



HEI MAKERS

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Technical creativity in 3D printing
module



Co-funded by the
Erasmus+ Programme
of the European Union
2017-1-LT01-KA203-035231



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LESSON #6 ENTREPRENEURSHIP IN 3D PRINTING

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OUTLINE OF THE LESSON #6

- Topic 6.1 – Entrepreneurship Overview
 - Topic 6.2 – Case Study – Carbon3D, Inc.
 - Further learning
 - Tasks for reflection
- 
- An abstract graphic in the bottom-left corner consisting of several overlapping, semi-transparent teal rectangular blocks of varying heights and widths, creating a 3D architectural effect.

6.1. ENTREPRENEURSHIP OVERVIEW

- Aim: To provide an insight into the mechanisms for developing and growing an idea, funding acquisition, protecting idea, developing and growing business.
- Expected learning outcomes: Recall the processes involved in establishing success in entrepreneurship

Duration	1 academic hr
Author / Lecturer	Name Surname, Inventya
Delivery methods	Individual / Teamwork / P2P
Evaluation methods	Test / Report / Feedback / Exam etc.

WHAT IS ENTREPRENEURSHIP?

Process of developing something new by:

- Recognizing or creating an opportunity
- Acknowledging the involved risks and uncertainty
- Responsible for its success or failure
- Gather the necessary resources to go into business



Figure 6.1.1 Entrepreneurship processes Source: Columbia University

KICKSTARTING IDEA

In order to kickstart your idea, you need to first effectively identify specific entrepreneurial **opportunities** within the sector i.e. think of a **solution** to a certain problem that you wish to solve.

There are many routes to jump start your ideas that are aimed for business beginners e.g.

- **Business incubator-** Helps beginner companies and entrepreneurs to negotiate hurdles, overcome isolation and stress of starting a new business. They provide access to a range of expertise, mentors, investors etc.
- **Business accelerator-** Program that gives young businesses the opportunity to access mentors, investors and other support they might need to become self sufficient

FUNDING YOUR IDEA

When looking for funding opportunities, the easiest way to do so is through **friends and family**. Though the amount of funding may not be as sufficient but it is a great place to jump start your idea.

Other options include angel investors or venture capitalists:



Angel investors are essentially individuals that puts their own finance into the growth of a particular early-stage company. To access angel investors, you need to search within your connections and networks and branch out from there.



Venture capital funding involves professional investors and majority of the venture comes from public or private firms. They specifically seek out businesses that has along term growth potential and is becoming an essential type of funding for young companies between 2-4 yrs.

FUNDING YOUR IDEA

Alternatively, you can apply for **government grants and funding** that are available to startups and business owners. For example:

Eurostars- Supports the development of marketable innovative products, services and projects that will have a positive impact on people's lives. This is a joint program between EUREKA and the EU commission. Between 2014 - 2020, it has a total public budget of **€1.14 billion**. The Eurostars process consists of application submission, evaluation and monitoring.

Horizon 2020- The largest EU research and innovation program with around **€80 billion** of funding available between 2014 to 2020. This programme is supported by European political leaders and the members of the European parliament to drive economic growth and provide job opportunities. The application process involves submission of proposal, finding partners (Min. 3), evaluation by independent specialists and grant agreement.



Figure 6.1.2 & 3 Eurostars and Horizon 2020 Logos

PROTECTING YOUR IDEA

Intellectual property

IP is an intangible property that allows the designated owners to have exclusive rights to their invention by preventing others from potentially using and benefiting from it without permission. There are different types of IPs.

