STANFORD
GRADUATE SCHOOL OF BUSINESS

CASE: SI-90
DATE: 12/14/06

X PRIZE FOUNDATION: REVOLUTION THROUGH COMPETITION

I think the X PRIZE changes the paradigm, and changes the way people think about a problem. By putting a large cash prize on a grand challenge, we're not saying 'can it be done?' We're saying 'it can be done, and we will pay the first guy to do it.'.

—Peter H. Diamandis, M.D., X PRIZE Foundation Founder and Chairman.[1]

At 8 A.M. on the morning of October 4, 2004, the privately built and funded SpaceShipOne rocketed into space at more than three times the speed of sound, peaking at an altitude of 368,000 feet above the earth before returning to land at Mojave Airport in California. This was the ship's second successful flight in six days, and won the $10 million Ansari X PRIZE for Mojave Aerospace Ventures, led by designer Burt Rutan and its financial backer, billionaire Paul G. Allen. It also cemented a recent deal between Rutan's team and Virgin Group CEO, Sir Richard Branson, to form Virgin Galactic—a commercial venture that would transport paying customers into space using technology developed for SpaceShipOne.

More importantly, the successful sub-orbital flight opened "a new era where space is no longer the exclusive domain of massive government space programs and ordinary people can now realistically dream of one day reaching for the stars."[2] In reality, spaceflight would initially remain the province of the wealthy, as the price of a seat on early Virgin Galactic flights was estimated $190,000. Still, this was a breakthrough compared to trips to the Space Shuttle, which had cost participants upwards of $20 million and required plus months of intense training. Hailing the dawn of a new era, X PRIZE founder Dr. Peter H. Diamandis exclaimed, "Today we made history….Today the winners are the people of Earth." [3]

[1] Quotations from interviews with the author, unless otherwise specified.

[2] Scott Simmie, "Right Stuff for Right Price; Designer Challenged Convention," *Toronto Star*, October 5, 2004, p. A01.

[3] Ibid. For other reports of the SpaceShipOne flights, see, for instance, David Chandler, "Final Frontier: Space Tourism Prize Gives Space Tourism A Boost," *The Boston Globe*, October 19, 2004, p. B9.; and John Schwartz, "Private Rocket Ship Earns $10 Million In New Space Race," The New York Times, October 4, 2004, p. 1.

David Hoyt prepared this case under the supervision of Professor James Phills as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

THE NEXT FRONTIER: GOING BEYOND THE ANSARI X PRIZE

By early 2005, the glow and hype surrounding the X PRIZE had subsided and Diamandis was contemplating the future of the X PRIZE Foundation, the organization he had created to stimulate private spaceflight. For five years, the foundation's focus had been the Asari X PRIZE, and now that the prize had been won, decisions about the organization's future weighed heavily on Diamandis' mind. He outlined three options under consideration at that time: "(1) shut down the foundation, (2) continue the X PRIZE focused on space, or (3) create a world-class prize institute that uses the prize-incentive model to solve today's grand challenges."

Ultimately the foundation decided to leverage its prize-based approach in the pursuit of an even higher and, arguably, bolder aspiration stated in the foundation mission statement: "Radical breakthroughs for the benefit of humanity." Diamandis elaborated, "Our mission is to become the world's expert in the design, implementation, and execution of prizes, such that wealthy individuals who want to create a large prize [to inspire breakthroughs] will come to us and say, 'will you create this competition and run it.' That's our mission."

In pursuit of this mission, the X PRIZE Foundation moved quickly. It expanded its board, adding visionaries from outside the space field such as Google co-founder and president Larry Page and genomics pioneer Dr. Craig Venter. The foundation planned to launch 10-15 prizes over the next five years, each of which would lead to transformational change in an important field such as medicine, energy, education, and social issues. The first of these, the Archon Genomics X PRIZE—a $10 million prize for sequencing 100 human genomes in 10 days—was launched on October 4, 2006, the second anniversary of SpaceShipOne's prize winning flight.

As 2006 drew to a close, the foundation faced three major challenges. First was the challenge of translating the prize model which had worked so well for an objective, "technology-centric" competition into a tool for use in social challenges such as poverty and education. The second challenge was to grow and develop a structure that would allow the foundation to scale its prize model so that 10-15 prize competitions could be run efficiently. The third was to fulfill Diamandis' goal to revolutionize philanthropy by using the leverage and efficiency of the prize model, enticing traditional foundations and benefactors to provide substantial cash to address society's greatest challenges through competition.

DR. PETER DIAMANDIS AND THE X PRIZE FOUNDATION

Peter Diamandis grew up on New York's Long Island, the son of Greek immigrants. Inspired by the Apollo moon program at the age of nine, he wanted to be an astronaut. He demonstrated early interest in space, winning first place in a model rocket design competition in the eighth grade. He went on to MIT, earning a bachelor's degree in molecular biology and a master's in aeronautics. By the time he finished at MIT, however, the Apollo moon program had long since become a distant memory, and the NASA space program had gone in directions that did not fire his imagination.

Diamandis enrolled in the Harvard Medical School, in part to bolster his chances of becoming a NASA astronaut. After graduation, however, he decided to pursue space travel on a private basis, becoming a space entrepreneur rather than entering the government space program or

practicing medicine. One company he co-founded was Space Adventures, which helped make Dennis Tito the first space tourist, when Tito paid $20 million to visit the International Space Station. Diamandis also started a company called Zero Gravity Corporation that used a Boeing 727-200 to make FAA-approved parabolic flights that gave passengers the experience of weightlessness.[4]

The Orteig Prize and the Spirit of St. Louis

In 1994, a close friend, Gregg Maryniak, gave Diamandis a copy of *The Spirit of St. Louis*, by Charles Lindbergh. In the book, Lindbergh told about the Orteig Prize, offered in 1919 by a Raymond Orteig, a French-born American hotel owner. Orteig offered to fund a $25,000 prize for the first non-stop flight between New York and Paris, and delegated the details of the competition to the Aero Club of America. Nine different groups tried to win the prize, spending a total of $400,000 in the effort. Lindbergh's success, in 1927, was celebrated around the world. Of more lasting importance, the flight changed the public perception of aviation, proved the feasibility of long-distance air travel, and stimulated development of the civil aviation industry. By 1929, the number of airline passengers in the U.S. had increased nearly 40-fold from 1926, and air cargo in the U.S. had increased by more than a factor of five. The number of airports, licensed aircraft, and licensed pilots in the U.S. also dramatically increased.[5]

Diamandis thought that a sufficiently large, properly designed prize might have a similar impact in stimulating private spaceflight. He said,

> I got the idea when I was reading *The Spirit of St. Louis*—a big prize for getting private vehicles into space. We would call it the X PRIZE and offer a $10 million purse. Initially, the X was just a placeholder for the eventual name of the sponsor. As finding the title sponsor became more and more elusive, the X began to stand for other things as well, such as the Roman numeral for ten, and for 'experimental,' as in NASA's famed X planes.

Lindbergh's flight was not the result of new technology being applied to the problem, but rather the creative use of existing, well proven, technology by a highly motivated, privately funded team. Space had been the domain of governments, or large government-funded contractors. Diamandis wanted to challenge entrepreneurs to think in new and creative ways, as the Orteig Prize had challenged the civil aviation community in the 1920s.

The long-term purpose for going to space was not simply to promote space tourism. The desire to make space accessible originated from a desire to address issues such as environmental problems. Maryniak, who became the foundation's executive director, observed:

> A lot of people think that the purpose of the X PRIZE was so rich white guys could fly in space. It's not. That's one of the steps [to reach a much larger objective]. Let the rich white guys and other people fly in space so the price comes down to where you can bring your tools up there…to use the stuff that's

[4] John J. Miller, "Extraordinary Feats of an X-Man," *Philanthropy*, July/August 2005, pp. 26-27.

[5] http://www.xprizefoundation.com/prizes/default.asp (August 9, 2006)

> [in space], like the Moon and asteroids to create things, systems, and provide pathways that will alleviate a lot of the very serious problems that we have.

