



JÖNKÖPING UNIVERSITY  
*School of Engineering*

# Industrial DESIGN

## DESIGN OF AN IMPACT DRIVER

Julia Lázaro García

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Master in Product Development with a specialization

INDUSTRIAL DESIGN



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*School of Engineering*

# **DESIGN OF AN IMPACT DRIVER**

## Utformning av en slagdrivare

Julia Lázaró García

This degree project is performed at the School of Engineering in Jönköping in the subject field Industrial Design. The project is a result of the master program Industrial Design. The writers are responsible of the result, conclusions and reflections.

Tutor: Jonny Tran

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## **Abstract**

This Master project describes the process of designing an impact driver that fits with the range of tools from the company Cramer tools.

Power tools are a must in terms of manual construction work both for the home and in a more professional environment. However, as this tool collection grows and you start learning more things about this topic, some new products with specific tasks start gaining importance. So, you start to evaluate which tools would be necessary to have better finishes, more efficient and in less time in order to improve into a professional work.

An impact driver is a good example for it, this tools has a similar function to a drill driver with the difference that it does the job in a more powerful way and the task is much more effective. Besides, regarding to design, there are also many differences. First of all this tools is more compact, then it is also lighter that a drill. The fact that it is used by knowledgeable people in the field make it have a more professional look.

During this project I will try to find the best design that fits with the Cramer style. This is a German company focused on garden tools, as well as tools for a professional environment. It is important that this impact driver meets the company's guidelines regarding to design.

## **Keywords**

Impact driver

Drill driver

Cramer

Greenworks

3D printing

Design process

## Sammanfattning

Det här examensarbetet beskriver processen för att utforma en slagdator som passar in i Cramers verktygssortiment.

Elverktyg är ett måste när det gäller manuellt byggnadsarbete både för hemmet och i en mer professionell miljö. Men när denna verktygssamling växer och man börjar lära sig mer saker om detta ämne börjar vissa nya produkter med specifika uppgifter få betydelse. Så du börjar utvärdera vilka verktyg som skulle vara nödvändiga för att få bättre finish, effektivare och på kortare tid för att förbättra dig till ett professionellt arbete.

En slagskruvmejsel är ett bra exempel på det, detta verktyg har en liknande funktion som en borrhmejsel med skillnaden att det utför jobbet på ett kraftfullare sätt och uppgiften är mycket effektivare. När det gäller utformningen finns det också många skillnader. Först och främst är detta verktyg mer kompakt, sedan är det också lättare än en bormaskin. Det faktum att det används av kunniga personer inom området gör att det har ett mer professionellt utseende.

Under det här projektet kommer jag att försöka hitta den bästa designen som passar in i Cramers stil. Detta är ett tyskt företag som fokuserar på trädgårdsredskap, samt verktyg för en professionell miljö. Det är viktigt att denna slagdator uppfyller företagets riktlinjer när det gäller design.

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# **1 Introduction**

## **1.1 Background**

Cramer tools is a German company with knowledge and experience in gardening tools for more than 150 years. It joined the Globe Group in September 2017; Globe Group is one of the worlds leading manufacturers of battery-powered and gardening tools. Besides, Greenworks Tools is an affiliate brand which are the owners of this project, therefore they will be the ones who will give feedback and evaluate the final result of this project. Greenworks tools is specialized in electric powered products for commercial and professional use.

Cramer is starting development of a completely new series of battery-powered high-performance devices for among other areas gardening and landscape care. Cramer tools are known as long life products easy to keep and good maintenance.

This project is prepared to be evaluated in the course Design Communication 2 and Human Factors 2. The purpose is to engage in problem-based learning in the form of projects studies and aims to have the opportunity to apply previous knowledge of product design and acquire new skills in the subject.

## **1.2 Purpose and research question**

This project aim to develop some design proposal for an impact driver for the company Cramer tools. During the design process, ergonomics and user man/machine are factors to consider and will have a reasonable importance when grading it. There should be some problems and areas of opportunity identified to improve the next generation of impact drivers in a future so the target consumer will be satisfied with the product.

The questions that I want to answer during this project are:

- Which are the future's trends for impact drivers?
- What is the best way to assembly the interior components to extend the lifecycle to the maximum?
- What are the most common features in Cramer products and how can I reflect them on my design?
- Which ergonomic basis should I implement to make the handle and product the most comfortable as possible?



## I.3 Delimitations

The project embraces a conceptual product design. The design language should follow the actual Cramer style, but taking into account new changes and perspectives that the company wants to follow.