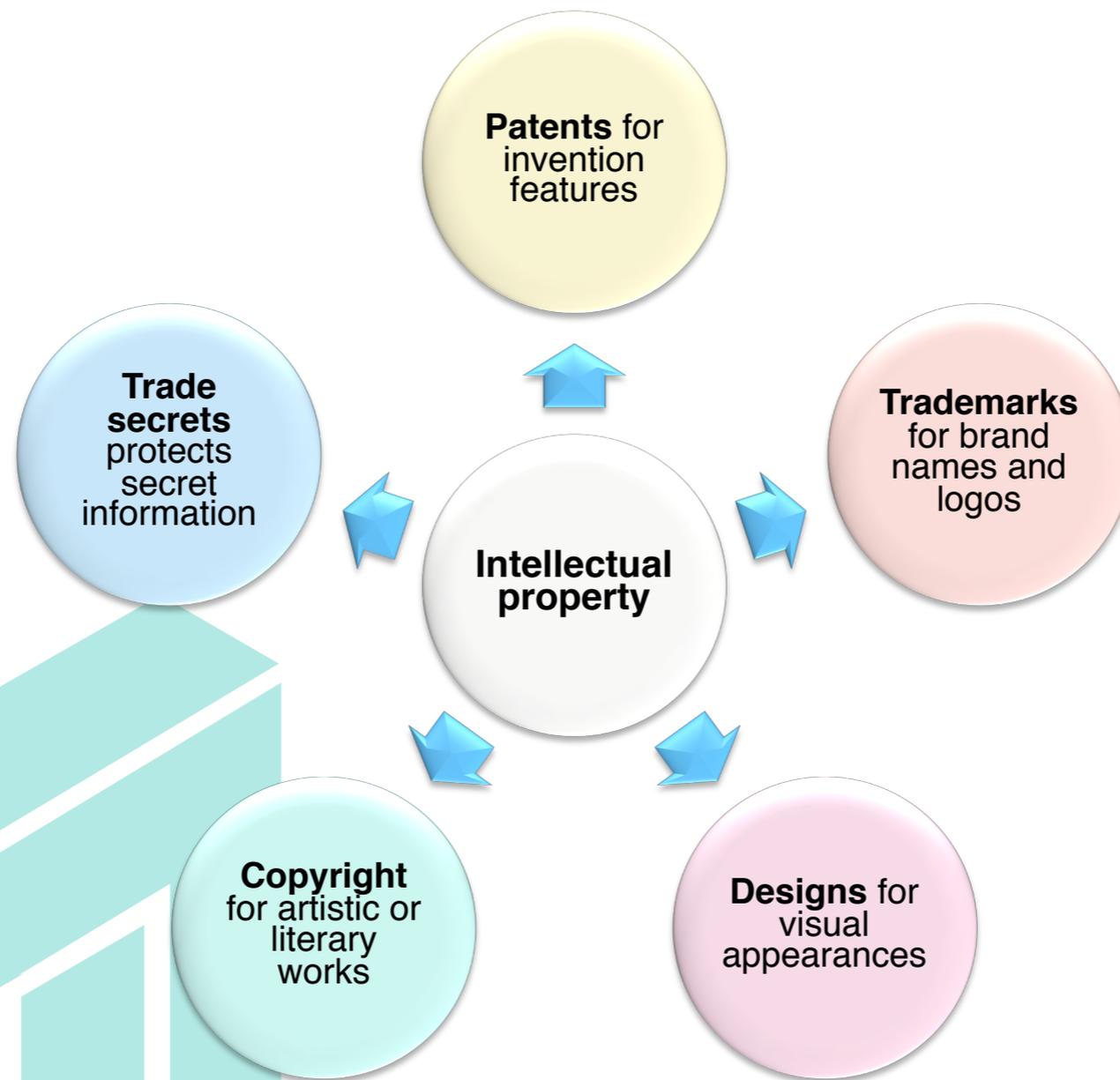


Figure 6.1.4 Types of Intellectual Property Source: Inventya

DEVELOPING YOUR IDEA- ROLE OF STAKEHOLDERS

Stakeholders are individuals, groups or organisations that have an **interest or concern** in your business and they can either **affect or be affected** by your products, services or actions. There are various types of stakeholders:

- **Primary Stakeholders-** these are **internal** stakeholders that have a direct functional or financial engagement with the company e.g. employees, managers, customers, suppliers
- **Secondary Stakeholders-** these are typically **external** stakeholders that have indirect relationship with the company but they can affect or be affected by company action e.g. communities, activist groups, media, general public



DEVELOPING YOUR IDEA- STAKEHOLDER ENGAGEMENT

There are many reasons to engage with stakeholders e.g.

