

Aleksandar Minkov

Advanced Design Principles

IKEA Project | Wilko Project

2018 Logbook



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**Advanced design principles
IKEA project**

2018

Technologies and Types of Light Bulbs

Today there are various types of light bulbs on the market and broad ways to implement their beauty in our homes. However, it was not that long ago when the convenience of having an electric light at home was a luxury accessible only for a few.

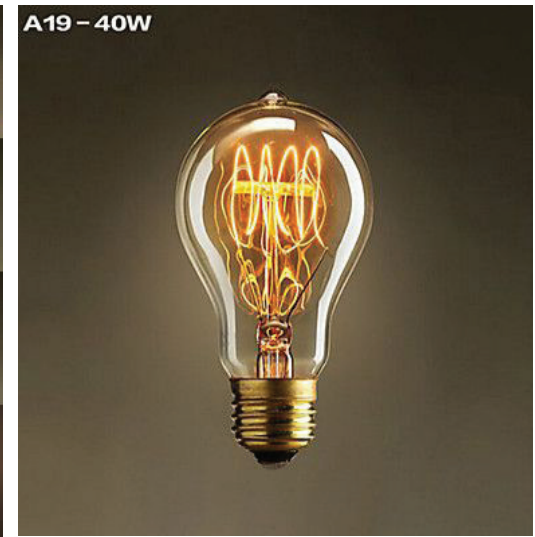
The incandescent light that we use to this day (although very rarely) was the first commercially practical light that began its manufacturing process for the wide public in 1880 by the American company Edison Electric Light. However, Thomas Edison was not the first nor the only person who was trying to invent an incandescent light. The lamp has a wire filament that is heated with an electric signal so that the wire produces light. The inner parts are protected with a thin layer of glass: this way, the parts can withstand the oxidation of the open space.



Img.1



Img.3



Img.2

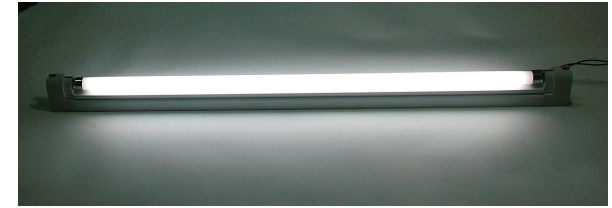
*In the mid-1930s, the first **fluorescent light** for commercial use was introduced. The bulb looks like an elongated tube or as a U-shaped bulb. The inside of the tube is fluorescent coated with that helps convert the UV light into visible. The bulb is filled with mercury vapor, which with the help of an electrical signal helps it emit UV light.*



Img.4



Img.5

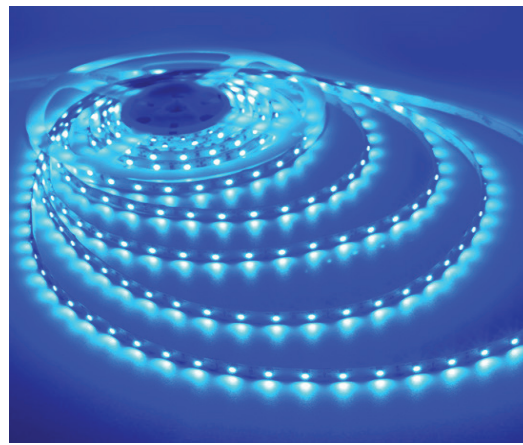


Img.6

*These days, **LED lights** are the most efficient way of saving energy – with almost 85% cost reduction compared to the incandescent lights. The LED lights are also highly environmentally friendly and due to their very low wattages and exceptionally long lifetime, they are favored by more and more people and slowly become the main source of light in their homes.*



Img.7



Img.8



Img.9

Market Diversity

The proper positioning of the lighting in home is very important. The light in the room provides not only the desired visibility but with the right choice of light sources, positioning and considering where the accents should go, the mood of the room can change dramatically.

There are many options on the market to achieve the desired look of the room.

Ceiling lights are probably the most common and traditional types of lights available on the market.

They can vary from a centrally located light source that provides good illumination in the middle of the room (but losing that effect in the corners of the room) to recessed lights that can cover the entire premises and can be installed in every corner of the ceiling, due to their small-scale size. They are excellent for “opening” the full capacity of the room by installing them across the places where accents are needed.



Img.10



Img.11



Img.12

Desk lamps are also a universal tool for a better control over the light in the room. They are flexible and adjustable, sometimes equipped with mechanical “arm” and a moving head. They provide various ways for the light to be directed at the desired position. The desk lamps are usually small and compact, which allows the customer to relocate them everywhere with ease.

Img.13



Img.14,15



Table lights can be an ideal solution for every dark corner or just for a nice place to read and relax. They can come in numerous shapes, materials, and colours, such as metal, wood, glass, and plastic.



Img.16



Img.17

The wall lights are very efficient in bringing light to the apartment; and moreover, they help place an accent on the architectural appearance of the space.

Wall lights can truly change the mood in the room depending on where and how they are placed.



Img. 18-20



Price Consideration

Considering the price of the product is very important and can have a strong impact on the overall outcome of the product.

Knowing exactly what the market I am aiming for is plays a crucial role. IKEA is well known for the practical solutions it offers and the very reasonable price and good quality materials they use. For almost every part of our homes, IKEA has to offer a replacement that is stylish, simple and creative.

Choosing the right materials and considering all possible approaches to production techniques makes a big difference in the price brackets when the final cost has to be determined. Assuming that the customer is expecting to receive something that IKEA is well-known for, the price of the lamp with exceptional design and good quality has to be carefully thought of.

Having the options of two price brackets to choose from (between 5 and 15 pounds or between 20 and 30 pounds), I decided to select the higher price range of 20 to 30 pounds due to the fact that I am aware of the amount and type of materials IKEA would use if the lamp were to be manufactured. Furthermore, a few external components are predicted to be added in the packaging box, and they would potentially be shipped to the assembly factory, which would also cause a light increase in the final price.



Img.21

Sin L Table Lamp by Santa & Cole
Design: Antoni Arola
£1.783.92



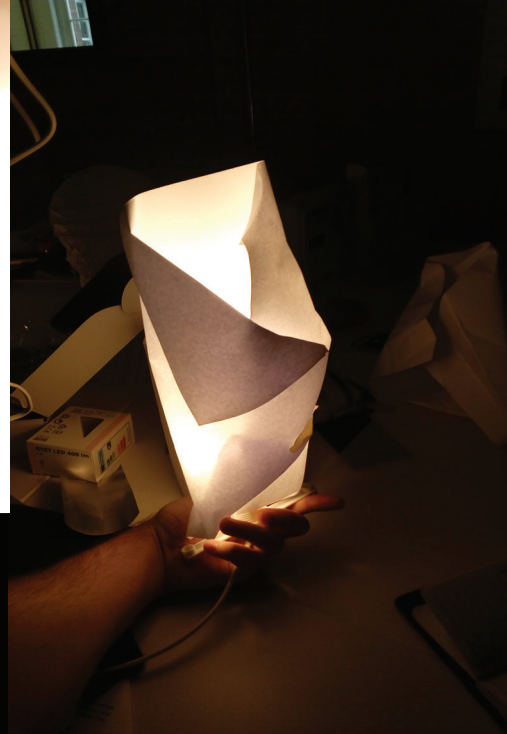
Img.23

Collection Dali Touch Table
Lamp
£34.99



Material Testing

During the first studio day, I had the chance to experiment with materials given to me, as well as some materials I brought with me for the session. I tested several materials and experimented with forms and two different types of materials that day. Different forms were produced during a few two minute brainstorming challenges. The experiments with forms and the way the light reacts with materials brought a very useful knowledge I used later in the development of my product.



By testing several different materials, I learned that colour plays an incredibly important role and can dramatically change the levels of illumination. Depending on how light or dark the colours of the materials I choose to use are, the light will spread differently in the space. Furthermore, I can use this as an advantage in improving the final look of my lamp. If I need to choose a material that has low light reflective quality due to its other desirable properties, I can compensate the material's disadvantages with the proper choice of colour.





IKEA Visit

IKEA is a worldwide retail company with over 400 stores in 49 countries. It is well recognized for their ready-to-assemble furniture, kitchen appliances and home accessories. The company was founded 75 years ago in the small Swedish village of Älmhult located between the largest Swedish cities Malmö, Gothenburg, and Stockholm.

Slowly, the company has started to expand and in 1963 IKEA opened its first international store in Norway. Later on, the news about the new Scandinavian furniture exporter spread all around the globe and in the next 40 years the firm opened more than 200 stores in four continents.

Today IKEA is the largest retail furniture company in the world and is listed as one of the top 40 wealthiest companies.



