Technology update

Evacuation, coatings, higher productivity, digital manufacturing—and the end of an era

The **Airbus** A380 is on schedule for certification and first delivery by the end of the year. Although some injuries occurred during the passenger evacuation trial of the twin-deck A380 aircraft MSN7 (including a broken leg), the test was "successfully completed," said the company in a statement, paving the way for the aircraft's certification and scheduled first customer delivery.

Half of the aircraft's 16 doors were used for the trial that involved evacuating 873 people, all of whom left the aircraft and reached the ground within the 90 seconds required. The test was held under the supervision of the European Aviation and Safety Agency (**EASA**), and the **FAA** was represented. "The airworthiness authorities will thoroughly review the material available, analyze the passenger flow on the two decks, and the evacuation itself," added the company's statement."

Airbus Chief Operating Officer Charles Champion, who is also head of the A380 Program, said the trial has cleared the way for transportation of passengers in a three-class configuration, as defined by initial customers for the aircraft: "And even in a higher-density two-class layout, the A380 cabin will continue to set new standards of comfort," said Champion.

To make the test as demanding as possible, the aircraft was fitted with a very high-density cabin layout with 853 seats, all of which were occupied. Added to this number were captain and first officer plus 18 **Lufthansa** cabin crew. Airbus regards it as the most stringent evacuation test of a passenger aircraft ever to be performed. To strengthen the test further, it was carried out in darkness. The film record of the event was via IR cameras. The doors and slides to be used were not known before the trial.

The completion of the test was particularly meaningful as it involved about 300 more passengers and crew than the 555 in three classes that would typically be carried.

The A380 order book stands at 159 aircraft for 16 customers. **Singapore Airlines** is the lead customer and is scheduled to take delivery of its first A380 at the end of the year.

Many things about the Airbus A380 are special, and that includes its coatings system. **Akzo Nobel Aerospace Coatings**' (ANAC) specially developed paint for the twin-deck airliner is a second generation of its Selectively Removable System (SRS). It allows the topcoat only to be removed during maintenance, cutting downtime by as much as 40% by avoiding the need to strip layers to the bare metal. SRS is focused on reducing the time it takes to repair and repaint aircraft leading.

The company explains that exterior coating systems for aircraft are usually difficult to strip. It regards most mechanical processes using waterjets or blasting as neither technically nor economically efficient solutions. SRS facilitates the chemical removal of selected coating layers using mild/neutral strippers. These avoid the need to strip to bare metal, thus keeping the basic OEM-applied anti-corrosive primer layer and pre-treatment intact.

ANAC states that the SRS incorporates an extra sealer coat between primer and finish, which allows the selective removal of only the topcoat in preparation for re-painting, avoiding the need to reapply the primer and so resulting in substantial time and cost savings. Once the finish has been removed, the old sealer coat is washed with a thinner and another coat of sealer applied before the new topcoat. ANAC adds that this can save up to 50% of the time needed when having to strip back to bare metal.

The company claims that its mild/neutral paint removers are safer for operators to use and also reduce the amount of hazardous waste, in turn lowering the cost of waste disposal. A further consideration is that many traditional methylene chloride-based strippers and chlorinated solvents are becoming unavailable, states ANAC, which is one of a small number of companies approved to supply the A380's exterior coatings. It also supplies structural coatings for all other Airbus aircraft.

While the A380 is scheduled soon to receive certification, the long-range Airbus A340-600 has just received its certification from EASA. The aircraft has extended range (up to 14,600 km) and greater passenger capacity (380) compared to other A340 variants. The aircraft first flew in November last year, with

Air India has operated a fleet of A300s and A310s since the 1980s.

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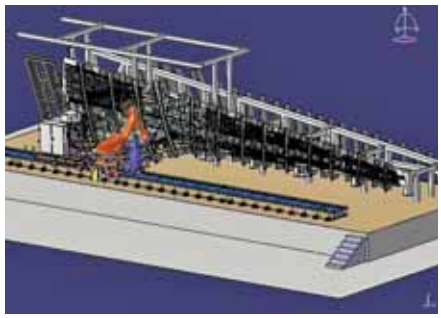
Circle 7

Akzo Nobel Aerospace Coatings has developed a system for the Airbus A380 designed to reduce downtime for re-painting.



