



**Forward Looking Aerospace  
Manufacturers Are Reviewing  
Their Operations in Order  
to Sharpen Their Competitive Edge**

**Suppliers need to be ready to efficiently respond to the forthcoming return to flight. Progressive suppliers are seeking ways to meet these new productivity challenges, including increasing demand and shorter lead times.**

**Aerospace and Defense (A&D) suppliers are evaluating their production capabilities.**

Although the ramp-up will be delayed by a few years from the initial plans, original equipment manufacturers (OEMs) are expected to increase commercial aircraft production to record levels; 21% higher than the previous peak production levels. The ramp-up will mean that suppliers will face unprecedented challenges. They must find ways to satisfy demand for more components while OEMs place more pressure on them to decrease lead times and prices.

Industry 4.0 technologies, including the Internet of Things (IoT), automation and advanced machine tool capabilities, such as 5-axis machining centers, will become much more common on A&D shop floors as suppliers seek ways to keep pace with industry demands.

These technologies will help A&D suppliers respond to market needs faster, without the necessity of expanding their workforce. This white paper discusses the industry trends and the production solutions that A&D suppliers need to remain competitive.



# Enable Faster Throughput for Complex Designs

Modern aircraft designs and production requirements are forcing suppliers to rethink their current production capabilities. Older machine tools may not be well equipped to process aircraft parts in the most efficient manner. Materials such as aluminum alloys, along with “harder” metals such as titanium, are best processed using modern machining centers that are purpose-built for aerospace applications. These cutting-edge machines provide reduced set-up times, increased accuracy and improved throughput relative to older machine designs.

## Titanium vs. Aluminum Considerations

Aluminum makes up around half of the aerospace materials market by volume. But titanium use is increasing as manufacturers seek ways to reduce weight for components in next-generation planes. Titanium is lighter than structural steels historically used and almost as strong. Aluminum and titanium present different challenges that manufacturers must take into consideration when selecting machine tool solutions. Aluminum requires more horsepower and high rpm, while titanium requires high torque at low rpm.

## Speeding - Up Material Removal Rates

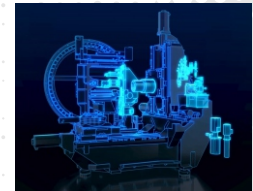
Aerospace suppliers need access to a variety of machine tools that can provide high metal removal rates on a wide range of materials, including aluminum, stainless steel and titanium. Several key advancements in machine performance features are helping A&D suppliers address these different material requirements.

Some of the key technologies developed to increase productivity for titanium machining include:

- **Autonomic spindles** - This technology helps to protect the spindle from excessive forces damaging the bearings. This can reduce unplanned downtime related to machine damage - which, in turn, optimizes productivity.
- **High-pressure, high-flow coolant systems** - Coolant delivered in large volumes directly to the cutting zone allows for faster chip

evacuation, increased production and longer tool life.

- **Vibration damping systems** - By adjusting frictional forces based on low-frequency vibration sensing, avoiding chatter and cutter damage from structure resonance in real time, it will enhance depth of cuts, which results in higher removal rates.
- **Makino Health Maximizer (MHmax)** - This predictive technology was specifically designed to reduce unplanned downtime. By pairing 22 embedded sensors with Makino's proprietary machine learning software, MHmax collects and monitors key machine functional areas that are critical to the health of the machine. This unique, self-learning software gathers and analyzes thousands of data points to monitor the health status of the machine and predict failures before they happen - automatically sending an email or text alert for out-of-spec conditions.



New developments in aluminum machining are helping A&D suppliers increase productivity. This includes greater spindle power to improve processing speeds, improvements in acceleration and cutting feed rates, and large-capacity automatic tool changers.

In both aluminum and titanium, 5-axis capability can be key to efficiently producing typical, complex A&D part geometries. In addition, large-capacity tool changers and pallet-changing automation allows for unattended machining, which means less labor costs per part. These system features reduce machine downtime between parts. Furthermore, it lessens part handling between set-ups, which also lowers labor costs. The ability to reduce part-handling time, including moving parts from machine to machine or resetting them on new fixtures, also helps increase throughput and shrink production lead times to enable faster deliveries.

