

An Aerospace Action Plan

Three Trends to Consider Heading into 2021

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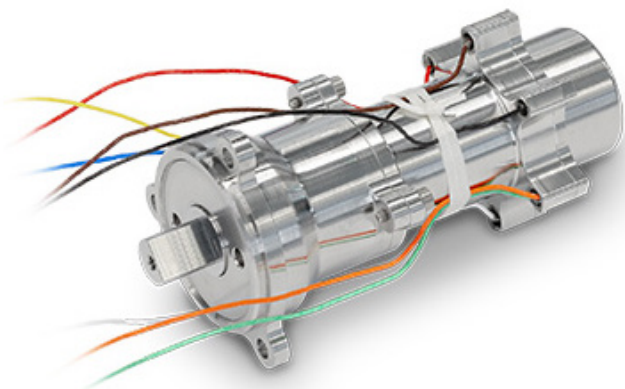
For many trade publication editors, October and November 2020 shall forever be known as the “Virtual Conference Months” as companies provided a slew of informative and educational virtual presentations in order to make-up for the lack of a trade show schedule.

Aerospace was a hot topic in many of the presentations, a market that in some areas suffered greatly due to the pandemic (I’m looking at you international and domestic commercial airlines), but managed to stay the course in other areas (military applications, drones and space exploration).

Three of the trends we’re seeing in aerospace/defense applications include the need for more complex and compact components, the ability of software tools to reduce aircraft assembly costs, and the not quite as negative drone and UAV market forecasts — with caveats. Here’s what we’ve learned from multiple sources in the aerospace community:

1. Component Complexity

In one presentation from Teal Group examining the aerospace/defense outlook moving forward it became obvious the need for more compact/complex components in aerospace applications. When Maxon Motors, for example, sends its products into orbit via a Mars rovers or a SpaceX cargo capsule, this technology becomes so much more valuable for similar high quality aerospace projects back on Earth. A motor that can handle the environments on Mars can be equally valuable in a commercial airliner flying at 35,000 feet.



The Maxon EC20 flat combined with a GP 22 HD planetary gearhead is being utilized for mission-critical tasks on the Mars 2020 rover, Perseverance.

Maxon offers compact design, wide temperature range, capabilities, long service life, flexible configurations as well as high quality in its motors, gearheads, sensors, encoders, and controllers used in aerospace applications.

Maxon’s drives are used in complex flight systems, like autopilot systems that control flight altitude using mechanical control surfaces. They are also used in auto-throttle systems



Maxon EC32 motors have been equipped with low-temperature Hall sensors in aerospace applications.

and force feedback joystick or fly-by-wire flight control systems. In meeting the strict requirements of the aviation industry, Maxon motor developed a production method that electronically records the data of each product automatically during the manufacturing process. This ensures even the highest requirements can be met.

Maxon motors have also found use in passenger planes, where a single aircraft can require up to several hundred small drives. Many of these drives are used in the cabin itself, where they ensure comfort for passengers and crew members. DC motors and gearheads can be found in the in-flight entertainment systems (IFE), environmental control systems (ECS), and window shades. They also allow for seat positioning at the press of a button, as well as adjusting cushion hardness. An ECS system requires 48 Maxon DC motors for cabin ventilation, cooling the electronics, and closing and opening the air inlet on the outside of the aircraft.

Reliable components are critical to unmanned vehicles, whether aerial or ground. These components and vehicles often face harsh conditions and must withstand shocks and vibrations without issue. The drives must also be energy-efficient in order to allow for long periods of operation. Maxon DC motors meet all of these requirements and automated production lines help maintain the high-quality standards that these applications demand.

www.powertransmission.com/articles/0918/Motor_Insight:_Anatomy_of_a_Drone/

In 2012, SpaceX launched the first private cargo capsule to the international space station. On board were ten Maxon motor brushless DC motors to fulfill mission critical

functions. EC 40 drives kept the two solar panels facing the sun at all times, ensuring adequate power supply. By 2015, more than 60 Maxon brushless DC motors had participated in many SpaceX Dragon flights without a single failure.

