EQ-WOOD

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TRAINING TOOLKIT

SUMMARY UNIT 1

DESIGN THINKING, CONCEPTION, PROTOTYPING

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UNIT 1 - DESIGN THINKING, CONCEPTION, PROTOTYPING

INTRODUCTION

This unit aims to describe:

▪ how to lead in a professional manner a brainstorming for the stimulation of innovative ideas, starting from a specific brief

▪ how to map the ideas raised from the brainstorming through some digital tools of mind mapping

▪ how to evaluate the ideas through the relationship between potential and feasibility

▪ how to lead a process of fast ideas validation, including *Biomimicry Design Approach*

▪ the process and the most important tools of rapid prototyping / 3D printing

Subject 1. DESIGN THINKING

In this session you will learn the phases of Design Thinking, how it supports **problem identification** and the **conception of ideas**.

Design Thinking can be described in a series of steps from the beginning of problem definition through idea generation, to the selection and prototyping of potential solutions.

Topic 1. HOW TO STIMULATE DESIGN THINKING

There are many different models or methodologies of Design Thinking.

The Design Thinking model from IDEO considers three main phases: inspiration, ideation, implementation.

The Design Thinking model from the Institute of Design at Stanford has five phases: empathize, define, ideate, prototype, test.

The Double Diamond method from the Design Council gives us four main phases: Discover, Develop, Design, Deliver.

Another model is a design thinking method known as *Biomimicry*. In the Biomimicry Granada Design Thinking model, there are five different phases: Discover, Interpret, Ideate, Experiment, and Evolve.

Topic 2. METHODOLOGIES FOR BRAINSTORMING

In this section we will work with the first three phases: Discover, Interpret, Ideate.

The goal of the discovery phase is to create a one sentence design challenge and to identify important principles that must be met.

One way you can work to get a new perspective on the situation is by using a methodology that we call "**Reverse Brainstorming**" and allows you to develop deeper insight before you jump into possible

solutions: instead of looking for ideas or potential solutions, the goal is to figure out what questions you should be asking.

Another brainstorming technique that is working towards coming up with as many ideas as possible, no matter how odd or out of the box so that we can later narrow them down into those ideas that are the most plausible solutions for our problem. The goal is to **disrupt your normal thinking process** by using all the information you and your team have built to date.

One of favourite brainstorming methods is using the **Post-its** – you can literally see creative energy spilling out of people. The team is trying to answer this question – "What are all the ways in which we can solve this problem?"

Another tool that it's useful for generating a lot of ideas, organising them into a hierarchy that clarifies our concepts is **mind mapping.**

Topic 3. IDEA SELECTION

To support you in this process, consider developing a 2x2 matrix that allows you to visualise where your ideas fit on dimensions that are important to the goal.

Share 2x2 matrix showing how a matrix can be visualised: **performance and potential**.

It is important to note that just because an idea is good because it scores high on both of the elements that you value or that it is bad because it does not do as well on one of the elements, you still need to talk as a team to make sure it "feels right".

Topic 4. IDEAS VALIDATION

In order to understand the best potential ideas, it is necessary to validate them.

When you decide to experiment with an idea, you are bringing it to life by making a tangible prototype of it. This is because, even if the prototype is not an exact replica of the idea at this point, it will still help to share the idea with other people and receive valuable feedback about it.

As the end goal of this whole process is the development of innovative ideas that have market potential, it is important to keep in mind the fact that modifications of ideas are inevitable.

The two phases of experimentation and evolution will be intertwined as you will find yourself developing something only to improve it before creating the second prototype.

Subject 2. IDEAS IMPLEMENTATION - RAPID PROTOTYPING

Through this series of lessons, you will learn how to make your idea tangible with the most innovative technique of RP, the 3D Printing. Rapid Prototyping represents the Experimental Phase of a Design Thinking process, that gives you the opportunity to validate the idea and step into the following phase of Evolution.

Topic 1. HOW TO LEAD AND CONTROL THE PROCESS OF RAPID PROTOTYPING

Rapid prototyping is a group of techniques used to quickly fabricate a scale model of a physical part or assembly. Construction of the part or assembly is usually done using 3D printing or "additive layer manufacturing" technology. So to understand and choose the right rapid prototyping technology, is critical to the success because we can use more than one manufacturing technique to assemble a prototype.

In this Topic, we go more in depth in the techniques for use and doing Rapid Prototyping. We will also see how this process can be applied to the furniture design.

Production processes can be grouped in three categories: Additive, Subtractive and Formative Production. Additive Manufacturing is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of a quite large selection of materials - thermoplastic, photosensitive resin or powder grains of metal - that can being fused together

The second category is the subtractive manufacturing or subtractive fabrication, that involves cutting away from a solid block of material. It consists of removing material from an initial block of the material of the part to obtain the desired shape.

The last one is the Casting technique where you create several parts from a first model, used as a reference.

At the end of the Topic we'll look at ways to use 3D printing to prototype furniture, covering three of the crucial aspects of furniture design. This initial part is usually made using an additive manufacturing technology. Once the object is 3D printed, a mold is created around it with silicone rubber. It is cured and then removed. Afterwards, the mold can be filled with the final material – usually resin.

Topic 2. HOW TO CREATE AN STL FILE

In this Part you will learn how to create the STL file. The STL (Stereolithography or Standard Tessellation Language) file format is the most commonly used file format for 3D printing and describe the surface geometry of a 3D object, without any representation of colour, texture or other model attributes. 3D design is the modern way of sculpting objects, using special softwares and a virtual space instead of scalpel and hammer, which makes it faster and less dusty.

We will see different softwares for design for 3d printing: The software you should use when designing something to be 3D printed is entirely dependent on what you are trying to make. In general, 3D design software falls into two categories. The first is CAD software and the second is 3D modelling software.

After that we will talk about the key design considerations that apply to all 3D printing processes.

The specific design software you use to create your 3D model does not matter.

Anything can be "drawn" in 3D on a digital canvas, but not everything can be 3D printed.

Topic 3. STL FILE CHECK

This Topic aims to explain how detect any possible STL files defects.

Defects lead to poor printing or outright print failures. Here we are at the checking phase. As we said, anything can be "drawn" in 3D on a digital canvas, but not everything can be 3D printed. One of the most common errors leading to printing failures is missing triangles. This occurs when the adjacent triangles fail to share two common vertices.

Once the checking phase is complete, there is the slicing phase. A slicer software takes a 3D drawing (most often in.STL format) and translates this model into individual layers. It then generates the machine code that the printer will use for printing. After having sliced the model, the software converts the STL file into G-code, which is the language that 3D printers understand. It's called a slicer because that's literally what it does; it divides the 3D model into thousands of flat 2D layers and provides G Code instructions to the printer about how to print each layer.

A slicer program allows to calibrate printer settings for various types of "areas to print"

Topic 4. 3D PRINTING

Here you need to choose which material will best achieve the specific properties required for your object. The variety of materials used in 3D printing is very broad. It includes plastics, ceramics, resins, metals, sand, textiles, biomaterials, glass, food.

The material chosen for the project will also determine which printing methods are most suitable. Let's look here the most commonly used 3D techniques, for each group of materials.

We will see the process to print Plastic: The FDM - Fused Deposition Modeling Technology, is at the very entry of the market as it mainly used by individuals. It is probably the most popular printing method due to the number of printers available on the market.

And we will also see methods to print resin or wax material with photopolymerisation technology. This technique involves the solidification of photopolymer resin by means of a UV light.