

E-BOOK

The background features large, overlapping geometric shapes in red, grey, and white. A large red triangle points downwards from the top left, overlapping a grey triangle that points upwards from the bottom left. A white triangle points upwards from the bottom right, overlapping the red and grey shapes.

ADOPTING ADDITIVE MANUFACTURING IN AEROSPACE & DEFENSE

ADDITIVE MANUFACTURING IS COMING: WILL YOU BE READY?

INTRODUCTION

The benefits of Additive Manufacturing (AM) – also known as 3D printing – in the aerospace and defense (A&D) industry are huge. Through AM, a manufacturer can swiftly design and craft complex components.

This technology could allow A&D manufacturers to effectively print parts for wings and engines, embed electronics directly onto machined parts, or print repair parts on demand.

AM has the potential to be a game-changing solution for A&D companies, and the industry is moving rapidly towards adopting this new technology. In 2013, the A&D industry contributed 12% of AM's \$3.1 billion revenues.

While some industry experts claim A&D is finally entering an era of AM, not all companies are prepared to successfully implement the technology.

Some companies have already adopted AM into their processes, though many others have been slow to embrace or even consider AM.

Implementing a new process is a big undertaking, and many manufacturers are either unsure how to start or lack the right digital resources to support AM once it's in place.

It's only a matter of time before manufacturers of all sizes will need to embrace AM in order to remain competitive; those who are prepared will be poised to success in the competitive market.

CHALLENGES FACING ADDITIVE MANUFACTURING (AM)

Regardless of the industry, AM faces its own set of growing pains as new and evolving manufacturing process. If not properly understood, AM implementation may not improve manufacturing operations as intended. Before considering whether you have the resources and time to implement AM at your own company, it's important to understand the ways in which AM is still growing.

For AM to truly supersede traditional manufacturing operations, it needs to overcome the following challenges:

CHALLENGE 1: SCALABILITY LIMITATIONS

Most A&D manufacturing companies manage large inventories of materials and parts to meet last-minute demands. Today's AM technology doesn't reduce these large inventories, as build speeds are still too slow. Although companies are researching ways to build AM machines with faster build times, A&D manufacturers must be realistic about what problems AM can address in the short-to-medium term.

CHALLENGE 2: RESTRICTED PRINTING CAPABILITIES

One of the greatest potential uses for AM equipment will be the ability to print with several materials at once, but multi-material printing is still being developed and not widely available yet. Manufacturers must weigh the value of investing in AM technology today that has a limited ability to print only a few types of metals, or waiting for advancements in multi-material printing before investing in AM equipment.

CHALLENGE 4: THREAT OF FAKE PARTS

One of the greatest opportunities for AM is the potential to create spare parts. Demand for spare parts is difficult to predict; many manufacturers have to stock potentially unused components, or find a supplier who can fill last-minute needs. AM technology may enable manufacturers to easily print out the needed parts within minimal supply chain disruption.

However, the ease of 3D printing could result in a spread of fake parts via the black market. Not only does this disrupt the traditional supply chain with potentially cheaper parts, but it leaves unknowing buyers at risk of purchasing parts of poor quality.

While this shouldn't deter manufacturers from embracing the value of AM, it's something for industry leaders and management teams to be aware of and monitor closely as AM evolves.

CHALLENGE 5: LACK OF QUALITY REGULATIONS

AM production methods are far from perfect. High heat levels used in AM can cause consistency issues, which can be more prevalent in metal part production. Companies will have to adjust their QA process for AM-specific issues. These can include embedding controls within AM machinery to assist with dimension accuracy and using automated inspections of parts.

While many leading organizations in research and development (R&D) are actively pursuing advancements to the technology and the processes surrounding it, the majority of A&D manufacturers will likely wait for AM to grow into itself a bit more before embracing it across their plants.

BARRIERS TO IMPLEMENTING AM IN A&D

In the previous chapter, we covered the challenges AM must overcome in order to truly provide value to manufacturing companies. However, this is only half the puzzle.

Even once AM does catch up in terms of technological capabilities and process standards, A&D manufacturers face their own set of specific barriers that prevent many plants from being able to successfully embrace AM at this point. As it seems highly likely that AM will become a key process for A&D manufacturing industry, manufacturers should start addressing these barriers now, so they'll be agile and ready to embrace AM.

Specifically, A&D companies face the following hurdles:

BARRIER 1: COST OF TRAINING TO USE AM PROPERLY

AM offers companies the ability to test designs and iterations of their products. This also means training the engineers developing these designs on how to use AM, or hiring skilled engineers already familiar with the technology. Companies implementing AM must also budget for the training required for employees who will use AM equipment and processes.

BARRIER 2: NEED FOR QUALITY MANAGEMENT PROCESSES

Manufacturers already spend time and funds maintaining quality assurance processes for their existing operations, and A&D manufacturers in particular must comply with stringent quality and safety standards. For AM to truly provide value to companies, the industry must develop quality assurance processes that enable A&D manufacturers to remain compliant with industry standards such as AS9100, DCAA, ITAR, and ISO 9001.