www.powertransmission.com/issues/0920/Motors-in-Space.pdf

Within NASA's Mars rover, Opportunity, you will find more than 30 Maxon DC motors, specifically optimized for use in the 8 mbar of CO₂ Martian atmosphere. More than 11 years and 42 kilometers later, the drives are still performing as intended. The knowledge Maxon Motor gains from these missions furthers the benefits they can provide customers on Earth.

www.maxon.com

Meggitt Enhances Aerospace Portfolio

Electric motor design for aerospace applications includes considerations such as speed, torque, duty cycle, weight, volume, lifespan, thermal, efficiency, control, power source and more. Brushless DC motors are often used in these applications due to their high torque, high efficiency, low heat dissipation and extended life capabilities. However, AC induction, BDC, and stepper motors are also suitable for aerospace applications.

Meggitt PLC, headquartered in the U.K., produces a high-power density using high performance materials and the latest design and construction. This allows the company's



Meggitt has upgraded its service and support capabilities in China.

brushless motors to provide low wear and low maintenance. Since 1948, Meggitt has specialized in motors, power electronics and sensors for extreme environments. They offer an extensive range of electric motors intended to fit on-board aerospace, defense, and other extreme applications.

Meggitt PLC recently secured a three-year contract with leading China-based operator Shandong Airlines for the supply of maintenance and repair services of the Boeing 737NG. The SMARTSupport contract will be supplied out of Meggitt's Services and Support regional center of excellence in Singapore. This is the first SMARTSupport LTA Meggitt has completed in China

"We believe this order for our SMARTSupport flexible



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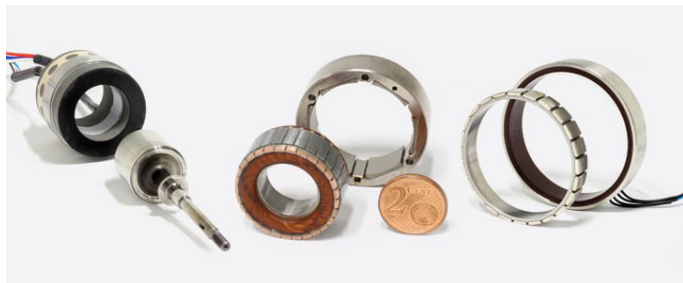
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aftermarket care package will be the first of many with our Chinese customers. Asia Pacific is a very important region for us, this contract will be supplied from our Singapore facility while we establish our base in China,” said Adrian Bunn, senior vice president, general manager for Meggitt’s service and support division.

At 42,000 square feet, the facility has doubled in size to incorporate fire detectors, cable assemblies, actuators, sensors, valves, and heat exchangers, adding several new capabilities to the current portfolio.

Meggitt’s Services & Support division established its site at Seletar Aerospace Park, Singapore, in 2012, and this latest expansion was driven by the significant growth in content Meggitt has secured on next generation aircraft platforms including the A350XWB, A320neo, Boeing 737MAX and both



Electric motor design for aerospace applications includes considerations such as speed, torque, duty cycle, weight, volume, lifespan, thermal, efficiency, control, power source and more.

GTF and Leap engines.

“Our Singapore team has continued to work hard throughout the coronavirus pandemic to ensure we reach this important milestone. In spite of the recent crisis, long-term growth prospects in the Asian region remain strong. With our enhanced portfolio we are better equipped than ever to support our regional customers once the green shoots of recovery emerge,” said Bunn

www.meggitt.com

2. Software Tool Advancements Critical to Long-Term Success

Cloud computing. It’s everywhere in automotive, aerospace, trucking, rail, shipping and public transportation systems. Improving safety, security and the overall design of transportation components/systems is essential to long-term success—with or without a pandemic to challenge daily routines and disrupt business plans. Companies are paying much more attention to simulation software in order to push technology farther and faster in the extremely competitive aerospace market.

According to Siemens, getting an aircraft certified, whether new or modified, is a long, expensive, and bureaucratic process, albeit one that has led to the safest mode of transportation. From the largest aircraft in history to small two-seaters made of steel and fabric, every plane needs to prove airworthiness and compliance and be certified by regulatory

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TLG Aerospace has helped numerous customers receive FAA certification in the U.S. at a low cost and in a short time, something they have achieved with impressive efficiency.

authorities before operation.

