# New wings

## Boeing's Unmanned Airborne Systems business takes flight with Insitu acquisition

All stories by Doug Cantwell

The era of gargantuan mergers in the defense industry may have passed, but Boeing has continued to target smaller strategic acquisitions to augment Boeing Integrated Defense Systems' portfolio of capabilities. Last year, the company closed on six such deals, bolstering its presence in sectors of the defense market expected to grow faster than others.

One of these acquisitions, a 500-employee high-tech firm called Insitu Inc., developed the diminutive but rugged ScanEagle, a 40-pound (18-kilogram) tactical unmanned aircraft system (UAS) that has quietly logged more than 150,000 service hours keeping watch over coalition forces in Iraq and Afghanistan. Since 2004, Insitu had supplied the 10-foot- (3 meter-) wingspan intelligence, surveillance and reconnaissance (ISR) vehicle to its partner Boeing, which operated it in-theater under service contracts to the U.S. Navy, Marine Expeditionary Force, Special Operations Command, and Australian and Canadian defense forces.

While UASs are trending toward smaller wingspans, worldwide demand for them continues to grow exponentially. "We're looking at a huge UAS market 20 years out," said Vic Sweberg, who heads IDS' new Unmanned Airborne Systems division, announced at last month's Paris Air Show. "Half of IDS revenues could come from unmanned airborne and ground-based systems by then."

Given constrained government budgets and the urgent ISR needs of customers in the United States and internationally, analysts forecast that the market for less costly and logistically simpler UASs such as ScanEagle will continue to surge. "Acquisitions like Insitu are tied to our strategy of becoming more vertically integrated," said IDS President and CEO Jim Albaugh,

**PHOTO:** An Insitu engineer launches a ScanEagle from a pneumatic catapult at a test facility near Boardman, Ore. ED TURNER/BOEING

**PHOTO:** Insitu engineers Andy Mack (left) and Wayne Larson prepare to flight-test a prototype of Integrator, a larger, twin-boom derivative of ScanEagle. PETER KUNZ/INSITU

"and also of moving into adjacencies that we think will grow faster than the rest of the defense budget."

UASs are expected to play an increasing role in network-centric operations (NCO) and force projection, which makes it critical that firms with system-of-systems expertise such as Boeing have an internal UAS capability. With Boeing's market-leading command and control portfolio, including the Airborne Warning and Control System (AWACS) and Airborne Early Warning and Control (AEW&C) aircraft, as well as its depth in NCO, a strong UAS presence will fill out the company's networked battle-management offering.

Boeing's unmanned effort eroded after the U.S. Air Force canceled the Lockheed Martin/Boeing DarkStar UAS in 1999 and the company lost the 2007 competition for the U.S. Navy Unmanned Combat Aerial System demonstrator.

The Insitu partnership did not just help reinvigorate Boeing's UAS business. The rapid response to an emergent wartime ISR need helped lay a cohesive groundwork for the new Unmanned Airborne Systems division by requiring Boeing Military Aircraft, Phantom Works and Global Services & Support to collaboratively support ScanEagle.

The acquisition of Insitu has given IDS something more as a UAS provider: a drop-everything, "special-ops" response to customer needs and a highly nimble process for rapid prototyping. "We wanted to have a strong, established position with customers," said Albaugh, "in addition to an internal capability in small, tactical UASs."

## ORGANIZING AROUND THE CUSTOMER

When IDS leaders signed the papers in September 2008 to acquire Insitu, the two companies had hammered out an unorthodox operating agreement. Insitu would function as a wholly owned subsidiary of Boeing, retaining its culture as a dressed-down cadre of hands-on scientists, engineers and executives known for wrapping themselves around customer needs.

"They want us to spread our DNA into Boeing, rather than have it flow the other direction," said Steve Nordlund, Insitu vice president for business development. "Boeing leaders have urged us not to change what we're doing. They've encouraged us to view their processes with healthy skepticism, so we don't adopt processes for processes' sake."

So what does Insitu expect to gain as a new Boeing subsidiary? "There are a lot of lessons learned from decades of prototyping and developing that we can tap into," Nordlund said. "If we can get access to all those resources, it will be a huge advantage."