The X PRIZE Creed, published on the foundation Web site prior to SpaceShipOne's success, included this statement: "We believe that the resources of space are the key to enhancing the wealth of all nations and people while preserving and repairing the environment of our home planet. We believe that this is our duty to our species and our fellow passengers on spaceship Earth."[6] This objective would be achieved through a long series of small steps, one of which was stimulated by the Ansari X PRIZE. (For a more detailed discussion of the social underpinnings of the Ansari X PRIZE, see **Appendix 1**.)

Launching the X PRIZE Foundation

In 1995, Diamandis created the X PRIZE Foundation, initially headquartered in the basement of his home in Maryland. He looked for a community to embrace the concept, and approached leaders in St. Louis after meeting Doug King, president of the St. Louis Science Center. The city had a long history in the aerospace industry. From the years immediately following the Wright Brothers' 1903 flight, St. Louis had been the home of innovation in aviation and spaceflight. In 1925, nine St. Louis businessmen had funded Lindbergh's plane, which was then named for the city. Later, NASA's Mercury and Gemini space capsules were built in St. Louis.[7]

St. Louis business leaders enthusiastically backed the X PRIZE, providing seed funding for the foundation. Diamandis then moved the foundation to the city. A funding organization, called "New Spirit of St. Louis" was formed, with the objective of recruiting 100 people who would each contribute $25,000 (the amount of the Orteig Prize). Within one month, the first 10 members were signed up, and the first dinner of the New Spirit of St. Louis organization was held on March 4, 1996 in the same club in which Lindbergh had closed the funding used to build his New York-to-Paris plane.

Before the project was publicly announced, Diamandis briefed NASA, the FAA, leaders of the aviation and space organizations, and also recruited international support. On May 18, 1996, the X PRIZE was announced under the Arch in St. Louis. Present at the announcement were the important supporters of the foundation, including the NASA administrator, 20 astronauts, and two of Lindbergh's grandsons.

The years from the initial announcement in 1996 through the successful completion of the X PRIZE in 2004 were very difficult for the foundation. Diamandis built a world-class board of trustees, including Hollywood producer Robert K. Weiss, Internet entrepreneur Adeo Rossi, astronaut and foundation co-founder Byron Lichtenberg, Erik Lindbergh (grandson of Charles

---

[6] From the X PRIZE Foundation Web site as of April 2, 2002, accessed by Internet Archive: http://www.archive.org/web/web.php on December 14, 2006.

[7] This, and the following two paragraphs, are based on: http://www.xprizefoundation.com/about_us/history.asp (August 9, 2006).

Lindbergh), and St. Louis civic leader Alfred Kerth. Despite this strong board, fundraising proved difficult, and the foundation survived on an annual budget of $500,000.[8]

THE ANSARI X PRIZE, AND JUMP-STARTING THE PRIVATE SPACE FLIGHT INDUSTRY

The basic rules of the Ansari X PRIZE were simple: the $10 million prize would be awarded to the first team to fly to an altitude of 100 kilometers twice within a two-week period. The ship had to be built with private funds, and had to carry three people (or one pilot and additional weight equivalent to two people). Diamandis noted that the competition was carefully designed to address critical problems that would have to be solved to achieve practical, private spaceflight:

> For example, flying to space twice within two weeks, with the same ship, means that the cost of the second flight is the cost of the fuel plus the touch-up labor. In this fashion we could make sure that the eventual ticket price would be affordable, without getting too many accountants involved in the competition.

Diamandis' greatest challenge was to find a title sponsor and raise the $10 million prize money. He and Maryniak traveled around the country in search of a title sponsor. Diamandis recalled:

> I probably pitched over 200 CEOs and CMOs [chief marketing officers] on the title sponsorship over the course of five years. We came close a few times and went to the obvious players including folks such as [Virgin Group founder Sir] Richard Branson and [FedEx founder and CEO] Fred Smith. Always the same answer, 'this is too dangerous,' 'why isn't NASA doing this?,' and 'do you really think anyone can win this?' It was frustrating, but I refused to give up.
>
> I never expected it to be so difficult. I never thought philanthropists and corporate sponsors would be so conservative—especially for a contingent gift that they would only pay once the flights were successfully made! Eventually I turned to an idea that was a last recourse. I placed a bet through a 'hole-in-one' insurance policy. Using an aerospace insurance broker, I negotiated a multimillion dollar policy payment against a $10 million payout if the flights were successfully made by January 1, 2005. The underwriters, conservative as well, were convinced that since Boeing and Lockheed were not competing, no one else could pull it off.

The premium for the policy was paid by Anousheh Ansari, an Iranian-born software entrepreneur from Texas with a passion for spaceflight. As a result of this financial support, the prize carried Ansari's name.

[8] In 2000, the foundation moved to the Los Angeles area, as Diamandis took a job as CEO of a company in the area. The move increased the foundation's ability to publicize the competition and participating teams, due to close proximity to the entertainment and media industry.

SpaceShipOne and the Ansari X PRIZE Competitors

On June 21, 2004, SpaceShipOne made a test flight to an altitude of more than 62 miles, sufficient to meet the Ansari X PRIZE altitude requirement. Its designer, Burt Rutan, was a legendary figure in aviation. Among his many innovative designs were Voyager, which had made the first round-the-world flight without refueling in 1986, and Global Flyer, which surpassed Voyager's distance record in 2006.

Microsoft co-founder Paul Allen provided about $26 million in funding for Rutan's effort, which involved designing and building two vehicles for the flight—White Knight, and SpaceShipOne. White Knight carried SpaceShipOne to an altitude of over 50,000 feet. After being released, SpaceShipOne lit its hybrid rocket engine, powered by laughing gas (N_2O_2) and rubber, and climbed toward space. The most novel part of the design was SpaceShip One's movable wings. When in space, the wings tilted, or "feathered" to provide high drag for reentry and the proper orientation for reentry without any input from the pilot. Once back in the atmosphere, the wings returned to their normal position for landing.

Even before the actual Ansari X PRIZE flights it was clear that the objective to jumpstart commercial spaceflight was being achieved. On September 27, Rutan and Sir Richard Branson of the Virgin Group announced plans for Rutan's company, Scaled Composites, to build a 5-passenger successor to SpaceShipOne. A fleet of these space vehicles would be operated by Branson's newly formed Virgin Galactic. At that time, Branson anticipated that passenger flights might start as early as 2008.

SpaceShipOne, now carrying the logo of Virgin Galactic, made its two Ansari X PRIZE flights on September 29 and October 4, 2004. The first flight reached an altitude of nearly 64 miles, and the second reached 69.6 miles, surpassing the previous unofficial record for altitude set in 1963 by the X-15 rocket plane. SpaceShipOne was the first privately funded and developed manned vehicle to reach space.

On November 6, at a meeting of the X PRIZE Foundation's board in St. Louis, Paul Allen and Burt Rutan were presented with the $10 million Ansari X PRIZE—an oversized check and bronze trophy.

There had been 26 competitors for the prize, from seven countries. Together, they invested more than $100 million in private space flight. The competitors used many different approaches in their attempts to win the prize, including launching from a balloon, launching from an aircraft (as done by Rutan's team), and conventional rocket launched from the ground. (See **Exhibit 1** for a description of each competitor, and **Exhibit 2** for illustrations of different approaches taken.) "The X PRIZE was a Darwinian experiment in spaceflight," observed Diamandis. "Without paying a penny [of foundation funds for the prize], we had the chance to preview 26 different designs that explored every approach to spaceflight."

The efforts of the competitors did not stop after the prize was won. Several continued working to develop regularly-scheduled flights to take passengers into space. Thus, the Ansari X PRIZE had played a significant role in creating a revolution in spaceflight—one led by small, private

companies as contrasted with the huge governmental efforts that had previously dominated the field.

Regulations and Infrastructure

An important requirement for developing a private spaceflight industry was establishing a supportive regulatory environment. Stimulated by the Ansari X PRIZE competition and the resulting publicity, Congress enacted a set of regulations that would enable the new industry to develop. The regulations used by the FAA for commercial aviation, for instance, would have stifled private spaceflight. Diamandis observed that, "These new laws will allow this industry to grow in the United States, rather than in Canada or South America. Our objective was not just to promote technology, but, more importantly, to change the paradigm so that everyone understands that spaceflight is not only the purview of governments. I want every kid growing up today to dream and believe that space is an option for them."

