

Big Success with Small UAS

How AeroVironment became a world leader in the small UAS market

By Alyce Moncourtois with significant contributions from Scott Newbern

THE FOUNDATION OF SUCCESS

"For AeroVironment, success came as a result of four core elements: innovation, simplicity/elegance of design, reliability, and customer collaboration," said Scott Newbern, AeroVironment's chief technology officer. Newbern, who has been with the company since 1997, identified these core elements as the foundation that launched AeroVironment into the global, small, unmanned aircraft systems (UAS) business.

INNOVATION	SIMPLICITY/ Elegance of Design
RELIABILITY/ Robustness	CUSTOMER Collaboration

According to Newbern, the innovative spirit has been a distinct characteristic among AeroVironment employees since the company's inception. "Back in the early days, many employees were aviation enthusiasts in one way or another," he stated, "and some were world champions competing in aircraft modeling events around the world. The concept of making the best possible thing you could make and achieving incredible results is what drove these individuals." He says it was this kind of innovative enthusiasm that led to the conceptualization of **Pointer**, the predecessor to **Raven**.

Simplicity and elegance of design were also very important. Doing more with less and limiting the number of features and the complexity of capabilities was a significant component of AeroVironment's success. A traditional aircraft design approach would lead to complicated avionics and intricate moving parts, but AeroVironment was not traditional and decided to take a different approach. "We kept it simple because then there was less that could go wrong," said Newbern. "Our control systems architecture and the user interface are great examples of this."

Reliability played an essential role in solidifying trust in AeroVironment products. Since components and features were simple in design, there was a lower probability that things would fail. A commitment to leverage the deep-stall landing method forced the engineers to design structures and electronics that could handle the punishment, and this in-turn, resulted in a system design that was very robust, reliable and forgiving. These features were critically important to users on the battlefield where risk is high and response time is short.

By the late '80s, AeroVironment was well ahead of anyone else in terms of even thinking about small UAS. "The company's early work and perseverance led to a wealth of experience and understanding that our competitors did not have when they eventually came along," Newbern recalled.

WHAT CAME NEXT?

The project that thrust AeroVironment into being a genuine pioneer of small UAS was the company's work with early **Pointer** and its subsequent evolution into **Raven**.

"The **Helicopter Pointer** project was an early experiment that led to the configuration of a fixed-wing **Pointer**," Newbern said. He points out that in the early '80s, a helicopter configuration was their first conceptualization of a small UAS. "It was really an experiment to see what kinds of small UAS might work for the soldier, and it was an important experiment because we learned that while VTOL was desirable, we did not have





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Early aircraft that significantly impacted AeroVironment's success in the small UAS market

the technologies necessary for reliability or robustness to put this capability into a soldier's hands." The key take-away from that work was the decision to switch to fixed-wing aircraft.



Helicopter Pointer small UAS

Several iterations of **Pointer** followed. It received the military designation **Pointer FQM-151** in association with orders and fielding with the Marines in 1991. **Pointer** became the first official backpack-portable small UAS. The government was also in the early phases of understanding unmanned systems, and from 1988-1994 these programs were run out of the Joint Project Office (JPO) for Unmanned Aerial Vehicles. AeroVironment received special recognition from the JPO as a technology leader and for success of the program.

There was a core team of employees — in particular Martyn Cowley and Paul Trist, Jr. — who kept the vision of **Pointer** going after this phase while continuing to explore potential government, commercial and international applications of small UAS.

THE ARMY NEEDED HELP

In the late '90s, the Army's Natick Soldier Center identified a significant need for a small reconnaissance UAS for dismounted forces under the MOUT ACTD (Military Operations in Urban Terrain, Advanced Concept Technology Demonstration). The AeroVironment team worked side-by-side with the end user, conducting numerous exercises in the field to assess **Pointer's** usability. The team made modifications to the design based on their interpretation of user feedback. As a result, **Pointer** was refined, modernized, militarized, simplified, and made easier to use.

"This work with the Army was very significant," Newbern said. "It started the growth phase of small UAS for AeroVironment, as well as

a steady production and deployment of **Pointer** systems."

Based on this learning experience, advances in technology, a proof-of-concept named **Flashlite**, and a collaborative effort with the customer at the Army Natick Soldier Center, the AeroVironment team continued to make major improvements to **Pointer**. Ultimately, these improvements in design and capability led to the development of **Pathfinder Raven**.

