

# Space Tourism Business Model

The Virgin Galactic Approach

by

**Pilar Alegre**  
alegripilar@hotmail.com

**Patti Spitler**

**David Wells**  
david.wells@sinclair.edu



## **Executive Summary**

Virgin Galactic, a division of Virgin Group, is a leading company in the Suborbital Reusable Launch Vehicle (SRLV) industry. The Office of Commercial Space Transportation of the FAA licenses and regulates all space activity within the U.S.A. Virgin Galactic, along with two other companies, has taken advantage of the new regulation and has filed for and received the required permits to provide suborbital space tourism. Virgin Galactic is considered to be a first mover in this field.

Virgin Galactic is planning on having its first launch to take customers into space in the year 2008. These customers, according to the research done by the Futron Corporation for NASA fall in a very specific range of people in the U.S.: millionaires that are employed full-time (61%), are married (100%), are mostly men (94%) and with an average age around 54. There is an estimated 5.6 million people that fall within the first requirement of being able to pay for the flight. Of these, only 10% have an interest in space flight and it is estimated that 10% of these will actually take a flight into space. This gives us a potential 56,000 customers eager to fly into space and can afford it. Virgin Galactic is planning on sending 600 of these customers a year into space.

The two other companies that have filed for and received permits are Space Adventures and Incredible Adventures. The latter has been around for a while and is currently providing customers with other tours. Virgin Galactic's primary advantage over these competitors is its plan to offer more than just the space flight. It plans on offering a full first-class vacation, along with the training and medical testing needed for the flight for a cost of \$200,000. To be able to offer all this, Virgin Galactic is relying on its sister companies in the Virgin Group.

The sister companies along with Virgin Galactic's space ship supplier, Scaled Composites present a strong set of complementary services and support. Today, the Virgin Group has a strong presence in the aviation industry (i.e., Virgin Atlantic) and Virgin Galactic is planning on using it to provide transportation for the customer to and from the resort being built. The Virgin Group also is providing the financing needed for the initial investment (\$150 million) and all the media, advertising, and publications needed for the venture.

This paper presents four different cash flow projections. These projections are based on a 17.6% cost of capital and uses two different variables to determine the four cases. These variables are based on the variable costs and if a 10% down payment is required or not. In the most optimistic case, which is still fairly conservative, we show a net present value of almost \$4 million from the 10 year cash.

With an 18% internal rate of return, this project is a good fit for Virgin Galactic and keeps the name of Virgin in the minds of its customers as an innovative group of companies.

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## **1 Introduction**

With the advent of public Suborbital Reusable Launch Vehicles (SRLVs) many new and exciting business models are now emerging. These models range from launching spacecraft to place satellites, remote sensing, microgravity research, space tourism and many other to be determined.

This paper focuses on the space tourism aspect, in particular, the business model used by Virgin Galactic and other similar projects.

### **1.1 The Business Model**

Space tourism has many potential markets. This model is focusing on one of the first of the commercial markets; that of sub-orbital space tourism. It is a model that is best described as a jump into space and back. Many of the companies that will use this model will also venture into other models: orbital space tourism, satellite launch, etc...

### **1.2 Overview**

With the advent of the Ansari X-Prize being won, the road to commercial space tourism has been open. This model is designed to show how to implement space tourism with the technology used by the winner of the Ansari X-Prize, Scaled Composites and Paul Allen, who formed a joint venture called Mojave Aerospace Ventures.

Like with any new technology, there are risks and the potential of high start-up costs. Virgin Galactic, one of the companies implementing this model, is in a unique position to provide its customers an experience of a lifetime, that of space tourism.

## **2 External Assessment**

The external assessment is made up of four primary parts: the customer, market, competitor and environmental analyses.

### **2.1 Customer Analysis**

The customer analysis will narrow the field of potential customers and describe the target market.

#### **2.1.1 The Target Market**

There are two vastly overlapping groups of people that will want to take a trip into space as a tourist: those people that have a life long dream of space travel and who want to “be one of the first” to do something. Both groups are limited by the ability to pay for the luxury of taking a trip into space.

