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Study and Design of 3d Bendable Materials for Furniture Design

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Abstract

This dissertation was written as part of the Master in Strategic Product design at the International Hellenic University. The aim of this dissertation is the creation of a series of furniture for households, created under the same philosophy of bendable materials, inspired by words like hug and balance ,that are important today, and assembly of different parts without a screw or glue.At the first part dissertation refers to a variety of strong furniture examples and presents an extended analysis of bendable materials of today and processes typically used in the manufacturing sector. The research was limited by values such as eco friendly consciousness, adjustment to the new technology achievements, style and consumer needs satisfaction.

Through the research, keeping the most appropriate materials and processes, a series of furniture developed, representing a specific concept that responds to tiring routine days for the human being. The way furniture designed, followed the state of “nothing is irreplaceable”, “synthesis of parts is a kind of an interaction game” and “ little qualitative moments can offer us a big pleasure”. More specifically, every part of the furniture can be easily replaced, the synthesis of parts become the first meeting experience between user and his new furniture and the result is a birth of spiritual moments.

Thanks to my instructor Prof.Panagiotis Kyratsis, that we had a great cooperation, my dissertation was a strong leak of knowledge experience and a personal design pleasure.

Keywords: bendable materials, furniture design, CNC milling, plywood, felt, design thinking, technology

Vasiliki Koutsikou
Date 24/01/2020

Methodology

In my dissertation I followed the Product Development process. After an extended research of materials and machines, realizing the human needs of today, I tried to create concepts of combinations of furniture that addressed to people that need to relax into their houses and who need a place to have little creative and spiritual moments.

Trying to answer questions like what are the furniture needs of today, how important is a furniture, what has changed compared with the past, what material technology is available and what are the construction machines that exist for this kind of materials, I came into some important and determinant conclusions for my design.

Setting the desirable guidelines that refer to material selection and use of furniture, choosing some valuable words that inspired me, translating them into design principles, I concluded at the development of my design concept, its storytelling and the target group it is addressed to. Finally, I created the 3d model in Rhinoceros program.

The outcome of this dissertation is a series of simple, cute, ergonomic and functional furniture made by bendable materials, adjusted at today's need of warm moments at home.

Introduction

It is well known that we live in a world that differs a lot from this of the past. The continual changes, the way we interact with our environment, the ecocide , the way we work, our body posture when sitting on chairs, how we constantly consume and the rapid development of technology gave birth to new needs and challenge the way designers work and think.

Due to the fast paced life we no longer are focused on personal creative thinking moments even if we have some time to chase away the virtual world we live in. Human being needs a place that can relax his body and his brain after a long tiring stressful day. This place is his home, but one of the things provide serenity and relaxation at home is the furniture included in, and what kind of relationship user develops with.

The aim of my dissertation is the creation of a series of furniture for households, created under the same philosophy of bendable materials and assembly of different parts that are easy to be produced and replaced, offering warm and qualitative moments to its users.

Furniture is a tangible consequence of a strong relationship between culture, nature and sentiments. The most inspiring environment that we should take into consideration for all our creations and inventions is of course nature. Nature has the same tool box all the time, providing us a variety of material combinations. The idea of using bendable materials into our constructions is becoming more interactive into our haptic cognitive world. Nowadays all the materials are potentially new, because they have adjusted to new technology developments and possibilities in order to satisfy new kind of needs.

It is unquestionable that materials and needs direct furniture design, defining the relationship between products, technology, society and quality of living. The main idea of finding the most appropriate bendable material is to invent a new one or reinvent an existing one. Materials and furniture serve needs, but also functions. But why not being something more, something that would extend our home experiences, to give us a sense of life?

1. RESEARCH

1.1 Furniture

Furniture obtain a little more value when they are used by their owners. When a strong relationship between them does not exist, furnitures are discarded. Users tend to refresh and replace whatever does not have a meaning for them. In furniture design, what really matters is how the product make the user feel when imagine him interacting with it and which are the things that he combines doing when using it. But interaction has to do with lots of things, doesn't it?

1.1.1 Introduction

Furniture plays an important role in our lives because they serve a big variety of needs and desires. It determines the the way we live, that changes year per year, so furniture design follows the same direction.

Needs can be derived into two categories. The first one refers to basic needs, so what we need is furniture for a better quality of living, that makes our life easier, more organized and leaves us a freedom of movements and actions when interacting with them. Furniture that represents this kind of needs are a bed to sleep, a table to eat, a light lamp to see in in the darkness. The second one represents needs of personal distinct that has to do with decoration, optical pleasure, personal taste of morphology and aesthetics of space. These needs are served by furniture installations that have no use but give an other sense to a space, or to another functional furniture. Many times a furniture can fulfill both kind of needs at the same time.

Thus, furniture types could be categorized according to the needs they serve but also what is important enough is the space they are addressed to, the way they are constructed, their material, durability and their form style.

Every furniture has a personality, it speaks to user's mind about how to interact with it, how to feel, which activities to combine with, where to place it. The language has the form of lines, shapes, colors, textures and style. Consequently, user's and furniture relationship is about comfort, ergonomics, ease of use, touch, smell, vision, adjustment at user's space and awakening of senses.

1.1.2 Furniture Examples

There are so many different significant examples of furniture that succeeded due to their style, their strong concept, their adjustability in modern times and material technologies. Three of them are presented below, having in common their pliability. From the first glance, before knowing their storytelling, what distinguish them are their elegant curved forms that succeeded with the

appropriate material selection and the way material worked through in order to obtain this kind form.

Image 1 : Paimio armchair, Alvar Aalto (The Museum of Modern Art, 2020)

Paimio armchair constitutes a strong design example since it was inspired and made for victims of pulmonary tuberculosis in Finland prior to World War II. It was constructed with the available means and technological options of that time. The message that the designer, Alvar Aalto, wanted to spread around was about breathing and healing, responding into vulnerable people's need of horizontal possession. This armchair is a passively support that wants to raise vital senses and body's activities.

Image 2 : Wassily Chair, Model B3 chair, Marcel Breuer (The Museum of Modern Art, 2020)

Wassily Chair is another strong example that distinguishes due to its artistic pliability of tubular metal steel structure. It was designed by Marcel Breuer in 1925-1926. This modern design proves

that a strong structural material such as tubular metal steel is, can be an aesthetic material too, since today there are lots of available support systems.

Image 3: Desile Folding Chair by Christian Desile (Designbuzz, 2020)

The third example, Desile Folding Chair, refers to a different kind of design that serves the mandatory today's need for saving space. It is a folded chair addressed to small spaces, made from bamboo and recycled PET material, showing eco friendly consciousness. What make this design unique is that when chair closes it has less than an inch thickness. Lastly, it can be hanged on a wall, like a two dimensions product, giving a nice graphic interest to the ambiance.

1.1.3 Conclusions

What somebody can realize observing examples like the above is that the reason and the way of a furniture design have to do with many things. Every design has its own cause of existence, it responds to needs, to questions, to technology, to tendencies.

Throughout history, what we realize is that furniture has changed due to a lot of spatial and intellectual reasons. Every period of life has its own specific features and needs. Personal mentality, changes in sociocultural structure, economical factors, working life and lifestyle leads to a different way of designing. These strong examples referred above, prove that furniture design can become except from a basic human need, an important passive support to people that suffer from diseases and anxieties, a statement, but also a prominent evidence that there is a huge evolution in materiality and in technology. Design's role is to rapidly get adjusted into changes, at present human needs and different way of living.

1.2 Materials

1.2.1 Introduction

Determinant role in the awakening of senses of human being plays the appropriate material selection of the furniture. Fortunately, there are many materials for all the different tastes of both designers and consumers.

But, when designing something, except from the personal taste we should also take into consideration other parameters. Our mentality, the environment and the way of living tend to change. At the same time ally in these huge changes is the technology, which keep evolving and surprise us in order to obtain an eco friendly consciousness with a variety of material possibilities.

There are many researchers proving that today there are lots of ways in order to stop using the natural resources with the wrong way. For example, the harmful act of tree logging for furniture production should be prevented. Today, there are alternative ways of production that are as good as the older ones without destroying our environment. Resin, embedded with recycle waste material, constitutes a strong evidence of this statement. What significantly observed from a research made, is that a big integrating of recycle waste material with resn leads to higher mechanical properties. Consequently, it is urgent most of materials to be adjusted to the new environmental situation and become more eco friendly, still remaining strong and durable.

1.2.2 Wood - Steel - Plastic - Glass

There are many popular furniture materials used for different purposes like wood, steel, plastic and glass. All of these materials have subcategories with different properties and applications that need a different kind of process and attention in order to obtain the desirable shape. However, the most commonly one and diachronic material for furniture constructions is wood, because of its versatility, renewability and sustainability.

Image 4: Types of Wood

Cedar is a reddish softwood with a distinctive sweet odour that is easy to work with, uniform in texture and resistant to decay. It has applications in chest making , closet lining and household novelties and outdoor house shingle. **Cherry** is a close grained hardwood that resists warping and shrinking well and reddens when it is exposed to sunlight. It is used for cabinet making, boat trim, novelties and solid furniture handles. **Chestnut** is a hardwood that loses its durability when it is grown beyond 50 years. It is suitable for small outdoor furniture pieces, fencing and wooden shingles for covering buildings, barrels. Moreover, **Chipboard** is an artificial wood from actual wood chips that is mainly used for kitchen furniture and cabinets, covered with a laminate or wood veneer. Also, **Elm** is about an interlocking grain with high resistance to splitting, pliant and available in long planks due to the long, straight, trunks of the tree, applicated at chair seats, coffins and ship constructions. The **Fir** is a soft, uniformly textured wood with low resistance to rotting. It is easy to work with it and has applications in furniture products, doors, picture and window frames and constitutes the main component of plywood material.

Image 5: Types of Wood

It is well known that **Glass** breaks under pressure into sharp shards and of course is not suitable for use in furniture but what is not known is that toughened glass came from heating and rapid cooling process has permanent compressive stresses into its surfaces and it can be bent and curved like wood materials do and be used for furniture design. **Hemlock** is a lightweight softwood with wide grain and rarity of knots that is uniformly textured and has low resistance to decay. It is used for the construction timber for planks, door panels, sub flooring and transportation crates. Furthermore, **Lime** is a hardwood in pale yellow colour material which gradually darkens over time. It has carving properties, is stable and soft enough to be carved, having good bending properties. Lime is the wood that master wood carvers use for delicate works in furniture. **Mahogany** is a finely grained hardwood in a reddish brown color. It is durable and resists swelling, shrinking, warping and twisting. It distinguishes for its high quality, high resistance to swelling and warping caused by water. It has applications in expensive furniture such as wooden cabinets and veneered tables and dressers but also for construction of boats. Another kind of wood is the **Maple** one, a fine textured hardwood with immense strength and hardness and moderate shrinkage. It is a very light coloured wood and sometimes it is even bleached before finishing to make it look even whiter. It is suitable for flooring, fine furniture, hard wearing surfaces such as bowling alley lanes are. At the last image it is presented the MDF material, **Medium Density Fiberboard,** an artificial wood made from powdered wood bonded with glue and compressed to form sheets usually 2400mm x 1200mm in size. It is quite soft, fairly pliable and very easy to work with cuts, sands and finishes very easily. It is used for interior projects, shelves, cupboards.

Image 6: Types of Materials

Oak is a hardwood, light in colour with good pliable qualities that stains and finishes well and resists moisture absorption. It has natural aesthetic qualities as well as strength. It is used for furniture, boat framing, wooden desks and flooring. **Pine** is a fast growing softwood with uniform texture. It is very easy to work with and finishes well, resists shrinkage, swelling and warping despite having a wide grain. Finally it is fast growing and suitable for the construction of timber frame houses, panelling, mass produced furniture and wood pallets. **Plastic** is an artificial material with ability to be moulded into any form, used for mass produced furniture, modern bespoke furniture, ready to take any shape or form is needed. Moreover, **Plywood** is an artificial pliable wood, made from numerous thin laminates of wood glued together, where each layer is at right angle to the grain of the other to give it great strength. The thinner the sheet is, the more pliable the piece becomes. Plywood is suitable for boats, used for landing craft for the military, building industry as a sub flooring material or as a structural casing between walls. It is also an attractive, easy to work with material used a lot at today's furniture constructions. Furthermore, **Redwood** is a light , durable softwood that is also easy to work with. It has good natural resistance to rotting and decay, appropriate for outdoor furniture, fencing and house panelling. **Rosewood** is a tight grained hardwood in a dark reddish brown color that compared with redwood is hard to work with and requires a lot of polishing to achieve a good finish. We find it mainly in musical instruments such as pianos, tool handles, sculptures, veneers but also in furniture products.