This project will end when the final physical prototype is made and presented. Besides, the project will not concern construction and cost analysis. Materials selection and manufacturing processes will only be covered briefly.

This process will start the 1<sup>st</sup> of March and the final presentation will be the 27<sup>th</sup> of May. So, the duration of it will be for 3 months.

## I.4 Disposition

The report will include four chapters:

- **Introduction:** in this part the project topic will be introduced, apart from the limitations and the goals of it.
- **Theoretical background:** will include all the design methodology I used for the project, and some theory parts to know when designing an impact driver.
- **Methods:** I will explain all methods used during the implementation along the process.
- **Approach and implementation:** in this part it will be explained how the methods were implemented.
- **Results:** the final result is explained in detail.
- **Conclusions and discussion:** the report finish with an overview of the project and what which knowledge I get for future projects.

## 2 Theoretical Background

### 2.1 Industrial Design

Industrial design is a branch of engineering applied to arts and design where the aim is to create solutions to day-to-day problems to make life easier and with fewer impediments. These solutions are given the shape of a product or product-services system (PSS) and then they are mass-produced. During this process, the designer has to consider different factors such as external appearance, secondary uses or marketing, and the way of commercialization. However, it is also important to think about maintenance, recycling, assembly, spare parts ... in order to extend the life of the product and keep sustainable ideas.

“The industrial designer can create objects for everyday use with an aesthetic and functional sense. It requires a critical and analytical profile to understand what people's real needs are.” [1]

This discipline is becoming more and more famous during the years and more companies feel the need to have a design department to develop products. However, it has not been long since these programs and job offers came out. This is why this whole world is relatively new and it is based on the following similar steps from great industrial designers such as Dieter Rams. Dieter Rams is a German designer that became famous during his stage working for Braun. He was also the creator of “Less is better” and the 10 principles of a good design which influenced the design of many products and can be so helpful when starting a new project. These are the principles: [2]

1. **Good design is innovative.** The possibilities for innovation are not, by any means, exhausted. Technological development is always offering new opportunities for innovative design. But innovative design always develops in tandem with innovative technology, and can never be an end in itself.
2. **Good design makes a product useful.** A product is bought to be used. It has to satisfy certain criteria, not only functional but also psychological and aesthetic. Good design emphasizes the usefulness of a product whilst disregarding anything that could possibly detract from it.
3. **Good design is aesthetic.** The aesthetic quality of a product is integral to its usefulness because the products we use every day affect our person and our well-being. But only well-executed objects can be beautiful.
4. **Good design makes a product understandable.** It clarifies the product's structure. Better still, it can make the product talk. At best, it is self-explanatory.
5. **Good design is unobtrusive.** Products fulfilling a purpose are like tools. They are neither decorative objects nor works of art. Their design should therefore be both neutral and restrained, to leave room for the user's self-expression.
6. **Good design is honest.** It does not make a product more innovative, powerful or valuable than it really is. It does not attempt to manipulate the consumer with promises that cannot be kept.

7. **Good design is long-lasting.** It avoids being fashionable and therefore never appears antiquated. Unlike fashionable design, it lasts many years – even in today's throwaway society.
8. **Good design is thorough down to the last detail.** Nothing must be arbitrary or left to chance. Care and accuracy in the design process show respect towards the user.
9. **Good design is environmental-friendly.** The design makes an important contribution to the preservation of the environment. It conserves resources and minimizes physical and visual pollution throughout the lifecycle of the product.
10. **Good design is as little design as possible.** Less, but better – because it concentrates on the essential aspects, and the products are not burdened with non-essentials. Back to purity, back to simplicity.

Based on some of these concepts, on similar approaches and on your personal experience which increases over time, you can make a good product that doesn't have an expiration date and last for years.

## 2.2 Design methods

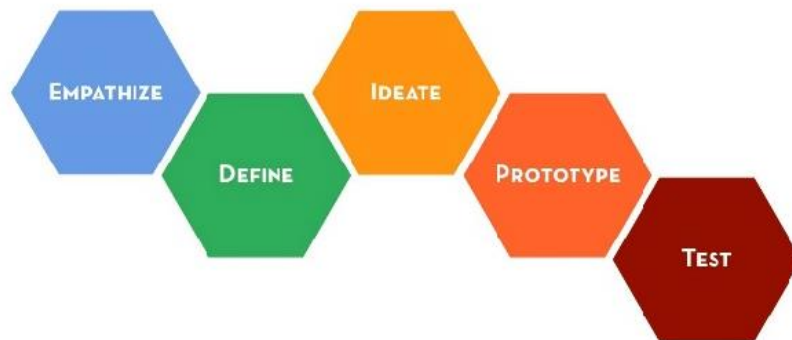
### 2.2.1 Bootcamp bootleg

The Bootcamp bootleg is a design method that includes five models with steps to follow and get more ideas about. This was created by the Stanford Institution and tries to show how to develop Design Thinking. [3]