Following the success of the Ansari X PRIZE, Diamandis set out to create an annual event to keep the other 25 X PRIZE teams moving forward. He developed the idea of the X PRIZE Cup, a "grand prix of space," and put out a request for proposals to state governments throughout the U.S. The state of New Mexico embraced the X PRIZE Cup concept, and private spaceflight, and planned to develop the "Southwest Regional Spaceport" on 27 square miles of state-owned land about 45 miles north of Las Cruces. The project was expected to cost $225 million, most of which would be provided by the state, supplemented with some federal and local funds. Construction was planned to begin in 2007. New Mexico Governor Bill Richardson commented that, "What we are calling the second space age will open up a wide range of commercial opportunities, including point-to-point cargo delivery, with personal and business travel."[9]

Virgin Galactic planned to use this spaceport as its base when the facility was completed in late 2009 or early 2010. The company planned to negotiate a 20-year lease, paying $1 million a year for the first five years. After the first five years, lease payments and user fees would increase, and were expected to pay off the construction costs by the end of the 20-year lease.[10]

Commercializing Innovation

The Ansari X PRIZE had clearly stimulated a great deal of investment and interest in personal spaceflight. However, the winner of the prize would not necessarily be the most successful at commercializing personal spaceflight. Following Lindbergh's successful New York-to-Paris flight, the rapid development of commercial aviation was not led by Lindbergh, Ryan (who built his plane), or his St. Louis backers. Rather, there was a change in the public perception of aviation, and many airplane manufacturers and airlines competed to take advantage of the resulting commercial opportunity.

The winner of the Ansari X PRIZE was certainly well positioned for commercial success in private spaceflight, building spacecraft for Branson's Virgin Galactic. Virgin Galactic was also

[9] Alan Boyle, "New Mexico Lays Out Its Spaceport Plan," MSNBC, December 14, 2005. Online at: http://www.msnbc.msn.com/id/10467451/ (October 31, 2006).
[10] Ibid.

positioned as the front-runner of the prospective operators of personal spaceflights. However, a number of other companies planned to operate space flights for paying passengers, using technology developed for the X PRIZE competition. One of these groups was funded by Amazon.com founder Jeff Bezos. The companies and technologies that would ultimately triumph in the commercial world were not yet known. But, the Ansari X PRIZE had played an important role in creating an environment in which commercial, private spaceflight could develop.

LESSONS FROM THE ANSARI X PRIZE COMPETITION

The successful completion of the Ansari X PRIZE represented a turning point for the X PRIZE Foundation. As early as 1998, Diamandis had thought about using the prize model in to address major problems in fields other than space. However, it had been so difficult to fund the space prize he could not address other areas. He noted that,

> It's been immeasurably easier to raise money since we awarded the Ansari X PRIZE than before. It was the most difficult thing in my life to raise the money, and now people are: (a) willing to take my meetings, and (b) willing to believe in the model. The fact of the matter is, by doing space first, by doing what was perceptually a very difficult challenge, it made it easier for us to do the other things. If we can do this, we can clearly do the others.

With the visibility and credibility that came with the success of the first X PRIZE, the foundation faced decisions about its future direction. An important aspect of that consideration was to understand the lessons of the Ansari X PRIZE.

Leveraging Donor Funding

Diamandis viewed the X PRIZE as "an alternate financing engine. It's a financing engine to attack the grand challenges of our time." One essential aspect of that financing engine was the leverage that funding prizes offered to donors.

The Ansari X PRIZE, like the Orteig Prize before it, had shown that a substantial prize could generate investment far greater than the amount to be awarded by the prize. The Ansari X PRIZE had generated investment of at least $100 million, ten times the prize amount. Diamandis saw this as a way to revolutionize philanthropy—donors' funds could be multiplied by 5 to 10 times though investments in seeking to win the prize. The donated prize funds would also be efficiently used—they would only be paid for success.

Designing a Prize Competition

Achieving the organizer's objectives required that the prize competition be properly designed. The Orteig Prize and the Ansari X PRIZE both had simple requirements that could only be met by efforts that furthered the objectives of the prize organizers.

If a prize was not properly defined, however, it might be won without developing the technologies envisioned by the organizer. The case of a prize offered by Nobel Laureate

physicist Richard Feynman illustrated this risk. In 1959, Feynman gave a lecture at the California Institute of Technology that is generally regarded as the beginning of what is now known as "nanotechnology." He discussed DNA, and how living organisms can make microscopic machines for information storage and manipulation, and for manufacturing. At the end of the lecture, Feynman offered two $1,000 prizes—one for the first book page shrunk by a factor of 25,000 in each dimension that could be read by a microscope, and one for the first operating electric motor with dimensions no larger than 1/64th of an inch on each side.

A local engineer, William McLellan, read about Feynman's challenge. Working in his spare time, he made the tiny motor within two months. However, he used conventional tools—a watchmaker's lathe and a microdrill press, rather than the molecular self-assembly methods that Feynman envisioned. Nevertheless, Feynman wrote him a personal check for $1,000.[11]

Diamandis vision was that X PRIZEs would be substantial prizes that stimulated solutions to the most important problems facing society—problems for which conventional approaches were stuck, and breakthroughs were needed. The challenge had to be difficult, in order to stimulate the new thinking required to achieve breakthroughs, yet at the same time had to be achievable. Diamandis described the process of arriving at an appropriate challenge as "balancing the crazy and the conservative."

For instance, when considering the space challenge, some had suggested that the prize wouldn't excite the imagination and change the public perception of spaceflight unless an orbital flight was required. However, Earth orbit was a much greater technological reach than a suborbital flight. If a suborbital objective was chosen, some insisted that it had to achieve an altitude of 100 miles. Diamandis chose a somewhat lower objective of 100 kilometers (62 miles). The objective retained the easily remembered number "100," clearly achieved the objective of flying into space, required breakthroughs in private spaceflight, yet was sufficiently achievable to attract many competitors.

Maryniak described the importance of choosing the correct objective as follows:

> The real genius, and it was Peter's idea, was in picking a baby step. We were led to believe that if it isn't orbital, it isn't space flight—which is bologna. It's like saying if you don't make a flight of at least 6,000 miles it's not really aviation. That would leave out a lot of the profitable stuff, and all of the early stuff—you'd never get to the long [range flights].

The foundation spent about a year developing a simple set of rules that could be easily understood and verified, yet would ensure that the competition's objectives were met. As previously described, one objective was to minimize cost. The foundation did not want to have to analyze the competitors' accounting records, so sought a surrogate that would achieve the

[11] James Gleik, *Genius: The Life and Science of Richard Feynman*, (New York: Vintage Books, 1993), pp. 354-356. The book page challenge was not met until 1985, when a Stanford graduate student succeeded in putting the first page of *A Tale of Two Cities* onto silicon, using methods similar to that envisioned by Feynman.

same result—requiring two flights within two weeks, which would require competitors to build cost-efficient systems that could easily be prepared for each flight.[12]

The Ansari X PRIZE had 26 teams registered to compete. Diamandis estimated that about one-third of these were new startups formed specifically to go after the prize, and another third were already formed and working toward spaceflight. The final third were organized to do something else, and redirected their efforts toward winning the prize. Getting groups that had been working in other fields was important to Diamandis. "From my standpoint, you really want to be attracting the non-traditional players," he said. "The breakthroughs come from folks outside the traditional players in the area—people who bring completely different thinking. Rutan, for example, principally an aircraft designer, brought his ideas and techniques to spaceship design. John Carmack, another of the front-runners, was best known as a video-game designer."

The Ansari X PRIZE took eight years to compete, from its announcement in 1996 to the success of SpaceShipOne in 2004. This was the same amount of time between launching the challenge to successful completion as in the Orteig Prize (1919-1927), and President Kennedy's challenge to fly to the moon (1961-1969). Diamandis noted that eight years was not unreasonable, given the time required to form teams (particularly those bringing new approaches to the problem), raise money, and do the necessary research and development. A prize that could be won in 2 or 3 years would be too easy to represent a true breakthrough. On the other hand, if teams were not able to make substantial progress within about 8 years, teams and the public would lose interest.

