

the critical metrics that show how it will help them get the job done. It also takes convincing all other stakeholders in the broader customer community that there is added value.”

When it comes to outside influences, Whelan has plenty of inspiration. “The leading innovators impacting my thinking are Apple with their iPhone, iTunes and apps integration; and Intel for their never-ending improvement in processing power. For the aerospace and defense industry, I’m a huge fan of Darpa and the Naval Research Laboratory [NRL] for the risk-embracing impacts of their programs.”

Just as innovations such as miniaturization revolutionized the electronics industry, so Boeing sees similar potential for aerospace. “At the macro level, we are continuing to leverage . . . the implications for continued miniaturization, the potential for brilliant systems, and autonomy,” Whelan says. “Since we build large-scale systems that defy gravity, we are always seeking improvements in new materials and processes to make our systems stronger [and] lighter, but are also exploring nano-engineered designer materials with special properties to enable new capability, adaptability or functionality,” he says.


“We are working on trying to leverage all of these developments along with high-bandwidth mobile communications links and the power of networking systems together,” Whelan continues. “Distributed systems moving at the speed of sound coupled with information systems moving at the speed of light will break the constraint of a single physical location/perspec-

tive, and allow a system of systems to use the best sensor coupled to the best thinker/decider and the best shooter.”

Like others in his field, Whelan has concerns about the future of the innovation pipeline in the U.S. “Government data shows there is a real decline of 40% in industry 6.2 applied technology accounts over the last 19 years. . . . This reduced level of investment not only impacts our technology pipeline for new systems, causing risk and schedule impacts to those programs, it also reduces the pool of experienced people who grew up managing technology development programs.”

The biggest challenge for any innovator, however, “is to find an open mind that is willing to listen and understand the potential that new technology can bring,” Whelan says.

Among recent Boeing innovations, he highlights the High Integrity GPS (iGPS) program with NRL. To mitigate GPS shortfalls in jammed or restrictive environments, Boeing demonstrated how to upload new flight software to current Iridium communications satellites, enabling them to broadcast aiding signals that allow a modified GPS receiver to quickly track the Iridium satellites, then calculate its position from their passage through the sky. Combined with precision time transfer and other aiding data, this allows the receiver to function through severe jamming.

“This idea has high synergy between the Iridium system and the GPS system, allowing a better combined solution,” Whelan says. 

Open Invention

GRAHAM WARWICK/WASHINGTON

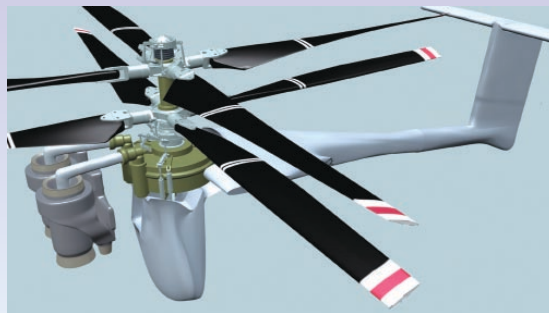
Douglas Baldwin is a familiar presence at conferences, explaining and promoting his Mono Tiltrotor (MTR) concept for a vertical-takeoff-and-landing unmanned aircraft. Persistence is paying off—Baldwin Technology has just won a significant contract from the U.S. Office of Naval Research (ONR) to advance the design of a ship-based cargo UAV.

As an inventor, Baldwin’s advice is to fully develop the idea, understand the market, patent the essential idea, publish everything, “and accept what you will learn about self-interest and organizational behavior” in trying to get the idea off the ground.

“Anyone who takes the path of an innovator will learn that meeting an executive who has the word ‘innovation’ in their job title or job description is not necessarily the same as meeting someone whose actions support innovation,” Baldwin says, based on experience with the small rotorcraft industry subculture.

For the MTR, “the essential idea simply was to suspend a payload about an aircraft’s pitch axis using a freely rotating shaft with rigid struts at either end,” he

says. The patent draft isolated that idea in a simple written legal claim, then conceived a wide range of embodiments to carve out a broad space for development of an optimal design.



Suspending the load from the Mono Tiltrotor’s pitch axis simplifies conversion between vertical and forward flight.

“I decided from the beginning to adopt the open-source software development model of publishing everything on the Internet,” he says. “As a new entrant to the industry, public disclosure gave us access to a wealth of experience in our search for a reasonable truth.”

Baldwin solicited feedback from experts, who pointed out technical flaws, helping the MTR configuration evolve. “Any fundamentally new idea is initially

assumed by experts to be fundamentally flawed,” he says. “In the end, the idea of a pitch-axis-suspended load survived intense scrutiny.”

The first patent was filed in 2001, and the design evolved from a civil roadable aircraft with ducted coaxial propeller to a military unmanned cargo aircraft with tilting coaxial prop-rotor and wing panels that aerodynamically deploy in forward flight. “The only constant was the idea of a pitch-axis-suspended payload,” Baldwin says.

After initially targeting the civil market, he concluded that a “new aircraft configuration must first succeed in the U.S. military market. . . . The essential idea of the innovation was held constant and, after accounting for all technical constraints and market realities, a cargo unmanned aircraft system design emerged.”

ONR provided the first research funding in response to a white paper drafted for Baldwin by the University of Maryland, but despite promising conclusions from that study, it took congressional budget additions to continue work with U.S. Army funding. By 2008, Baldwin was ready to close out the work when the U.S. Marine Corps asked him to look at turning the proposed MTR scaled demonstrator into a cargo UAV. The new ONR contract is a step in that direction. 