How does he see the future unfolding? "Designing to requirements, which we'll be doing more and more of as a military supplier, is definitely changing the way we develop products," he said. "There's a lot more testing, a ton of documentation and much more depth to the requirements. The question is: Can Insitu conform to that and remain nimble?"

That's where Boeing's wealth of experience in working with U.S. Department of Defense customers and designing to deep requirements comes into play. IDS leaders, in turn, are interested in studying Insitu's way of organizing around the customer and emulating it where possible.

Nordlund added that Insitu's U.S. Navy and Marine Corps customers have said they'll be watching closely, now that the acquisition has gone through, to make sure Insitu doesn't change its responsive ways.

"We like to help define requirements," he said. "To that end, we try to focus on what we call our customer's 'pain.' Is there some capability gap we could fill that would relieve that pain?" Helping customers formulate requirements not only increases their satisfaction but keeps Insitu innovative.

Nordlund cites the early days of Operation Iraqi Freedom in 2003, when the company was called upon to provide urgent ISR support for ground troops who were drawing fire from snipers and dealing with roadside improvised explosive devices. "Because of the way we operate, we were able to put FSRs [field service representatives] and hardware on station within days," said Nordlund. "Our Marine Corps customer, who assumed we would work through the usual acquisition channels, had anticipated it would take five months."

This responsiveness has garnered a wealth of gratitude from ScanEagle's ultimate customers—the soldiers going into harm's way daily. One Marine wrote that on three occasions, the "birds" circling overhead had warned him and his platoon of an ambush. He credited ScanEagle with nothing less than their survival.

## A PROTOTYPING ENVIRONMENT

The village of Bingen, Wash., overlooking the waters of the Columbia River Gorge, might seem an unlikely venue for the design and manufacture of high-tech unmanned surveillance aircraft. But you don't hear Insitu employees grumbling about having to live in this scenic recreational area an hour east of Portland, Ore. It was recreation, in fact, that brought technology used in ScanEagle here. The lightweight composite-layup airframes derive from material you find in windsurfer and snowboard manufacture—both established industries in the area since the 1980s.

Mechanical design engineer Calder Hughes has grown fond of the Insitu culture. "This is a true prototyping environment," he said. "We're able to make our own parts as we go. We can figure out quickly where the stumbling blocks are, where we want to put our energy."

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This fast-track, trial-and-error approach allows engineers to learn quickly—not only about the aerodynamic geometry of a new design but also about the engineering and manufacturing processes they've applied in bringing it to the flight-test phase. "Once we've gotten there," Hughes said, "we can go back in a more deliberate way and apply those processes a second time."

Jaime Mack, senior mechanical engineer and group lead for advanced development, already knew how to lay up fiberglass and do vacuum-bagging when she came to Insitu. She'd been designing high-tech composite sporting equipment for the many windsurfing and snowboarding enthusiasts here.

Mack also appreciates the culture around Insitu. "It's an incredibly creative atmosphere," she said, "and one that's very supportive at the personal level. It's not uncommon to see people walking into [Insitu President and CEO] Steve [Sliwa's] office and laying it on the line if they have a gripe … or pitching him a new idea they've come up with."

Brian Dennis, a senior mechanical design engineer who's been with Insitu since its inception, also came to the firm by way of high-tech recreational equipment—specifically, the formed metallurgy required to make snowboarding boots and bindings.

What's kept him there? "I've had the freedom to develop projects I have ideas for," he said. "If you come up with something new here, you propose it, you make it happen. The culture is driven by enthusiasm: if an idea pops, say on a Sunday evening, I'll call one of my colleagues to chat about it. I feel I have a personal stake in what goes on here." ■

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**PHOTOS:** A Boeing field service representative and U.S. Marine Corps specialist launch a ScanEagle at the U.S. Army's Yuma Proving Ground, Ariz. JIM ANDERSON/BOEING **(INSET)** Insitu's Calder Hughes, mechanical design engineer (left) and Jaime Mack, senior mechanical engineer and advanced development group lead, remove the fairing from an Integrator. ED TURNER/BOEING

# Iraq field service rep diary

"We are a 24/7 operation," said Gerry Camacho, ScanEagle field service theater lead in Iraq, currently on deployment with the U.S. Marine Expeditionary Forces (MEF). "We share living space and work side by side with USMC intelligence assets."