These five models are:

- **Empathize:** This first one is about human empathy, it tries to first get to know your target to be able to put yourself in his/her shoes and design from their perspective. By having some talks or interviewing people you will know their emotions, likes, dislikes, and everything that can affect their point of view. Besides, that's not enough and you need to experience the same as them to understand their perspective in a better way. [3]
- **Define:** in this stage, you have to analyze and process all data collected from the first step *Empathize* and from that define a design idea. Then, you will also get deeper knowledge about your target and persona and with that create your own point of view. Some techniques for this are journey map or empathy map. [3]
- **Ideate:** This mode is the halfway point between identifying problems and generating solutions. During this stage, you have to be creative and show different alternatives for the same problem and explore different shapes for the ideas given in the *Define* step. Apart from that, you will also have to grade them to know which one is the best; for that methods like 2x2 matrix or Powers of Ten are good to have an idea about them. [3]

- **Prototype:** The fourth step is to prototype everything that can be taken for testing. Building your design in a rough form can help you to know which parts work well and which you have to think more about and change them. User-driven prototyping works perfectly because you involve the user in the final result. [3]
- **Test:** This is the final phase. Here, the idea is presented to a user and this one has to give feedback related to his experience. Then, the ideas are evaluated and might generate changes in the final design. [3]



*Figure 1: Mind map of Bootcamp Bootleg method*

### 2.2.2 Double Diamond

The Double Diamond is a model of design process popularized by the Design Council in 2005. This process is based on two diamonds that represent the process of exploring an issue more deeply -divergent thinking- or taking focused action -convergent thinking-. [4]

These are the phases:

- **Discover:** a deep dive into understanding the problem we are trying to solve. [5]
- **Define:** synthesize the information from the phase before to be able to define the problem in a different way. [5]
- **Develop:** think about different solutions for that problem, getting the inspiration from the experience, talking with people and opening your mind to different ways to solve it. [5]
- **Deliver:** try out all the solution, rejecting the ones that doesn't work and improving the ones that have a chance to work. [4]

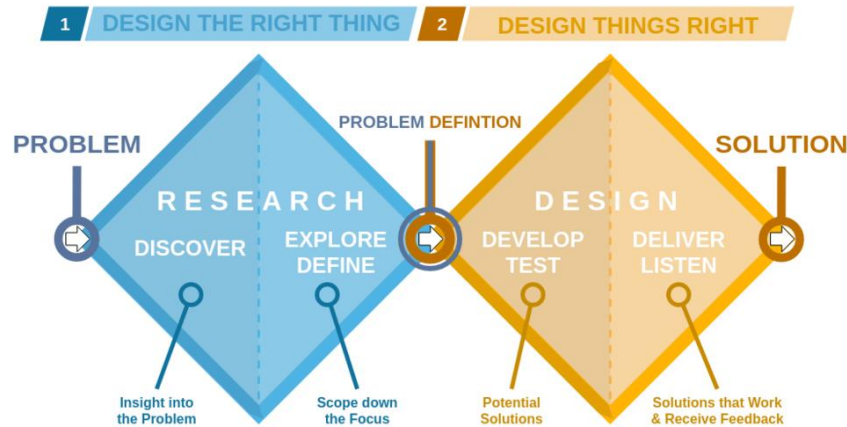


Figure 2: Mind map of Double Diamond method

## 2.3 Power tools Ergonomics

When designing an impact driver, like any other power tool, we have to take into account that feeling comfortable while working with it is a must regarding product design. A bad design regarding ergonomics for a power tool may cause work-related musculoskeletal disorders (WMSDs). This is an injury of muscles, joints, tendons, or nerves that usually manifest over a while [6]. The first step should be to analyze the user and its scenarios to see to which part we should give more importance and which factors may change its function. So, I created a storyboard and came up with these considerations:

- As it is a tool for, in most cases, professional use and it is used in addition to some other sharp or dangerous tools, it is common that the user is wearing some thick gloves for protection, which means that the size of his/her hand increases and, therefore, the handle should be longer.
- An impact driver is a heavy tool that requires making an effort simply by the fact of lifting it. Besides, when it starts working the battery makes it vibrate which makes it even more uncomfortable than before.
- The diameter of the handle, and including the length of the button, should be preferable small for big hands people rather than big for the small hand's population, due to the important thing is to reach it and even though being too small would be uncomfortable for the big hand's population, the other way around would be much worst. Besides, some tables say the diameter necessary for a given population.
- The user would probably be a professional worker who is used to these kinds of tools so he/she knows how it works and the best way to use it. Besides, it is important to analyze in which postures do people usually hold the impact drivers and try to give solutions to that.