# Maximize Productivity to Avoid Costly Delays

Many A&D suppliers were struggling to meet production demands prior to the MAX grounding. Both Boeing and Airbus had reported delivery shortfalls due to supplier delays. The lead time in A&D manufacturing is already longer compared to other industries, which means suppliers can't afford machine failures or any other issues that could result in interrupted production. Suppliers will need to place a greater emphasis on predictive maintenance and automation to maximize productivity and remain competitive.

## Why Reliability Matters

Historically speaking, delivery issues were urgent enough that Boeing and Airbus began working with suppliers to ensure that they were equipped to meet expectations. The MAX return to flight will once again focus on supplier abilities to achieve the desired production rates. Over and above having enough capacity to meet production demand, suppliers will need to implement efforts in order to minimize and manage non-productive machine time. Unplanned downtime costs manufacturers about \$50 billion annually, and equipment failure is the cause of downtime 42% of the time.

## Smarter Approaches to Efficiency

Manufacturers are implementing automation and Industry 4.0 technologies to gain visibility into machine performance issues before they lead to major repairs or failures. In the A&D sector, Industry 4.0 is bringing predictive insights to operators and technicians in several ways, including:

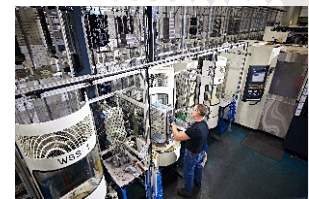
- The ability to access charts that display alarm events, so operators and technicians can observe and analyze trends and implement corrective measures.
- Access to spindle and axis monitoring technologies that record and display axis forces, loads and speeds. This data can then be used to fine-tune processes for faster cutting speeds and greater depths of cut. In addition, manufacturers can monitor critical tool data for multiple machines from one centralized location. Operators can use this data to make adjustments for enhanced tool performance and lifespan.

- Camera monitoring capabilities that capture an internal view of a machine's work zone, making it easier to solve processing errors before they impact part quality. Technicians also can receive email and text notifications of alarms, including images of the work zone. This helps service staff immediately address maintenance issues before they become costly problems.

According to Deloitte, manufacturers that implement predictive maintenance technologies typically experience:

- Operations and MRO material cost savings of **5% to 10%**
- Reduced inventory carrying costs
- Equipment uptime and availability increases of **10% to 20%**
- Reduced maintenance planning time of **20% to 50%**
- Overall maintenance cost reductions of **5% to 10%**

A&D suppliers also are realizing enhanced performance through automated machining solutions, such as multiple pallet systems. The Makino Machining Complex (MMC2) is an automated material handling system that links Makino horizontal machining centers, pallet loaders and operators. The system provides a constant flow of parts to the machining centers, so it can operate for extended periods unattended, including overnight and on weekends. The ability to automate manual processes reduces the need for time-consuming manual tasks and increases flexibility to meet OEM demands.



# Bridging the Workforce Skills Gap

As machine tools become more technologically advanced, the A&D industry must confront another persistent challenge: the lack of skilled workers.

In a recent industry workforce survey, 75% of respondents said they are concerned with the availability of key skills. According to a 2018 Workforce Report from Aviation Week, “The need for talent will become even more critical in the next few years, as the baby boom generation moves beyond traditional retirement age.”

Machines that are equipped with IoT, artificial intelligence (AI) and other smart capabilities can enhance productivity for existing employees and minimize the learning curve for new hires.

## The Case for a Connected Workforce

Voice-assistant technology common in the consumer world, such as Alexa and Siri, is now making its way into modern machine tools. In fact, more than **80% of A&D industry executives say they expect their workforce to be directly impacted by an AI-based decision** within the next three years, according to an Accenture report. Voice-activated commands reduce manual interaction with the machine and help operators translate and analyze big data. This digital voice-assistant technologies through the use of headsets. Operators speak commands into the headsets, such as “turn the machine’s lights on,” “change tools,” or “show set-up instructions.” Voice-actuated capabilities simplify machine operation by reducing the time operators spend searching for **information or performing manual tasks**.