Image 6: Types of Materials

Spruce is a strong light in color soft wood that finishes well with low resistance to rotting and decay. It possesses moderate shrinkage and favorable strength to weight ratio. It is used for making masts, spars for ships, aircraft, crates, boxes, general millwork and ladders. **Steel** is a structural but aesthetic at the same time materials that has succeeded great creations in furniture design. **Teak** is a renowned hardwood. It is very moisture resistant and resists warping, cracking and decay with extreme strength and hard wearing qualities. It has also application in furniture, panelling, window frames, ship building, church doors and flooring. The last material presented above is **Walnut,** a strong, dark, fine in texture hardwood that is easy to work with and resists shrinking and warping. It can take numerous types of finishes as it takes stains and glazes very well, used for making solid and veneered furniture, cabinets, wall panelling and decorative novelty trinkets.

1.2.3 Bendable materials of today

Taking into consideration all the existed materials, combining new technologies and appliances, a variety of new bendable materials are born, ready to be used for furniture design, giving another dimension into human being experiences. This experience come from material properties, their way of acting, make user feel, their durability, the sense of touch and the prestige that give to the furniture.

Plywood as flexible material, FLEX

Flex is a clever upside down converty of a simple material, like Plywood is, into a new kind of materiality which promotes unusual functions, beauty and different utility.

FLEX acts like a fabric do. It is a flexible material created by a combination of a sheet of plywood laminated with plywood, foam having springy machine-slit composite. It is a product suitable for furniture and architecture design. Flex succeeded to convert the hard, planar, work-a-day surfaces of

plywood into soft and deformable ones. The surface that is engaged with is thicker, deeper and absorbs and dissipates the elastic deformations from the hand or the body's load.

FLEX is both a product and a process. The fundamental material properties of the bonded wood veneers of the plywood determines flex appearance and engineering behavior. Slit widths and patterns of FLEX give a different sense into structural and aesthetic ends. Limits determine the engineering and functional performance and also flexibility is succeeded by the tightening of the slit pattern. In seating furniture load bearing needs a decrease of slit periodicity or the lamination of some additional appropriate material to the tension face of FLEX in the design.

Flex is about a sustainable material but also a sensory experience that gives pleasure in touch, which is the unconsciousness of vision. It gives motion, changing the bulk properties that convert the hard to soft things. What also characterize this material is the adjustability of the seating surface at the human body seated on it. It is not only a beautiful material but also a psychological feedback that speaks to all the senses at once.

Image7: Plywood as Flex material, FLEX (Plyproject.com, 2020)

Furthemore, a robust example of piece of furniture style with plywood material, could be a project created by Japanese studio Nendo. During this project plywood was worked through a distinct way. The chair follows the "puzzle-like" joinery so as to assemble the components consists of. This chair, named NO1 was created for Fritz Hansen and have launched at 2018 year's urban center style week.

Nendo's structural components are made of solid wood, whereas others – particularly the shell – are crafted from nine skinny layers of veneer, formed with molding technique. Joints were designed to be hidden – like they're "barely touching".The studio notices that the joints between a frame and a shell are thickened to increase the strength, but typically lead to an attractive look, and that the barely touching of joints offer a lighter look to the product.

Finally, the N01 chair is formed from twenty three wooden pieces. Every part is created by hand. The layered back slots into sections on the frame. The chair can be pushed right up towards a dining table, while the seat slopes at either side to fit around the body due to its short armrests.

Image 8: NO1 chair for Nendo(nendo, 2020)

Bending Method

There are two ways to accomplish the bending of wood. The first one is succeeded by using the steam process. The wood become flexible when is heated and vapored, being ready to be reshaped. The piece of wood can be bent and clamped into a new shape. After drying, it retains its new shape. Finally, if the wood is exposed again to high heat and humidity it can be spring back.

The second method has to do with the lamination of several thin pieces of wood together, clamping them to a form as they dry. This process, compared with the other, uses a rigid adhesive between each layer, which does not allow any spring-back.

In order to create Curved parts of wood, the bending method is the most economical and the most productive of high strength.

Felt

Image 9: Felt material (Lush Fabric, 2020)

Felt is one of the oldest fabrics known to human being. It is easy produced since it does not require a loom. The earliest felt appeared in the frozen tombs of nomadic horsemen in Siberia. They used it for making clothing saddles and tents because it was a quite resistant and strong material for wet and snowy weather conditions.

The first person realized the benefit of felt was a monk trying to make his sandals look comfortable. He discovered how moisture from perspiration and ground dampness combined with the pressure from his feet matted these tow fibers together and produced a cloth. Felt was also the main material for hat making.

In comparison with previous years, felt production has changed a lot. At past, felted fabric used to be produced using heat, moisture and pressure, to mat and interlock the fibers. At middle age, the hat maker separated the fur from the hide by hand and applied pressure and warm water to the fabric to shrink it manually. Until the late nineteenth century, mercury was used in the processing of felt for hat making, but it was discovered to have debilitating effects on the hatter, causing a kind of poisoning that led to psychotic symptoms so it was forbidden, getting out of the felt process.

Nowadays, felt material is used by crafts enthusiasts for all the kind of projects. It is one of the most attractive toys' materials, because the edges of felt material do not unravel as woven fabrics do. Also, felt has applications in cars industry and production machinery.

It is produced from wool, that grips and mats easily, and a synthetic fiber that provides resilience and longevity. The most typical combinations of felt are the wool – polyester and wool – nylon. Moreover, for the thickness process of felt material it is used steam, a weak sulfuric acid mixture.

Felt Manufacturing Process

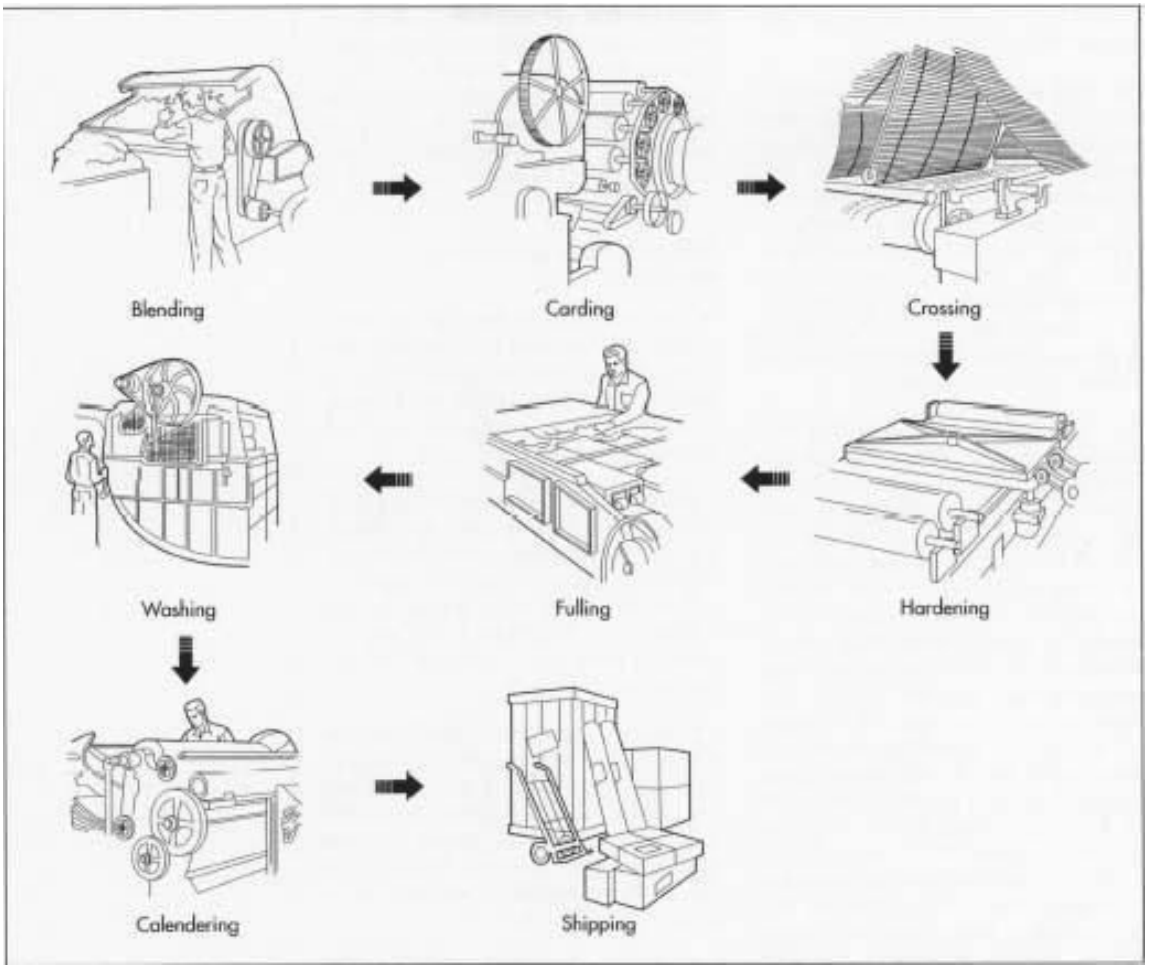


Image 10: Felt Manufacturing Process (Madehow.com, 2020)

It is important to be referred that during felt production there is some waste. At the final stage of production the felt edges are trimmed and small pieces are cut off, being unusable for other purposes due to the oil and grease from the machinery.

Polypropylene sheets

Polypropylene is a tough, rigid and crystalline thermoplastic polymer with similar properties as polyethylene has. However, it is slightly harder and more heat resistant. Polypropylene is the second-most widely produced commodity plastic (after polyethylene) because of its low mechanical properties and of low cost, having the lowest density among plastics. It is suitable for packaging and labeling.

Polypropylene sheets are suitable for a variety of Design and Technology applications. It is about a lightweight material that can be cut with safety in a laser cutter or using a sharp knife. Compared with PVC these sheets do not create any chlorine gas. The hot or cold technique allows the creasing of the material. As a result, the resulting 'hinges' can be folded many times without destroy the

material. Finally, Polypropylene has applications both as a plastic and a fiber in Automotive Industry, Industrial Applications, Consumer goods and furniture market.

Image 11: Infiniti chair, Drop model (chairs, 2020)

The chair presented above, designed by Orlandini and Radice, is a soft and embracing chair where outlines meet charming and fresh design. It is made of recyclable polypropylene with glass fibre added by injection molding. This technique makes the chair resistant to weather conditions, suitable for outdoor use.

Foam Rubber

Foam rubber is a versatile solution suitable for a range of applications. It can be used for pillows, in automobile seats, for furniture but also for insulation in buildings and freezers. The process of the creation of foams require forming of gas bubbles in a plastic mixture with the use of a blowing agent. What foam rubber products offer is cost-effectiveness sealing and cushioning solutions for any project.

Foam rubber is categorized into two categories, the flexible foams and the rigid ones. Flexible foams have open cell structures and can be produced in low and high densities compared with the rigid that have a closed cell structure that prevents gas movement.

Foam rubber is additionally referred as cellular, sponge, or expanded rubber. What is noticeable is that it constitutes a versatile substance that can be adjusted and reshaped in order to fit anywhere, maintaining its properties. Moreover, foam rubber offers many natural and chemical resistances that make it durable enough for more demanding environments and applications. It is a material characterized as lightweight and buoyant, suitable for cushioning performance, thermal/acoustic insulation and impact dampening.However, Foam Rubber can be used also into the Manufacturing sector for packaging and also cushioning for furniture, automotives or shoe soling.

Image 12 : Van de Klomp soft cabinets (Williamson, 2020)

The example presented above is a functional whimsy proposal of poetically impractical pieces of soft furniture, made from foam rubber by Studio Dewi van de Klomp, giving an other sense into furniture creations. This furniture of foam rubber move sideward, right or left, depending on the volume inside the cabinet. The user can put it next to a wall or another cabinet and fill the cabinet with his stuff. The cabinet forms and becomes a unique model.

Flexible WoodSkin

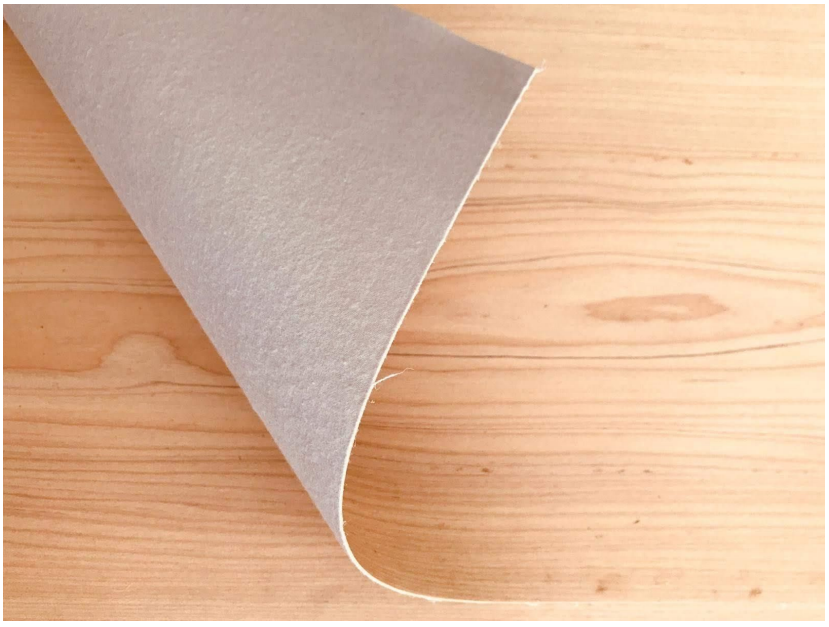


Image 12 : Flexible WoodSkin material (New Atlas, 2020)

Generally, flexible WoodSkin has been designed as an alternative solution to animal leather. It needs a specific treatment in order to become flexible, sew able and washable at the same time. What really has value is that WoodSkin material is environmentally friendly, 98% flexible, not thermo-formable and resistant up to 80°C. It is also soft in touch like leather. Flexible WoodSkin constitutes an “ecological” material due to the fact that the treated natural wood can be coupled with eco-fabrics and other sustainable and natural backing materials such as his “companion”, the Cypress fabric.In addition, it can be engraved by laser.