- The environment where this tool will be used most of the time will be a kind of indoor workshop with connection to electricity, tables and places to support, more tools within reach and nice weather conditions. However, this tool can be also used outdoors and under different conditions.
- Some other risk factors are: awkward wrist and hand postures, static muscle loading, mechanical stress, noise, torque, temperature or pinch points. [6]

Once this considerations are analyzed and taken into account, a guideline for power tools can be helpful for the design process:

1. Tool weight: due to the battery is a heavy element and it is not easy to reduce, we have to take into account that the top part should be heavy as well, enough to have a good load distribution and therefore a good balance, but not too much for the user to feel tired. [6]
2. Handles: In this part there must be a grip that avoids the tool to slip away. Besides, it has to correspond and adapt to the hand shape. Fingers should be align such that they work is able to maximize the hand capacity. [6]
3. Diameter: the section should be an oval or circle with a preferred diameter of 3,8cm (between 3 and 4,6cm) [7]
4. Length: the length should be long enough for all hands to be able to fit in there, even though they are wearing gloves. However, the shortest the better, due to it reduces material and then weight. The preferred handle span is 14cm (at least 10,2m) [7]
5. Material: The material for the handle should ensure sufficient friction with the hand. Rubbers work the best in this kind of products due to they are non-slip and non-conductive. Besides, when they have any kind of texture, the gripping increases even more. [7]
6. Vibration: to avoid this, the distance between the vibration-generation part should be as far as possible from the hands. [7]

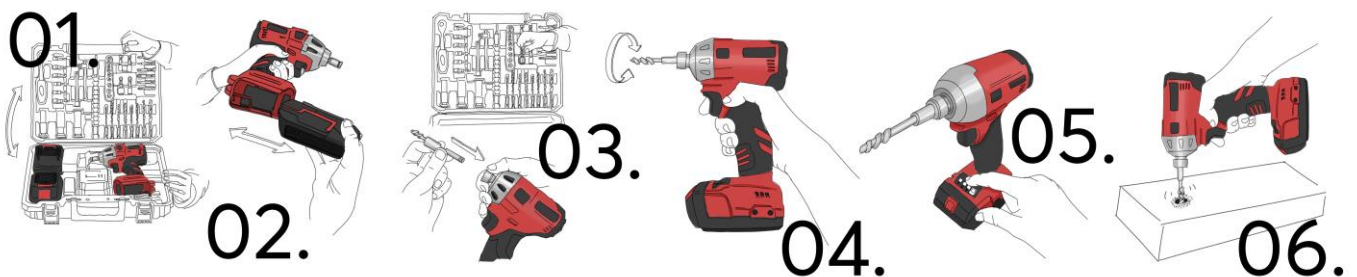


Figure 3: Scenario of an impact driver

## 2.4 Inside components

As I am not designing the inside of this impact driver, knowing the parts of this tool will only help me to take in consideration how many components are necessary to work, which dimensions do they have and which layout would be the most efficient.

Therefore, this analyze will be broadly defined without any interest to improve them.

These are the main pieces that form an impact driver:

- **Gear box:** consist on a series of integrated gears within a housing, it works the same way as like any gear system: it alters torque and speed between a driving device like a motor and load. [7]



*Figure 4: Gearbox image*

- **Motor assembly:** we can find an electric motor, which converts electrical energy into mechanical energy, and then the tool starts working. [8]



*Figure 5: Motor assembly image*

- **Button switch:** is a mechanism to turn the power on and off when pressing the button in the middle of the tool. Besides, the mechanism to change the direction of the movement is also included. [9]



*Figure 6: Switch for trigger image*

- **Circuit board:** a physical piece of technology that allows for the assembly of electrical or data circuits on a horizontal layer of material. [8]



Figure 7: Circuit board image

- **Battery:** is the down part of the impact driver which function is to give energy to the circuit board and then, make everything work. This piece can be detachable from the body to charge it and also can be used in any other power tool from the same company. [10]



