

## Burt Rutan: Icon of Homebuilding...And Space Travel

By David Gustafson



Burt Rutan's list of airplanes designed and flown (45), of honorary Doctoral Degrees (6!), of national and international awards (112... not counting the milk drinking contest he won at the age of 12), of patents held (7), and of design projects related to aviation in some way (several hundred) takes up 11 pages! This all occurred in the years between 1965, when he graduated from California Polytechnic University, and his retirement from Scaled Composites in April, 2011. It includes a work schedule that would have crippled most people: escalating over the forty-six years he spent in the high desert to six or seven days a week, 8 to 16 hours a day. Vacation time was rare. "I think the main reason is there wasn't much to do in Mojave. I kept my head down and my elbows up and I worked like hell." When he retired, he found "with a clear calendar, I could sleep in and then decide on a given day what I would do *after* I woke up. That concept was so foreign to me that it was absolutely amazing. I still haven't gotten used to it." He's still looking for the "off" switch.



Voyager Aircraft Program  
Burt Rutan shows his pride in a hangar at Edwards AFB after the successful landing of the Voyager on December 23, 1986. The Voyager was a unique aircraft designed by engineer Burt Rutan to fly around the world non-stop and non-refueled. The craft piloted by Dick Rutan and Jeanna Yeager achieved its milestone goal in December 1986 after flying around the world in slightly over 9 days.

In his lifetime he went from model airplanes to rocket science, from homebuilts to transports, from internationally recognized projects like the Voyager and Spaceship One to classified stuff we will probably never know about. He changed the culture of aviation.

Burt evolved into an unusual blend of scientist and artist. He was able to visualize airflow in ways the rest of us can't, and he knew how to direct that flow through the laws of physics. His airframes, especially the fuselages, were the most radical and graceful exhibits of sculpture ever seen in the air before. Burt is a sort of industrial sculptor that guys like Rodin would have admired. Spaceship One and The White Knight belong in an art museum as much as the National Air and Space Museum.

The late Jack Cox, editor of Sport Aviation from 1970 to 1999, wrote his last article for that magazine in April, 2011, focusing on Burt's early years. He characterized Burt's supersonic mind and *Über werkethik* this way: "If thinking outside the box and turning that thinking into successful



A very young Burt Rutan with one of his scratchbuilt model airplanes...it was his passion through high school.



Burt with a model he created for endurance.

ventures and products is a mark of genius, then Burt Rutan, EAA Lifetime 26033, has claim many times over to that distinction. No other individual in the history of aviation has designed as many aircraft...radically different aircraft...and had them built and flown.”

Burt’s fascination with aviation began as a young man. In high school he ignored kits and began designing one-off models experimenting with different configurations. A local hobby shop owner, whose day job was laying bricks, began taking Burt and some of his buddies in Dinuba, California, to competitions in San Francisco every other weekend.

At age 17, his mother trucked Burt and 11 of the unique aircraft models he had designed and built to an AMA national convention in Dallas. Burt came home with a few



Burt’s first experiment with a canard

trophies. In 1961, he went off to California

Polytechnic University to pursue a degree in Aeronautical Engineering. While there, an idea germinated in his fertile imagination, following a research project he did on the virtues of canards. Intrigued with the anti-stall, anti-spin characteristics of the canard configuration, and enamored with the Saab Viggen, he began sketching out his first homebuilt: the two-seat, tandem

VariViggen. It was to be built out of wood and metal. He conducted wind tunnel tests on the concept at Cal Poly in 1964, but didn’t begin building it until 1968. Finished in 1972, Burt



VariViggen Car Tunnel Model, showing the instruments to measure the effect of wind.

flew it to Oshkosh where he won the Stan Dzik Design Contribution Trophy.

It was probably the first canard pusher to show up at Oshkosh and it created quite a stir when it got there. Delightfully nicknamed the “Thunder Chicken”,

it was Burt’s answer to the fighter pilot wannabe complex that he developed during the years 1965 – 1972, while he was working at Edwards Air Force

Base and taking trips in fighter aircraft...in the back seat...as a test engineer.



Burt’s first job out of University was at Edwards Air Force Base.

