged, and she wears bracers to hold them still.
As soon as we started talking about cooking, she mentioned the ''great knife" she has, which finds so comfortable to use. This knife has a 90º angle between the handle and the saw. The handle is big and she doesn't have to make a big effort to grasp it; her hand and wrist are in comfortable position. Next, she only needs to move the elbow back and forward, what makes with ease. She holds the food with a fork while she is cutting.
The most difficult action for her is to carry out twisting movements. Grasping a bottle or a jar and turning the lid to open it is extremely difficult for her. When the lid is small, like in the milk carton or in her pill containers, is even impossible.

"I use my teeth to open to open the milk cartons, I can not do it with my fingers. And I have to ask to the nurses to open the pills' bottles."

Inge-Lise, Osteoarthritis

Inge-Lise had surgery in her hands because of the severity of the osteoarthritis she has. To relieve the pain and avoid further deformation. She has metals in the finger joints, and the joint that connects the thumb and the wrist was extracted. After the operation, her fingers are stiffer and she doesn't have any control of the thumb.
Inge-Lise has the same knife than Margrit and also thinks is really helpful.
She also finds many troubles opening jars and bottles. She uses a nut cracker to open bottles and milk cartons.

The first contact with Margrit and Inge-Lise, conditioned the focus of the next four interviews to research if the problem with opening jars and bottles was as big as it seemed to be after the meeting.

Ill. 27. Participants on the interviews.

Procedure of the next interviews

The next interviews are held in the *Gigt Center* from Aalborg, and the interviewed persons are two of the coordinators at this center, Rud and Rudy. Rudy is also distributor of arthritis products, and after the interviews very gently showed me the products that he sells.
This interviews were held in a more dynamic way, since the time planned for them was longer and the findings from the previous interviews was used.
The interviews started with general questions about the disease: kind of arthritis, how long did they have it, if they cook, if they use special products for it, etc. After, pictures of different moments cooking were shown, and they had to put them in order according to the difficulty they entail to them.
As in the two pervious interviews the difficulty to open containers was expressed so clearly, different openers bought in current shops were brought to the interview, so Rud and Rudy could try them out and give their opinions. The openers brought to the interview were "Multi Grip bottle opener", "Cap Gripper" and "Jarkey", from the brand Brix, and the rubber surface opener (Chapter Openers in the Market, page 31).

Summary of the interviews

Rud

The symptoms of RA that Rud used to suffer have decreased a lot since she takes biological medicine (injections). The pain, swelling and the stiffness she suffered have been reduced significantly.
"Before, I didn't want to go out to eat. I felt so insecure about myself that I preferred to stay at home with anybody looking at me."

Unfortunately, this medicine is only effective in RA, not OA; and, even if it has improved considerably Rud's situation, she still faces limitations cooking. She doesn't have strength in her fingers. Consequently, the most difficult actions for her are to open jars and bottles, followed by lifting pots.
Cutting (with the special knife mentioned before) or stirring are not a problem for her, since are open movements of the elbow.

She only used one of the openers, the one that pulls the lid so the pressure comes out, and she succeeds opening the jar. The rest, she didn't even try, she said she had tried before and do not work for her.
"I know I can't use that, I don't have the strength to twist them."
Furthermore, she said she could not roll the small wheel

Ill. 28. Classification of cooking actions in order of difficulty according to the participants.

in the opener to adjust it to different lid sizes.

Rudy

Rudy also takes the biological medicines to relieve the RA he suffers.

Rudy likes cooking, but usually is his wife who cooks because is easier for her.
She agrees with Rud and lists twisting as the most difficult action for him, also followed by lifting pots.

“Many milk cartons end up in the floor because of the frustration that not being able to open them provokes me”.

He tries the openers I brought, which are meant to help twisting, but they do not work. He has the manual dexterity to adjust the band to the lid size, but not enough strength to open the lid. Then we find out that is not only because of the arthritis, my hands are healthy but I cannot open them either.
He brings his own openers from the suitcase, one similar to “Cap gripper” from Brix -instead of a rubber surface with teeth is a metallic flat surface (ill. 29)- and another one that is fixed to the table.
The problem with the first, like with the A product, is that it needs small movements that require dexterity to adjust the band to the lid, rolling a small wheel. “I can’t do that”, says Rud while Rudy is trying to adjust it.
The second product works very well, it is fixed to the table so only one hand is needed. Many products incorporate grooved surfaces in the rubber, it seems it ensures a better grip, but a flat rubber surface -like the one in this product-, works better.

“The teeth work only if they are the same size of the teeth on the lid, if not they stay on the top with no effect. Furthermore, they are not very hygienic.”

Track to follow: design a opener that works

The four interviewed persons have pointed out opening jars, bottles and cartons as a very difficult or impossible task for them, and even if they have tried out different assisting products, any of them works; except the stationary opener, which has to be fixed in the wall. From now on, the analysis is focused on finding out how to design an opener that works and belongs to the inclusive market.

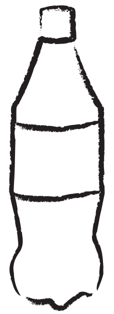
Ill. 29. Illustrations of the participants trying out the products.

Container types in the market

The different types in local supermarket where listed and measured (Appendix 5), in order to have a database ready for the concept development. It is believed that the ideal solution to the problem would be to design containers that are easy to open to everybody (Appendix 6), instead of having to design an utensil to open them. But since this is far from reality right now, and it does not seem to change in the early future, utensils to open them are needed.

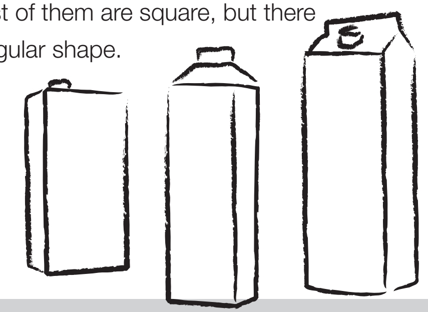
Bottle lids

Bottles have circular lids with grooves for better gripping. The way the lid is attached to the bottle is by small plastic flaps. When turning the lid, this flaps are broken and then the lid released.
The bottles screech as they get closer to the lid. At the base, the cut out of the shape is not a circle, they have prominences for a better support of the bottle.
The only exception I could find to the circular shape was the olive oil bottle, which is square.



Cartons

The lids in tetra-pack containers are disposed in two different ways: horizontally or in an angle of more-less 45º. Same than in the bottles, they have a grooved circular shape, and the way to attach them to the container is also but plastic flaps.
Regarding the profile, most of them are square, but there are tetra-pack with rectangular shape.



Jars

In jars the size of the lid has a high variation. The lid is adhered to the container by pressure. The high pressure between the lid and the jar creates a vacuum effect that makes the lid hard to unscrew.
Most of the profile shapes are circular, but polygonal shapes are also common in jam jars.

Ill. 30. Bottles, cartons and jars in the market.

Openers in the Market

A research on existing utensils designed to facilitate opening jars and bottles was done. The market analyzed was the inclusive market; products that are directed to the whole population and not specifically to arthritic people. The aids shown below can be found in current shops. The objective of the analysis was to see the different existing interactions to open jars and/or bottles in the market, to help figuring out what is missing or can be improved; also as source of inspiration to examine if some feature can be re-used.

Evaluation of products

Some of the products showed below -the ones inside the thick lined box- have been tested with the users. The rest have been evaluated according to online reviews of costumers combined with my criteria.

Electrical products

Only manual openers have been considered, leaving apart the electrical ones. Examples of electrical openers can be seen in Appendix 6. I did not involve electronics because this means:

- Higher price.
- Inconvenience for cleaning.
- Need for battery replacement (inconvenient action for people with arthritis).

KUHN RIKON SWITZERLAND

"THE GRIPPER"

Specifications

Open lids from 25 mm to 90 mm.

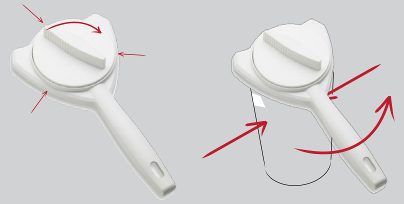
Price: 11 €, 85 .-

Dimensions: 24 x 15 x 5 cm

Opens

Jars, bottles and cartons.

Interaction



Similar products

RÖSLE

Evaluation The opener adjusts to a large range of caps and lids, which is very positive; however, the way to adjust it to different sizes, rotating the flap, requires an accurate movement which can be difficult to do for people with limited manual dexterity.

OXO

"JAR OPENER"

Specifications

Price: 7 €, 53.-

Dimensions: 23 x 12 x 2,5 cm

Opens

Jars, bottles and cartons.

Interaction

Similar products

Cuisipro.

Evaluation The non-slippery surface that the product includes reduces the amount of effort that is needed to grasp the jar. The lid is not fixed strongly, so it might slip.

BRIX

MULTI GRIP BOTTLE OPENER

Specifications

Price: 5 €, 40 .-

Dimensions: 8 x 7 x 3 cm

Opens

Bottles.

Interaction

Similar products

Evaluation

It did not work with the tested users. The utensil it small, so is not comfortable to handle for people worth arthritis. Furthermore, it does not adjust correctly to the lid. If the lid is small -like milk cartons- the opener collides with the carton before is adjusted to the right size, being useless

BRIX

CAP GRIPPER

Specifications

Price: 8 €, 60 .-

Dimensions: 20 x 4,8 x 2,4 cm

Opens

Jars, bottles and cartons.

Interaction

Similar products

Not found

Evaluation

To adjust the band to the lid, a small wheel needs to be scrolled. One of the users said that this was impossible for her, she could not make such a precise movement. The other user succeeded adjusting the opener, but was not able to open it; the strength he could apply was not enough. In this case, the problem was not only the arthritis, I did not succeed either.

BRIX

JARKEY

Specifications

Price: 5 €, 40 .-

Dimensions: 14 x 5 x 2,7 cm

Opens

Jars.

Interaction

Similar products

Evaluation

Both tested users succeeded opening the lid using this product. The disadvantage is that, as it works decreasing the pressure from the jar so the lid is released, it only works with jars and no with bottles or cartons. One of the interviewed users mentioned that she always ends up braking the handle.

“LID PUNCH”

Specifications
Price: 14 €, 105 .-

Dimensions: 21 x 15 x 10 cm

Opens
Jars.

Interaction

Similar products
Not found

Evaluation This opener approaches the problem in a different way, changing the turning by the pushing. It makes a hole in the jar to release the pressure, that later can be covered with magnets that came with it. The problem is that also works only for jars.

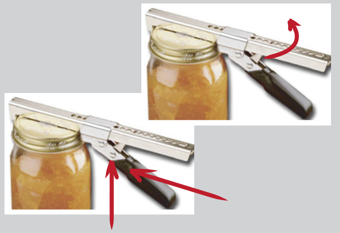
“SWING AWAY OPENER”

Specifications
Price: 10 €, 79 .-

Dimensions: 23 x 10 x 25 cm

Opens
Jars and bottles.

Interaction



Similar products
Not found

Evaluation The adjusting to the lid is done linearly and the handle is big, so it seems easier for people with limited manual dexterity to adjust the utensil to the lid. But the adjusting part is in the handle, so it becomes less efficient as the size of the lid increases.

RUBBER SURFACE

Specifications
Price: 3 €, 20 .-

Dimensions: ø 14 cm

Opens
Jars, bottles and cartons.

Interaction

Similar products
Not found

Evaluation The difference that this product makes is very small. Is less slippery because of the friction of the rubber, but still much strength needs to be applied if the lid is tight.

Evaluation summary

The solutions on the market do not solve the problem in integrity. The ways to adjust to different sizes require small and accurate movements, like Kuhn Rikon’s and Brix’s openers. OXO’s does not require precision adjusting, but the adjustment is not strong enough and the opener slips. The “Swing away opener” does not require high precision either, but the handle is not ergonomic and the lever decreases as the lid becomes smaller.

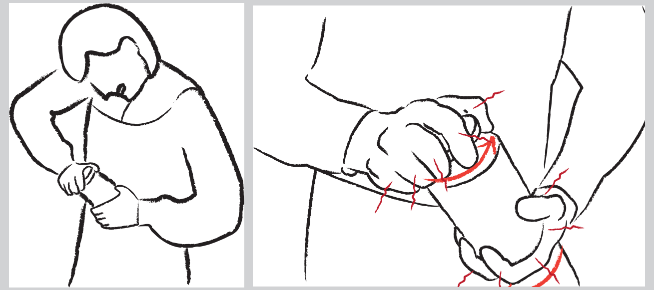
Most of the products require applying turning strength while griping the lid steadily. The exception are *Jarkey*, from *Brix*, and *Lid Punch*, which demand pulling and pushing movements, that are softer for the wrist. The problem with this products is, as they work decreasing the pressure level, that only work with jars, excluding bottles and cartons.

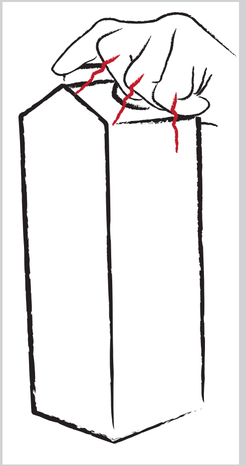
OXO’s opener integrates a rubber material rub, which makes the container to be more steady on the table. In the market for arthritic people, there can also be found this kind of rubs. The positive point about OXO’s rub is that is kept together with the opener, favouring compactness.

The solutions that work with jars, bottles and cartons (*The gripper*, *Jar opener* and *Cap Gripper*) require two kind of user interactions: the first one to adjust the utensil to the correct lid size, and the second to open the lid.

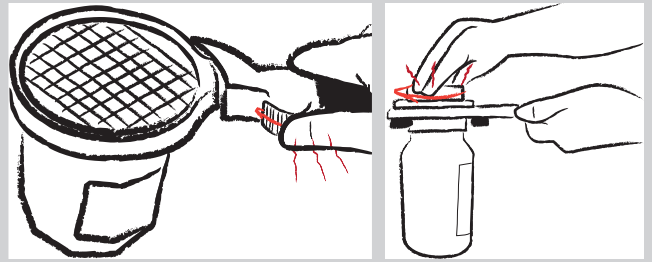
There are products -the first example in “similar products” for *Multi Grip Bottle Opener*, from *Brix*- that integrate a flange that helps opening the plastic that some cartons have underneath the lid. This is a good idea, since sometimes the work is not finished after unscrewing the lid; then we uncover the plastic that needs to be pulled. This is a really difficult task for people suffering arthritis, according to the interviews.

Summary of the analysis





Ill. 31. Opening a jar/bottle/carton requires a high amount of stress in both hands. One of the hands is holding the container tightly while the other is trying to turn the lid in the opposite direction. Besides strength in our fingers and wrists, it also requires manual dexterity when the lid is small and, with severe arthritis, the ability to make precise movement might be completely gone.



Ill. 32 The openers that adapt to different lid sizes, require accurate movements to carry out the adjustment that people suffering from severe arthritis are not able to do.

Arthritis is a disease that affects more than 300.000 million people worldwide, and, since is a disease that is more frequent in medium adults and elderly, due to the aging of the population the percentage of people suffering arthritis is going to grow on time.
There are many types of arthritis, but the two more common, and also the ones that affect the hand more severely, are Osteoarthritis and Rheumatoid Arthritis. The cause of them is different, but the symptoms are similar: pain and swelling, which cause mobility and manual dexterity loss, and, consequently, make daily life harder. Therefore, the arthritis patients lose their independence as they need to depend on somebody to do the tasks that they cannot do.