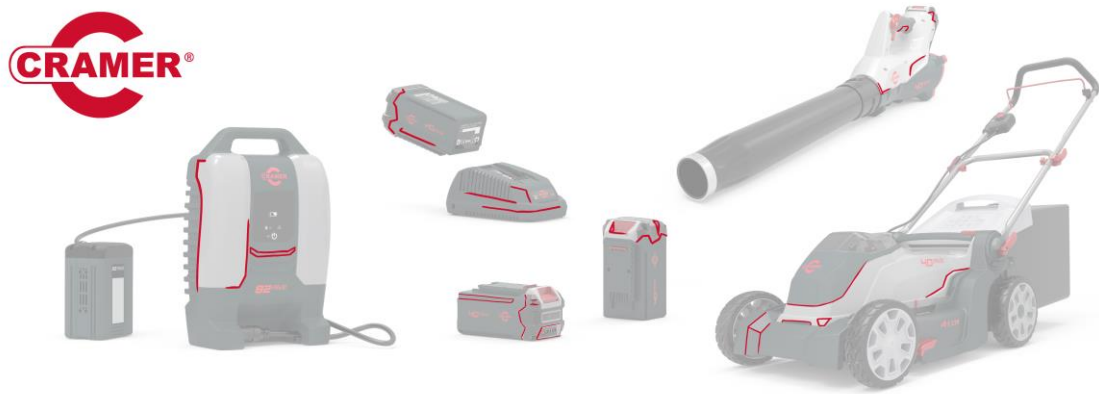
Figure 8: Battery for power tools image

## 2.5 Cramer style

To analyze the brand style and language the company Cramer tools use I first went to their website and checked all their products, after that, I took some of their most representative ones and made a board to compare them and look for common features. I realized about the color language; light grey and dark green for the main body, then black for handles and red for the logo, and smaller details such as buttons or supporting pieces.

Finally, for the shapes, I opened this board with some Cramer products and drew on them highlighting some shapes, curves, and details they use to understand their meaning.





*Figure 9: Analysis of Cramer's style language*

Besides this, during a meeting with some design team members, they told us their intentions to change the layout of the colors due to using light grey in the main body of the products make them less visible, especially when the user is using it outside and the place is full of snow. Then, I tried to use more red in my final design.

## **3 Method**

### **3.1 Gantt schedule**

A Gantt schedule, mostly used in project management, is a chart that shows the steps that you are following when doing a project. This is the best way to show your time planning due to you is a visual tool where you can see which percentage is done and what is left at a glance. [11]

The layout is as follows: on the left side, the lists of activities are shown, as well as the duration and the beginning and end date of each. On the right side, a bar represents each activity during the time, which means that all of them are in order of time and depending on their duration they are longer or shorter.

### **3.2 Design brief**

The UK's Design Council states that product design briefing is: “knowledge sharing activity, usually prescribed in a briefing document, describing what is required. The brief can be complex and backed up by research or, equally commonly, not really created until all influencing factors are better understood...” [12]

A design brief is a document that can be used in product design, industrial design, graphic design, architecture,... and it will frame the specific design process, guide assessment and evaluation of process and final product and influence design opportunities beyond the projects life. This document can be generated by the client, the designer, or both. In other words, it is an agreement from both sides where it is written what the project will and won't include. It has reflective, administrative and legal purposes.

### **3.3 Product breakdown structure**

Product breakdown structure (PBS) is a methodology quite common in project management. It aims to analyze and get to know all the components of a product. Usually, it starts with the product itself, and it breakdowns to lower levels until it reaches the most basic components. [13]

### **3.4 TAIDA process**

TAIDA is a well-tried model for scenario planning. It means:

- **Tracking.** The main purpose of this step is to trace and describe changes in the surrounding world that may have an impact on the focal question. *Open mind!* [14]
- **Analyzing.** With the tracking done, the next step is to analyze changes and generate scenarios. *Focus!* [14]
- **Imaging.** After gathering insights about plausible futures, it is time to create images of what is desired: visions. *Vision!* [14]
- **Deciding.** In this phase of the process, we identify development areas and strategies to meet threats and achieve visions and goals. *Shape, make, decide!* [14]
- **Acting.** Plans in themselves rarely give results. Acting is about taking action and following up. We will show how scenario planning can be followed up. *Concretize!* [14]

### 3.5 Mood board

A mood board is a visual tool that tries to communicate and convey a general idea, feeling or style. It is a composition of images, texts and objects and it can be based on a set topic. This tool is used by graphic designers, interior designer, industrial designers, photographers,... generating a document where to visualize the style that they want to pursue. [15]

In the mood board you can show pictures of forms, shapes, colors, textures and materials, feelings,... anything that helps you to get inspired during the creative process. This is focused on the external appearance.