“The fascination of having my own fighter, which would allow me to sit in the front and have my hand on the throttle, provided the major reason for doing the VariViggen.” Burt had joined EAA in 1965 and while he was working for the Air Force, he joined EAA Chapter 49, but he had to put off the start of construction because he was working seven days a week and had no spare time. What little time he did have went into the construction of another wind tunnel model of the VariViggen, but this was after Cal Poly and he had no wind tunnel. So he used his car, mounting the model above the roof of his Dodge Dart. It was an articulating mount with instruments. Driving down roads, he was able to simulate a wind tunnel of his own making. He then built an RC model of the VariViggen and flew that shortly before flying his completed homebuilt. That happened late in 1971 while he was in St. Louis supporting the F-15 program.



The car Top VariViggen model ready for the automotive wind tunnel.

In the summer of '71 he had made his first trip to Oshkosh. It's funny to think about Burt Rutan wandering around the Oshkosh flightline, unrecognized. That would change the following year when he introduced his VariViggen.



Burt in the early phase of building the first VariViggen.

That same year, after returning to Lancaster and his work at Edwards, he encountered one of

those life-changing experiences that would take him in a very different direction. A designer/kitmaker named Jim Bede came through nearby Fox Field and members of the local EAA chapter encouraged Burt to meet Jim. He did. He showed Jim pictures of his VariViggen, which was nearing completion. Someone had already told Jim about Burt, and, knowing that Burt was involved in flight testing at Edwards



Burt with the VariViggen

Air Force Base, Jim offered Burt a job as his Chief Flight Test Pilot. Burt told Jim that he needed a Chief of Experimental Tests, adding “I know how to do that. I'm a professional flight test guy and I could organize and run your flight test program. Jim was planning on introducing other aircraft and I told him he could get pilots anywhere, but what he really needed was someone to put together a testing organization. I was looking for



Burt Rutan in a BD5

a job, knowing it would probably only last about a year. I planned to return to Edwards within a year to hold onto the benefits associated with that job. I didn't like the BD-5, but I went to work for him with the idea that I would have fun and learn."

Burt was also formulating a plan that might lead him into the homebuilt kit business. The idea occurred to him after he had read about Bede's plans to sell the BD-5 kit. He sketched out the concept for a MiniViggen (single-seater) for which Burt would create a kit that could be added onto a BD-5 kit. As long as Jim could sell his BD-5 kits, Burt expected he would have no objections to the concept. "I figured it would be a win/win situation for both him and me." The MiniViggen would be the size of a BD-5 (considerably smaller than the VariViggen), but it would be transformed into a canard airplane. So before Burt went to work for Jim, he ordered his own BD-5 kit, thinking he would lay out his design and change the BD-5 into a MiniViggen. "And if it flew well, I would go into the kit business." As it turned out, Bede never did deliver the BD-5 kit as the total package he had advertised; not to Burt or anyone else. It became one of the biggest scandals in the homebuilt movement.

Burt managed to avoid the scandal. He functioned as the principal designer on the BD-5 Jet and the trainer that was mounted in front of, and attached to, a truck for assisting pilots with transition training. He wound up staying with Bede longer than the one year he had planned on. During the two summers he was there, Burt brought his VariViggen to Oshkosh, where he attracted large crowds. In early 1974 after leaving Bede, "I decided I would bite the bullet and try to make a business...the same kind of business that Bede was running, but I would do it without taking deposits before I had something to sell. I had learned some of the business mistakes Bede made, and if it wasn't for those experiences, I would have made some of those same mistakes. It was clear that he was digging a hole that he couldn't get out of. He was actually selling kits for less than it cost him to buy the materials. Then he got distracted and kind of abandoned the homebuilders. I decided it was going to fail in just a handful of months and I didn't want to be a part of the people who got the black eye. So I decided 'I'm out of here.'"

Knowing he had a marketable product in the VariViggen, Burt moved back to California. "I didn't especially want to make plans for the VariViggen because it was really hard to build." However, he began shipping out plans and started machining some of the more challenging parts of the design. To assure a minimal level of security, Burt borrowed \$15,000 from his dad. But first he had to find a place to establish

his business. It had to be cheap. He needed a hangar for his VariViggen, a shop for making plans and parts, and a home for a family of four.