The Futron Corporation prepared a Market Analysis<sup>1</sup> on Space Tourism for NASA. The survey was taken from a pool of 450 people. The sole qualification to take this survey was to either have an income of over \$250,000 or have a minimum of \$1,000,000 in net worth.

##### **2.1.1.1 Survey Demographics**

The demographics of the respondents are detailed in table A-1 Survey Demographics.

Futron’s research revealed the average age of the respondents to be 57-years-of-age and the male / female ratio matched the published ratio of wealth holders in the United States as reported by the IRS (70% are male).

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<sup>1</sup> *Space Tourism Market Study*, Futron Corp., October 2002 ([www.futron.com](http://www.futron.com))

### 2.1.1.2 Customer's Perception and Adverseness to Risk

The Futron survey attempts to measure the respondent's perception and participation of risky activities. The reason for this is that space travel is intrinsically risky. The findings are summarized in Table A-2.

As can be seen in the above mentioned data, most of the respondents to the survey are adverse to physical risk. When asked to rank where space travel fell in the above listed activities, the respondents ranked it third (Skydiving and Mountain Climbing came in higher than spaceflight).

### 2.1.1.3 Discretionary Spending Patterns

The survey also shows that 32% of the respondents are willing to spend their discretionary spending on travel and vacations. Furthermore, 10% of the respondents are willing to spend over \$50,000 on discretionary spending.

Another question posed to the respondents is "how would they spend \$100,000." Of the respondents, 56% want to invest the money where only 12% want to spend it on a sub-orbital space flight. The respondents also answered the question with a figure of five million dollars. This time 45% chose to invest the money and 17% want to spend it on a sub-orbital space flight. The report states the respondents did not know the pricing of sub-orbital space flights at this point in the survey.

### 2.1.1.4 Vacation and Leisure Patterns

Since space tourism is one of the "ultimate" vacations, it will need to be done in the same length of time that our customers will be taking their vacations. Table A-3 shows the respondents answers to the length of maximum and average vacation times taken.

The survey also asks how much the respondents normally spent on vacation. Only 1% would normally spend over \$50,000 on vacation, whereas, over 77% would spend less than \$10,000 a year.

### 2.1.1.5 Fitness

Physical health of the potential tourist (astronauts) is crucial to space travel, therefore, the respondents were asked to rate their physical fitness. Over 47% of the respondents rated themselves as above average or extremely fit and 39% rated themselves as having average fitness. When asked how long they would train for a given activity, 46% will train for less than three weeks.

### 2.1.1.6 Interest in Space

The survey asks the respondents about past participation in terrestrial space-related activities to find out their interests in space. The following table outlines the responses:

ACTIVITY	PERCENT PARTICIPATION
Space Camp	4%
Other	6%
Attended Space Shuttle Launch	15%
Visited Space Shuttle Launch Site	48%
Visited a Space Museum	80%
Visited a Planetarium	92%

Many of the people responding to the survey stating that they participate in more than one of these activities. The study also states that 34% participated in two, and another 34% in three or more of the above activities.

### 2.1.2 Customer's Decision Criteria

The number one reason given for space travel is "To be a pioneer" at 24%. The next group of 15% state, "To see the Earth from space". The last significant group at 9% state that spaceflight is "A life long dream". There is another group, at 20%, having no interest at all of going into space.

Of this last 20%, there are several reasons for not wanting to go. These reasons vary from it being too expensive (21%) to being too dangerous (11%). Some of the respondents (9%) state they are not interested in space at all.

This Futron Study indicates 10% of those who want to travel into space and are willing to pay \$100,000 to \$250,000. Of this subset, 22% (2.2% of total respondents) are willing to pay between 20 and 25 million dollars for an orbital space flight.

The following table summarizes the demographic for those interested and willing to pay for a trip into space:

DEMOGRAPHIC	INTERESTED AND WILLING TO PAY \$100,000 - \$250,000	ALL SURVEY RESPONDENTS
Average Age	54	57
Employed Full-Time	61%	35%
Self-Employed	22%	24%
Retired	17%	29%
Have Dependant Children	28%	32%
Have Other Dependants	39%	27%
Married	100%	86%
Male	94%	70%
Female	6%	30%

### 2.1.3 Sale Attraction

The main attraction for this product is in differentiation which will be discussed in more detail later, but Virgin Galactic is offering a complete vacation/training package, something that the direct competitors are not offering.