### 3.6 Sketching and ideation

“Sketching is a rapidly executive freehand drawing that is not usually intended as a finished work”. [16] Sketches in industrial design represents the results of ideas and concept as channels to express and communicate what we think. Besides, it can also help the designer to remember an idea or to get inspired later.

During this section I like to start by copying some product similar to the one that I am going to design and get to know the shapes that I have to consider when doing my own concept. Secondly, I create some thumbnails exploring different shapes. For this step, the more exploration, the better because I will have a bigger range of shapes to choose the ones that can be interesting in a future. From that point I create more and more sketches and add some notes if it is necessary. After some hours of ideation I will get some interesting concepts which, for the last step, I will have to develop in a better quality adding some color, shapes and more details. I also like to create some quick sketch of the product itself in an environment or gripped by some hands to see the proportions.

### **3.7 CAD model**

3D modeling or CAD (Computer Aided Design) is a way that designers, architects and engineers use to build digital prototypes as pieces and assemblies. With this program you can basically create unlimited complex shapes of all sizes and shapes. Making a CAD model gives a clear idea about the dimensions and tolerances of the design besides of the overview of the design that it offers with all details as you want.

There are many programs but the ones that I use are Solidworks and Alias. First, I do the main shape in Solidworks to check all proportions and once I like the results I caption it with different views and use them to model the product in Alias.

### **3.8 Mockups and prototype**

A mock-up is a tool that helps designers to realize about which size will be the correct for the concept, besides you can visualize your idea and check if everything looks as the design looked like in your head. In this way it is easier to see which parts need some changes. It is always a better idea to make these mockups in their real size to be able to try them and check its accessibility, in case the final product would have some buttons or interaction parts.

However, a mock-up shouldn't take as much time to build as a real prototype, because details and high-quality surfaces are not important for it. This will help both designer and client to reach an agreement about how they want the final result to look like and not waist time on doing a design to them not be happy with it and change it again. [17]

A prototype is a high-quality tangible model of the design, in real size and with excellent surface finishes. Generally, a prototype is used to evaluate the design, feel it and see in which parts the design is failing and need to change. Unlike a mockup, a prototype is more focused on details and final shapes. It helps to test the design before investing in a mass production. [18]

## **4 Approach and Implementation**

### **4.1 Gantt schedule**

I created a Gantt schedule to understand the projects time limitations and, therefore, plan my time on the best way as possible. Having it, will give me an overview of the project and how to manage all the tasks to not to get stuck in any of them and get to know the maximum amount of time that I can devote to each task.

The time was estimated with the references of the two presentations: week 16 mid-presentation and week 21 final presentation. The brief was given the 1<sup>st</sup> of March so we had 9 weeks to finish the project.

### **4.2 Product breakdown structure**

I analyzed some impact drivers by looking for information, then I found some videos about how do they work and some maintenance of the interior components. There I learn in which parts an impact driver is divided. I got to the conclusion that each of them has to have: a gear box and a motor assembly with some ventilation, a circuit board which keeps all the information about the functioning, a button switch for the trigger and the direction button and all the cables and connections between these pieces. It is also quite often to place a LED light focusing the top part. Besides, the battery which can go in and out, gives the energy the tool needs to work. Additionally, there should be a button to be able to remove the battery when it needs to be charged. All these pieces are inside a case. This case is divided into two pieces and attached by screws along all the side.

As other details, for a good gripping on the handle, there are some rubber overlays with texture that help the hand to stay still will using it.

### **4.3 Mood board**

As this project is based on Cramer tools, my final design had to follow the same style language as the company. Besides, knowing how other impact drivers, and power tools in general, look like will also help to give the impression of a professional product. This was my final mood board from where I got inspired during the whole process:

