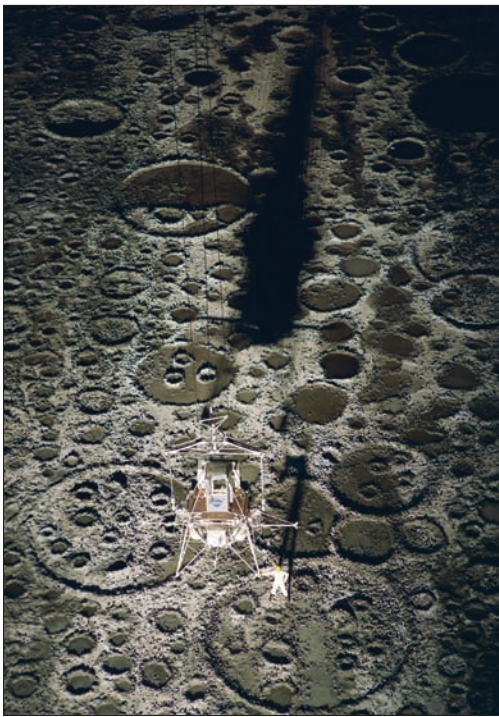


ECONOMIC HISTORY

Virginia and the Final Frontier

BY DAVID A. PRICE

Federal space centers and proximity to customers have helped to attract private space firms



Apollo astronauts practiced for lunar missions at NASA Langley's Lunar Landing Research Facility. This 1969 photo of the facility shows its model Lunar Excursion Module, or LEM. The LEM was suspended from cables to enable the astronauts to simulate piloting on the moon. A Langley worker is standing beneath the craft.

On a Saturday morning a little more than a half-century ago, Oct. 24, 1959, some 20,000 visitors swarmed Langley Research Center in Hampton, Va. The occasion was an open house to give the public a look inside the National Aeronautics and Space Administration, or NASA, which had been hurriedly created by Congress and President Eisenhower in mid-1958 in response to the orbiting of the Russian Sputnik satellite.

America's early efforts at chasing Sputnik had not gone well. An attempt by the U.S. Navy to launch a satellite in late 1957, two months after Sputnik, failed when the rocket exploded spectacularly on the launch pad. Now Americans looked expectantly to NASA to put the United States in front of the space race.

At the center of attention inside Langley's open house were spacecraft and rockets: Among them were a model of a German V-2 rocket engine; a rocket known as "Little Joe" that would soon be used to launch a seven-pound Rhesus monkey into space and back again; and a mock-up of the Mercury space capsule, which was to carry an American into orbit. At an exhibit on Project Mercury, an engineer told attendees, "The possibility of venturing into space has shifted quite recently from the fantasy of science fiction into the realm of actuality. Today, space flight is considered well within the range of man's capabilities."

The visitors were led to understand that they were in one of the birthplaces of the American-manned space program — and they were. Two and a half years later, the Langley-run Mercury program would send John Glenn around the Earth. Langley managed the project, trained Glenn and the program's six other astronauts, carried out aerodynamic and structural tests, and created the ground-

tracking system, among other things.

Soon afterward, Langley would make crucial contributions to the Apollo program: Its Lunar Landing Research Facility trained the Apollo astronauts in piloting spacecraft near the moon's surface and in moon walking. In the overall design of the Apollo missions, a Langley engineer, John Houbolt, argued as a voice in the wilderness for a plan of lunar-orbit rendezvous — that is, the docking of two spacecraft in lunar orbit after one of them had landed on the surface — and ultimately convinced other NASA centers of its superiority. Langley then built a rendezvous and docking simulator in an airplane hangar to train the astronauts in the technique.

Today, the 788-acre center employs some 3,800 workers in the Hampton Roads area — divided roughly 50-50 between civil service employees and contract employees — who work on projects ranging from wind tunnel tests to next-generation escape systems for saving astronauts in case of launch failure.

In recent years, policymakers in Virginia have been seeking to build on the presence of Langley and other federal and private space centers with the aim of expanding the state's space industry — and, with it, the high-paying skilled jobs that the industry brings. To that end, the Virginia General Assembly has enacted legislation to promote the industry's development: The Spaceport Liability and Immunity Act of 2007, which protects space transportation companies from liability for the injury or death of a spacebound passenger if the company has given warning of the risks, and the Zero G Zero Tax Act of 2008, which exempts human space launches and some cargo space launches from state income taxes.

While such measures may make the state more attractive for investors, the

PHOTOGRAPHY: NASA LANGLEY RESEARCH CENTER

history of Langley and other players in the Virginia space sector highlight the powerful role of nonpolicy factors — and sometimes sheer serendipity — in bringing space activities to the state. The stories of a cross-section of Virginia's space organizations, public and private, suggest that the state does have a number of advantages that have seeded development in the past and that will likely continue doing so, including its proximity to the nation's capital and its strong public university system.

