2

Revolution through Competition

> "Gentlemen: As a stimulus to the courageous aviators, I desire to offer, through the auspices and regulations of the Aero Club of America, a prize of $25,000 to the first aviator of any Allied Country crossing the Atlantic in one flight, from Paris to New York or New York to Paris, all other details in your care.
>
> Yours very sincerely,
>
> Raymond Orteig"

THE ORTEIG PRIZE

The prize offered by Raymond Orteig, was announced in 1919. Eight years later, four pilots had been killed, three others had been seriously injured, and another two had gone missing. Despite these failed attempts, US Mail pilot Charles Lindbergh (Figure 2.1) reckoned he had a chance. He persuaded a group of St. Louis businessmen to support his attempt, using their financing to build an aircraft he called the *Spirit of St. Louis* in honor of his sponsors.

At 7:52 a.m., on 20 May 1927, Lindbergh fired up the *Spirit of St. Louis* and pointed the custom-built, single-seat monoplane (Figure 2.2) down Roosevelt Field. Heavy with fuel, the plane tracked down the muddy runway, before finally becoming airborne, almost touching the telephone wires at the end of the field. There were those who reckoned the plane's single-engine design wouldn't be capable of a trans-Atlantic crossing. They had a point. After all, previous attempts had used multi-engine planes. They had also included co-pilots, whereas Lindbergh had opted to fly solo. Lindbergh also decided against taking a parachute or a radio, choosing to take more fuel – decisions prompting newspapers to call him "the flying fool".

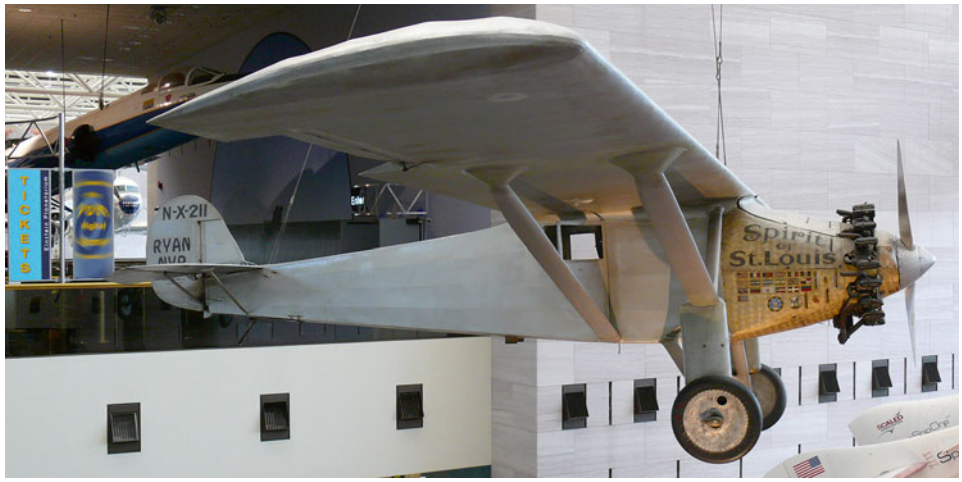
Lindbergh flew over Cape Cod and Nova Scotia, reaching the Atlantic at dusk. Fog made navigation challenging, and sleet formed on the *Spirit of St. Louis* as it flew through the clouds. Fighting drowsiness, Lindbergh struggled to stay awake as he sometimes flew

E. Seedhouse, *Virgin Galactic: The First Ten Years*, Springer Praxis Books,
DOI 10.1007/978-3-319-09262-1_2

2.1 Charles Lindbergh, with the *Spirit of St. Louis* in the background. Courtesy: Wikimedia/ Library of Congress

only three to four meters above the ocean. As he approached Europe, he spotted a fishing boat and, a short while later, he reached land. He flew at an altitude of only 500 meters over Ireland and England, before heading towards France as darkness fell. Shortly before 10 p.m., he saw the lights of Paris, where his landing was witnessed by 100,000 people. The crowd swarmed around the *Spirit of St. Louis* and hoisted Lindbergh on their shoulders. He had covered the 5,810 kilometers in 33.5 hours, and had won the Orteig prize! The papers redubbed him "Lucky Lindy".

