

X-Prize AMA: I am Burt Rutan, designer of the world’s first private spaceship (SpaceShipOne), and the first aircraft to fly around the world without stopping or refueling (Voyager). AMA!

Burt_{Rutan}¹*andr/ScienceAMAs*¹

¹Affiliation not available

April 17, 2023

Abstract

Good morning, Reddit! This is Burt Rutan here to answer your questions. While I am best known for just those two projects, I am known in aviation circles for an unprecedented list of 45 other research aircraft developed by the two companies I founded and ran over a 43-year career. My first company, Rutan Aircraft Factory, also developed 14 other research aircraft and marketed plans for five of them so individuals could build their own personal airplanes. Or, you may, know me because my small team at my second company, Scaled Composites in the Mojave Desert covertly developed an entire Manned Space Program, and flew three of the world’s five manned space flights in 2004. You can read about me at burtrutan.com, or in a new book, How to Make a Spaceship, by Julian Guthrie. “Black Sky”, an award-winning 2004 documentary by Discovery TV described our private, non-Government space program. I will be back at 3 pm ET to answer your questions, Ask Me Anything!

[REDDIT](#)

X-Prize AMA: I am Burt Rutan, designer of the world's first private spaceship (SpaceShipOne), and the first aircraft to fly around the world without stopping or refueling (Voyager). AMA!

BURT_RUTAN [R/SCIENCE](#)

Good morning, Reddit!

This is Burt Rutan here to answer your questions. While I am best known for just those two projects, I am known in aviation circles for an unprecedented list of 45 other research aircraft developed by the two companies I founded and ran over a 43-year career.

My first company, Rutan Aircraft Factory, also developed 14 other research aircraft and marketed plans for five of them so individuals could build their own personal airplanes. Or, you may, know me because my small team at my second company, Scaled Composites in the Mojave Desert covertly developed an entire Manned Space Program, and flew three of the world's five manned space flights in 2004. You can read about me at burtrutan.com, or in a new book, [How to Make a Spaceship](#), by Julian Guthrie. "Black Sky", an award-winning 2004 documentary by Discovery TV described our private, non-Government space program.

I will be back at 3 pm ET to answer your questions, Ask Me Anything!

[READ REVIEWS](#)

[WRITE A REVIEW](#)

CORRESPONDENCE:

DATE RECEIVED:
September 21, 2016

DOI:
10.15200/winn.147437.75859

ARCHIVED:
September 20, 2016

CITATION:
Burt_Rutan , r/Science , X-Prize AMA: I am Burt Rutan, designer of the world's first private spaceship (SpaceShipOne), and the first aircraft to fly around the world without stopping or refueling (Voyager). AMA!, *The Winnower* 3:e147437.75859 , 2016 , DOI: [10.15200/winn.147437.75859](https://doi.org/10.15200/winn.147437.75859)

© et al. This article is distributed under the terms of the [Creative Commons Attribution 4.0 International License](#), which permits

Burt, I am an aerospace engineer for Northrop Grumman, and everyone I talk to here seems so excited to have your company be a part of us. I have two questions if you don't mind:

- 1) do you think we will see the glider style of spacecraft regain practical use anytime soon? I understand the merits of a capsule-based system but it seems like we're going back in time regarding orbiter design.
- 2) you seem to have grown up loving aircraft design. What does someone like me you need to know in order to get into the hobby of homebuilding aircraft (full size or scaled down)? It seems like such a daunting learning curve. Do you have any suggestions regarding reading material or other information?

Thanks for taking the time to do this. It's great to have AMA subjects who have actually changed the world!

[blackoak81](#)

My original concepts for SS1 were capsules, with high-drag devices for reentry (feathers). However, an employee reminded me that I was an airplane designer and that parachutes were inherently unreliable. My focus then led to the invention of the feathering config on ss1. The models you see on the Black Sky, were not really for data collection, just to get an initial feel for the basic subsonic stability. All those models worked, but only the final config gave adequate drag and stability for the real supersonic reentry.

unrestricted use, distribution, and redistribution in any medium, provided that the original author and source are credited.



You designed some of the most visually stunning aircraft. Why haven't more canard designs caught on? Is there a functional limitation to the size and/or speed of the aircraft of this design?

[goalsquid](#)

I had always thought that new, different looks were an advantage. However, my very best General Aviation design, the asymmetric Boomerang (best safety, best performance and best efficiency) has gone through 3 groups that have failed to raise investment \$ to certify a production version. Aviation, it seems is shy to try new ideas - The jet airliners all look basically the same, except for engine placement.

Burt: I work onsite at NASA JSC and am in a funk. I'm developing operational software and the culture here is a clusterf...

There are silos of expertise, some redundant, with strings and cans between them. Everything revolves around fiscal years. I'm supposed to wrap up development on operational software two years before we launch. No one believes this- we absolutely will have to continue work in those two years as we get closer to launch and networks come online and rubber meets road, but we do this kabuki chicken dance of signing off on things not completed and punting.

I really want to take a sledgehammer to this place and do twice the work with half the people. I don't know if I have a clear question, I just imagine you as someone who does n't put up with this kind of nonsense. I guess my question would be: how can I break out and do good work and leverage best modern practices and not get laughed out of the room for not aw shucking my way through the politics?

[uhoh_dads_mad](#)

Good question/comment.

NASA works at the direction of the White House. You have been asked to do and to emphasize lots of things that do not involve manned space exploration.

Insiders tell me that you are basically now just a large Jobs Program..... hope it is not true.

I remember in 2004 SpaceShipOne made its flight and was going to usher in a new Era of manned spaceflight. But in the last twelve years it seems like no progress had been made. What gives?

