

The X Prize and Mercantile Astronautics

by Michael Martin-Smith



[Mercantile Astronautics](#),^[7] as advocated chiefly by Adriano Autino of Tecnologie di Frontiera, calls for the opening up of Space and its assets – energy and raw materials for the continuing advancement of multitudes of ordinary humans and their enterprises rather than the narrow band of special interests – military, big business and, scientists who now have the outer realms to themselves!

Adriano, like many futurists before him understand that the true potential of Space for Humankind will not be realised until it is opened up to the creative talents of the species as a whole, and that this is best done through effective commercial access.

The biggest stumbling block to this vision is, simply, the high cost of infrequent unreliable and almost monopolistic access to Space; without change we cannot see the possibility of creating self-sustainable closed – or nearly closed – eco systems and the large scale use of local resources which the occupation of Space, a presently hostile environment, demands.

All of this is true despite the fact that many of the public have a fascination with Space, and many youngsters would welcome access to Space, whether for tourism, scientific, exploratory or even habitation purposes.

The present major players in Space have for various reasons consistently proved unable to make the necessary changes so as to allow for public access to Space; China, after all, describes Space as the "Fourth Territory". The logic of this is that in time people must have access to it, just as they do to Land Sea and Air.

In 1996 a group of Space academics and entrepreneurs – Peter Diamandis and Gregg Maryniak^[5], decided to look to History and take a hand themselves.

Looking back to the glory days of early aviation, they saw that the Orteig Prize in America and the Schneider Trophy in Europe had greatly stimulating effects on early aviation. By setting a series of advancing goals and rewarding private engineers and entrepreneurs.

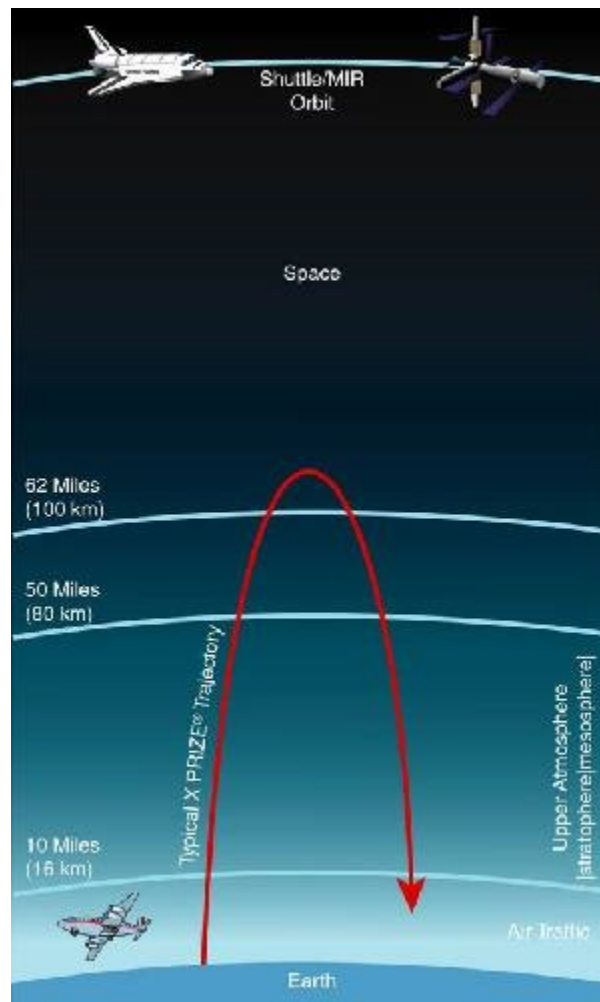
Each year, in pursuit of the Prizes and the fame which went with them, aeroplanes were pushed to fly ever higher, faster and more reliably; thus aviation progressed from the old Vickers Vimy biplanes to the Merlin engine powered Spitfire in little more than a decade without significant tax payer input.

Out of such labours not only did passenger aviation arise, but also the defeat of the Nazi airforce by British fighters.