Los Angeles was out because the high cost of hangars and shop space. He borrowed his uncle's Ercoupe and went down to Brown Field on the Mexican border, then looked at Montgomery, Ramona, Flabob and a host of others. He was shocked by the prices people were asking. "Once I got to Mojave, I found this old, nearly abandoned airport with a few run down wooden buildings on it and the hangar rent was almost nothing and the shop rent was almost nothing, because they had all this empty space. I found a house nearby that had a low enough price and so it turned out that Mojave was the first place I'd found where I thought I could survive on cost. The other thing was that it was close to Edwards, and if my business failed I could always try to get my old job back with the Air Force."



Burt Rutan at his drawing table in the Pre-CAD days.

After parking his VariViggen in the corner of an old wooden hangar for \$15/month, Burt moved into Building 13, which was about a hundred yards back from the flightline. He put up a sign: Rutan Aircraft Factory. It was a large building, far bigger than what he needed to develop his next aircraft, the VariEze. So he partitioned off about a third of it, hung some insulation on the partitions and sublet the other two-thirds of the building for twice the amount he was paying for the entire building. This meant he had a free office and shop facility.

"That's called survival."

Of course, survival requires more than a workspace. There has to be a viable product. At \$27 a set, for VariViggen plans, Burt had income, but knew it would be a losing battle. "I didn't see a viable business selling plans or kits for the VariViggen. People were fascinated by how cool it looked and how it could make tight turns at full aft stick. It was a fun airplane to fly, for sure, and I enjoyed giving airshows at Oshkosh in '73 and '74, but it was horribly difficult to build. It was mixture of metal and spruce and birch plywood, it had complicated controls and an electric retractable landing gear. I could see that there was a small audience, who had the skills and patience to build one, but clearly if I was going make a business out of selling plans and kits, I had to have something that was easier to build and wider in appeal."

Burt liked the configuration of the VariViggen, found it fun to fly, was impressed with the stall-proof nature of the canard, but was disappointed in its performance and efficiency. He focused on producing a new

version of it that would be considerably easier and quicker to build. The VariEze was born.

During Burt's University days, RC modelers began experimenting with foam core wings. They had mastered the technique of carving or hot-wire cutting of foam wing cores and covering them with balsa wood skins. Burt had heard of the technology. When he was working for Jim Bede and living in Valley Center, Kansas, he began experimenting with foam and fiberglass, producing elevators for his MiniViggen. "I became enthralled with the process. It took me a very short time to build. I walked away from it and the next morning it had cured and was ready for use. It was smoother and nicer than aluminum. I didn't have to pound out ribs, didn't have to use clecos...I was really jazzed by this."

A few hundred yards from Burt's new location, Building 13, was an operation called Fred Jiran's Glider Repair. Fred was European and had familiarity with the sailplanes that were being produced in



One of the prototype wings for the VariEze.



The first VariEze in the early stage of construction.

Germany and Switzerland. It was a technology that was still in its infancy in America. These sailplanes were produced in tooling that utilized vacuum bagging of fiberglass impregnated with resin. Carved foam was then set inside the upper and lower surfaces of the wings. When they were dinged in an accident, Fred would shape foam to fill the hole and then lay new fiberglass over it. He didn't need tooling to fix wings. These "moldless" repairs inspired Burt. He began to conceive of his VariEze as an all-composite aircraft.

One of Fred's employees, Gary Morris, an artist and a craftsman, began going over to Burt's shop after work to see what was going on. He pitched in, offering much needed help to Burt

and was offering suggestions on how work with fiberglass. Burt asked Gary to keep the project a secret, in case something went wrong with it. Gary worked for food as Burt couldn't afford any wages, but decided to buy dinner if they worked late enough. Initially, Burt was thinking of hand-carving the foam cores for the wings, but then he struck on the idea of cutting large blocks of foam with a hot wire, just like what was being done with small RC models, using templates at each end.

Bingo! This eliminated the need for tooling and dramatically reduced the time required to complete a wing. For the fuselage, he laid sheets of foam (1' or 2" thick) on a table, carved various depressions of them and skinned them with fiberglass. Those sheets became the sides and bottom of the fuselage with their skins being the fuselage inside surfaces. The three sides were bonded together around a few bulkheads, creating a square box with an open top. The plexiglass canopy and frame would later be the fuselage top. The outside surfaces were then carved down to the corners, resulting in a rounded external shape. The



Burt seen conducting an early workshop on hotwire/foam cutting techniques.

big structural advantage would be the outside skin, which could be one continuous fiberglass layup all around, without fasteners or secondary bonds. Thus, the Rutan aircraft factory created an entirely new way of fabricating airplanes. It was now possible to build up an airframe without expensive tooling and in very little time. Hand tools amounted to little more than a pair of scissors, a sharp knife, a paint brush and some sandpaper.