[iorgfeflkd](#)

Yes, I have been surprised and disappointed to see that 12 yr after ss1, no one has even flown humans in a commercial spaceship. I had predicted that there would be multiple space lines flying rat public by now.

The SkiGull looks to be, in many ways, my current dream plane. Do you envision ever licensing the design for commercial development?

One of the highest barriers to entry in the general aviation world is the many costs. Based on your experiences with the Catbird, LongEZ, etc., what do you feel would need to happen to make it worthwhile for Scaled Composites and other manufactures to pursue that market?

Can I borrow the ARES for just one afternoon? :)

[Chatayu](#)

Still working hard to develop SkiGull. I had to give up on using wheels on the soft-super flexible water/snow skis. It now has a separate tricycle landing gear with main gear located just outboard of the skis.

You've made no bones about the "black aluminum" approach to conventional aerospace composites manufacturing.

Do you perceive the industry softening to the idea and what do you feel will continue to help make integral composites manufacturing processes more mainstream?

[macblastoff](#)

The key is the development of new methods of manufacturing composite structures to reduce their costs. With these new breakthroughs in the near future, we will finally see the demise of aluminum aircraft structures.

If composites had preceded aluminum, we would have never certified aluminum for aircraft, due to its fatigue characteristics and its corrosion issues.

Hi Burt,

Huge fan. Talented engineer I worked with, Phil, mentioned that while the aerospace industry has adopted composite materials for lighter, stronger, more durable construction, the aircraft parts themselves, are still designed as small components that must be assembled the way aluminum craft have been assembled. I saw in Scaled Composites/ Documentary footage that some of your designs call for very large layup components that take advantage of the strength, repairability, and capability available in composite fiber construction. Assuming that an assembly seam is weaker than a contiguous part, can you comment on how you balance limits imposed by manufacturing processes such as autoclave size or max width of a commercial roll of fiber material against desired design strength/weight? Thank You for doing this AMA. Can't wait to see your responses.

[AtomicPoppingTart](#)

I have always been a fan of winding continuous fiber, that is loaded in tension only. This can eliminate 99% of the fasteners. Fasteners work well in aluminum, but poorly in composites.

Burt Rutan! Any chance of you designing a hybrid electric aircraft? A new generation of batteries will be coming out soon with double the energy density of current batteries, and new free piston engine designs incorporating linear electrical generators are popping up. NASA's X-57 with tons of electric powered propellers looks promising. It seems like a small aircraft with at least a 6 hour, 750 mile range could be possible with these technologies.

[mutatron](#)

I did. It was called the BiPod flying car. I finished phase one, accessing its roadability and flying it via wheel-launched runway flights, the day before I retired. Unfortunately Scaled got too busy to proceed with it after I retired. I am now trying to get them to give it to me so I can continue with Phase Two - the completion of the hybrid propulsion system for flight.

As an engineer how do you approach a design problem? Do you start with the form factor and go from

there or with the governing equations and let the firm of the aircraft develop? For my preliminary design project I have to design SpaceShipTwo which I have to say is gorgeous.

[Regis_Mk5](#)

In general, I look at how to reach the function/performance/efficiency GOALS, without just evolving the past art. I always thought, and still think, that evolution is way too slow and boring for Fun seeking folk.

Mr Rutan: R/C sailplane flier here...There's a story in the radio control sailplane community about you listening with some scepticism to a presentation about the speeds being attained through R/C dynamic soaring.

The story goes that when you were given an actual demonstration of high speed R/C DS, you exclaimed "I'm seeing it but I'm not believing it!" (which is probably a lot of people's reaction). I always thought that was a great line, just wondering if there was any truth to the story?

[WarthogOsl](#)

True story. A world class RC DS guy came to scaled and gave a presentation. I stood up and called him a liar, with fake videos (a bit tongue-in-cheek for my employees :-). I then followed him to a special ridge line hill near palm springs, with a 45-knot wind blowing over the top. The experience was the most impressive thing I has seen in aviation (even thou I have flown at Mach 2.15 in the Phantom at 35kft and 820 Kt on the deck).

Are plans for the LongEZ ever going to be available again?

[John_Rigell](#)

No. The last plans and license agreement (to allow the plans-purchaser to build one LongEZ) was sold in 1985, 31 years ago.

I am too old now to do the builder support needed for safe homebuilts. I did support for free for more than 20 years after 1985.

What was one airplane that never got the respect it deserved? Either civilian or military.

[adam_demamps_wingman](#)

My favorite airplane is the A11/SR71. Kelly deserves all the respect he got and more.

I played a young version of you on the History Channel show called "Man, Moment, and Machine" in the early 00's. Did you ever watch it?

[Bluevinegar](#)

Yes, and enjoyed it!

Cannot remember if you grew sideburns ???

Where did your initial money to start in business come from?

[pseud0nym](#)

15k\$ from my father in 1974 to start RAF. I paid him back when the VariEze plans went on sale 2 years later.

750k\$ from Howard Keck in 1982 to start Scaled Composites. 3.5 years later, I paid him back four times that when Raytheon bought his stock.

As someone aspiring to be a GA pilot I often wonder what aircraft are the most fun to fly. So Mr. Rutan, what aircraft put the biggest smile on your face?

Edit: Wording.

[Kwiatkowski](#)

Boomerang, especially if you are an experienced GA twin-engine pilot.

Hi Burt! I am a huge fan of your work. Thank you for doing this AMA. I study dynamic wing morphing in birds, and some of my work has the potential to improve the efficiency, safety, and overall performance of flight as we know it.

My question is this: What's the best way to break into the aircraft development industry? If I share my ideas with Scaled or AeroVironment, I think they'll steal them. However, to apply my knowledge to aircraft, I need financial backing. How should I go about getting my morphing wing technologies to market? And, can you put me in touch with someone at Scaled Composites? Thanks!