In 2019, TLG Aerospace, Seattle, Washington, used a Siemens Digital Industries Software solution for faster, cost-effective certification by analysis.

“What has changed is the balance between how much analysis you can do and how much you can use in the certification process,” said Robert Lind, director of engineering, FAA flight analyst designated engineering representative (DER), FAA flutter DER, TLG Aerospace. “This is a really exciting development in my 30 years in the industry. As CFD codes and computers have become more capable, we can certify faster and cheaper.”

Most of Lind’s work involves getting customers to type

certification with analysis. As one of TLG Aerospace’s four resident DERs, he can sign for certain certification functions on behalf of the FAA. TLG Aerospace uses *Simcenter STAR-CCM+* software from Siemens Digital Industries Software for CFD analysis and *MSC Nastran* software for FEA to develop full-vehicle certification models for loads, flutter and handling qualities, modeled appropriately for the entire flight envelope.

“We utilize *Simcenter STAR-CCM+* in a certification environment which is different from design. There is a great role for CFD in the certification process. We don’t use CFD to get an answer that the FAA signs off on. We use CFD to build a full-scale aero/structure/controls model so we can simulate vehicle response and produce loading and handling information,” said Andrew McComas, engineering manager and aerodynamicist, TLG Aerospace.

To certify a new aircraft, an aerodynamic database is required. To build the entire analysis database would require data for hundreds of thousands of conditions to be available in a short amount of time. The aerodynamic properties of the vehicle are calculated at design and at flight envelope extremes using CFD. The CFD results are mapped to a reduced-order aerodynamic model within the aeroelastic process. TLG Aerospace calibrates the aeroelastic model to develop full-vehicle aeroelastic solutions that are underpinned by the rigid CFD. The final aeroelastic model will reproduce full-vehicle integrated and distributed aerodynamics in rigid mode and yield a converged aeroelastic solution in seconds.

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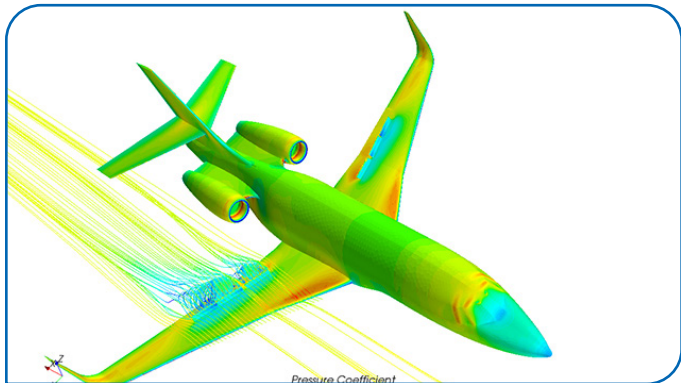
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The predictions are now in place to show regulations are met at certain conditions. Flight testing then validates the analysis models. This validation may be limited to something less than the full flight envelope to reduce risk for in-flight testing. Once validated, it can be used to show compliance at other flight conditions. Having a high-fidelity pre-flight test model significantly reduces the amount of required post-flight test model adjustments and calibrations.



Having a high-fidelity pre-flight test model significantly reduces the amount of required post-flight test model adjustments and calibrations.

“Simcenter STAR-CCM+ runs robustly, accurately and repeatedly with simple processes and best practices,” says McComas. “That has given companies confidence that the code can be used as a source for aero database generation. Elastic computing from AWS, with Siemens’ power-on-demand licensing, helps run multiple simulations on multiple compute clusters simultaneously on the cloud in a secure way. If we did not have the POD licensing model, we wouldn’t have the capability to take full advantage of elastic computing resources and would incur the large cost of annual licenses.”

In short, the entire aero database is built in a shorter time with cost-effective licensing. Simcenter STAR-CCM+ is built from the ground up to enable innovation. In a recent blog, Siemens Digital discussed the need for engineers to have access to unlimited compute capacity, on-demand, in order to maximize their use of simulation data. If high performance computing resources won’t work, cloud computing is a viable alternative:

blogs.sw.siemens.com/simcenter/five-compelling-reasons-to-run-cfd-simulations-on-the-cloud/

TLG Aerospace has helped numerous customers receive FAA certification in the U.S. at a low cost and in a short time, something they have achieved with impressive efficiency. TLG Aerospace credits *Simcenter STAR-CCM+* combined with cloud computing for a significant reduction in certification costs.