The sprawling can city at Al Asad, affectionately named "The Presidio" after the military base in San Francisco, houses 10,000 people, many of whom are nonmilitary contract employees. Probably because of this, the Presidio has an oddly domestic look and feel. "There's even a huge commissary that looks a lot like your local mall," Hilliard said, "especially when it's decorated for holidays."

Hilliard recalls the not-infrequent "haboobs," or sandstorms. They'd come in like a towering tsunami of orange dust, several hundred feet high and visible for miles, sometimes lasting for eight hours, sometimes for three days. "At least you can see them coming, so you have time to batten down the hatches," he said. In spite of dust masks and the heavy-duty air-conditioning unit that kept his can temperature comfortable, he often awoke in the morning with nose and throat clogged.

Although Hilliard and his mates pulled the ScanEagles in whenever a haboob threatened, he was amazed at their ability to operate in extreme conditions. "The larger unmanned platforms can't take off in a 30-knot wind," he said. "But ScanEagle doesn't take off in the traditional sense, and it will keep flying even when all you can see on the monitor is orange."


**PHOTO:** Dave Hilliard (foreground), a Boeing field service representative, retrieves a ScanEagle after its capture on the Skyhook system as another haboob (sandstorm) closes in on Al Asad Air Base, Iraq. ERIC MALMGREN/INSITU

The field service representatives (FSRs) provide real-time video to the Marines and security-cleared Iraqi officials. Their customers assign the specific missions, but Boeing FSRs have responsibility for launching, recovering and maintaining the aircraft.

For the most part, ScanEagles support convoys and troop movements, scanning for ambushes and improvised explosive devices, a threat that has proved tough to monitor. The persistent little platform—nearly invisible and inaudible from the ground—also guards oil pipelines and offshore drilling platforms, often targeted by saboteurs.

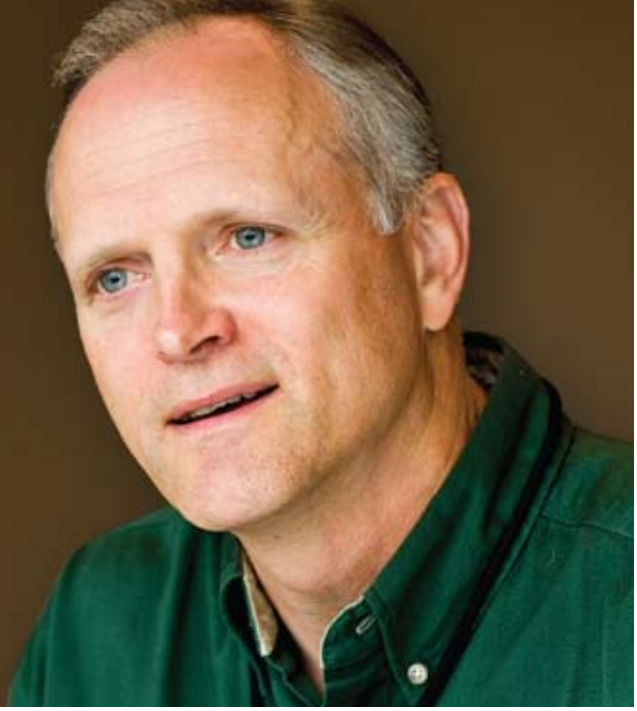
Dave Hilliard, an FSR who has logged two years in Iraq, described life in a "can," or modular metal hut, at Al Asad Air Base. "You and your canmate share a space roughly 8 by 20 feet (2.4 by 6 meters)," he said. "Hundreds of cans are bolted together, forming entire can cities."

## VIDEO IS THE PRODUCT

Boeing FSRs have to remind themselves that, as Hilliard put it, "The product is not the airplane; it's the video feed." Their ultimate customers—the battle commanders—have just three requirements of the ScanEagle FSRs, but they're critical ones. "First, that we stay in the air; second, that our product—the sensor output—is available to them on demand; and third, that we keep our operating expenses within their budget parameters."

