

Technology update

Can regulation and innovation coexist?

In terms of design, manufacture, and operations, the aerospace industry is one of the most heavily regulated transport sectors. The result is a fine safety record, but according to Peter Stokes, CEO of airliner floorpath marking specialist **STG Aerospace** it may now stifle technology advances that could enhance safety levels.

"Such a widely regulated and tightly controlled environment limits the introduction of new technologies and products, yet the industry is constantly under external pressures to make technical advances," he said. "And the traditional challenges of saving product weight and cost have now been joined by the need to use technology to help counter the threat of terrorist attacks."



STG's latest ColorMatch floorpath system has been designed to blend with airline cabin decor.

Stokes believes a distinction needs to be made between invention (the design and/or creation of something that has never been made before) and innovation (the introduction of changes and new ideas). "The difference is in the acceptance of the components or make-up of the new product," he said. "An invention involves products, the components or concepts of which are entirely new to the regulatory authorities and therefore subject to extensive and lengthy examination. If the product is innovative, it may comprise a number of trusted and proven technologies brought together in a new way to deliver the innovation. If the regulatory authorities have approved elements of the innovative product, the route to certification should, theoretically, be less onerous for the developer. Yet that is not always the case because the regulators are invariably driven by the inherent conservatism of wanting to retain a status quo in respect of safety."

A further regulatory issue that affected the application of innovation was the need for regulations to be framed in such a way that they ensured compliance with the original intention for those rules, said Stokes. He believes that increasing competition could bring with it pressure to create competitive advantage by compliance with the "letter of the rule" rather than the "intent of the rule." Stokes also said that he regarded a situation as dangerous when rules were not as prescriptive as they might be, and awareness of the original rule makers' intention was diluted through delegation of approval to Aircraft Certification Offices and Designated Engineering Representatives.

"In those circumstances, there is a requirement for regulators to educate internally, and suppliers, who may not be the original innovators, to be responsible and assist this process," he said. "It is clear that in a commercial and competitive environment, such an undertaking from some suppliers may not be universal. In an environment where cost reduction is key, the aircraft manufacturer role tends



"The traditional challenges of saving product weight and cost have now been joined by the need to use technology to help counter the threat of terrorist attacks," said Peter Stokes, CEO of STG Aerospace.

to be as integrators of increasingly complex subassemblies and subsystems. In this business model, it is almost inevitable that the responsibility for research and development is delegated by the OEMs to the Tier 1 and Tier 2 suppliers—an important responsibility."

In such an environment, Stokes believes there were two dominant pressures on innovative companies, the first being cost—R&D, test houses, aircraft tests, and the certification processes. "The total cost of bringing new products to market can therefore be many times the R&D budget," he said.

The R&D costs for STG's photoluminescent ColorMatch floorpath system was approximately 10% of the overall product development budget, the major expenditure being a naïve evacuation demonstration (a standard test done with members of the general public involving the ease of egress from an aircraft in an emergency), liaison with the regulatory authorities, and the achievement of certification.

The second major R&D pressure was because suppliers must deploy not only the necessary product development expertise but also the knowledge and contacts in the regulatory environment to take the new product through to certification. This understanding ensured that "design for regulation and certification" would be one of the primary considerations. It also extended into bringing the

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regulatory bodies into the design and development process at an early stage to ensure that the developer retained control of the process.

"We have found that it is vital to work closely with the key individuals—we need to get on the same wavelength early to minimize additional development or repeat certification costs and ensure compliance with rule intent," said Stokes.

Corporate structure also has a significant effect on a company's ability to

bring new products to market successfully. "STG is a small company that has won the British Aerospace Innovation Award and two Queen's Awards for Enterprise, winning for both Innovation and International Trade. It has a structure that supports and endorses innovation, from the Board downwards. It has a firm commitment to R&D and is a privately owned company with no short-term pressures or restrictions from institutional shareholders. Other innovators in aero-

space also tend to be small, relative newcomers to the aerospace industry. One only has to look at the explosion of interest in the very-light-jet market to see more shining examples of innovation rather than invention, where small is often beautiful. It is clear that even in a heavily regulated market, innovation can still thrive so long as the will and expertise exist."