- Develop business intelligence
- Expand market
- Provide new opportunities
- Reduce risks
- Build brand reputations

Successful stakeholder engagement follows a step-by-step guide:



Figure 6.1.5 Stakeholder engagement process Source: Inventya

GROWING YOUR BUSINESS

There are five main growth strategies that will allow the successful expansion of your business:

Market Penetration

- Increasing market share of an existing product or service through strategies such as offering discounts and different packages

Market Expansion

- Selling existing products in another market such as a 3D printing business may expand their market from automotive to healthcare companies

Product Expansion

- Expand existing product line by adding new features or new products

Diversification strategies

- Developing new products for a different market which is risky as the organisation may not have sufficient experience of the new market

Acquisition strategies

- Purchasing another company to expand product line and enter new markets

FURTHER LEARNING

How Do You Build a Start-up?

<https://insights.som.yale.edu/insights/how-do-you-build-startup>

Four Ways Startups Can Get On The Radar Of Angel Investors & VCs

<https://mindsea.com/attract-angel-investors-vcs/>

Copyrights, Trademarks, Patents & Trade Secrets: Protecting Your Idea - How To Start A Business

<https://www.youtube.com/watch?v=PAVbXGXelsY>

How to Develop a Business Growth Strategy

<https://www.inc.com/guides/small-business-growth-strategies.html>

6.2. CASE STUDY – CARBON3D, INC.

- Aim: To provide an insight into the strategies employed by a 3D printing company to establish their business
- Expected learning outcomes: Learn about the motivation behind the company and the types of services they offer. Identify and recall the key strategies used by Carbon and link it to the content learnt in 6.1.

Duration	1 academic hr
Author / Lecturer	Name Surname, organisation
Delivery methods	Individual / Teamwork / P2P
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CARBON3D, INC.

- Carbon3D, Inc is a private additive manufacturing company founded in 2013, Redwood City, California by Joseph and Philip DeSimone.
- They provide services within the additive manufacturing sector by designing, developing and manufacturing 3D printers.
- They currently have 481 employees
- The motivation behind the company was to develop an innovative 3D printing technology that will address the three main challenges with the 3D manufacturing process:
 - Slow production
 - Mechanically weak printed parts
 - Limited material choices