It can be used in fashion production of belts, bags, clothes inserts, shoes, leather-alternative goods but also in interior design and decoration.

What distinguishes it from other materials is that this wood comes only from sustainable forests, respecting the ambient heritage and the trees life cycle through a rational and controlled use, favoring the necessary recycling and reforestation.

Image 13 : WoodSkin product, a sandwich of plywood triangular tiles with a textile mesh in-between

The WoodSkin product presented above is characterized as a sandwich of plywood triangular tiles with a mesh in between, made by design studio MammaFotogramma. Their creation was a strong statement showing their hope to go some way towards, by bridging worlds at real or virtually. This bridging of worlds is succeeded with the development of the flexible wood surfacing material named WoodSkin, which, being CNC-friendly, lending itself to all sorts of abstract forms.

According to the production process, a composite nylon and polymer mesh is encased between sheets of Finnish plywood. Then they are glued together with the help of a custom mixed adhesive. After that, a three-part compression process strengthens the material to support its movements.

CNC mill cut in small pieces the desirable sandwiches and creates the 3D pattern, breaking up the rigid surface.

Users has the choice to specify the triangle size, geometry and density within the sheet, as well as the thickness of wood, that ranges between 4 and 30 mm. Also, WoodSkin is available in modules, sheets or rolls and has the ability to be linked together to form large continuous surfaces. Finally, when building your product, stability is achieved through the bends and folds or in some cases with the insertion of supporting struts.

Bamboo

Bamboo is a sustainable material that can be used for furniture design. The purpose for this kind of use was raised at first from the need that existed in disaster and remote areas of Indonesia territory. However, there are many and different types of bamboo that serve different kind of needs. The goal of taking the benefits of bamboo material is the creation of higher valued products.

Image 14 : Bamboo Material

Generally, bamboo is an inexpensive solution, that is easy to be processed. However, it is noticed that its potentials as a material for furniture, had not fully optimized by people who live in disaster

and remote territories. It has also proved that bamboo treated with preservative expected to live 40 years, being robust enough to earthquakes. Also, bamboo is grown very rapidly reaching the height of up to 30 m within a year. It distinguishes and provoke the designers and architects interest since it has remarkable mechanical properties, such us tensile strength better than steel and elasticity. Also it is pleasingly graphic in its natural and linear form.

It is remarkable that recently bamboo has become a shining star of sustainability. It constitutes a durable, versatile and rapidly renewable resource-with aesthetic appeal to boot. Bamboo loves drawing carbon dioxide out of the atmosphere and produce oxygen in its place. It also thrives without the need for pesticides. Bamboo is a vulnerable plant for captive breeding, having a relatively short term of planting, effortless processed with simple equipment that has become the cultural roots of Indonesian society.Furniture made by bamboo are relatively inexpensive and satisfies consumers' desire for the 'exotic'.

Bamboo products

Image 15 : Bamboo Products by Emilie Voirin (Lisa and Lisa, 2020)

The bamboo products by Emilie Voirin represent a new interpretation of iconic modern chairs into biodegradable seats. The designer used woven rattan and bamboo material, creating sustainable versions of popular chairs like 'Panton chair', 'Thonet chair No. 18', 'LCW plywood chair' and 'Wiggle Chair' are.

The sustainable twist on these classic chairs succeeded with the use of rattan plant fiber, that is durable and is used for furniture constructions and household objects.

Other examples of bamboo objects are presented below.

Image 16 : Bamboo Products

The process of Bamboo bending

Bamboo skeleton bending

The methods followed for bamboo bending is the fire, the open groove bending method and the saw triangular notch. For the skeleton's joint, a use of other round bamboo sheets joint is succeeded.

There are many ways for this job like Rod then is, T-then, cross then, L then, arch then, embedding and entanglement. For the best skeleton result, use of the round wood core, bamboo nail, steel nail and glue is needed. Additionally, the machining is really important to create a really good surface, made from bamboo sheets.

1.2.4 Smart Materials

It is well known that materials tend to become more and more intelligent . They are adjusted at today's needs, having more application options, obtain a more multifunctional, flexible and sustainable way of acting. This material evolution give a big freedom of possibilities for designers and give birth to new intriguing user experiences.

Archi-living want to show this fast evolution mentioning that the tabletop charges the smartphone, while the window blinds open and close automatically according to the position of the sun. The finish on the wall ensures that the room is kept at an optimal temperature. This may sound like a dream, but it is increasingly becoming reality today with smart materials. *(Archi-living.com, 2020)*

Thus, interior furnishings influenced by this innovative material world, that react to temperature and act like a power source. Smart materials tend to become more lighter, strong and flexible, something that can bring a huge change into furniture and architecture design.

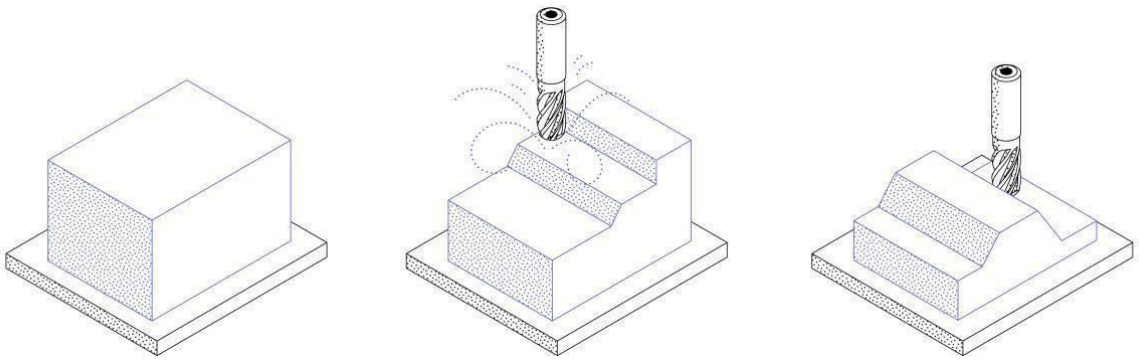
However, even if these improvements and changes impress a lot of people, there are many that find this evolution unnecessary, they prefer the simple, the traditional, the furniture that are over time, with the common materials, which speak the language they used to understand before the technology explosion. They support that they are daily surrounded by technology and they would prefer a more classic way of living into their houses.

1.3 Production Process

In this chapter following I will give a few information about machines like CNC, Robotic Wood tectonics and 3d printing, about their way of acting in order to produce the desirable shapes and forms of furniture parts. Also, some indicative examples are presented.

1.3.1 Cnc Machine

In the production process we have the opportunity to use a CNC machine in order to create our parts by removing material from a solid workpiece, using a variety of cutting tools. It is a fundamentally different way of manufacturing, compared with 3d printing or Injection Molding technologies. The material removal mechanisms have significant implications on the benefits, limitations but also at the design restrictions of CNC.

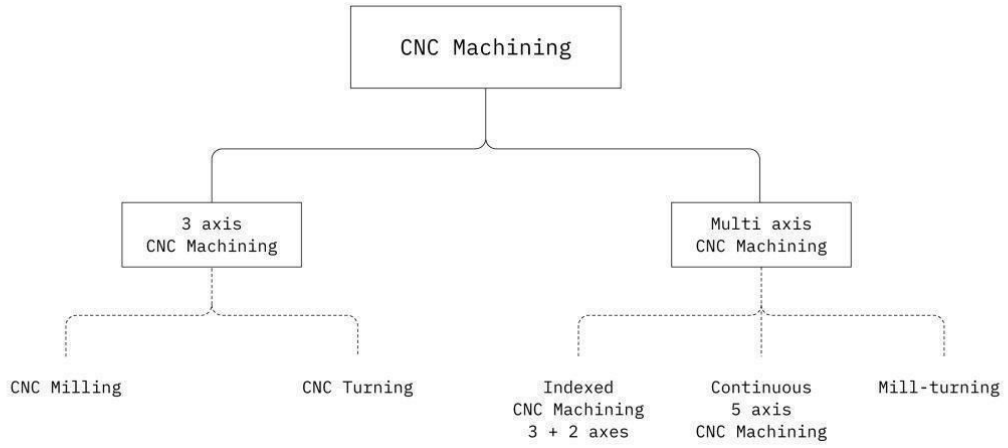


CNC is a digital manufacturing technology that produces high-accuracy parts, characterized by a high level of automation that leads to price competitive results. A cad file guides the cutter, that is usually a router or a laser. The essential of router bit and laser is that lasers cut with heat and not with friction. During Cnc process a high energy light beam burns through wood.

What is also interesting is that almost all the materials can be CNC machined. However, the most common material examples are metals (aluminum and steel alloys, brass etc) and plastics (ABS, Delrin, Nylon etc), even foam, composites and wood.

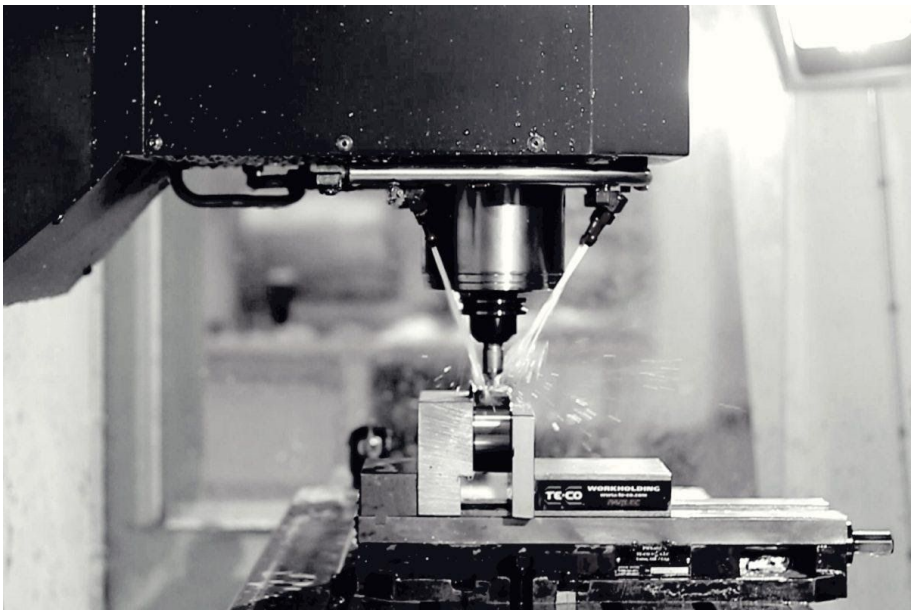
CNC process is succeeded through three steps. Firstly, the engineer designs the cad model, then the machinist turns the cad file into a G code program that is understandable by the Cnc machine and sets it up. Finally, the Cnc system executes all the machining operations with little supervision, removing material and creates the part.

Like we can notice below there are different types of CNC machining and at every type, subcategories referred to the number of axis, to milling or turning processes.



Cnc Milling Process

In CNC milling process the workpiece is held stationary directly on the machine bed or in a vice. Cutting tools or drills are rotated at a high speed removing material from the workpiece. The tools are attached to a spindle that moves along three linear axis.

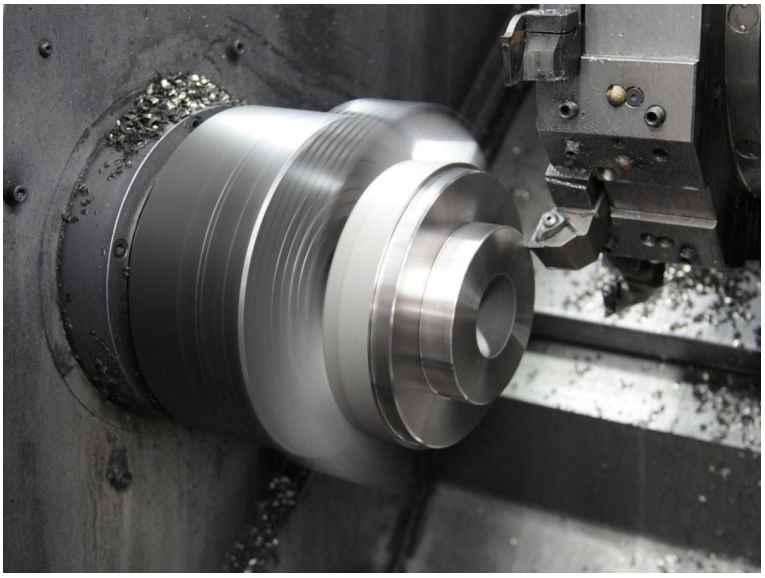


Physically, CNC milling process has both advantages but also disadvantages, some of them referring below.