Stuart Birch

Rolls-Royce adds intelligent access to inspection process

Eight Planet Platforms AIRdeck units are being used to facilitate the stringent final inspection process of the 500, 700, 800, and 900 Trent engines at Rolls-Royce's Civil Aerospace Customer Delivery Centre in Derby, UK.

Each AIRdeck system can be positioned at preset heights from 1131 to 2981 mm, giving engineers the flexibility to raise or lower the platform to suit each engine type. The variable height of the platform and hydraulic lift also enables

a good understanding of the processes and objectives involved. We started from the ground up and designed the system specifically for the application."

However, once the Rolls-Royce units had been installed in Derby, Pemberton



The AIRdeck intelligent access platform from Planet Platforms was initially developed specifically for the final inspection process of Rolls-Royce's 500, 700, 800, and 900 Trent engines.

One AIRdeck system is made up of two preset heights hydraulic scissor packs, with platforms positioned in a parallel configuration. Once the engine to be worked on is brought into position, the outer and inner fingers of each AIRdeck unit extend to form a 360° wrap-around inspection bay.

The inner deck area is made up of a series of independent aluminum fingers, which pneumatically extend to shape to the contours of the engine. This feature provides inspection engineers with a safe work platform from which to closely inspect every part of the engine.

engineers to raise toolboxes and small parts up to the point of inspection.

Four of the units are mounted on hover pads to allow the platform to be removed from the flow line to enable access and for the engine to be removed.

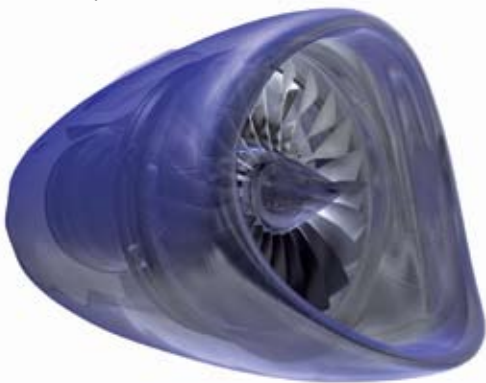
According to Toby Pemberton, who managed the project on behalf of Planet Platforms, "The Rolls-Royce inspection line is a highly sophisticated, highly technical environment and as such required an access solution with very specific considerations. We visited the Derby plant on numerous occasions throughout the research and development process so that we had

soon came to recognize that the system had a number of attributes that could be easily transferred to other industrial situations. "Although the system was designed to allow engineers close access to aviation engines, the principle of the pneumatic fingers could be applied to the manufacture, inspection, or maintenance of any large object," he said. "It therefore made sense to give the system a name and roll it out to a wider audience."

Jean L. Broge

Volvo Aero increases presence on next-gen engines

Volvo Aero Norway has signed an agreement with GE-Aviation to produce two key components for the F136 engine that is being developed for Lockheed Martin's F-35 Joint Strike Fighter. The agreement covers the development phase and specifies that Volvo Aero Norway will be the exclusive supplier of the components, the aft compressor case and the forward compressor case.



Volvo Aero in Trollhättan, Sweden, will offer its expertise in turbine exhaust case technology during the development of Pratt & Whitney's next-generation geared turbofan engine.

The F-35 is expected to be the predominant fighter aircraft in the coming decades. Some sources estimate the sales volume of the fighter to be more than 5000 aircraft. The aircraft will be certified with two engines, the F136 from GE-Aviation and the F135 from Pratt & Whitney. Volvo Aero Norway will be supplying the low-pressure turbine shaft and the intermediate case for the F136 from P&W, whose parent company is United Technology Corp. (UTC).

The order value of the signed agreements is about \$1.7 million and the entire program could yield up to \$177 million. In total, Volvo Aero Norway has agreements for the F-35 amounting to about \$2.5 million. The potential order value for the entire program is up to \$400 million.

The first components for the F136 will be delivered during 2007.

Volvo Aero Norway was established in 1981 as a division in KongbergsVäpnenfabrikk (later Norsk Jetmotor and since 1999 Volvo Aero

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IEEE INFORMATION DRIVING INNOVATION





Volvo Aero Norway will have components on both of the engines that are slated to power Lockheed Martin's F-35.