IKEASheffield (2017)





IKEA Sheffield (2017)





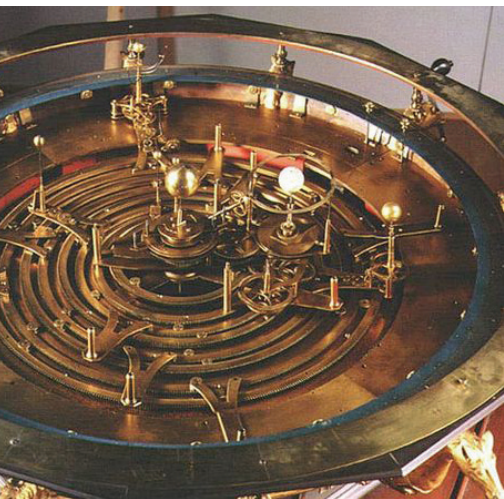
IKEA Sheffield (2017)

Inspiration

I was fascinated with the way light can be controlled by using almost any kind of materials that I can think of. Almost immediately the idea of theater projectors came into my head as a starting source of inspirational development.

The amazing effects of the light that these projectors can provide made me curious to know how light can be reflected, defused, concentrated and even coloured with just a few control mechanisms.

Astronomic clock mechanisms from the late Romantic period were also a prime inspirational source for my idea. The late stages of my product's mechanism development were highly influenced by these clock mechanisms.



Imgs. 23-28

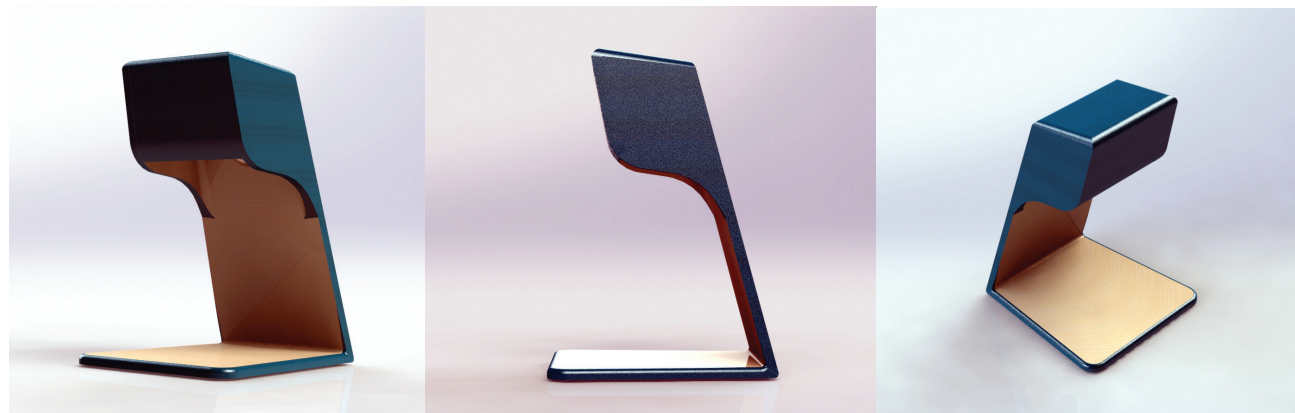
Initial Ideas

While visiting IKEA, I saw intelligent and inspiring design solutions. During the first week of the project, I tried to throw in as many ideas as I could on the sketching sheets. By learning IKEA's practical ideology based on receiving their products in parts (in order to save space while shipping and bring emotional satisfaction to their customers by letting them self-assemble the products), I focused my thinking in the same direction.

First, I concentrated on a system of surfaces that reflect the light on each of their planes by bouncing it from one piece to another. The pieces were positioned and bent in a specific arrangement in order to achieve the desired effect. The parts could be constructed from a wooden material that will be bent with the help of steam and then coated with a reflective material on one side. The idea was inspired by the pyramid tombs. As the light cannot go through the closed rock structure, the Egyptians used a system of mirrors pointing at one another thus reflecting and carrying the light from the outside to the bottom of the structure.

My second concept was an eccentric attempt trying to apply the Scandinavian design philosophy. My speaker project from last year was based on the Nordic and Scandinavian philosophy, and since the aim of this year's first project is a light design for a Swedish company (IKEA), I decided to implement these beliefs in this second concept of mine. (Bottom right corner)

The third and final concept I generated was strongly inspired by the theatrical and contemporary exhibitional lighting, as well as some very interesting clock mechanisms. This light is designed to be a practical and flexible ceiling light that can regulate the incoming light in the room with a brilliant yet minimal mechanism. The structure has three different main bodies - base and top parts, and four attachable shaders. The idea of the product is to give the customer control over the light flow with a simple twist of the mechanism.



