Most Common Misconceptions about Additive Manufacturing

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European Association of the Machine Tool Industries
and related Manufacturing Technologies

Introduction

Additive Manufacturing (AM), also known as 3D printing, is a modern fabrication process that can use a wide range of materials (metals, polymers, composite, ceramic and more) to create products layer- by-layer from a digitalfile.

AM proposes a novel paradigm for design, manufacturing, and business models based on design freedom, localized value chains, and waste production and material consumption reduction.

Having been an important prototyping tool for decades, the technology is becoming a viable solution for manufacturing applications.

Nevertheless, there are still a lot of misconceptions about the technology, which brought different stakeholders to underestimate or exaggerate the capabilities of AM. For this reason, CECIMO has decided to clarify some of the most common misconceptions regarding AM.

1. AM will replace conventional manufacturing

AM will not be used to replace but to complement and enhance other manufacturing technologies.

AM is an excellent tool in any manufacturing toolbox as it is able to revolutionize the way products are designed, manufactured, and distributed to end-users.

In Europe, the AM market and its ecosystem grows steadily every year. According to the CECIMO market trends survey, the AM total business and AM exports registered positive balances in all categories (products and parts, machines, materials and services), which outline a growth scenario for AM business in the domestic and foreign markets. Furthermore, the European Patent Office's 2020 report shows that European Union (EU) countries account for 47% of the total number of AM-related patent applications.

The industry has evolved from prototyping to functional part manufacturing (with different degrees of maturity achieved) in various sectors such as aerospace, health energy, industrial equipment and tooling, and construction.

These industries continue to introduce AM solutions in their industrial supply chains, creating use- cases that help make the technology's mainstream adoption increasingly feasible as time progresses.

Like with any other manufacturing technologies, there are several factors to consider before adopting AM: type of application, costs, materials, availability of skilled workforce. In particular, the use of AM is usually recommended for:

- Components with long lead times (printing complex parts in less than 24 h)
- Creation of new material structures that can enhance the properties of the components being fabricated, e.g. increased strength, stiffness, corrosion resistance)
- Increasing product efficiency at the design phase saving materials
- Customized and complex parts (conventional methods cannot produce the part, for example, for highly complex, topology-optimized geometries)
- Materials that cannot be easily machined, like metal superalloys

2. AM will replace conventional manufacturing

3D printing is not only suitable for producing small parts.

AM can solve many challenges manufacturers face when producing big parts such as aircraft wings. These parts are heavy and difficult to transport, requiring long setups and large tools. This ultimately translates into higher manufacturing costs and longer lead times.

Large-scale 3D printing can help companies achieve a cost-effective, fast and flexible solution for manufacturing large parts and components. AM allows these large parts to be printed simultaneously (reducing assembly line time) and achieving lightweight and enhanced performance.

Printing big parts remains a new application comparing to the more conventional use of the technology.

Some of the key reasons are:

- Cost of the technology
- The lack of business cases and awareness of the benefits of using AM
- Build volume of a 3D printer. Today, it is possible to find 3D printers that can offer printing big volumes for applications in different sectors (Maritime, Construction or Aerospace among others)

Large-scale 3D printing can produce parts faster and with reduced material waste and consolidate multi-part components in a single part. Sectors such as aerospace can benefit from this application, as producing large structural parts with conventional methods like forging and machining can take up to a year. The technology has the potential to expand to other markets and applications such as maritime and automotive.

Good examples of the use of AM to print large parts are available in two CECIMO events:

- Repairing with Additive Manufacturing: An opportunity to boost industrial sustainability.
- Additive Manufacturing: An opportunity to fill the gaps in traditional supply chains

Construction is another sector that could benefit from the great potential offered by large scale AM. 3D home construction is still in the early stage of development, but many companies are developing new technologies that aim to achieve faster and more efficient building construction. A good example of the use of AM in the construction sector was presented during a CECIMO event: "The impact of additive manufacturing on product sustainability".

3. Everything can be 3d printed

No, not everything can be 3D printed.

A 3D printer can print almost any shapes, no matter how complex and detailed. Nevertheless, certain fundamental criteria are met when deciding to use AM to produce a specific object.