Customer reviews and informal feedback indicate the FSRs are producing in spades. "Flying thousands of hours of intelligence, surveillance and reconnaissance support in theater, month after month, requires a high degree of organization and teamwork," said Major Dan Griffiths, former officer-in-charge, Marine Unmanned Aerial Vehicle Squadron 1. "The execution of that task falls on the shoulders of the FSRs. Day in and day out, they do whatever it takes to meet requirements."

# New Unmanned Airborne Systems division to drive growth



Boeing has many widely scattered enclaves of excellence that contribute to its unmanned aircraft programs, but Integrated Defense Systems leaders saw the need to bring "One Boeing" energy to bear. To that end, they created a new Unmanned Airborne Systems (UAS) division that will draw on the best of IDS' businesses.

Vic Sweberg, who heads the new division, played a major role in acquiring unmanned aerial systems manufacturer Insitu. "It's great to be able to nucleate around something," he said. "Insitu has established a unique and very successful style of engaging customers that gives us entree into some areas of the market we haven't engaged yet."

That style, Sweberg added, "sometimes means meeting critical operational needs immediately and catching up with the paperwork afterwards." When soldiers on the ground in Iraq needed intelligence, surveillance and reconnaissance (ISR) support immediately—not months down the road—Boeing found a way.

The Advanced Boeing Military Aircraft unit collaborated with Insitu to develop ScanEagle to meet specific U.S. Department of Defense requirements. Global Services & Support then stepped in to provide the platforms, operators, ground stations and maintenance on a turnkey basis.

Insitu had noted opportunities in several countries but lacked the global marketing reach and established foreign offices that could open doors in Latin American, European and Asian capitals. That's where Boeing was able to help. Insitu's 2008 international revenues are projected to quadruple in 2009.

The new division will also develop unmanned aerial systems command/control from Airborne Warning and Control System, P-8A, 737 Airborne Early Warning & Control (AEW&C), Apache and other Boeing platforms. In March, a Seattle-based team demonstrated control of three ScanEagles from a Wedgetail AEW&C. In May, a Mesa, Ariz.-based team used an AH-6U Unmanned Little Bird to demonstrate UAS vehicle and sensor control from a Block III Apache.

The Phantom Works arm of the division will further develop Boeing's proprietary common ground-control technology. It will refine its modular, open-architecture system to control many unmanned aerial vehicle types from a single node, minimizing the need for stand-alone ground control.

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> *– Vic Sweberg, Unmanned Airborne Systems*

What does Sweberg see as the division's objectives? "We will drive growth by building a healthy UAS business. We will strive to intensely satisfy our customers with our products, services, innovations and value." Last but not least, he said, "We will be profitable."

## ISR SERVICES: UAS FIRST RESPONDERS

Essential to the division will be ISR Services. This GS&S organization has provided ScanEagle services to the U.S. Navy, Marines, Special Operations Command and several foreign governments. Under fee-for-service contracts, Boeing assumes the financial risk of deploying and operating the aircraft and ground stations.

Boeing won contracts in 2007 and 2008 totaling a maximum of $312.7 million to continue supplying the Navy and Marine Corps with ScanEagle services. In April, the company inked another service contract with the U.S. Special Operations Command potentially worth $250 million.

"Our ability to leverage across the UAS division, including Insitu, Phantom Works and GS&S, positions us well to offer innovative services through a number of contracting approaches," said Darren Sekiguchi, director of ISR Services. He noted that at its projected rate of expansion, the unmanned aerial systems services market will likely approach $10 billion in a decade.

**PHOTO:** Vic Sweberg leads Boeing's new Unmanned Airborne Systems organization. The unmanned airborne systems market is projected to approach $10 billion in 10 years. MARIAN LOCKHART/BOEING

# Navy calls for bigger payload, more endurance

**PHOTO:** The Boeing-Insitu team has offered Integrator, a larger and longer-endurance derivative of ScanEagle, as its entry for STUAS, the U.S. Navy and Marine Corps' Small Tactical Unmanned Aerial System/Tier II program. STUAS will call for hundreds—potentially thousands—of aircraft as well as ground equipment, support and training. DAVE SLIWA/INSITU

The bids are in. The Small Tactical Unmanned Aerial System (STUAS)/Tier II competition presents the opportunity to sell hundreds—potentially thousands—of aircraft and associated equipment, support and training to the U.S. Navy and Marine Corps. With the U.S. Air Force likely to place orders as well, STUAS will be one of the largest U.S. procurements of unmanned systems to date.

