

# In New Space Race, Enter the Entrepreneurs



Isaac Brekken for The New York Times

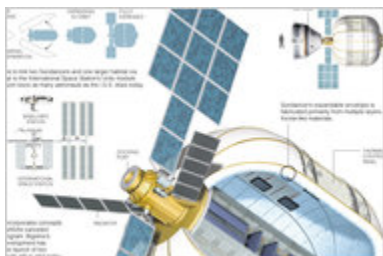
**IN THE FUTURE** Prototypes of Bigelow Aerospace's Sundancer habitat, which has an inflated volume of 180 cubic meters, at a hangar in North Las Vegas. [More Photos »](#)

By [KENNETH CHANG](#)

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NORTH LAS VEGAS, Nev. — At the Bigelow Aerospace factory here, the full-size space station mockups sitting on the warehouse floor look somewhat like puffy white watermelons. The interiors offer a hint of what spacious living in space might look like.

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NASA

**INFLATABLE** NASA's Echo satellite was basically a Mylar balloon. Bigelow's design uses aluminized and foam skins. [More Photos »](#)

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“Every astronaut we have come in here just says, ‘Wow,’ ” said Robert T. Bigelow, the company founder. “They can’t believe the size of this thing.”

Four years from now, the company plans for real modules to be launched and assembled into the solar system’s first private space station. Paying customers — primarily nations that do not have the money or expertise to build a space program from scratch — would arrive a year later.

In 2016, a second, larger station would follow. The two Bigelow stations would then be home to 36 people at a time — six times as many as currently live on the International Space Station.

If this business plan unfolds as it is written — the company has two fully inflated test modules in orbit already — Bigelow will be buying 15 to 20 rocket launchings in 2017 and in each year after, providing ample business for the private companies that the Obama administration would like to finance for the transportation of astronauts into orbit — the so-called commercial crew initiative.

[President Obama](#)'s budget proposal for 2011 calls for investing \$6 billion over five years for probably two or more companies to develop spacecraft capable of carrying people into space. Then, instead of operating its own systems, like the space shuttles, [NASA](#) would buy rides for its astronauts on these commercial space taxis.

“This represents the entrance of the entrepreneurial mind-set into a field that is poised for rapid growth and new jobs,” Maj. Gen. [Charles F. Bolden Jr.](#), the administrator of the National Aeronautics and Space Administration, said in February. “And NASA will be driving competition, opening new markets and access to space and catalyzing the potential of American industry.”

Officials have been careful not to say their commercial crew plan relies on a market beyond NASA, but for now, Bigelow appears to be the only non-NASA buyer for commercial crew services.

“Nobody,” Mr. Bigelow said of competition he sees on the horizon.

Thus, the rosier promises of the president's plan rest on this enigmatic, 100-employee company located on 50 acres of desert not far from the casinos and strip clubs and the ability of Mr. Bigelow, an iconoclast who made his fortune in real estate including the Budget Suites of America hotel chain, to get his dreams off the ground.

He has spent about \$180 million of his own money so far and has said he is willing to spend up to \$320 million more. An expansion of the factory will double the amount of floor space as the company begins the transition from research and development to production.

Mr. Bigelow only occasionally gives interviews, and except for Michael N. Gold, the director of Bigelow's Washington office, the employees almost never speak publicly. A company document titled “Some Important Bigelow Aerospace Cultural Values” implores employees, “Keep your work and the work of your co-workers very private from people outside the company.” (Mr. Gold said that the confidentiality stems from federal regulations designed to protect technological information and that the engineers are busy working.)

The Las Vegas site is hemmed by barbed wire and patrolled by armed guards.

The soundness of the business case is unknown to outsiders. Mr. Bigelow declines to say if he has firm commitments from any countries or companies to rent space on his space stations. In recent years, he has played down the notion that he is building a space hotel for rich tourists, although he says space tourism could provide a part of his business.

Over the past year, Mr. Gold visited countries like Japan, South Korea, Singapore, the Netherlands, England and Sweden to gauge interest. A stay on a Bigelow station, including transportation, is currently priced at just under \$25 million a person for 30 days. That is less than half the more than \$50 million a seat that NASA is paying for rides alone on [Soyuz](#) spacecraft to the International Space Station. Doubling the stay to 60 days adds just \$3.75 million more.

For a country or company willing to sign up for a four-year commitment, the lease for an entire six-person module would cost just under \$395 million a year, and that would include transportation for a dozen people each year. “You see why this is attractive for the sovereign client market,” Mr. Gold said.

The Bigelow prices are good through 2018, and Mr. Bigelow said the prices would drop by then if, as he expects, rocket prices drop.

“We’re very comfortable with our numbers,” he said, although he declined to discuss the details. Space Exploration Technologies Corporation, or SpaceX, which is the most optimistic in reducing launching costs, estimates that rides to space on its Falcon 9 rockets would be \$20 million a seat.

“You have to trust a little bit that we’re making these investments because we think it’s going to make sense economically at the end of the day,” Mr. Bigelow said. “We won’t execute our business plan if those numbers aren’t there.”

His space stations are not his only interest in space. “I’ve been a researcher and student of U.F.O.’s for many, many years,” Mr. Bigelow said. “Anybody that does research, if people bother to do quality research, come away absolutely convinced. You don’t have to have personal encounters.”