Flashlite

Developed as a proof-of-concept to demonstrate that an airplane roughly half the size and weight of Pointer could be produced while maintaining Pointer performance.







"The advancements in batteries, electronic propulsion and electronic sensors enabled us to create an aircraft half the size of what the soldier had been using," Newbern stated. "We were working with operators and literally sleeping in the dirt with them on exercises to evaluate our systems."

'The success of the Pathfinder Raven system is attributed to a number of factors. Most importantly, this system was developed by users, with the government engineering team acting as a conduit to the developer/ manufacturer. The system would not be the success that it is without the input of the warfighter."



Excerpt from "The Pathfinder Raven Small Unmanned Aerial Vehicle Report" dated December 2004, authored by Phil Tokumaru and the Army Natick Soldier Center.

DRAGON EYE DEVELOPED IN PARALLEL

Also during this time period (1999-2003), AeroVironment was working on **Dragon Eye** in parallel to **Pathfinder Raven**. In 2003, AeroVironment competed for, and won, the production contract for **Dragon Eye**, which was a small UAS designed by the Office of Naval Research. **Dragon Eye** became AeroVironment's first Program of Record. It was also the first of multiple DoD Small UAS Programs of Record. Those same elements of innovation, simplicity, reliability and customer collaboration were the key to AeroVironment's success in winning this important program.

RAVEN BECOMES PROGRAM OF RECORD

AeroVironment entered into a phase where the focus was on building a small UAS into a more sustainable product (1998–2002). Also during this time, a much larger portion of the company was contributing to the small UAS business. Under the leadership of Kyle Swanson and Phil Tokumaru, those core elements continued to be emphasized with respect to the design and development of the aircraft systems.

In 2003, the Army was ready to order the first 10 **Raven** systems, which were deployed in October. "We knew if we stuck to our original core elements, we would be successful, and a Program of Record would be forthcoming," stated Newbern. "Once again, the core elements were applied, but not just to the system and user experience, they were also applied toward the manufacturability and producibility of the system." By March of 2004, AeroVironment was at a production rate of 25 aircraft per day.

In 2005, **Raven** became a Progam of Record by winning a competitive fly-off against candidates from big aerospace heavyweights, L3 Technologies and Lockheed Martin. Still leveraging those initial core elements and basic philosophies for success, AeroVironment continued development of many small UAS, as well as DDL and GCS systems. Today, the expanded family of small UAS includes: Puma LE, Puma 3, Raven, Wasp AE, VAPOR and Quantix, and our customer base has grown throughout the DoD and to 50 allied nations.





AeroVironment made its first significant UAV delivery in 1991. FQM-151 Pointer aircraft were delivered to the USMC, and we received the TQM flag from the Joint Program Office, UAV.

Pictured I to r: Mandy Cannone, Mark Shipley, Greg Kendall, Mike McCarthy, Win Banning, Dave Busch, Bob Curtin, Jim Daley, Stan Levy, Graham Gyatt, Bill Parks, and Mike Reagan.



In June 2002, Pointer systems were delivered under the Military Operations in Urban Terrain, Advanced Concept Technology Demonstration (MOUT ACTD).

Pictured I to r: Mark Navas, Igor Panchenko, Gerrie Ryane, Brian Buass (consultant), Kyle Swanson, John McKeaney, Carol Brennan, Johnny Asplund, Lisa Dobbs, Carrie Sundra, Mark Levoe, Lisa McKeeman, and Paul Trist, Jr.





Paul Trist, Jr. (c) and Martyn Cowley (r) talk to Rear Admiral Bill Shannon (PEO U&W) about the Pointer UAS at the 2001 AUVSI International Conference prior to performing a demo.



Dragon Eye (front row) and Pointer (second row, left) were among the UAVs flown during the inaugural year of outdoor flight demos at the 2001 AUVSI International Conference.





Calvin Au (I) and Phil Tokumaru (r) pose with AeroVironment's Army customer in January 2006 to celebrate delivery of the 500th Dragon Eye, which was delivered the prior November.



AeroVironment employees display the Dragon Eye aircraft prior to making an important delivery to our Army customer in February 2002.

Pictured I to r: Peter Zwaan, Ken Carbine, Phil Tokumaru, and Paul Belik.