There is a quite broad market directed exclusively to arthritis patients, with gadgets designed to make them able to carry out the actions that are difficult for them due to arthritis. This products are merely functional, the aesthetics are not considered on the design. As a result, the products are ergonomic and usable, but non attractive, which is a important parameter in kitchenware design, since are utensils that are going to be standing out in the kitchen.
The design flow chosen in this project has been universal design, design for the whole population. The goal was set as design an utensil that is suitable for a person that has arthritis, but will also catch a person that does not because of its usability and appealing look.

After listing the different actions that are carried out while cooking, people having arthritis were interviewed and asked about what is the main difficulty for them. The four interviewed person consider opening jars as a very big challenge (ill. 31), and any of the utensils they have had satisfy them, so this interviews led to chose the design direction: design a kitchen utensil to make opening jars/bottles/cartons easier for people suffering arthritis, but also for people who does not and still has problems with it.

The types of bottles/jars/cartons in the market were analyzed, and the existing solutions in the market to help opening them. This solutions are not suitable for people suffering arthritis, since, the ones that can be adjusted to different lid sizes, require accurate movements for this adjustment (ill. 32). Furthermore, any of the products we can found in current shops solve the problem of the stress that suffers the hand holding the jar/bottle/carton.

Based on the research, the project track is defined:

Design a product meant to open jars, bottles and cartons, that is suitable for a person that has arthritis.

STRATEGY AND CONCEPT DEVELOPMENT

After defining the problem, a strategy about how to approach it was made. The design parameters than wanted to be fulfilled were listed and, then, the concept development started. In this chapter is described the strategy and the different concepts that were created and, finally, the one that was chosen to develop further on. The concept that was chosen at the beginning was not the final one, so this change of direction is also explained in this chapter.

Vision of new product

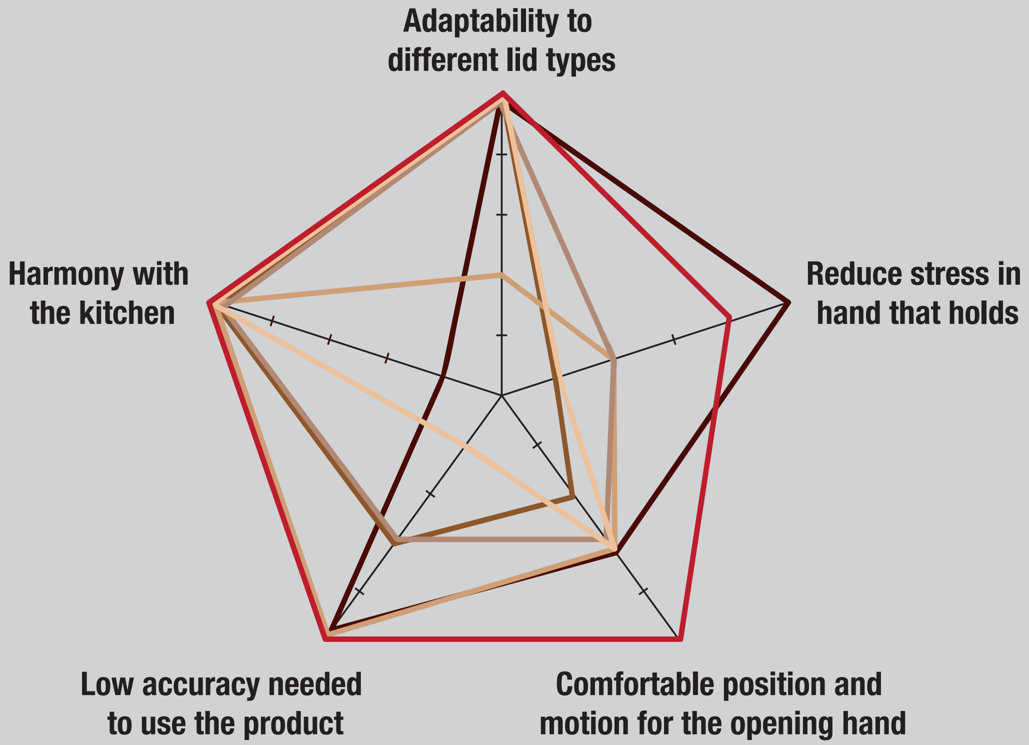
Important characteristics that the new product should fulfill were defined, which are:

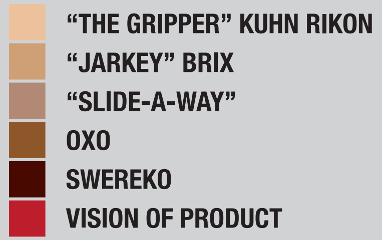
- Ability to adapt to different lid sizes and types: lids that are pressure sealed and plastic lids; regarding the diameter, a range that goes from 25 mm (milk cartons, for example) to 90 mm (jelly jars, for example).
- Reduce stress in the hand that holds the container.
- Ensure a comfortable position for the hand that opens the lid.
- Avoid accurate movements that require manual dexterity when using the opener, both when adjusting to the lid size and when opening it.
- Harmony with the rest of kitchen and the utensils in it. The new product does not have to take much room in the kitchen, becoming disturbing according to space and also visually.

This parameters were evaluated in five competitor products, and then a vision for how the new product should fulfil them was made (ill. 33).
"Reduce stress in the hand that holds" is considered a very important characteristic that the product should have, since the existing products do not solve this problem. The only one focused on this, is the wall-mounted solution -belonging to the market directed to arthritis-, which releases completely the effort that the holding hand has to made. However, compromises the aesthetics of the kitchen, since is an object that is always visible and is not attractive. Furthermore, it has an ergonomic negative aspect that is not reflected on the chart. If it is mounted next to the extractor hood, the user needs to rise the container above the shoulder level, which might be difficult with big and heavy jars, not only for a person that has arthritis but for a person that has not strong arms. It can also be placed under the table, but then there is no visual contact with the product and the container while we are opening the lid. Another option is to place it on the top of the table or the counter-top, but then is even more visible and takes usable space.
The reason why the new product was not rated with the maximum score was because if the stress from the gripping hand needs to be completely removed, the container needs to be fixed, so the product where the container needs to be placed has to be fixed. So the solution had to be focused on releasing as much stress as possible of the hand that holds the container, but without compromising the harmony with the rest of the kitchen. It turned out, that the final solution removes the stress completely and is not mounted in the kitchen.

Pricing

On a market where there is already a variety of openers and, besides, low-priced (see chapter *Openers in the Market*, page 32), it is essential to keep the price low. A strategic price is set for the product as 15€, approximately 100 Danish krone. If the price is higher than this, the target market will only become users that really need the product, letting out the consumers that the product will make life easier, but they can live without it. Furthermore, if the price is higher, the difference with the electrical products will be low, what might make consumers to buy an electrical opener instead. If the price is lower, the perception of the product will be that is a cheap non-effective and non-durable gadget, one more in the market that does not work as it should.





Ill. 33 Chart showing the vision of the new product comparing it with the competitors' products.

KHUN RIKON BRIX "SWING-A-WAY" OXO SWEREKO

Product Specifications

Ill. 34. The juice carton does not have plastic tabs, but a strap that is pulled when the lid is unscrewed. The yogurt carton does not have visible tabs, so is not possible to cut them.

Based on the design parameters that want to be fulfilled, the requirements that the product should have were set, in order to have a guideline for the concept development stage.
Some of the specifications were modified or added once the concept development started, after getting more awareness and knowledge about how to solve the problem.
The final product matches most of the set specifications, but not all of them. In order to make a realistic product that does not become too complex, is important to know what can be dispensable and leave it out.

Function to open the lid

The way lids are attached to the containers were analyzed. This analysis led to decide how was going to be approached opening a bottle: if the pressure inside the jars was going to be released, if the utensil was going to rotate the lid, or a new approach was going to be taken.

The vacuum effect

The high pressure inside the jars is what makes them hard to open. Because of the vacuum effect is created, there is a high friction between the lid and the jar, making the rotation of the lid difficult. When the pressure inside is released, the lid is not tight anymore -unless it is sticky because of the content of the jar-.
Focusing only on releasing the pressure from inside the container, the problem to open bottles and cartons is not solved. Thus, designing a product on this direction is ruled out.

Plastic tabs in bottles

Regarding bottles, the main difficulty is to pull apart the plastic tabs joining together the lid and the ring around the bottle neck.
One of the suggestion at Status Seminar was to consider designing an utensil that brakes the plastic tabs. Who has not used a knife to cut them when it was difficult to open the bottle? However, not all the bottles have exposed plastic tabs, having them beneath the lid. Furthermore, not all the bottles work with plastic tabs, exist more packaging solutions (ill. 34). So, focusing only on pulling apart the plastic tabs, the product would be limited to bottles of a certain kind -with visible plastic tabs- which is not considered enough. Furthermore, the jars would be completely out.

Rotating solution

If the solution is based on rotating the lid, cartons, bottles and jars will be included. Therefore, the utensil is not going to be limited to a specific container type, which is an important goal to achieve. Besides adapting to all lid types, it has to adapt to a broad range of lid sizes.

Lid sizes

Besides adapting to all kind of lids, it has to adjust to a broad range of sizes. After measuring many containers in the market (Appendix 4), the rank is set from 25 mm to 90 mm.

Interaction with the product

The amount of interactions needed to adjust the utensil to the lid and to open it have to be kept to the minimum. To open the lid, two must be the maximum: adjust and open. The ideal solution would be to make it both with the same interaction.
To carry out this interactions, accurate movements of the fingers have to be avoided. The motions need to be as wide as possible.
The solution needs to low down the strength applied by the hand that holds the container. The hand that opens the lid needs to be in a stress-free position.

Dimensions

Anthropomorphic data has to be used to define the dimensions of the utensils. The parts that the user needs to grasp have to be big enough to ensure comfort.
The solution needs to be as compact as possible, considering that has to be kept in a closet.

Materials

Plastic has to be the main material, because is economical and has low density (generally speaking about plastics), which will avoid the product to be heavy.
The parts in contact with the hand should be covered with a rubbery material, to make them non-slippery and secure good gripping.
Grooves should be avoided in the handles, since they make the product less hygienic. Yes, they help having a better grip, but a rubbery material itself make this function. The grooves do not improve that much the grip according to how dirty they get (Rud, 2009).

Appearance

The product must me self-explanatory, having a shape that suggests how to use it. It has to be shown clearly where needs to be held, using rubber in this parts is a good idea because it also makes the non-slippery function.
The shape needs to follow the function of the product. Keep it simple, following the form of the internal construction and styling it to make it appealing. No sharp edges and abrupt changes in the shape, the lines of the product need to be continuous.
The form, the colors and texture of the product have to be inviting, have to awaken the desire of using it.

Extra-features

The product could have an extra-feature that helps pulling can flaps. This will depend on the construction of the product, if it does not match with it and is not possible to add it in a simple way, then this option should be left away.

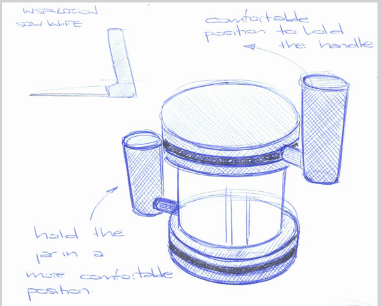
Electronics

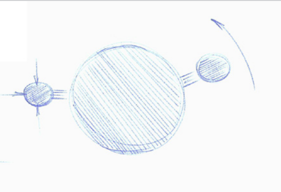
Designing an electrical product is not considered because this would leave the product price out of what is desired. Furthermore, involving electronics would add an-extra interaction: the battery changing or charging, which is not suitable for people having arthritis. Additionally, being a product that is used for opening food containers and will be standing on the kitchen, has to be cleaned, and adding electrical parts will make this more difficult.

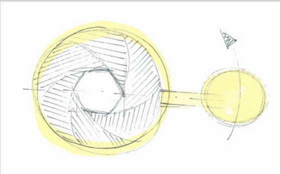
Sale-points

The product will be sold in home-ware and kitchenware shops and online.
It is easier to introduce the product into the market going through the market directed to arthritis, because the primary contact is already made. However, the product could jump to current shops once is inside the market.
The price should be between 10€ and 20€, 100.- and 150.- approximately.

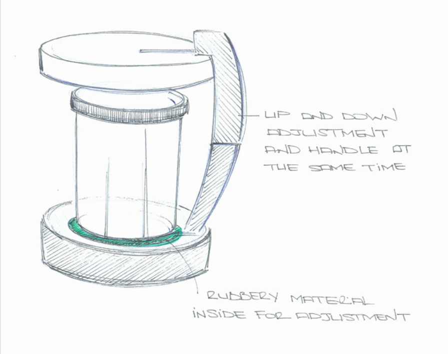
Exploring the Interaction with the Product





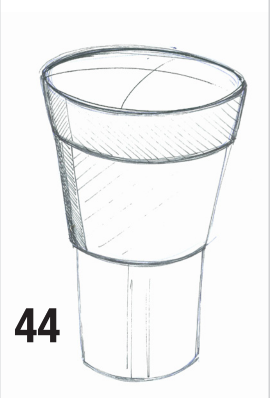


Ill. 35. Rotatory handle concept. Inspiration, concept and adjusting mechanism.



Ill. 36. Stationary opener concept.

Ill. 37. Push it concept.



Sketching sessions were carried out to came up with ideas for the interaction with the product. During the sketching, ergonomic products in the market were a source of inspiration. A toy store was visited to get inspiration from the toys directed to children in their very first years. At this time, when they are learning to grip, they do not have complete control over their fingers, and since decreasing the stress in the fingers is one of the design objectives, I considered interesting the possibility of translating the interaction with a toy into a kitchen utensil. In this chapter the concepts that are considered the most interesting are presented.

Rotatory handle

This idea was inspired by the "saw knife" directed to arthritic people (ill. 35). The hand is placed around the knife in a stressless position, so this concept is based on holding the utensil's handle in the same way (ill. 35). The adjustment to the lid size and the opening of it, should be both done using the handle, having the same interaction during all the opening process. To make the adjustment, when the handle is rotated, the hole in the middle goes decreasing its size, until the lid is grasped. This kind of handle takes more space in the closet, but it would be possible to design a folding solution.
To decrease the stress in the hand that holds the container, a similar product to the opener is placed in the bottom of the container, holding it. The holding effort is not totally removed, but the strength that the hand needs to make lows down, because the grip is more comfortable than gripping the container, and because it is at a distance from the container's gravity center.

Stationary opener

This concept consists on fixing the bottle to the ground, to eliminate completely the force that the gripping hand needs to make. The way the product should be fixed to the table or counter set is not set. It could be mounted or it could have a heavy base that keeps it still.
With this concept, it would be enough to use one hand to rotate the lid. The part we use to grip the lid and to rotate it are build in the fixed base. This part should also be used to adjust the bottom part to the container and the top part to the lid. To open the lid, the handle is pushed around the lid. The weakest point in this concept is that, besides adjusting to different lid's diameters, it also has to adjust to height and shape of the container.