Second concept

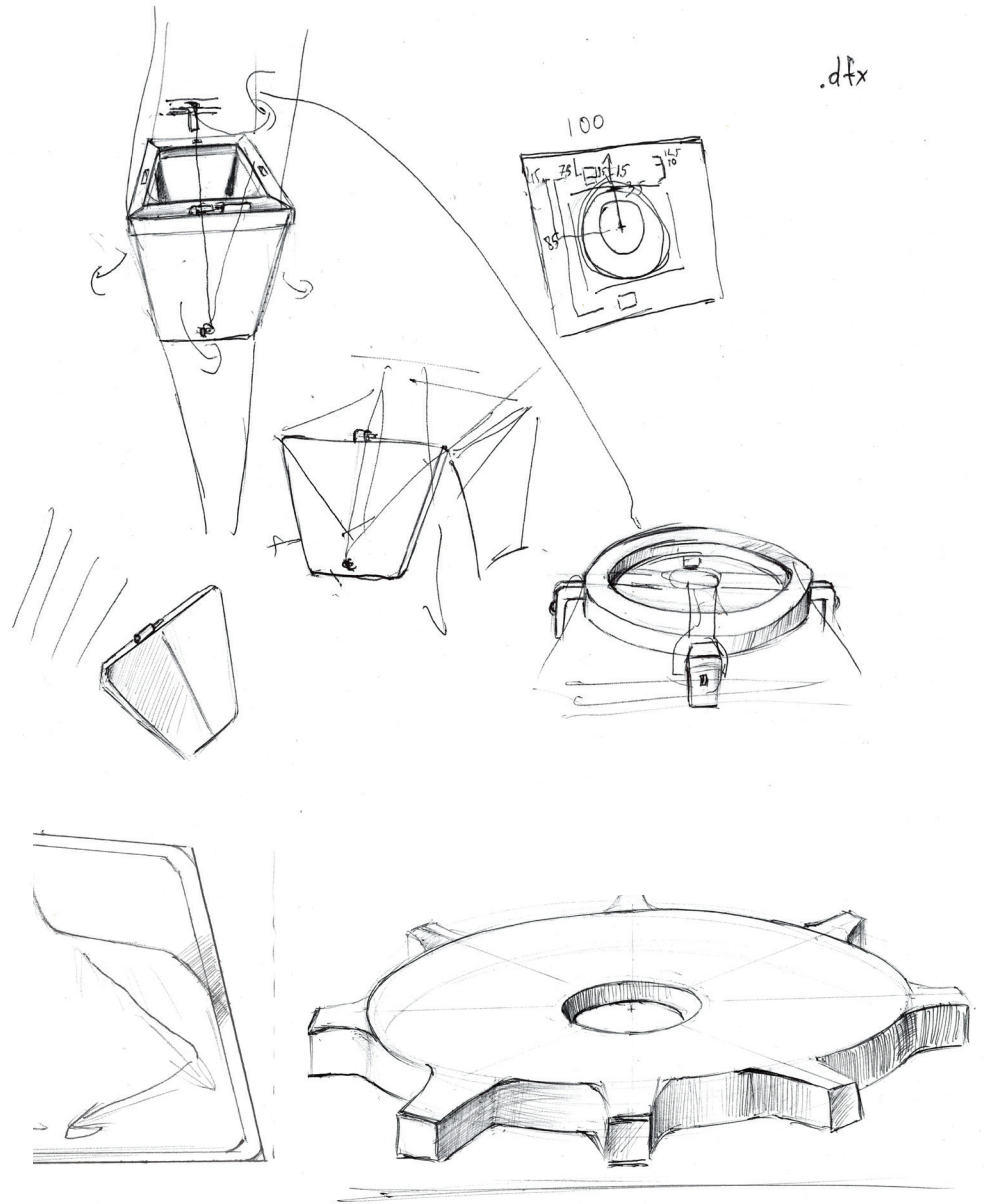
Sketching and Experimenting with Forms

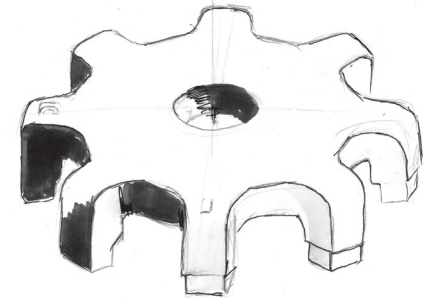
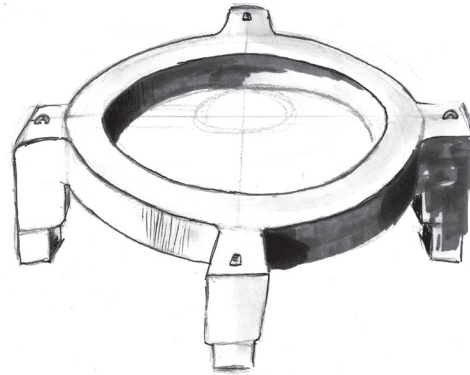
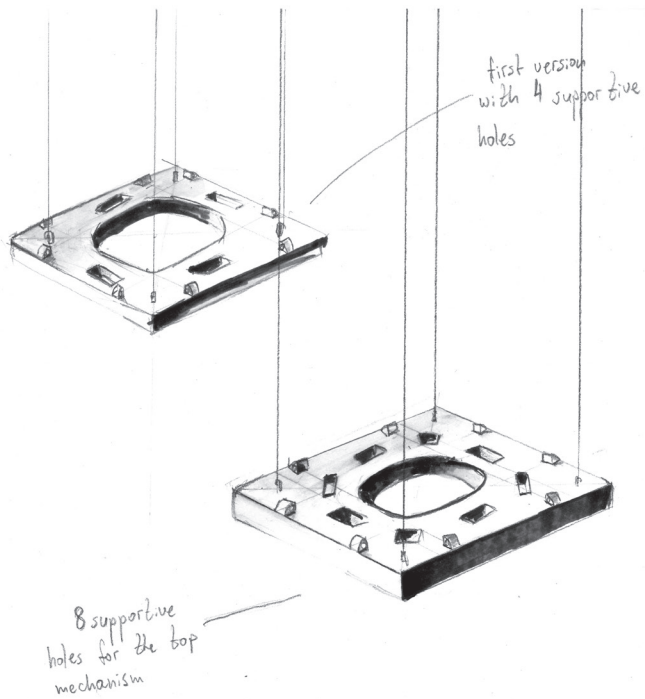
The idea that I stopped on (top right) has a very interesting vision and functionality.

How it works:

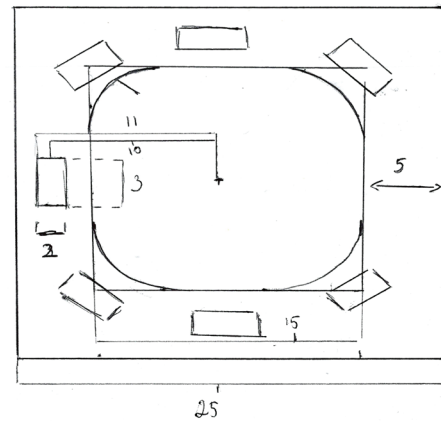
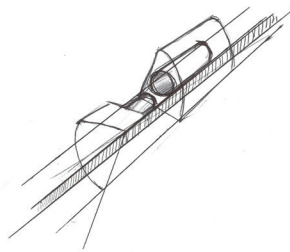
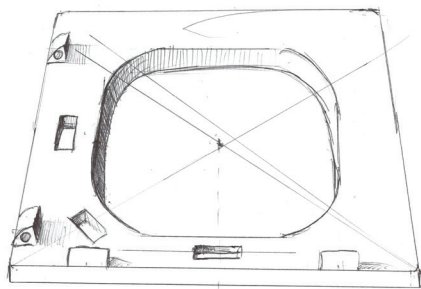
The light has three main components: a base structure, a top structure that fits in the base structure (looks like a gear wheel) and four shades.

The principle is simple: pull-strings are attached from the bottom of the shades to four hooks that are mounted to the top structure. When the top part is pulled upwards and twisted clockwise from the base, the pressure that is applied to the strings makes all the shades lift simultaneously. Once the desired form of the lamp is reached, the top part needs to be pushed back down, so it locks in.





The base structure went through various changes. The gear holes and the extension legs have a very important role as they would hold all parts in place and provide support for the external components. My initial design with four holes and four legs was replaced by the same design principle but this time with eight holes and legs offering exceptional precision over the tension the strings apply.



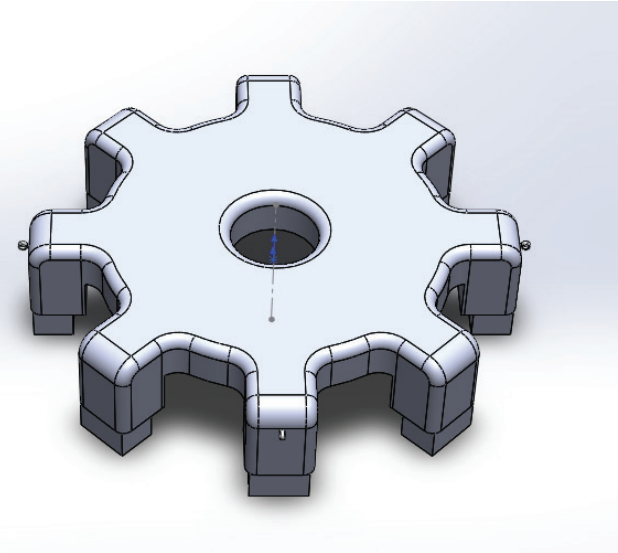
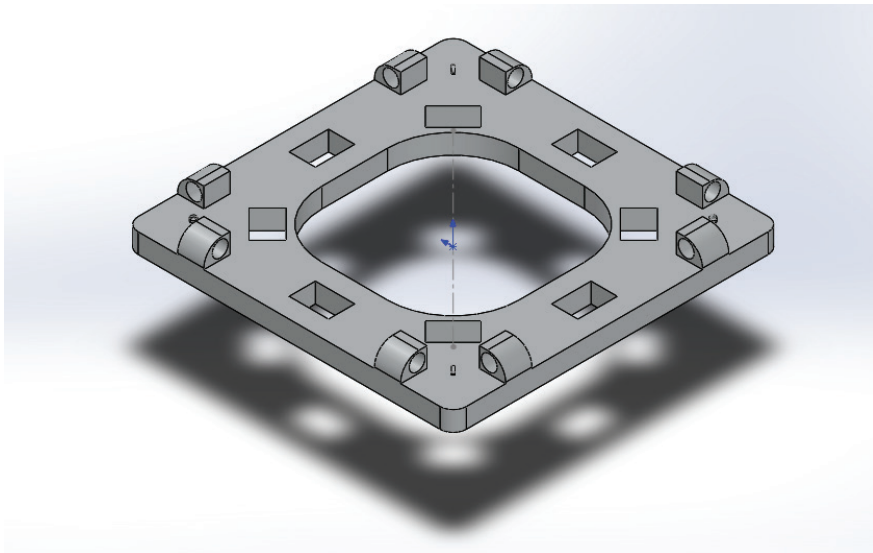
CAD Process/ 3D Development Process

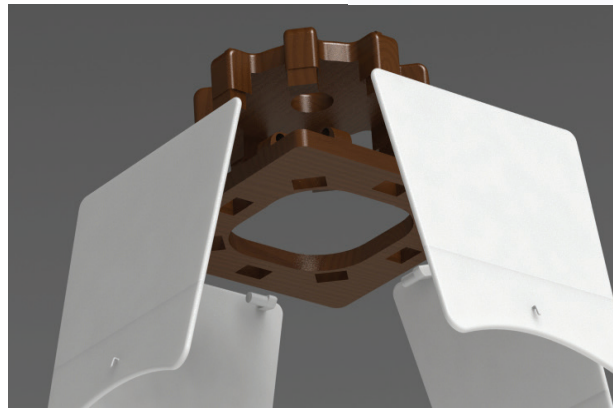
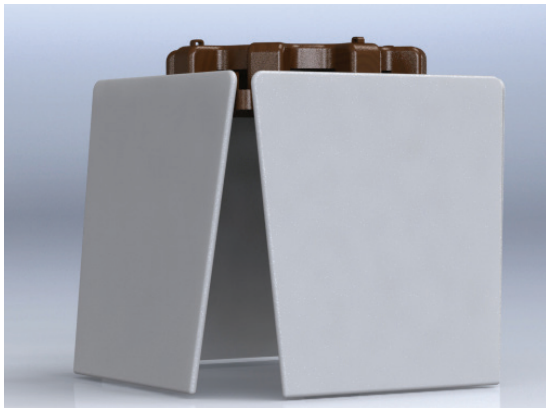
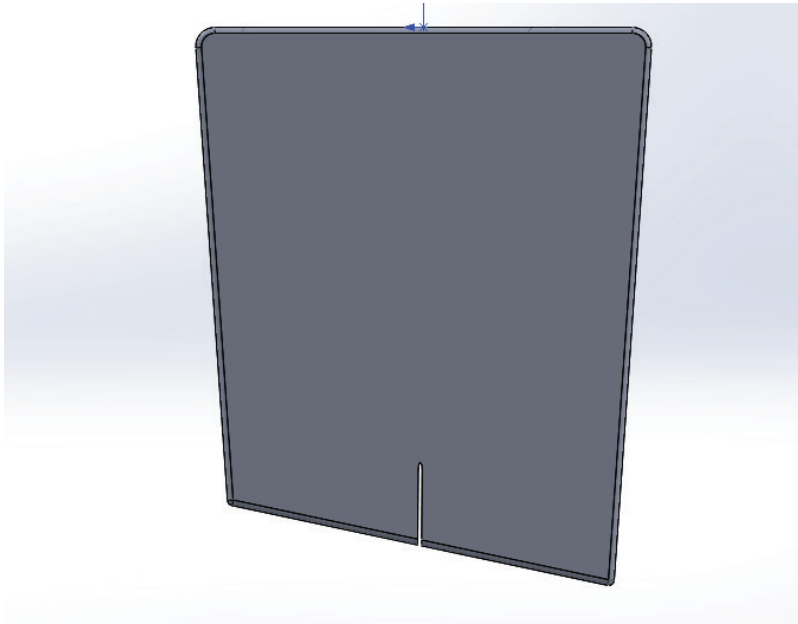
Starting to work with Solidworks early on helped me a lot with this project. I implemented two of my initial ideas in Solidworks in the first week of the project, which helped me to scale, visualise and enhance my ideas. Later on, this saved me many hours in the workshop.

