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IO2-A2: DUAL EDUCATIONAL PACK

3D2ACT:

FOSTERING INDUSTRY 4.0 AND 3D TECHNOLOGIES THROUGH SOCIAL ENTREPRENEURSHIP: AN INNOVATIVE PROGRAMME FOR A SUSTAINABLE FUTURE

Author (s): **NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"**

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PROJECT INFORMATION

PROJECT ACRONYM:

3D2ACT

PROJECT TITLE:

FOSTERING INDUSTRY 4.0 AND 3D TECHNOLOGIES THROUGH SOCIAL ENTREPRENEURSHIP: AN INNOVATIVE PROGRAMME FOR A SUSTAINABLE FUTURE

PROJECT NUMBER:

2020-1-EL01-KA202-078957

WEBSITE:

https://3d2act.eu/

CONSORTIUM: PARTNER LIST

- **NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS" (GREECE)**
- **EUROPEAN DIGITAL LEARNING NETWORK** (Italy)
- **POLITEKNIKA IKASTEGIA TXORIERRI S.COOP** (Spain)
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- **REGIONAL DIRECTORATE EDUCATION OF CRETE** (Greece)
- **UNIVERSITY OF CRETE** (Greece)

LESSON PLAN 1.1.1

TEACHING MODULE 1.1.1	
Chapter 1.1	Introduction to 3D printing
Equipment (if needed)	Projector. Optional: PC with access to the internet
Duration	1,5 Hours
Short description	In this worksheet students will learn about the basic concepts of 3D printing. Environmental and practical aspects of decentralized manufacturing. Example applications of 3D printing in Industry and in other sectors.
Learning Outcomes	At the end of this chapter, students must be able to: Identify what 3D-P pipeline is, software and additional equipment needed to generate a 3D printed product.
	Argue about the benefits, challenges and advantages/disadvantages of 3D-P.
	Realize the potential impact of 3D-P and the possibilities for entrepreneurship and career opportunities from the acquisition of related skills.
Activities	
Activity 1	Activity 1.1.1.1
Aim of the Activity	The general aim of the Activity is to familiarize students with the concept of 3D printing
Duration	25 minutes
Type of Activity	Presentation
Teaching Objectives	After completing the Activity, students will be able to:

	• Explain the concept of Additive Manufacturing. • Argue about the Environmental benefits of 3D Printing compared to traditional manufacturing • Recognize the basic applications of 3D printing • Argue about the potential impact of 3D printing and the possibilities for entrepreneurship and career opportunities from the acquisition of related skills.
Resources	Worksheet 1.1.1 / Presentation 1
Activity 2	Activity 1.1.1.2
Aim of the Activity	The general aim of the Activity is to familiarize students with the changes that 3D printing and decentralized manufacturing could bring to the world.
Duration	45 minutes
Type of Activity	Discussion / Debate
Teaching Objectives	After completing the Activity, students will be able to: • Argue about the potential impact of 3D printing and the possibilities for entrepreneurship and career opportunities from the acquisition of related skills. • Argue about the advantages and disadvantages of Decentralized Manufacturing
Resources	Worksheet 1.1.1/ Discussion 1
Further Reading	
	https://www.lexology.com/library/detail.aspx?g=84abb734-0bec-428c-9077-35aaeb73488f https://www.autodesk.com/autodesk-university/article/Real-World-Applications-3D-Printing-2015 https://www.makerbot.com/stories/design/top-5-3d-printing-applications/ https://www.youtube.com/watch?v=JVWac0inseM

	https://www.3dnatives.com/en/fused-deposition-modeling100420174/#! https://all3dp.com/1/stl-file-format-3d-printing/ https://fileinfo.com/extension/gcode https://www.central-scanning.co.uk/3d-printing-future-of-jobs/

Activity Worksheet 1.1.1

Level 1 (Novice Level: Basic Competences)
Chapter 1.1: Introduction to 3D Printing
Activity Worksheet 1.1.1

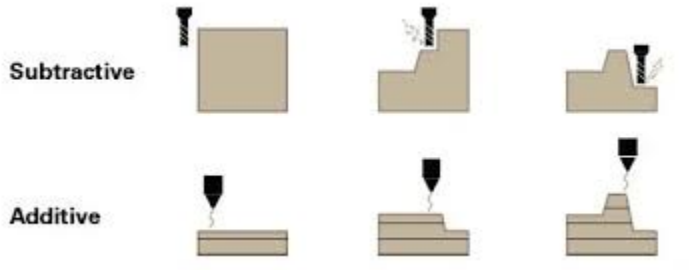
Presentation 1: What is 3D Printing?