[mightybird](#)

You will get almost nowhere if you fear others will steal your ideas.

Share them, and get others to notice them and appreciate them. Believe me, if they like the idea they will want to hire you to move forward.

Then, with some experience, (and investment if needed) take your NEXT new idea and enter the exciting role of being your own boss.

Why work 40 hr/week for a boss when you can slave 80 hr/week for yourself?

When building structural composites, how critical is it to have a perforated barrier bag under your breather cloth on wet lay ups? Is it acceptable to have a non perforated barrier which does not allow excess resin to escape?

Edit: spelling

[50calpainpill](#)

without an autoclave to provide the pressure, edge bleeding is just not adequate.

You have to fly on a space mission that will last one full Earth year. You get to take five people with you. They cannot be family members or existing friends. Which five people do you take? GO!

[ButtCutt](#)

I think that answer would not be G-rated.....

When I was a teenager, my dad and I built one of your VariEze. It was/is a brilliant design and building it helped me and my dad have bond over something. No real question just wanted to say that.

[store_bought_hero](#)

Thanx.

These stories do mean a lot to me.

Between suit-happy litigation and restrictive FAA regulations (especially regarding power plants,) general aviation seems to have stagnated since the 1980's. Experimental types do allow us to pursue innovative solutions (fuel injection, electric motor, etc) but certified types lag behind the state of the art by decades.

Do you see any hope in the future for innovation within the GA community?

Edit: Additionally, certified types have become solely the domain of the rich, with entry level Cessna aircraft costing well over \$150,000 and thus beyond the reach of most aspiring aviators. Do you have any thoughts on this, as well?

[Cephalopodia](#)

When I graduated from college in 1965, my starting salary (lowest paying offer at Edwards AFB in flight test) was \$7,070/year. That was the cost of a new certified American AA-1, 2-place Yankee.

It is a fair question now that why cars have become more affordable but airplanes have not.

Is it true that you aren't allowed to fly on some of these aircraft? I've heard that you've been classified as something akin to a national treasure, and that "they" won't let you fly on some of the aircraft you've designed.

If that's true, what are your thoughts on this? On the one hand, such a situation wouldn't be fair to you, but on the other, it works out pretty good for the rest of us who benefit from your work. What are your thoughts on this?

[randomcaveman](#)

I stopped doing first flights and envelope-expansion test flying in 1978 as a personal choice after a friend was killed on a dive test. I broke my rule in 1996 when I flew with Mike on the Boomerang first flight and flew all the dive and stall tests myself.

I cannot remember being told to not fly.

What was the diciest flight you ever made?

[Jenkins Palabro ESQ](#)

The flat spin in the F-4E at Edwards AFB, 1969. Piloted by Jerry Gentry, with me in the back seat. It remains the only flat spin in an F4 that was followed by a normal landing, not a fireball crash.

How involved have you been personally with the Stratolaunch system?

I think a lot of people primarily associate you with Virgin Galactic, despite the fact that you've been working on a variety of other projects since. I think you should put more publicity into Scaled Composite's role in the Stratolaunch - it's **only the biggest aircraft in the world.**

Also, what is your perspective on SSTOs like the Skylon?

[ion-tom](#)

I sit on the Board of SL, but otherwise am not involved at all.

For two decades I did preliminary designs of a huge launch airplane for orbital boosters, but the current airplane is very different from my earlier concepts.

I've loved your planes since I first saw the series Reaching for the Skies as a child.

If I might ask, of all your designs, do you have a favourite, and if so, which is it?

[codeduck](#)

I used to say "the next one" to that question, but after 2004 I always say SpaceShipOne.

The homebuilt aircraft in attendance at Oshkosh seem to have shifted from fiberglass (in the 80s and 90s) and your designs -- or variants thereof -- to aluminum and more "conventional" designs largely populated by various aircraft from Van's. What do you think is driving this change?

(As a side note, Oshkosh seems... smaller... *older* than I remember it being. It feels like we, as a community, are failing to attract the next generation.)

The Light Sport class seems like it's helping -- a bit -- but GA on the whole seems to be shrinking. (9/11 didn't do us any favors either.) What future do you see for homebuilding, private aviation, and small airports in the United States?

[BryanMP](#)

Once Van started offering kits with matched-holes drilled in ribs/bulkheads/skins I have to admit that their are easier to build than composites.

Also, I am still suffering from sanding carbon fiber dust and getting epoxy everywhere...

SpaceShipOne had lots of large windows. Windows make sense for space tourism. But it seems working spacecraft are stingy with windows. Why?

It seems that breathtaking views would lead to a practical, positive mental health benefit to the crew of a long-term spacecraft. Is there a practical or economic constraint that leads to the decision to include only tiny observation windows instead of actual viewing windows designed with aesthetics in mind?

[richardcpeterson](#)

Windows are heavy and risky.

You could populate the outside with tiny cameras and then show the scene on digital screens, but why

not just stay on the ground.

Interesting, that Cameron, who went to the ocean bottom claims he never looked out of his tiny window !

It seems as though the home built aircraft world has stagnated ever since you left. Any chance that you'll ever return to your origins and release new designs?

Possibly releasing them in a more open source type model to avoid the liability issues that unjustly affected the Rutan Aircraft Factory in the past.

[hertzsaе](#)

Too old and tired to start a new business involving hundreds of customers....

I want to retire and explore after I get my Skill homebuilt flying correctly.

Oh, VariViggen and SkiGull were the only two of my airplanes built in a garage.....

How scalable is the Virgin Galactic model of spaceflight? Would it be possible to increase the passenger capacity with few modifications? Or would the next step be to have a manned spacecraft carried by the [Stratolaunch](#)?