### 2.1.4 Recurring Revenue

It is not expected that the average customer will repeat the sub-orbital space tour. Since the customers will be impressed with the sub-orbital trip, many will be prone to use Virgin Galactic's new services in the future. These services can include other space adventures such as going to the moon or visiting space stations. Therefore, the major recurring revenues will be from complementary products.

### 2.1.5 Affects on Purchase Behavior

Being strictly a high-priced luxury item, the general ebb and flow of the market and the economy will be a short-term modifying agent. As the technology evolves, the ability to do more than just a sub-orbital flight will emerge and the customers will expect more. For this reason, the market for sub-orbital tourism will quickly dry up in around five to six years.

## 2.2 Market Analysis

The Futron Study presents a thorough analysis of the market. It estimates there will be for the first five years over 5,000 people taken up into space as tourist on sub-orbital flights. Using a Fisher-Pry model, the survey estimates a market maturity in about 35 years. This model also predicts that over 23,000 tourists a year will be taking some form of space tourism by the year 2021 and that the price will have dropped to \$50,000 by then.

The study gives a couple projected points on the demand curve for space tourism. At a price of \$100 to \$200 thousand it estimates a demand of around 50,000 potential customers. When that price is raised to \$5 million, there are only around 9,000 potential customers.

John Spencer<sup>2</sup> in his book on Space Tourism states more marketing to women needs to be done since women determine over 70% of the vacations in America. He believes that unless more women become interested in the industry, space tourism will fail.

John Spencer also suggests that this market will only have an optimum time period of five years. After this time, the price and demand will start dropping because of new technology and higher competition. The newer technology will make “just going into sub-orbital space” not so appealing to the pioneering enthusiast. The new space craft will be able to orbit the earth and take passengers to the space station (or space stations). There will still be a demand for sub-orbital tourism, but it will be at a lower price.

## **2.3 Competitor Analysis**

The competitor analysis will focus on the direct competitors with a broad look at the recent past and other potential competitors.

### **2.3.1 Direct Competitors**

In this business model, the direct competitors are US tourism companies involved with space travel that already announced suborbital space tourism agreements and have estimated to start operational flights in 2007 or 2008.

There are other US companies that are developing commercial suborbital vehicles, but are not in the sub-orbital space tourism market.

Also, there are other countries emerging as major providers of suborbital launch services, which include Norway, Japan, Brazil, India and Canada.

Based on the above criteria, the two direct competitors of Virgin Galactic are Space Adventures and Incredible Ventures.

#### **2.3.1.1 Space Adventures**

Space Adventures was founded in 1998 with the purpose of becoming the world's leading space tourism, entertainment, and event-production company delivering the public opportunities to experience space today. In order to gain position, the company plans to offer four different programs: Suborbital Flights, Orbital Flights, Spaceflight Training, and Space-Related Flight Adventures.

The company's vision is: “Space Adventures will fly tens of thousands of people in space over the next 10-15 years and beyond, both orbital and suborbital, around the moon, and back, from spaceports both on Earth and in space, to and from private space stations, and aboard dozens of different vehicles; and by continually providing newly available space experiences and improving existing space experiences.”<sup>3</sup>

For the suborbital flights, Space Adventures plans to use a vehicle operated by XCOR Aerospace<sup>4</sup> called Xerus. Xerus is rocket powered; it takes off from a runway; and it is capable of high altitude and high speed. XCOR Aerospace says that this ship is going to serve three different markets. These are: for microgravity research experiments, to launch micro-satellites into low Earth Orbit, and to fly passengers into

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<sup>2</sup> John Spencer, 2004, *Space Tourism: Do You Want To Go*, Canada, Apogee Books

<sup>3</sup> *Space Adventures*, <http://www.spaceadventures.com>, copyright 2005

<sup>4</sup> *XCOR Aerospace Goin Suborbital: The Xerus and other commercial reusable launch vehicle concepts*, <http://www.xcor.com/suborbital.html>, Accessed 13 April 2005

space. In the latter case, the ride will be to at least 100 km altitude and return within a half hour to the takeoff site.