Introduction

Additive manufacturing, also known as **3D printing**, is the technique of creating three-dimensional solid items from a computer file.

What is Additive Manufacturing?

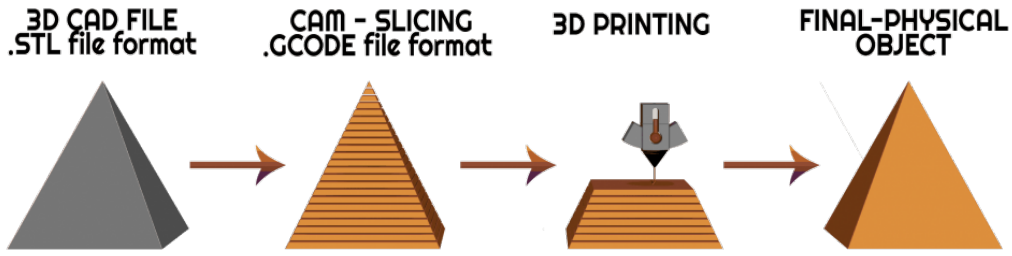
3D printing is the **opposite of subtractive manufacturing** which is cutting out / hollowing out a piece of metal or plastic with for instance a milling machine (ex. CNC Manufacturing).



When compared to traditional production methods, 3D printing allows you to **create complicated shapes with less material**.

How Does 3D Printing Work?

3D printing works by generating a **physical three-dimensional object** from a **computer model in a 3D CAD** (Computer Aided Design) file. An object is scanned - or an existing model of an object is used (usually an STL file) - and then processed by a piece of software, which is called "slicer". The slicer **breaks down** the model into a **series of thin, 2-dimensional layers** and **generates a file with G-code** instructions specific for the 3D printer. Finally, the **3D Printer prints the object by following the G-code instructions**.



What is an STL File?

An STL (Standard Triangle Language) file stores information about 3D models. This format describes only the surface geometry of a three-dimensional object without representing color, texture, or other common model attributes.

These files are typically created by a computer-aided design (CAD) program as an end product of the 3D modelling process. You can identify STL files by the ".stl" file extension.

What is a G-Code File?

A G-Code file contains commands in G-Code, which is a language used to describe how a 3D printer should print a job. It stores instructions in plain text with each line representing a different command, such as how fast the printer should print, the temperature it should be set at, and where the printing parts should move.

GCODE files are created by slicing programs, that translate CAD drawings into G-Code, which a 3D printer can read.

Environmental Impact of 3D Printing

3D printing can help the environment by **reducing production waste**, **lowering carbon emissions**, and **promoting the circular economy**. 3D printing has been hailed as one of the key drivers of **Industry 4.0**, providing a glimpse of a new era in industrial manufacturing processes. It is worth noting the positive impacts 3D printing could have on the environment:

- **Reduced manufacturing waste:** Additive manufacturing (layer-by-layer) processes allow us to optimize raw materials, because we **use only the amount we need to build a product**. Less manufacturing waste means that **we save a considerable amount of resources**.
- **Lower carbon footprint:** 3D printing also has a positive effect on the carbon footprint. Because it **does not rely on complex manufacturing and assembly supply chains**, it

facilitates localized production and **reduces the need to transport goods manufactured in third countries**.

- **Supports the circular economy:** It does this in two ways. Firstly, it is becoming increasingly popular to **manufacture printing filaments from recycled materials**, which adds value in the eyes of more environmentally aware consumers. Secondly, **consumers will be able to repair broken products by self-manufacturing spare parts** on home printers or at 3D printing centers. These two practices lengthen the useful life of original products, either by transforming them into a new raw material or by repairing and reusing them.

Industry 4.0

Industry 4.0 is revolutionizing the way companies manufacture, improve and distribute their products. Manufacturers are integrating new technologies, including Internet of Things (IoT), Cloud Computing and Analytics and AI and Machine Learning into their production facilities and throughout their operations.