You continue to be a major inspiration to myself ever since my ME college days. May your models be accurate and the heavens bring tailwinds :)

[shark_zeus](#)

VG SpaceShipTwo was designed initially for 9 passengers, and 135 Km apogee. Virgin did not want to sell any "center seats" (even though the top centerline windows had the same space views, so they nixed the 3 center seats.

VG is suborbital, Stratolaunch is to launch orbital boosters - A HUGE difference.

Scrolling through these comments, I see I'm not the only one to be personally inspired by the Long-EZ, VariEze and your other canard designs. As a child, your planes inspired a love of aviation and aviation design in me that persists to this day. I know home-built composite aircraft are probably nowhere on your radar know, but I hope you know how much your creativity has inspired a generation of aerospace engineers and general aerospace dreamers. No question, just appreciation!

[zipzipzap](#)

SkiGull, built in my garage with many of the techniques similar to the EZs is forefront in my radar today....

- [Synergy Aircraft drag reduction](#)
- John McGinnis revealing his **Synergy** double boxtail reminds me of when you revealed the "feathering" reentry design for **SpaceShipOne**.
- Unfortunately, to date, no full scale Synergy aircraft has flown yet. This is where your opinion would be soooo valuable.

- What do you think about their claims of having significantly reduced drag by combining multiple features, beyond just the double boxtail?? Is this design on to something or is it heading in the wrong direction? Should mankind explore double boxtails or try another design?

[longhegrindilemna](#)

I have been candid with the synergy designer in private, but I usually do not publish critiques of other people's designs.

Your airplane and space ship designs are the kinds of things that inspired me as a child and an adult. How is it that you've been able to come up with so many odd and innovative designs for so long? What continues to inspire you and drive you?

[Freeman001](#)

There is nothing else to do in Mojave California. I lived in that small desert area for 46 years.

Hi Burt, I had the pleasure of meeting you up at the Coeur d'Alene phenom pilots meeting. You'd long been an inspiration for my love of outside the box aircraft design.

I'm curious for you thoughts on a few questions:

Did you find much of a materials limitation in the design of spaceship one? Compared to your standard composite aircraft, did the skin thickness have to be increased substantially for the pressure vessel?

Do you think there's any chance a newer spiritual iteration of the Beechcraft starship could come to be in this day and age? It was so far ahead of its turboprop equivalents of that time, even with the burdensome certification financial and weight costs. I ask because as a home builder I've been really intrigued with the idea of a turbofan starship-esque aircraft.

What are your thoughts on compression molded carbon? They're maybe not as strong as your standard directional or weave carbon fiber, but it seems to me the ability to mold in ribs and other complex features with greatly reduced labor and fabrication simplicity has great potential (specifically thinking of pressing whole airframe components).

Thanks for your time Burt, I hope to run in to you again back in Idaho! If you're interested in working on any more fun projects, I'd love to know.

[k2pilot](#)

No, I use structures similar to what I had used for general aviation airplanes. Because my friends would be in space with out a personal spacesuit, I used a safety factor of 3 for the pressure vessel, and made redundant seals and windows. This added very little weight since the shape at every station is a circle, not a shape that bends under pressure.

Good morning Mr. Rutan!

There's a saying that "Sometimes science is a little more art than science." I believe this saying holds true, especially in your case.

Using off-the-shelf components and previously developed designs is something many engineers do. It speeds up production time, many tests have already been done, and the results are more predictable.

Developing new designs and new materials takes creativity and multiple trials. Often times, people hit creative dead ends. Sometimes people become discouraged by "writer's block" or failures. What motivates you through discouragement. How do you get over the "writer's block"?

Many people, myself included look up to you. Who do you look up to?

[Pele2048](#)

kelly johnson and von Braun

What do you think about Scaled Composites building [Stratolaunch](#) ?

[ballthyrn](#)

What they are doing is amazing. The world's largest aircraft, and its all composite ! It is by far today's most exciting shop tour, but unfortunately they do not give shop tours.

I spent about 21 years doing concept designs for what became Stratolaunch, but we did not get a customer for it until after I retired. I am not the designer of the current airplane, others made major changes to my preliminary designs.

Mr. Rutan you and your team are AMAzing! I have no background in your field so this may sound dumb but, up to which part of the space did the SpaceShipOne flew? Did it actually reach the "space" as the name suggests, or did it flew only at the areas where airplanes, jetplanes could fly at?

[rescure](#)

international definition of space (out of the atmosphere) is 100 km, or 62 miles. SS1 flew to 69.7 miles.

We have all seen the recent announcement of the astounding New Glenn rocket by probably your biggest competitor in commercial suborbital space, Blue Origin. Are there any similar follow up plans at Virgin Galactic for when Spaceship two is "complete"? Maybe a Skylon competitor ... ?

[CSX6400](#)

Competitor? My Scaled company was always focused only on research, not offering product to the public. So I never considered that VG or BO were competitors.

Hey Burt! I am currently in a Materials Engineering undergrad and am curious what advice you could give me moving forward in my degree? How does someone get into industries like research aviation? And what do you think the future of materials is? Thanks!

[BeerMolecule](#)

Of course I would love to see materials breakthroughs. 20 years ago I predicted that thermoplastics would replace thermosets for aircraft structures. It did not happen, to my disappointment, even though I did some research on them. at the time I had Dr Sam Williams convinced to use them on V-Jet production.

Hello sir! To what extent do you think your creations have catalysed the growth of the "affordable"

space travel industry? And how affordable do you foresee it to become in this century? Thanks in advance.

[ottamind](#)

I made a prediction in 2004 that in about 15 years it would be routine, flying more than 10,000 people per year with competing space lines for <80k\$.

I was wrong...

