



## WHARTON AEROSPACE & DEFENSE REPORT

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# **Ever-shrinking, Flying, 'Nano Birds' Recast the Battlefield: Miniature Flying Robots Can Weigh Less Than an 'AA' Battery with a Wing Span of Six and a Half Inches**

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*Unmanned Aerial Vehicles (UAVs) might be imperceptible dots in the sky, but their growing utility and presence in the U.S. arsenal is increasingly apparent. Drones such as the Predator, built by General Atomics, and the Global Hawk by Northrop Grumman have the most recognizable names. But AeroVironment, a California-based company, is making big inroads with smaller packages. They have sold small drones with names like Wasp and Raven. Soldiers can carry these drones in backpacks and launch them simply by tossing them into the air. The Pentagon has noticed.*

*To learn more about these new technologies, Knowledge@Wharton spoke with Steven Gitlin, AeroVironment's vice president for marketing strategy about new developments in the UAV market and how the company hopes to remain innovative as it grows bigger.*

*An edited version of the transcript appears below.*

**Gitlin:** Thank you very much for asking me to join you.

**Knowledge@Wharton:** AeroVironment is not the first name that comes to mind in an increasingly competitive drone market. How does it stand out compared to the larger and better known companies producing drones like Boeing and Northrop Grumman?

**Gitlin:** AeroVironment was founded in 1971. We are celebrating our 40th anniversary this year and we have been focused on translating technology innovation into practical solutions that fundamentally help our customers operate more effectively, more productively. We have had a core team of people to focus on the small unmanned aircraft system domain for over 20 years. We actually introduced the first electric-powered military reconnaissance unmanned aircraft system that is launchable by hand back in 1987. So we have really been focused on what was once white space in a larger market and over the years have broadened our product portfolio.

We have competed in each of the four programs of record that the U.S. Department of Defense (DoD) has sponsored for small unmanned aircraft systems, and as a result today, we are the leading developer, supplier, and provider of small unmanned aircraft systems for U.S. DoD and internationally.

**Knowledge@Wharton:** The company has been ahead of the curve, producing many of the smaller-scale drones. Now that other aerospace companies are entering this market, what are you doing to stay ahead of that curve?

**Gitlin:** When people think about the unmanned aircraft systems market, typically they think of the larger systems like the Predators, and the Reapers and the Global Hawks. Ours are focused on the dismounted war fighter, on ground forces, people who carry these systems around in their backpacks. The innovation that has enabled that technology includes innovation in efficient electric energy technologies, taking advantage of miniaturization in sensors and in radio frequency communication sets.

We have kept very close contact with our customers to understand their needs, while at the same time keeping very close contact with our supply chain to make sure we can take advantage of advances in miniaturization and efficiency as they come to the market place.

So looking forward, we are constantly working out ways to enhance the capabilities of our small unmanned aircraft systems while at the same time coming up with innovative new types of unmanned aircraft system capabilities that can keep us ahead of our competitors in this market place.

**Knowledge@Wharton:** Could you tell me a little bit more when you talk about miniaturization, specifically your Hummingbird model. How far is that from actually making its way to the field?

**Gitlin:** The Nano Hummingbird is an incredibly innovative technology that we have developed for DARPA, the Defense Advanced Research Projects Agency. It is a one-of-a-kind item. It is an actual unmanned aircraft system that weighs less than an AA battery about 19 grams. It has a wing span of six and a half inches, and it propels and controls itself using two flapping wings and those two flapping wings change their shape during the course of the flapping cycle in order to move in different directions, to hover, to accelerate, to decelerate.

It is a great example of the kind of innovation that AeroVironment has been performing for decades.

**Knowledge@Wharton:** There is the Nano scale and then the other extreme, the much larger drones. Could you tell me a little bit more about what you hope the Global Observer brings to your product line?

**Gitlin:** Certainly, if you think about the unmanned aircraft systems marketplace, then one way to plot that on an XY graph is to think about the altitude these aircrafts typically operate at on the vertical axis and the endurance on the horizontal axis. So at the low altitude, relatively short endurance intersection, you have the small unmanned aircraft system space. These are the kinds of systems we have been selling in high volumes, the Raven, Wasp, and Puma that are being used by every service within the Department of Defense and a number of allied military forces.

As you go to higher altitudes and to longer endurance, you get up to the class 2 systems, e.g. of that are Shadow & ScanEagle. You move higher and longer endurance, you get to class 3 which are considered systems like Predator, Reaper, Great Eagle, and then class 4 is typically considered to be the highest and longest endurance in current systems.

Those are typically the Global Hawk. Global Observer is a development program just like our Nano Hummingbird is and Global Observer is designed to fly even higher and for even longer periods than the current incumbent which is the Global Hawk. Global Observer is designed to fly for up to a week at a time at altitudes of up to 65,000 feet and its whole purpose for existing

is to basically fly to a location and orbit over that location for an extended period of time, providing affordable persistent communications, relay or ISR (intelligence, surveillance, and reconnaissance) capabilities anywhere, for as long as needed.

The “as long as needed” part is enabled by a system of global observer aircraft, where you would have at least 2 aircraft swapping positions every week or so.

We have been developing that capability actually for about 20 years dating, back to a series of high altitude, solar-electric unmanned aircraft systems we developed for NASA, and Global Observer is a hydrogen powered system that we had been testing successfully up at Edwards Air Force Base as part of a 31/2 year program for the U.S. military.

**Knowledge@Wharton:** The Global Observer actually crashed recently during a test flight. Problems crop up during development -- like with the Joint Strike Fighter. What are the lessons for your company from that crash?