3D Printing Applications

Over the years, 3D printing has seen a number of transformations. 3D printing was time-consuming and expensive in the beginning, making it unsuitable for applications outside of industry. However, with today's more flexible and cost-effective 3D printing processes, there are applications where 3D printing is now a viable option.

Replacement Parts

The replacement parts market is one of the fastest-growing sectors in 3D printing. Parts can be produced on demand rather than being stored in a warehouse. Plus, unlike conventional manufacturing techniques, if an item is no longer manufactured, **a replacement may be created and printed rather quickly**. Because of additive manufacturing, the replacement parts market is changing dramatically.

Useful Items

A practical application does not always have to be an industrial one; it might simply be something that works. With 3D Printing you have the **ability to create anything you need for almost any reason as a designer**. You can take that design and transform it into a working actual thing using 3D printing.

Consider the tasks you perform on a daily basis, whether at home or at school that may be simplified. Or, think about organization and where it might be good to have something that's created for a specific function. A basic design for a wall-mounted bracket for hanging headphones near your computer, for example.

Professional

Professional applications are a common type of 3D printing application today. While this category continues to grow, there are some important sectors where additive manufacturing technologies have been widely used.

Prototyping

Prototyping is **the first and by far the most common application of 3D printing technology**. Designers and engineers realized early on that having their prototypes printed rather than machined might **save them time** and **money**. Till the company could afford one of the few very expensive printers available at the time, the prototype had to be sent out to a service bureau. Printer costs have dropped considerably in recent years, while output quality has improved to the point where **even low-cost printers can produce parts suitable for prototyping**.

Personal

With the advent of low-cost 3D printers in 2008 came a new form of expression as output became available. Immediately, people put their printers to use creating all types of 3D printed designs. Within the vast number of categories of things being 3D printed, some of the more popular models created can fall under three main categories: **art and design, cosplay and toys and games**.

Education

The advantages of 3D printing for education include the ability to make prototypes without the need for expensive tooling, which helps students better prepare for their future. Students gain knowledge of 3D printing applications by creating and fabricating models that they can hold.

3D printing **bridges the gap between thoughts and images** on a page or screen and **the physical, 3-dimensional world**, enabling for the fabrication of those ideas/images.

3D Printing Future

Additive manufacturing is what 3D printing is all about. This means the objects are created with the addition of materials.

One of the most important advantages of 3D printing is that it **has increased the pace** with which activities are accomplished in the workplace, allowing for the rapid creation of a huge number of prototypes. When **products** are ready, they reach customers rapidly and **produce income quickly**, giving businesses more confidence to **invest by creating new jobs**.

Another significant benefit of 3D printing is that it **reduces the danger of making subpar products**, which reduces waste and allows businesses to spread their budgets further. One member of staff can handle all printing, allowing up other team members to focus on other tasks.

How 3D Printing is Creating New Jobs

3D printing can also free up physical space in the workplace. Companies that specialize in this field don't need to store backup machines on site if their systems break down. They can instead download files and print parts so their machines can be fixed. Growing numbers of people are now becoming involved in 3D printing – becoming **researchers, designers and engineers**.

Additive manufacturing is becoming increasingly important around the world, and more and more uses for 3D printing are being identified. The number of jobs related with additive manufacturing skills increased in the first half of the past decade. It means industrial **engineers, software developers, designers and mechanical engineers** are in demand.

Transforming Markets

3D printing has been embraced by a diverse range of industries, with **aerospace** being one of the most enthusiastic. Engine parts have been made from components produced via 3D printing, as have combustion chambers. It has also shaken up the **medical world**, with additive manufacturing being in use to produce organs, bones and more. 3D printing has seen a great deal of growth in North America and Europe, with China also showing an increasing amount of interest in it.

Discussion 1

Suppose you are the production manager of a small footwear company that is preparing to expand across Europe. In addition, assume that the production and distribution of your products can be done both in a traditional way (a large production plant and then transporting the products by land) and by 3D printing (with small local small industries that will produce and sell the products locally).

Divide into two groups and each one will undertake to support one way of production and distribution over the other.

You should keep the following in mind:

- The environmental impact of each production type
- The environmental impact for the transportation of the products
- The logistics that are required
- The jobs that will be lost and the new jobs that will be created

References

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https://www.central-scanning.co.uk/3d-printing-future-of-jobs/