Norway) in conjunction with Norway acquiring the F-16. The company—which is owned by **Volvo Aero** (78%) and UTC (22%)—manufactures and delivers 160 shafts annually for the F-16 engine and will continue to do so for the foreseeable future.

Volvo Aero is also working with P&W

to demonstrate new technology for what the companies describe as “the aircraft engine of the future.” It does not involve any agreement regarding a new engine program, but the new cooperation is still an important step toward a new engine undertaking.

P&W claims its next-generation

geared turbofan engines will “involve a new technology leap for commercial aircraft engines.” The intention is that the engines will be used in the medium-class (single-aisle) aircraft that will eventually replace the **Boeing 737** and the **Airbus A320**. Customers of such aircraft are expected to be equally focused on engine performance and cost of operation.

It is projected that the new engines will provide for 12% less fuel burn and that the noise level will be 30 dB lower than Stage 3 requirements. The first ground tests are scheduled for the second half of 2007. Volvo Aero recently ordered forged and cast goods for the turbine exhaust case and low-pressure turbine case that will be part of the new demonstrator.

P&W will also be cooperating with **MTU** and **Avio** in the development work.

Jean L. Broge

Boeing takes to the air with light helicopter

Boeing has flown its newly designed A/MH-6X light-turbine helicopter for the first time, marking what it describes as a significant milestone in the continuing development of the versatile manned/unmanned military aircraft. The aircraft combines the proven performance of the A/MH-6M Mission Enhanced Little Bird (MELB) with the unmanned aerial vehicle technologies of the Unmanned Little Bird (ULB) Demonstrator, a modified MD 530F

civil helicopter that has been in development since 2004.

According to Dino Cerchie, Boeing Advanced Rotorcraft Systems Unmanned Little Bird Program Manager, the A/MH-6X is “the first true hybrid manned/unmanned aircraft, adding another mission capability to the combat-proven, multi-mission MELB helicopter. The A/MH-6X offers exciting new possibilities for an already outstanding platform.”

The A/MH-6X lifted off in September at the Boeing Rotorcraft Systems facility in Mesa, AZ, and flew as a piloted aircraft for about 14 min before landing safely. Future testing will expand the manned and unmanned envelopes. Aircraft performance will be similar to the ULB Demonstrator with an additional 1000 lb of payload that can be used for increased range, endurance, or mission hardware. Total payload for the ULB Demonstrator is over 2400 lb.

Boeing designed and developed the derivative helicopter for civilian and military, manned or unmanned, applications, including Homeland Defense. The helicopter’s external appearance and mechanical systems are similar to the operational A/MH-6M helicopter flown by the **U.S. Army’s** 160th Special Operations Aviation Regiment.

Boeing made the most significant mod-

ifications to the cockpit avionics and electrical systems. The A/MH-6X aircraft has a prototype “glass” cockpit that provides system redundancy and additional technologies in digital maps and data fusion. It also has many network-centric features such as Ku-band communication; digital radios; Internet protocol-addressable aircraft systems; and on-board, high bandwidth data processing and storage.

“The unmanned hardware and capability developed in this program can be installed in any helicopter,” said Cerchie. “The A/MH-6X [is] a compact, highly transportable aircraft that can leverage many existing qualified aircraft systems. The demonstrator, which first flew just over two years ago, has logged nearly 500 manned and unmanned flight hours. The first flight of this much more capable A/MH-6X was a logical extension of [that] developmental program.”

Boeing is preparing the aircraft for domestic and international markets. “The desire and need for an all-purpose compact workhorse is there, whether it’s manned or unmanned,” said Cerchie. “This aircraft is the low-cost solution for urban or confined operational areas, where full mission capability and connectivity are required.”

Jean L. Broge



Boeing considers the A/MH-6X light-turbine helicopter as “the first true hybrid manned/unmanned aircraft.” Its first manned flight occurred in September.

Testing and prepping a wind tunnel for reactivation

After almost three years of inactivity, the National Full-Scale Aerodynamic Complex (NFAC) at **Ames Research Center** (ARC), Moffett Field, CA, is tentatively scheduled for its first test under Arnold Engineering Development Center (AEDC) in December. The NFAC is being reactivated as an AEDC remote operating location.