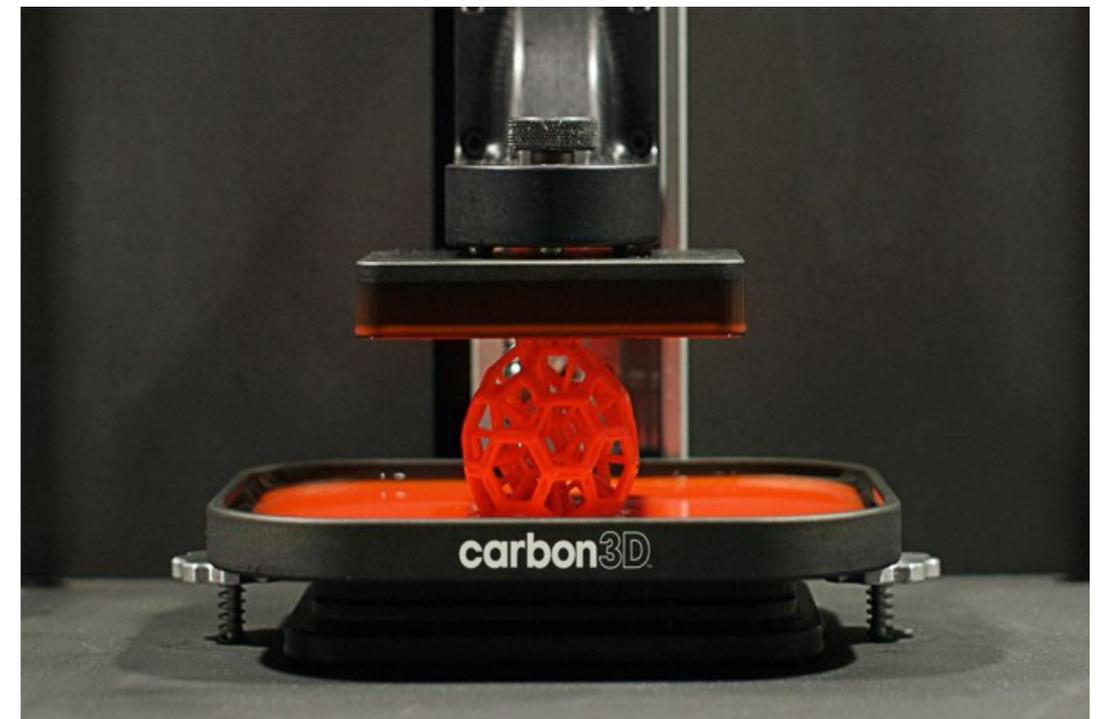


Figure 6.2.6 Carbon 3D Printer in Action. Source: Carbon3D

JOSEPH DESIMONE, CO-FOUNDER

Joseph is the co-founder, chief executive officer and director of Carbon, Inc.

Education- Received his BSc degree in Chemistry in 1986 from Ursinus College (Pennsylvania) and his Ph.D. also in chemistry in 1990 from Virginia Tech University (Virginia).

Before Carbon, he was employed as Chancellor's Eminent Professor of Chemistry at the University of North Carolina at Chapel Hill.

Throughout his career, Joseph has published over 350 scientific articles and has co-founded several companies including Micell Technologies, Bioabsorbable Vascular Solutions, and Liquidia Technologies.