I was working at the Mojave Air and Spaceport on Halloween two years ago when the VG accident occurred. That day was very emotional and difficult to comprehend. Watching White Knight Two land alone was a sight I will never forget.

Did you learn any important lessons from that day that you'd like to share with an aerospace engineer just at the beginning of his career and dreaming of one day going into space myself?

[ZuluGestapo](#)

That happened 3 years after I retired and left California. Best to ask those who were there.....

Burt,

Your designs have always resonated with me. I am always shocked to hear of fellow aerospace students or colleagues who don't know of you and all of your accomplishments.

Question: What is the current progress of the Skigull? I absolutely love the idea of an all terrain trans-ocean motor glider. It seems to be the perfect retirement aircraft. Will you be taking your 'Mitty' trip soon? Hope all's well. Thanks for your time.

[Quantum_Shadow](#)

some of the features of skigull did not work properly in test, so I am now making modifications. I do not plan to give up on skigull goals.

I'm just starting my aerospace career and find it quite frustrating at times. Is there a specific project/issue that especially sticks out in your mind. One that really gave you a run for your money?

[allez2015](#)

I guess that luck played a role, but I enjoyed a 46-year career developing 47 airplane types while never being afraid of any competitor.

I'm a new pilot, and I am fascinated with canards. I cannot wait to fly one of your planes (or spaceships? One seems more likely!). What was your inspiration for using the canard design? Your aircraft and spacecraft are beautiful machines, sir!

[rabble-dabble](#)

I was inspired by the SAAB Viggen and the B-70.

Burt, 9 years ago I was an intern at another small rocket company in Mojave. Before I left, I gave a

notebook full of sketches of (probably mostly terrible) aircraft-related ideas to the secretary at Scaled Composites to give to you. Did you get the notebook, and if so did any of the sketches in it provide any useful inspiration?

[AarontheSpaceBaron](#)

I do not recall specifically....

Which company did you intern at? What did they show?

Hi Burt, I have been following you for years; reading about your homebuilt aircraft in the early days and your work that was bought by Virgin and your new Stratolaunch system. You are a massive inspiration. I was wondering what you think about the feasibility of a suborbital/ballistic airline? Something that could take-off on a reusable booster like White Knight or a SpaceX or Blue Origin booster and then land half way around the world in an hour and change? It would surely be a niche market at first but not without it's takers. Any thoughts you have would be great! Thanks again for doing this AMA and for making all the great aircraft designs over the years. FYI my favorite design of yours is the Rutan Quickie.

[Silverbodyboarder](#)

A flight like ss1 (boost, parabolic coast, reentry and landing) does not work for distances over about 500 miles. Too high on the coast and you cannot survive reentry.

Thanks for the AMA, Mr. Rutan! Where do you see general aviation in five years?

[antiquekid3](#)

marginal improvements in this short time period. Will see improvements in cost due to manufacturing methods for composites, and the use of automobile-like systems.

I do not see the advantage of electric aircraft and will not, until batteries have at least a 4X improvement in energy density.

Remember, regardless of the range, electric airplanes burn coal of fossil fuels, and do it with much lower overall efficiency than a Rotax 912IS.

Burt, I'm in Ridgecrest and would love to visit the site for the next test. Any idea when that would be?

[DJ-Anakin](#)

I live in North Idaho, nearly Canada. Those Mojave rascals do not give me schedules....

How hard do you believe it is for fresh engineering graduates to come out of universities and find positions in aerospace/aeronautic companies? Especially for electrical engineers that don't have any particular specializations in said topics, would you recommend we find more general jobs for experience first?

As always, keep up the great work!

[OddlyRoger](#)

Scaled Composites is hiring, even paying their employees bonus \$ for finding engineers.

I just came here to say I think you're awesome. Also, a question: I inherited a signed, framed picture of the Voyager from a grandparent, but have always been curious about the signature--it looks like 'Geo "Pop" Rutan' Who's signature would that be?

[jello_drawer](#)

My dad.

Born in 1916 Died in 2009

Hello Burt.

What is the biggest hurdle for aerospace in the coming future and what can I do to help?

[expatmiguel](#)

The phenomenal work done during the 1960s (America developed and flew 7 different rocket systems to launch men to space in just 9 years) was done at a time when America's people and its Leadership thought that being an Exceptional country, and showing the world ho exceptional we were, was very important.

Without that, prepare fore continued boredom....

So, your plans for the next big adventure are?

[Kflynn1337](#)

To get SkiGull working properly so Tonya and I can enjoy some world exploration.

Once you have the goal of whatever you're working on, what's the first part you typically start to design?

[Porsche_Curves](#)

the outside mold line. Make it as small as possible for the known payload. Then revise it as needed to fit all the other systems inside.

I have been impressed with your work for many years. A while ago, I saw a post online that said that you were a climate change denier, which it turns out was a very unfair statement. I read your PDF on the subject, linked below, but was wondering if you could give a summary of your thoughts here? I think you have a very unique and non-alarmist perspective, and would love to see some discussion about it in this AMA. Many thanks!

<http://burtrutan.com/downloads/EngrCritiqueCAGW-v4o3.pdf>

[nthdesign](#)

The PDF, even though it has not been updated in many years, speaks for itself. I am not a climate scientist, just an engineer who has spent a lifetime looking at data, and was horrified to see what the scientists were doing with the climate data.

Many years ago, I read an article on the iterative process you went through in coming up with the Boomerang's design. It made me appreciate just how sensible and logical changes lead to such a radical shape.

So what else is there out there to fix in conventional aircraft designs? You've solved the two-engine problem, spins can be designed out, so what gaping holes in aircraft design need to still be addressed?