As service-contract suppliers of the incumbent ScanEagle, Boeing and Insitu face a formidable field of challengers. Because STUAS calls for a larger payload and longer endurance than ScanEagle provides, the team will offer Integrator, a double-boom platform with 15.8-foot (4.8-meter) wingspan and 50-pound (23-kilogram) payload capacity that can stay aloft for 24 hours-plus.

Following Boeing's acquisition of Insitu in September 2008, which was aimed partly at better positioning the two partners to compete for STUAS, other contractors followed suit with partnering agreements or acquisitions. Raytheon teamed with Swift Engineering to bid the Killer Bee UAS. Killer Bee is offered in four incrementally sized variants ranging from a 6.5-foot to 33.2-foot (2- to 10-meter) wingspan that carry substantial payloads due to their blended wing/body design.

AAI, a subsidiary of Textron that has provided larger unmanned aerial vehicles to the U.S. forces, has teamed with Aerosonde Pty Ltd. of Australia to offer the Aerosonde Mk 4 for the STUAS competition. The Mk 4 set a world-record endurance mark for its class of more than 38 hours in 2006.

General Dynamics Armament and Technology Products has partnered with Elbit Systems to bid the Israeli company's Skylark II, a 75-pound (34-kilogram) vehicle with a 14-foot (4.2-meter) wingspan. Skylark II is equipped with an electro-optical/infrared sensor payload, laser illuminator and optional laser designator.

Key discriminators in the competition will include a small launch-and-recovery footprint and a heavy-fuel engine (that burns JP-5 and other kerosene-type fuels used for safety on board Navy vessels). Insitu uses the same Skyhook recovery system for Integrator as for ScanEagle, which provides a minimal, runway-independent footprint and enhanced safety for shipboard deployment.

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>
> *– Steve Sliwa, Insitu president and CEO*

"Along with our Boeing teammates, we reviewed the STUAS Request for Proposal exhaustively," said Insitu President and CEO Steve Sliwa. "We feel confident that we've submitted an outstanding proposal, one that supports all of the mission requirements for both the Navy and Marine Corps." A decision is expected in September.

# Family

## with the right connections

of Defense's goal of achieving fully network-enabled operations drives this activity, along with broader initiatives to promote interoperability among U.S. services and coalition forces.

"The idea behind our mission-management software is to create an open, nonproprietary system for our customers," said John Hearing, manager of Advanced Unmanned Control Systems. "One station can control multiple vehicles or types of vehicles and then pull the data transmitted by those vehicles onto existing command-and-control system displays."

Developing common mission-management software for unmanned systems advances a wider Boeing effort to meet customers' total information needs. "A battle commander with a number of unmanned systems can generate a tremendous amount of data," Hearing said. "Our challenge is to help him do this affordably, with fewer people, using less bandwidth—while deconflicting the airspace with other manned and unmanned platforms and freeing up his manned assets to do critical missions."


Boeing's strategy for the burgeoning unmanned airborne systems market is to offer a stable of highly evolved, autonomous unmanned systems that incorporate the best capabilities from across the company as well as those of strategic partners. Key to that approach is network-enabling: linking the aircraft together through common mission-management software that allows them to operate effectively in the same network.

"The Boeing line of UASs focuses on the entire system—the vehicle, ground-control station, human systems interface and mission management," said Dave Koopersmith, vice president of Advanced Boeing Military Aircraft. "We're developing and refining software that will cover mission management, mission and sensor planning, communications, and visibility of the vehicle to the operator."

Advanced BMA engineers are writing this software with commonality as their chief objective, so that modification will be needed only to create interfaces for individual platforms. The U.S. Department

### A160T ONLY LOOKS LIKE A HELICOPTER

Built for intelligence, surveillance and reconnaissance (ISR) and precision resupply missions, this aerodynamically clean platform employs a unique optimum-speed rigid rotor system to increase fuel economy and endurance. Designed to loiter at 30,000 feet (9,100 meters) for 20 hours, the Hummingbird offers an operating range of 2,250 nautical miles (2,590 miles, or 4,170 kilometers).