Push it

Many products in the kitchenware market use the principal of pushing to carry out different actions (ill. 37). With the pushing principal, the use of the fingers is avoided and when doing the pushing movement the hand is in a neutral, comfortable position.
The function of adjusting to the lid size and the function of opening should be both done pushing, having the same interaction for everything.

Mill

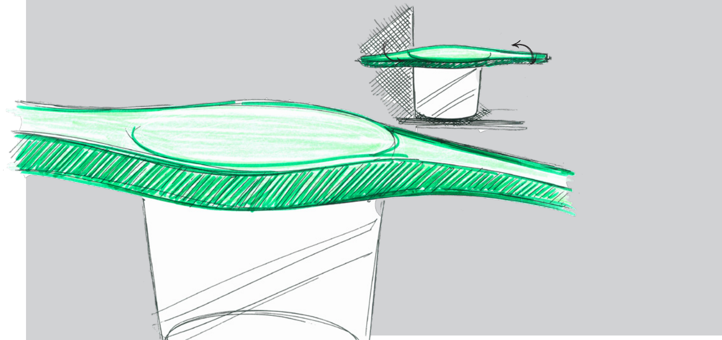
This concept consists on taking advantage of the kitchen wall or any other wall nearby to use one of the sides of the utensil as a lever and, consequently, making the turning easier and decreasing the amount of stress in the hand that holds the container.
To adjust the utensil to the lid, the handles are slid into the center part when the diameter needs to be decreased, and pulled back to increase it.

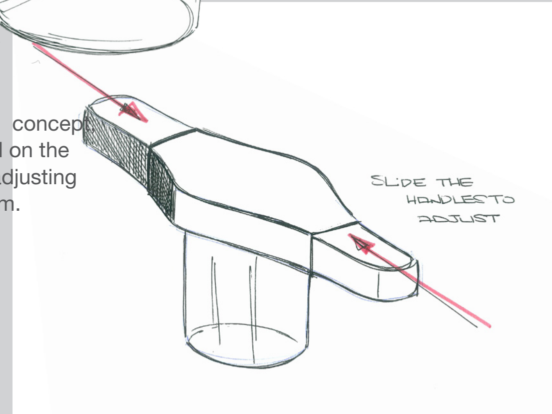
Flip-it

This last concept consists on a two-in-one product. In one side, is designed to pull the lids in jars to release the pressure, so they become easy to open. In the other side, has two flanges that adjust to the lid size, that are meant to open bottle and carton lids. Once the flanges are adjusted to the lid, we rotate the handle to open it, like with the conventional openers.

Evaluation of concepts

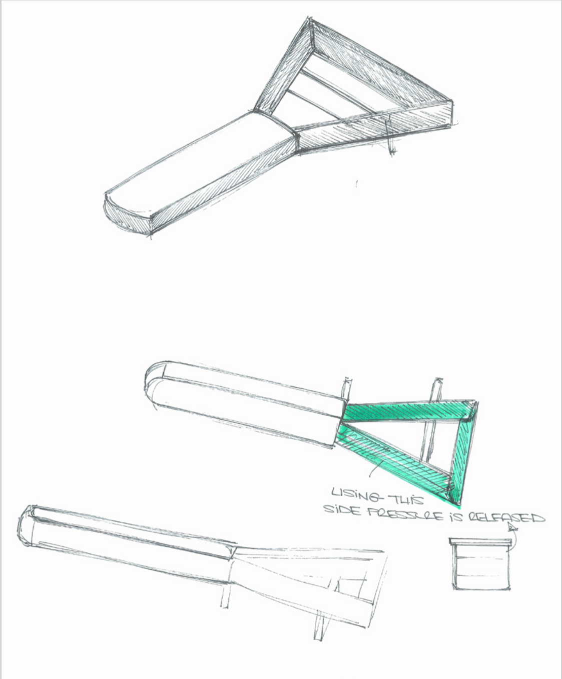
This five concepts were evaluated according to the most important specifications that the product needed to accomplish.
"Push it" seemed to me the direction to go clearly. The points were it stood out from the rest were: the fingers do not need to be used opening the lid, so the overuse of them is prevented. The up and down movement of the wrist would be the actuator, while it is arranged in a neutral position. Another plus was, that the adjusting and opening both would be made using the same interaction: pushing until the lid is grasped and, then, pushing to open. It was also considered a positive aspect that it was a compact product, no big handles standing out, so many styling possibilities to make it look attractive. These aspects were considered strong, unique selling points that would differentiate it from the rest of the products in the market. Regarding the stress that the second hand stands, this would be reduced because the strength is applied downwards, where the table is supporting. In the conventional openers, where a handle needs to be rotated, the holding hand has to act against the opening movement, but, with "Push-it", the table would do part of the job.
The one that fulfills better the objective of distressing the hand that holds is "Stationary opener". However, designing a product that needed to be exposed always mandatorily, would make it very weak in the inclusive market, limiting it only to the consumers that really need a product with this characteristic. With this concept, another problem was found: since it also needs to be adjusted to the height of the product, it would be hard to design it so it could be adjusted to big bottles, like the 2 liters cola bottle.
Because of the potential that was seen in "Push it" compared to the others and, because of the difficulty of designing a mechanism that would turn when pushing it, adjusting to the lid size and opening it once it was adjusted, only this concept was taken further on, starting to design the mechanism. It was found further on that having stopped exploring the rest of the concepts was a mistake.



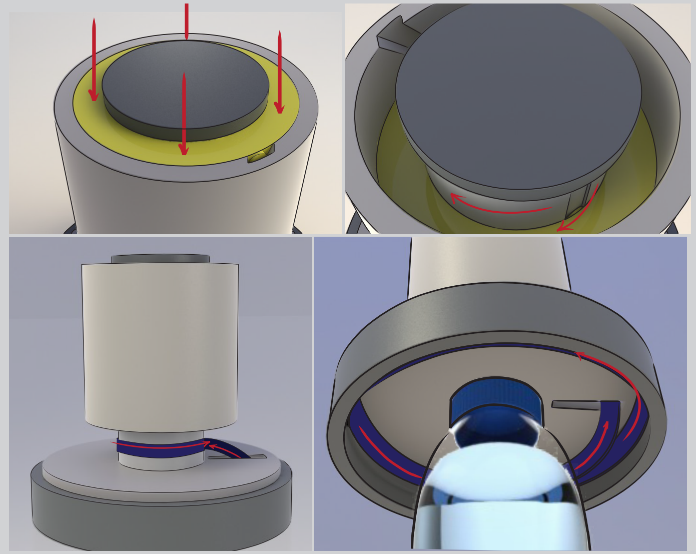


Ill. 38. Mill concept supported on the wall and adjusting mechanism.

Ill. 39. Flip-it concept.



Developing the Idea (and finding out is not feasible)



Ill. 40. Internal mechanism of the concept.

Ill. 41. Rough model of the internal mechanism.

Designing the mechanism

Four different mechanisms were proposed. As explained in the previous chapter, by pushing:

- The lid had to be grasped.
- Once the lid is grasped, it had to be turned.
- The lid had to be released once is opened.

The four concepts were evaluated and one of them was chosen to develop into detail (Appendix 7). The chosen mechanism was "Grasping band", a band that surrounds the lid until is thigh, then the lid will turn together with the band (ill. 40). This concept was chosen because it had the most simple modus operandi and the less amount of parts, meaning that the chances of something failing was lower than in the rest.
The development of the concept was made using reverse engineering. The mechanism of a chopper was analyzed, which had blades that rotate when it was pushed. The band only needed to turn in one direction when it was adjusting to the lid, and to block the turning in the opposite direction, inspiration was found in a socket wrench.

The solution becomes unrealistic

Force that is needed pushing

A test was carried out to prove if the force that needed to be applied linearly in order to turn the lid was realistic (Appendix 8). First, an experiment was made to calculate the momentum needed to open a bottle. After obtaining this data, it was replaced in a free body diagram of the mechanism, and the force that was needed pushing was obtained. The value of the force was 8 kilograms, which is feasible. So, it was validated that the force that had to be done pushing was reasonable.

Reduction on lid sizes' coverage

An important characteristic that the product should have, was to adjust to a broad size of lids. Since this concept needs to be supported on the top of the lid when using it, a conflict was found: if the maximum diameter of the lid that can be opened is 90 mm, that means that the base surface of the product needs to have at least that value. This means that, when opening a small lid of value 25 mm, the minimum decided, the product is going to be very unstable. Therefore, it was decided to split up the product in two categories: one product that opens lids from 25 to 55 mm and another one for lids that go from 55 to 90. This solution was considered appropriate because, trying to make it work for the whole range of sizes, would make the product weak with small lids. However, is not considered ideal, since it means having to buy two products instead of one.

Complexity of the mechanism

The mechanism that was the more simple of the created ones and was chosen because of that reason, starts becoming more and more complex as I detailed it.
Parts needed to be added on to ensure that it worked, meaning more friction between more parts, it gets difficult to fit all of them in a reasonable space, and it gets more and the certainty that everything will work as it should goes disappearing.
The product becomes unrealistic, nobody is going to produce an opener with so many parts that need to work together; is expensive and probably has a short life.
Changing the solution from mechanical to electrical is considered. This would reduce complexity internally and also in the use. Another weak point of the product is that the user needs to push many times, 10 more-less (Appendix 9), to adjust the band from the biggest lid size to the smallest. So, making it electrical, it would be enough to push one time to open the lid, and another time to release it. However, making it electrical goes against the goal of designing a low-price product, and adds the battery changing problem. Plus, it makes it weak against the competitor electrical products (Appendix 6), which open a broader range of lids.

It was decided to go back and re-evaluate the concepts, in order to find a simpler, and, as a result, more realistic solution.

Re-evaluation of Concepts

Changing the direction to develop the "Mill"

The concepts are re-evaluated, as another direction needs to be taken.
The "Mill" idea was chosen to be explored further on; this concept fulfilled all the design parameters to a medium-high extent: did not require precise finger movements, could adjust to many lid sizes and container shapes, could be kept inside the closet, and the idea of using the wall to release stress from the hands was considered to have a potential. The objective was to use the walls in the kitchen as an element to help opening the containers; like fixed openers do, but without making it stationary, so it can be put back in the closet when we finish using the product.
The final decision of stopping trying to make realistic "Push-it" was taken once another option -the "Mill"- was seen as a capable solution. It was a hard decision to take, since it was very late in the design process and much effort had been put in developing "Push-it". However, because of the simplicity of the idea, was considered a more feasible solution that would meet the set design parameters in a more effective way.
In order to make a good design, the weakest points of the idea needed to be improved. This meant keeping the interaction level to the minimum, ensuring that there is no manual dexterity needed to interact with the product and make it as compact as possible.

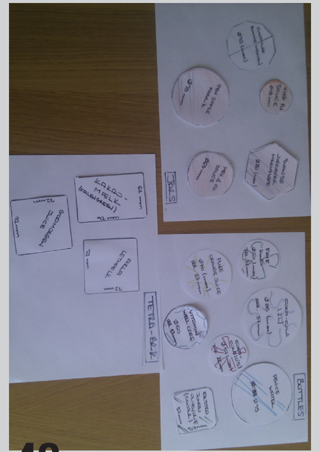
Ill. 42. 3-D model of shape proposal.

Ill. 43. Physical dimensional model of the shape.

Designing the Support on the Wall

Ill. 44. Primary concept for how to take advantage of the wall.

Ill. 45. Experiment with the rectangular carton. In this picture is also visible the wooden frame on the counter-tops.



Ill. 46. Drawings of different container profiles.

Developing the idea

The main differentiator of this concept was the idea of supporting the utensil on the wall to assist the grasping of the container. Therefore, that was the initial focus and the first aspect to bring further on.

Sketching session were carried to develop this feature of the concept.

The first sketches revolved around the idea of having two different arms, where one was used to open the container and the other was supported on the wall, to act like a lever (ill. 44).

This ideas would reduce the strength needed to hold the container, but still some needed to be applied. If the arthritis is very severe, it might not be enough helpful for the user to be able to open it. Therefore, it is decided to keep developing concepts in a direction where the container is going to be completely fixed, to ensure that is going to be useful also for people with very damaged joints.

Fixing the container, without fixing the product

So, the goal was to fix the container without designing a stationary product. It was considered that, a flat and wide enough surface, supported on the wall, might act like a stopper itself. It was tried out with a rectangular carton, if supporting one of the widest sides on the wall, the lid could be opened without having to hold it (ill. 45). And it worked.

Then, a sketching session was made to develop a product that has a flat surface to support on the wall and adapts to all kinds of sizes and shapes. As guidance on sketching, the data about different bottles, jars and cartons (Appendix 6) was used, and different profiles were drawn with the shapes of the containers (ill. 46).

The chosen concept had two walls where one slides into the other to adapt to different container sizes (ill 48). This solution covered rounded, square, rectangular and polygonal shapes, and to adjust it the user simply needs to push one of the walls and this slides inside the other. Since one of the sides fits inside the other, the range of sizes that can be adjusted is, from the maximum chosen, to the half of that. The maximum value that was chosen was 90 mm, since the biggest container found had a diameter of 96, and the smallest a diameter of 48 mm.

Frame on kitchen counter-tops

In many kitchen counter-tops, there is a wood frame covering the edge between the counter-top and the wall (ill. 46). This edge obstructs the supporting on the wall, so needed to be avoided in some way to ensure the stability of the product. After measuring different counter-tops, a cut-out on the product was made, considering that the biggest should fit in it (ill. 47).

Detailing the function to grip the container

Besides pushing one of the walls to adjust it to the container size, this needs to be fixed in the desired position afterwards, so it does not let go the container when the lid is being unscrewed. After working on some concepts, there were fixed some design parameters that the construction should follow, in order to evaluate the ideas so far and as a guideline for the next ones:

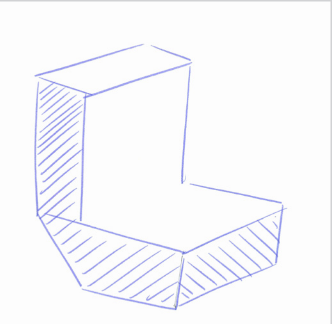
- The adjustment can not be rigid, it needs to have a minimum flexibility to adjust to the in-between container sizes.
- It has to be ensured that it does not slide back, releasing the container, once is adjusted.
- Avoid precise movements of the hand.
- Avoid visible grooves.
- Keep the construction as simple as possible, integrate parts on each other.
- Design it in harmony with the opener (while the wall support was being designing, simultaneously the opener was being developed).

After drawing more ideas and evaluating them, the concept that was chosen consisted on tightening the two walls with an adjustable rubber band (ill. 48). The interaction consists on: first, the user pushes the wall and slides it inside the other. Second, adjust the band to the size and ties it at that position, so the wall does not slide back (ill. 47). This concept was chosen because of its simplicity in the construction and the use.