Once I decided that the idea with the moving mechanism of the ceiling light would fit best the needs of the project, I forced myself to work in the direction of improving and eliminating any imperfections of the product.

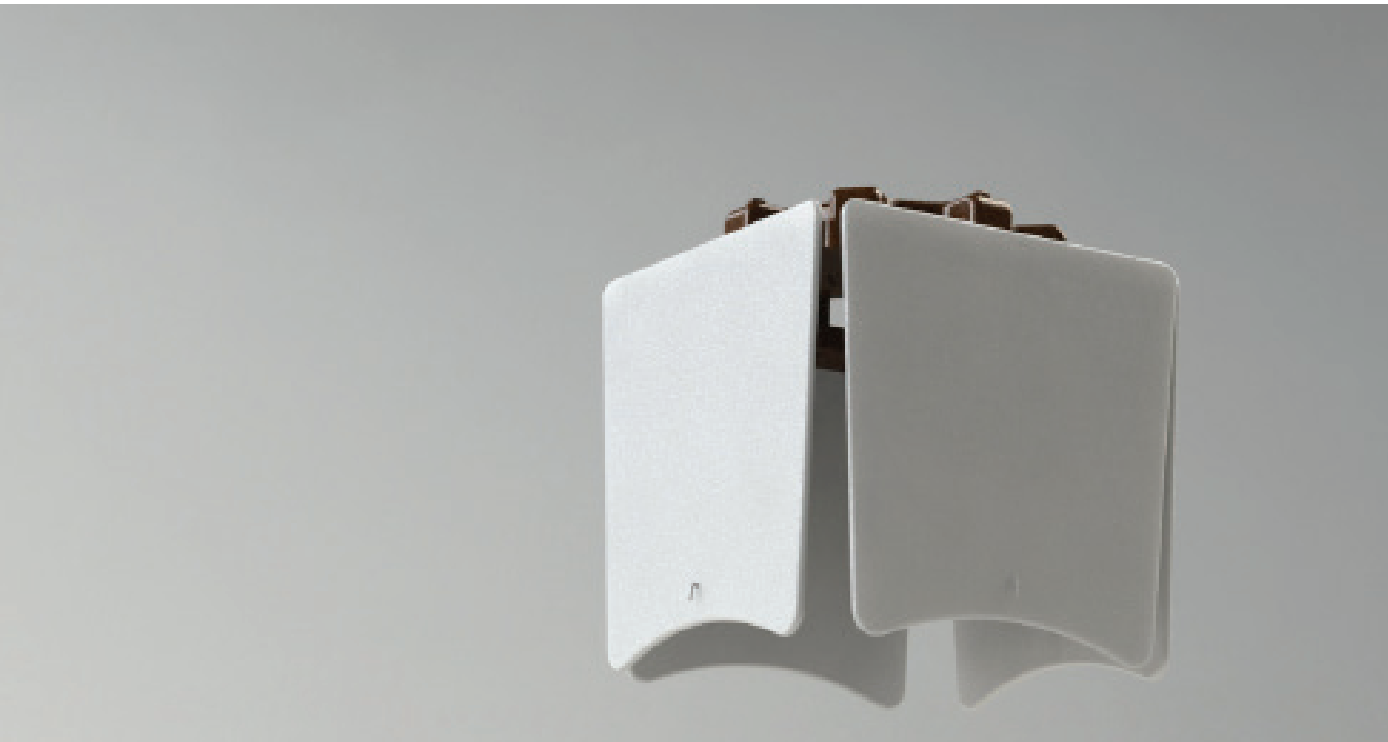
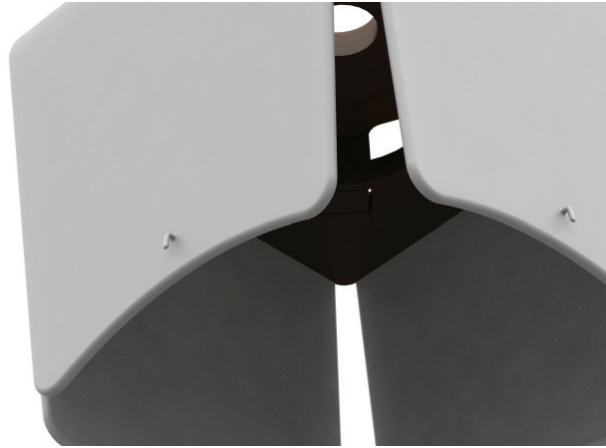
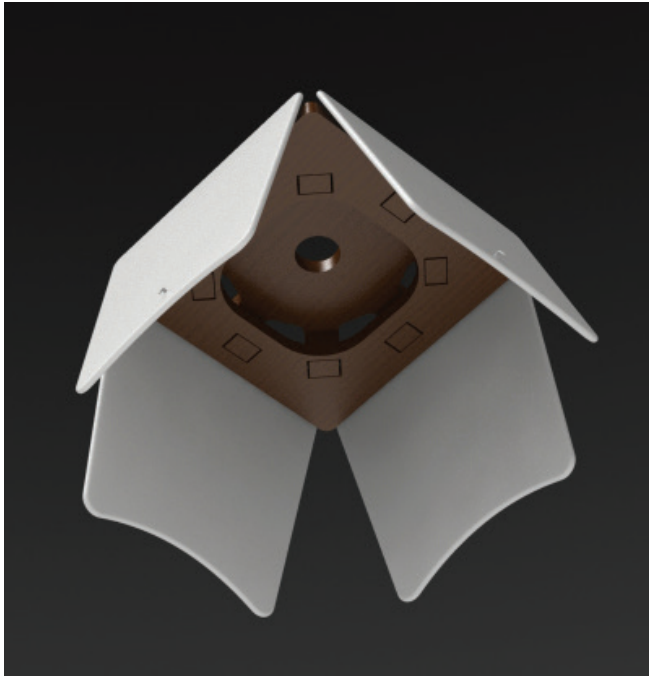
In a period of five days of constant development of the 3D solution, the product has gone through three main stages of renovation besides many other small changes.

Solidworks has a wide variety of options of how a file can be exported. The CAD product was taken into parts and exported as drawings and DXF files so that all the measurements can be imported into a laser cutting machine. Accuracy and precision were needed for every single part since every part must fit perfectly in position in order for the mechanism to fulfill its function.