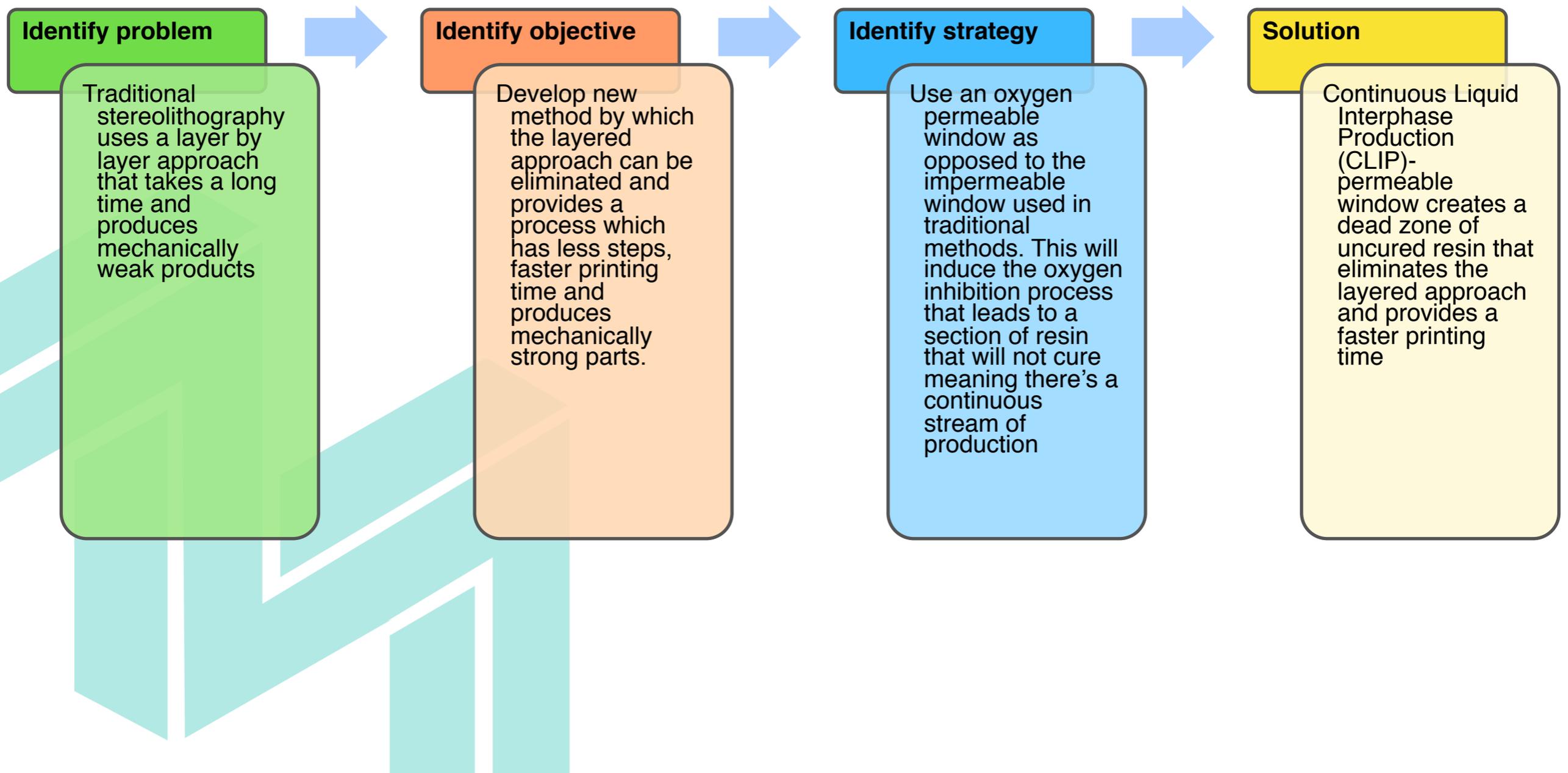


Figure 6.2.7 Carbon CEO and Co-Founder Source: Forbes

INNOVATION- CLIP

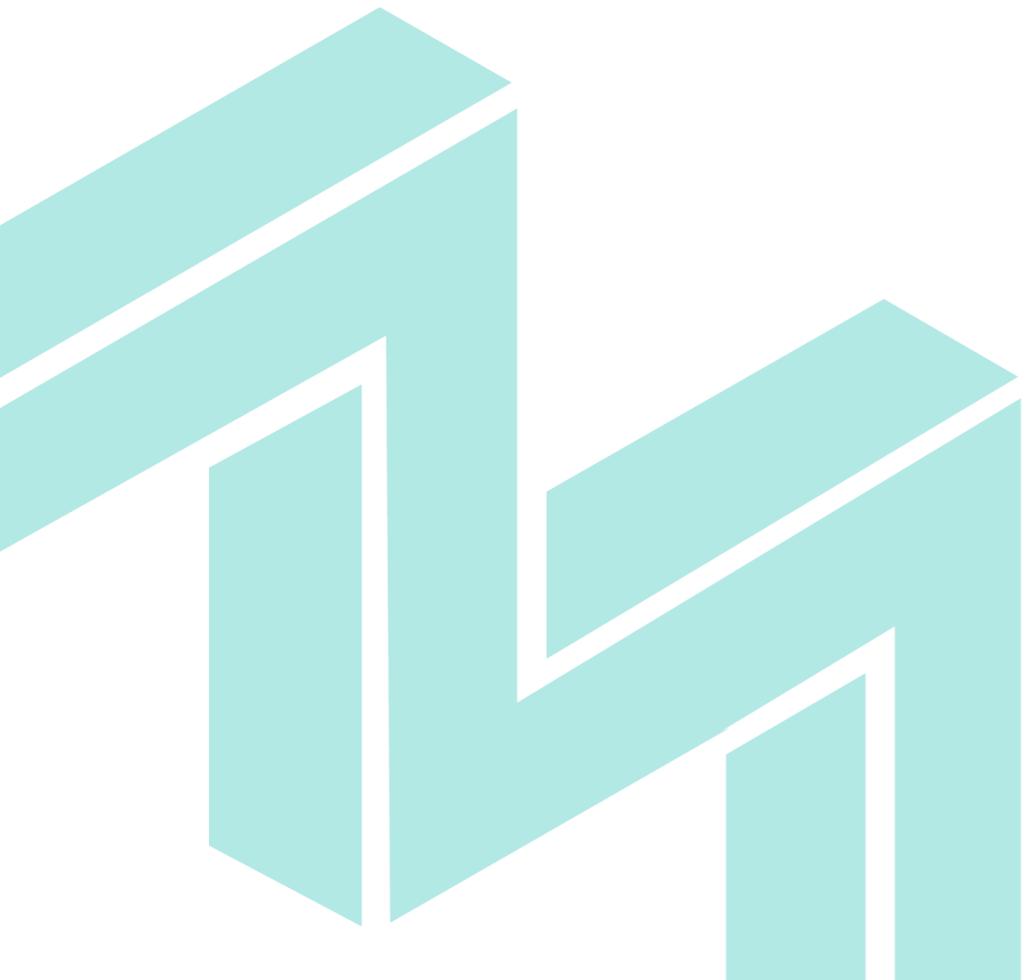
Joeseeph DeSimmone, co-founder of Carbon invented a new photopolymerization printing method known as **Continuous Liquid Interface Production (CLIP)**.