On his return home, Lindbergh toured 92 cities in 49 states, and received the Medal of Honor and the Distinguished Flying Cross from President Coolidge. His New York



2.2 *Spirit of St. Louis* photographed in the National Air and Space Museum. Courtesy: Ad Meskens/Wikimedia

reception was the among the most raucous in the city's history, with four million people lining the parade route. In 1941 Lindbergh resigned his commission in the reserves, but served during World War II as an advisor. He also flew a number of combat missions and shot down a Japanese plane. After the war, he worked as an aviation consultant and visited several countries in Latin America at the US government's request of the US government, but he will always be remembered for his epic flight – one that became a singular event that not only captured the world's attention, but changed history and laid the foundation for the development of the aviation industry. Lindbergh later chronicled his daring flight in a book entitled *The Spirit of St. Louis* – a publication that served to inspire a doctor with more than a passing interest in flight. His name was Peter Diamandis.

PETER DIAMANDIS

Born on 20 May 1961, just weeks after Alan Shepard became America's first astronaut, Diamandis was eight years old when he watched Armstrong and Aldrin set foot on the Moon. The Moon landings had a profound effect on the young Diamandis, who decided spaceflight would be his life's mission. He set his sights on becoming an astronaut, deciding that obtaining a medical degree would help his application. To fulfill the undergraduate requirements for medical school, Diamandis studied molecular biology at the Massachusetts Institute of Technology, where he also gained a master's degree in aerospace engineering. While at college, he met NASA astronaut Byron Lichtenberg, who painted a rather bleak picture of astronaut selection, telling Diamandis (Figure 2.3) that the chances of being selected were slim and flights were few and far between. Lichtenberg's account didn't go down well with Diamandis, who decided he would find a different way to get into space. He didn't know how until several years later when a friend gave him a copy of Lindbergh's

2.3 Peter Diamandis enjoying parabolic flight. Courtesy: Peter Diamandis

book. Lindbergh's book gave Diamandis the inspiration he needed to create the X-Prize (the "X" stood for the name of the benefactor who remained nonexistent for a long time), figuring that, if it worked for Lindbergh, it could work for spaceflight. And, if it did work, then perhaps Diamandis would get that spaceflight he had been dreaming about for so long. The first step was to find seed money to get the idea off the ground. The active space communities seemed a good fit, but Diamandis's friend, Doug King, the President of the St. Louis Science Center, suggested that St. Louis would be the ideal place to launch the Prize [1]. It was a logical choice of location. After all, St. Louis was where Charles Lindbergh raised the money to build his aircraft, it was home to the McDonnell Douglas Corporation which built the Mercury and Gemini capsules, and St. Louis is historically known as the Gateway for early exploration of the West [1]. Diamandis met with Al Kerth, head of the St. Louis community's Civic Progress Organization, who was quickly convinced of the potential of the X-Prize, suggesting they find 100 St. Louisans to each pledge US$25,000. Donations followed and suddenly the X-Prize was news. Big news.

RICHARD BRANSON

We'll return to the X-Prize shortly, but before we do, we need to introduce another key figure in the genesis of what was to become Virgin Galactic: Richard Branson (Figure 2.4). A renegade billionaire who made his money by making bold plans profitable, Branson was knighted in December 1999 for "services to entrepreneurship". Not bad for a high-school dropout who started his business empire with a mail-order record company called Virgin to help fund his magazine efforts [2]. The mail-order company quickly became a record shop in Oxford Street, London, and, with the success of Virgin, Branson was able to build a recording studio. From there, the Virgin brand was seen everywhere: everything from cars to cosmetics. A believer in living life to the fullest, Branson has experienced some epic adventures. He made several record-breaking attempts to make the fastest Atlantic Ocean crossing, the first of which was in the *Virgin Atlantic Challenger*, which capsized. Branson was rescued by RAF helicopter and received wide media coverage [2]. Then, in 1986, in *Virgin Atlantic Challenger II*, with sailing expert Daniel McCarthy, he beat the record by two hours. The following year, his hot air balloon *Virgin Atlantic Flyer* crossed the Atlantic [2]. In January 1991, the eccentric adventurer crossed the Pacific from Japan to Arctic Canada – a 10,700-kilometer journey, in a balloon, breaking the record for the trip with a speed of 390 kilometers per hour. Branson's next goal was to fly around the world in a balloon. In December 1995, Branson was stuck in the Marriott hotel in Marrakech, Morocco, with Will Whitehorn, waiting for favorable weather to carry the *Global Challenger* balloon on what Branson hoped would be a circumnavigation of Earth. Joining Branson and his co-pilot, Per Lindstrand, was Buzz Aldrin. Since retiring from NASA, Aldrin had played a leading role in promoting a continued role for the US in manned spaceflight. At one point in the evening's proceedings, Branson asked Aldrin why rockets were launched from the ground and not from a balloon. Aldrin replied that the US government had experimented with the concept but, after Sputnik, the tests were put on a backburner as attention was focused on the Gemini program. The following day, Branson made a note to register the Virgin brand for space.