Advantages	Disadvantages
Can produce most parts with simple geometries	Tool access & workholding design restrictions apply
High accuracy & tight tolerances	Manual repositioning of the workpiece is needed leading to low achievable accuracy

Cnc Turning Process

In CNC turning process, compared with milling, the workpiece is held on the spindle while rotating at high speed. The desirable form geometry is succeeded with outer trace or inner parameter of the part. The cutting tool or the center drill do this job. In this process the tool does not rotate and moves along polar directions.



In comparison with cnc milling, CNC turning are extensively used, because they can produce parts at a much higher rate and at a lower cost per unit, especially for larger volumes.

What is quite restrictive is that CNC turning produce only parts with cylindrical profiles. In order this limitation to get overcame, features of the part are often CNC milled in a separate machining step. An alternative solution is the use of 5-axis mill-turning CNC centers that can produce the same geometry in only one step.

Advantages	Disadvantages
The lowest cost per part compared with other CNC machining operations.	Suitable for cylindrical profiles and simple geometries.
Very high production capabilities	

Some examples of products created with CNC machines presented below, showing us how a combination of CNC cutted parts can create an attractive product that seems to be unexpectedly simple and beautiful. Some of the products created by the assembling of different Cnc produced parts giving us the sense of solid parts that separated into smaller thin pieces. And some others, just cutted and bended in order to obtain the desirable geometry.

Image 17 : CNC products

1.3.2 Robotic Wood Tectonics

The mass customization of geometrically complex wooden elements has become one of the major concerns in terms of robotic wood fabrication research and wood - producing industry.(Buri & Weinand, 2011).

The rapid development of digital design technology leads to falling of the linear wood component fabrication methods, that needs lots of time and have big material waste. (Brell-Cokcan et al., 2009)

Image 18 : Robotic Wood Tectonics project (Anon, 2020)

Trying to solve the problem of big material consumption, that CNC milling production process has, the 'Robotic Wood tectonics' project of 2016 Digital Future Shanghai created a full scale pavilion, combining robot wire cutting technology with traditional woodcraft. The main project goal was the mass customization of large scale parts through the demonstration of robotic wood tectonics, a process that links the design with the fabrication.

Many research institutions try to find out new possibilities of wood manufacture by employing industrial robots in the fabrication process, something that proved to have a great impact on the design thinking.

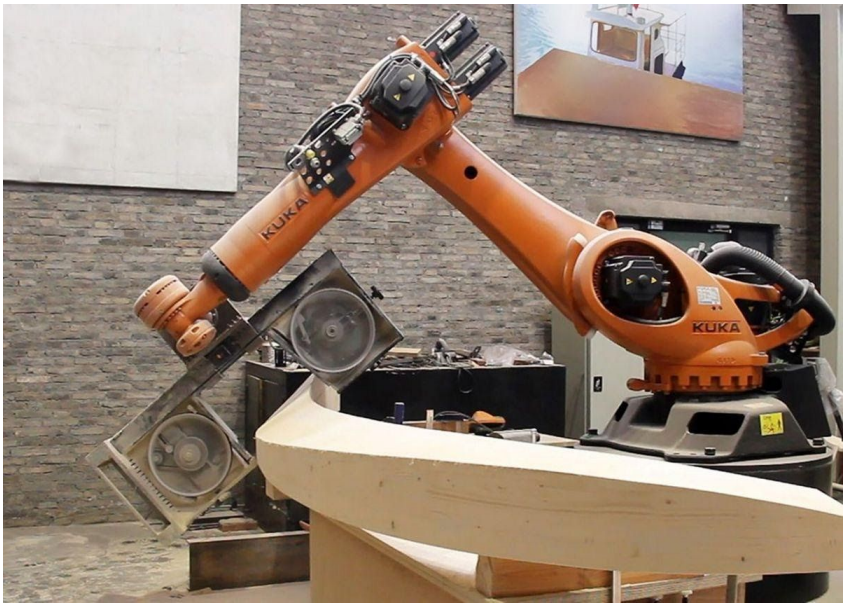


Image 19 : Robotic Wood Tectonics project (Anon, 2020)

It is an inescapable fact that robots can transform in a more direct way the design information into a fabrication tool path without the complex Cnc data. What is researched and proved that constitutes a successful solution is the combination of a conventional mechanical band saw with robotic wire cutting technology.

More specifically, in the 'Band Sawn Bands' paper: 'Feature-Based Design and Fabrication of Nested Freeform Surfaces in Wood', researchers from Greyshed and Princeton University (Johns & Foley, 2014) for the first time utilized a robotically operated bandsaw to cut a series of curved strips which rotated and laminated, succeeding approximate doubly-curved and digitally defined geometry. Using a robotic band saw was demonstrated as a materially efficient technique for designing and fabricating freeform surfaces within the constraints of irregular wood flitches.

Furthermore, the robustness of this new craft with regard to speed, accuracy and material finish in the mass customization has studied from the RMIT University (Williams & Cherrey, 2016). The paper 'Crafting Robustness: Rapidly Fabricating Ruled Surface Acoustic Panels' has demonstrated the feasibility of double-curved non-standardized wood elements in furniture and decoration in robotic fabrication.

This project analyzes the entire process chain that begins with the form finding and optimization and finishes to fabrication. The result is a technologically and aesthetically successful prototype, in this occasion the pavilion, that is efficient structurally and rich in aesthetics, proving the huge technology possibilities. Furthermore, the robotic band saw performs with a high material efficiency in both the design and fabrication stages due to its small kerf, that distinguishes compared with other mechanical wood cutting methods. What really matters is that the 6-axis industrial robot allows the fabrication not only of two-dimensional curved surfaces, but also of high quality three-dimensional ruled geometries through the continuous rotation of the blades, which apparently have a higher resolution than the traditional milling geometries created from CNC.This project is a demonstration of robotic bandsaw capacity for mass customisation of full scale geometrically complex wooden components.

Of course except from the great advantages in material efficiency, this technique has also differences that has to be improved. There is still a waste of material due to the volume difference between two dimensional raw beams and the desired three dimensional beams that can be minimised through the optimisation of gluing technology or by employing a more precise CNC template to guide the material distribution to minimise the volume difference between the raw and desired beams. Additionally, something that should also be improved is the speed control, that is quite low due to the continuous change in beam thickness during the fabrication process. A good solution could be an automatic speed control system, that adjust the speed according to the resistance that the blade is facing in real time. A a result we would have better fabrication results and life of the blade itself.

In conclusion, this kind of technology throws the traditional subtractive mode of CNC milling into question, since the project proves clearly the higher efficiency in material, time and mass customization capabilities of robotic wood tectonics in complex geometries.

1.3.3 3D Printing

A different manufacturing process is the 3d printing that give you the design freedom of making complicated geometries, sculptural forms and easy prototypes. The designer has also the opportunity of 3d print different parts that would make a product. This process has a great benefit to the delivery part, because the product can be sent to consumers disassembled and quick assembled by him. It distinguishes compared with the other methods because of the flexible funky and cost effective pieces it can create.

A clever use of 3d printing is also the creation of parts that assembles different parts of a product, playing the role of joint. An interesting example of 3d printing joints is presented below.

Image 20 : Table and chairs by designer Jon Christie (Jonchristie670.com, 2020)

The process used for this product is a merge of traditional furniture manufacturing with the cutting edge 3d printed technology, showing the beauty of the meeting of tradition with modernity. This product, made by designer Jon Christie, constitutes a strong example of 3d printed furniture parts, a table and chairs, using hybrid 3D printing technology. He was intrigued by how 3D printed joints

could assist furniture craftsmen, and help them to make something with high visual impact, the perfect blend of old and new capabilities, through the substitution of tricky woodworked parts with 3D printed joints.

1.4 Synthesis of parts produced

There is a plethora of assembling techniques of multi layer panel elements. The most common ones are the laminated technique, the nailed staples, screwed, stress laminated, doweled, dovetailed and wood welded. Every part can be produced separately and then be linked with the other in order to obtain the final product form. In this chapter we will see some images of a variety of linkage alternatives.

1.4.1 Screw and coil

The part linkage with screws is the most common method in assembling process. It is used for furniture that need to be more stable and durable, for furniture that accept big pressures and a lot of weight. Screws and coils usually constitute individual and necessary parts of the product design existing for practical and functional reasons.

Image 21 : Screwed parts linkage

1.4.2 Union of parts with the use of an other material piece

Linking parts with a different kind of material, such as rope or a piece of leather, constitutes except of a reason for assembling different parts, an important finishing touch in the whole design. It is a clever way of using these material pieces that make your product stable, ergonomic and functional for image reasons too, making the product more beautiful and unique.

Image 22 : Parts linkage with rope

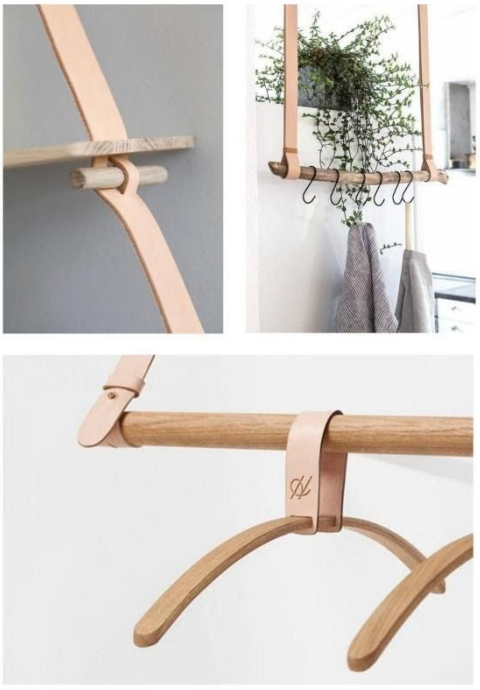


Image 23 :Union between wood - leather

1.4.3 Part to Part joinery

Puzzle joinery has a similar philosophy like the linkage of parts with a different kind of material piece because nothing seems to be needlessness. Every part intersects into the other in a right way in order to keep the product stable. Moreover, the puzzle joinery offers an harmonical, balanced, clever and playful design image. This kind of joinery belongs to japanese woodworking philosophy that we will analyze underneath.

Image 24 :Puzzle Joinery

1.4.3.1 Japanese Woodworking

Part to part connection has a direct relationship with Japanese woodworking. It is a kind of art representing Japanese aesthetics and philosophy for robust production and consummately crafted works.

Japanese culture is based on values like patience is, perseverance, meticulous attention to detail, discipline, simplicity and of course harmony with nature. All of these values are translated into architecture of traditional structures. Japanese woodworkers respect the nature and work with it, rather than against it. They think that wood material is a living tissue that expands and contracts with the environment and is given a second life in the structures it becomes.

They tend to use use wood from local trees that died of natural causes. Also, they respect the wood's natural curvature, and maintain nature's order by using wood cut from the sturdy base of trees in order to form the base of structures. This mean that structures are created around wood's natural elements. What is extremely interesting is that traditional Japanese structures and furniture are held together with wooden joints, without using a single screw, nail, bolt, or other metal hardware, that is known like wood to wood connection. Their constructions are characterized strong

and durable to weather conditions. Everything is held together with compression, the tightness of the joint against the end grain of the wooden recess.

What this natural technique offers in structures is robustness and flexibility since joints accept the motion of the building, allowing them to easily withstand the destructive earthquakes that are so common to Japan. It is a quite simple approach that needs lots of accuracy when carving the wood, using the traditional hand tools, because every piece should fit together perfectly.These hand tools require time consuming attention to detail and rigorous labor but allow clean and personal precision, something that is difficult to get succeeded with electric jigsaws and sanders.

The use of hand tools and joinery embodies a preindustrial approach to woodworking and architecture, deeply rooted in Japan's cultural past. Traditional Japanese woodworkers, who waste so many hours at every project, are able to create works of art that not only align with the natural world, but can also be more durable than the more expedient postindustrial methods.

2. A WARM MOMENT WITH FURNITURE

Due to the technological era we live in, the fast paced life and the social pattern caused by social media, we no longer are focused on personal creative thinking moments even if we have some time to chase away the virtual world we live in.

Human being needs a quiet home ambiance that will relax his body and his brain after a long tiring stressful day at work, at school, in means of transport, after a day with lots of traffic jam, with many colorful marketing advertisements at every wall or screen, with lots of noise and air pollution.