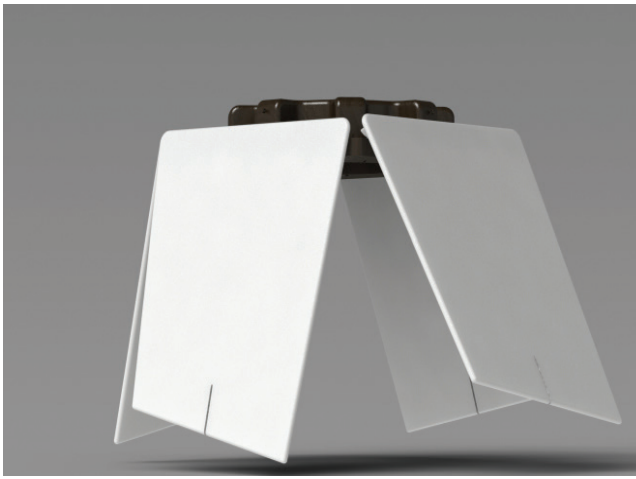
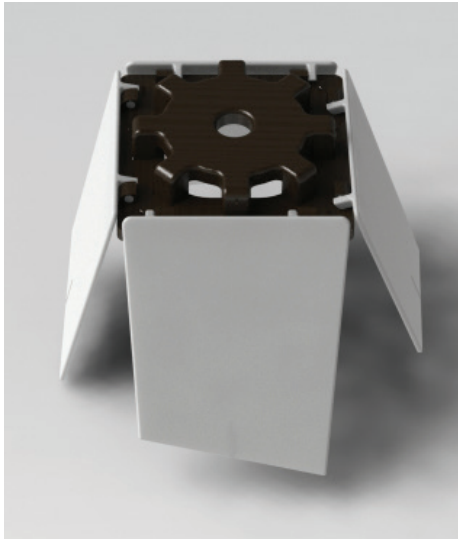
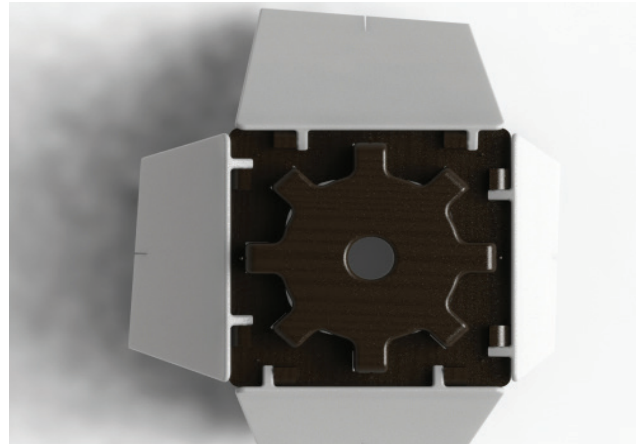
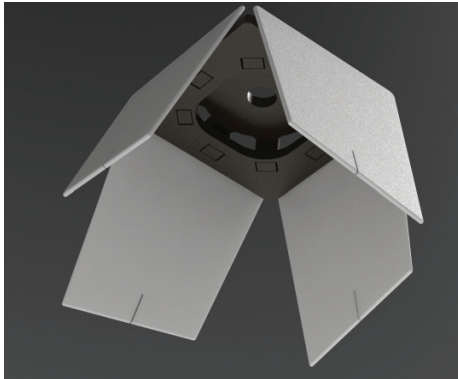




Once I had the bottom and top structures of the main body, I started thinking in the direction of how I could improve the form of the shades and in particular the light flow. Three different shade designs drew my attention. My light structure has four regulating shades controlling the incoming light in the room. They will define the rate of defusion of the light and will make up the largest part of the visual appearance of the lamp.



The first recreation of the lamp in Solidworks consisted of a dark gloss wood finish of the main components combined with gently curved edges of the shades, which seemed to be a very delicate finish to the overall look of the light.

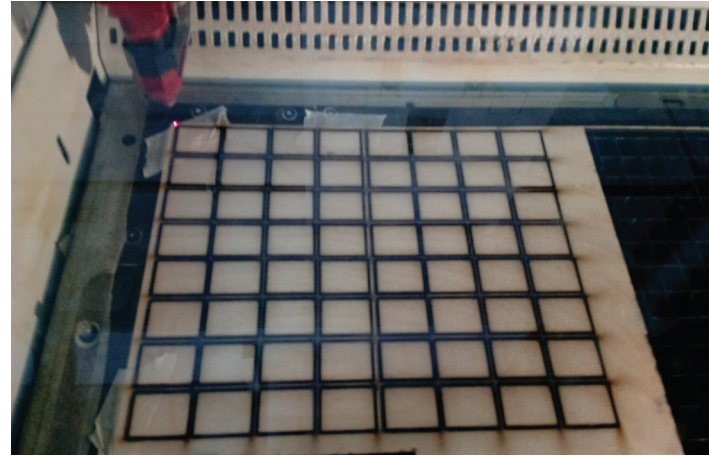


Final CAD Model

The final CAD model had slightly noticeable larger shades than the previous models, in addition to small delicate cracks on the bottom side of each shade, so the string knots can slide in easily.

I chose the colour of the shades to be pure white, as they will have to reflect the light from their surfaces. Furthermore, I chose light warm gray in a combination with dark neutral brown for the top and bottom components trying to keep the appearance of the wood as natural as possible.

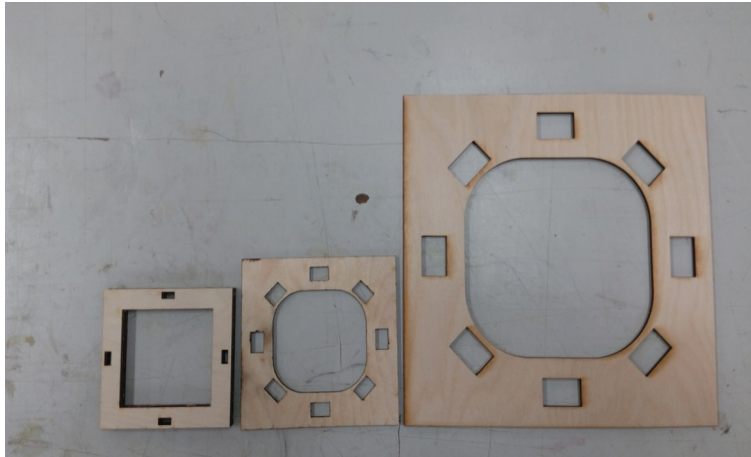
Testing and Model Making



Once I was aware of all the measurements of my product, I imported my CAD files into a laser cutting machine, so I could begin the actual testing and scaling. The precise cut of the laser was needed in order to obtain high accuracy.

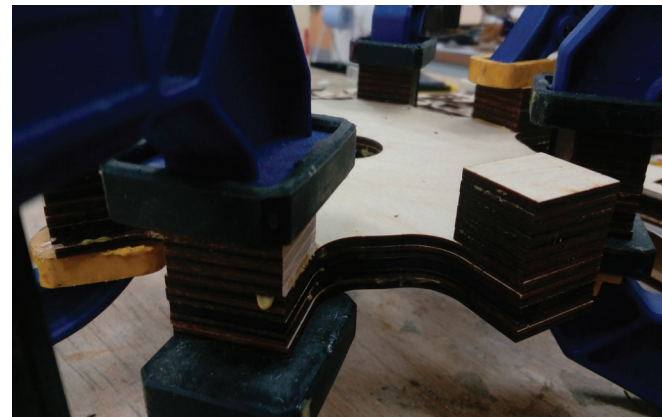
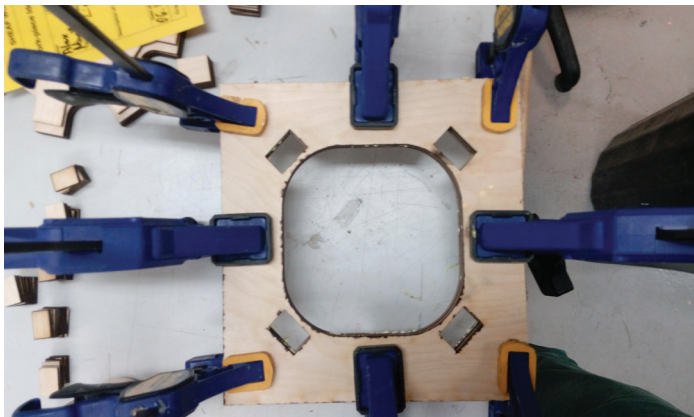


All 191 bits were cut out from a 3mm plywood. All pieces that make up each component had to have the exact same size so that they can fit correctly. They were then all glued together and left to dry overnight.

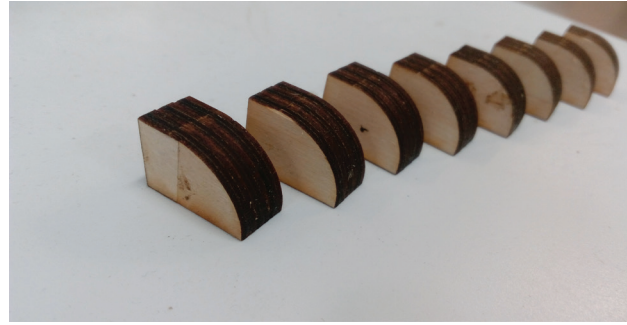


The bottom frame went through some changes in terms of form and functionality. The latest version (on the left) was scaled and shaped, and served as a starting point for the rest of the components.

A few of the parts had to be reshaped and redesigned over and over. This gave me a hard time and put me back in the starting position several times, but it also served me well in learning how to manage my time better. The redesigning process had to start from the sketches and go to the 3D program next, until I could finally continue with the model making.