Union between the two rubber ends

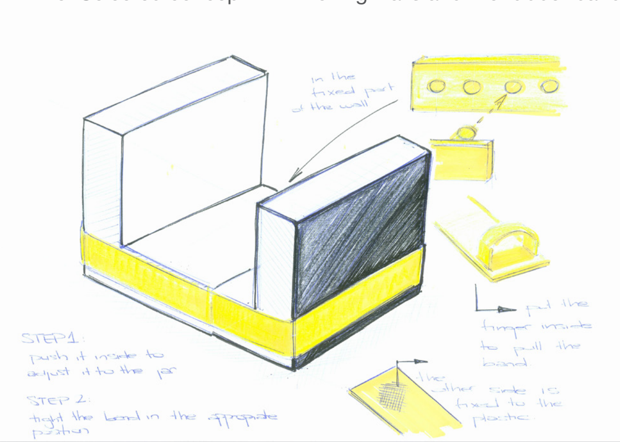
The next thing to define was how the two ends of the band were going to be tied. The objects around me were used as inspiration to sketch on different possibilities: belts, bags... The solution that was chosen was to unify the two endings magnetically, this way is not going to be required manual dexterity to put them together.

To guarantee an easy handling of the band for people with low manual dexterity, the end of the band that is held to adjust it needed to have grip.

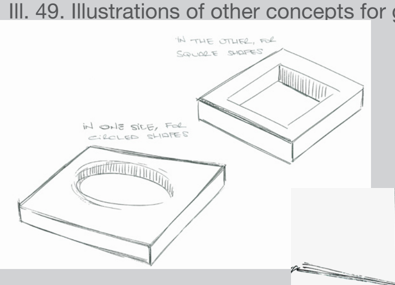


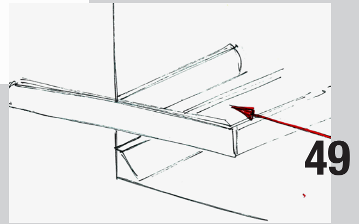
Ill. 47. Groove on the product so it does not have contact with the wooden frame.

Ill. 48. Selected concept with moving walls and the rubber band.

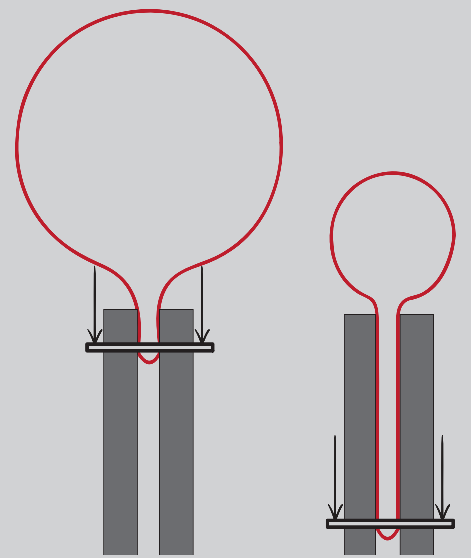


Ill. 49. Illustrations of other concepts for gripping the container.

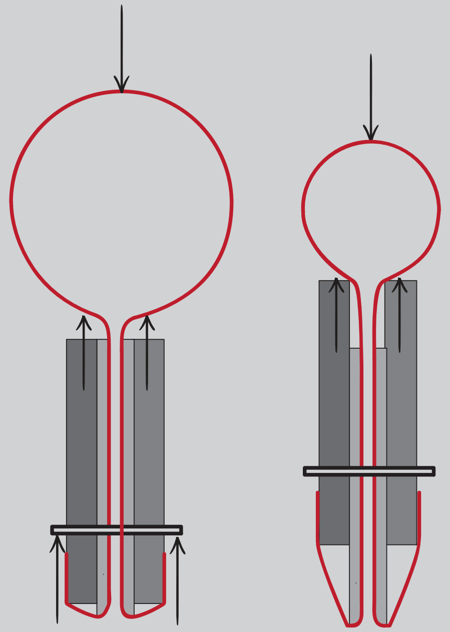




Designing the Opener



Ill. 50. Illustrations showing how the rubber band increases size.



Adjustment to different sizes

The opener would complement the wall support product, making the lid easier to rotate once the container is fixed. It needed to be adjusted to different lid sizes, and to make this adjustment precise but at the same time efficient, it was decided to do it applying a linear movement, like the competitor product “Swing it away”. Thus, the effort of adjusting will be done using an open movements of the elbow, instead of a precise movement of the fingers.

Rubber band

To grasp the bottle, it was decided to use a rubber band which size would be adjusted by the back and front movement (ill. 50). When the rubber band was pulled, its circumference would be released and when it was pushed, it would be increased. The rubber band would ensure that the lid is gripped in the whole circumference tightly.

Slider

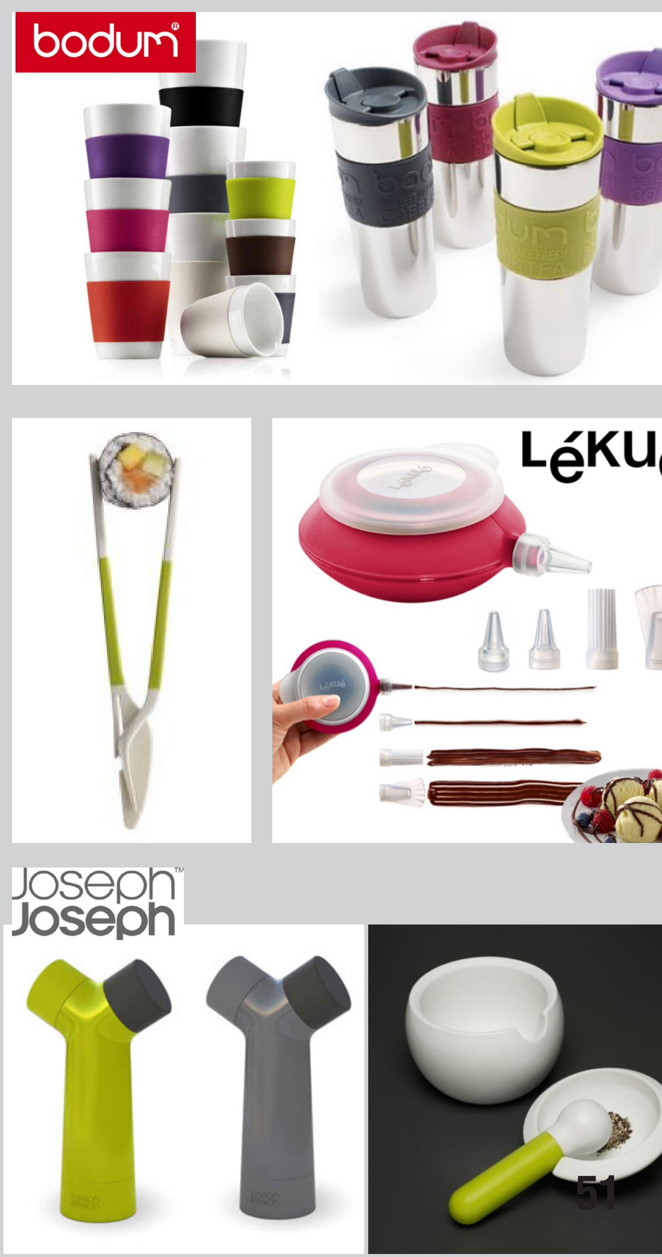
In order to make the adjustment, instead of moving the whole handle, it was decided to add a slider. This way, the size of the handle wouldn’t vary, being always what is suitable considering human dimensions.
The slider was placed at the bottom of the handle, so the groove that allowed the slider to move back and front was not visible.
Once the slider was placed in the right position, with the rubber band adjusted to the lid, it needed to be ensured that it was not eased. For this, a inner part with teeth that would hold the rubber band in its position was incorporated.
Pushing the rubber band back would mean that the center of the circumference would be also pushed backwards, so the lid would not be in the center. To solve this problem, instead of pullin the band back, a part would be pushed forward. The band would be connected to this part in a way that as the part goes ahead, the band goes backwards. Using this system, besides keeping the center of the band in the same position, the distance that the slider needs to be moved is shorter.
The shape of the slider was detailed further on, after testing different possibilities with the user (chapter Detailing Ergonomics, page 56).

Aesthetic Inspiration

After defining the function and the interaction with the product, the style of the two concepts was developed. Brands like Bodum, Lekué and JosephJoseph were chose as a source of inspiration for defining the outer look. Combining silicone and another material, like Bodum and Lekué do, was considered an applicable aspect in the project. Using rubber in the parts where the user has to interact with, will work increasing the ergonomics, since the surface will be less slippery, but also will out-stand the parts that the user needs to interact with. Plus, the attraction to touch that rubber provokes, and the playfulness that provides to the product, will increase the desire of the user to try it out. The minimalist shapes that the products of JosephJoseph have was also translated into the sketching of the style of the product. This considerations were listed in order to have a guideline for sketching the outer look of the products:

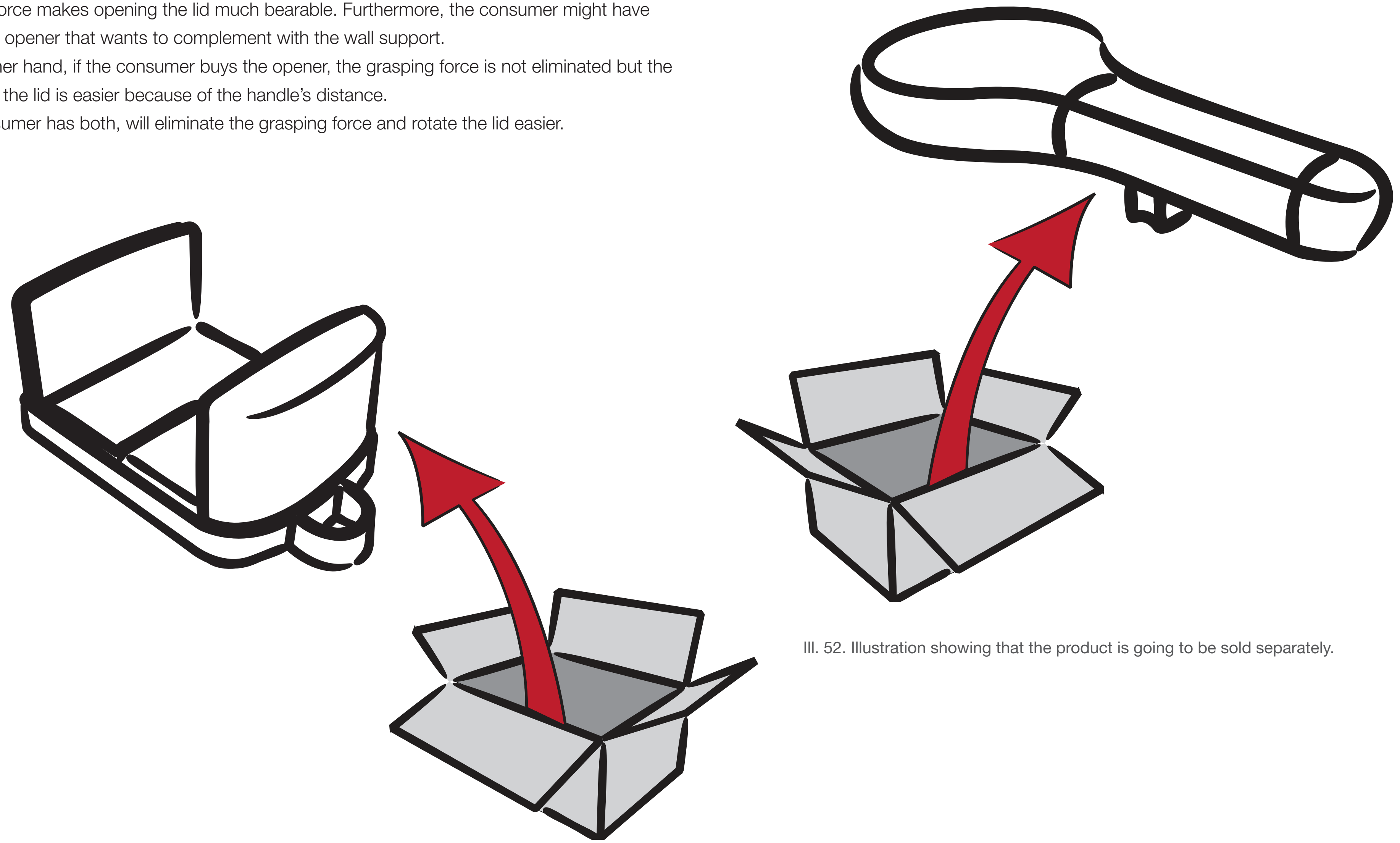
- Besides being ergonomic, has to transmit that it is.
- Rubber will added on the parts that the user will interact with, to increase ergonomics but also as a guideline.
- The product has to be inviting, the user has to have the desire to try it out just by seeing it.
- The form of the product has to follow the inner structure, keeping it simple and without adding pompous shapes with no reason.

Ill. 51. Pictures of products that have been a source of inspiration aesthetically.



Product Package

The two products will be sold separately. In this way, the consumers have the possibility to choose if they want the wall support, the opener or both.
Both products work well individually. The wall support holds the container, so it is enough to use one hand to open the lid. The fact that the container is steady and there is no need to apply a grasping force makes opening the lid much bearable. Furthermore, the consumer might have already an opener that wants to complement with the wall support.
On the other hand, if the consumer buys the opener, the grasping force is not eliminated but the rotation of the lid is easier because of the handle's distance.
If the consumer has both, will eliminate the grasping force and rotate the lid easier.



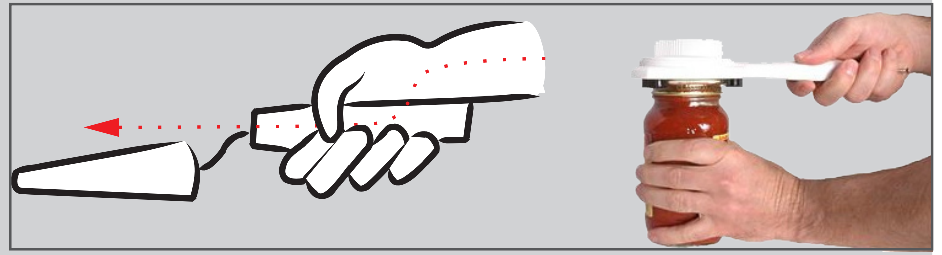
Ill. 52. Illustration showing that the product is going to be sold separately.

DETAILING THE PRODUCT

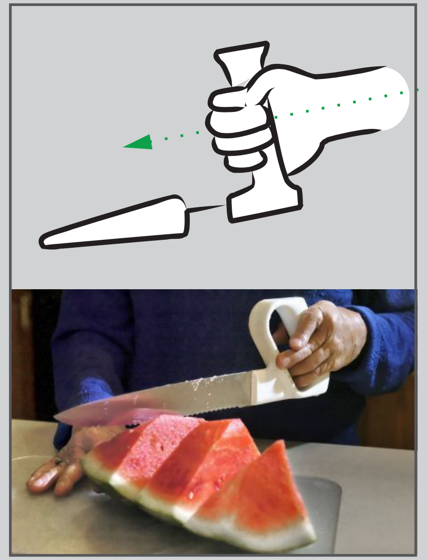
The last chapter of this report contains information about the steps carried out to detail the product closer to production level. Final ergonomic, aesthetic, constructional considerations and selection of materials and production processes can be found in the next pages.