The development process of this idea could essentially be categorised into the following steps:



CONTINUOUS LIQUID INTERFACE PRODUCTION

- <https://www.youtube.com/watch?v=23at9QglAm8>



FUNDING

Carbon has raised 5 funding rounds with a total funding amount of **\$422 Million** from 18 investors:

- Early Stage Ventures 2013 – 2015: **\$41 Million** in total
- Late Stage Ventures 2015 – Current: **\$381 Million** in total

Key investors included cooperation and firms that particularly specializes in startup stage companies and growth stage investments in private companies.

Carbon's latest Pre-Money Valuation is currently at **\$ 1.7 Billion**

PATENTED INNOVATION

Continuous Liquid Interphase Printing

International Patent No. W O 2014/126837 A 2

Filing date: 10 February 2014

“A method of forming a three-dimensional object, that comprises of:

- continuously maintaining a dead zone of polymerizable liquid in contact with the build surface
- continuously maintaining a gradient of polymerization zone between the dead zone and the solid polymer and in contact with each thereof, the gradient of polymerization zone comprising the polymerizable liquid in partially cured form.”

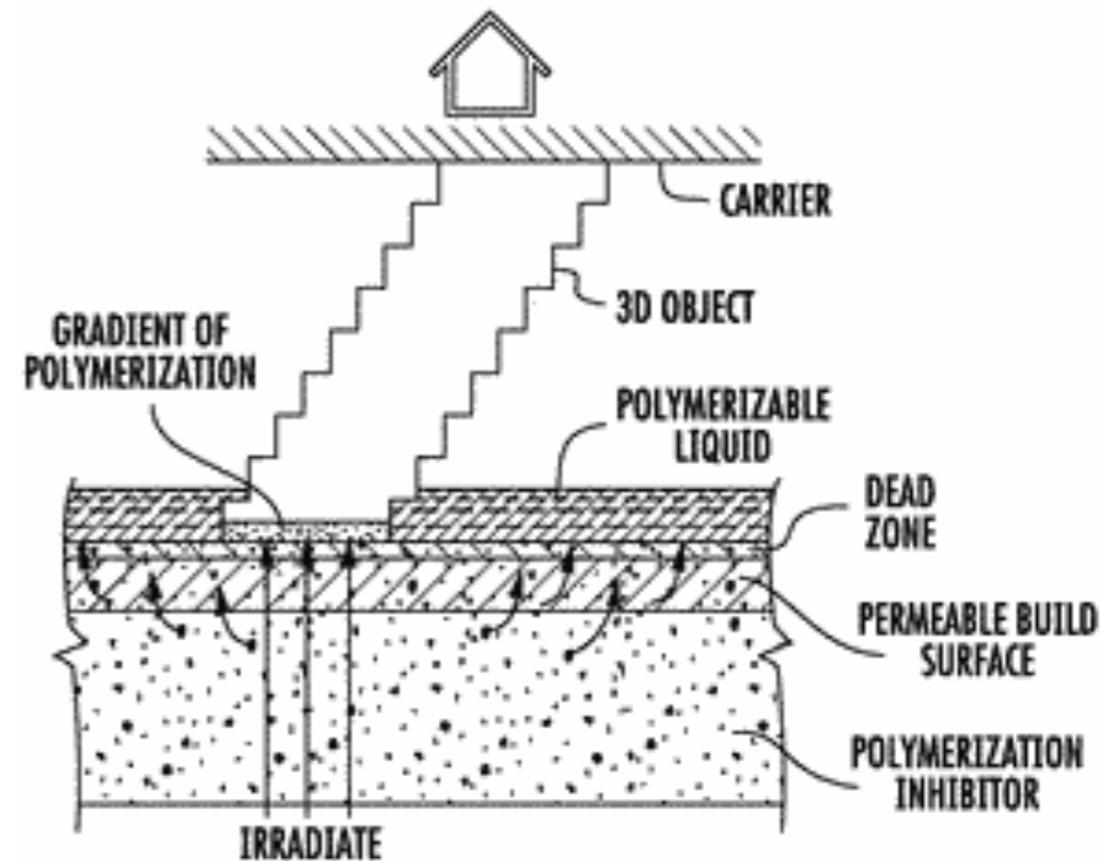