Airbus UK (Broughton) Delmia Robotics workcell for wing assembly. V5 Robotics will first be applied to the A400M transport.

deliveries starting this summer.

The A340-600 achieves reduced maintenance costs and is powered by the latest development of **Rolls-Royce**'s Trent 500 engines. The aircraft is said by Airbus to provide 18% greater productivity for operators compared with other A340s and achieves an extra 463-km range.

Airbus recently announced that it will begin using **Delmia** V5 Robotics digital manufacturing solution to simulate, validate, and program the robotics assembly line for new Airbus aircraft programs. The move is designed to optimize design and manufacturing cycle time, reducing both costs and time to market.

Initially, V5 will be applied to the Airbus A400M military transport, which Airbus says is the first aircraft designed entirely with CATIA V5 and simulated on Delmia V5 from the range of **IBM** PLM (Product Lifecycle Management) solutions developed by **Dassault Systèmes**. The acquisition would enable Airbus to optimize programming time and to fine-tune its production resources without disruption through off-line programming, said the companies in a joint statement. The solution is supported by Fastip-Fastrim tools from Dassault Systèmes' technology partner, **CENIT**, working on the CATIA and DELMIA V5 data model to provide trimming, drilling, and riveting capabilities.

IBM and Dassault Systèmes' statement added that in addition to these robotic solutions, "Airbus is using the ergonomic and assembly simulation tools of Delmia V5 Human and Delmia V5 DPM (Data Protection Manager) Assembly to meet the increasing need for simulation in the field of digital manufacturing. Already used for the A400M program, it offers the ability to check accessibility during the assembly and maintenance phases of various airplane parts throughout the design cycle." Airbus aims to harmonize PLM tools on the V5 platform. It believes that the automatic solving of machine/environment conflicts will optimize machine paths, thus reducing maintenance costs and immobilization time.

While the A400M program is looking ahead, the A300/A310 is soon to be in the past—at least from a manufacturing aspect, as final assembly is steadily phased out after 35 years' production. The A300/310 was the first member of the Airbus family, and the last example will be in the hands of its customer in July 2007. A300/310 production is making way for more modern models, including the forthcoming A350.

Orders for the A300/A310 totaled 821 aircraft, with one a month reaching the final production line during the past two years. The A300, the first wide-bodied twin to the market, was launched in May 1969, with **Air France**, its first customer, putting it into service in 1974. The A310, launched in 1978, was the first wide-body with a two-man cockpit. The aircraft introduced digital technology and CRT (cathode ray tube) displays to usher in the glass cockpit for larger passenger jets. About 650 A300s and A310s remain in service with about 80 operators. Around half the fleet is likely still to be in operation beyond 2025, Airbus operating a long-term fleet support program. This year, Airbus deliveries are set to exceed 400 aircraft compared to 378 in 2005.

Stuart Birch

Research continues on blended-wing-body concepts

In cooperation with **NASA** and the **U.S. Air Force Research Laboratory** (AFRL), **Boeing**'s Phantom Works is actively exploring and validating the structural, aerodynamic, and operational advantages of a blended-wing-body (BWB) aircraft.

Two high-fidelity, 21-ft wingspan prototypes of the BWB concept have been designed and produced for wind tunnel and flight testing this year. The **U.S Air Force** has designated the vehicles as the X-48B, based on its interest in the design's potential as a flexible, long-range, high-capacity military aircraft.

X-48B Ship No. 1 began wind tunnel testing in early April at the Langley Full-Scale Tunnel at the **Langley Research Center**. When testing was completed in early May, it was scheduled to be shipped to NASA's **Dryden Flight Research Center** in California to serve as a backup to Ship No. 2, which will be used for flight testing later this year.

According to the team, both phases of testing are focused on learning more about the low-speed flight-control characteristics of the BWB concept.

"The X-48B prototypes have been dynamically scaled to represent a much larger aircraft and are being used to demonstrate that a BWB is as controllable and safe during takeoff, approach, and landing as a conventional military transport airplane," said Norm Princen, Boeing Phantom Works Chief Engineer

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The X-48B cooperative agreement by Boeing, NASA, and the U.S. Air Force Research Laboratory culminates years of blended-wing-body research by Boeing and NASA. The AFRL is interested in the concept for potential military applications.