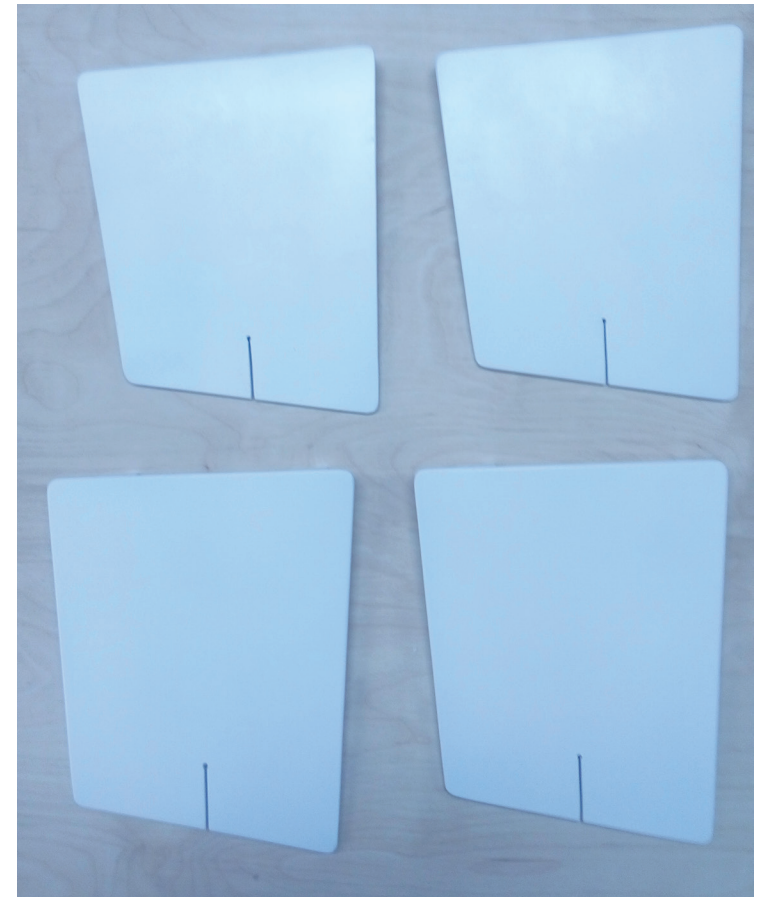
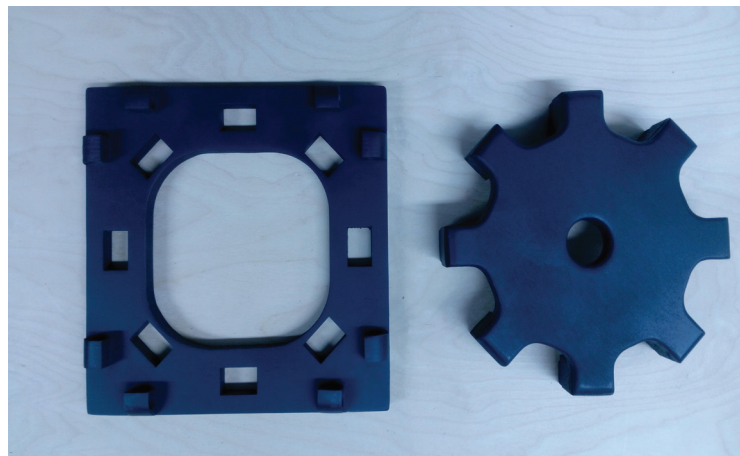


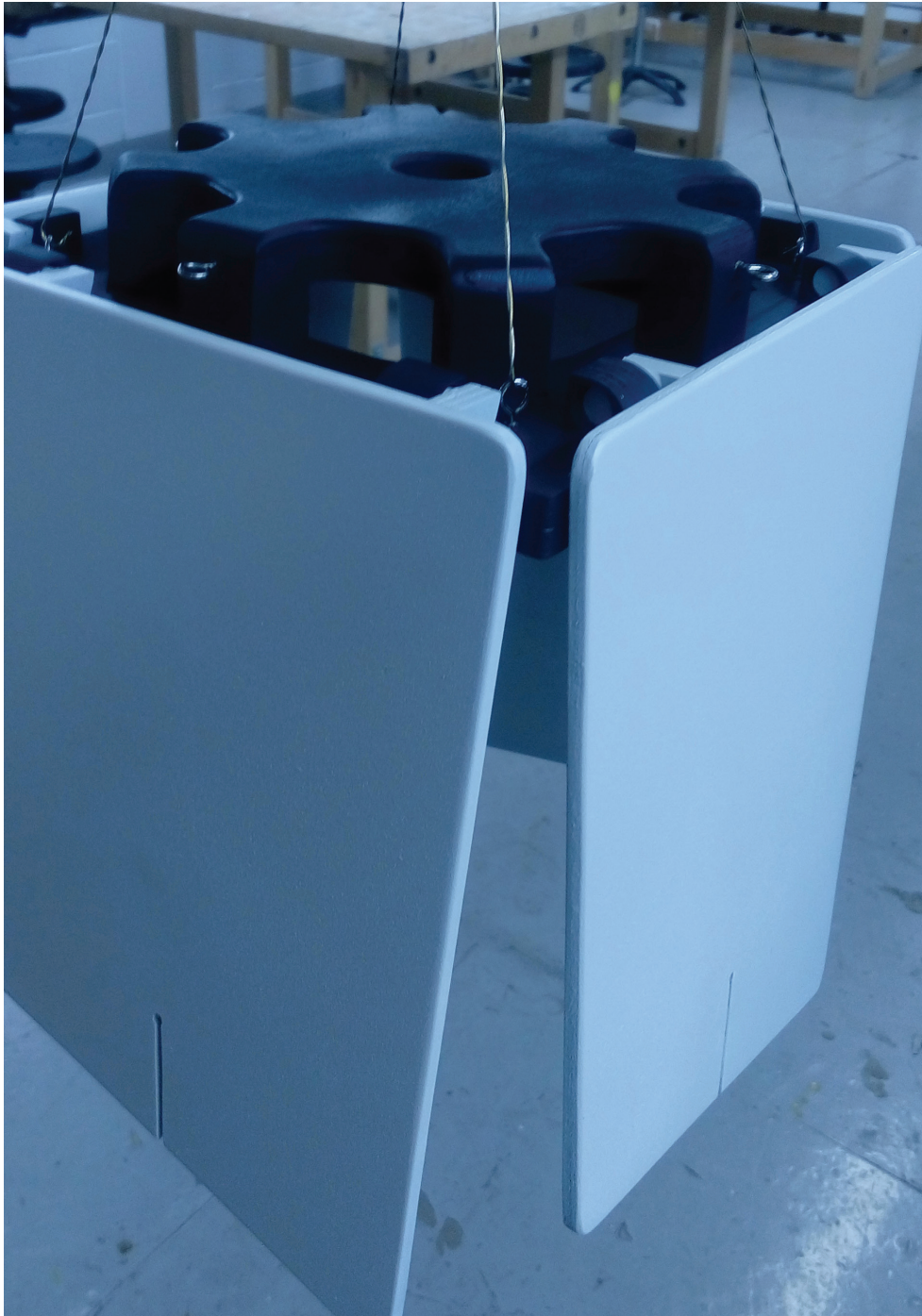
At the end of each day in the workshop, the parts were glued with polyvinyl acetate formula (PVA) and then clamped together overnight.