Facilitating Novel and Creative Thinking

Diamandis perceived one of the problems inhibiting breakthroughs to be the risk-averse nature of potential funders, whether they were from the government, corporate, or philanthropic sectors. Recalling the race to the moon in 1961-1969, he noted that the average age of the engineers working on the Apollo program was 26 years. This was the age at which people had their greatest potential for true breakthrough thinking. However, in 2006, traditional research funding favored those who were more advanced in their careers, with impressive credentials and long experience—the safe bets. Those without credentials, or with "crazy" ideas, were unlikely to attract funding. Diamandis noted that, "Typical funding sources…fund those who have been in the field for awhile, and are the safest bets. You're not going to have your breakthroughs with the safest bets. I'm fond of saying that the day before something is a true breakthrough, it's a crazy idea."

A prize competition, however, was entirely focused on results, regardless of where they came from. Diamandis observed that, "a prize says, 'I don't care what race, creed, color, age, or background. I don't care if ever graduated from school. I don't care what other people think about your ideas. If you solve the problem, you win.' It rewards genius and brilliance [without any] precondition."

[12] The foundation achieved its objective in this respect. The Rutan team spent $26 million on the project, including all their R&D, test flights, White Knight, SpaceShipOne, and three flights by humans into space. The cost of the entire project was less than the price of two NASA space suits, according to Maryniak.

In the case of the Ansari X PRIZE, Burt Rutan, the leader of the SpaceShip One team, had long experience in aviation. He was not a traditionalist, however. Rutan had a legendary reputation as a creative, "outside-the-box" thinker, innovator, and pioneer. The presence of a substantial prize, combined with high visibility, had helped Rutan and 25 other competitors gain funding, so that a wide range of ideas, from "crazy" to more conventional, could be tested.

Promotion and Visibility

Providing prize money and properly designing a prize challenge was not sufficient. To change public perceptions, a prize had to be highly visible, and easily understood. This had been the case with the Orteig Prize, Kennedy's moon challenge, and also the Ansari X PRIZE.

According to Diamandis,

> X PRIZEs are going to have to be high visibility. That's the key ingredient to success of this program. You can't have things where the end result is low visibility. The money by itself is insufficient—it serves only to credential the objective as important and valuable. It really needs to be scripted and created and shaped into something that gets global visibility.

This was important for two reasons—public perception, and financial support of competing teams. Changing public perception was one of the key objectives of the X PRIZE concept. This could only be done if the public was aware of, and interested in, the competition. Michael Lindsay, vice president of prize and program development, noted that "the goal definition process is one of simplification. You need to keep simplifying the concept until it can be easily understood and embraced by the public."

A key role of the X PRIZE Foundation was, as Lindsay put it, "story telling, creating heroes, and public relations." This was needed to change the public perception of major challenges, so that the public would view them as solvable given enough creative effort. It was also important for the competing teams. Diamandis saw this as a central role of the foundation, saying, "We are basically a marketing, sponsorship, and public relations organization. Our job is to make heroes out of people competing for the prize. We give them a global stage." Substantial prizes helped teams attract funding. But, the ability to attract funding was not just due to the potential to win the prize—after all, there was only one winner of the Ansari X PRIZE. The ability to attract funding was in large part due to the high visibility of the competition, and the visibility that this brought to the teams.

A key objective of the competition was thus to help tell the stories of the competing teams, and to get the public involved in supporting them. Publicizing the teams would also bring attention to the different approaches being taken by the participants, further increasing public interest. One competitor for the Ansari X PRIZE told Lindsay, "the best thing would be for us to win the prize. The next best thing would be for the prize to be won [since that would validate the private spaceflight field and attract interest and funding]."

The Ansari X PRIZE suffered from one important problem in this respect, however. There was no way to know when or where it would be accomplished. Media coverage was an important

element in developing sponsorship, but without knowing where or when an event would take place, there was only a limited ability to engage the media. As Diamandis observed, "I couldn't tell [the media] whether it would take place in Kazakhstan or in the Mojave Desert [in California], in 2003 or 2004."

NEW BOARD MEMBERS AND FUTURE DIRECTIONS

In order to look at new directions in which prize competitions could stimulate breakthroughs on important problems, the foundation recruited new board members. One key early addition was Larry Page, co-founder of Google, who joined the board on December 3, 2004. Page introduced Diamandis to Craig Venter, the genomics pioneer and entrepreneur, who had led the team that first sequenced the human genome. Venter's foundation had announced a $500,000 prize for low-cost genome sequencing. Diamandis met with Venter, who joined the X PRIZE board, and the X PRIZE Foundation took over and reformulated the genomics prize (which is discussed below).

Other new board members were recruited, such as Elon Musk, who joined on the same day as Page. Musk had been one of the founders of PayPal, and now was CEO of a company working on private spaceflight. Of more importance to the X PRIZE Foundation was Musk's interest in the automotive field. Another board member with interests outside the space and aviation field was Dean Kamen, a renowned inventor of products including medical devices and the Segway® Human Transporter.

The foundation decided to focus on four broad fields: space, energy and transportation, medicine and genomics, and social and education. This was not a big change for the foundation, in Maryniak's view. He felt that interest in these fields came from the same philosophical concerns that led to the Ansari X PRIZE (as described in **Appendix 1**).

By the end of 2006, a genomics X PRIZE had been launched, prizes were being developed in the transportation and social fields, and an annual event (the X PRIZE Cup, discussed below) had been staged to further the space effort. Diamandis viewed these fields of interest as "verticals," in which the foundation would maintain a continuing effort, either through prize competitions or events.

In late 2006, the foundation board included 22 members (**Exhibit 3**). There were about 40 staff members, led by Diamandis as CEO and chairman. Lindsay, as vice president for prize and program development, was responsible for evaluating ideas for prize competitions, interfacing with technical and media experts in developing competitions, and overseeing other foundation projects. To help develop the sponsorship aspect of prize financing, Diamandis recruited a senior vice president of partnerships and marketing who had extensive experience in developing Olympic and Superbowl sponsorships. This brought a new dimension to fundraising, which had historically been limited to philanthropic donors.

Once a prize competition was sufficiently developed, an executive director was recruited to focus on the competition. In late 2006 there were two executive directors, one for the Automotive X PRIZE, and one for the recently launched Anchon X PRIZE for Genomics. A director of space

projects continued the space initiative. A director of media relations emphasized the importance of public relations for the foundation, its prizes, and the competing teams.

The Prize Development Process and Planned X PRIZE Competitions

X PRIZEs were intended to be large ($10 million or more), and focused on creating breakthroughs in the world's great challenges. Lindsay described the concept with the example of a person who had contacted the foundation about creating a competition related to oil spills. The caller stated that the biggest problem related to oil spills in Alaska was getting oil out of ice. Lindsay observed that while this was an important problem to people cleaning up oil spills, an X PRIZE would look at the situation from a higher level. To raise the issue one level, the problem could be formulated around preventing oil spills. The next level up would be even better suited to an X PRIZE—changing to alternate fuels so that there was no need to transport oil.

The ideal X PRIZE addressed a substantial problem in which the existing players (industry, government, research foundations, international agencies, etc.) were stuck. Once a field was identified, the X PRIZE Foundation did research to understand the root causes of the problem. This included discussions with experts in the field, including members of the foundation board and advisors. Lindsay noted that Vice Chairman Robert Weiss was a particularly important resource. Weiss was a prolific movie producer, and provided important counsel on formulating ideas so that they could be easily understood and crafted into stories that would engage the public and sponsors of competing teams.

One important tool during the formative stage was the summit meeting. This was a meeting in which the leading experts in the field of interest, as well as great minds from other fields, gathered to discuss the issue and potential prize concepts. For instance, when considering a prize that addressed problems in the developing world, and lifting people out of poverty, Dean Kamen suggested focusing on water delivery. He had invented a technology for water purification, and recognized that one of the critical challenges facing developing economies was poor water distribution.

A summit was convened to look at this question in depth (held on a private island owned by Kamen, so that, fittingly, the participants were surrounded by water). The summit included the world's leading experts on water distribution, entrepreneurs, philanthropists, and others whose perspectives could aid the discussion. The summit participants concluded that focusing on water was too limiting. Rather, the real problem was that most people did not make any money. Spurring entrepreneurial ventures that helped the maximum number of people participate in money-making activities would have a far greater impact. People that made money could afford shelter, food, water, education, health care, and move out of poverty. A second summit was planned to look at this larger issue.