And so it was that in 1996 the X Prize Foundation was launched; the idea was simple enough – to offer a \$10 million Prize to the first team which could, without Government subsidy, build a craft which could take 3 passengers to 100 kilometres altitude, return them safely, and repeat the feat after 2 weeks without more than aircraft scale re-fuelling and maintenance.

This we must recall, was a task quite beyond the giants of NASA ESA, Energiya and the rest^[1] – but which if accomplished would smash once and for all that Space is too costly or difficult to become truly relevant to the Common Man. Achieving 100 kms altitude is, effectively to touch the borders of Space by NASA definitions- although we must understand that to reach orbit itself is a bigger problem^[2].

Nevertheless the technological leap is impressive and would generate a major suborbital space tourism and sounding industry from which more investment would come.



The X-Prize trajectory



View of Earth from approximately 100km

Such at any rate was the dream – but back in 1996 not many believed that it could be done still less by Jan 1 2005 – the closing date for availability of the Prize. Nevertheless it had to be tried, and against the odds is nearing success.

And so it is that in December 2003, some 7 years after the X Prize was launched there are 26 listed competitors who have submitted designs and declarations of intent to go for the Prize.

These Teams come from seven countries – The USA, UK, Russia, Romania, Argentina, Canada and Israel, and feature designs ranging from to staged rockets, aeroplane lifted rocket powered gliders, to balloon lifted rocket planes.

All of these aim to lift a passenger carrying reusable rocket vehicle to a height above 99% of the atmosphere, where a quick burst of rocket power would accelerate the craft to 4500-5000 kph and upto 100 kilometres. Passengers would enjoy 3-4 minutes of weightlessness, and a real cosmic view of the Earth and its curvature as well as an astronaut's view of the stars.

It is calculated that once the ice is broken, a \$1billions per year space tourism industry would be born directly from these vehicles. The X Prize winner will most certainly NOT take all!



Starchaser Industries, Ltd



Starchaser Industries, Ltd Steve Bennett
Thunderbird coast

More than this, we are now seeing several contenders building and testing actual hardware and systems for an X Prize attempt; these are being backed either by private fortunes, sponsorships, or subscriptions from members of the public via a Supporters' club.

In the case of the UK Starchaser Industries entrant Thunderstar we are seeing medium firm sponsorship and a supporters' club of volunteers and subscribers working together.



SpaceShipOne above left

This venture is largely driven by the energy and drive of one man- its founder and Chief Executive Steven Bennett, who is motivated by a longstanding desire to do the impossible coupled with a strong conviction that there is a business to be built out of cheap and accessible space travel. Already Starchaser Industries has flown 14 rockets of increasing size and sophistication, and has now developed in less than a year the Churchill Mark 2 liquid fuelled reusable engine, capable of 3 tons thrust, as well as drop-testing a parafoil guided re-entry/passenger capsule.

Work is now started on the final Churchill engine – of 15 tons thrust – two of which are to power an actual X Prize entrant. An escape system is being developed.

Bennett anticipates that with £2.5 millions or so further funds, he will be able to make an X Prize launch within a year or so. The key to this is publicity and increased Club membership, but he already has significant commercial sponsorship as well.

The significance for Mercantile Astronautics of being able to develop a passenger carrying spaceship for less than £5 millions (all told), even if he were to be beaten to first place, is enormous.

The two other principal front runners are American.

Spaceship One is being developed by the world famous aviator and entrepreneur Burt Rutan who flew nonstop around the world in an aeroplane built and designed by himself. His company, Scaled Composites, specialised in exotic aircraft design and the use of lightweight composite materials – which will surely form the basis of eventual commercial low cost spaceflight.

His X Prize bid began with the development of a high flying economical research aircraft, Proteus, which can reach altitudes of 60,000 feet with minimal fuel thanks to careful elongated wing design and light weight structural materials. This vehicle has been developed into the White Knight, and has now accumulated several dozen flights.

In 2002, work began on the Spaceship One which is carried under the belly of White Knight to 50,000 feet or so, and then released like the old X-15 from a B52, to fire up its rocket engine.