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"We believe the BWB concept has the potential to cost-effectively fill many roles required by the Air Force, such as tanking, weapons carriage, and command and control," said Capt. Scott Bjorge, AFRL X-48B Program Manager. "This research is a great cooperative effort, and a major step in the development of the BWB. AFRL is inspired to be involved in this critical test program."

NASA also is committed to advancing the BWB concept. NASA and its partners have tested six different BWB models of various sizes over the last decade in four wind tunnels at Langley.

"One big difference between this airplane and the traditional tube and wing

aircraft is that instead of a conventional tail, the blended wing body relies solely on multiple control surfaces on the wing for stability and control," said Dan Vicroy, NASA Senior Research Engineer at the Langley Research Center. "What we want to do with this wind-tunnel test is to look at how these surfaces can be best used to maneuver the aircraft."

The two X-48B prototypes were built for Phantom Works by the UK's **Cranfield Aerospace** in accordance with Boeing requirements and specifications. Made primarily of advanced lightweight composite materials, the prototypes have a mass of about 400 lb each. Powered by three turbojet engines, they will be capable of flying up to 120 knot and 10,000 ft in altitude during flight testing.

Boeing also contracted with Cranfield Aerospace to provide the ground-control station, in which a pilot will remotely control the X-48B during flight research testing.

Jean L. Broge

Solving the solvent problem

BAE Systems is using **3M**'s Paint Preparation System (PPS) to reduce solvent consumption and improve quality. PPS incorporates lightweight disposable liners to reduce the need for solvent cleaning of spray guns during part painting. A BAE spokesman said that the system had reduced solvents consumption by some 60%. There had also been a reduction in quality problems caused by inclusions in the paint. The introduction of PPS has won the team responsible a BAE Systems' Chairman's Award for Innovation.

The Paint Preparation System from 3M has been designed to reduce solvent use.

Since the PPS's initial introduction at BAE Systems last year, its use has been extended to seven paint shops on four of the company's sites, including its major design and manufacturing center at Salmesbury, which is involved in the production of **Eurofighter** Typhoon, **Lockheed Martin** F-35 Joint Strike Fighter, and **Airbus** structures and components.

PPS is a modular dispensing system that comprises reusable plastic cups and disposable, flexible liners and lids. Paint or primer is mixed in the liners within the reusable cups. The system, which contains a built-in filter, attaches directly to standard spray guns. During use, the liner collapses to ensure maximum paint utilization. When empty, the liners are discarded, eliminating the need to clean the spray guns with costly and toxic solvents. PPS works with both gravity-fed and siphon spray guns.

PPS was developed by a 3M R&D team in the UK, with first applications within the automotive industry before its use was extrapolated to aerospace manufacture. Martin Topping, Airbus Operations paint shop supervisor at BAE Systems, Salmesbury, said: "The fact that the system operates equally effectively with the spray gun in any orientation has also boosted productivity, particularly when working with complex parts."

Stuart Birch

Quality control with laser-tracking technology

In the world of aerospace manufacturing, measurement inaccuracies have enormous negative consequences on both timelines and bottom lines. Finding the weakest link and the right answer is the job of every quality assurance professional in aviation.

Bremen, which is the second largest **Airbus** site in Germany and one of five main design offices, focuses on wide-body wing equipping and the manufacture of high lift components and sheet metal parts. Each year roughly 2.5 million metal parts for all Airbus models are produced in Bremen. The factory also produces all landing flaps for Airbus in the structural assembly process and the wing assemblies for the A330 and A340. These tasks require extremely high levels of precision, and to meet this demand Airbus employs seven laser trackers from the Metrology Division of **Leica Geosystems**.

Leica's new T-Probe can be used in combination with trackers to allow operators to inspect hidden points and probe in areas unreachable by traditional probing solutions.

Leica's laser tracker is essentially a mobile coordinate measurement system. Due to the laser interferometer, high precision measurements can be carried out rapidly. For both single point and surface measurements, the laser tracking system can record data from a single set-up position with a measurement volume of up to 80 m in diameter, with an accuracy level of ±10 ppm at a measurement rate of up to 3000 points per second. Laser trackers are highly effective for inspection of high-precision tool manufacturing and geometrical examination in the automobile and aircraft sectors, and other related industries. Periodic inspections, repetitive testing, and other measurement tasks can be carried out automatically with the help of the laser tracker's integrated absolute distance meter.