Ideally, each step of the prize development process was funded by specific donations. This allowed general donations to fund the foundation staff and infrastructure, and enabled donors with specific interests to fund projects that would lead to prizes in those interest areas.

When a prize concept was sufficiently developed, an executive director was recruited to head up that prize competition. Teams that might participate in the prize competitions were identified,

and asked for feedback on the prize objectives and rules. The concept was simplified so that it could be easily explained and embraced by the public. Detailed rules were developed. A prize sponsor was solicited. An initial set of teams were signed up. At that point, the prize was "launched."

The prize launch was an important milestone, as it was the first formal, public announcement of the competition. After the launch, the foundation would work to promote the competition and the participating teams. Hopefully, the end result would be a successful completing of the prize challenge, and the awarding of the prize.

The Archon X PRIZE for Genomics

On October 4, 2006, exactly two years after SpaceShip One captured the Ansari X PRIZE, the foundation launched its second X PRIZE competition—the Archon X PRIZE for Genomics. The idea for a prize for rapid genome sequencing had originated at the J. Craig Venter Foundation, which had offered a $500,000 prize. Venter was a visionary and entrepreneur in the field of genomics, and had led a private team that had sequenced the genome in nine months, at a cost of about $100 million. Government efforts had taken years, and hundreds of millions of dollars.

Diamandis had been introduced to Venter by Larry Page. Diamandis later recalled, "I met with Craig, we hit it off, and [the X PRIZE Foundation] basically agreed to take over Craig's prize under the precondition that we could turn it into an X PRIZE by rewriting the rules, and taking it to a $10 million level—which he enjoyed doing." Venter also joined the X PRIZE Foundation board.

The X PRIZE Foundation defined the competition so that it could be easily understood by the public, and would represent a breakthrough in technology. They decided that the competition would require sequencing 100 human genomes within 10 days. In 2006, the task would take months, and many millions of dollars, so meeting the challenge would represent a substantial breakthrough. However, the ability to quickly and inexpensively sequence a person's genome offered the potential for radical breakthroughs in medicine, making medical treatment preventative rather than reactive.

They then had to find a sponsor. Dr. Stewart Blusson, the president of Archon Minerals in Canada, had been attracted to the X PRIZE Foundation after the success of the Ansari X PRIZE. He was interested in stimulating important research, although he did not have a specific focus on genomics. However, he found the chance to create a breakthrough in this important field compelling, and quickly agreed to be the title sponsor of the prize. In addition to the $10 million purse, Blusson donated $2.8 million to pay the cost of running the competition.

The Anchon X PRIZE for Genomics required 100 human genomes to be sequenced in 10 days. There were additional requirements, such as achieving an accuracy of no more than one error for each 10,000 bases sequenced, and coverage of at least 90 percent of the genome. The sequencing cost could not exceed $10,000 per genome. The prize expired after seven years, but could be renewed by the X PRIZE Foundation.

To compete for the prize, teams had to register, sign a Master Team Agreement (MTA), and pay a $1,000 registration fee. At the time the prize was launched, there were three teams signed up to compete. Many others were interested and expected to register.

The teams could begin an attempt to win the competition on January 15 or July 15 in any year, but no earlier than July 15, 2007. In order to make an attempt, a team had to submit a "Notice of Readiness" at least six months prior to the date of the attempt. Once this was done, the team had to submit a documentation package no later than five months before the attempt was to begin. The package would be reviewed by the competition judges, and teams would be declared eligible to compete four months before the attempt would take place.

If more than two teams succeeded, the fastest team would receive $7.5 million, and the other team $2.5 million. If three or more teams succeeded, the fasted would receive $7 million, the second fastest would receive $2 million, and the third fastest would receive $1 million.[13]

Automotive X PRIZE

In March 2006, the foundation announced that it was developing a competition to bring about a new generation of automobiles. The initial idea was for a $25 million for the first mass-produced vehicle that would have fuel consumption of 250 miles per gallon and sold 10,000 vehicles. The executive director for the "Automotive X PRIZE," Mark Goldstein, described the two assumptions behind the competition, "One, that the technology exists today to give us an order-of-magnitude improvement in efficiency, however you measure it. The second [assumption] is that the prize ought to be defined by the market."[14]

In July 2006, the foundation hosted a brainstorming session to discuss the challenges that would be faced in developing a vehicle that could meet the prize objectives, as well as potential competition rules. The session was attended by 26 experts from the automotive, environmental, regulatory, scientific, governmental, and media fields.[15]

The objective of the prize, in Lindsay's words, was, "to make a real impact on perceptions—that highly efficient cars can be affordable, high performance, desirable, and available. We want the competition to develop cars that are ready to work on the street," not just a laboratory version that was optimized for the competition—thus the idea that a relatively large number of vehicles had to be sold in order to win the prize. This, however, introduced a number of other problems, such as distribution, service, spare parts, and capital investment for mass production.

The concept for the competition evolved, so that by late 2006 the foundation was thinking in terms of an endurance race for clean, production-ready vehicles that exceeded 100 mpg (or equivalent, for non-gasoline powered vehicles). The race winner would win the prize. The foundation had developed a draft set of rules, which had been sent to industry and potential

---

[13] Competition guidelines online at: http://genomics.xprize.org/assets/downloads/Archon_X_PRIZE_for_Genomics_Competiton_Guidelines.pdf (November 3, 2006).

[14] Justin Hyde, "Lots of Bucks for Lots of MPG; Foundation to Offer $25 Million Award," *Detroit Free Press*, March 11, 2006, p. A2.

[15] http://auto.xprize.org/news/events.html (September 18, 2006).

competitors for comment. The foundation hoped to launch the Automotive X Prize in early 2007. (See **Exhibit 4** for a description of the goals of the competition, as of late 2006.)

Social X PRIZEs

The foundation was also working on two X PRIZEs in the social arena. Diamandis observed that,

> In dealing with big social problems, society today has become apathetic to a large degree. 'Oh, people will always be hungry. Oh, there will always be poverty. Oh, that's just the way they are.' The most important thing to solving these problems, no matter what they are, is the belief that you can solve them. That's a fundamental first step.

Two foundations, the Templeton Foundation and the Kaufman Foundation, provided seed funding for work in the social arena. The Templeton Foundation was also the first foundation to become a major donor and participate in the X PRIZE Vision Circle, the group underwriting the foundation's ongoing operations.

The Kaufman Foundation provided seed funding for the X PRIZE Foundation's first social prizes in the field of education. The foundation hired a senior advisor to help think through issues in education and to develop prize concepts. The idea was to find ways to accelerate learning, particularly in math and science. An education summit was scheduled for the first quarter of 2007.

The second social prize, funded by the Templeton Foundation, addressed world poverty. The "Global Entrepreneurship X PRIZE" intended to spur breakthroughs that would enable large numbers of people to engage in money-making activities. As previously described, this had begun as an investigation of a possible prize related to water distribution, but had expanded to the broader problem of poverty. A summit was scheduled in early 2007 to focus on this subject.

X PRIZE Cup

As noted above, one of the problems with the Ansari X PRIZE was that there was no way to know where or when a team would try to win the prize, so it was difficult to engage the media. That, in turn, posed challenges in raising sponsorship money. The X PRIZE Cup sought to address those problems while continuing the foundation's initiative to support private spaceflight.

Before the Ansari X PRIZE was won, the foundation began preparations for an annual "grand prix of space," the "X PRIZE Cup." The inaugural event was held in New Mexico in 2005, and featured models of Ansari X PRIZE competitors, the test of a prototype lunar landing vehicle, a development precursor to the Rocket Racing League's ship, a rocket test, and a space museum.

The Rocket Racing League (RRL) was planned as a competition in which rocket planes raced over a fixed course, much like a NASCAR race (hopefully without the crashes). The league was scheduled to begin in 2007, and the final race of the season would be part of the X PRIZE Cup. The RRL, partially a spin-out of the X PRIZE Foundation, would draw attention to the X PRIZE

Cup and spark public imagination for private spaceflight. Eventually, it was envisioned that the X PRIZE Cup would also include space launches.