A few of the factors that might limit the possibility to produce a part with AM are:

- Final cost of the item
- The type of part we want to 3D print (not all objects are suited for 3D printing e.g. an item that has big overhangs)
- Availability of the design in the form of a digital file (including dimension and aesthetics details of the part)
- Availability and cost of materials

• Right skills to choose (material and printer), operate the printer and finish (if post processing is necessary)
• Specific requirements for the surfaces of 3D printed parts that are located in areas that cannot be reworked later on, or only with great difficulty

Therefore, contrary to common beliefs, 3D printing does not allow everyone to print everything. It is not possible to print objects outside of the scope of what the actual material is extruded.Therefore, it would not be possible to print wiring, motors, drivers etc.

Although not everything can be 3D printed, AM can help businesses expanding their production capabilities. For instance, AM gives the opportunity to build new structures. This task can be achieved by consolidating the number of components within an assembly and creation of complex material structures. This gives manufacturers the opportunity to reduce the need for tooling, the errors in production, and the time needed for production and assembly of the part – resulting in both costs saving and the reduction of environmental impact.

Other benefits of using additive manufacturing are:

- Freedom of design
- Increasing level of process and product sustainability (Focus 1)
- Inventory stock reduction
- Production flexibility
- Supply chain improvement

To conclude, having access to a 3D printer will not allow you to create or reproduce any desired item. Nevertheless, this technology can open new business opportunities and the chance to develop brand new structures that make your production more efficient and enhance the properties of the components being fabricated, e.g. increased strength, stiffness, corrosion resistance.

Focus 1: Additive Manufacturing as key enabling technology for green manufacturing

Additive Manufacturing (AM) has been identified as having the potential to provide several sustainability advantages, by proposing a novel paradigm for design, manufacturing, and business models that enables more cost- and resource-efficient production. The main benefits that make AM a key enabling technology for green manufacturing are:

On-demand Manufacturing

- Reduced total energy consumption and waste generation
- Lower inventory waste including unsold and obsolete products
- Improved productivity, cost, and resource efficiency through make-to-order manufacture of components and products
- Higher product quality/performance and reduced rejection rates

Recycling
- Improved material efficiency through recycling
- Use of recycled materials and by-products as inputs
- Simplified assembly process with less material diversity increasing the scope for recycling

Repairing and Remanufacturing
- Reduced time and waste generation for the repair process
- Improved product utilization through repair and remanufacturing
- Business models for repair and remanufacturing extending products lifetimes, aligning business and sustainability interests

Process Re-design
- Simplified assembly process with fewer components, materials, actors, stages, and value chain interactions
- Reduced cost, time, and quality/performance issues through simpler assembly processes
- Lower time gap between design stage and manufacturing stage

Component and Product Re-design
- Design freedoms and optimized geometries to meet functional requirements
- Consolidation of the number of components and creation of new material structures
- Improved product functionality, durability, and overall quality/performance

4. The growth of AM will bring more IPR infringements

There is no evidence that shows a link between AM growth and the increase of intellectual property rights (IPR) infringements in any sector or portion of the market.

The attempt to make such a connection began when optimistic market growth projections of desktop 3d printers, cheaper material development, and the fast digitalisation of inventories gave the impression that the possibility to produce anything, anywhere, was just around the corner.

Today the AM market is very different from that scenario. Many market analyses have shown that the growth of desktop 3D printers for personal use is not rising at the same speed as 3D printing for industrial and regulated B2B environments.

In Europe, the law is effectively regulating this technology and its different applications. This statement was also supported by the European Commission study "The Intellectual Property implications of the development of industrial 3D printing", published in May 2020. The study highlighted that only a few areas would need to be further investigated (e.g. CAD files protection) and confirmed that the IPR law in Europe protects IP owners from most of the infringements.

The industry has also adopted different solutions to protect IP owners:

-QR code can be fused into a part of the product, allowing a smartphone to scan the code and receive information

-Embedded technologies that enable restrictions on the type of 3D printer that can be used to generate a part of a given digital file.
-The use of blockchain to protect the design by not providing access to the original file or other relevant information (e.g. printing process or the orientation of the part in the machine) – Examples can be found in one CECIMO's event: "Repairing with Additive Manufacturing: An opportunity to boost industrial sustainability."

Another technology that has been often wrongly identified as an enabler of IPR infringements is 3D scanning. This technology is experiencing high growth with the emergence of low-cost systems, improved scanning capabilities, and increased availability of data storage and data processing capabilities. Despite these promising improvements and benefits (particularly to solve supply chain issues), the state-of-the-art 3D scanning technology is still far from reproducing exact copies of any items. Furthermore, allowing the print of object does not necessarily mean to reproduce all its features and components such as batteries, or engines (which would require the use of other technologies and specific materials).