[swordgeek](#)

I dreamed up the Beech Baron iteration steps after the Boomerang had flown, in order to show what the advantages were to someone who is totally confused about the rationale.

Working now on SkiGull so it can eliminate the most popular fatal accident with Amphibian seaplanes (land on water with gear down, flip over and pilot drowns. Skill now has a retractable tricycle landing gear that should be fine if it lands on the water with the gear down.

Dear Burt Rutan, I just read Ed Heinemann's autobiography and have enjoyed many other books by aircraft designers, Igor Sikorsky, Gerhard Fieseler, Kelly Johnson, Geoffrey de Havilland, etc, etc. Will you consider writing your own, focused on the aeronautical side of things, your evolutionary thought processes while you did your many designs? I'd love to read it. Also, which designers do you admire?

[Buddingastronomer](#)

I do plan a autobio focusing on what you list.

I did get a chance to meet Ed, Kelly, Jack Northrop - all very impressive folk.

when designing a new aircraft, what proportion of your time is spent sketching it out and what proportion is solving equations?

[meat_croissant](#)

for my first 12 aircraft we did not have any relevant computer software, not even a spreadsheet, so I spent about 25% of my time writing software for design, test data reduction/presentation, lofting, etc.

Huge fan! Would love to fly a Long-EZ one day or in a Beech Starship. What beautiful designs.

1) If you had an unlimited budget, what project would you pursue now? 2) What do you think of the approach of Blue Origin building single stage fly back boosters with a capsule as compared to your approach of a mothership and hybrid rocket motor? 3) Hindsight being what it is, are there any broad, strategic points you'd change about the process you've gone thru from 2004 to now with Space Ship Company and Virgin Galactic? (It goes without saying if you could have made a change that would've prevented loss of life, you would have.)

[FurryFeets](#)

B O has spent a bunch of time, working methodically toward a commercial suborbital system. They have demonstrated that it works by multiple un-manned flights.

However, if they compete directly with the method of SS1, their per-seat operational costs will be more than twice that of a system that uses the SS1 method.

What would you say would be the best way for someone to get into space as an astronaut if they are from a country that has very little to do with manned space flight? Could the increase in private space companies be the best route for those without the citizenship requirements to get into somewhere like NASA/ESA?

[wabbidywoo](#)

Hmmm..... Interesting that today, NASA and ESA cannot take anyone to space. Weird.

I remember learning about the "Rutan Boomerang" back in aerospace class, and how sometimes impractical-looking designs can work very well. Have you come up with any other designs that are even stranger-looking that you wish you'd got to actually build full-size? What role do you think improved computer simulation of fluid mechanics will play in making weirder-looking aircraft in the future?

[DrSuviel](#)

The fluid mechanics simulations work great in analyzing a known design. But they do not create new designs.

Hi Burt,

As a professional pilot you are one of the most inspiring figures in the industry, and before anything else I'd like to thank you for your achievements and the effort you put into pushing the boundaries of aviation. The things you've accomplished are damn amazing! I just have a few questions:

1. If I wanted to get into the manufacturers side of the industry and flight test, how would I do it? The stuff you guys build is so cool and out there, how does someone get the experience to fly things so aerodynamically different?
2. Of all the things you've been a part of, which project are you most proud of?
3. I have been following the development of the Skigull - what a badass design by the way! - I remember there being some less than adequate stall performance during tests, what do you plan on doing to make the stall characteristics more favorable?

Thanks Burt!

[gypsydrifter](#)

Just sent Resume's to the companies. Scaled is hiring, as well as many others.

SpaceShipOne.

leading edge modification to get stall warning and eliminate the wing drop.

Hello Mr. Rutan, and thanks for doing this! Are the circular windows on your craft more cost effective than a standard window for how strong they are? Is that cost an effective trade for reduced pilot visibility?

[mach-disc](#)

reason for the round windows was structural weight and structural risk, not cost. Each window was two panes with the interior one holding the pressure and the outer one being redundant in case of failure of the interior one.

From a visual standpoint, what is your favourite airplane? Mine are the Long EZ and Quickie.

[andersonsjanis](#)

SR71 for visual. Boomerang for function.

Mr. Rutan, I just want to express my thanks for your contributions in aerospace. I have watched your creations for so many years and spent years at Edwards and the NTPS, watching the early development of your space program.

I hope to see many more visionary endeavors in the future.

Thanks to you and the entire team out there for the great work.

[myrandomredditname](#)

You are welcome!!

Mr. Rutan,

You are an absolute inspiration for many of us interested in aircraft design. Thanks so much for doing an AMA!

I would love to know, what inspires you when you begin to design an aircraft?

[OneAviatrix](#)

I do not know. However, the ideas usually come when I awake from a good night's sleep.

Are you upset that the inquiry into the loss of spaceship one claimed design error was the cause? It seems unfair.

For those not aware, it was stated that the design of the craft allowed the pilot too much freedom in piloting and didnt have adequate automatic recovery features. The actual cause of the accident was pilot error.

[dontbothermeimatwork](#)

you mean SS2, not SS1.

SS1 is not lost - just look in the Milestones in Flight Gallery at the Smithsonian National Air & Space Museum.

Have you changed your mind about global warming?

If not, how do you explain the record hot temperatures for almost 3 years in a row at the same time the sun is at record low activity?

[Archimid](#)

My hobby of researching presentation fraud of GW data stopped in ~ 2010, when it became clear that it was no longer needed. I do not follow it nowadays in any detail.

I believe the fraud is still there, of course. It is a lot more political than scientific.

If you are interested it a search for the unbiased truth - data, not politics you can start here:

<http://www.c3headlines.com>

Mr. Rutan,

I just want to congratulate you and your brother and Ms. Yeager for that monumental achievement so many years ago.