Figure 6.2.8 CLIP process Source: World Intellectual Property Organization

PRODUCTION- ADIDAS

Collaboration with Adidas to produce the **Futurecraft 4D Midsole:**

- Personalized complex lattice pattern that is difficult to manufacture using traditional methods
- Designed to optimize performance
- Carbon team developed a new elastic material by working closely with Adidas and gathering data regarding the material properties they require
- Manufactured 100,000 pairs

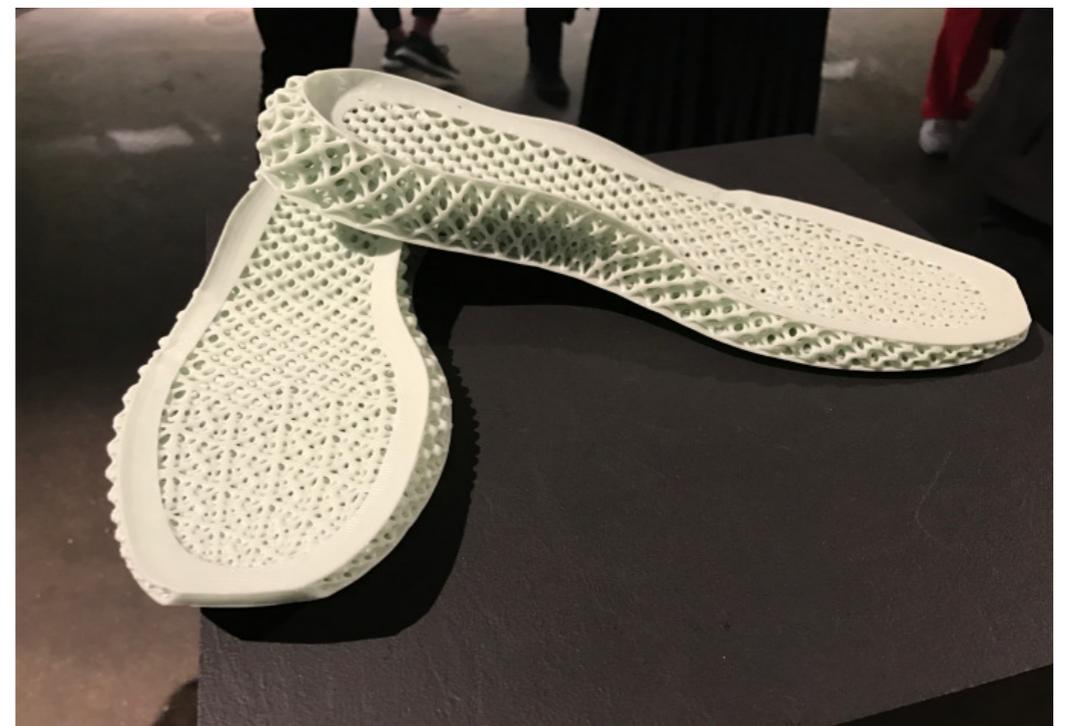


Figure 6.2.9 & 10 Futurecraft 4D midsoles Source: Carbon3D, Inc.

PRODUCTION – DERBY DENTAL LAB

Collaboration with Derby Dental Laboratory, one of the largest dental labs in U.S., specialising in fixed and removable prosthetics, support and clear sequential aligners.

In 2018, Derby Dental Laboratory and Carbon produced the Smile Shapers Aligners using biocompatible resin designed for durability and precision.

These products were printed using the Carbon M2 printer which has increased the laboratory production efficiency by up to 60%



Figure 6.2.11 Smile Shapers Aligners Source: Derby Dental Lab.

BUSINESS GROWTH

Carbon has expanded their product line and introduced new products by analyzing the needs of their customers.

