SpaceX likely to win NASA’s crew competition by months, for billions less

Enlarge / SpaceX’s Crew Dragon approaches the International Space Station in March, 2019.

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Nearly five years ago, NASA faced a difficult decision. The agency had spent about $1.5 billion to help Boeing, SpaceX, and Sierra Nevada Corporation design spacecraft that could carry US astronauts to the International Space Station. As it sought to build flight hardware, NASA prepared to select just two providers to move forward—both to generate a healthy competition and provide redundant access to space.

NASA had a total of $7 billion for the winning companies to finalize development of their spacecraft, integrate their rockets, and each fly up to six missions after NASA certified the vehicles as space-worthy.

Publicly, some Boeing officials were denigrating SpaceX, emphasizing their own blue-blooded legacy. Boeing has had a successful working relationship with NASA dating back to 1961 and the first stage of the Saturn V rocket. By contrast, Boeing would note, Elon Musk seemed more interested in flashy marketing and never met his launch targets. “We go for substance,” John Elbon, head of Boeing’s space division, said at the time. “Not pizzazz.”

Behind the scenes, Boeing was pushing hard to win *all* of the funding for NASA's commercial crew program, and the company was encouraging NASA to go with the safe choice over spaceflight newcomers SpaceX and Sierra Nevada. "We were fighting to keep two providers as many in Congress, lobbyists, and some in NASA were fighting to down-select to only Boeing," one government source familiar with the process told Ars.

In the end, NASA's chief of human spaceflight, William Gerstenmaier, kept two providers, Boeing and SpaceX. This has proven a wise decision for reasons of both cost and schedule. It also offers a timely lesson as NASA administrator Jim Bridenstine considers new approaches to taking humans back to the Moon with a reasonable budget and schedule.

Cost disparity

In terms of cost, NASA is getting a better deal from SpaceX. Perhaps the best way to determine costs is by "seat prices," the amount of money NASA pays to get one of its astronauts to the International Space Station. In recent years, since the retirement of the space shuttle in 2011, NASA has paid Russia as much as $81.8 million per seat.

NASA has rarely talked "seat price" for commercial crew. Really, it has only come up during Congressional hearings, when Gerstenmaier has quoted a figure of $58 million. "Assuming all 12 missions are purchased and flown at a rate of two per year, the average seat price is $58 million per seat for commercial crew," he testified in 2015.

Enlarge / NASA Administrator Charlie Bolden, right, and Boeing space chief John Elbon in front of a Starliner in 2012.
However, this number does not reflect what NASA is paying Boeing and SpaceX individually. According to the US Government Accountability Office, there are three main funding lines in the commercial crew agreement: *line item 001* is for development and testing, *line item 002* is for service missions, and *line item 003* is for special tests, studies, and analyses. To determine the per-seat price, we need to know the value of *line item 002* and then divide by the number of seats per flight (four) and flights (up to six).

Neither the agency nor the companies have publicly disclosed the values for *line item 001* or *line item 002*. But we can make a pretty good estimate. By subtracting *line item 003* (up to $150 million for each company), knowing the total value of the

contracts, and using NASA's own average value of $58 million "seat price," we can back into the total value of *line item 002*: $2.784 billion. This, then, is the total amount NASA is paying for 12 operational flights to the space station from 2020 to 2024, or a total of 48 seats from both companies.

Now, for the final step: overall, NASA awarded Boeing $4.2 billion for its commercial crew contract and SpaceX $2.6 billion. If this proportion of funding holds for *line item 002*, which a NASA source indicated is more or less accurate, then the seat prices NASA is paying Boeing and SpaceX are substantially different. According to this analysis, NASA will pay Boeing about $71.6 million per Starliner seat and SpaceX $44.4 million per Dragon seat.

Why is NASA paying Boeing so much more? Probably because the company asked for it. As part of this competition, SpaceX bid a low price because it believed the space agency would prioritize lower prices. "Knowing I could have bid more, after the fact, I sure wish I would have bid more," Gwynne Shotwell, president of SpaceX, said about this price disparity in 2018. Essentially, competition drove SpaceX to offer a lower price.

Schedule

Despite receiving less money from NASA and having less spaceflight experience, it now seems likely SpaceX will deliver a crew capability sooner. The California-based company has already flown its demonstration mission for NASA a month ago, and it is now working toward final testing that would allow its first crewed mission later this year, probably no earlier than October.

By contrast, Boeing will not fly its first uncrewed demonstration mission until at least August, and NASA has acknowledged that this date may well slip again. One troubling sign for Boeing is that the company still has not performed a launch-pad abort test—during which Starliner's emergency

escape system is fired from the launch pad to ensure the capsule can rapidly get away from the rocket during a launch problem.

This test was originally scheduled for June 2018, but it has been indefinitely delayed after an anomaly occurred that month during a hot-fire test of the launch-abort engines. After this accident, which Boeing did not publicly disclose until a report in Ars nearly a month later, the company said, “We are confident we found the cause and are moving forward with corrective action.” However, 10 months after the incident, Boeing is only now “preparing to restart” a campaign that will culminate with the abort test at some point in the future.

SpaceX has had its own technical challenges with the Falcon 9 rocket and Dragon parachutes, but it now appears likely to deliver a finished product to NASA before Boeing by several months, for less money. It seems plausible that SpaceX will, in fact, fly crew into space before Boeing flies a Starliner demo mission. Had NASA issued a sole-source contract to Boeing for commercial crew, not only would the agency have had a single provider with a higher price, it probably would have had to wait longer for that product.

The implication here for NASA, as it looks to extend human spaceflight from low-Earth orbit into deep space, seems clear. If the agency is serious about lunar landings by 2024, it has a lot of contracts to set soon: for Gateway modules, for lunar lander components, for spacesuits, and for rockets to get all of that material into lunar orbit. The lesson from commercial crew is that healthy competition among providers is good, commercial contracts can lead to lower prices, and just because a company has a long history of spaceflight success doesn’t mean they’ll necessarily perform better than the new kids on the block.

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