2.4 Richard Branson at the Time 100 Gala, 3 May 2010. Courtesy: David Shankbone/ Wikimedia

The 1995 circumnavigation attempt failed but Branson persisted. In 1998, Branson, Per Lindstrand, and Steve Fossett made a record-breaking flight from Morocco to Hawaii before crashing in the Pacific Ocean. Fortunately, rescue services were nearby. Branson was unable to make another attempt before Bertrand Piccard and Brian Jones circumnavigated the planet in their *Breitling Orbiter 3* in March 1999. Looking for a new challenge, Branson decided to finance Steve Fossett's quest to fly an aircraft nonstop around the world. It was this endeavor that first put Branson in contact with Burt Rutan, when Scaled Composites was commissioned to build Fossett's aircraft, the *GlobalFlyer*. While in Mojave to check on the progress of *GlobalFlyer*, Will Whitehorn, Branson's project

manager, noticed a pair of unusual aircraft on Scaled Composites' shop floor: SpaceShipOne and WhiteKnight. Recalling Branson's discussion in Morocco, Whitehorn immediately phoned Branson. Rutan later pitched Branson's enthusiasm for the SpaceShipOne project to Paul Allen, who was writing the checks. Negotiations between Allen and Branson followed, with the outcome that Virgin would purchase an exclusive license to SpaceShipOne's design and technologies. But that couldn't have happened without the X-Prize, so let's return to 1996.

On 18 May 1996, Diamandis, along with NASA Administrators, FAA Associate Administrators, Buzz Aldrin, Owen Garriott, Byron Lichtenberg, and 17 other astronauts and members of the Lindbergh family, stood underneath the St. Louis Gateway Arch, and announced the $10 Million X-Prize for the first team to fly two flights to the edge of space within two weeks (see sidebar). More than 50 media outlets were on hand to report the event. All they needed now was a sponsor to come up with the US$10 million. Diamandis was optimistic, thinking the hardest part was behind him, but finding a title sponsor was to prove a challenge. He presented the concept to several CEOs, but most thought the venture too risky. In 1997, Diamandis traveled to the UK to pitch the idea to Branson, suggesting they call it the Virgin X-Prize. Branson also thought it too dangerous, but Diamandis persisted and, in 1998, he met with Will Whitehorn, who was to become Virgin Galactic's president. Whitehorn liked the idea, but explained that Virgin wanted to build the venture into a business rather just sponsor a prize. He promised Diamandis that Virgin would keep their eye on the project and Diamandis went back to his search. The following year, Whitehorn took a trip to the Mojave with Branson to take a look at the Rotary Rocket (the Roton Atmospheric Test Vehicle, or ATV), a single-stage spacecraft being developed to deliver payloads into space. Whitehorn and Branson witnessed what proved to be a disappointing test flight, but they did get the opportunity to meet Burt Rutan who had helped develop the ATV. Sitting in the Voyager restaurant at Mojave Airport, Whitehorn, Branson, and Rutan discussed possible mission architectures that involved a mothership with a spacecraft slung underneath. The two vehicles were to become the genesis of a secret space project run by Scaled Composites.