The set-up procedure for the laser tracker can easily be adapted to the object size or to confined spatial conditions.

Airbus uses Leica's laser tracking devices for a number of applications, including the inspection of assembly tooling.

Airbus' new countersinking facilities are dismantled and examined using the tracker. The collimation of tracks and landing flaps during the preparation of wing assemblies for the A330/A340 is performed using the mobile measurement system. The trackers are also deployed during setup and approval of the entire production system and machinery, during structural assembly at the final examination of all large-capacity components produced at Bremen, and during individual component production.

Production of the inner landing flaps of the A320 family of standard-fuselage aircraft is carried out by the Bremen team on behalf of the Stade factory. The team members not only assemble the equipment using a laser tracker, but also use it to dismantle everything afterwards. Another laser tracker application involves the Ariane 5 program where the top-level power generators are measured with a laser tracker.

Airbus measurement technicians take on nearly all application cases and measurement tasks at the Bremen factory. The multi-use laser tracker is also used for cause-of-error investigations. The Bremen team has a number of accessories for the Leica trackers including the wireless, armless T-Probe. By using the trackers in combination with the new T-Probe, operators can inspect hidden points and probe in areas unreachable by traditional probing solutions.

In the past, Airbus has measured landing flaps continuously either from two separate tracker locations or from a single tracker location, but with the need for a rotation of the measurement

object. The T-Probe allows technicians to work with a single setup, which saves time because both the handling of the flaps and the setup and preparation of the measurement process can be done more rapidly. In addition, the calculation process and the evaluation process become easier and more reliable because there is no longer a need to factor in reference points.

For the A400M program, Airbus will have several stations with permanently integrated tracker systems. Both trackers will be used in the context of quality assurance procedures for the A400M, for examination of interfaces and handoffs before the fuselage is sent to the final assembly line in Spain.

Jean L. Broge

Training for the Heli-Basket

Virtual reality specialist **Virtalis** is working with Heli-Basket manufacturer **Precision Lift** to create a crew training program. It is being developed from Virtalis' Virtual Winching and Underslung Load Simulator, part of its helicopter voice marshalling training system, called Helicopter Crew Reality.

Virtalis is developing its Helicopter Crew Reality voice marshalling training system for use with Precision Lift's Heli-Basket.

"With training time in a Blackhawk helicopter exceeding $2000 per flying hour and $6000 for a Chinook, the armed services are forced to consider their training budget very seriously," said Virtalis Managing Director David Cockburn-Price.

Precision Lift has developed its Heli-Basket system to carry equipment, supplies, emergency workers, military personnel, disaster victims, or livestock as an underslung load. The system is capable of carrying up to 15 people or 2000 kg and has been designed not to spin in flight. It is in service with the **U.S. Army** National Guard in support of the U.S. Forest Service and has been trialed by the **U.S. Air Force**.

The Virtalis VR training simulator with Heli-Basket modules, featuring a fully or semi-immersive headset combined with a tracking system, is driven from a high-end PC workstation.

"The latest graphics cards have allowed us to build in accurate shadows and improve the realism of various sea states," said Richard Davies, Virtalis Development Team Manager. "This has proven to be especially important for our new winching function, as the shadows thrown out by a helicopter and its underslung load provide visual cues for the aircraft's crew."

Voice marshalling is used by helicopter aircrew to relay flight commands to the pilot while maneuvering during search and rescue missions and in the delivery of military and survival resources, often in remote areas with confining topography. Extensive—and intensive—training is vital to ensure safety and success.

In 2001, **VP Defence**, a subsidiary of Virtalis, developed its VR Voice Marshalling Simulator to reduce the **Royal Air Force**'s training costs. A commercial-off-the-shelf PC workstation with dual graphics cards driving both the real-time rendering engine for the voice marshalling student and the scenario control interface, is used by the trainer to set up, run, and replay/debrief scenarios. Sea states 1 through 6 are available together with variable levels of vision obscuration caused by rain, fog, or low-light conditions. Target objects such as a single air force survival dinghy, a rescue launch, or even a surfaced, disabled submarine, can be included in the virtual seascape provided by the Helicopter Crew Reality. Landscape and coastline scenarios showing a variety of topographical and man-made features are also provided. The system can simulate underslung load handling including making a drop in a confined area with obstacles; it was this that led to the Heli-Basket application.