Initial product:

M1 3D Printer with Digital Light Synthesis Technology that utilizes the CLIP process

New products:

M2 3D Printer- Improved features and larger build areas for the production of bigger parts

Smart Part Washer- For complex parts that cannot be washed manually and requires mechanized high-shear cleaning

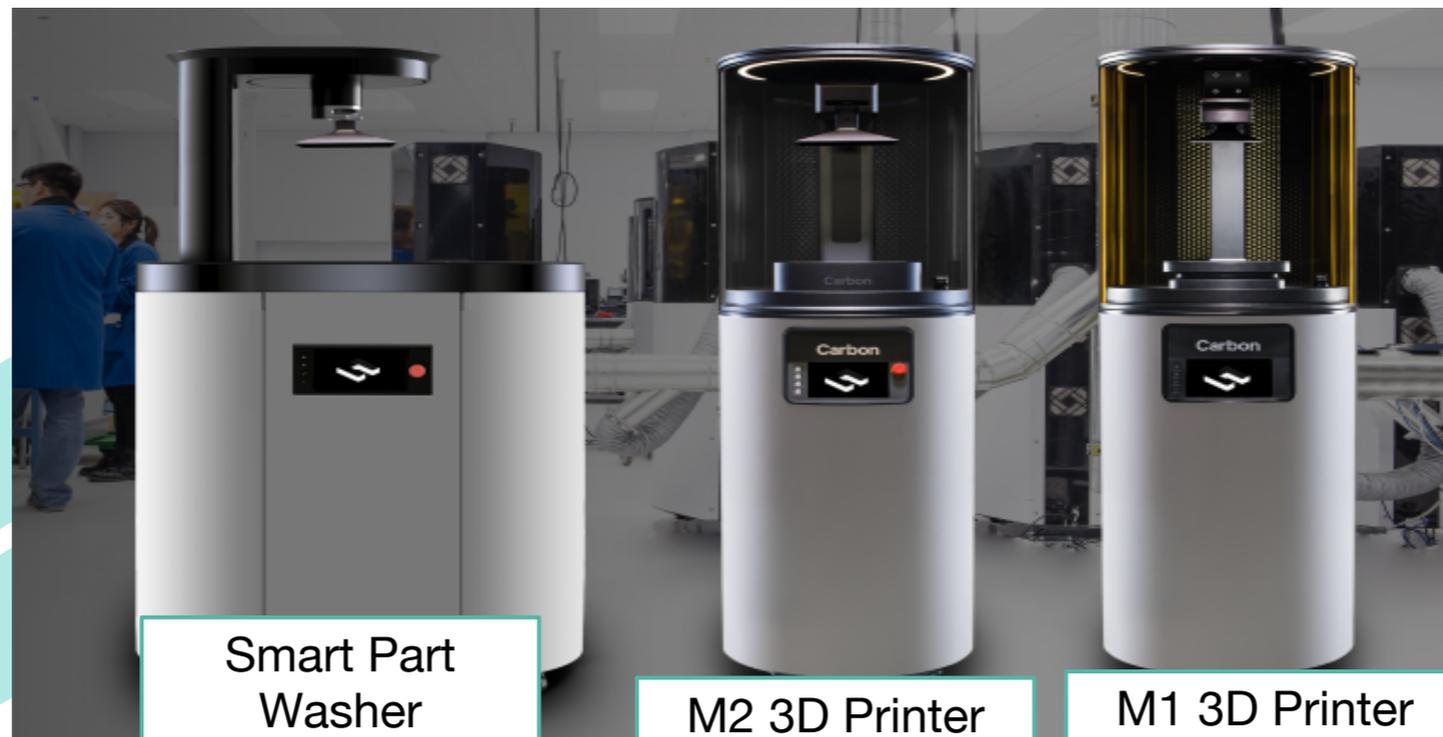


Figure 6.2.12 SpeedCell™ System Source: Carbon3D, Inc.

FURTHER READING

Carbon Case Studies

<https://www.carbon3d.com/stories/>

This is how Carbon is going to 3D print millions of durable end-use parts

<https://www.3dprintingmedia.network/this-is-how-carbon-is-going-to-3d-print-millions-of-durable-end-use-parts/>

TASKS FOR REFLECTION

Consider the details regarding the development of Carbon, Inc. What are the strategies that led to the company's progression in the 3D printing market?

- What type of funding did they acquire?
- How did they protect their idea?
- How did they engage with their stakeholders? (hint: think back to Adidas example)
- How did they grow their business?



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