Whoever said the future of engineering lies in computational fluid dynamic simulations in the cloud was clairvoyant — and apparently knew they’d be handling the workload from their home office in 2020.

www.sw.siemens.com

3. Drone Production Set to Triple in Next Decade

Drones were sort-of built for 2020. From Amazon dropping packages in suburbia to inspection drones monitoring an oil and gas facility, the unmanned aerial vehicle has plenty to offer in a world where people are being asked to stay away from others. Teal Group’s recent presentation on aerospace forecasts touched on some of these developments.

Civil Unmanned Aerial Systems (UAS) will be the most dynamic growth sector of the world aerospace industry this decade as commercial applications take off and civil governments adopt systems for new roles in border security and public safety.

“The pandemic is reshaping growth in the industry, boosting support for delivery drones while hurting investment in some longer-term applications,” said Philip Finnegan, Teal Group’s director of corporate analysis and author of the study. “On balance, the negatives appear to *slightly outweigh* the positives.”

The goodwill created by delivery of medical items by drone will help speed regulatory approval for wider deployment of drones and has encouraged companies to adopt UAS to do distance inspections of facilities. Yet the pandemic has sharply cut venture capital financing of drone companies, major aerospace companies are cutting investment in next generation systems, and the oil and gas sector is slashing capital spending.

Teal Group’s 2020/2021 World Civil UAS Market Profile and Forecast suggests that non-military UAS production will total \$108 billion in the next decade, soaring from \$5 billion worldwide in 2020 to \$18.4 billion in 2029, a 15.6% compound annual growth rate in constant dollars. The study includes annual forecasts of commercial, consumer and civil government systems and the individual submarkets. Teal Group, an independent aerospace and defense research and analysis company, has provided support for the FAA in the preparation of past annual commercial UAS forecasts.

Commercial use will drive the market as consumer drone



Drone: Civil Unmanned Aerial Systems (UAS) will be the most dynamic growth sector of the world aerospace industry this decade.

purchases slow and government purchases remain a small but growing portion of the market.

“A growing number of corporate clients are now moving from proof of concept work to deployment of fleets, helping to drive the commercial market,” said Finnegan. That is driving more than a 21% compound annual growth rate for commercial UAS production over the ten-year forecast. “The growing promise of the civil market is attracting the world’s leading technology companies, driving ever faster development of systems and business applications,” said Finnegan.

Delivery as a premium service promises to lead market growth in the United States, with the segment emerging as the leader by the end of the forecast period. Agriculture will be the leading sector overseas by 2029 thanks to heavy Chinese investment in subsidizing agricultural drone spraying.

Industrial inspection will emerge as a major commercial drone market over the next decade. Construction will be the largest segment of industrial inspection over the next decade, according to the Teal study. All 10 of the largest worldwide construction firms are deploying or experimenting with systems and will be able to quickly deploy fleets worldwide. Industrial inspection also includes other major segments such as energy, mining, and railroads, ranked in order of size over the next decade.

Other important commercial segments, ranked in order by ten-year size, include general photography, communications, insurance, and entertainment.

Civil governments are deploying an increasing number of unmanned systems. The United States and European governments have new pilot programs to deploy systems to protect land and sea borders. The United Nations and other peacekeepers are deploying systems to provide protection. Use by law enforcement, particularly in the United States, is soaring.

Firms in traditional aerospace, data analysis, semiconductors, telecommunications are all driving aggressively into serving this diverse civil market. Technology companies like Intel, Qualcomm, Microsoft, Apple as well as venture capitalists have poured more than \$2.8 billion into drone startups from 2012 to 2019, according to the Teal Group study.

US start-ups have received 65% of the funding over the period, enabling them to take the lead in development of drone analytics. Chinese firms, which have received 16% of the investment, are focusing on continuing their lead in hardware, moving from consumer to commercial systems. Europe is lagging at 9%.

It’s an industry worth keeping a close eye on post-pandemic. **PTE**

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