The only way somebody to feel secure and calm again is to return back to his home, into his personal space. The space that cars do not have a seat, where tv/laptop screen can close wherever user wants, the voice of radio can be louder, a book can become user's best friend and make him go into the most imaginative places. The user decides if he/she needs company or not.

Every household has specific places that people choose to have some internal moments. For some moments, maybe a little seconds after work arrival, or at afternoon coffee time or before sleeping. These moments are the most precious. What determines the space we choose for these moments are the furniture included in. Furniture talk like people do, but in its own unique way.

Furniture language is about design lines, colors, materials, symmetry or asymmetry, texture. These elements determine the way we feel when first see it and then interact with it. Firstly, user sees the furniture in a shop, then he imagines it in his personal space and then he/she decide to buy it. When include it at precious, personal moments, furniture obtain value. It becomes the place user want to drink his/her coffee, to read a book, to join a movie. A synthesis of furniture that speaks to the user or make the user speak in a qualitative way into his house could play an important role into his/her attitude and way of living.

3. CONCLUSIONS

Through the extended research I made, I realized how rich nature is and how technology tries to find new ways of designing and constructing without destroy it. I perceived that connecting the way of design with a kind of sentiments expression, way of thinking, daily needs has a big value. I also felt that the material of furniture, the way it will be delivered and assembled by the user, can offer a sense of life. Moreover, design can be a passive support for human being and as a result, a strong relationship can be built. It is noticed that the lack of strong emotional bonds between owners and furniture, and their possessions are that make users get bored of them.

From all the bendable and smart materials I searched about, I found a big interest in wood material and specifically in plywood that is an artificial one, because I found out that in plywood, the wood is viewed as a living tissue that expands and contracts with the environment and is given a second life in the structures it becomes. It distinguishes for its versatility, renewability and sustainability, having the greatest strength and remaining pliable at the same time due to numerous thin laminates of wood glued together. What made me excited is the new materiality that can be created turning the material habit of a simple, modest thing upside down causing it emerges in a different way of utility, function and beauty.

Except from plywood I found a big interest in the history of felt material that was used for clothing saddles at first. What made me search more about this material and way of produced was that it constitutes a material for the most attractive toys, which means that is a funky material. Also, it does not unravel as woven fabrics do. It can be easily be cut like plywood pieces with CNC milling. CNC is a tool that offers great accuracy and tends to get developed finding new ways of acting through a piece when it has to do with a simple product.

CNC cut easily both selected materials. The reason I resisted in CNC machine was my passion for many cut parts that can be assembled together without need any glue or screw due to their geometries, creating an attractive product which is simple and beautiful at the same time. Except from the cut of pieces I impressed by the bending method of wood that it is the most economical one, productive of high strength and cheapest method that can create desirable curved wooden parts.

Finally, I had to decide which kind of linkage is the most desirable for my constructions and including that I would like a construction that everything could be replaced and nothing would be needlessness, I felt that Japanese way of thinking about wood to wood connection was the most suitable.

4. DESIGN PROCESS

4.1 Introduction

At this stage of dissertation I tried to include the human need for qualitative moments into my design concept and include the materials selected, that would represent it in a simple but cute way.

The core of my inspiration were tiring, difficult days that could be expressed by a variety of words. These words talk about things that give us pleasure on a daily routine, for things we are lack of today, influenced by the pressure and anxieties existed in our lives.

Firstly, I researched projects that express a warm moment with the user. I found inspirational images of colors, people and furniture and created my mood board. Then, I tried to have some sketches using one line that represent a series of movements a person do when returning at home after a long tiring day and finally I made a brainstorming of possible forms of furniture. After this process I had to choose which concept I would develop, determining its specifications and making some renders.

Having in mind that the fast paced life is difficult to be changed it is suggested, to all of us, to find a little time for qualitative moments when getting into our houses. Tiring, difficult days can lead us to poetic, spiritual, creative, warm home moments and furniture could inspire us to make them better.

4.2 Contemporary examples

Some examples of furniture with bendable materials, promoting intriguing moments with the user through clever constructions are presented below, giving another dimension into interior design and user- furniture interaction.

La Eva, chair design by David Ortiz

La Eva is a hall chair that presents its own structure as an essential component that looks unique. it is a clever chair design concept that arouses emotions in a simple but functional way.

Image 25 : La Eva chair by David Ortiz (WE AND THE COLOR, 2020)

Tripod side table, designed by Noon Studio

Noon studio complains that simple does not mean boring, so created tripod side table that bolds how simplicity drives into elegance. This product consists of a cantilevering tripod leg system and just four parts, the ceramic tabletop and its wooden legs. What is impressing is that it sets up and disassembles in seconds.

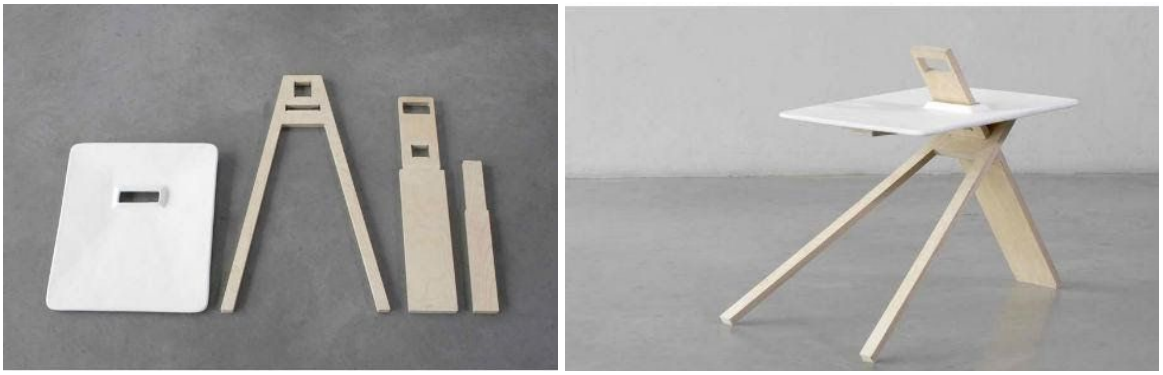


Image 26 : Tripod Table by Noon Studio (Ganea, 2020)

Steps seat and side table by Geof Ramsey

This product was designed by Geof Ramsay and represents a small staircase that is used as a seating with built-in tables. Its steps made of plywood and constitutes a beautiful minimalist design that can be part of the user's relax time.

Image 27 : Steps seat table by Geof Ramsey (Howarth, 2020)

Feel it, floor lamp by camilla engholm poulsen

Feel it is about a flexible floor lamp for secondary lighting. These lamps are upholstered with mink fur. This kind of design invites you to use multiple senses through touch! It provides the full experience when you touch and feel the lamp. It is not only the light that it offers you but also the way it make you feel when touching it, a warm moment.

Image 28 : Feel it, floor lamp by Camilla Engholm Poulsen (designboom | architecture & design magazine, 2020)

B66 side table, by Christian Pulsen

B66 side table is a beautiful furniture by Christian Poulsen, inspired by Nature and sweetness. It consists of a single piece of hardened resin wool and a cork top. It is characterized by its interesting pure lines and its warm materials of felt and wood.

Image 29 : B66 side table by Christian Pulsen (Trendy Home Decorations, 2020)

Laceup leather shoemaker chair, created by Martin Azua

It is an adjustable chair due to its shoe - inspired lace and eyelet system. The piece offers a backrest and sloping arms form comfort. The legs are made from copper, contrasting with the matte leather seat which is made from a single hide.

Image 30 : Laceup leather shoemaker chair by Martin Azua (Martín Azúa, 2020)

Plywood and PET – felt chair

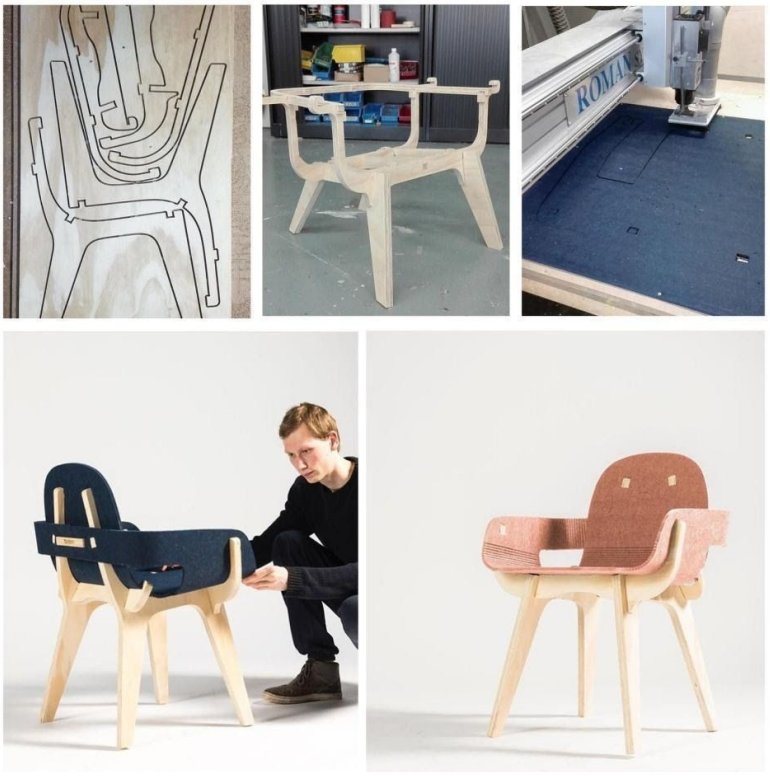


Image 31 : Plywood and Pet-felt chair

This project presented above started of a research of the possibilities of the CNC milling machine to create 3D bendable materials. It is about a series of chairs made of PLYwood and PET - Felt, using the CNC techniques. It promotes the ability of assemble by hand without any glue or screws

4.3 Inspiration

Inspiration can get born by a kind of sound, a sense, by research, by people, an attractive image, a personal need, thought or by a combination of all the above.

4.3.1 Mood boards

The mood board is a presentation created by a combination of images and words that inspired me develop a series of concepts that represent a series of things that give us pleasure on daily tiring routine days.

The images refer at today way of living. " How fast do you put your clothes in order to catch up the bus to go to work, how mechanical are your movements when you repeat every day the same things, how much do you need to just relax on a chair, let your body free and just watch the ceiling with music company". It is important to notice that these days are easier and happier when some light get into our houses or at the place we are, making the furniture look more pretty than before

and our way of acting more friendly and amiable. Because the way we live have made us a bit closed to ourselves, making us afraid of letting our sentiments free and like the image shows a big, warm hug is really important. Finally, the last image that presents some books is a kind of motivation to find some little inspirational moments that would make our life more poetic, travelling us into long imaginative leisurely trips."

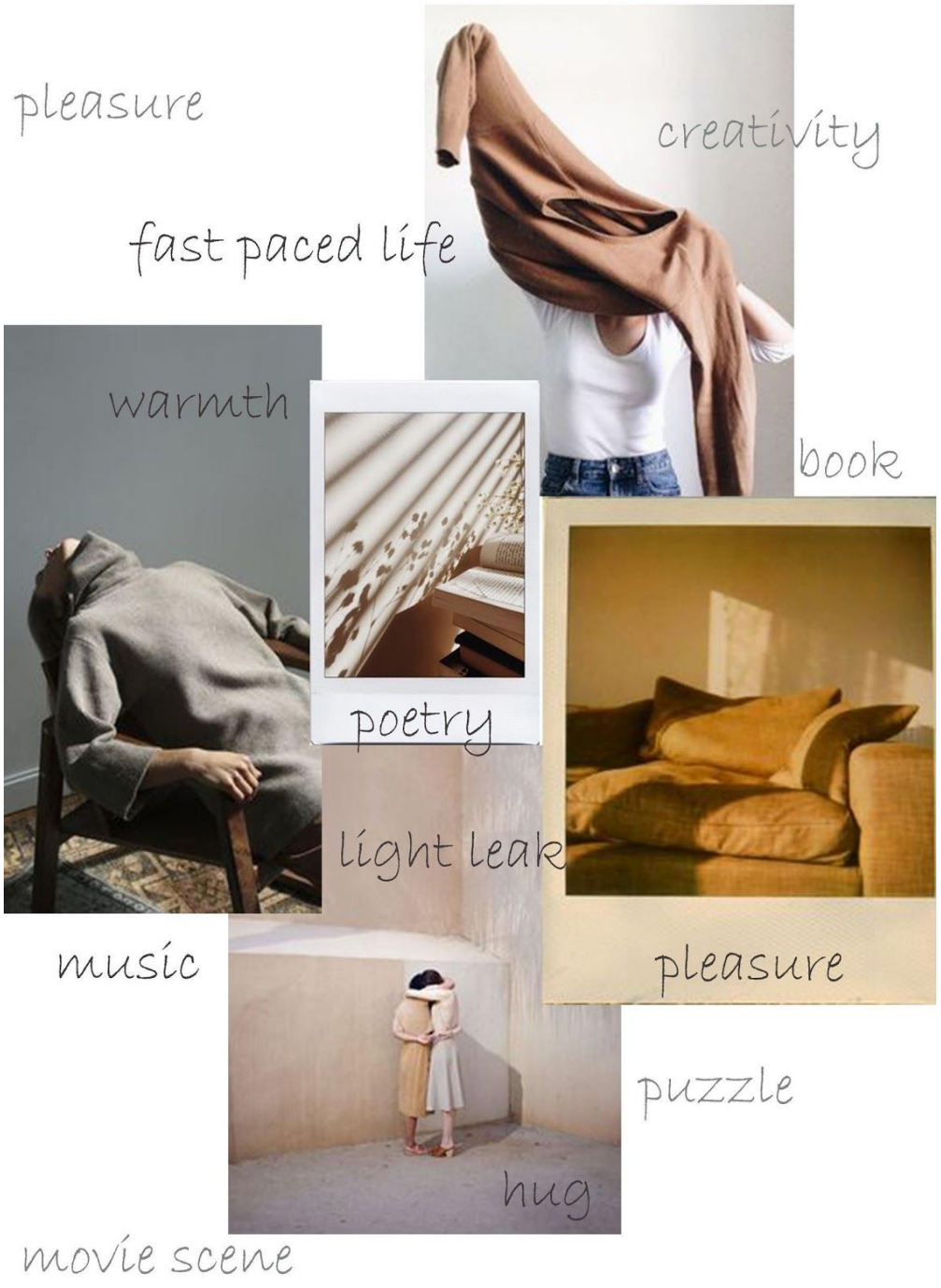


Image 32 : Mood board

Brainstorming

The first brainstorming started by thinking about what people want to do when return back to their houses after a tiring day. It is an abstract representation of a combination of furniture and of movements that the user imagines doing when feels tired. A continuous line that starts from the arrival at home, after a long day, is the beginning of the story of the sketches.