Detailing Ergonomics

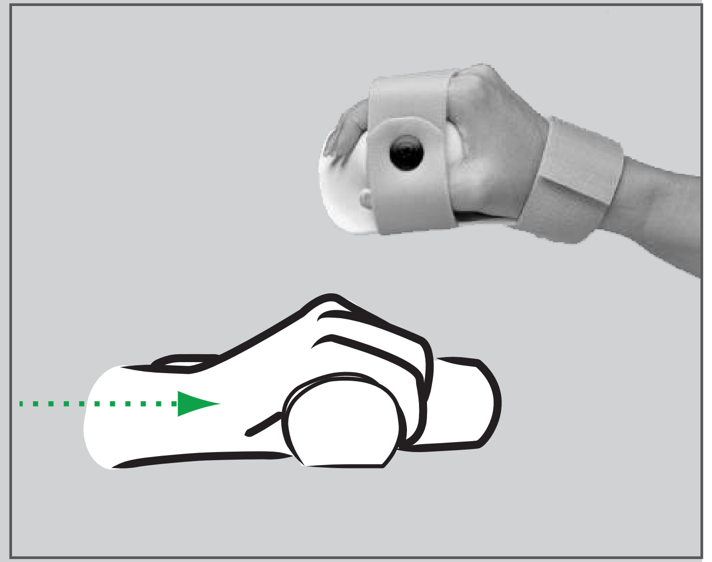
Ill. 53. Wrong position of the hand, stressful for the wrist.



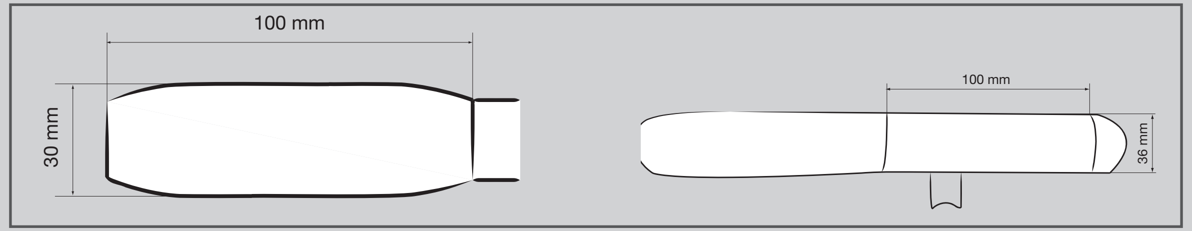
Ill. 54. Optimum position of the wrist.



Ill. 55. Position of the hand around the handle compared to a splint.



Ill. 56. Measurements of the handle comparing to what is recommended ergonomically.



The detailed shape of the opener was developed considering anthropomorphic and byomechanical ergonomics.

Interaction with the handle

Most of the openers in the market, have a handle that needs to be hold in a position were the wrist is under high stress (ill. 53). The hand is not in a neutral position, does not have the wrist and the hand palm aligned, so, besides having the wrist in an uncomfortable position, the strength that can be applied is not the optimum.
The handle of the opener in, has the right dimensions and shape to be held as is shown in illustration 55.
In this position, the wrist is in a more appropriate position; as we can see in this illustration, is very similar to the posture that hand splints position the hand.
Furthermore, the force that can be applied is bigger, since the extension of the elbow is in the direction of the force.

Dimensions

The dimensions of the handle were defined with the objective of adapting to the broader range of users as possible. The handle needs to be big to be easy to grip, but within a limit so people with small hands can use it comfortably. To choose the right measurements, anthropometric data was applied (ill. 56) (Dul, Weerdmeester, 2008).

Contour and cross section

The contour shape has to be curved, so a larger surface is in contact with the hand. To facilitate the contact of all the fingers, is more recommendable a non rotational symmetrical cross section. This two parameters were considered in the design of the openers's handle (Dul, Weerdmeester, 2008).

Rubber around the handle

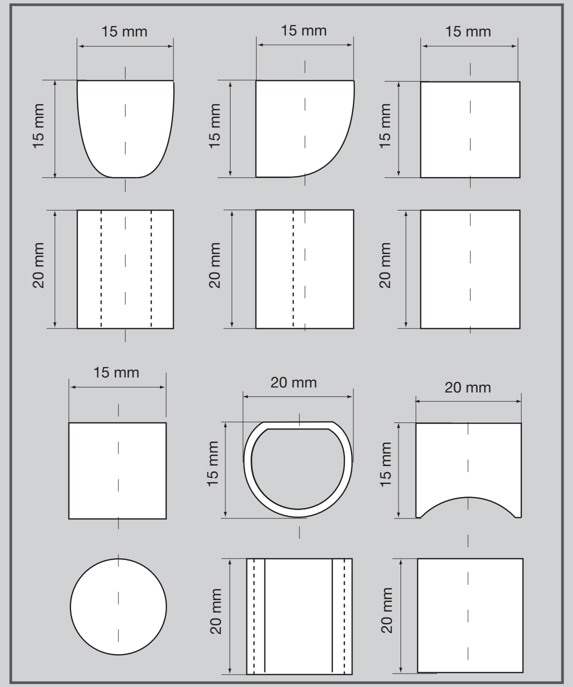
To ensure a non slippery surface where the user holds the product, the handle was covered with rubber.
This will create a better grip, and also will guide the user, highlighting the parts that needs to interact with. Besides, gives a color touch to the product, making it more attractive visually.

The slider

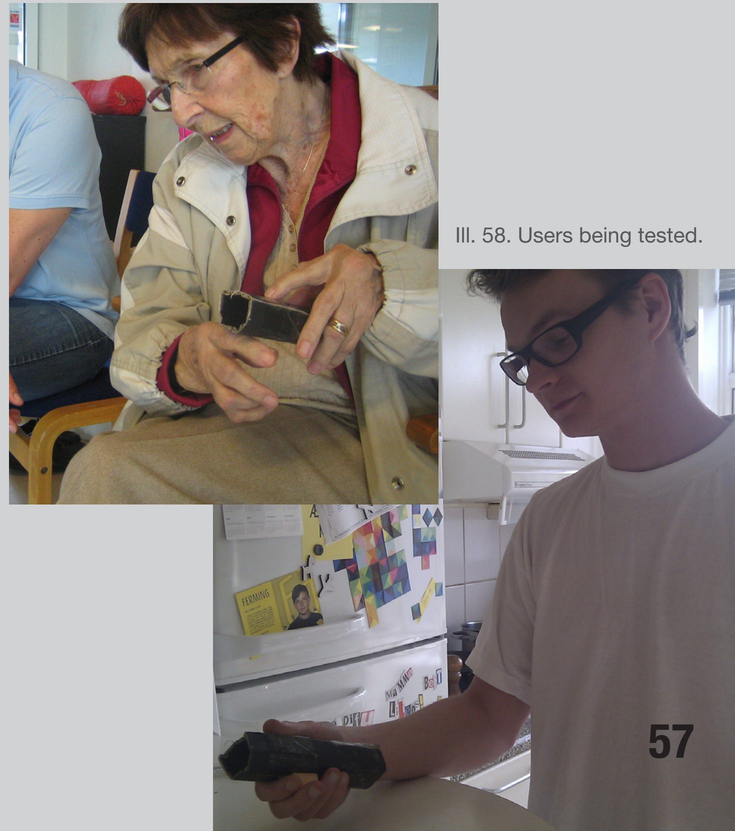
The slider is a crucial part of the opener, since is the part that the user interacts with to adjust the rubber band to the lid. Is essential that it has the correct size and shape to ensure a comfortable and easy interaction, even to people with very limited manual dexterity.
Because of that, the Grønlandstorv aktivitetscenter was visited once again to test different slider shapes with Margrit and Inge Lise. The slider was also tested with a person with no arthritis problems.
The sliders where built in foam and attached to a cardboard part that simulated the handle.
The person with perfect manual dexterity used only one hand to move the slider, but the two women suffering arthritis used both (Ill. 58). The product gives the possibility to do it in both ways.
After the tests, these were the most important conclusion obtained:

- The handle needs to be flat where is pushed and pulled, since a person will low manual dexterity will not pinch it, will use the fingers surface to pull and push (ill. 58). If the face is flat, there will be more surface in contact with the finger that if it is rounded.
- The small cavity under the slider helps pulling and pushing, since becomes and extra support for the finger. This cavity needs to have a quite open circumference, so adapts to big fingers.
- The size of the slider needed to be augmented according to the tested persons having arthritis.

The slider was re-shaped considering these findings.

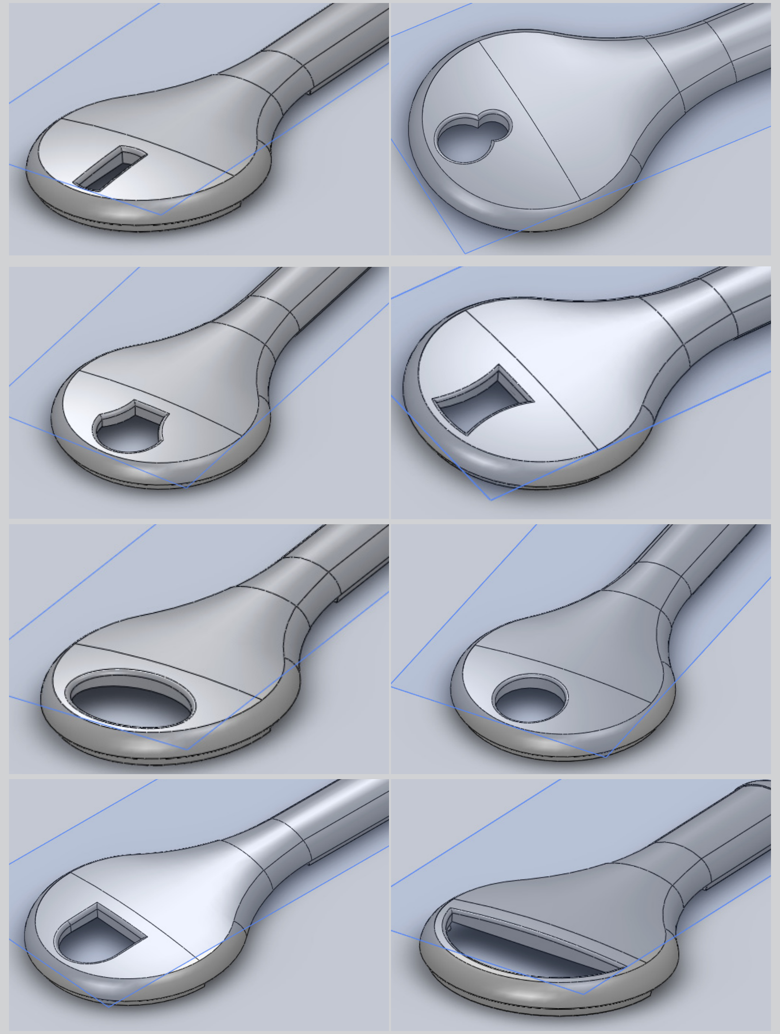


Ill. 57. Slider shapes that were tested on the users.

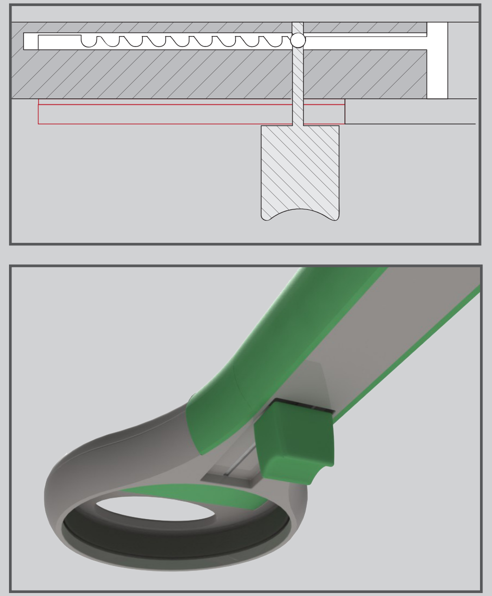


Ill. 58. Users being tested.

Final aesthetic details



Ill. 59. Different trials in Solid Works for the hole on the top.



Ill. 60. Illustrations showing groove inside the opener, to avoid there is a space between the top of the slider and the bottom of the handle.

The opener

Hole on the top

With the former shape of the opener, the user could not see the position of the band as it was being adjusted to the lid size, this action had to be done only by feeling. Therefore, it was decided to make visible the adjustment of the band, so the user could have a visual feedback too.
Two options were considered, place a transparent surface on the top, or make a hole. The chosen option was the second one, ass less material was used and having to assembly the transparent plastic part with the rest of the top part was saved.
Different options for the hole were draw on Solid Works (ill 59), and the chosen option was the oval hole, because is big enough to see the adjustment of the band from 90 mm to 20 mm and does not break the harmony with the shape of the product.

Groove for the slider

To avoid the gap between the slider and the handle, since the slider needs to be pushed up three millimeters, a groove was made in the handle (ill. 60). Then, when the handle is in its natural position, the bottom of the handle and the top of the slider will be at the same level. When the slider is pushed, it will be introduced inside the groove.

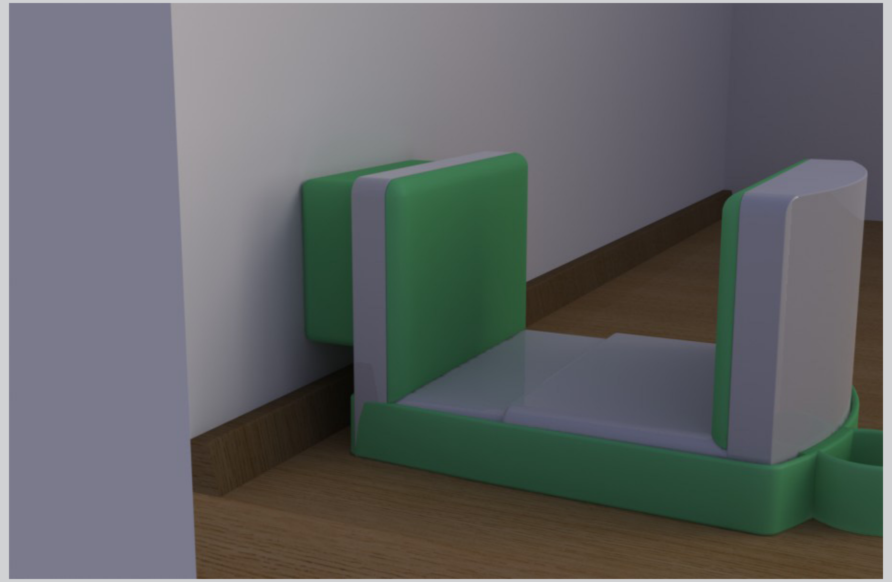
The wall support

Frame on the counter-top

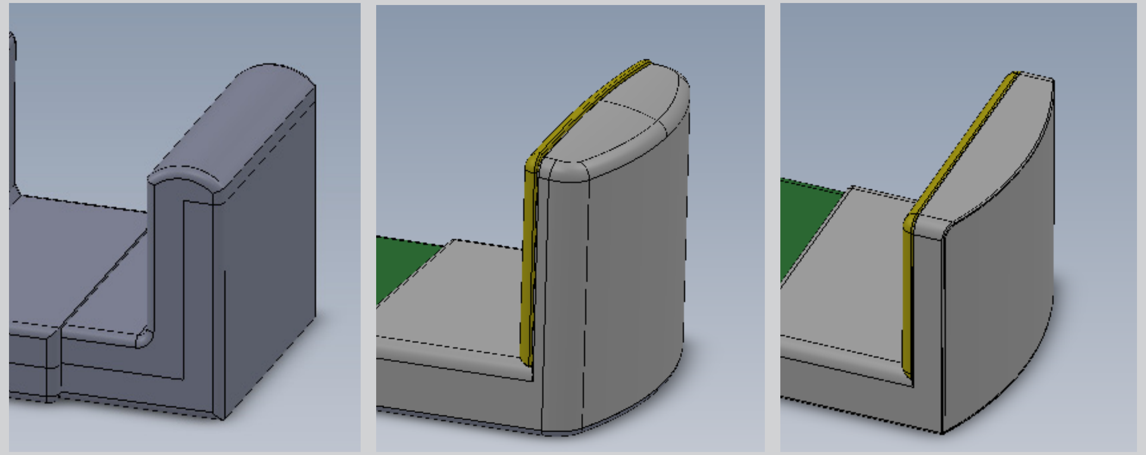
In order to avoid the frame on the counter-top, the first idea was to make an aperture in the back of the part that is supported on the wall. Due to aesthetic considerations, and bearing in mind that the new kitchens do not have wood frames anymore, the solution was changed.
The new proposal consisted on a rubber block that is put behind the product, between the wall and the part, so there is a distance between them. In this case, it would be used when needed, not like the groove that would be part of the product even if the user does not have any kind of wooden frame in the kitchen.
Furthermore, this rubber block could have a second use: most of the containers have a diameter of fifty millimeters or higher, but there are smaller ones (containing olives and capers, for example). This containers are less difficult to grasp because of their small diameter, but in case the product wants to be used, the rubber band could be placed between the container and the inner wall, filling the space between them.