Burt started his VariEze, N7EZ, in February of 1975, intent on making the Oshkosh Fly-In that summer. He got there. He had finished the first VariEze in 3.5 months. It was smaller, leaner and could go faster and farther than the VariViggen. Jack Cox had visited the Rutan Aircraft Factory in early May, 1975, took pictures of the project and then ran an article in Sport Aviation he called "VariViggen Vignette," in which he introduced the VariEze concept and the new process of building aircraft out of composites. Jack followed that up with a bunch of photos of the completed VariEze, priming the EAA Fly-In for a revolution.



Burt in the prototype VariEze

It wasn't uncommon in those days to see four to eight new designs at Oshkosh every year. Innovation was a way of life at the Convention. But nothing had ever compared with the introduction of the VariEze. The buzz among homebuilders when the aircraft first flew over the Oshkosh airport was punctuated with gasps and more than a few salty phrases. This was the beginning of a revolution and everyone knew it.

Aside from the unusual shape, presaged two years earlier by the VariViggen, the VariEze had no moving parts on the wing. The rudders were mounted on the trailing edge of the new winglets, a concept

developed by Richard Whitcomb. Burt was the first designer to use winglets. The elevators, which Burt called elevons, were attached to the trailing edge of the canard, with control levers about two feet from the stick. The elevons moved up and down to control pitch, but also operated differentially, as ailerons. To accommodate entry and egress, Burt had designed a crank system that raised and lowered the nosewheel. None of these features had ever been seen before. The fact that Burt had put it all together in less than four months just blew peoples' minds.

According to his plan, Burt wouldn't take any orders that first year. His brother, Dick, had flown the aircraft from Mojave to Oshkosh, but had to make a forced landing enroute due to an engine failure. John Monnett graciously offered to replace the Volkswagen engine in the prototype with one of his own and worked



The Defiant (closest), the VariEze and Mike Melville's VariViggen.

all night to get the plane ready for a closed-course endurance record. After the convention, Burt flew N7EZ back to Mojave and experienced a second engine failure. That soured him on using Volkswagen powerplants. He got home and began to think seriously about what he was doing. He made the decision to not sell plans for the Volkswagen-powered N7EZ (it is on display in the EAA Museum). He built and tested another prototype

VariEze, a bigger one that would use a certified aircraft engine. The new

aircraft, N4EZ, formed the basis for the homebuilder's plans-built airplanes. It used a Continental O-200, 100 hp engine. N4EZ is now on display in the Air and Space Museum's Dulles facility.

People began sending money in, even though he didn't yet have anything to sell. After his experience with Jim Bede, Burt had resolved never to accept money until he had a product that was fully flight tested and complete. He sent the peoples' money back, refusing to take any deposits until a month before Oshkosh '76. At that time, he put the word out to the thousands of people who had subscribed to his quarterly newsletter (this was before the internet and websites). A couple days after sending out his newsletter, announcing the availability of plans, some guy flew in from San Diego in a Cessna 182 and paid for a hundred sets of plans. He took a full third of Burt's inventory of plans and grossed out his Skylane with them. Then he took off and flew back to an eager bunch of builders,



Burt has held forums every year he's been at Oshkosh. You can guess which tent he was in for this forum.



who couldn't wait to get started on their own VariEze.

"On that one day, I made enough money to survive for a full year."

Burt started selling plans at \$125 a set. In the first year of the VariEze's existence he went to the bank with \$750,000 that came in from plans sales and royalties from kit sales. Burt took home less than \$8,000, preferring to put the rest back into RAF and future developments. He began paying Gary Morris a salary and hired one other employee.