The 2006 X PRIZE Cup, held October 18-21 at Las Cruces, New Mexico, was sponsored by Wirefly.com, and thus was titled, "Wirefly X PRIZE Cup." It included a wide variety of activities, including the NASA Centennial Challenges, a student rocket flight competition, an RRL demonstration, ground displays, and a symposium. It was attended by about 20,000 people, including more than 6,000 school children who were bussed to the event. Thousand more viewed a live Webcast of the event. (see **Exhibit 5** for a schedule of events).

NASA Centennial Challenges

On May 4, 2006, NASA announced that the X PRIZE Foundation would manage a prize competition as part of the space agency's Centennial Challenge. The competition required that a vehicle simulate a "trip between the Moon's surface, to lunar orbit, and back to the lunar surface." NASA was planning a return to the Moon, and wanted entrepreneurial organizations to develop technologies that could further that objective.

Northrop-Grumman joined as title sponsor, and thus the competition was called the "Northrop-Grumman Lunar Lander Challenge." There were two parts to the challenge. The simpler challenge required a vehicle to take off, reach an altitude of 150 feet, hover for 90 seconds, and land on a pad 300 feet away. The more difficult challenge required that the vehicle hover for 180 seconds, and land precisely on a simulated rocky moon surface 300 feet from the launch pad. In both challenges, the vehicle had to then return to its original starting point.

A total of $2 million in prize money was available. The simpler challenge would pay $350,000 for first place, and $150,000 for second place. The more difficult task would pay $1.25 million for first place, $500,000 for second place, and $250,000 for third place. The competition took place at the Wirefly X PRIZE Cup. Any prize money not won in the 2006 competition would carry over to 2007.[16]

At the Wirefly X PRIZE Cup, several attempts were made to achieve the simpler of the two challenges. One team successfully flew to the landing pad, but failed on the return flight.

On August 8, 2006, another competition, the Space Elevator Games was added to the NASA Centennial Challenge. This competition was run by the Spaceward Foundation, and conducted at the Wirefly X PRIZE Cup. The space elevator concept consisted of a ribbon extending to an orbiting counterweight. The space elevator could climb the ribbon, making access to space much less expensive than by using rockets. The competition was for $400,000, divided into two parts. The first part, with a $200,000 prize, was for a vehicle that could climb a ribbon to a height of 50 meters, averaging at least 1 meter/second, carrying a payload, and powered by a beam transmitted to a receiver on the climbing vehicle. The second part, also with a $200,000 prize, was for a ribbon tether with greatly improved strength than currently available.[17] A number of

[16] X Prize Foundation Press Release, "X Prize Foundation and NASA Offer $2.5 million Lunar Lander Challenge," May 4, 2006. Online at http://www.xprize.org/newsevents/press_releases_21006-05-04_Lunar_Lander.html (September 18, 2006).

[17] "Space Elevator Games to Take Place at the 2006 X Prize Cup in New Mexico," *Business Wire*, August 8, 2006.

teams attempted to meet the challenges, with one team narrowly missed claiming the prize for climbing when it exceeded the maximum allowable time by just 3 seconds.

Beyond X PRIZEs: Using Prizes to Address Technical and Local Problems

While X PRIZEs were intended to stimulate breakthroughs in the great challenges facing mankind, prizes could also address other important problems. The NASA Centennial Challenges were an example, addressing specific problems dealing with returning to the moon. The characteristics of this "second-level" competition, as compared to an X PRIZE, included: a more narrow impact, smaller prize money, lower visibility, and an audience consisting of people in the field rather than the general public.

Diamandis also envisioned a third type of competition—one dealing with local or community issues such as crime in a neighborhood, graffiti in a local park, or providing a town with clean water. He believed that it might be possible to for the foundation to provide an infrastructure that could help address local issues through prizes. He called this "myXprize," and noted, "I love the idea that eventually high school students will go online and say, 'where can I make some money? I'll do a prize—is there a project I can attack?'…[We'd like to get to a place] where people do this as a way to make their mark in life, and solve a problem—transition from success to significance."

OTHER PRIZE-BASED ORGANIZATIONS

Prizes as an incentive to achieve specific objectives that were important to the prize organizers had a long history, as mentioned earlier and as discussed in **Appendix 2**. However, the Internet enabled a new generation of prize competitions, allowing a wide range of organizations to define problems critical to them, and tapping into the creativity of a wide range of potential problem solvers.

Innocentive, for instance, was a web-based community in which companies could post R&D challenges, together with a financial incentive ranging from $10,000 to $100,000. Scientists from around the world could register to solve the problem. The successful scientist would receive the financial reward.[18]

Idea Crossing created competitions for companies that sought to engage the creativity of employee, customers, or others to address issues of critical interest. Idea Crossing created a web-based system for administering idea contests. These contests might foster innovation among employees or engage potential customers in product definition.[19]

CHARTING A NEW FUTURE

The X PRIZE Foundation had achieved great success in its objective of jumpstarting personal spaceflight. SpaceShipOne had successfully met the challenge, creating world-wide excitement. The Ansari X PRIZE had stimulated investment totally many times its $10 million value. Many

[18] http://www.innocentive.com/ (August 11, 2006).
[19] http://www.ideacrossing.com/ (August 11, 2006).

groups from around the world were pursuing plans to offer space flights to paying passengers. Government regulations had been adopted to provide for personal spaceflight.

The foundation had now broadened its scope, taking its experience to a wide range of important issues. Unlike the aviation and space arena, the new areas addressed by the foundation, particularly those directed at social issues, had not previously been subjects of prize competitions. Could prize competitions provide the motivation needed to tackle these problems and jumpstart initiatives that would then be carried forward by the marketplace? Could the X PRIZE Foundation provide the infrastructure to support prize competitions that could address the most important problems facing humanity? And, could the prize model revolutionize philanthropy, enabling donors to stimulate success in achieving breakthroughs, rather than continually spending money for traditional approaches that not solved the important problems?

Appendix 1
Accessing Space for the Benefit Of Humanity:
The Philosophical Background of the X PRIZE Foundation

The roots of the X PRIZE Foundation traced back to the late 1960s and early 1970s, and the work of Gerard K. O'Neill, a Princeton physics professor. O'Neill was concerned about the future of the human species in the face of a rapidly expanding population and ecological pressures. In one of his physics classes, he posed the hypothetical question, "Is a planetary surface the best place for an expanding technological civilization?"[20]

In studying this question, O'Neill concluded that the answer was "no." As Maryniak put it, "the Earth is a little island in space, surrounded by an ocean of energy and mineral resources." If the resources of space could be accessed, many of the most pressing environmental problems could be solved—problems such as energy supply, materials shortages, pollution, and overpopulation.

However, space is difficult to access, since Earth's gravity must be overcome in order to reach space. Nearby, however, are objects such as asteroids which contain useful materials and have extremely little gravity. If humans could access space readily, the tools necessary to tap these materials sources could be put into space, and space-based human colonies established.

O'Neill wrote a paper on this concept, called "The Colonization of Space," which appeared in *Physics Today*, a respected scientific publication, in early 1974. Later that year, a conference on the topic was held at Princeton, which was widely covered by the media. The conference was held again at Princeton the following year in cooperation with the American Institute of Aeronautics and Astronautics, and took place every other year from 1975 to 2001. O'Niell expanded on his ideas in a monograph, "The High Frontier: Human Colonies in Space," which won the 1977 Phi Beta Kappa Science Book of the Year Award.

NASA embraced O'Neill's ideas, supporting his research with a grant, and then recruiting him to work at NASA's Ames Research Center in Mountain View, CA in 1976. The next year he founded a private non-profit corporation called the Space Studies Institute (SSI) devoted to research and education, with the long-term objective of achieving the benefits he envisioned from space.

Gregg Maryniak was recruited to run SSI. Among those that Maryniak recruited was Peter Diamandis, who was very interested in O'Neill's concepts, and had started Students for the Exploration and Development of Space (SEDS).