Recent accomplishments in preparing the facility for operation included inspection and maintenance on the wind tun-

nel's system of eight vane sets. The vane sets, which are critical structural and aerodynamic components of the wind tunnel circuit, are located throughout the wind tunnel to direct the airflow generated by the fan and drive system, and to

configure the wind tunnel to the 40- x 80-ft test or the 80- x 20-ft test section modes.

Consisting of as little as six large moving doors to as many as 162 fixed air foil-shaped columns, the vane sets span



Source: AEDC and NFAC

A Remote Access Technology (RAT) team member performs magnetic particle tests on welds in the wind tunnel as it is being prepared for reactivation.



RAT crews inspecting vane set number eight.



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Besides inspecting vane sets in the NFAC wind tunnel, the RAT crews also performed work on other hard-to-reach systems, such as the actuating components of the 40- x-80-ft test section overhead doors.

along lengths of up to 244 ft and ceiling heights to 132 ft. The NFAC contracted Rodeo, CA-based **Remote Access Technology (RAT)** for vane set inspection, maintenance, non-destructive testing, and more. RAT specializes in industrial rope-

access methods to safely achieve elevated access of hard-to-reach areas.

While a RAT crew of five managed the job of rigging, climbing, and accessing vane areas, NFAC engineers and consultants on the ground communicated

the working tasks, monitored safety procedures, and addressed all reports on the spot. The combined team inspected the integrity of all vane set structures and associated mechanisms and assemblies, performed magnetic particle testing of critical weld locations and suspected weld cracks, cleaned and lubricated critical mechanical components, repaired faulty electrical and structural components, photographed abnormalities, and documented its work.

"The NFAC and RAT team successfully completed a thorough inspection and maintenance program of the vane sets as well as repair tasks within a time frame of one month," said Nick Jize, NFAC contractor Site Manager. "That is a job that historically required several months for NFAC technicians to accomplish with the use of man-lift baskets and scaffolding."

At this time, all tests currently slated at NFAC are aircraft or aircraft-application tests. The first test, slated for January or February, is for a foreign customer. The first "full-up" test will also be sometime next year for the UH-60 Independent Blade Control test for the **U.S. Army** and **NASA** in the 40- x 80-ft tunnel

Jean L. Broge

Titanium cutting made easy by Cincinnati Machine

RTI Claro will use an updated version of **Cincinnati Machine's** dual-gantry five-axis Wide-Range Profiler to machine titanium structures made from extruded product. The machine will use 7000-rpm, 70-hp gear-driven spindles.

The dual gantry configuration will operate on 240 ft of X-Axis rail with multiple spindles delivering full five-axis contour-

ing capabilities. A redesigned spindle support housing reduces overall moving mass and will significantly improve Z and B-axes servo response and machining dynamics. FEA modeling, which Cincinnati Machine calls a core in-house engineering area of expertise, was employed in the redesign of this structural, moving element of the machine.

The Wide-Range Profiler is field-proven, with heavy titanium cutting capabilities demonstrated at installations around the globe. While this machine has dynamic stiffness optimized for aggressive metal removal rates in titanium and other hard metal alloys, the dual-range geared transmission enables very high-volume aluminum and other light alloy five-axis machining.

RTI Claro has been a machining and assembly solutions provider to the aerospace market for more than four decades. Working with parent company **RTI International Metals** (a supplier of titanium to global aircraft manufacturers), RTI Claro will leverage its new capital investment to meet the increasing demand for titanium aircraft parts.

The first gantry is scheduled to ship from Cincinnati Machine's recently expanded manufacturing facility in April 2007. The second gantry will ship the following July.

Patrick Ponticel

Cincinnati Machine says its Wide-Range Profilers have dynamic stiffness optimized for aggressive high metal removal rates in titanium and other hard metal alloys.



Fluid detective solves crime of oil contamination

Lots of downtime and high maintenance costs are partners in crime because they work hand-in-hand to rob profits from manufacturers.