The real question is, where do you see aerospace design in thirty years? We see NASA devoting research to better, more efficient airfoils designed to achieve supersonic flight over Landmasses. If successful, how long would it to realize the practical application of this research? How would this breakthrough impact general aviation, in your vision? I personally believe the impact would be minimal for many years, as there will always be a place for low and slow flying etc.

Thank you for your time and your beautiful aircraft.

[SoyMurcielago](#)

I published my views on this for the 100th anniversary issue of Aviation Week magazine.

I've been following your work since the the quick Ez and all your kit canards. I knew then if you had ever been offered real financial support you would do something great. Any chance you will go back and rehash some of those older designs with what you have learned? A sort of trickle down from the space X race back into general aviation?

[Joshua Seed](#)

would be fun indeed, but I am too old to want to do it now.

I will watch with joy as others do it !

Given the technical limits (weight, fuel) against crew comfort and supply, how do you foresee solving long-duration missions? Do you anticipate a biological or technical solution winning out, and what would that look like? (if it isn't a hybrid)

Thanks.

[zxcvb94105](#)

Long duration flights.... like a trip to Mars??

Most of the folk who endured the very dangerous covered wagon trips to california did not come home. They stayed there and made a new home partially because they feared another dangerous voyage.

When you were a kid, what is your job dream?

[tonypham003](#)

As soon as I saw that formation of B-36 homers fly over my backyard when I was 9 or 10, I knew what I wanted to do.....

What other X-Prize contestant were you most eager to see succeed, for the sake of their design?

[putins_humble_nikola](#)

The only one that I thought might be a serious competitor in the future space tourism market was the Russian one.

To what extent was the X-Prize a motivating factor in SpaceShipOne?

Would you have done it without the prize being out there?

How did the prize change your thinking?

[pm_me_your_kindwords](#)

The X-prize motivated us and Paul Allen only after early 2004, when they finally had the 10M\$ prize available to be awarded to a winner.

In early 2001, I did scale up my prelim design for 3 seats, in the event that they would eventually get it funded.

Can you share any cool designs or doodles that you never got to make?

[CitizenPremier](#)

47 of my designs flew manned flight tests. The list can be downloaded at burtrutan.com.

SkiGull is my 375th design that went through the concept stage. Most of those 375 will be shown in my autobio.

Burt, I have crossed paths with you and your aircraft a couple of times: the beautiful Beech Starship flew past my little Cessna near General Fox/Palmdale, I bolted a research sensor to the bottom of your amazing Proteus aircraft, and I made the drive to watch flight 15P of SpaceShipOne (the first to break 100k altitude). As a young engineer, your visions and design were inspiring.

My question for you: Which of the SpaceShipOne flights was the most exciting? The first powered flight? The first feathered flight? The first to break 100k? The winning X-prize flight?

[SaltedAndSmoked](#)

Most exciting and historic was 15P

Hi Mr. Rutan, a two part question: Any plans to return to twitter & did the guy you gave a shoutout last year pay his burger debt yet?

[Malhallah](#)

I have never done twitter or Facebook. Just no time. May do it after I retire.

Hi Burt!

My father and I have been big fans of your work for a long, long time. We used to talk for about your latest efforts whenever we got in a new magazine about airplanes. He even designed and built a RC model based on your Quickie from scratch.

Up until recently, most of the aircraft industry has stuck to pretty conventional designs. With the advent of better computer control systems, we're seeing a lot more flying wing recently, as with the B-2 and various UCAVs.

Do you think that's going to be the "end of the road" as far as aircraft design, or will we see more research and innovation with novel shapes and configurations? And who will do that?

[ansible](#)

You can only have an END OF ROAD if you are meek and fearful. Courageous folk will assure there is no end to the road.

If anyone could design a flying car that's safe for anyone to drive it's you. So where is it? What is the biggest challenge in making this sort of thing happen?

[always-there](#)

Answered a few questions up....

Hi Mr. Rutan,

My hometown of Dinuba has you listed as one of the great individual that's from the area. What are some of your memories and do you still have any roots in the Dinuba area? Congratulations on all the success and thank you for your time.

[Maxable 83](#)

All my model aircraft work, including competition at the Nationals, was done in Dinuba. I soloed at a duster field, Alta Airport just east of dinuba.

I left there to go to college. while at college, my folks moved away so i rarely went back.

First off, huge fan. I've always been fascinated by the Pond Racer. As I understand it, Bob Pond wanted the aircraft to follow the configuration of the P-38, but as I also understand it, that is not the ideal configuration for aerodynamics given the greater frontal area and higher number of fuselage-to-wing intersections. If you were given free-rein to design another Unlimited racer, how would you do it?

[RandyBeaman](#)

Pond did it so as to keep the racing crowd from destroying the few remaining WWII acft engines. I do not recall him specifying a shape of the loft.

When will it be ready for trivial trips to the ISS ?

[Vendura](#)

ISS is run by NASA.

Trivial trips there will never be available.

Actually, the SkyLab would be a lot more fun to visit than the cramped science-lab rooms of ISS. Skylab flew in 1973, just 4 years after go-ahead.

Do two things, google to find the video of the guys running around the 360-deg "floor" of skylab using centripetal force to run on. Visit NASM in DC and go inside a real Skylab (backup).

What do you think about the state of the world when you fly over it?

Wars, misery, poverty, inequalities

[Scellow](#)

i enjoyed flying from Mojave to Oshkosh Wisconsin and back each summer for 39 years. That trip includes the Colorado Rocky Mountains, the plains of Nebraska and the Grand Canyon.

Each year I enjoyed the view and I never once saw the four horrible things on your list.

Ever since I heard of your journey around the world on Voyager, I wondered: What was it like inside? How was sleeping, space, how did you eat? How was restroom business taken care of?