Rounded side

To make the two products follow the same style, the side that is not supported on the wall was curved. This way, besides following the rounded shape of the opener, it is more clear for the user which is the side that is supported on the wall.

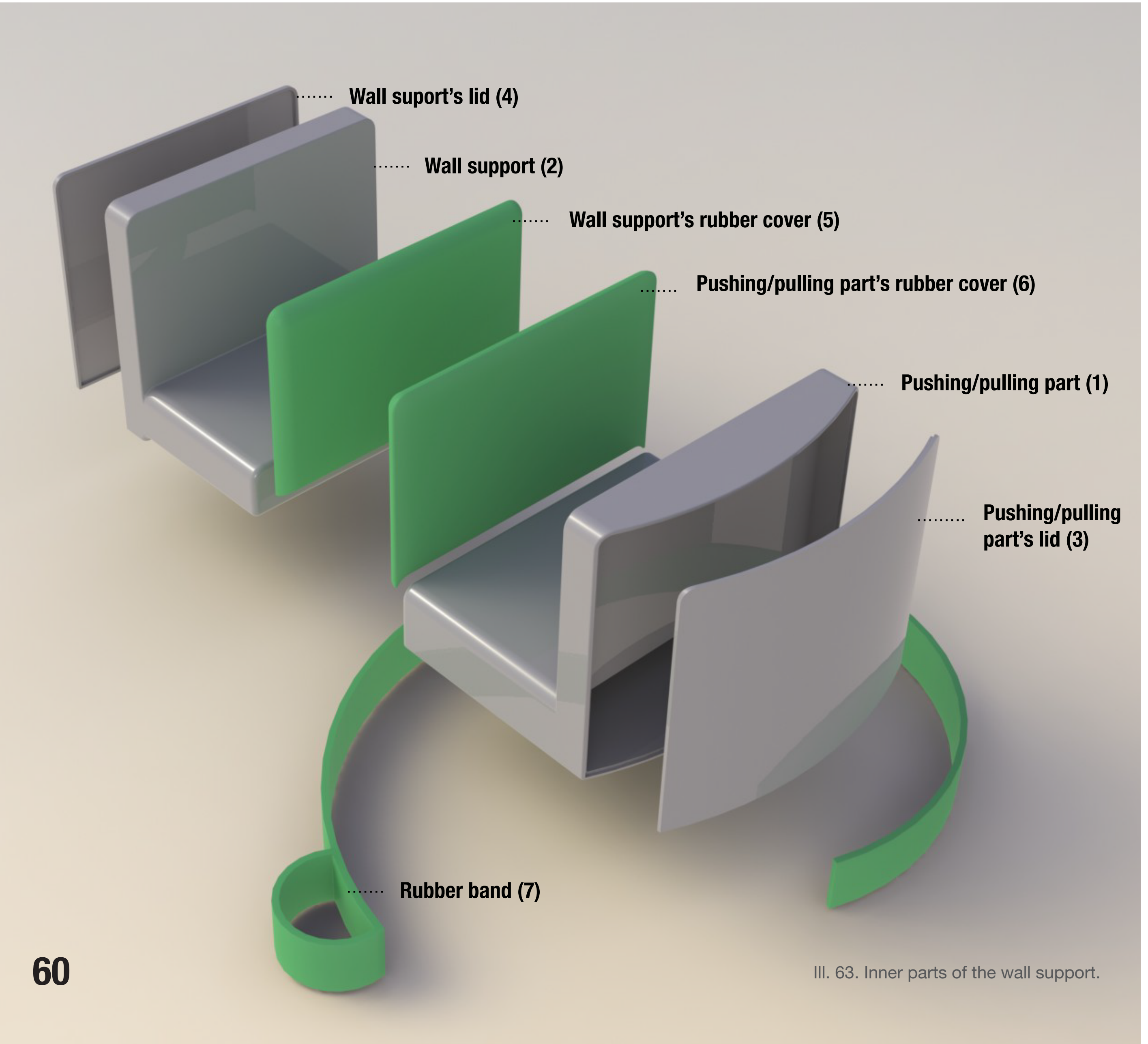


Ill. 61. The rubber block avoids the instability of the product due to the wooden frame.



Ill. 62. Illustration showing some of the stages of the back part of the moving part. The roundness of the part was limited in order to not compromise production cost.

Product architecture



Ill. 63. Inner parts of the wall support.

The construction of both products is further detailed for both products, the opener and the wall support. After developing different construction proposals, the final product architectures are presented in this chapter.

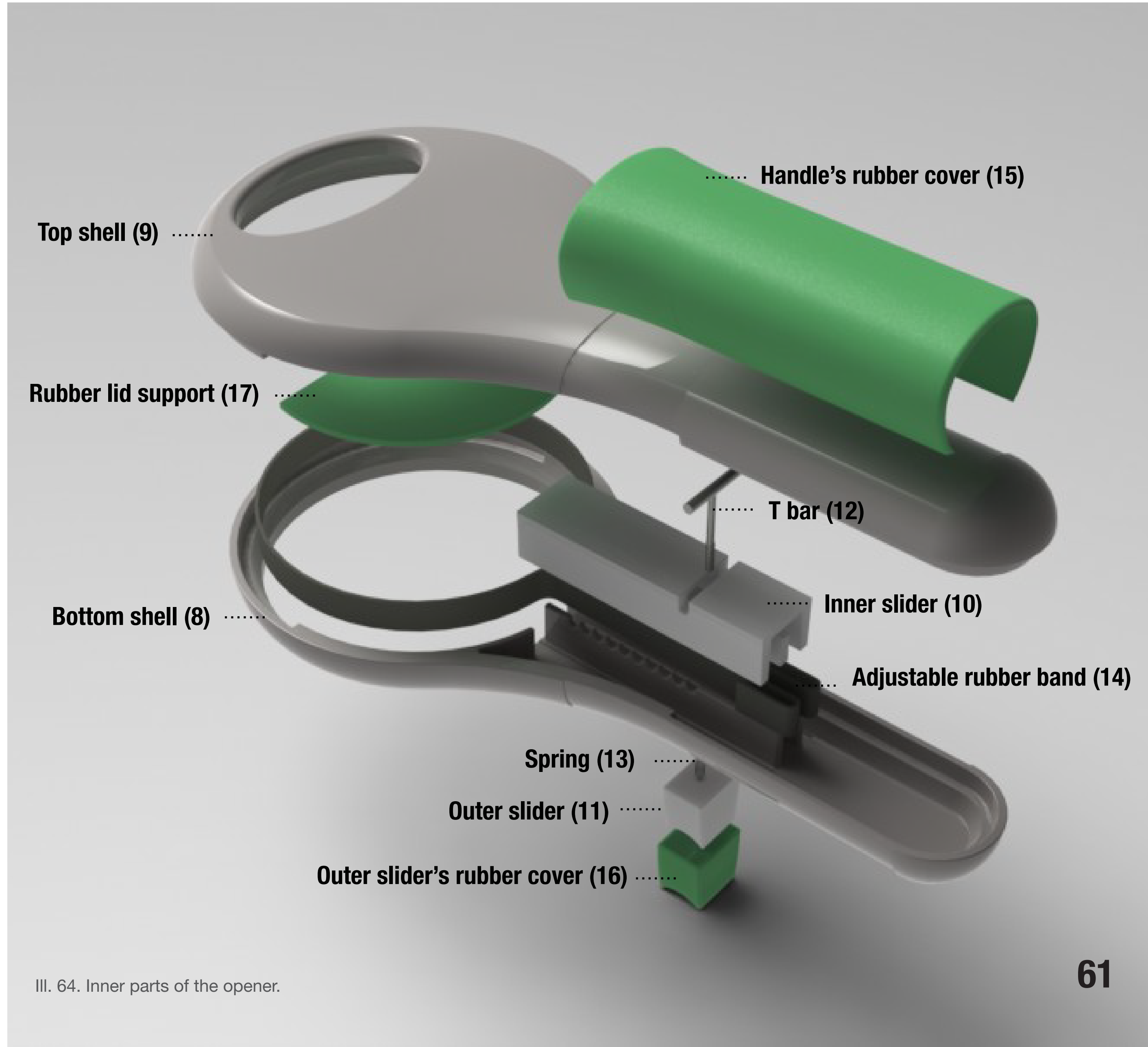
Wall support

The wall support is divided in four stiff parts (1, 2, 3 and 4), plus the rubber parts, which are the two parts that are in direct contact with the container (5 and 6) one in each side, and the rubber band that holds the walls in their position (7). The rubber bands on the sides have the function of providing a better grip of the container, since the contact surface is more rough.

Opener

The opener's has two shells, which contain the adjusting mechanism. The teeth that hold the beam are mounted in the bottom shell (8). The part that moves back and forward (10), is supported on the bottom shell, and connected to the T shape bar that moves it (12) and the rubber band (14) that grasps the lid. At the same time, the bars are assembled with the slider (11), which is the part that the user interacts with.
The slider, as well as the handle, are covered with rubber (16 and 15), with two objectives: the first, to make the grip easier, being less slippery; second, to indicate to the user the parts that has to interact with, where has to put the hands on.
The surface in contact with the lid is also covered with rubber (17), with the objective of being supported on the lid more stably, as the friction between the rubber and the lid will be higher. Furthermore it will eliminate the contact noise when the opener is placed on the lid.

To see the construction evolution of both products, go to Appendix 10.



Ill. 64. Inner parts of the opener.

Materials

In this section the process followed in the material selection for the parts of the two products is explained. First, the products that needed the same material specifications were grouped:

- **Group 1.** From the support: pushing and pulling part **(1)**, wall support **(2)**, pushing and pulling part's lid **(3)** and wall support's lid; from the opener: bottom shell **(8)** and top shell **(9)**.
- **Group 2**. From the support: pushing and pulling part's rubber cover **(6)** and wall's support's rubber cover **(5)**; from the opener: outer slider's rubber cover **(16)** and rubber lid support **(10)**.
- **Group 3**. From the support
- **T bar (12).**
- **Inner slider (10).**
- **Outer slider (13).**
- **Adjustable rubber band (14).**

For each group, the requirements that the material needs to fulfill were specified. After defining the requirements, different possible candidates were selected and compared between them. The material that fulfilled the specifications best, was the selected one (Appendix 10). In order to choose the different material candidates, the knowledge obtained designing previous products has been applied, together with looking into products in the market with similar applications.

Group 1

The requirements that the material for these parts have to meet are:

PHYSICAL	Light.
MECHANICAL	Stiff. Not breackable, impact resistant. Resistant to skratch.
AESTHETICAL	Possible to color. The color does not have to fade on time.
PROCESSING	Easy to manufacture the desired shape.
ENVIROMENTAL	Low impact.
ECONOMICAL	Low cost.
CHEMICAL	Suitable for dishwasher, so resistant to water and chemicals. Possible to glue.
THERMICAL	Resist cold and worm weather conditions. Resist hot water from the dishwasher.

Acrylonitrile Butadiene Stryene (ABS)

Density	0.350 - 1.26 Kg/dm³
Young modulus	2275 - 2900 MPa
Impact strenght	0.56 - 2.2 J/cm
Hardness	R 90.0-121
Easy to colour	Yes
UV resistant	Poor
Easy to form	Yes
Recicable	Yes
Cost	Low
Water resistant	Yes
Chemical resitance	Good
Gluable	Yes
Working temperature	From -4 to 80 Cº

After checking the properties of different materials, Acrylonitrile Butadiene Styrene (ABS) is the selected one. With this material it is possible to obtain a glossy surface, is cost-effective and easy to mold. Toughness is a very important property of ABS, being one of the toughest commodity plastics on the market Besides, is scratch resistant and has good resistance to chemicals. An example of ABS producers is the German company Bayer, under the trade name of Laustran (Lefteri, 2006).

Group 2

The properties of the rubber were specified before choosing the rubber type:

PHYSICAL	Light. Non-steacky.
MECHANICAL	Elastic but stiff at the same time. Not breackable. Resistant to skratch.
AESTHETICAL	Possible to color. The color does not have to fade on time.
PROCESSING	Easy to manufacture the desired shape.
ENVIROMENTAL	Low impact.
ECONOMICAL	Low cost.
CHEMICAL	Suitable for dishwasher, so resistant to water and chemicals. Possible to glue.
THERMICAL	Resist cold and worm weather conditions. Resist hot water from the dishwasher.

The Ethylene Vinyl Acetate (EVA) will be injected as a two component mould together with the ABS. This material has elastomeric properties according to flexibility and softness, but can be processed like a thermoplastic. The company Arkema produces this material with the trade name of Evatane (Lefteri, 2006).

Ethylene Vinyl Acetate (EVA)

Density	0.94 Kg/dm³
Non-sticky	Yes
Young modulus	140 Mpa
Tensile strenght	9 MPa
Elongation at break	300-900%
Hardness	R40
Easy to color	Yes
UV resistance	Good
Easy to mold	Yes
Recycable	Yes
Cost	Low
Water resistant	Yes
Chemical resitance	Good
Service temperature	From -76ºC to 131ºC

Group 3

Properties that this group needs to fulfill:

PHYSICAL	Light. Non-steacky.
MECHANICAL	Elastic but stiff at the same time. Not breackable.
PROCESSING	Easy to manufacture the desired shape.
ENVIROMENTAL	Low impact.
ECONOMICAL	Low cost.
CHEMICAL	Suitable for dishwasher, so resistant to water and chemicals.
THERMICAL	Resist cold and worm weather conditions. Resist hot water from the dishwasher.

Silicone is a high performance plastic elastomer, with soft touch and playful aesthetic. It is very common in kitchenware products, many brands combine plastic or metal with silicone (Lefteri, 2006). A very important characteristic that the chosen rubber part needs to fulfill, and the silicone does, is not being sticky, so dirt does not stay on it. Silicones can be bond with an adhesive. Bonding is only possible with cyano-acrylaat after the application of a primer (www.matbase.com). Primasil, placed in the United Kingdom, is an example of silicone manufacturer companies.