He added: “People have been killed. People have been hurt. It’s more than observational kind of data.”

Other views that run counter to mainstream science include a belief in the power of prayer and a disbelief in the Big Bang theory.

The idea of inflatable spacecraft dates back almost to the beginning of the space age, solving a stubborn conundrum with putting stuff in space. Rockets are tall, but not particularly wide. With inflatable spacecraft, the structure can be packed tightly into the payload and then filled with air once in orbit.

NASA’s Echo I and Echo II satellites, launched in 1960 and 1964, were large Mylar balloons. NASA commissioned Goodyear to build prototypes of an inflatable space station, which looked like a big rubber inner tube.

The rubber space stations never flew, in part because of an obvious design weakness — they could pop if hit by meteoroids.

The idea remained dormant until the 1990s, when NASA started exploring how to build living quarters for a human mission to [Mars](#). William C. Schneider, then the senior engineer at the Johnson Space Center in Houston, returned to the inflatable design.

Instead of rubber like the 1960s Goodyear design, Dr. Schneider used an airtight bladder surrounded by Kevlar straps. “It dumps its pressure load into the straps,” Dr. Schneider said. “Those two together make a very efficient design.”

Outside the straps, alternating layers of aluminized fabric and foam absorb and disperse the impacts of micrometeoroids, providing better protection than metal structures, Dr. Schneider said.

Even though he was sure the design was sound, he built two prototypes of the TransHab module and demonstrated their resilience in a swimming pool and a vacuum chamber. “People would think of it as a balloon,” said Dr. Schneider, who now is a visiting professor at [Texas A&M University](#). “In cases, it was six times as good as needed. It’s absolutely verified.”

In the meantime, the Mars plans were shelved as too expensive, and TransHab was reimagined as a crew quarters module for the International Space Station. Then the space station costs grew, and in 2000, Congress prohibited NASA from spending any more money on TransHab.

Mr. Bigelow, 66, said that he was inspired by NASA’s successes of the 1960s, culminating with the Moon landings, and that he always hoped to invest in space someday. He read about TransHab in 1998, and learning of the project’s imminent demise, he established Bigelow Aerospace in 1999 and bought an exclusive license to the NASA patents.

Dr. Schneider joined Bigelow as a consultant. The Bigelow designs are essentially very close to his NASA work, Dr. Schneider said, with some changes like replacing the Kevlar with Vectran, another bullet-resistant fabric. There are also some notable improvements like the addition of small windows, already tested on the Genesis I and II test modules that were successfully launched from Russia using converted ballistic missiles.

“He had great manufacturing capability,” Dr. Schneider said. “They have some real good engineers as well. I’m sure they will be very successful.”

The biggest hole in his plans, Mr. Bigelow said, is the one not entirely in his control: getting to and from the space stations.

For a while, Bigelow and [Lockheed Martin](#) were collaborating on a small capsule that would launch on an Atlas V rocket, which currently launches Air Force satellites and other payloads. Lockheed Martin won the NASA contract for building the Orion crew capsule for NASA’s Constellation program and dropped out of the work with Bigelow.

Mimicking the \$10 million [X Prize](#) that spurred the development of the suborbital spaceplane SpaceShipOne, Mr. Bigelow offered \$50 million to anyone who could build an orbital spacecraft. No one tried to claim the prize before it expired in January.

Bigelow is collaborating with [Boeing](#) using \$18 million that NASA has provided for preliminary design of a commercial crew capsule.

Keith Reiley, the program manager at Boeing for the capsule, said he was not very familiar with Bigelow's space station plans, but was impressed with what Bigelow has contributed to Boeing's capsule. "They're a lot more entrepreneurial than we are," Mr. Reiley said, "and it's refreshing for us."

If the Boeing spacecraft is ready by 2014, that is when the dance of Bigelow space station modules will begin.

A habitat called Sundancer, with an inflated volume of about 6,400 cubic feet, would launch first. A separate rocket would then carry two Bigelow astronauts to take up residence in Sundancer as additional pieces — a second Sundancer, a larger habitat of about 11,700 cubic feet, and a central connecting node — are launched. The modules are to dock by themselves with the astronauts present to fix any glitches.

Once the stations are up, Bigelow still needs to demonstrate that it can juggle the logistics of supplying food, water and air, as well as fix the inevitable glitches that will arise. Mr. Bigelow said that he would hire people with the needed experience and skills, and that space stations were not all that different from hotels.

"I've had four decades of serving people, tens and tens and tens of thousands of people, all over the southwest part of the United States," he said. "I have four decades of building all kinds of things. The principles are the same."

As a private company, Bigelow can operate space stations much more efficiently than NASA and its governmental partners can operate the International Space Station, Mr. Bigelow said. (Another of the company values declares: "Make up your mind quickly. Don't take forever, people are waiting, the company is waiting, the future is waiting and time costs money.")

NASA's interest in inflatables has also been revived once again. Among several large technology demonstration projects proposed in the president's 2011 budget is an inflatable module for the International Space Station. Bigelow is currently talking to NASA about that.

Mr. Bigelow envisions variations of the inflatable modules being used for a Moon base or a mission to Mars.

"Our hope is that we can serve NASA," he said. "Because we can do it so much more economically."

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