**Gitlin:** So, it is very, very early in the investigation process and we do not yet have findings coming out of that that categorically define what happened and why it happened. It will take some time for the Investigation Board to provide those findings, but in the context of developing innovative new solutions, particularly when it involves flight testing, history is replete with examples of early systems that suffer mishaps. The key in these development programs is not [to] not have those mishaps, it is learning from those mishaps, and incorporating that learning into more reliable, more robust, and more effective solutions that follow.

**Knowledge@Wharton:** AeroVironment has been around for a long time but it is still a small innovative company. I was curious, as a small innovative company begins to become more successful, begins to grow in size and establish processes, what would you say are the two things that you have to continue doing in order to remain innovative?

**Gitlin:** Maintaining a culture of innovation is not an easy task. Many, if not all, of the large innovative companies that we think of today -- even in the large aerospace companies -- started out as small agile innovative organizations. And as they grow, there is often a tendency to incorporate more processes, more bureaucracy, more things that can hamper innovation and the speed with which you can get ideas to market. AeroVironment addresses those in a couple of important ways.

Number one, the hiring of people is an incredibly important aspect of how we succeed as a company. There are many more people who want to work at AeroVironment than we can actually offer positions to, and part of that is because we are extremely selective, not only in terms of finding the people with the right backgrounds and the right capabilities, but really finding people who will fit into the culture at AeroVironment. It is the kind of environment where young engineers, young business people, young operations people can join the company and have an immediate impact, and that requires a great deal of trust.

**Knowledge@Wharton:** Those are all positive things that you look for to keep innovation going. Is there anything that you are on the lookout for to steer away from that you know will douse the innovation that the company is now conducting?

**Steven Gitlin:** One aspect of our culture is that it is very much a team-oriented environment, and while we celebrate the individual contributions of our teammates, those contributions make a difference when they take place in the context of a team.

That team environment really is one of the aspects of the company that has served us extremely well, so to some extent individuals who have difficulty operating in that kind of a team environment will probably have a difficult time operating in this organization and with this culture. So being able to work effectively and having a demonstrated track record of working effectively in a team environment is a very important aspect of people who are successful at AeroVironment.

**Knowledge@Wharton:** During your recent earnings report, I read that the company would be increasing its research and development spending by 52% to \$7 million or so in the quarter. That's a small amount compared to your competitors. How do you get so much out of that fairly small amount of money?

**Gitlin:** Well, two things. First of all, we operate what is possibly an unusual business model in this industry. We are focusing on the products that we are producing and selling today, and focusing on increasing our market share and penetration of those products into the markets that we often pioneer.

Secondly, we are constantly developing innovative new solutions of those that we have talked about like Global Observer, like our lethal small UAS, like our electric vehicle charging systems. And that innovation pipeline, we think, positions us well for long-term growth. And the net effect of that is that we end up investing somewhere between 8% to 10% percent of our annual revenue into internally funded R&D types of programs.

From a percentage perspective, that is a relatively high percentage compared to a lot of other companies in the field. From an absolute dollar perspective, it probably pales in comparison to the amount of R&D spending going on at the multibillion dollar companies. But because we are focused on a small number of key market areas involving a relatively small number of enabling technologies, we are able to deploy that investment strategically to try to get a maximum ROI out of it.

**Knowledge@Wharton:** When you talk about the amount of money you are pumping into research, I am assuming that it does not include additional sources of research funding like from the DoD, you mentioned DARPA earlier. Is that right?

**Gitlin:** That is correct. We look at internally funded R&D as I mentioned historically is 8% to 10% of our annual revenue but we also secure additional R&D funding from our customers. We call that customer-funded R&D. And that can amount to an equal amount depending on what is going on in any given year.

**Knowledge@Wharton:** The DoD budget is flat at best right now. How do you think that is going to affect AeroVironment's sales and market standing?

**Gitlin:** As a smaller company, we are certainly much more sensitive to dramatic shifts in government spending and even the timing of orders from government customers. So whereas large companies might have several multi-billion dollar programs, any one of which sliding out could be offset by another sliding in, we are relatively small and we have a relatively small number of programs, whose timing could impact our short-term performance or short-term financial performance that is.

From a dollar perspective, from a perspective of where the money is going, we are focused on an area within the DOD that has garnered an increasing investment and that is the intelligence, surveillance, and reconnaissance category. ISR refers to a category of solutions that help our warfighters acquire better situational awareness -- in other words knowing what is going on around them and how to respond to the threats that might become apparent through that better situational awareness. So ISR is a category that has garnered a great deal of investment and a great deal of attention from the DOD because it has become such an important part of how the DOD operates.

There is a great deal of scale in offering in terms of force multiplication and force protection, that for a relatively low dollar amount, gives our warfighters much more effectiveness, much more safety in their operating environments.

**Knowledge@Wharton:** I have been reading about the miniaturization of actual weapon systems as well. Do you see at some point where you move away from ISR and more towards actually carrying munitions as well on your models?

**Gitlin:** Yes, in fact we are on the verge of doing that as we speak. Traditionally, our small, unmanned aircraft systems have been used for ISR. They are basically electric powered airplanes that carry video sensors, color video and/or infrared video sensors, and transmit that video in live streaming format back to a handheld controller that has got a large color monitor in it.

One way to think of our small unmanned aircraft systems is as eyes in the sky that enable the warfighter to see farther, to gather more information when and where they need it. We have been developing over the last several years, a lethal, small unmanned aircraft system which incorporates the same capabilities as our Raven, Wasp, and Puma, which are the ISR-type small unmanned aircraft systems. But the main difference with the lethal system is that it also carries a payload of a small high-explosive charge.

**Knowledge@Wharton:** Thank you very much for your time this morning. I appreciate it.

**Steven Gitlin:** Well thank you very much. It has been a pleasure speaking with you and if anybody has any more interest in our company, our website is [www.avinc.com](http://www.avinc.com).