Spaceship One has been thus drop tested with pilot some seven times since August 2003, so that its automatic landing, navigational and aeronautical gliding/handling characteristics are becoming well explored.

In parallel with work on the winged SpaceshipOne development of a hybrid fuelled rocket engine (using nitrous oxide gas and polybutadiene – rubber solid fuel^[3]) has been contracted out to two aerospace enterprises. The winner of this competition – James Benson's Space Dev Inc – is wellknown to many of us in TdF. Jim Benson is well known to attendees of the IAF Congresses, and it is no surprise to find him in such a vital role in the radical opening up of space transportation.

Hybrid rockets, for the uninitiated, use a solid fuel and liquid or gaseous oxidant, thus combining the advantages of conventional liquid and solid rocket motors. They have a lower ISP^[4] than cryogenic fuels but score very heavily on safety, cost and ease of storage and manufacture. At the same time, they are more powerful than solid rocket motors and can be throttled.



SpaceShipOne above front left

Most importantly, although they consume fuel to give thrust as befits a rocket engine they cannot actually explode, and so, even according to the exacting standards of the UK Health and Safety Executive, do not count as explosives.

This has important regulatory and legal benefits as well as astronomical ones!

Although at present they cannot compete, in thrust per kilogram, with Lox/Liquid hydrogen, theoretical developments and exotic fuels could bring hybrids into the same range as liquid fuels in time.

On Dec 17, the centenary of the Wright Brother's flight Spaceship One was accelerated by its Benson built rocket engine to 1550 kph, and 22000 metres altitude – thus being the first supersonic flight in a privately developed non military vehicle.

Thus one taboo – the impossibility of privately built supersonic aircraft already lies in ruins!

The writing is now on the wall for Government monopolies in spaceflight.

Rutan and Scaled Composites are backed by Rutan's own entrepreneurial fortune as well as sponsors, and his programme is estimated to cost some \$20-30 millions to achieve suborbital spaceflight.

The classic route of careful incremental test flying of Spaceship One will presumably see longer and higher flights with the new engine until sometime next year his pilots will reach the 100kms altitude mark.

The question of whether his craft can then be stretched to carry 3 passengers, and so take the \$10millions Prize, remains to be answered!

A third contender is Armadillo Aerospace who are developing a computer controlled testbed of four engines, set on a cruciform frame powered by hydrogen peroxide ignited by a catalyst/electronic igniter. This craft is being tested and developed in a small scale and full scale model so that alterations can be developed and tried on the smallscale before being applied to the full scale actual vehicle.

Assembly and testing of a full scale vehicle with a view to manned flights is well underway, and a bid for the Prize next year is likely.



Thus we can see that 2004 is likely to be a landmark year in the history of Mercantile Astronautics and innovative private spaceship design.

What then?

The X Prize Foundation is not stopping with the winning of the X Prize and is already looking to the next steps. It is negotiating with a number of spaceports to establish an annual competition rather like the Grand Prix in which contenders can

aim for higher, flights faster, or more rapid turnaround times for sponsorship and prize money; facilities are also proposed where supporters of individual competitors can come to the spaceport and watch flights – or even bet on them! This would be one element of the emerging Space tourism industry.

It is to be remembered that sporting contests attract very large sums in sponsorship – quite enough to fuel the fledgling private space industry all the way to orbit, and beyond.

The prospects for the ignition of Mercantile Astronautics via the X Prize over the next year or two, at the start of 2004 are looking much more favorable than even 2 years ago^[6] – with a possible lengthy period of restructuring of NASA after the Columbia disaster, this Space Renaissance could not come at a better time.

Happy New Year!