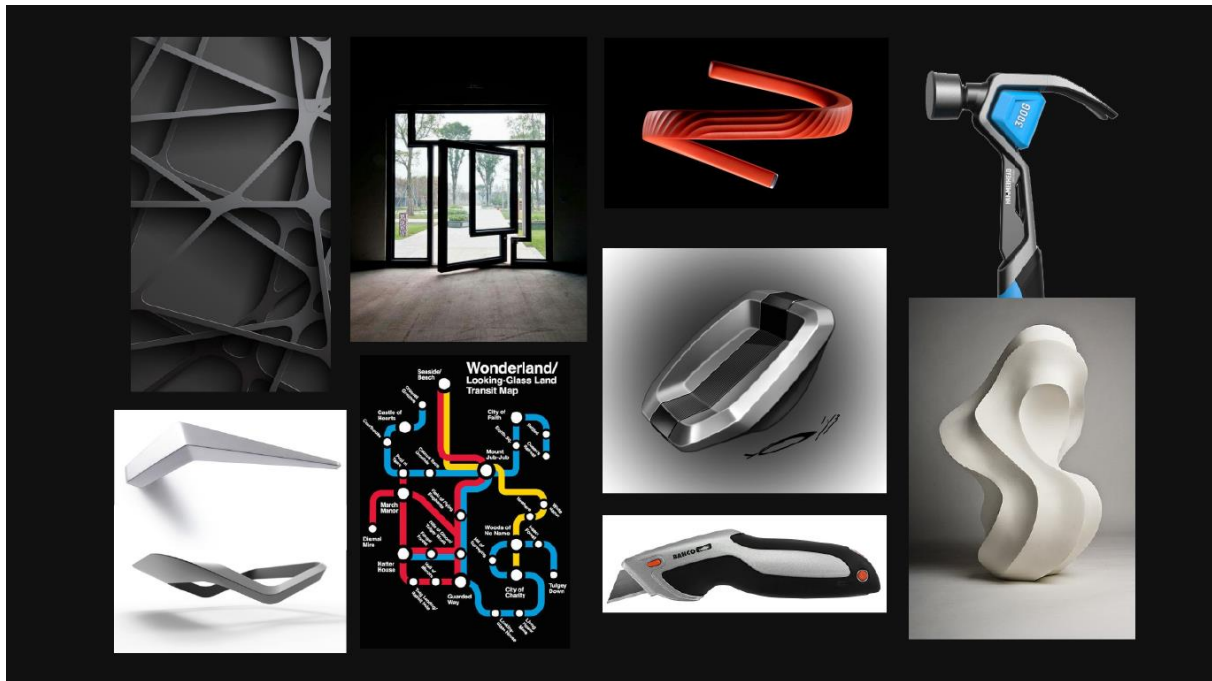


Figure 10: Mood board of the project

## 4.4 Sketching and ideation

After defining the style guides I wanted to follow, I started to sketch different shapes and explore with the forms to see what I liked the most. From that I created my ideation. - During this process I used a template with a shape of an impact driver to help me in the proportions of this product, due to it is one of the most important things: each part has a reasonable size, therefore it looks good in general.

This was my ideation:

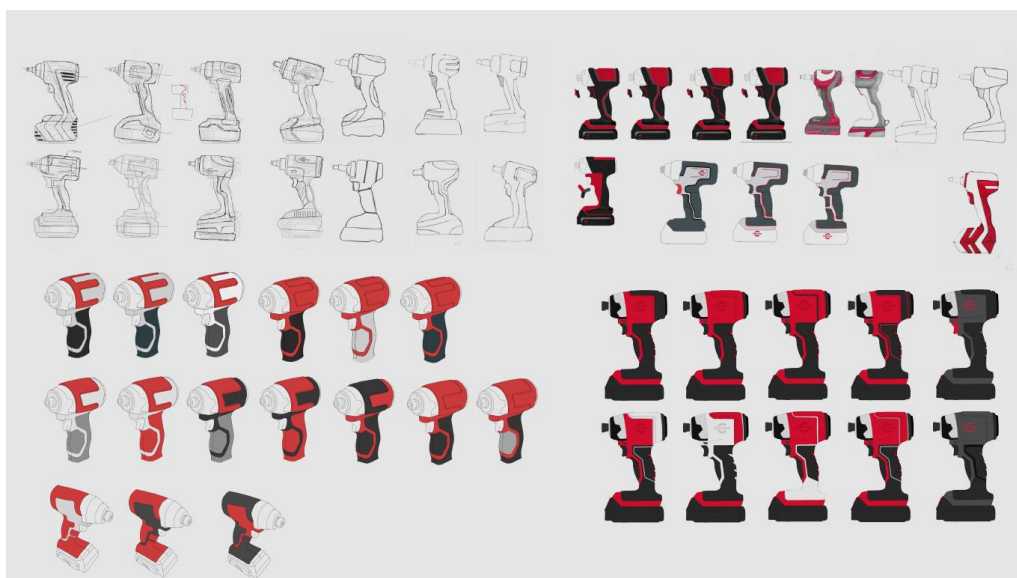


Figure 11: Sketching and ideation

After the ideation, I choose the shapes that I liked the most and got my tree concepts:



*Figure 12: Final concept*

## 4.5 CAD model

I design my model in Solidworks and Alias.