## Minimizing the Learning Curve

AI also serves as a coach for operators who may not be familiar with various operating procedures, such as how to perform different maintenance tasks. For example, a worker can ask the voice assistant how to change a filter. In many cases, these intelligent machines are not replacing operators, but helping the existing workforce perform their tasks more efficiently.

This technology is also allowing workers to move easily from one type of machine to another without a significant learning curve because they’re using uniform voice-activated software and aren’t solely relying on an unfamiliar, machine-specific interface. These intelligent machines may help A&D manufacturers identify and onboard skilled workers with greater ease because they require less training and experience than more traditional technology.

## Looking Ahead: What's Next for A&D Machining

In the short run, MAX return to flight will be the major driver of aerospace manufacturing requirements. Fortunately, high-tech machining solutions are advancing at a rapid pace. The availability of new technologies comes at a critical point for the A&D industry. Suppliers must continue to improve productivity and reduce costs amid a constantly changing environment in order to survive.

Suppliers need equipment that can reduce downtime, increase productivity and minimize labor costs. Manufacturers should consider machine-tool providers with a broad portfolio of equipment built specifically for the aerospace industry. The latest machining centers can perform high-precision tasks faster than ever. Machine builders with experience in the aerospace industry can help A&D suppliers evaluate their needs and select a solution that is appropriate for specific aerospace applications. Makino is continuously updating its machines with the latest technologies, including automation, AI and IoT capabilities, in order to help the industry produce accurate structural and turbo machinery parts faster with less variability and at the lowest cost.

For more information on how modern machining solutions can help your organization meet current and future A&D industry needs, contact Makino with questions.



## How ATEP Slashes Titanium Machining Costs

Arconic Titanium & Engineered Products (ATEP) in Laval, Quebec, Canada, needed titanium-machining solutions to meet customer demands to lower costs and shrink delivery times. ATEP specializes in assembly and precision machining of various titanium aircraft components, including wing attachments, seat tracks and doorframes. Standard machine platforms couldn't provide the rigidity, flexibility or control the company needed to meet its customer requirements. The company decided to install several Makino T-Series 5-axis horizontal titanium machining centers. Research engineers from ATEP determined the machines could help the company perform certain production processes three times faster than previous methods. It eventually led to a 60% reduction in cycle times and 30% reduction of tool costs.

The company also has realized benefits related to quality improvements. ATEP is a fully integrated supplier of titanium and other specialty metals products. ATEP is receiving additional business from customers who are asking the company to correct quality issues from other suppliers, according to a company executive.



## Automation Enables JIT Delivery for Universal Machining

Universal Machining Industries Inc. (UMII) needed a solution to keep pace with growth and remain competitive with suppliers in low-cost labor countries. The Muenster, Texas, manufacturer of machinery derives **70% of its business from the aerospace industry**.

UMII transitioned from primarily stand-alone vertical machining centers to horizontal machining centers in automated cells. This included the purchase of a 60-pallet Makino Machining Complex (MMC2) and five Makino a61 horizontal machining centers.

The automated system allows operators to manage five machines simultaneously. Its fourth-axis table, tombstone fixtures and rigid cutting capabilities along axis extremities have helped operators fixture more parts per face. Parts now require fewer setups and are produced with higher quality and consistency.

Key benefits cited by the company include:

- Utilization rates of more than 90% from its a61 machines
- 30% increase in part production in automated cells
- 20% improvement in cycle times

Automation has also helped the company focus on smaller batch production. The system's cell-control software allows operators to store program, fixture and tooling data for each part order into the cell's database and retrieve them when needed. Smaller-batch production cut WIP inventory by 30%. The company also decreased raw-material inventory by 25%.

Overall, the investment has helped the company address customer demands for shorter lead times and reduced part costs.