All the images on this page appears thanks to the courtesy of [The X PRIZE Foundation](#)

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NOTES. <i>Since we don't think that all the readers are familiar with some technical terms and other details, we asked Michael to provide some more explanations, and the result is hereafter. Should anyone have other questions, please do not hesitate to write us.</i>	
1/ The state of the art.	NASA and ESA have not so far been able to develop ANY manned space vehicle for anything like as small a sum as \$20-30 million dollars. If the X Prize achieves this, it can certainly be claimed that it has advanced the cause of space development. ▲
2/ Speed to orbit.	We need 4500-5000 kms per hour to reach an altitude of 100 kilometres in a suborbital "straight up and down" mode (X Prize) and c 8 kilometres per second (>28,000 kph) to go into Low Earth Orbit (as in a mission to the ISS). Because of residual atmospheric drag it is best for LEO to be a minimum of 300 kilometres altitude - although the actual minimum possible is more like 200 kilometres. To leave the Earth (e.g. to reach the Moon) requires 11 kms per second, or nearly 40.000 kph. The best way to imagine these ideas is to think of throwing a stone at progressively higher speeds - at first you can achieve a small height and rapid return to Earth, but gradually although of course the stone slows down, it eventually reaches a speed at which although it falls, it falls "round" the Earth, over the horizon, rather than coming back to the ground - that is Low Earth Orbit. ▲
3/ Liquid and solid fuels.	Most rocket motors burn a fuel (eg kerosene, liquid hydrogen or powdered aluminium or magnesium, etc...) in an oxidant (to work in the vacuum of Space, where oxygen - abundant in the earth atmosphere - is lacking). The oxidant can be liquid oxygen, ammoniumperchlorate fuming nitric acid, hydrogen peroxide, etc... In the case of Jim Benson's hybrid rocket we have a solid fuel - polybutadiene which is easily cast, safe to handle and cheap since it exists as rubber, while the oxidant is a gas - or compressed into a liquid. The point is that this motor is a hybrid (chimera) between liquid and solid fuels and combines the benefits of both types of engine. It is also safer and cheaper for the needs of Mercantile Astronautics - at least in the early years. ▲
4/ ISP.	ISP stands for Specific Impulse and is usually given in seconds. Very crudely it is a measure of the duration for which an engine supplied with 1kg of propellants can deliver 1kg of thrust; eg an engine delivering 100 kg of thrust per second from 1kg of fuel would have an ISP of 100 seconds. Thrust in turn depends on the mass of gases expelled from the rocket nozzle, and the speed with which it is ejected. Ion engines achieve very high ISPs because the exhaust velocity is enormous - but the actual thrust is low because only very small masses of propellant are involved. ISP is put crudely a measure of the efficiency with which an engine can turn its fuels into actual propulsive power. In chemical engines Lox/Liquid Hydrogen is the most powerful, and in the Space Shuttle engine ISPs of 460 seconds are possible - but the technology is complex and demanding. For economy compromises are unavoidable! ▲
5/ The X-Prize founders.	Diamandis and Maryniak are Americans and the XPrize Foundation is based in America but open to all comers as long as they meet the criteria to flights at 100 kms with 3 passengers each time within 2 weeks and no Government/military involvement. ▲

<p>6/ The X-Prize agenda.</p>	<p>There is no deadline for entrants - there were indeed two new ones in the last few weeks. I understand that the original financial promoters who have put up the \$10millions for the purse are holding it open until the January 1st 2005; if it is not won by then, they may reclaim their Prize as uncollected, or they may be induced to extend their time scale.</p> <p>Or, if the Prize looks close to success but misses the Jan 2005 deadline other promoters may take over the "promise to pay". We cannot tell yet, but as of now, the chance is quite good that this Prize will be claimed in 2004.</p> <p>It is opinion of Dr. Michael Martin-Smith that Burt Rutan has even now done enough to make the concept of winning the X Prize realistic enough to ensure that the \$10 million Prize money stays in the kitty until success is achieved. ▲</p>
<p>7/ Mercantile Astronautics.</p>	<p>The concept of Mercantile Astronautics, or Merchant Astronautics, or Commercial Astronautics, appeared firstly in the Science Fiction, by Paul Anderson (the stories of Nicholas Van Rijn Space Merchants - "The Earth Book of Stormgate" 1978) ▲</p>