X-Prize Rules

1. Build a manned spacecraft. No government funding allowed.
2. Launch three people in the spacecraft to 100 kilometers altitude and return to Earth; this requirement ensured the vehicle would be capable of transporting a pilot and two fare-paying passengers
3. Repeat Step 2 within two weeks; Diamandis wanted a spacecraft capable of repeated flights akin to an airline

Meanwhile, Diamandis continued his search for a sponsor. In 2002, he reckoned he had found one. In 2002, Anousheh Ansari (Figure 2.5), an engineer and the co-founder and

2.5 Spaceflight participant Anousheh Ansari holds a grass plant grown in the Zvezda Service Module of the International Space Station. Courtesy: NASA

chairwoman of Prodea Systems, told a reporter she wanted to fly in space.[1] Diamandis happened to read the article published in *Fortune* magazine and arranged a meeting with Ansari, her husband Hamid, and his brother Amir, who also happened to be space enthusiasts [1]. The timing was fortuitous because the Ansari family had just sold their company for US$750 million, so they weren't short of money. Diamandis traveled to Dallas, where he gave a PowerPoint presentation to Amir and Anousheh, who were sold on the first few slides. As entrepreneurs, the Ansari's knew the huge amount of work it would take to make Diamandis's idea succeed, but they were captivated by his enthusiasm for the project. His vision resonated with the Ansari family, who had been looking for a commercial route to space. They had looked at options, but they hadn't been impressed. The attraction of the X-Prize was that the Ansari's didn't need to decide which company had the greatest chance of building a spaceship and they wouldn't have to pay unless someone won. The investment also acted as an incentive for teams from around the world to compete, and those teams would find sponsors to invest in their technology. The Ansari family signed on to sponsor the prize, which became known as the Ansari X-Prize [1]. Under the terms of the insurance policy, the prize had to be won by the end of 2004. If the prize wasn't claimed,

[1] Ansari got her wish with a flight to the International Space Station in 2006, becoming the first Iranian in space.

the insurance company, XL Capital, would pocket the premiums. For XL Capital, it must have seemed like a good bet!

ANSARI X-PRIZE: BUILDING A SUBORBITAL *SPIRIT OF ST. LOUIS*

26 teams entered the X-Prize. Among the those that took up the challenge were a Californian aviation hero, a Second World War Navy pilot, and aerospace experts from Argentina, England and Russia. Many of the teams included those who had been involved in commercial space travel long before Diamandis's X-Prize was envisaged. While several teams chose to develop high-altitude aircraft or ballistic rockets, with no government involvement it wasn't surprising that these companies used their ingenuity to design all sorts of entries. Some were qualified to do what they were trying to do whereas others were … well, let's just say they were probably going to hurt somebody. In many ways, the competition echoed the earliest days of aviation with a touch of Darwinism thrown in, creating an environment in which only the strongest and smartest survive. The entries included spacecraft shaped like discs and spheres. Some were built out of metal while others used composites. Looking at some of the computer-generated concepts was, in some cases, akin to viewing art in a science-fiction gallery. Here's a snapshot of some of the entries.

Da Vinci

One of the front-runners was Canadian rocketeer, Brian Feeney, who was confident that his sleek *da Vinci* spacecraft would be the first to reach space. The *da Vinci* vehicle was designed to be carried to high altitude beneath a balloon before being dropped and rocketing into space. After re-entry, the vehicle would glide to a landing suspended under a parafoil. Feeney's design was based on solid engineering, good science, and it featured several layers of redundancy [3]. If the primary and secondary sets of explosive bolts (which separated the rocket from its balloon tether) failed, the rocket engines would shut off, and the capsule would separate from the rocket and parachute [3]. There were two backup parachutes in case the main parafoil didn't deploy and, even if all three failed, a ballute would probably save the pilot [3]. And even if the ballute failed to deploy *and* the parafoil failed, the pilot could separate the capsule and float down on its chutes. In an absolute worst-case scenario, the pilot would still have been able to save himself, since his spacesuit featured a military aero-conical chute, as well as a separate ballistic one. The safety was a significant feature because the raison d'être of the X-Prize was kick-starting a commercial future. Feeney had gathered an impressive team of volunteers – engineers, aerospace professionals, and mathematicians. He had also persuaded aerospace organizations to volunteer equipment and expertise. For example, the display technology and much of the avionics equipment on board were made by Omnivex, the pilot's spacesuit was from Nuytco Research, and the spaceflight training was courtesy of the Canadian Defense and Civil Institute of Environmental Medicine [3]. In common with all but one of the competitors, money was Feeney's biggest hurdle, but he had grounds for optimism.

Advent

A different mission architecture was proposed by American Advent Launch Services, which envisioned a methane-fueled vehicle launching from the Gulf of Mexico to sidestep regulatory unease about safety of the launch and landing. NASA engineer and project leader, Jim Akkerman, created the rocket with materials that were either donated or self-financed. He tested the engine in a farmer's field in Texas.