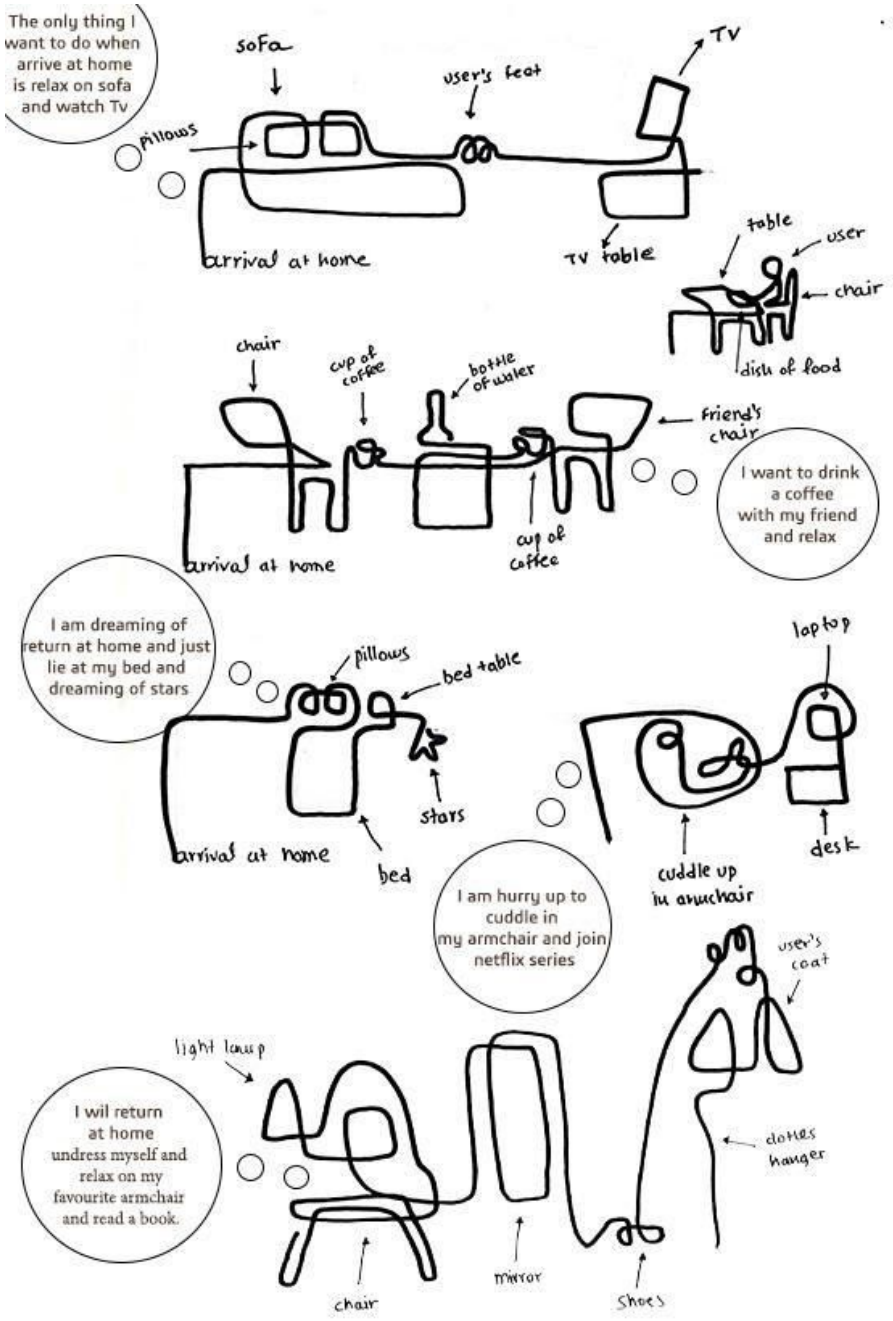


Image 33 : Brainstorming

Then a brainstorming of sketches of forms followed, trying to find the way hug, asymmetry, balance, pleasure and nature can pass onto a paper. The central role of the series of furniture I was trying to

design,had the chair, because I think that a good chair staring at every house and it could be easier for me to begin with a furniture like this and then produce ideas of how the other ones would be blended.

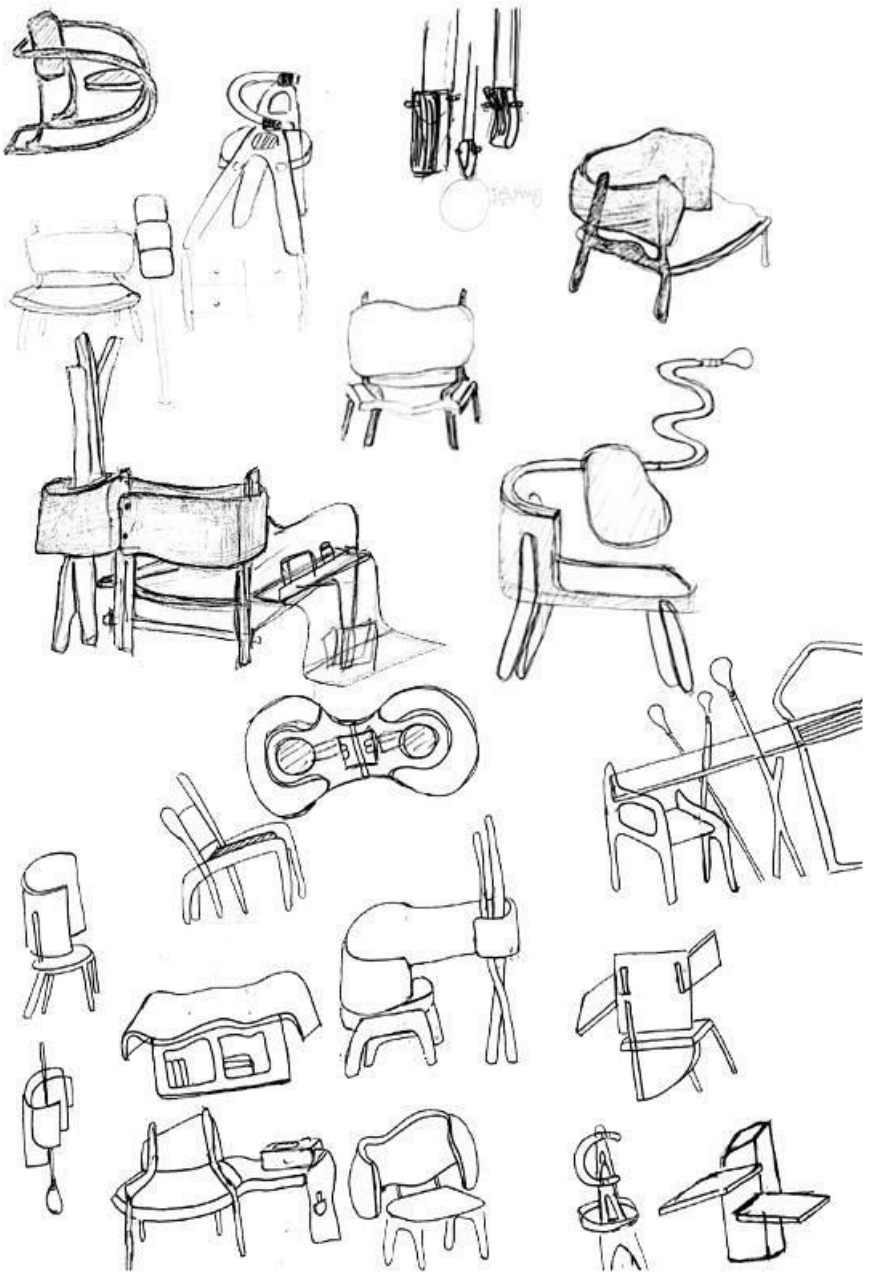


Image 34 : Brainstorming

4.5 Concept Selection

At this stage I had already decide which concepts and forms where my favourite ones. It was quite easy because I started from a chair and the chair drove me into the synthesis. The materials selected before were suitable for the forms I created and it was really interesting how the lines were passing the message i was talking about.

A short text that describes sentiments, using the words I inspired by, convert the way we live into design principles.

“Nowadays, many people look lonely, isolated, unhappy and scared. The relationships tend to become more superficial. There is lack of strong sentiments that a hug can offer, of physiological balance that has to do with the exercise of mind and body and lots of anxieties and chaos that could be translated as asymmetry in our concept. Little important moments make people happy and it is necessary not to forget to include them into our days. “

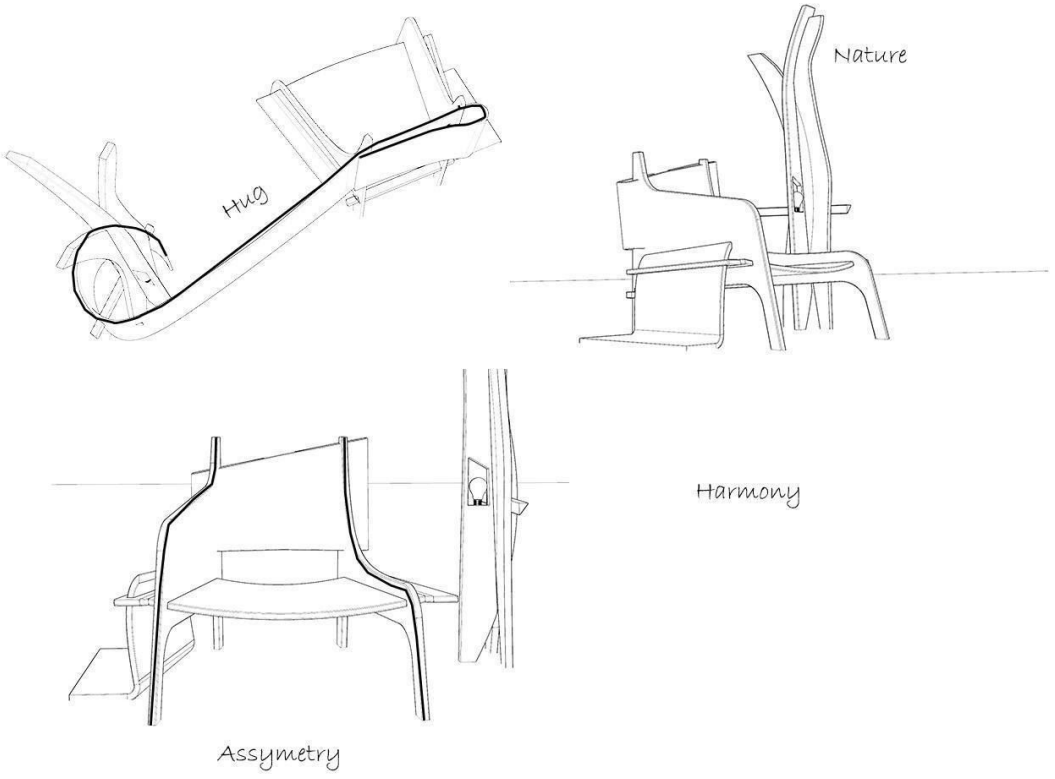


Image 35 : Words converted into design

More specifically at the design concept selected, the curved piece of the felt material that passes through the plywood feet structure curl the floor lamp like it hugs out it, so it represents the hug word.