Maryniak and others at SSI did not believe that the problems limiting the use of space were technological. In 1979, Maryniak had asked Professor Freeman Dyson (who later became SSI's president, a position he held in 2006) what technologies would be required to take ordinary people to space. Dyson told him, "it's not about the technology. We need a completely different style of operations." The problem was that there was very little traffic to space. In 2005-2006,

[20] Material for this Appendix is from an interview with Gregg Maryniak and information from the Space Studies Institute Web site (http://ssi.org).

there were fewer than 20 commercial flights a year to space. The economics of going to space were so unfavorable, with costs of up to $10,000 per pound of payload, that there was no incentive to go to space.

Maryniak likened the problem of reaching space to climbing a 50 step ladder, with the first 49 steps missing. The only way to do it was by huge investment, of the sort that only governments could afford. What was missing was a series of commercially viable small steps that would eventually result in economically viable ways to escape the Earth's gravity and make space accessible for the benefit of humanity. Years later, the Ansari X PRIZE became one of the first small steps on this ladder.

Maryniak expressed the grand concept that eventually led to the Ansari X PRIZE as follows:

> Basically, we see this as a whole new area of hope. It's really about hope for the human species. Make our species unkillable, make it more robust, be more efficient about how we get energy, and not have all our eggs in one basket. I don't mean just the planetary basket—[we need to] have many solutions. Just like having North America was a good thing for Europe, having this new opportunity for a significant subset of our species to be operating off-planet is a good thing.
> `
> I'm not saying it's Utopia, and a lot of people accused O'Neill of being Utopian. He really wasn't; he was actually a very practical guy. But he liked to paint a rosy picture of what it could look like, so people would be excited about it.
>
> That was the background. So, when you realize that, you suddenly come to the realization that [in the effort to utilize space] the X PRIZE was step one of a many step program. It always was about a big, socially motivated program. It always was about trying to make the world (and the world doesn't mean just the planet) better for people, and offer a very strong message of hope.

Appendix 2
Examples of Historical Prizes

Prizes have been used to help solve problems for centuries. For instance, in the 17th and 18th Centuries, one of the most important problems facing the British Navy was accurate navigation. Latitude could be determined accurately, but determining longitude could not be accurately measured. Since the Navy was the foundation of Britain's power, this was a very important problem. Parliament issued the Longitude Act of 1714, providing substantial prizes for solving this problem. This sparked efforts by many people, eventually resulting in the development of highly precise chronometers, which enabled accurate navigation.

In the 1700's, one of the important challenges for the textile industry was washing, which was required during several steps of the production process. Industrial soaps, using sodium carbonate, were expensive and difficult to produce. In 1775, the French Academy of Sciences offered a prize of 100,000 francs for a process that could convert salt to sodium carbonate. In 1791, French chemist Nicholas Leblanc succeeded in developing this process, which was a significant stimulus to developing the modern chemical industry.[21]

Aviation has been heavily influenced by prizes. Following the Wright Brothers' flight in 1903, hundreds of prizes were offered for advances in aviation. One well known prize was the Schneider Prize Cup created in 1911, setting forth a competition for seaplanes. This was intended to encourage advances in civil aviation, and offered a prize of £1,000. This series of competitions, held from 1913-1931, eventually became a speed contest for participating countries' military aviation programs, but did further airplane development, especially in aerodynamics and engine design.

The prize that inspired Diamandis to create the X PRIZE was the Orteig Prize, offered in 1919 by a French-born American hotel owner. He offered to fund a prize of $25,000 for the first non-stop flight between New York and Paris. Orteig delegated the details of the competition to the Aero Club of America. In 1927, Charles Lindbergh won the Orteig Prize, inspiring rapid development of the civil aviation industry.

A more recent aviation-related prize was the £50,000 Kremer Prize, established by British industrialist Henry Kremer in 1959. The prize required a human-powered airplane to fly a one-mile, figure-eight shaped course. This prize inspired Paul MacCready, founder of a young aviation engineering company. He later commented:

> In 1976, I had no interest in human-powered flight but was aware of the 50,000-pound Henry Kremer Prize… The light bulb of creativity flashed on while I was daydreaming on a vacation trip... The prize equaled the debt [acquired from co-signing a friend's loan for a business that later failed]. Suddenly, human-powered flight was exciting.[22]

---

[21] http://en.wikipedia.org/wiki/Nicolas_Leblanc, and http://www.fathom.com/feature/122205/index.html (both August 9, 2006).

[22] Paul MacCready: Flying Higher and Quieter, Progressive Engineer,

MacCready went on to win the £50,000 prize on August 23, 1977 with the Gossamer Condor. Two years later he won a £100,000 Kremer Prize when the Gossamer Albatross successfully crossed the English Channel under human power. While human-powered flight was not a practical form of transportation, technologies developed for these projects were applied to improving airplane efficiency.

In 2003, the U.S. Defense Advance Research Projects Agency (DARPA) initiated a competition to develop autonomous land vehicles, which could complete a course over difficult terrain without any human intervention. This competition was driven by the military's desire to develop vehicles that could travel in hazardous environments without jeopardizing soldiers. The $1 million prize was to be awarded for an autonomous vehicle that could traverse a course of about 200 miles through the California desert in less than 10 hours. As with the X PRIZE, the competition was inspired by the Orteig Prize.

The first DARPA Grand Challenge was held in March 2004, but none of the 25 finalists completed the course. A second DARPA Grand Challenge, with a $2 million prize, and run over 132 difficult desert miles, was held in October 2005. Autonomous vehicle technology had advanced during the intervening year as a result of the Challenge. This time, 5 of the 23 entrants completed the course, four within the 10 hour time limit. The winner, based on the fastest time, was the entry from Stanford University.

---

http://www.progressiveengineer.com/PEWebBackissues2003/PEWeb%2042%20Sep%2003-2/MacC.htm (August 9, 2006).

Exhibit 1
Ansari X PRIZE Registered Competitors

The following 26 teams were entered in the Ansari X PRIZE competition.

Mojave Aerospace Ventures
Location: Mojave, California, USA.
Approach: The spacecraft, SpaceShipOne, is carried to approximately 50,000 feet by an airplane, White Knight. It is then released, and powered to space with rocket motors. Upon return to earth, SpaceShipOne glides to an airport landing.

The Golden Palace.com Space Program Powered by the Da Vinci Project
Location: Toronto, Ontario, Canada
Approach: A reusable helium balloon carries a Wildfire Mk VI rocket to an altitude of 24 km. The rocket is then released and carries a capsule into space. The capsule is released from the rocket. Rocket and capsule parachute to the ground.

Canadian Arrow
Location: London, Ontario, Canada
Approach: A ground based rocket carries a crew capsule to space. The crew capsule separates, continuing upward. Both the rocket and crew capsule parachute to splashdowns in the Great Lakes.

Armadillo Aerospace
Location: Mesquite, Texas, USA
Approach: A rocket is launched from the ground. The crew compartment is part of the rocket. After reentry, the rocket parachutes to ground.

Starchaser Industries Ltd.
Location: Cheshire, England
Approach: The Starchaser rocket is launched from ground, carrying the Thunderstar crew capsule. Both rocket and capsule parachute to earth.

Advent Launch Systems
Location: Houston, Texas, USA
Approach: The Advent winged rocket is launched from the water with a crew compartment attached. It makes a controlled landing in the water, much like a sea-plane. It can then be towed by boat to the launch facility for relaunch.

ARCA (Asociatia Româna pentru Cosmonautica si Aeronautica)
Location: Ramnicu Valcea, Romania
Approach: The rocket is launched from land, and carries a crew capsule. The capsule separates from the rocket and continues into space. Rocket and capsule each parachute to splashdowns in the water.

Pablo de León and Associates
Location: Buenos Aires, Argentina
Approach: A rocket carries an Apollo-type crew capsule to space. After separation, both rocket and capsule parachute to splashdowns in the water.

High Altitude Research Corporation
Location: Huntsville, Alabama
Approach: A rocket is launched from a ship. The rocket carries an Apollo-type capsule, which separates from the rocket. Rocket and capsule parachute to splashdowns in the water.

Rocketplane, Ltd.
Location: Solvang, California, USA
Approach: A four-seat rocket plane takes off from an airport, climbs using a turbojet, then accelerates into space using rocket power. Upon return, it glides to a landing at the airport.