Jim Irwin, president of Aircraft Spruce, remembers Burt visiting his office in the spring of 1975 to talk about materials kits. Jim listened politely but had no way of knowing what was coming. For that matter, neither did Burt. The foam began arriving at the old Aircraft Spruce facility by truck, then

by train load. It flew out as fast as it was trained in. "It

was a phenomenon," said Jim. "For a while we sold more foam, fiberglass and resin than everything else combined."

In 1977, Burt rolled out the Quickie, a single-seat design he created in collaboration with Tom Jewett and Gene Sheehan.

It won the Outstanding New Design Award at Oshkosh '78. Then he began a center-line thrust twin, called the Defiant (Burt's

personal airplane, not intended for a kit program), which was debuted at Oshkosh '79 along with the Long EZ.

The VariEze had pretty much decimated the existence of 0-200 engines. Builders wanted to use the heavier Lycoming engines and insisted on having a starter and full electrical system, which made the VariEze tail-heavy. In 1979 Burt developed a larger, Lycoming-powered EZ with some significant improvements in flying qualities. The

Long-EZ was introduced in 1980 and it became the most popular and longest-range homebuilt in the world. Its distance records still stand today. The rest, as they say, is history and it's been well documented. After 1985, RAF developed two high performance prototypes, the 5-place Catbird which won the CAFÉ



LongEZ flown through one of those YeeeeHAAh!!! maneuvers.



VariEzes and Long-EZs gathered at Mojave for a celebration of composite aircraft.



A grouping of Quickies

efficiency competition and the Boomerang Twin. Both were hangared after Burt lost his Airman's Medical in 1998. Last year as Burt retired, two Scaled engineers restored the Catbird and the Boomerang and flew them to AirVenture 2011. In total, RAF designed, built and flew 15 different aircraft.

Burt continued to attend the annual Oshkosh Convention. From 1976 to 1986 RAF rented a 10' by



The Defiant leads the VariViggen and VariEze.

10' booth during the Oshkosh Convention and during the week he would make 20 percent of their annual sales. It wasn't just plans sales. There were T-shirts, patches and other memorabilia that crossed the counter by the case. "It was tremendously important to us." His forums became one of the highlights of the conventions, drawing the largest crowds for nearly two decades. "To us, it was all about homebuilts."

Not everything at RAF had turned to gold. Burt finally started selling plans to the Defiant six years after he flew the prototype and he only sold plans for a year with about a hundred sets going out the door. The Solitaire was even less popular. The self-launching sailplane cost more to develop than the VariEze and Long-EZ combined,



The VariEze (closest), Defiant and the VariViggen.

but Burt only sold a few dozen sets of plans. Over the years, Burt sold kits for six models: the VariViggen, VariViggen SP, VariEze, Defiant, Long EZ and the Solitaire. The other 9 models that Burt developed were done without an

audience...with no intention of developing plans or kits.

By 1996, Burt's second company, Scaled Composites, was 14 years old and was demanding so much of Burt's time that he just didn't have time for homebuilders. He had sold his last set of plans to a homebuilder in 1985 but continued to support his builders for over 20 years with newsletters, even though there was no revenue to cover the costs of the newsletters. "I never charged for builder support, because I didn't want people shunning it and



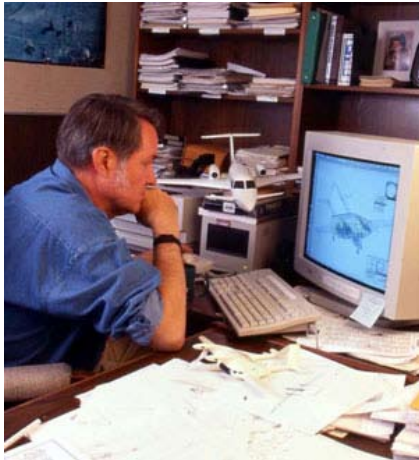
The Solitaire, a self-launching sailplane.



The Solitaire's retractable engine.

building bad airplanes as a result. Initially I did not realize what an enormous tail you create when you sell plans.”

During the 1980s the flightlines at Oshkosh and Sun ‘n Fun were dominated by aircraft Burt had designed. Thousands of VariEzes and Long-EZs were added to the FAA registry. They began showing up on airports all over the world. They spawned a variety of copies and stimulated a variety of other homebuilt



Burt Rutan logging time on his computer. Note the model just to the right of the keyboard.

and certificated designs that used composites: like the Glasair, Lancair, Cozy, Pulsar, Glastar, Europa, Velocity, VK-30, SR-20/22, Columbia, Boeing Dreamliner....