Silicone elastomer

Density	1,12-1,19 Kg/dm³
Non-sticky	Yes
Young modulus	1 - 5 Mpa
Tensile strenght	5-8 MPa
Elongation at break	300-950%
Hardness	12-90 (ShoreA)
Easy to color	Yes
UV resistance	Good
Easy to mold	Yes
Recycable	Yes
Cost	Medium
Water resistant	Yes
Chemical resitance	Good
Gluable	Yes
Service temperature	From -70ºC to 250ºC

Inner slider

The requirements that the material for these parts has to meet are:

PHYSICAL	Not heavy.
MECHANICAL	Stiff. Not breackable, impact resistant.
ENVIROMENTAL	Low impact.
ECONOMICAL	Low cost.
CHEMICAL	Suitable for dishwasher, so resistant to water and chemicals.
THERMICAL	Resist cold and worm weather conditions. Resist hot water from the dishwasher.

Considering that two parts with the same materials do not slide properly against each other, Polyamide Nylon (PA) was chosen for the inner slider. The properties in the family of resins vary due to the high number of different formulations. However, strength, toughness and stiffness are characteristics of PA. It has a natural waxy surface, and reinforced with glass it becomes even harder. The company Du Pont, which also discovered this polymer, is one of the producer under the trade name of Zytel (Lefteri, 2006).

Polyamide Nylon (PA)

Density	0.350 - 1.26 Kg/dm³
Young modulus	3000 Mpa
Impact strenght	96 J/m
Hardness	R92
Colour range	Yes
UV resistance	Good
Thickness	0.4-9.0 mm
Easy to form	Yes
Recicable	Yes
Cost	Medium
Water resistant	Yes
Chemical resitant	Medium-Good
Gluable	Yes
Working temperature	From -70 to 99 Cº

T bar and outer slider

The material properties for the T bar and the outer slider are:

PHYSICAL	Not heavy.
MECHANICAL	Stiff. Not breackable, impact resistant.
ENVIROMENTAL	Low impact.
ECONOMICAL	Low cost.
CHEMICAL	Suitable for dishwasher, so resistant to water and chemicals.
THERMICAL	Resist cold and worm weather conditions. Resist hot water from the dishwasher.

The chosen material was ABS, because of its mechanical strength and stiffness. The T part is under high stress, so to make it even tougher it can be combined with PC (Lefteri, 2006).

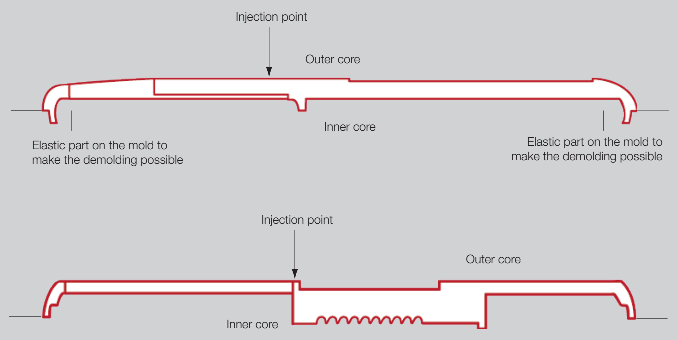
Adjustable rubber band

To ensure that the right rubber band was chosen, the rubber manufacturer factory in Aalborg, Gummivarefabrik A/S, was visited. One of the sales manager recommended and showed me different rubber kinds, according to the requirements that needed to meet:

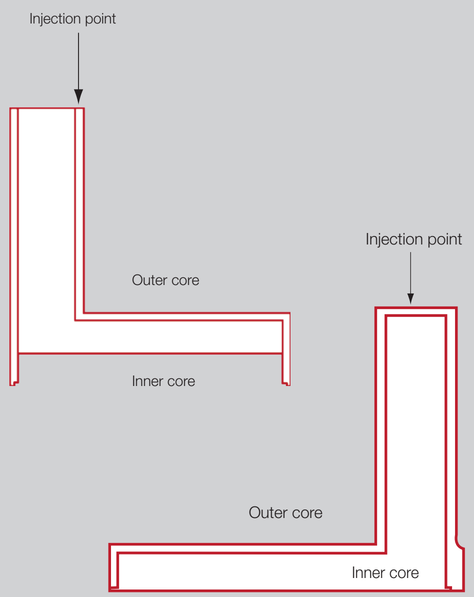
PHYSICAL	Light. Non-steacky.
MECHANICAL	Elastic but stiff at the same time. Not breakable.
PROCESSING	Easy to manufacture the desired shape.
ENVIROMENTAL	Low impact.
ECONOMICAL	Low cost.
CHEMICAL	Suitable for dishwasher, so resistant to water and chemicals.
THERMICAL	Resist cold and worm weather conditions. Resist hot water from the dishwasher.

Moss rubber was considered the most suitable rubber in the expert's opinion,regarding cost, roughness and elasticity properties. At the bottom of the page different rubber samples can be found (ill. 65).

Production



Ill. 63. Shell profile that will be produced.



Ill. 66 Wall support's parts profile.

In this section is explained the production method chosen for producing the parts of the products. As the parts are going to be molded, different techniques are considered.
Rotational molding is usually used in large scale and low production-run pieces. In this process there is no pressure involved, so this process is not suitable for parts that require final detailing, so is not appropriate in this case. Blow molding is suitable for parts with a cavity, but not for inner details (Lefteri, 2006).
Injection molding is found in all areas of plastic productions, since is possible to get almost any imaginable shape using this technique. Injection molding is meant to be for large production, since the cost of the mold is high. High tolerances and level of detail can be achieved (Lefteri, 2006). This is considered the most suitable production technique for this project, since is the most suitable for producing inner details. The product is for mass production, so the tool cost will be paid back.

Important aspects to consider in injection molding are:

- The wall thicknesses must be kept to the minimum, to make use less material making the product more economical but also more environmental friendly.
- The wall thickness must be as uniform as possible.
- The corners need to be rounded to reduce stress concentrations.
- Inner radius need to be at least the thickness of the walls.
- A draft angles of 1° or 2° needs to be applied to the walls parallel to the parting direction to facilitate removing the part from the mold.
- For structural support, is better to add ribs than increasing the wall thickness.
- Designing the ribs, he thickness of the ribs should be 50-60% of the walls to which they are attached. The height should be less than three times the wall thickness, round the corners at the point of attachment and a draft angle of at least 0.25° needs to be applied.
- External and internal undercats need to be kept to the minimum to avoid side or internal cores in the mold. (www.custompartnet.comA)

This parameters are considered in the design of the parts. The ribs have not been design but the possibility of adding ribs to the opener's shell is considered, in order to ensure the rigidity of the handle.

Illustrations 63 and 64 show the profiles of the opener's shells and the wall support. In this molds there is missing the cavity for the second material is going to be injected, EVA.

The rubber band in the opener, the one grasping the top of the container, will be extruded and cut in the needed dimensions.

Assembly

The parts are assembled between them using industrial glue. Using glue, there is no need to build screw towers or snap-locks, so the molds are simpler and material and components are saved. Glue is not a desirable solution in products that might need to be disassembled, but this is not the case. The products are cheap (see Price Estimation chapter in page 68), so in case an internal component is broken -in the opener, because in the wall support there are not internal components- it will be cheaper and cost less effort to buy a new one than opening the product, buying a new part and replacing it.
To choose the suitable glue, a research has been done in the market. To glue ABS with ABS, that is the two shells in the opener and the two lids to the corresponding parts in the wall support (8 to 9, 3 to 1 and 4 to 2), WELD-ON 2354 ABS plastic glue will be used. This glue type is recommended for joining ABS, styrene and acrylics to themselves where a water-thin cement
is desired. Is suitable and used on both large and small assemblies, with applications like signs, large displays, lighting fixtures, housewares, electrical assemblies decorator items and many other products. The American company Ridout Plastics Company Inc. distributes this adhesive, costing from 18.74$ to 28.03$, depending on the quantity is ordered (www.eplastics.com). To read more about this adhesive and how it is applied, go to Appendix 11.

To glue silicone, the adhesive that needs to be used is Cyanoacrylate (www.permabondllc.com). The silicone parts that need to be glued are the rubber band to the wall support (7 to 3) and the rubber handle to the top shell of the opener (15 to 9). The adjustable rubber band of the opener and the inner slider would also be assembled this way (14 to 10).

To assembly rubber and polymers, there are welding methods like cold vulcanization and hot melting that could supply the gluing. However, it has not been possible to determine if this methods are suitable to unions between the materials that are being handled. To get this information, the Belgian company *Grando* should be contacted (www.grando.net).

The silicone band that keeps the wall support's parts together when the container is being opened, needs to be magnetic at the ends so they can be clamped and opened again when needed in an easy way. A magnetic sticking tape would be added at the two ends of the rubber band, in a length of 80 mm, to ensure that the clasping is strong enough also in its most open position. The company Magsy distributes this magnetic adhesives; the price of a magnetic foil with the thickness of 0,7 mm is 16 $ (www.magsy.cz).
More possibilities of how to make the rubber ends magnetic should be investigated, contacting a production engineering expert.

Price Estimation

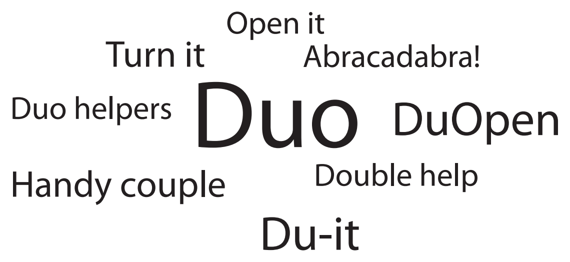
A price estimation for the wall support was carried out (www.custompartnet.comB), which revealed that the products will be cheap to produce, due to materials chosen and low number of components. However, the assembly is not considered in this estimation, what means that the price will be higher. To see the data for each of the parts, go to Appendix 12.

	Material	Production process	Material price (100.000 units)	Production price (100.000 units)	Tool price (100.000 units)	Total price (100.00 units)	Price per unit
Wall support	ABS	Injection molding	21.6 $	21.2 $	27.8 $	70.6 $	0.7 $
Moving part	ABS	Injection molding	19.8 $	20.9 $	26.3 $	67 $	0.7 $
Wall support's lid	ABS	Injection molding	7.1 $	10.7 $	21.3 $	39.2 $	0.4 $
Moving part's lid	ABS	Injection molding	6.9 $	10.7 $	21.3 $	39 $	0.4 $
Wall support's rubber	EVA	Injection molding	8.4 $	6.9 $	14.7 $	30 $	0.3 $
Moving part's rubber	EVA	Injection molding	8.4 $	6.9 $	14.7 $	30 $	0.3 $
Rubber band	Silicone	Injection molding	15.8 $	18.2 $	28.5 $	62.3 $	0.6 $

TOTAL PRICE PER UNIT: 3,2 $

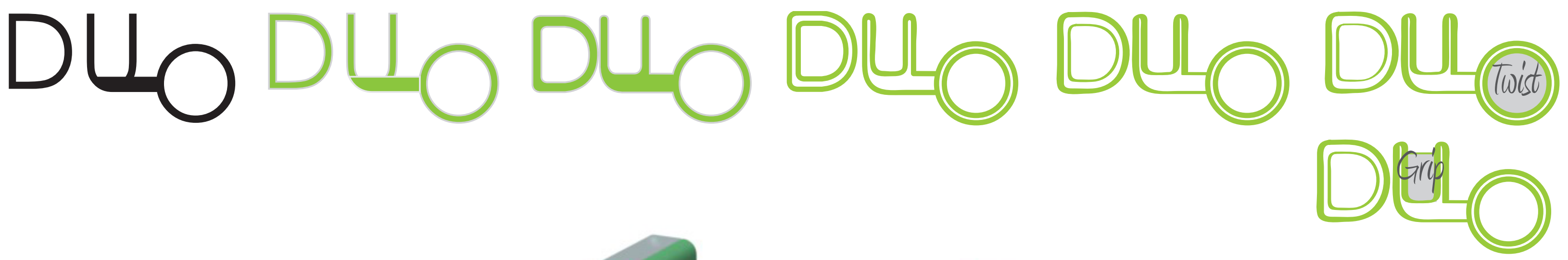
Product Name and Logo

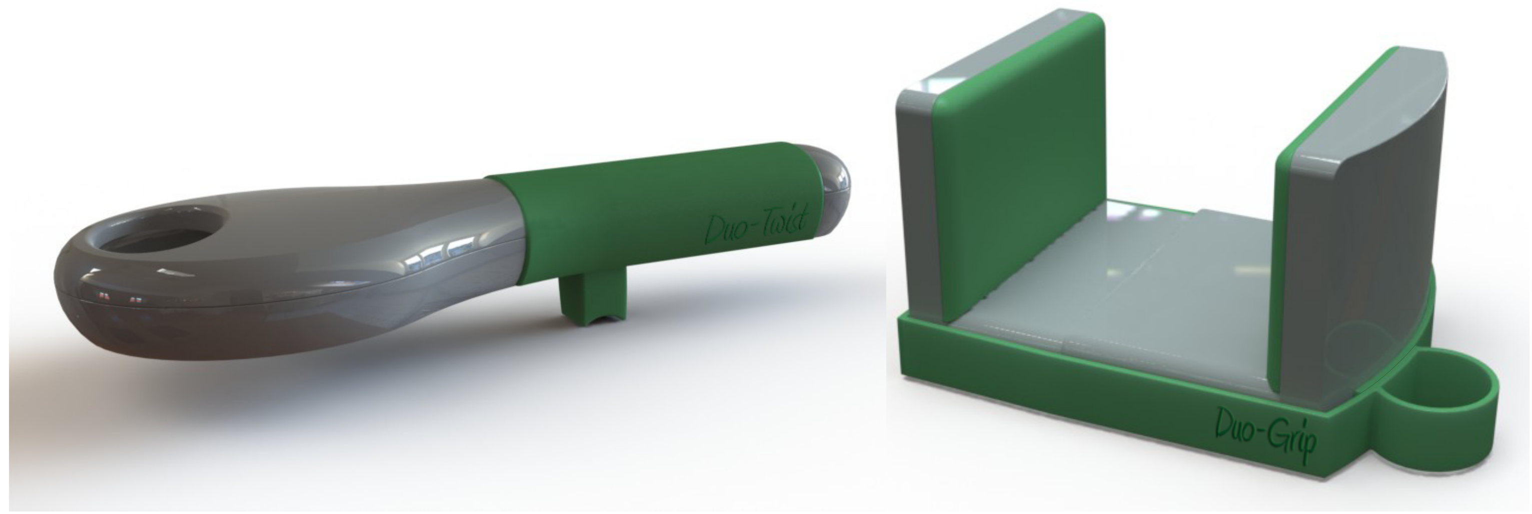
The product name is chosen underlining the aspect that the complete product package is a combination of two products, a couple. Besides, with the letters that the word DUO form, it is possible to create a logo in relation with the two products (ill. 68). The name of the product will be on the rubber parts of both products, embossed (ill. 69). Here the logo is not printed out, just the name, since the complete logo would be too tiering visually. The product logo will be printed in the product package, which it has not been designed within the project period.



Ill. 66. Brainstorm in different names.