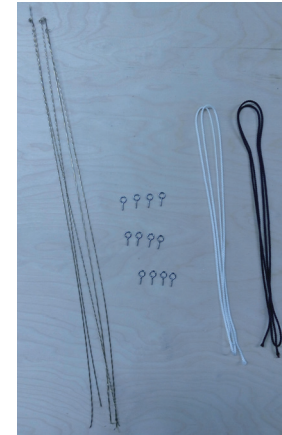
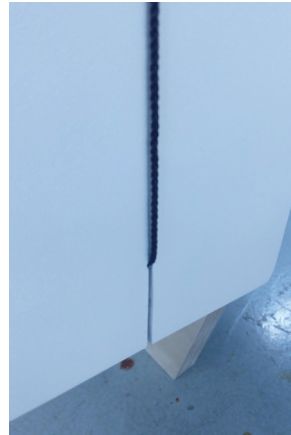
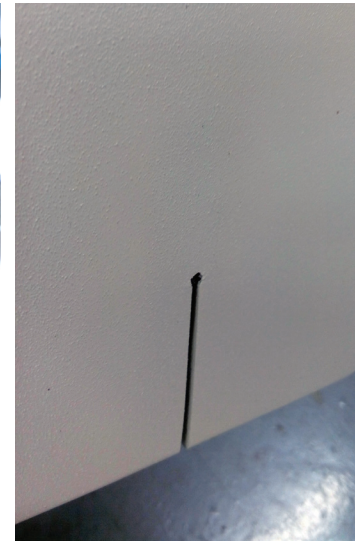
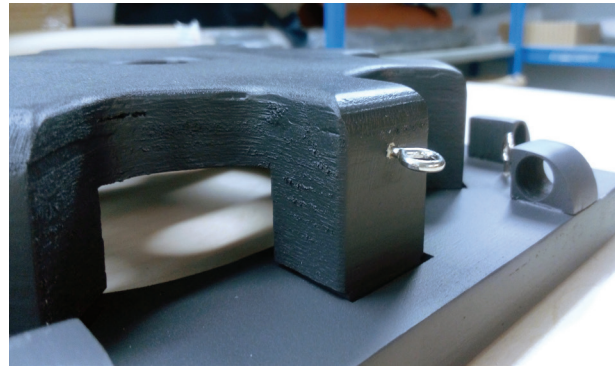
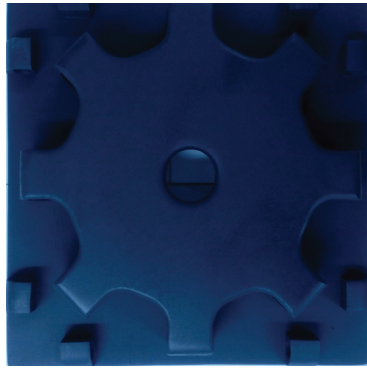
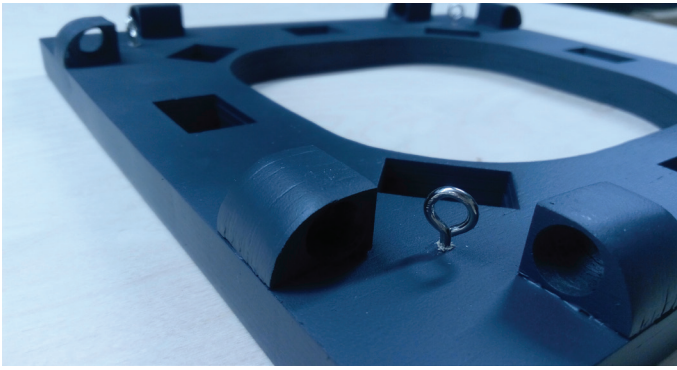


For the hinge pins, I used a combination of plywood and acrylic rods. The tricky part here was to determine how to sand down all acrylic bits in the same way. Even if the slightest deviation happened, the pins would not be able to fit into the knuckles and that would be catastrophic to the whole working principle.

When all pieces were glued together, I applied two layers of base and then paint to accomplish the desired colours. The combination of dark gray and pure white colours created an interesting contrast with the upper dark matt parts of the main components, where the light would not get in contact with. Moreover, the light reflective white colour helps the flow of the light to be broad.







In order for the product to be assembled, I created a short instruction guide manual of how this can be done safely. All the external materials were packed in separate envelopes and named accordingly in the assembly guide. All information needed for assembling was provided in the packaging box, as well as in the guide itself.

Assembly Instructions



In the box you will find the following components:

- Top part of the main body (pic.1)
- Bottom part of the main body (pic.2)
- Adjustable shades (pic.3)
- Steel hooks (pic.4)
- Metal wires (pic.5)
- Pull-strings in 2 different color (pic.6)

1. Installing the hooks to the ceiling

Find the four hooks in the box and locate the desired place on the ceiling you want to mount the light on. Mark all locations for the holes by keeping 22 by 22cm spacing apart from each hole. Drill four small 1,5mm holes into the ceiling.

Then simply screw the hooks to the ceiling. By using pair pliers.

2. Hanging the bottom structure and mounting the shades to it

Attach the metal wires that you found in the box to the already mounted hooks. Then hook up the other end with the wires to the hooks on the bottom component.

Once the bottom component is fixed and hanging from the ceiling you are ready to attach the shades.



Slide each shade into the hinges until they are all the way in.

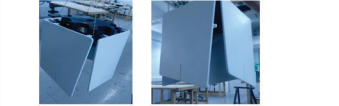
3. Connecting the pull-strings from the shades to the top component

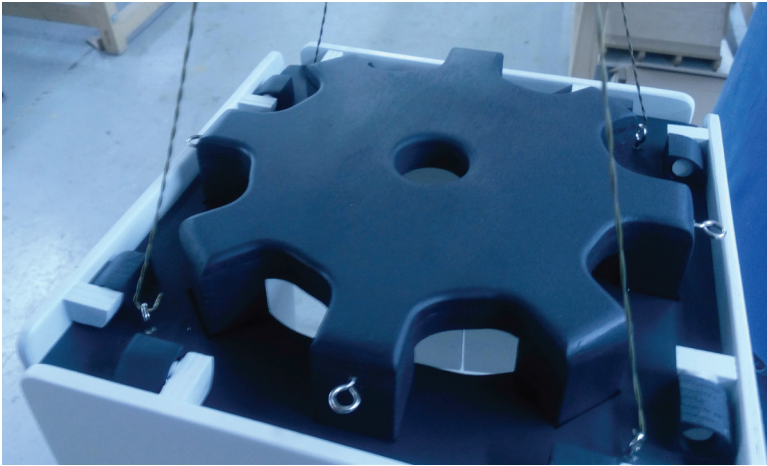
Insert the top mechanism over the bottom and lock it in place.

Then connect the pull-strings from the crack of the shades to the hooks on the top component. Make sure the knot is in a lock position. Excess material can be cut out.



When everything is fixed in place, pull the top component out a bit and twist it in clockwise direction, the shades will slowly rise. When they reach the desired position press the top component down in place until it locks.





First assemble in the workshop

IKEA's approach: Materials

Injection moulded poly-carbonate top and bottom components.

Stainless steel hooks

*Spruce wood shades.
The spruce is light, soft, has quite elastic properties, and can be found easily in Europe.*



IKEA's approach: Manufacturing

Considering the mass production capacity of IKEA and the price range of the light, the company would have to take an entirely different manufacturing approach.

First, the length of the cable would have to be much longer due to the fact that the product would be hanging from the ceiling.

Second, this would mean that the switch on the cable would be absolutely unnecessary, considering it would be located over the lamp itself.

Last, the propeller arm would also not be needed because the gravity will hold the bulb in place.

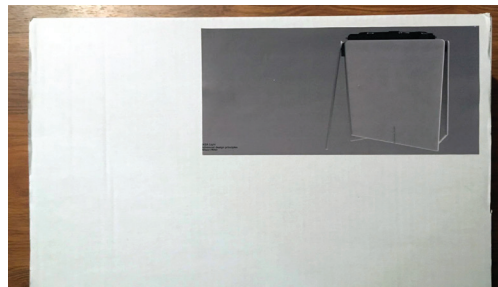
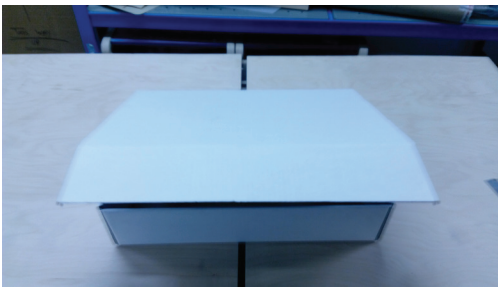
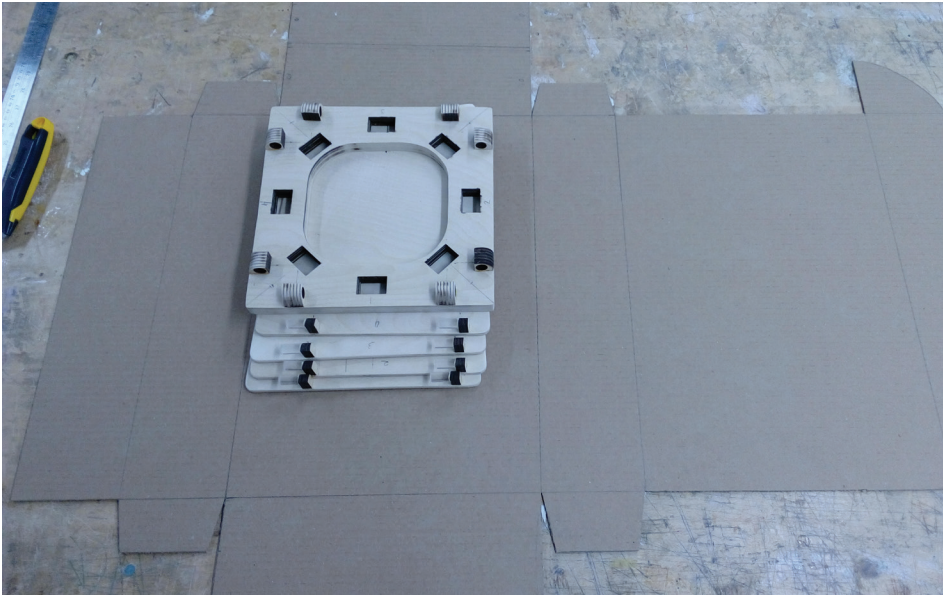
In terms of manufacturing the functional parts of the light, again IKEA would have to approach this from a different perspective than I did in my model.