BARRIER 3: OVERWHELMING COSTS & VARIETY OF MATERIALS

The ability to enter part and component designs into AM technology will only be useful for operations if the right materials are available to create the products. For a company to embrace AM today, it must replace or match existing materials (such as composites, metals, and plastics) to suit the capabilities of AM equipment.

Unfortunately, today's AM equipment uses materials that are much more expensive than those used in traditional production methods. For example, in 2013, the thermoplastics used in injection molding cost around \$2 per kilogram – compared to \$200 per kilogram for AM thermoplastics. Companies must consider not only the initial investment in equipment and training, but also the ongoing costs for materials. While advances in AM material creation will likely reduce costs over the next several years, the current high costs may deter companies until then.

BARRIER 4: LACK OF TECHNOLOGY TO SUPPORT AM

Implementing AM should cause as little disruption to established supply chains as possible, in order to achieve a high ROI on the new technology and protect the company's bottom line. Ideally, companies who want to adopt AM should already be using advanced technology solutions for operations (e.g. procurement, quality control, shipping) and data collection, which can more smoothly integrate with AM systems. Without an existing technology foundation, companies may face delays or disruptions in production due to time spent training employees, integrating AM with current systems, and adjusting the supply chain process as a whole.

WHAT A&D MANUFACTURERS NEED BEFORE ADOPTING AM

Implementing a large-scale process like AM requires proper planning. Companies should ensure they have the technology and knowledge foundation in place before adopting AM. This means manufacturers should begin to invest in the right “prerequisites” now, so they will be poised to smoothly integrate AM when they’re ready.

Before you can successfully implement AM, your manufacturing company should have the following in place:

SUPPLY CHAIN VISIBILITY

Scalability and cost reductions offered through AM can only be achieved if manufacturers have a clear picture of their supply chain. Without it, you won’t know how your new AM technology will impact your partners up and down the supply chain. This can lead to miscommunications in production schedules, costs, and procurement. Quantifying internal cost savings – which requires leadership to assign costs to every aspect of production – will also be more difficult without supply chain visibility. Before turning to AM, your company must have the right technology to offer you a full and up-to-date view into each link of your supply chain.

ABILITY TO EMPLOY PREDICTIVE ANALYTICS

Predictive analytics helps manufacturers identify shifts in demand (or supply in advance, so they can make smooth adjustments to production. While this can help with traditional manufacturers with longer production cycles, companies that employ AM can enjoy compounded benefits. Not only can AM reduce product life cycles, but predictive analytics improves AM manufacturers’ ability to product the right products at the right time.

ADVANCED ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM

A&D plants should already have comprehensive digital solutions in place before considering AM. An ERP solution unites an entire plants' processes under one system, centralizing information related to compliance, forecasting, suppliers, production, and more. In fact, ERP systems can address and ease many AM-related challenges including:

- Storing and organizing records of every part produced, to help maintain compliance, and identify and remove counterfeit parts from the supply chain.
- Storing and organizing records of processes, training, and knowledge, to help workers understand new materials, equipment, and operations suited for AM manufacturing.
- Providing real-time data analytics, to help leadership quickly identify areas for process improvement and cost reduction.
- Providing full visibility into the supply chain, to help leadership identify and plan accordingly for fluctuations in material availability/costs or delays in supplier schedules.
- Sufficient forecasting, to help companies to produce and store the right parts to address shifts in demand.

Modern ERP systems are designed to integrate smoothly with new technologies such as AM. When you have an advanced ERP system already in place, moving to AM processes, organizing compliance, and transferring new knowledge and operational procedures across your teams will be far easier.

PREPARING NOW FOR THE FUTURE OF A&D MANUFACTURING

A&D manufacturers have a lot to consider before adopting AM into their operations. They have to evaluate their current capabilities and weigh them against the barrier and potential benefits of AM. Today's AM technology comes with its own drawbacks and won't solve all problems faced by traditional manufacturing.

That's not to say AM won't get there. As AM technology improves, companies will also see a reduction in material costs, employee training, and production time. Investment into AM is growing and potential applications within A&D include:

- Printing complex engine parts
- Printing repair parts on battlefields
- Printing parts and structures directly in space

While AM may not be suited for every A&D manufacturer at this time, this advanced printing technology is positioned to become an industry norm – and a must-have for manufacturers who want to remain competitive in Industry 4.0. When improvements to AM make it readily available for your company to adopt, don't be caught unprepared with outdated technology, gaps in visibility to your supply chain, or a lack of real-time data. As an A&D manufacturer in a competitive landscape, it's crucial to invest today in setting up the right technology systems, knowledge base, and processes – so you'll be able to implement AM at your plants with

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