Suborbital Corporation
Location: Moscow, Russia
Approach: An aircraft carries a winged rocket to an altitude of 20 km. The rocket is released and accelerates into space. It glides to a landing at an airport.

IL Aerospace Technologies
Location: Zichron Ya'akov, Israel
Approach: A hot air balloon carries the rocket to about 10 km. The rocket then flies to space.

Interorbital Systems
Location: Mojave, California, USA
Approach: A rocket is launched from the water.

Space Transport Corporation
Location: Forks, Washington, USA
Approach: A rocket, including crew compartment, takes off from land. When it returns to earth, it lands vertically, using its rocket engines.

American Astronautics Corporation
Location: California and Oklahoma, USA
Approach: Single-stage rocket that is launched from land.

Bristol Spaceplanes Limited
Location: Bristol, England
Approach: A rocket-plane takes off from an airfield using a turbofan engine. It then fires a rocket, taking it to space. It then returns to a landing at the airfield.

PanAero, Inc.
Location: Fairfax, Virginia, USA

Approach: Eight rocket engines slowly carry a crew compartment and an ultra-light fabric wing to space. Upon descent, the fabric wing is reconfigured to act as a parachute.

Vanguard Spacecraft
Location: Bridgewater, Massachusetts, USA
Approach: A vertical take off is made from land. A crew capsule separates from the rocket and continues into space. Rocket and capsule parachute to a splashdown in the water.

Acceleration Engineering
Location: Bath, Michigan, USA
Approach: A rocket, incorporating a crew compartment, is launched from land. It returns to a vertical landing.

Discraft Corporation
Location: Portland, Oregon, USA
Approach: A 100 foot diameter, saucer-shaped vehicle, powered by pulsejets, takes off horizontally from a conventional runway, returning to the runway.

Flight Exploration
Location: London, England
Approach: A rocket is launched from land. After reaching space, it returns, slowed by parachutes, to a landing that is cushioned by gas bags.

Fundamental Technology Systems
Location: Orlando, Florida, USA
Approach: A rocket plane takes off horizontally from a conventional runway, flying to space and returning to the runway.

Kelly Space and Technology
Location: San Bernardino, California, USA
Approach: A rocket-powered delta-wing glider is towed from a conventional runway to altitude. It is released, starts its rocket engine, flies to space, and returns to a glider landing at the runway.

Lone Star Space Access
Location: Houston, Texas, USA
Approach: A rocket plane takes off from an airport using conventional jet engines. It then ignites rockets that take it to space. It returns to land at the airport.

Micro-Space Inc.
Location: Denver, Colorado, USA
Approach: A crew compartment is attached to a large number of small-diameter rocket propulsion modules, and launched into space.

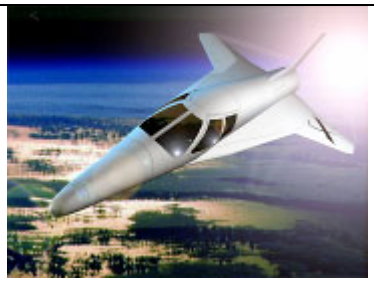
Source: http://www.xprize.org/xprizes/ansari_teams.html (November 21, 2006). This Web site has additional information about the teams, as well as links to team Web sites.

Exhibit 2
Illustrations of Selected Ansari X PRIZE Team Concepts

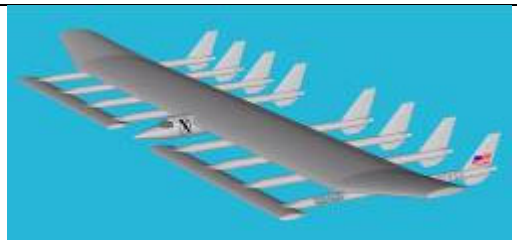
Mojave Aerospace's White Knight carrying SpaceShipOne.

The Golden Palace.com Space Program, showing rocket and balloon.

Armadillo Aerospace rocket.



Bristol Spaceplanes Limited rocket plane.



PanAero fabric wing, powered by eight rockets.

Discraft Corporation "flying saucer."

Source: http://www.xprize.org/xprizes/ansari_teams.html (November 21, 2006). Images reprinted with permission.

Exhibit 3
Board of Trustees in Late 2006

Peter H. Diamandis, M.D., X PRIZE Foundation founder and chairman; CEO, Zero Gravity Corporation.

Robert K. Weiss, vice-chairman. Movie producer.

Gregg E. Maryniak, secretary. Space scientist.

Jeffrey Shames, treasurer. Mutual fund chairman (retired).

Eric C. Anderson. President and CEO of Space Adventures. Commercial space flight and space tourism entrepreneur.

Amir Ansari. Co-founder and chief technology officer of Prodea Systems. Telecommunications inventor and serial entrepreneur.

Anousheh Ansari. Chair of Prodea Systems. Telecommunications inventor and serial entrepreneur.

Jack Bader. Information technology entrepreneur and executive.

Gil Elbaz. Engineering director of Google's Santa Monica, California office.

Richard Garriott. Computer game designer and entrepreneur. Vice chairman of Space Adventures.

Kevin Kalkhoven. Venture capitalist, former president, CEO and chairman of JDS Uniphase, co-owner of Champ Car World Series auto racing series.

Dean Kamen. Inventor and entrepreneur. Inventions include the Segway™ Human Transporter. Founder of FIRST (For Inspiration and Recognition of Science and Technology), an organization that motivates youth to understand and enjoy science and technology.

Erik Lindbergh. Grandson of Charles Lindbergh and director of the Lindbergh Foundation.

Diane Murphy. Communications and public relations executive.

Elon Musk. CEO and chief technology office or Space Exploration Technologies, which is developing low-cost, reliable space vehicles. Previously, co-founder of PayPal.

Rod O'Connor. Public relations, communications, and event marketing executive.

Larry Page. Founding CEO and co-president of Google.

Adeo Ressi. Financial industry executive.

Barry Silverstein. Attorney and communications entrepreneur.

Rich Sugden. Physician and pilot.

Barry Thompson. Financial services industry executive.

Craig Venter, Ph.D. Genomics visionary and entrepreneur.

Source: http://www.xprize.org/about/board.html#gil (September 18, 2006)

Exhibit 4
Automotive X Prize

The goals and objectives of the Automotive X PRIZE were described on the X PRIZE Foundation Web site in September 2006 as follows:

Goals of the Prize

Our goal is to stimulate automotive technology, manufacturing and marketing breakthroughs that:

- Radically reduce oil consumption and harmful emissions
- Result in a new generation of super-efficient and desirable mainstream vehicles that people want to buy

How it will work

The rules are being shaped by our philosophy that the Automotive X PRIZE must:

- Achieve our main goals (above)
- Be simple to understand and easy to communicate
- Benefit the world - this is a global challenge
- Result in real cars available for purchase, not concept cars
- Remain independent, fair, non-partisan, and technology-neutral
- Provide clear technical boundaries (i.e., for fuel-efficiency, emissions, safety, manufacturability, performance, capacity, etc.)
- Offer a "level playing field" that attracts both existing automobile manufacturers and newcomers
- Attract a balanced array of private investment, donors, sponsors, and partners to help competitors succeed (e.g., manufacturing assistance, testing resources, etc.)
- Make heroes out of the competitors and winner(s) through unprecedented exposure, media coverage and a significant cash award
- Educate the public on key issues

Source: http://auto.xprize.org/xprize/ (September 18, 2006)

Exhibit 5
2006 Wirefly X PRIZE Cup Schedule

Friday, October 20
Lunar Lander Challenge Round One Competitions
Vertical Rocket Challenge Round One Competitions
Student Field Trip
Student Rocket Fly-Off
Jet Pack Flight
T-38 Fly-Overs
Rocket Bike
Rocket Truck
Sounding Rockets
Elevator Games

Saturday, October 21
Lunar Lander Challenge Round Two Competitions
Vertical Rocket Challenge Round Two Competitions
T-38 Fly-Overs
Rocket Bike
Rocket Truck
Sounding Rockets
Elevator Games

Source: http://www.xprizecup.com/event.php?sub=event_schedule (September 19, 2006).