Virtalis has developed a portable version of Helicopter Crew Reality. It takes about 10 min to set up and works off a standard PC with a single graphics card. The system also includes a head-mounted display, tracker, two LCD panels, and a joystick. It can simulate various types of helicopter and can be customized to simulate local terrain.

Stuart Birch

Loitering attack missile takes flight

Lockheed Martin conducted a successful Control Test Vehicle (CTV) flight test of its Loitering Attack Missile (LAM) recently at Eglin Air Force Base. This latest flight test of the new square body LAM airframe included a turbojet and demonstrated launch through transition to cruise.

A more extended cruise was hindered by fuel issues that were promptly identified, reported, and addressed. One more flight test remains in the series to demonstrate LAM end-to-end performance.

During the recent flight, the LAM launched vertically from a container launch unit; maintained stability during rocket-powered ascent using a fin-control actuation system and a commercial IMU; maintained stability during wing deployment; started a micro turbojet engine with integral electrical generator; executed a high-*g* maneuver to limit altitude; transitioned to cruise; established a commercial GPS fix; and maneuvered and navigated to the initial waypoint.

The onboard telemetry subsystem provided real-time observation of all onboard operations including a nose-mounted color TV camera recording the missile view through a clear glass nose dome.

Building on a **DARPA** NetFires predecessor, this square-body LAM airframe features more room for fuel, bigger wings and fins for extended loiter time and improved control, a more fuel-efficient turbojet, and an **Aerojet** annular rocket motor.

The airframe, seeker, electronics, fuel system, and software suite were designed and integrated by Lockheed Martin Missiles and Fire Control in Dallas, TX.

Key subsystems of LAM included a miniature turbojet from **Technical Directions** of Ortonville, MI, a motor that shares heritage with an air-launched predecessor; a control actuation system from **Moog** of Buffalo, NY, with precision electro-mechanical actuators common with the Precision Attack Missile (PAM); and control surfaces made using advanced low-cost production technology at Lockheed Martin Aeronautics Skunk Works in Palmdale, CA.

The test flight's launcher was a collaborative Container Launch Unit (CLU), provided by the Non Line-of-Sight-Launch System (NLOS-LS) Project Office and fabricated by its Prototype Integration Facility (PIF).

"The continuing successes of the LAM Pre-PDR Flight Test series are very encouraging," said Col. Doug Dever, Project Manager of NLOS-LS. "LAM offers attractive potential to Future Combat and Army Modular Forces."

The remaining test in this five-flight series will be a Guided Test Vehicle (GTV) with a turbojet and LADAR (laser detection and ranging) seeker. The GTV will be a complete missile system and will be flown against a real target in an end-to-end demonstration from launch through search to target identification and attack.

"LAM executed all phases of crucial launch-to-cruise transition, and this flight further prepares us for the GTV mission," said Anne Johnson, Director, LAM program at Lockheed Martin Missile and Fire Control. "The Lockheed team working with our NLOS-LS project office is proving the maturity of hunter-killers for Army artillery. LAM is changing the paradigm for artillery, ushering in turbojet-powered loitering munitions with extraordinary range, automatic target recognition, and terminal-seeker precision lethality."

NetFires is a limited liability company formed by Lockheed Martin and **Raytheon** to develop the NLOS-LS consisting of the LAM, PAM, and the CLU. In operation, LAM is the loitering capability of NLOS-LS. It is projected to loiter, locate, identify, and destroy fleeting high-value mobile targets at extended range. Its range and unique ability to search large areas for moving or poorly located targets then decisively engage these targets will provide the **U.S Army** an artillery solution virtually independent of target location error. LAM is a responsive cruising artillery munition, suitable for hunter-killer missions where automatic target recognition finds and identifies precisely the target of interest. If the network is active, it can report these targets and be controlled by a man in the loop.

Lockheed Martin-designed loitering munitions have achieved many successful flight tests with multiple airframe configurations. LAM's LADAR seeker has been successfully demonstrated under previous DARPA NetFires and **U.S. Air Force** Low-Cost Autonomous Attack System programs. Loitering munitions with ATR technology will provide early entry forces with responsive artillery to hold moving or stationary enemy forces at risk anytime anywhere in the area of interest.

Jean L. Broge