The asymmetry word is represented by the plywood feet of the chair. This asymmetry gives the chance of the lying possession of the user who can use a pillow at the curved plywood seat for more comfort. What could be translated as asymmetry in our lives is anxiety, stress and chaos. But what we notice at sketches is that " when chaos has something natural near it, that offers light, it can be converted into something balanced." A little nature, because light lamp looks like a tree, brings this balance into our houses. This light lamp acts also like an accessories hanger.

A combination of puzzled furniture assembled by user's own hands, synthesizing product's parts is the beginning of my concept proposal. Relax, put some music and drink your favorite tea or wine with the best company, a book. Feel the unit of the furniture hug you, like you are part of it.

The concept selected is a whimsy proposal of poetically practical pieces of soft furniture. More specifically, is a combination of a chair, a floor lamp that acts like a monk hanger for accessories and a side table. All of the parts that create the series of furniture are made from plywood material, except from the backrest that varies according to user preferences. It can be from felt, leather or any fabric material. All of the materials are pliable and can be cut by CNC machine. They are linked with the help of part to part connection and with wedges for stability. It is about a method that needs a lot of design accuracy because every recess of a part should be covered by the same equivalent part dimensions that will clasp there.

The dimensions of the backrest felt piece let the freedom of the floor lamp movement in order to come closer or get away from the chair. Like we say freedom, isn't it? A helpful piece of wood that penetrates through the one part of the floor lamp, assures the possession of the backrest piece.

The concept is based at the fact that nothing is irreplaceable. If a part will be destroyed it can be easily be replaced, and the user has the chance to change the way it looks like by changing the material that plywood parts accompanies.

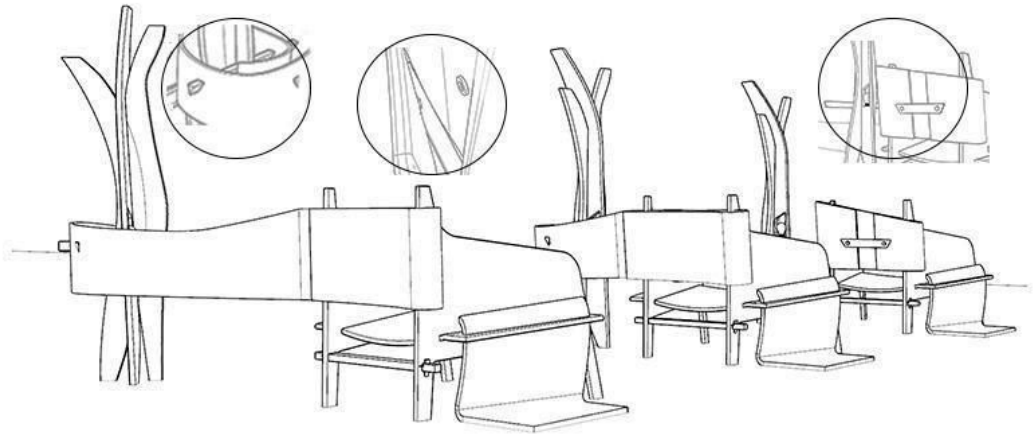


Image 36 :Concept details

There are some alternative proposals above, showing the way felt material is moving closer or far away from the chair. Also, at the third sketch a different piece of leather material is isolated only at the chair, stop hugging out the light lamp. At the first two sketches the felt is fastened with buttons at the backside of the chair compared with the third one that a piece of leather with buttons can link the two edges of the leather piece.

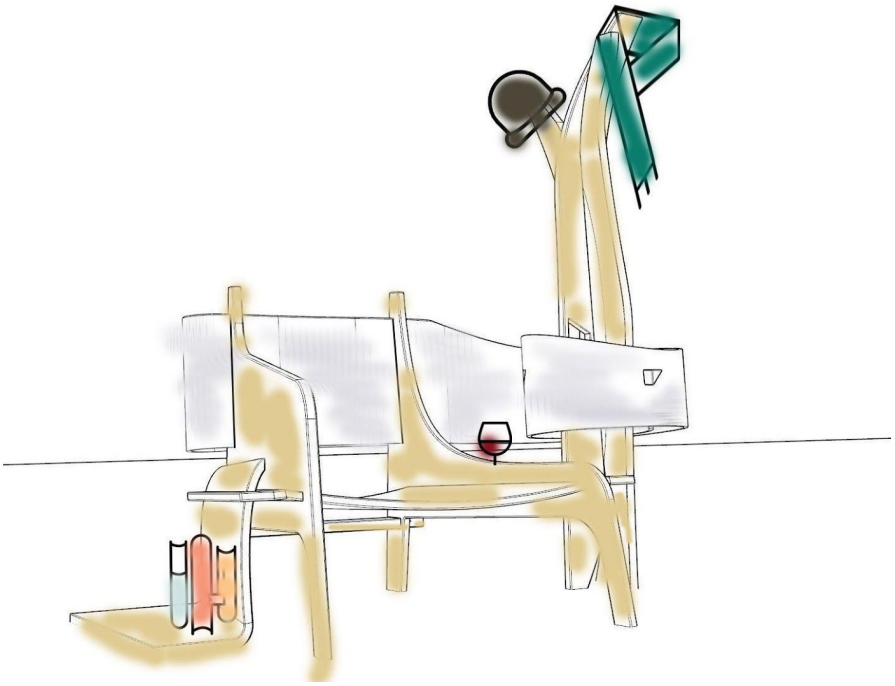


Image 37 : A poetic moment with the product

A poetic moment translated into an image of art,reminds us a kid of movie scene, is presented above, showing us the uses of concept selected.

5. PRODUCT DEVELOPMENT

In this stage of design process, after determined which concept of furniture would give the more pleasure, the warmest moment and motivation for more personal qualitative time to the user, representing and translating more clearly the words of hug, harmony, nature, asymmetry, poetry into design principles, keeping in mind the materials selected before, I wrote a brief description of what exactly is my concept and to whom it is addressed to, analyzing an indicative user persona profile. Finally, I created two scenarios of storytelling and referred the main specifications about the parts the product consists of, giving some indicative dimensions and renders.

5.1 Brief

Design of a synthesis of furniture with plywood and felt material that consisted of parts assembled with no glue or screw by the user, for the user, making solitary moments unique.

5.2 Target Group

The series of furniture is addressed to 18 - 45 aged people that spend many hours working, having limited time for relaxing, reading, listening to the music. Also it refers to people who live in a modern house, passionate about small inspiring productive home moments and cute minimal designs.

Personas

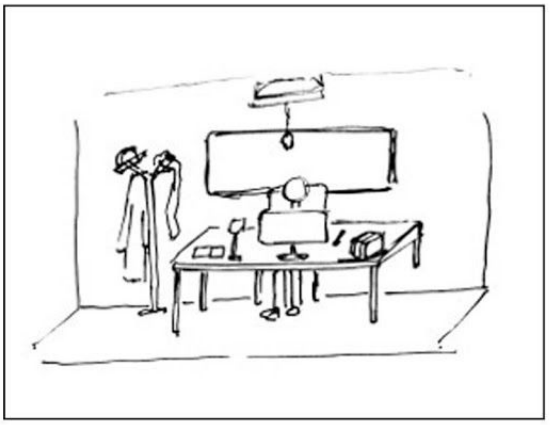
Kornelia is a 28 aged girl that loves reading books, sketching, watching movies and dancing. Since 4 years he works a lot as an architect, passing 8 hours in front of the small screen of computer. She wakes up early, prepare her meal, taking a coffee from the shop opposite her house and waiting for the bus in order to go for work. The bus is not always on time so she gets angry trying to find a taxi in order not to be late. The days the bus comes on time, she gets in and if she cannot find a seat, she stands up in a corner between other people and just noticing their reactions. They seem to be exhausted, sad and afraid of be stolen. She thinks that nowadays there is lack of happiness. When she is not watching people or the road, she tries to find inspirational poetic literature online to feel happy and ready to face up her day. She grow wary of her daily routine. After 8 tiring hours of work she follows the way back to her house. She does some exercise, have a bath, cook for the next day and wear her comfortable clothes trying to relax joining a glass of wine, putting some music at pickup and reads her favorite book.

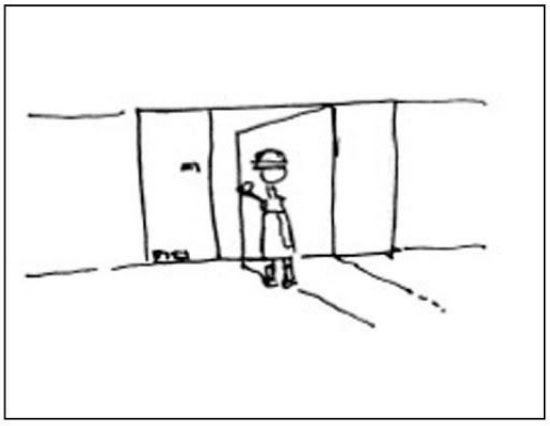
5.3 Storytelling

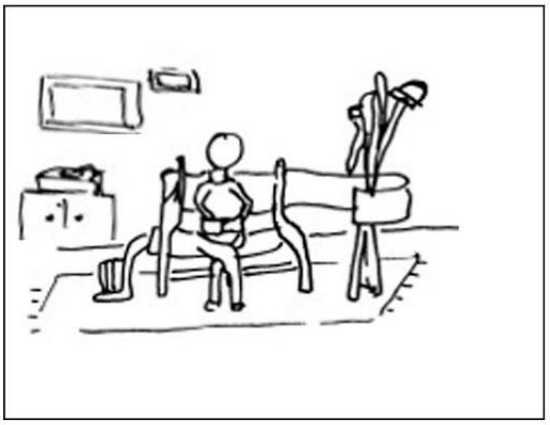
The “show don’t tell” method of storytelling wants to demonstrate how this product enriches people’s lives because it is well known that people are not just buying products, they are buying better versions of themselves and they want to know how the product will shape their lives. (Medium, 2020). So I tried to create a series of sketches representing days that include interaction with my product.

Scenario 1:

It is 7 o'clock in the morning. Anna is waiting for the bus to get her into her work. It is a cold day of winter. When she arrives at work she stays absorbed at computer for about 8 hours. When she finishes, she take the same bus and return tired to her house. She hangs her hat and scarf at the floor lamp branches and put a glass of wine and some music to relax in order to organize her next day schedule.

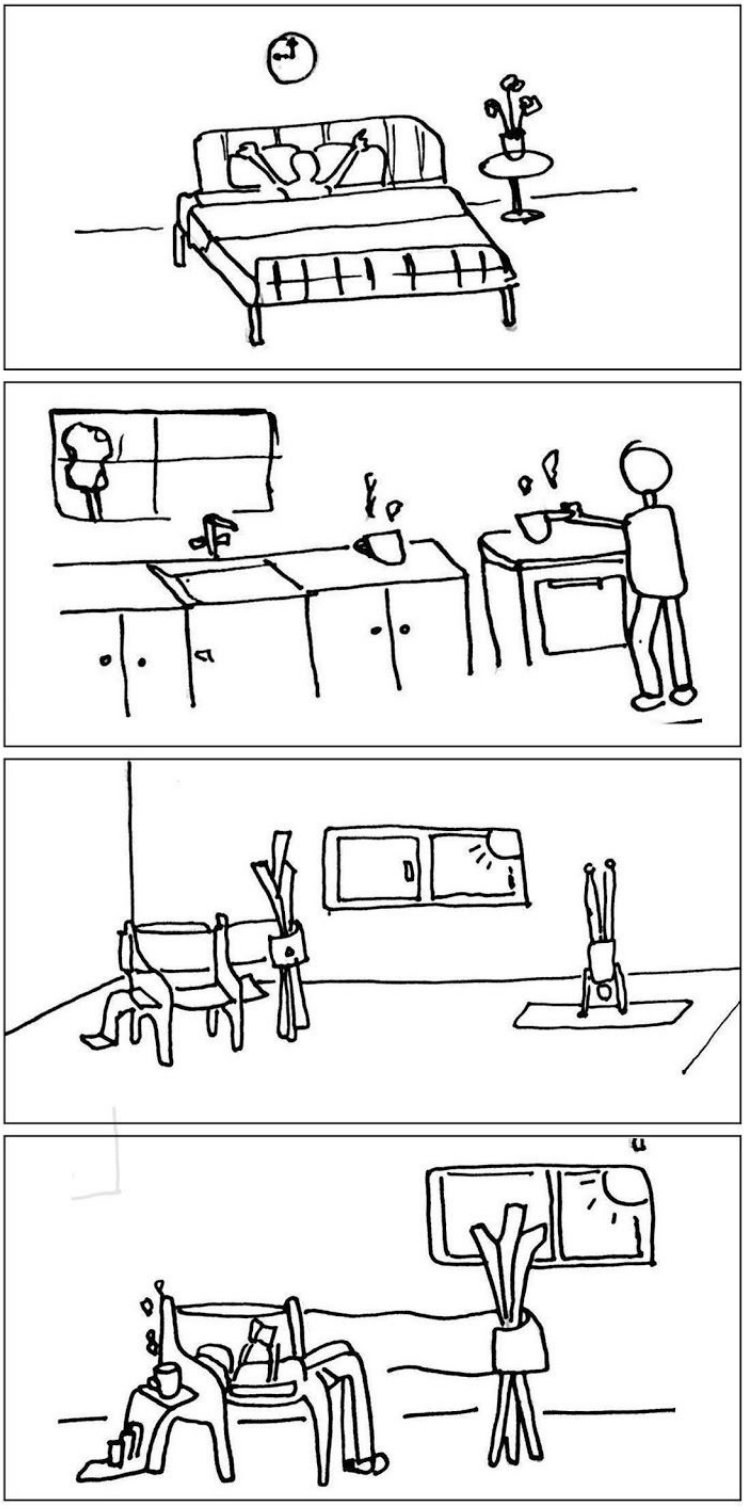






Scenario 2:

It is a sunny Sunday morning at home. Nikos wakes up. He is really happy because it is a free day that he can have some personal qualitative moments. He prepares his brunch and a cup of coffee, has some yoga exercises and has a bath. Then he is ready to greet the day reading his favorite book, enjoining the sun that gets into his house and relax.