NASA Lands in Virginia

The months between Sputnik and the creation of NASA saw a melee among defense agencies for control of the space program. (An Air Force publicist invented the term “aero-space” to reinforce the idea that aeronautics and space were inseparable.) Eisenhower opted for a civilian program that would exist in tandem with, and somewhat overlap, Pentagon missile programs. NASA's facilities would be plucked here and there from the military: the Army's missile program in Huntsville, Ala., headed by Wernher von Braun, the German missile designer and future director of the Saturn V moon-rocket program; the Army's Jet Propulsion Laboratory near Pasadena, Calif.; the Navy's Vanguard rocket program; and part of an Air Force test range at Cape Canaveral, Fla. NASA also inherited five centers from its predecessor, an aircraft research agency known as the National Advisory Committee for Aeronautics (NACA).

As it happened, two of those centers were in Virginia: One was Langley, and the other was Wallops Flight Facility, located on Virginia's Delmarva Peninsula and nearby Wallops Island. (Congress established another NASA center in the Fifth District, Goddard Space Flight Center in Beltsville, Md., a year after NASA's founding.)

Langley had been founded in 1920 as the first civil aeronautical research agency in the United States. Its site in Hampton, originally farmland, was chosen on the basis that it was a reasonable distance from Washington and yet was isolated enough for safe and secure flight testing. “Since then, we've been involved in advancing the science of flight,” Langley director Lesa Roe says. “Literally every aircraft today contains some technology that we developed at Langley.”

Roe hopes that Langley's capabilities will find customers in the private space industry. “We have met with the SpaceX folks [the launch vehicle and spacecraft company run by PayPal co-founder Elon Musk] and others,” she says. “If they need to use our facilities, we can put agreements in place so they can come and test in our wind tunnels or have access to our expertise in materials or aero sciences or systems analysis. We're eager and willing to do that.”

Wallops Flight Facility was built later than Langley, in 1944, as the Pilotless Aircraft Research Station; NACA staffed it with Langley employees to conduct research for the war effort. Rocketry was part of its research from the outset — to aid its aircraft work.

“In the early years, under NACA, it made sense to try out

a bunch of different aerodynamic shapes,” says Wallops director William Wrobel. “They didn't have wind tunnels. To get the high speeds, they put these shapes on rockets.”

Wallops today consists of an airfield for aircraft-related research on the peninsula and six launch pads and related facilities on the island. The center launches 15 to 20 rockets per year, ranging from targets for the Navy to suborbital science projects and satellites, and has 1,100 full-time employees.

Located alongside the NASA launch facility is the Mid-Atlantic Regional Spaceport, or MARS, operated by Virginia and Maryland in an effort to bring space business to the region. On land leased from NASA, it offers two launch pads to commercial customers. It is one of seven nonfederal spaceports that the Federal Aviation Administration has licensed. Its biggest deal so far is an agreement with Orbital Sciences Corp., based in Dulles, Va., for eight launches of Orbital's Taurus II launch vehicle between 2011 and 2015 to carry supplies to the International Space Station.

A Private Space Sector Thrives

One of the biggest private-sector players in Virginia's space industry started as an Arizona company. Motorola believed in the 1990s that there was a mass market for premium-priced satellite phone service with worldwide coverage. It started Iridium to serve this market and, with other investors, put \$5 billion into it. Iridium orbited 66 communications satellites (plus in-orbit spares) to service the hundreds of thousands of customers that it assumed would beat a path to its door.

Iridium opened for business in late 1998 — and filed for bankruptcy less than a year later. Its satellite system worked splendidly, but it never had more than a small fraction of the number of subscribers it needed to break even. In late 2000, as Iridium was preparing to shut down and de-orbit its satellites, a group of private investors scooped up Iridium for a comparative pittance, \$25 million, with the intention of offering the service to specialized markets. They had encouragement from the U.S. government, which, for strategic reasons, didn't want to see Iridium fail.

The new owners quickly moved the headquarters to Arlington, Va. (since moved to Tysons Corner) to be closer to Iridium's most important customer, Uncle Sam. In addition, the company had always maintained a significant part of its operations in Leesburg, namely, its Satellite Network Operations Center, operated under contract by Boeing to control the satellites.

In the past decade, Iridium's customer base has shifted more to private customers. “Although [the Department of Defense] is still our single largest customer, representing 23 percent of revenues, commercial is now the larger part of our business and is growing at a faster rate,” says Don Thoma, Iridium's executive vice president of marketing.

