ADDITIVE MANUFACTURING: Moving Beyond Rapid Prototyping

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We Manufacture Innovation

The evolution of additive manufacturing

For the past few decades, additive manufacturing (AM) has developed from rapid prototyping using simple 3D printers to a complex manufacturing technology that enables the production of functional finished components. Additive manufacturing is evolving due in part to the expanding number of materials that are

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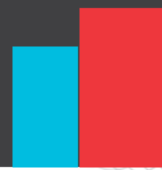
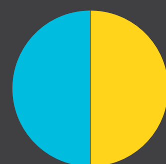
now being explored and used, such as composites, ceramics, and metal alloys. While a greater number of manufacturers are adopting AM technologies as they have become more commercially viable and more and more materials can be used, many still view it as simply a tool for rapid prototyping.

Additive manufacturing is growing rapidly



The industry grew by
35.2%
last year, according to Wohlers Report 2015[1]

but, according to a survey of 100 industrial manufacturers:



Over 50% are merely experimenting with 3D printing or using it for rapid prototyping only[2]

signaling the continuing potential for AM to revolutionize manufacturing as we know it today

The business case for additive manufacturing

Various 3D applications will have an estimated economic impact of $230 billion to $550 billion per year by 2025

-McKinsey & Company[3]

ADDITIVE MANUFACTURING WILL DEMONSTRATE THE GREATEST VALUE ONCE THE VOLUMES OF FINISHED PARTS AND COMPONENTS EXCEED THAT OF PROTOTYPE PARTS AND COMPONENTS.

Rapid prototyping will remain useful, but will not be the factor that expands additive manufacturing into widespread use.

While additive manufacturing is not the answer to every technical challenge, it does represent an ideal solution for a number of actual production processes. Because it enables the creation of unique builds without additional machining many industrial segments are exploring AM to solve their technical challenges.

Early adopters of additive manufacturing

Example: GE's LEAP jet engine features 3D printed fuel nozzles[4]

Aerospace was an early adopter of additive manufacturing because it enables lightweight designs and the production of parts with complex geometries. Additionally, aerospace manufacturers frequently incorporate high-value materials, and additive manufacturing allows them to maintain fine control of material properties and reduce raw material waste.

Example:

Lattice structures for lightweighting

The medical industry utilizes additive manufacturing to customize parts to meet patients' specific needs.

Example:

Dental implants, hearing aids, hip, knee, skull, and jaw implants

photo credit: EOS

Heavy manufacturers use additive manufacturing to cut the time and cost needed to replace components.

Example:

Turbine blades; pumps, valves

photo credit: EADS

Where additive manufacturing is heading

In the coming years, additive manufacturing will continue moving towards application-specific, robust manufacturing machines that have fully developed in-process and post-process quality control. To keep moving AM forward, manufacturers must take the lessons learned from early adopters to establish standards and develop the expertise needed to take advantage of process-specific alloys and new material developments in ceramics, carbon, refractory metals, and thermoplastics.

photo credit: ARCAM

Design for AM

Additive manufacturing allows for the fabrication of structures that are not feasible or possible via traditional manufacturing processes, including structures that are geometrically complex, consolidated, and highly customized.

However, to reach AM's full potential, various current limitations must be overcome. This will require advancements in:

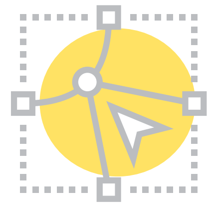
- In-process quality control and post-process inspection
- Materials development
- Heat treatment development
- Engineering data design
- Larger, faster machines

Metal additive manufacturing

Metal AM opens new avenues for low-cost manufacturing. It enables the creation of assemblies that are not possible with current fabrication technologies. Assemblies can be fabricated using titanium alloys, nickel alloys, and high-grade stainless steels with laser, electron beam, arc, ultrasonic, thermal/cold spray, and friction stir welding processes.

Evaluating your additive manufacturing readiness

Companies that are slow to adopt additive manufacturing beyond commercially available 3D printers will find themselves falling behind the competition. In order to be ready for a future in which additive manufacturing will be built into the value chain, manufacturers must be swift in determining if they should incorporate additive manufacturing.



Additive Manufacturing Checklist

☐ Do you produce parts/products in low volumes?

☐ Do you need to produce spare parts or parts for legacy systems?

☐ Do you need to produce parts with complex geometries?

☐ Do you need to create custom tooling?

☐ Would your parts/products benefit from lightweighting using lattice structures?

☐ Would conformal cooling provide improved properties for your parts/products?

☐ Do you need help designing parts/products to maximize the advantages of AM?

About our additive manufacturing capabilities

EWI leads the way in developing, testing, and applying emerging innovations in the application and control of new additive manufacturing technologies. Our expertise in additive manufacturing helps our customers improve the performance, quality, and manufacturability of their products. As North America's leading organization for manufacturing innovation, our AM team is supported by extensive in-house material characterization facilities and an engineering staff with expertise in laser processing, arc welding, materials engineering, nondestructive evaluation, in-process sensors and controls, and mechanical designers.

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[1]https://www.wohlersassociates.com/press69.html
[2]http://www.pwc.com/us/en/technology-forecast/2014/3d-printing/features/future-3d-printing.jhtml
[3]http://www.mckinsey.com/insights/manufacturing/3-d_printing_takes_shape, photo credit: ARCAM
[4]http://www.ge.com/stories/advanced-manufacturing