The turbine-powered A160T, now formally designated the YMQ-18A, burns heavy fuel (such as JP-5 or other kerosene-based grades). Its power plant, already fielded in commercial manned helicopters, boosts the Hummingbird's operating range to 3,000-plus nautical miles (3,450 miles, or 5,560 kilometers) and its payload to 1,000 pounds (450 kilograms). To date, the

**PHOTO:** Designed for intelligence, surveillance and reconnaissance and precision resupply missions, the A160T Hummingbird incorporates a turbine engine and adjustable optimum-speed rigid rotor system to boost operating range and payload. KEN GRAEB/BOEING

Phantom Works team has delivered two A160s (with a six-cylinder gasoline engine) and seven A160Ts to the U.S. Naval Air Systems Command for use by the U.S. Special Operations Command.

The Hummingbird can carry day or night long-range optics, a laser rangefinder and target designator, a precision microwave synthetic aperture radar, an electronic intelligence system, a SATCOM link and an electronic countermeasures payload.

## PHANTOM RAY: TAKING UCAS INTO THE FUTURE

Starting in late 2008, Phantom Works engineers employed rapid-prototyping techniques to develop an unmanned flying test bed to demonstrate advanced air-system technologies. Based on the fighter-sized X-45C developed for the Joint Unmanned Combat Air Systems (J-UCAS) competition, Phantom Ray will be used to expand that platform's flight envelope and develop such missions as weapons delivery, ISR, suppression of enemy air defenses, electronic attack and autonomous aerial refueling."Boeing is in the unmanned combat air system business—and in a big way," said Darryl Davis, president of Phantom Works. The strategy that has driven Phantom Ray, unveiled in May of this year, is to use internal Boeing funding to refine technologies that can be applied to future tactical aircraft bids. "It's critical that we're able to demonstrate technology readiness for the Pentagon when it articulates its next-generation needs," Davis said.

**PHOTO:** Based on the fighter-size X-45C airframe, Phantom Ray is being used to rapidly prototype an expanded flight envelope and unmanned combat missions capability. BOEING

## UNMANNED LITTLE BIRD

Based on a light-duty commercial helicopter adapted for use as a multi-mission asset by the U.S. Army's Special Operations forces, the AH-6 Little Bird can be configured as a manned or unmanned platform. Unmanned Little Bird (ULB), or AH-6U, has demonstrated effective operation in urban and complex terrain as an ISR platform, a communications relay, and a precision resupply and weapons-delivery vehicle.

**PHOTO:** The AH-6U Unmanned Little Bird can be configured as an unmanned or manned platform for operations in complex or urban terrain. BOB FERGUSON/BOEING

Since its first autonomous flight in 2004, the ULB has continued to demonstrate unmanned technologies, validating an autonomous flight control system that could be added to other manned aircraft. The Mesa, Ariz.-based program has received unmanned technology development contracts from the U.S. Army, U.S. Marine Corps and France's Ministry of Defense.

## HALE AND SOLAREAGLE: STRATEGIC MISSIONS AT STRATOSPHERIC HEIGHTS

Two projects on the Phantom Works drawing board will operate for longer duration at higher altitudes to execute more strategic missions. The High Altitude Long Endurance (HALE) UAS is intended to perform battlefield and border observation, port security and telecommunications at higher stratospheric elevations (65,000-plus feet, or 19,800 meters), staying aloft for seven days or longer on liquid hydrogen fuel-cell propulsion.

**GRAPHIC:** The High Altitude Long Endurance system, designed to take on border surveillance, port security and telecom missions at 65,000 feet (19,800 meters) and higher, will stay aloft for seven-plus days on liquid hydrogen fuel-cell propulsion. BOEING

SolarEagle, a 300-foot (90-meter) flying wing powered by solar energy, will carry a "pseudo-satellite" payload of up to 1,000 pounds (450 kilograms) in the high stratosphere (above 60,000 feet, or 18,200 meters). Designed to stay aloft for five years and generate a 5-kilowatt power supply, this low-cost platform could provide unprecedented persistence in ISR and communications missions.