5.4 Final Specifications

The basic parts that create the product are 13 parts. Analytically, there are 10 parts of plywood including wedges and 3 movement stoppers of parts and wedges. Also furniture consists of a felt or leather piece that intersects at the backrest of the chair bundling the chair with the floor lamp.

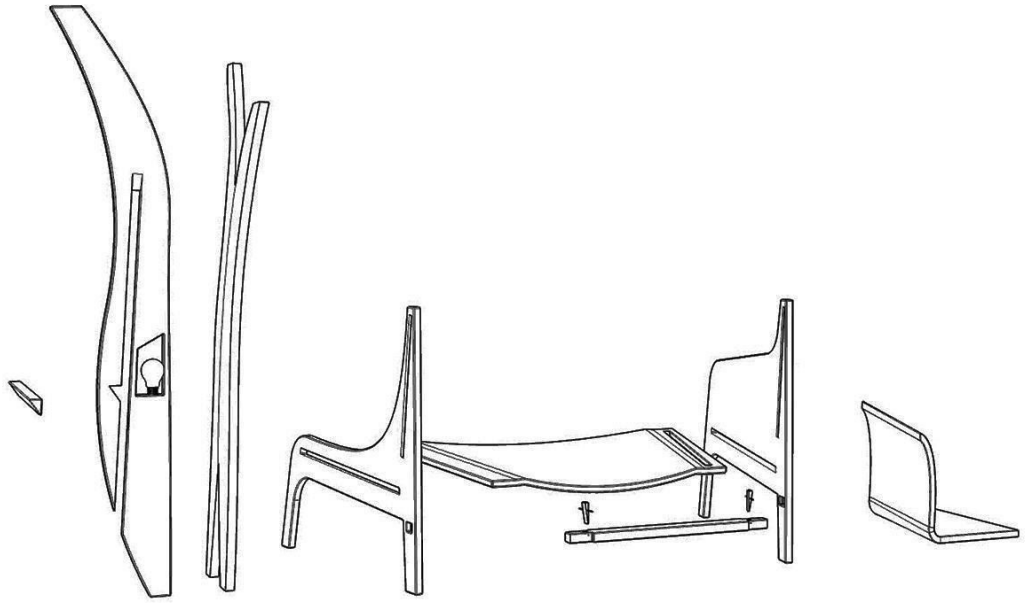


Image 38 : The disassembled product

The series of furniture are characterized by the guidelines presented below:

- Functionality, because they help you relax and better enjoy your living space with less stress.

- Practicality, since it can be assembled and disassembled easily due to its way of construction. There is no glue and screws, every part intersect into the other.

- Detachability, the piece that is used for backrest can be moved and be replaced by another one, maybe a different material piece. Also, user has the choice to bring the floor lamp more closely being clasped more times by the backrest piece.

- Environmentally friendly. The harwood plywood parts are postulated to be created with eco using glues with lower VOC and formaldehyde emissions.

- It is easy to be placed in a modest house of limited size since they does not occupy a big space when the light lamp is close enough to the chair.

- Components lock together requiring no glue or screws.

5.5 2d Drawings

At this stage of dissertation I tried to determine some indicative dimensions for the main parts of the furniture in order to create the 3d models. Of course they are not the final ones since a new product development demands the creation of prototypes in order to realize possible faults that have to be corrected but it is a good beginning for seeing a more complete image of the series of products.

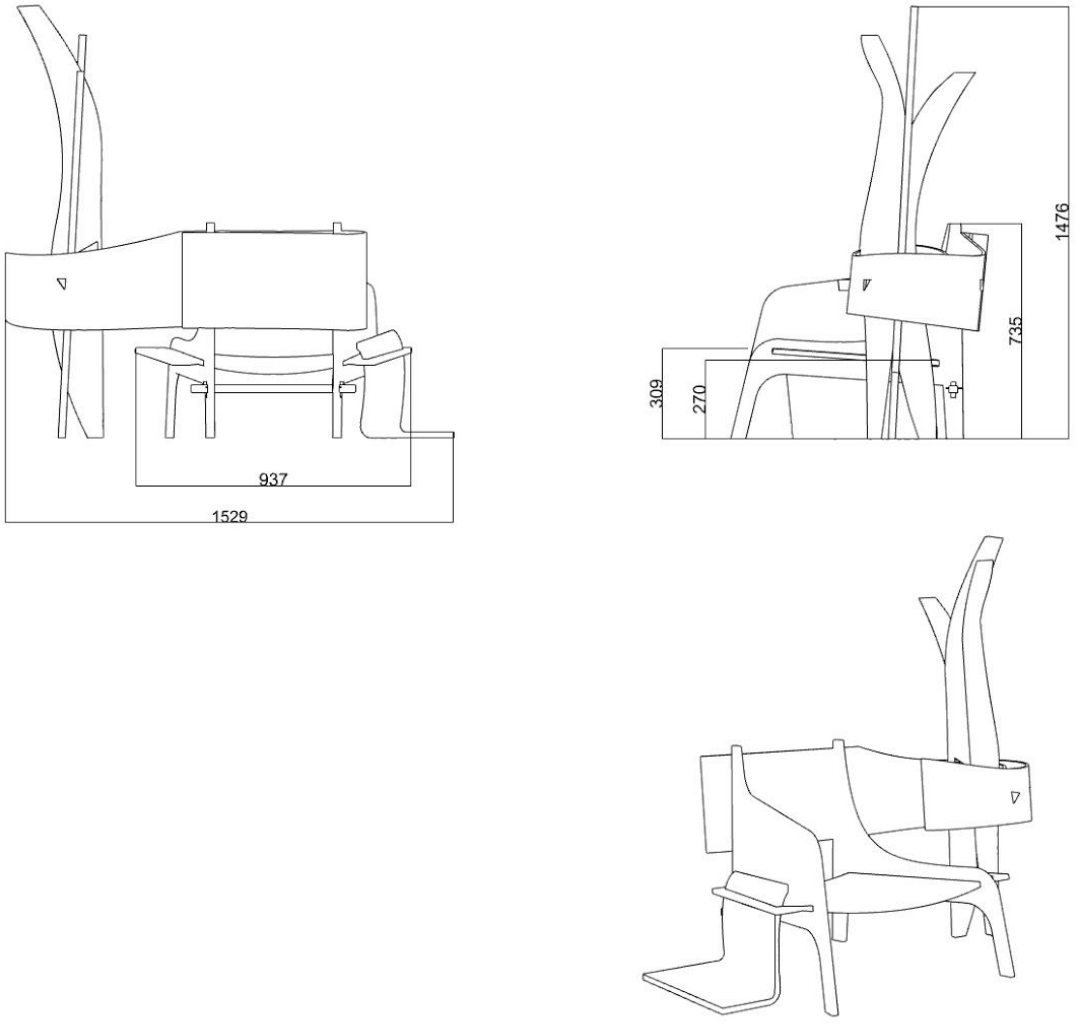


Image 39 : Basic dimensions of the whole product

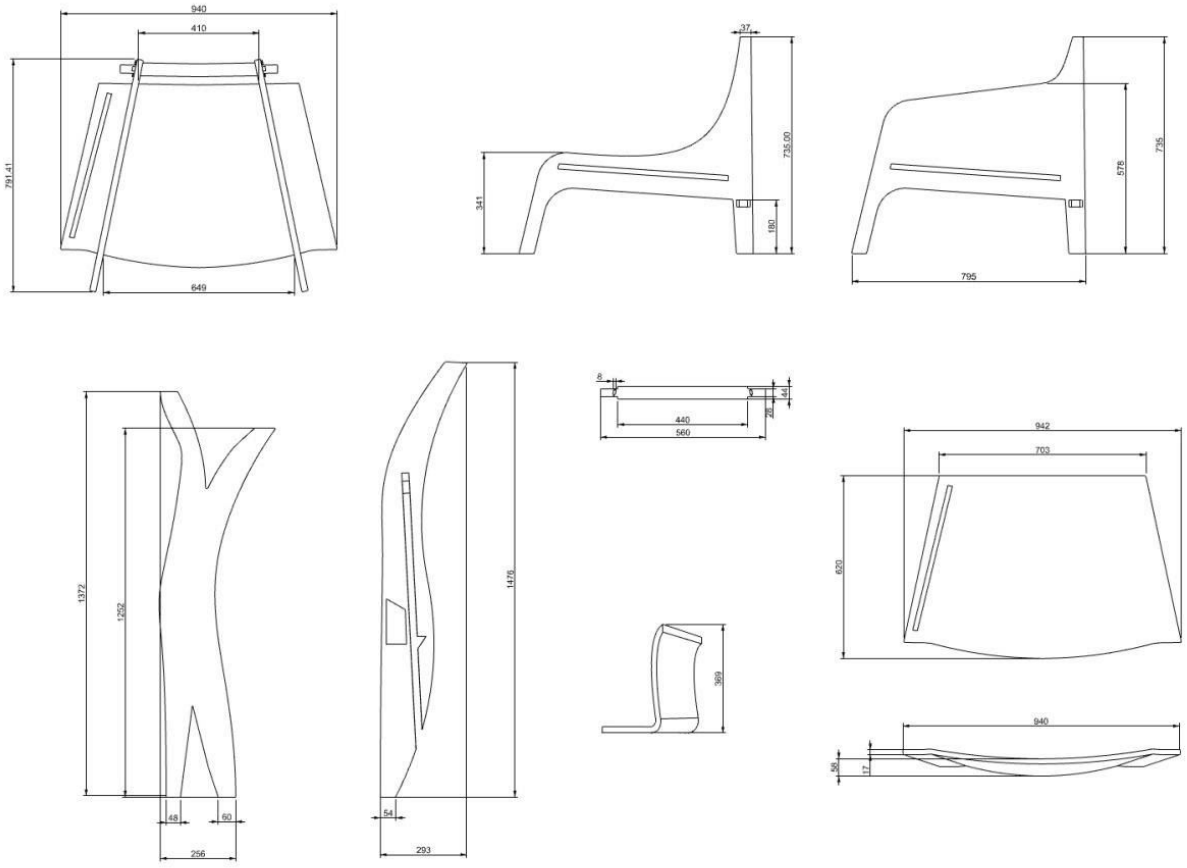


Image 40 : Indicative dimensions of the parts

5.6 Renderings

Image 41 :Perspective View of the model

Image 42 :Perspective View of the model from the above view

Image 43 :Perspective View of the back side of the model

Image 44 :Front view of the three alternatives of the series of furniture

Thank you.

6. CONCLUSIONS

This dissertation made me totally realize that the materials' evolution, the respect into nature, the plethora of today's technological achievements, that helps us work them out, the deep understanding of important creations of the past, the personal experiences and knowledge of our most important internal needs can constitute a kind of motivation and inspiration for a new invention - creation of a design concept. Also, made me think about furniture that can influence our lives in a more qualitative way.

The essential understanding of materials' nature, their total remaking into new tools for product development, but also our daily tiring routine days, were my first inspiration, and their combination managed to convert little meaningful words into simple design lines, giving a little push to users in order to join little spiritual moments when returning home with the companion of a book, with some music, under the distinctive light that can offer warm moments, through the plywood floor lamp that look like a plant.

However, the development of my dissertation taught me that except from the way you design the parts of a product, of equal importance is also the way parts are assembled together, since it represents a personal way of designer's thinking, of a culture and of course constitutes basic and integral part of the product design development.

So, what was succeeded with the accomplishment of this dissertation is a whimsy proposal of furniture, made by warm materials, parts that are simple assembled, easy to be replaced, trying to spread around the message of "have some little time for yourself".

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