One thing, however, has been a constant in Iridium's strategy: It still seeks niches, not the mass market. “Iridium fills a need for customers who operate in locations or

situations where there really are no reliable communications alternatives,” Thoma says. “Iridium complements cell phones by providing voice and data communications to the rest of the globe, where cell towers can’t reach. We offer a reliable option, for example, for ships in the middle of the ocean, planes flying over the North Pole, and first responders in the middle of a natural disaster.”

Iridium, now a profitable public company, derives a competitive advantage from its large satellite fleet (or “constellation,” to use the industry’s term). The approach of Iridium’s main competitors is to provide coverage of the Earth with just a few satellites placed in high orbit, around 22,000 miles up — known as geostationary orbit, because each satellite stays in a fixed position in relation to points on the ground. Iridium, in contrast, keeps its satellites in low Earth orbit, roughly 483 miles up, thus requiring the large constellation. Iridium’s way is more costly, but the shorter distance eliminates the transmission delay that comes with geostationary satellites and hinders phone communications. The shorter distance also means Iridium’s phones can have smaller, less bulky antennas. In satellite phones, as in other electronics, customers like things small.

Another space-industry company that values Virginia’s proximity to the federal government is Dulles-based GeoEye, which owns and operates three Earth-imaging satellites, and sells high-resolution images to the National Geospatial-Intelligence Agency (NGA), as well as to private customers. NGA, in turn, disseminates the imagery to U.S. intelligence agencies and military services. “It’s nice that we can drive to the agencies, to Capitol Hill, to the Pentagon,” says Uyen Dinh, senior director for government affairs at GeoEye.

The company is in Dulles because it started as a division of Orbital Sciences there before being spun off in 1997. Now the company has more than 230 employees in Virginia and \$270 million in 2009 revenue. Two-thirds of its revenues come from the U.S. government.

Another customer is Google, which uses images from GeoEye, as well as other providers, for display in Google Earth and Google Maps. The government allows GeoEye to sell imagery to private customers such as Google at half-meter resolution, while the images that GeoEye delivers to the government are much more detailed.

The company is positioning itself to sell sophisticated analysis of Earth images in addition to the images themselves. Part of that strategy is GeoEye’s acquisition in December of McLean-based SPADAC, which uses human analysts and software to perform “predictive analytics” of geographic images for terrorist attacks or other threats.

“As a market begins to mature, strategically you want to move further up the value chain and offer more comprehensive services to your clients,” says Chris Tully, the firm’s senior vice president of sales. “We don’t want to be simply a pixel provider.”

For affluent customers who prefer to look at Earth from space for themselves, there is Vienna, Va.-based Space Adventures, Ltd., which charges \$50 million per passenger for orbital missions of 10 to 12 days in a Soyuz spacecraft and the International Space Station. Since 2001, seven clients have flown on eight orbital missions (one client, ex-Microsoft executive Charles Simonyi, has gone up twice). The company’s latest offering is a trip around the moon on a Soyuz spacecraft. One of the two available seats has already been reserved. Ticket price: \$150 million.

Space Adventures is based in Virginia because its founder, a Coloradoan, Eric Anderson, had studied aerospace engineering as an undergraduate at the University of Virginia and decided to stay in the state. He had dreamed of being an astronaut until he learned during a summer internship at NASA that his eyesight would disqualify him from the agency’s astronaut corps. So he shifted his dream to starting a business that would put private citizens in space.

Two years after graduation, Anderson founded Space Adventures in his Arlington townhouse in 1998. He had no way to put people into space, so he offered terrestrial adventures in astronaut training — zero-gravity flights, high-gravity training in a centrifuge — and flights to the edge of space in a Russian MiG-25 fighter jet. By 2001, he had managed to engineer an agreement with the Russian Federal Space Agency and Rocket and Space Corporation Energia, a Russian manufacturer of spacecraft components, for the orbital flights.

Of course, the market for the Soyuz missions is limited because the ticket price is so high. “We estimate that for orbital space flights, there’s probably less than 10,000 people in the world who could afford them,” says Space Adventures president Tom Shelley. “But within that very narrow market, there’s a pretty strong interest. We have a large number of people in our pipeline who’ve stated they want to do this. The biggest limiter for them is time because it takes a good deal of commitment of time.” (Founder Anderson is now chairman of the company.)

The exploitation of space in Virginia has come far since the Saturday-morning preview at Langley in 1959. Economic incentives will play a role in the industry’s development. Yet if history is any indication, an even greater role will be played by proximity to sophisticated customers and a pool of highly skilled engineers to act as employees and entrepreneurs.

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