[Forte845](#)

Hard to believe it has been nearly 30 years since the Voyager flight !

Your questions have been answered in the Voyager Book, published in 1987.

Can you tell me something technical regarding planes safety ? I'm terribly afraid of flying and people aren't helping with their "it is safer than driving" . Its unnatural , seems like I could plummet to my death anytime and die a horrible death

[KoifishDK](#)

Look at the statistics. If you drive a car from coast to coast you risk of death is several hundred times greater than an airline flight.

Just wanted to say thank you for the Long-EZ and the education you provided around composite construction.

I still have my copy of Moldless Composite Sandwich Aircraft Construction.

[nettdata](#)

This book is still used at the North Idaho College Composites manufacturing courses.

Good morning Burt!

I wanted to let you know that you are still a household name in my family of aerospace engineers.

While many people know you for your milestones in aviation history, one of my favorite projects of yours was the attempt at making a CAS plane the ARES. I followed the progress of that aircraft as a child and I still love the weird little guy!

I know it was passed over by the military but I felt it was a very innovative approach. My question to you is do you see your company working on developing any other aircraft with military use in mind? I've always felt that your company could really innovate in the field of lightweight, long range, and long loiter time UAVs but I've not heard anything about ongoing development from your shop.

As someone who looked up to you and your company as a kid (and I still do now) it's awesome to see you on Reddit! Good luck going forward on your plans, I'll be eagerly watching.

[coothless_cthulhu](#)

ARES has done some very impressive things for military research, even though it never had a production line.

It was actually partially built at RAF, after Scaled was founded.

Wish I could tell ya more.

Mr. Rutan, you've been an inspiring figure in aerospace and my family has followed your work with interest for years. Any chance you will release the BiPod specs, or even plans, in the future?

Thanks for your time!

[sleet01](#)

love to, but I do not own them.

Mr. Rutan, Thanks for being an inspiration with your elegant designs and achievements. These days all we seem to hear about is Tesla and Space X. What other players in the aerospace industry would you bet on? Who has inspired you?

[rob5i](#)

I have a huge respect for my friend Elon Musk. I had the honor of presenting the Oral argument in Washington DC for him to receive the Collier trophy.

The only thing missing there is he needs competitors, to force him to keep up the focus on cost to fight for market share.

As an aspiring homebuilt airplane designer, first flight in a one-off airframe seems like the most daunting milestone. Do you have any thoughts you could share relating to your first flight of a one-off design? (Particularly when you were new to manned airplane design)

[Science6](#)

Good luck and have Fun.

The most fun anyone can have at an airport is to witness the first flight of a new type aircraft.

I recon I have seen more of them than anyone..... !?

Is there a possibility for aerospace related internships at Scaled Composites?

[NotBacon21](#)

Check at Scaled.com.

I did not allow it when I ran scaled due to the risk of disclosure of proprietary customer information.

When do you think the cost of space travel will be under 100,000k per person for 36 hours in space

[tolerant_man](#)

in late 2004, I predicted about 22 years.

I was wrong, since the intermediate goals were not met.

Mr Rutan, here are a few topics I think could benefit from your perspective. There are a lot.

In your opinion is the civil certification process too onerous? Could it be streamlined while maintaining extremely high levels of safety for the public?

Do you think analysis should supplant testing to a larger degree? If so what's holding it back? (I occasionally remark that Patran hasn't changed since I had hair, and Nastran barely so. But my phone is a 1975 supercomputer.)

Why do we keep designing the same airliner over and over since the 707? Is that truly the last best planform or is something else going on?

How important is talent? Is there such a thing as key personnel in aero?

Will air-breathing boosters happen? Should they?

Was the Starship a failure? Why? What was learned?

Is there an interesting story behind the Voyager winglet scrape-off?

Thanks, have a good one.

Edit: one more...how do you size those organic cutouts you like so much? SOL 200? Do you have a macro? Can I borrow a copy?

[prin_math](#)

The Part 23 and 25 regs are not onerous, but the process is.

I have always been a test guy, not heavy on analysis.

Boeing and AirBus are not able to accept the risk of failure on any new product.

White Knight and Stratolaunch are efficient, reusable air-breathing boosters.

Starship and Voyager true stories are interesting and will be covered in my autobio.

How did you get this far? What's your origin story?

[oorr23](#)

I do plan an autobio, with free downloads of each chapter as each gets finished.

In the mean time, click around at burtrutan.com

As the designer of some very interesting and unorthodox aircraft designs, what aircraft or even parts of aircraft do you find to be impressive from a design point of view?

[pjz4302](#)

SR71. For many reasons: materials, propulsion, aerodynamics, stealth.

At my first job after college, the SRs would run up for flight just outside my window at EAFB. This was only a year after they were revealed to the public.

Burt, Fellow aviator and Model aircraft enthusiast here... I really like your APGW videos on youtube... Do you still have the same stance on the issue or has it changed?

[Austinswill](#)

same stance. just no time now to pursue that hobby. I have had about 5 different hobbies during my career, each lasting about 6 to 8 years.

The Beech Starship is one of my favorite aircraft designs of all time and SpaceShip and White Knight are absolutely incredible. If you have any stories about the design of the Starship we'd be fascinated to hear them.

I have only one question - did you know LEGO once made a set inspired by the Beech Starship?

<http://brickset.com/sets/1818-1/Aircraft-and-Ground-Support-Equipment-and-Vehicle>

[Sastrei](#)

The Starship chapter in my autobio will be a fun read, indeed.

I was in Mojave recently and found your old energy efficient house out in the desert...what cool features does that house have that you're most proud of?

[OompaOrangeFace](#)

Only desert house that uses less energy in the summer than the winter