



Spaceflight

FLIGHT
INTERNATIONAL

DATE:20/08/08

SOURCE:Flight International

Rocketry's low-cost model

By Dan Thisdell

When it comes to developing launch vehicles, images of burning money as rapidly as rocket fuel spring readily to mind. Space is naturally the domain of big corporations and massive government contracts, so a private venture starting from scratch seems an unlikely candidate to be the future of this industry.

But that is how Hawthorne, California-based Space Exploration Technologies - SpaceX - is being described. So far, SpaceX has some heavy-hitting backers - the US Air Force and Defense Advanced Research Projects Agency are sponsors, and SpaceX is a leading candidate to supply crew and cargo launches under the Commercial Orbital Transportation Services contracts NASA intends to issue to keep the International Space Station supplied after the Space Shuttle fleet is decommissioned.

But the company has relatively little to show for itself its flight history consists of a string of three failures of its Falcon 1 rocket, now powered by a single regeneratively cooled Merlin 1C engine, which has been the centrepiece of its development efforts.

LIFT-OFF

Falcon 1's maiden effort, in March 2006, showcased SpaceX's earlier, ablatively cooled Merlin engine and ended 34s after launch when a fuel leak caused a fire and first-stage engine shutdown. Flight two, a year later and sponsored by the USAF and DARPA, achieved its primary objectives of demonstrating the fast, or "responsive", launch operations the US military wants to develop, gathering flight data and "retiring technical risk before the first operational flight". An upper-stage control fault prevented orbital velocity.

Flight three, earlier this month, carried a Department of Defense payload and "executed a picture perfect first-stage flight" to reach 217km (135 miles) altitude, according to Elon Musk, the founder, chief executive and chief technology officer of SpaceX, but failed when the first and second stages collided after separation, owing to residual thrust in the Merlin 1C. Musk is confident the faults that ended flights two and three are easily solved. With flight three came a \$20 million equity investment by Founders Fund, a San Francisco venture capital fund best known for its support of internet ventures including Facebook. Musk has assured staff that SpaceX has the cash available to carry out its development plans: "There should be absolutely zero question that SpaceX will prevail in reaching orbit and demonstrating reliable space transport." He adds: "I will never give up, and I mean never."

Founders Fund managing partner Luke Nosek, who joins the SpaceX board, adds: "We believe SpaceX will become the world leader in space transport."

Musk and Nosek - and Nosek's Founders Fund partners - made fortunes as co-founders of Paypal, the internet payment system.

Musk's track record in business and technology makes him attractive to head a company like SpaceX. He was the biggest shareholder in Paypal until eBay bought it for \$1.5 billion, and founded another successful IT company. He has a physics degree from the University of Pennsylvania, a business degree from Wharton and originally went to

California to pursue graduate studies in high-energy density capacitor physics and materials science at Stanford University.

And the launch market is worth going after. According to figures from the US Federal Aviation Administration and the Space Foundation, the commercial launch market - not including government launches - was worth \$1.55 billion in 2007.

SpaceX's basic technological premise is solid. Falcon 1 runs on one Merlin 1C engine, a modern version of a tried-and-tested engine concept. But with a cluster of nine Merlins, SpaceX plans to have a heavylift rocket, Falcon 9, able to send crew and cargo to the ISS and return them in Dragon, a SpaceX-developed capsule.

All of that adds up to SpaceX's "best price guarantee", starting at just \$36.7 million for a low-Earth orbit mission. David Todd, senior space analyst at the Ascend aerospace consultancy in London, says price is a huge attraction for SpaceX: "Once they get reliable they should be world-beaters." And as for SpaceX's reliability record so far he says early failures are normal, with 50% or more of first launches ending badly and reliability usually starting to come together by a third launch.

The Merlin 1C, he says, should be cost effective. But the clustering concept is the key to SpaceX's cost equation, so it is critical that Falcon 9 be reliable, he adds. Falcon 9's first launch could come by year end. But first, the fourth Falcon 1 could be on the launch pad next month. That launch, says Todd, will be carrying a key payload in the form of credibility for SpaceX and Musk: "If this one fails he'd be in trouble."