Looking back, Burt was asked to identify the three greatest accomplishments in his illustrious career. He elected to include the manufacturing methods developed for producing the VariEze and Long-EZ. He views the Long-EZ as a refined model of the VariEze, a natural part of the evolutionary process, a model B. There were a

lot of unique, innovative features on the two aircraft that have since been imitated. The robust structure, performance and appeal of the two models, coupled with the fact that for a very low cost, people could buy

and build one of the airplanes, was, in Burt’s opinion one of the major achievements in his lifetime.

When asked what his favorite airplane was, he’d always say: “the next one.” That was what usually held his attention and stimulated his passion. But after Spaceship One, he stopped saying “the next one.”

Spaceship One is his favorite and ranks right up there with the list of his three greatest accomplishments.

“Most of the program was completely covert and



Catbird & Boomerang



Catbird & Boomerang

people were guessing what this White Knight was for. The idea that a private company could develop their own space program without government funding was unheard of and un-thought of.”

The third part of the triangle “would be the fact that my tiny companies could attract contracts

from big aerospace firms and from the Government, gaining their confidence to do important research work. When RAF had only four employees in the 1970s, it designed the skew-wing AD-1 research



SpaceShip One and the Rocket Scientist.

aircraft for NASA. It is now on display at the Hiller Museum in San Carlos. One of the Scaled Composites' first contracts was with Beechcraft...to design the Starship which they planned to use as the replacement for their King Air line. That program started as a preliminary design study at RAF. Scaled went on from there with civilian, government and military, domestic and foreign contracts for an unbelievable array of

manned and unmanned machines.



Good Company: Paul Allen, Burt Rutan and Sir Richard Branson

At its peak, RAF employed five people. Scaled composites started with six employees and grew to about thirty-five when the Starship made its first flight in 1983. After that it was common at Scaled to see three or four designs being built in the shop while two or three more were in flight testing, when employment was well less than 100. When Scaled

undertook the Paul Allen manned space program in 2001, it was not their largest effort, in spite of the fact that they employed less than 140. When Burt retired in March 2011, the company had nearly 400 people on the payroll and was developing SpaceShip Two, the world's largest manned commercial space system. Last December, Scaled revealed that it was developing Stratolaunch, the world's largest aircraft; a design stemming from Burt's preliminary work that was started back in 1991.



The Beech Starship and friends.

Given the impact Burt Rutan had on the homebuilt movement, it seems inconceivable that we'll ever see that kind of innovation, popularity and commitment again. It seems strange not to be able to

ask the question anymore: "What will Burt turn up with next?"



Burt's highly unusual design by anyone's standard.... the Grizzly.



Burt and Tom Poberezny at Oshkosh 2005. Tom was quick to recognize and admire the genius and success of Burt Rutan.

## **RUTAN AIRCRAFT FACTORY: MANNED FIRST FLIGHTS**

- 1 VariViggen Model #27 May 18, 1972 (marketed 1974)
- 2 VariEze POC Model #31 May 21, 1975
- 3 VariViggen SP Model #32SP July 1975 (marketed 1975)
- 4 VariEze Homebuilt Model #33 March 14, 1976 (marketed 1976)
- 5 Quickie Model #54 November 17, 1977 (Sold to QAC to market)
- 6 Defiant Model #40 June 30, 1978 (marketed 1984)
- 7 Long-EZ Model #61 June 13, 1979 (marketed 1980)
- 8 AD-1 Model #35 NASA December 1979
- 9 Amsoil biplane racer Model #68 Mortensen Aug 1981
- 10 Next Generation Trainer Model #73 Fairchild September 10, 1981
- 11 Grizzly STOL Model # 72 January 22, 1982
- 12 Solitaire Model #77 May 28, 1982 (marketed 1983)

- 13 Voyager Model #76 June 22, 1984 (RTW on Dec 14th-23rd, 1986)
- 14 Catbird Model #81 January 14, 1988
- 15 Boomerang Model #202 June 19, 1996



Burt with models of some of his designs.



Long EZs and VariEzes on the ramp at Mojave.



The Boomerang



The Voyager at Oshkosh