Orizont

In Romania, the Aeronautics & Cosmonautics Romanian Association team, a group of aeronautical engineering students, developed the *Orizont* with an engine fueled by hydrogen peroxide. The monopropellant engine was reusable and made entirely of composite material, which was the first of its kind [4].

Thunderbird

Thunderbird represented a more traditional approach to rocketeering. Designed by Steven Bennett's Starchaser Industries of Cheshire, UK, *Thunderbird* was to be powered by four turbofan jet engines during its climb to high altitude before a liquid-fueled rocket would boost the spacecraft the rest of the way to space [3]. Bennett had already tested a scaled-down version of the *Thunderbird* rocket, when he launched his solid-fuel rocket *Nova*, an 11-meter model, on 23 November 2001. *Nova* did go up and it did return by parachute, but it only achieved 1,500 meters of altitude – less than 2% of the altitude needed to reach suborbital space. Bennett did have a novel means of drumming up funding by trying to sell the seat on board *Thunderbird* for US$650,000.

Cosmopolis

Cosmopolis C-XXI was a rocket-powered spaceship designed to be carried to an altitude of 16,000 meters by an M-55 aircraft. After detaching from the aircraft, the rocket engine would push it past the boundary of space. After re-entry, it would glide to an airplane-style or parachute landing [3].

Condor-X

PanAero's X-Prize entry was the *Condor-X*. Designed by Len Cormier, a former NASA employee who had worked for the space program in the *Sputnik* era, the vehicle featured a large wing allowing it to ascend and descend gradually, reducing re-entry speeds, and G-forces. With its fabric-covered aluminum truss that would have acted as a kite during descent, the *Condor-X* was typical of the novel designs that featured among the X-Prize entrants. Sadly, due to lack of finances, the vehicle was never constructed.

Scaled composites

In the media frenzy about who the likely X-Prize winner might be, the press painted a two-horse race between Scaled Composites, the big-budget competitor in the low-budget space race, and Feeney's *da Vinci* team. But, while Feeney had assembled an impressive array of talent, the guy didn't even have a pilot's license, so building and flying a spacecraft seemed a tall order. In fact, none of the competitors had ever put a spacecraft in space. So picking a favorite was like betting on a greyhound race in which none of the dogs had ever run. And, while Feeney, genius that he is, had a viable spaceship, he couldn't get the backing, which meant that the only greyhound with a chance was Scaled. That was because Scaled had the engineering nous *and* it had the financial support from Allen, co-founder of Microsoft. It was a huge financial advantage, but Scaled kept costs down, spending only what was necessary to compete. We'll talk about the development of SpaceShipOne in the next chapter but, before we do, we need to introduce the final piece of the Virgin Galactic puzzle: a reclusive billionaire and science-fiction fan.

PAUL ALLEN

The first step towards Paul Allen (Figure 2.6) becoming involved in the Virgin Galactic story was when the Microsoft founder met Rutan in 2001 and asked him to develop a spacecraft that could win the Ansari X-Prize. Allen was prepared to put US$30 million on the table to finance the deal. There was only one condition: the project had to be kept secret. Why did one of the world's richest men want to win a US$10 million prize when his personal worth was in the tens of billions of dollars? The name of his company, Vulcan Inc., which manages his various business and philanthropic efforts, gives you a clue. Allen is a science-fiction buff. He's founder of Seattle's Experience Science Fiction Museum, a must-see collection for sci-fi aficionados and those interested in space. He is also, as his company's name suggests, a big *Star Trek* fan. So building a spaceship was an extension of his science-fiction interests and his wish to demonstrate that space exploration could one day be within reach of private citizens. And so, with Allen's pledge of millions of dollars on the table, Scaled went to work developing one of the world's most famous and recognizable spacecraft.

2.6 Paul Allen. Courtesy: Wikimedia/Miles Harris

Notes

1. http://nextprize.xprize.org/2009/09/launching-commercial-space-flight-part.html
2. http://www.redorbit.com/education/reference_library/technology_1/entrepreneurs-ceos/1112920463/sir-richard-branson/
3. http://discovermagazine.com/2002/jul/featprize/
4. http://www.tms.org/pubs/journals/JOM/0411/Byko-0411.html

http://www.springer.com/978-3-319-09261-4

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