The base and top components would have to be injection molded as they are the only two parts that have close contact with the electrical components. The heat coming from the light bulb is also a factor that needs to be considered. Respectively, polycarbonate would be a good solution material preventing the risk of overheating.

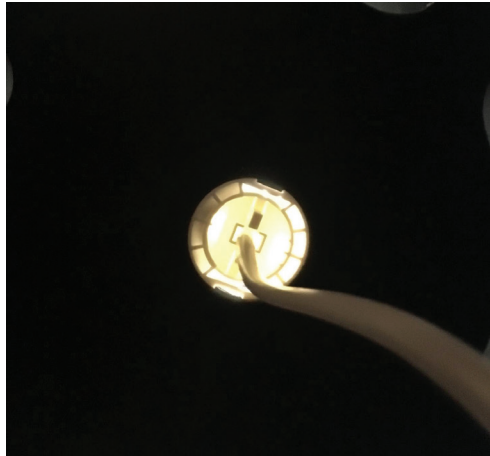
The shades can remain with the wooden texture that I applied to my product but with slightly different production technique. The wood pieces would be cut in shape on a conveyor line as a first stage of the process. After that, sanding rollers would give that round edge finish. Then automated saw machine would be adding the crack on the bottom of the shades.

The last step of the process would be applying white paint on the inside of the shades. As the wood is not a good reflector material, the white glossy colour would solve this obstacle.

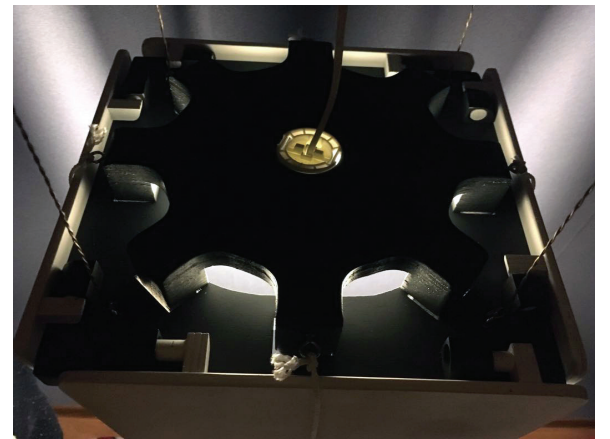
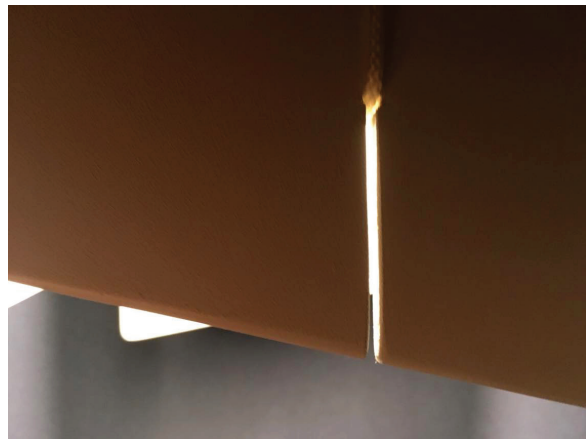
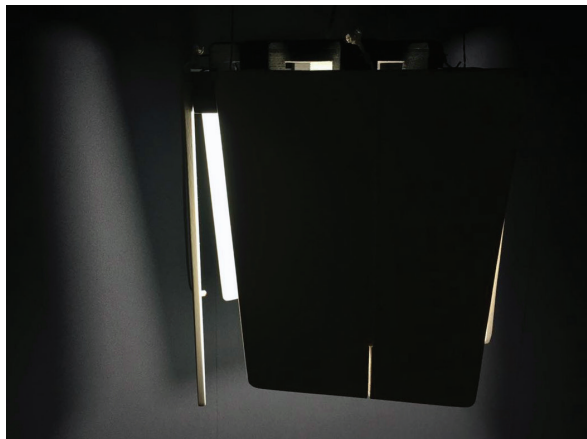
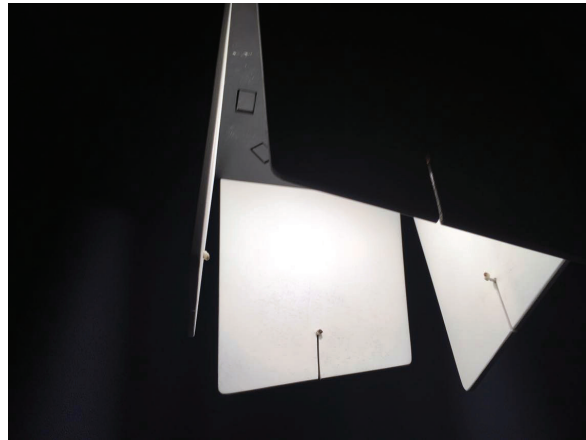
Packaging

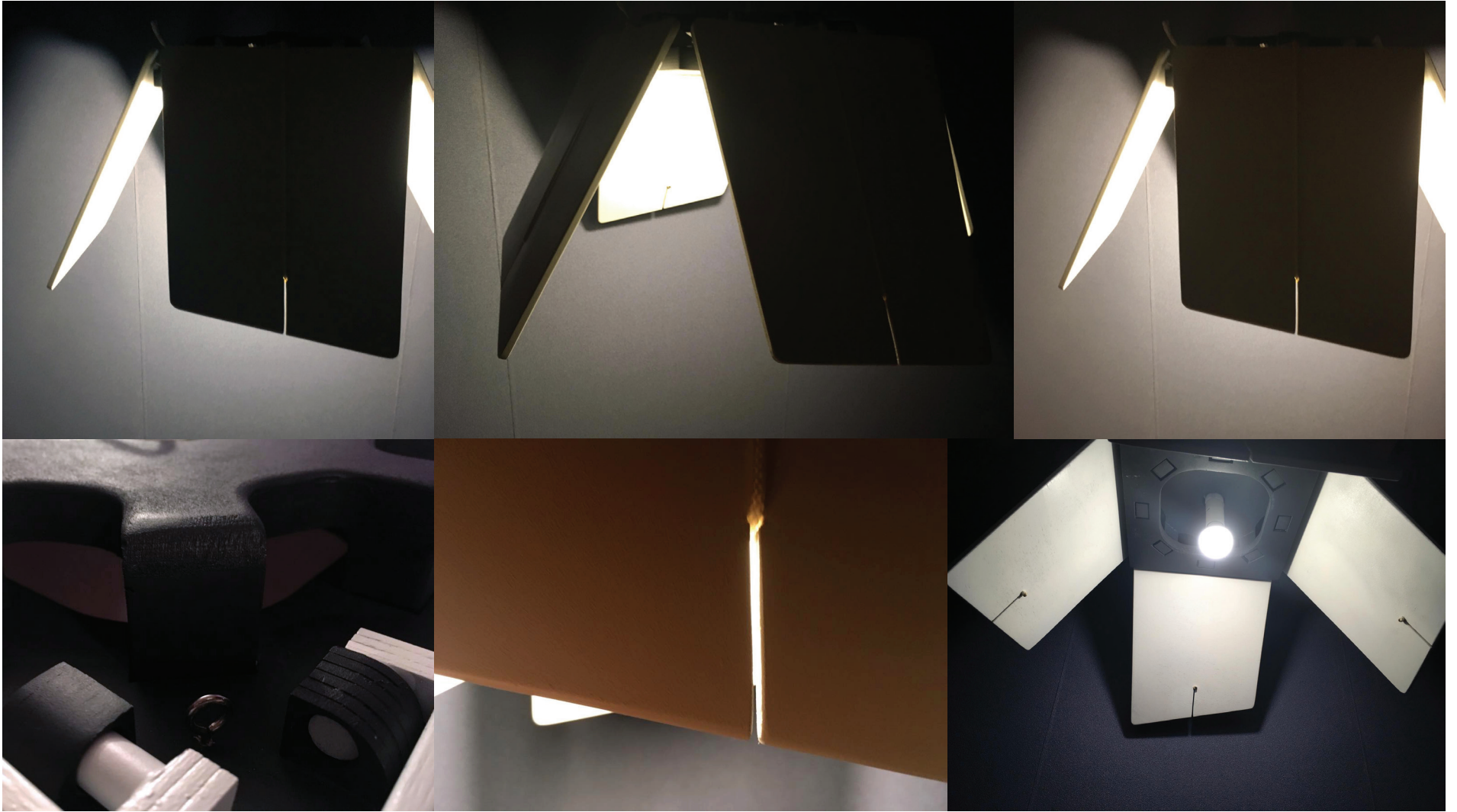


The package has the capacity to carry all the parts and the electrical components of the light. The inside of the box is divided into 3 sections: the main body parts and shaders; the pull-strings, mounting hooks and wires; and the electrical components. I have tried to save as much space as possible taking in mind how IKEA would approach this task.



Lamp Lit Up





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