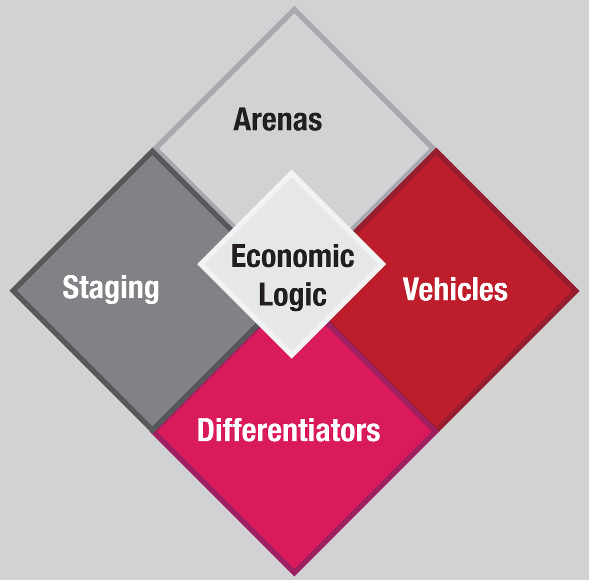
Ill. 68. Evolution of the logo and final logo.





Ill. 69. The two products with the name embossed in the rubber.

Strategy



Ill. 70. Chart showing the five points that a strategy should contain according to Hambrick and Fredrickson.

What is a Strategy?

A strategy has five elements that form a unified whole (ill. 70).

• Arenas: where will we be active?
• Vehicles: How will we get there?,
• Differentiators. How will we win the marketplace?
• Staging: What will be our speed and sequence of moves?
• Economic logic: How will we obtain our returns?

(Hambrick and Fredrickson, 2005)

An strategy according to these five points was developed, with the aim of having a plan to introduce the product into the market.

Arenas

The business where the product will be active is the kitchenware aids market. The product does not have an specific target, is directed to every person that needs help opening containers. The starting geographic area where the product would be released is Denmark, since it has been developed with information obtained in this country; the existing products in the market that have been tested and the dimensions of the containers, for example. However, if the reception of the costumers is good, will be expanded to the rest of Europe and after to other continents.

Vehicles

To introduce the product into the market, first an arthritis products supplier will be contacted. Even if the product is not exclusive for the market designing for arthritis people, the primary contact is established, so it is a more feasible starting point. The final product development will be carried out after the product is accepted and financing is get. Once the product is in the market, kitchenware suppliers will be contacted to expand the product to the common market.

Differentiators

In a competitive market, winning is the result of differentiators (Hambrick and Fredrickson, 2005). DUO is a combination of efficiency, comfort, style and an economical price. Both products are simple and handy to interact with. DUO-grip is the only product in the market that allows to release completely the stress of the gripping hand, without being fixed to the table or the wall.

Staging

The next logical step would be to make user tests and contact production engineers to improve the product ergonomically and optimize it according to components and molding.
Next, the arthritis product supplier will be contacted, to sell the product to them. If they show interest, the product will be developed in collaboration with them and when the development is accomplished, produced.
Once the product is in the market, it will be sold to current shops in order it can be found out of the exclusive market for arthritic people.

If the arthritic products suppliers is not interested, another company will be found, not necessarily inside the market for arthritis.

Economic Logic

Being a consumer product, the benefits will be obtained selling it to a higher price of the production price. An initiative to sell more of both products would be, to low the price if the consumer buys both products instead of a single one.

References

LITERATURE

Pullin, Graham (2009): Design meets disability, MIT Press
Bjorklund, Ruth (2010): Arthritis, Benchmark Books (NY); 1 edition
Clarkson J, Coleman R., Keates S. & Lebbon C. (2003): Inclusive design: design for the whole population, Springer Verlag, London
Dul, Jan Dul & Weerdmeester, Bernard (2008): Ergonomics for beginners, CRC PressTaylor & Francis Group, New York
Strasser, Helmut (2007): Assesment of the Ergonomic Quality of Hand-Held Tools and Computer Imput Devices, IOS Press, Netherlands
Lefteri, Chris (2006): Plastics 2, materials for inspirational design, RotoVision Book, Switzerland
Donald C. Hambric and James W. Fredrickson (2005): Are you sure you have a strategy? Academy of Management Executive
Tilley, Alvin R. (1993): The measurement of man and woman, Henry Dreyfuss Associates, New Tork

ONLINE REFERENCES

www.arthritiscare.org.ukA:	http://www.arthritiscare.org.uk/Home
www.arthritiscare.org.ukB:	http://www.arthritiscare.org.uk/PublicationsandResources/Listedbytype/Factsheets#cK45
www.cdc.govA:	http://www.cdc.gov/Features/ArthritisAwareness/
www.plusesmas.com:	http://www.plusesmas.com/diccionario/palabra/artrosis/
www.gigtforeningen.dkA:	http://www.gigtforeningen.dk/
www.gigtforeningen.dkB:	http://www.gigtforeningen.dk/viden+om+gigt/diagnoser/slidgigt
www.gigtforeningen.dkC:	http://www.gigtforeningen.dk/viden+om+gigt/diagnoser/leddegigt
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www.gigtforeningen.dkF:	http://www.gigtforeningen.dk/viden+om+gigt/diagnoser/b%C3%B8rnegigt
www.gigtforeningen.dkG:	http://www.gigtforeningen.dk/viden+om+gigt/diagnoser/sle+eller+lupus
orthoinfo.aaos.org:	http://orthoinfo.aaos.org/topic.cfm?topic=A00224
osteoarthritis.about.comA:	http://osteoarthritis.about.com/od/osteoarthritis101/a/what_is_OA.htm
osteoarthritis.about.comB:	http://osteoarthritis.about.com/od/osteoarthritissymptoms/a/signs_symptoms.htm
clinicaltrialsmgt.com:	http://clinicaltrialsmgt.com/Enrolling_Studies/Current/Osteoarthritis_Knee_Hip.html
www.pdrhealth.com:	http://www.pdrhealth.com/diseases/osteoarthritis/symptoms#BHG01RH08T01
www.livestrong.com:	http://www.livestrong.com/article/203908-rheumatoid-arthritis-factors/
www.metrohealth.org:	http://www.metrohealth.org/body.cfm?id=1611&oTopID=1604
www.cdc.govB:	http://www.cdc.gov/arthritis/data_statistics/national_nhis.htm
www.ehow.com:	http://www.ehow.com/info_8096839_uses-finger-joints.html
www.assh.orgA:	http://www.assh.org/Public/HandConditions/Pages/ArthritisOsteoarthritis.aspx
www.assh.orgB:	http://www.assh.org/Public/HandConditions/Pages/ArthritisRheumatoidArthritis.aspx
www.pncl.co.uk:	http://www.pncl.co.uk/~belcher/information/Osteoarthritis.pdf
www.oxo.com:	http://www.oxo.com/UniversalDesign.aspx
www.fiskarsgroup.com:	http://www.fiskarsgroup.com/corporation/corporation_5.html
www.alessi.com:	http://www.alessi.com/en/company/briefly-alessi
www.lekue.es:	http://www.lekue.es/filosofia.php
www.kuhnrikon.com:	http://www.kuhnrikon.com/products/tools/tools.php3?id=142
www.oxo.com:	http://www.oxo.com/p-408-jar-opener.aspx
www.brixdesign.com:	http://www.brixdesign.com/default.asp?Action=Details&Item=428
www.custompartnet.comA:	http://www.custompartnet.com/wu/InjectionMolding
www.eplastics.com:	http://www.eplastics.com/Plastic/ABS-Glue/WELD-ON-PLASTIC-ADHESIVE-GLUE-IPS2354-PT
www.permabondllc.com:	http://www.permabondllc.com/TDS/105_TDS.pdf
www.grando.net:	http://www.grando.net/uk/the-company.htm
www.magsy.cz:	http://www.magsy.cz/en/product/19147.magnetic-foil-with-the-thickness-of-0-7-mm/
www.custompartnet.comB:	http://www.custompartnet.com/estimate/injection-molding/

ILLUSTRATIONS

http://www.corbisimages.com/stock-photo/rights-managed/OF018506/hands-of-an-elderly-woman/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-23752553/mother-and-daughter-cooking-in-kitchen/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-21974212/grandmother-and-granddaughter-baking/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-25865927/a-couple-holding-various-kitchenware/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-25087849/couple-cooking-together/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-27145784/a-girl-decorating-a-biscuit-lolly-with/?tab=details&caller=search
http://www.gettyimages.de/detail/91523007/Stone
http://www.corbisimages.com/stock-photo/rights-managed/42-24083894/elderly-woman-cooking/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-20017385/woman-preparing-food/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-24110753/young-woman-sampling-spaghetti/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-18503342/home-cooking/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-27144553/three-young-people-preparing-chicken-dish-together/?tab=details&caller=search
http://www.gettyimages.dk/detail/200296150-003/Stone?Language=en-US
http://www.corbisimages.com/stock-photo/rights-managed/42-19186391/young-man-washing-carrots-for-cooking/?tab=details&caller=search
http://www.punchstock.com/com/DNK/en/asset_images/105664732
http://www.corbisimages.com/stock-photo/rights-managed/42-22543110/elderly-woman-cooking-in-kitchen/?tab=details&caller=search
http://www.gettyimages.dk/detail/101043706/Taxi
http://www.arthritisresearchuk.org/arthritis_information/arthritis_types__symptoms/rheumatoid_arthritis.aspx#non
http://www.cdc.gov/arthritis/data_statistics/national_nhis.htm
http://www.corbisimages.com/stock-photo/royalty-free/42-17022023/woman-reaching-for-a-book/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-23343886/man-sitting-on-bench-near-market/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-15354145/woman-with-shopping-bag/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-15274921/woman-walking-up-the-stairs/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-18564306/man-and-woman-passing-each-other-in/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-27363574/man-walking-in-kyoto-temple-grounds/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-21639399/belgium--waterloo--duke-of-wellington/?tab=details&caller=search
http://www.assh.org/Public/HandConditions/Pages/ArthritisOsteoarthritis.aspx
http://www.assh.org/Public/HandConditions/Pages/ArthritisRheumatoidArthritis.aspx
http://www.corbisimages.com/stock-photo/rights-managed/42-18526021/nurse-entering-information-into-vaccination-record/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-21710793/picking-up-squares-of-chocolate/?tab=details&caller=search

http://www.corbisimages.com/stock-photo/royalty-free/42-23884358/man-putting-car-key-in-door/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-16247305/woman-holding-glass-of-water/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/172-PE-288-AW8572/senior-man-speaking-on-cordless-phone/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/OF018513/woman-carrying-a-baguette-in-a-bag/?tab=details&caller=search
https://newsphilter.wordpress.com/2010/11/18/disastrous-attempt-to-take-lid-off-jar-leads-to-easy-pay-day/
http://www.corbisimages.com/stock-photo/rights-managed/AAHB001002/hands-using-a-can-opener/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-24996536/open-canned-goods/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-26519600/woman-stirfrying-vegetables/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-26518841/woman-chopping-carrots/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-22579780/african-american-woman-preparing-dinner/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-27313913/man-taking-cornish-pasties-out-of-the/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/royalty-free/42-22735937/woman-sorting-bowls-on-cupboard-top/?tab=details&caller=search
http://www.corbisimages.com/stock-photo/rights-managed/42-27101221/peeling-an-apple/?tab=details&caller=search
http://www.acaciamedical.com.au/products/daily-living/food-preparation.php
http://www.arthritissupplies.com/site/371928/product/NC28199
http://www.livingmadeeasy.org.uk/kitchen%20and%20household/mounted-screw-lid-openers-p/jar-opener-0105683-2285-information.htm
http://www.thisnext.com/item/34374DAF/25841425/Ring-Pull-Can-and-Jar-Opener
http://www.arthritissupplies.com/site/371928/product/AMCPKTFK
http://www.watercomfort.com.au/REHABALL/ReAids.htm
http://practicalpainrelief.com/tag/arthritis/
http://www.arthritissupermarket.co.uk/Scissors
http://www.activemobility.co.uk/shop/product_info.php?ref=32&products_id=299&affiliate_banner_id=1
http://www.techforltc.org/product.aspx?id=3693
http://www.forrmobility.co.uk/Products/DailyLivingAids/EatingDrinking.html#thumb
http://www.activemobility.co.uk/shop/product_info.php?ref=32&products_id=335&affiliate_banner_id=1
http://www.gadgetgrid.com/2007/10/03/back-to-basics-apple-and-potato-peeler
http://www.arthritissupplies.com/site/371928/product/CMI74527
http://www.arthritissupplies.com/site/371928/product/NC3534
http://www.mercante.no/productDetails.aspx?pId=1458&cId=0

http://www.oxo.com/default.aspx
http://www.oxo.com/p-406-magnetic-locking-can-opener.aspx
http://www.oxo.com/p-896-chefs-mandoline-slicer.aspx
http://www.oxo.com/p-562-6-piece-kitchen-essentials-set.aspx
http://www.oxo.com/p-504-angled-measuring-cup-1-cup.aspx
http://www.oxo.com/p-490-little-salad-herb-spinner.aspx
http://www.oxo.com/p-548-egg-slicer-chopper.aspx
http://www.rosleusa.com/
http://www.rosleusa.com/EnlargedProductView.html?plu=12782
http://www.rosleusa.com/EnlargedProductView.html?plu=12781
http://www.rosleusa.com/EnlargedProductView.html?plu=12804
http://www.rosleusa.com/Jar-Opener-plu12804.html
http://www.josephjoseph.com/
http://www.josephjoseph.com/kitchen-tools/smasher/smasher-grey
http://www.josephjoseph.com/kitchen-tools/compact-herb-chopper/compactherbchopper
http://home-ware.fiskars.com/web/fiskarsweb.nsf/uk/home-ware
http://home-ware.fiskars.com/web/fiskarsweb.nsf/uk/utensils_functional_form_rolling_pin_with_non-stick_surface_858174
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http://home-ware.fiskars.com/web/fiskarsweb.nsf/uk/utensils_functional_form_wine_opener_858113
http://www.alessi.com/en/
http://www.dezeen.com/2010/01/21/essentiel-de-patiesserie-by-matali-crasset-and-pierre-herme/
http://www.alessi.es/ashop-es/design-products/electrodomesticos-90150/apirador-sin-cable-2894.html
http://www.alessi.es/ashop-es/design-products/bar-y-vinos-90149/abrebotellas-a-presion-pop-up-4158.html
http://www.lekue.es/index.php
http://www.lekue.es/producto.php?prod=exprimidor-de-limones-1-unidad&referencia=3401100&opcion=linea&lineaProducto=&tipoProducto=&coleccionProducto=54&publicoProducto=&usoP
roducto=&pagina=0
http://www.lekue.es/producto.php?prod=decomax&referencia=3403200&opcion=linea&lineaProducto=&tipoProducto=&coleccionProducto=19&publicoProducto=&usoProducto=&pagina=0
Dul, Jan Dul & Weerdmeester, Bernard (2008): Ergonomics for beginners, CRC PressTaylor & Francis Group, New York
http://www.kuhnrikon.com/products/tools/tools.php3?id=142
http://www.wisdomking.com/product323533c301374.html
Donald C. Hambric and James W. Fredrickson (2005): Are you sure you have a strategy? Academy of Management Executive