In Solidworks I created the assembly of all the components, including the inside components, like gear box, battery, circuit board,...

In Alias I created the outside part, due to this program reaches better results in surfaces when modeling curves. Besides, I also made all the details and split lines there.

Finally, I used Keyshot to give all pieces the appearance they were planning to have and create high quality and resolution renders.

This was the result:



*Figure 13: Final renders*

## 4.6 Mockups and prototype

In the first part of the project I created my mockups in hard clay but I decided to make only the handles, due to it is a part which might give problems regarding to the ergonomics.



The main structure of the prototype was made by SD printing in PLA material. To be able to create all the split lines, I divided the product into 20 pieces for then to be assembly into one part but still have some holes. These are the pieces I printed:



*Figure 14: 3D printed pieces*

After printing, I applied a layer of plaster and sanded everything. I kept applying plaster to all the holes and defects on the surface and sanded until this surface was smooth enough to apply primer. Then, I painted everything in their respective colors and assembled the pieces. As the final step, I put the stickers on the suitable places.

## 5 Result

This is my final design prototype. Here you can see how the impact driver would look like as well as the dimensions and proportions it would have.



*Figure 15: Prototype images*

This impact driver consists of: a main body in medium grey, a battery in dark grey, some rubber handles in both sides in dark grey too, and a front part where the chuck is settled divided into two parts. This gives a feeling of more quality and notability. Besides, it has two buttons at the top, trigger and direction button, and one on the battery to be able to remove it from the body whenever it needs to be charged.

Regarding the colors: as the company said before, even though their products are in light grey and dark green with some smaller details in black and red, they want to stop using light grey due to most of their customers live in countries with high chance of snow during winter and the fact of leaving one of their products outside may be a hard task to find the product. Then, they would rather use red and black in their next generation of products. In the beginning, my first concept was in red and black/dark grey. However, having all the main body in red might be too tiring. So, I decided to change the red to a dark grey which is less vibrant and more neutral, besides it still fits to the brand style. I keep the handles in black due to they usually use this color for handles in their product catalogue. In addition, I did use the red color for the buttons, as well as for the logo and stickers, due to they are parts that need to pop out of the rest of the product.



*Figure 16: Sketches and changes*

Besides, regarding to the design, in the top part there is a chamfer shape which also helps to frame and stand out the logo. This chamfer, as well as the direction button, gives a feeling of speed with those tilted lines that compose them. Finally, there is also a LED light in the bottom of the product, at the end of the handle, which is pointing to the front part and helps you to work with it.

Here you can see some pictures of how this impact driver looks in an environment.



*Figure 17: Renders in environment*

## 6 Conclusion and discussion

### 6.1 Design process

I used the Bootcamp Bootleg method for my design process. This methodology helped me to organize and plan my time, as well as establish my goals. However, during the ideation and design process I had to go back and forward many times in different stages and I struggled a bit. As a conclusion, I think that this is a really common thing during a creative, due to you cannot strictly follow a plan but you have to adapt it to each of your projects.

### 6.2 Ergonomics

Regarding to the ergonomics, I realized by a survey and also as a personal opinion and test, that many people hold the impact driver by other parts in addition to the handle. It is quite common to hold it from the back when you need to work on a horizontal or tilted surface, for this reason I moved the ventilation holes to the side, then the impact driver doesn't heat up.

Besides, some others also hold it from the top to feel it safer. In this case, the chamfer shape will also help them to keep their hands still while working with it.



*Figure 18: Postures for the impact driver*

About the handle, it is tilted 70 degrees which makes it that it doesn't require any wrist flexion, allowing the user to have his neutral position. The length of it is enough for all kind of hands, even though they are using gloves. The Centre of Mass is in the middle of the handle which makes that no matter in which position the user has to work because all loads are equally distributed. Some other details are the textured rubber and serrated holes of the handle, or the curves in both sides to avoid the hand and fingers from moving.

## **6.3 Conclusion**

It was a good project, all my goals were successfully accomplished. Besides, it was really nice to work for a company, have feedback from professionals in the sector, as well as tips and advices to improve in future designs.

The project in the beginning was a big challenge due to I have never used an impact driver, I didn't even know what it was. Besides, I have never designed a power tools and I realized that these kind of products are so complex and have many details, not only to implement the functions that they were designed for, but also to have a professional appearance.

In addition, in every project I have I learn more tools and get more practice about Alias and the rest of the CAD model programs, then I do see an improvement since the beginning.

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