Messier-Dowty was a recent victim of such thievery. As a manufacturer of landing gears for commercial and military aircraft built by companies such as **Airbus, Boeing, Fokker, and BAE Systems**, Messier-Dowty and the companies it serves have a lot riding on the build schedule. In addition to threatening its relationship with its customers, the landing-gear maker was losing money by the barrel because of its filtration woes. According to **Wyko**, which was hired to investigate why pumps on several **Giddings & Lewis** five-axis hydraulic milling machines kept failing (an average of one failure per 18 months per machine), 16,000 lb per machine was how much the supplier was losing annually on pump overhaul, downtime, labor, oil disposal, and related costs.

The initial fix on one of the machines—repair of the pump and tempo-

rary installation of an off-line filter to decontaminate the fluid—proved inadequate; the pressure-line filter already fitted to the machine was functioning properly, but the fluid was becoming contaminated as it circulated through the rest of the machine, including the pump.

So, in a new trial, Wyko installed an additional, permanent return-line filtration system from **Pall**. The company also upgraded the tank breather filter and filtered new oil entering the system. A baseline **ISO** cleanliness level of 19/16/14 was established for the oil prior to the trial, with a **British Fluid Power Association** target of 15/14/12. (The figures represent the level of solid particles measuring, respectively, 4, 6, and 14 micron found in 1 mL of oil.)

The trial was a success, and conversion of the remaining six machines to the new system began this summer. The goal is for each machine to experience a mean time between failure (MTBF) of more than 3800 h—double the MTBF under the previous regime, according to



A new filtration system developed by Wyko for use at Messier-Dowty's landing gear plant in Gloucester, England, is expected to arrest pump failures.

Wyko. Return on investment of the capital expenditure comes at six months, the company says.

Patrick Ponticel

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Gaining ground on autonomous refueling

Late this past summer, **DARPA** and the **NASA Dryden Flight Research Center** performed what they describe as the first-ever autonomous probe-and-drogue airborne refueling operation. The demonstration was conducted with a **NASA F/A-18** configured to operate as an un-

manned test bed, though pilots were on board for safety purposes.

The Autonomous Airborne Refueling Demonstration (AARD) system developed by **Sierra Nevada** uses GPS-based relative navigation, coupled with an **Octec** optical tracker, to provide the precise

positioning required to place a refueling probe into the center of a 32-in basket dangling in the air stream behind an airborne tanker. The tanker was equipped with a small relative navigation pallet, but production refueling equipment was not modified in any way.

The flight was the seventh of eight planned for the 15-month AARD proof-of-concept program. For this particular test, the pilot provided approval to proceed at several stages of the maneuver but was otherwise hands-off, says DARPA. Operationally, unmanned systems are expected to locate the tanker, form up, accept clearances, refuel, and disengage without any human intervention.

According to the test pilot, the end-game movement of the autonomous system had none of the last-second, high-gain stabs at the basket that is often seen with manned refueling missions, with the computer approach being "incredibly stable and smooth, with deliberate movements throughout."

The AARD system was operating in benign flight conditions when it successfully engaged the basket in two out of six attempts. DARPA says that as important as the successful engagements, the system safely recovered from each missed attempt.

It is important to keep in mind too that miss tolerances were tight for this first attempt. During one of the missed attempts, the pilot observed that the probe was actually inside the basket when the system pulled back. More robust tracking algorithms and relaxed miss tolerances are planned to be demonstrated during a future flight.

Autonomous in-flight refueling is considered to be a critical enabler for affordable, persistent, unmanned strike systems.

"We chose to demonstrate the probe-and-drogue refueling method because it is the most challenging for autonomous systems," said Lt. Col. Jim McCormick, DARPA Program Manager. "The precise station-keeping capability we've demonstrated applies equally to the boom-and-receptacle method used by most **U.S. Air Force** aircraft." The same technology also promises to enhance reliability, safety, and the range of operating conditions for air refueling manned aircraft.

Jean L. Broge



An F/A-18 that was configured to operate as an unmanned test bed is shown behind a 707 from Omega Air Refueling Services during an Autonomous Airborne Refueling Demonstration (AARD) flight.



The HUD and video camera setup in the cockpit of the AARD F/A-18. A pilot was onboard the aircraft during the test for safety purposes.