Xerus flights are planned to depart from Mojave Airport, California, which is the latest facility in the US to obtain a launch site operator license from the Federal Aviation Administration/Office of Commercial Space Transportation (FAA/AST), in June 2004, specifically to serve suborbital vehicles that take off and land horizontally.

### **2.3.1.2 Incredible Adventures**

The story of Incredible Adventures<sup>5</sup> started in 1993, when an American entrepreneur was in Moscow and he was offered a flight in a MIG-29. He loved the experience and signed a deal to market flights worldwide. He returned to Florida and founded MIGS etc. MIGS etc. was asked to help find customers for IL-76 zero-gravity flights. The first weightless flight took place in February 1994 with a CNN reporter on board. In 1995, the company was sold to an employee-lead ownership group which decided to change the name to Incredible Adventures, Inc. Its offerings were expanded to include cosmonaut training adventures and Sahara adventures in Tunisia. In 1996, controlling interest in the company was sold to Norman Fast, a venture capitalist with experience in adventure travel industry. Today, Incredible Adventures is a well established company that offers fighter jet flights in four countries, space adventures at Star City, three different great white shark dives, and military adventures around the world, among others. The company maintains a full-time staff in Sarasota Florida and Moscow and a worldwide network of people to organize its customers' ventures.

For the suborbital flights, Incredible Adventures is working with Rocketplane Limited Ltd.<sup>6</sup> and plan to use its Rocketplane XP. Rocketplane has advanced the XP vehicle to the full design phase after years of internal vehicle development. The XP program is underway with a 30-month project schedule to achieve operation.

Rocketplane designers are taking the fore body, passenger cabin and jet engines of a Lear jet and adding a new wing, tail, aft body and rocket engine. The resulting Rocketplane XP will be a suborbital plane that takes off and lands like any other commercial aircraft, yet is capable of traveling over 100 km high at speeds in excess of 2500 mph.

Leading the development of the Rocketplane XP is David Urie, a recipient of the prestigious Engineer of the Year award from the American Institute of Aeronautics and Astronautics (AIAA). During his 30-year career with the Lockheed Martin Corporation, Urie led teams on Lockheed's X-30 National Aerospace Plane and the HL-20 Personnel Launch System.

The Rocketplane XP will be powered by the Lear Jet's two conventional jet engines and one very-reliable, cost-efficient rocket engine. The rocket engine is being developed by ORBITEC (Orbital Technologies Corp.) and will operate on a mixture of kerosene and oxygen. Based in Wisconsin, ORBITEC has been developing jet propulsion engines since 1988 and has been awarded more than 100 government contracts.

Rocketplane XP flights will depart from a brand new spaceport in Burns Flat, Oklahoma. The facility is home to the third-largest runway in the US (13,502-ft) and is the former site of Clinton-Sherman Air Force Base. This spaceport is still in its development process and has not received an FAA/AST launch site operator license yet.

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<sup>5</sup> *Incredible Adventures – Adventure Travel Around the World*, <http://www.incredible-adventures.com>, copyright 2005

<sup>6</sup> *Rocketplane, Inc.*, <http://www.rocketplane.com>, Accessed on 20 April 2005



### 2.3.1.3 Competitors SWOT Analysis

The following tables present the SWOT analysis for the two direct competitors.

<b>SPACE ADVENTURES</b>	<b>STRENGTHS</b>	<b>WEAKNESSES</b>
	<ul style="list-style-type: none"> <li>• Strategic partnerships: international reseller network, leading aerospace organizations and international government agencies<sup>7</sup></li> <li>• Early promotion to create solid customer base that includes corporate buyers, support from celebrity clients and media clients<sup>8</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Extensive and varied program</li> <li>• Pricing strategy: underestimating real cost</li> <li>• Capacity: allowance of only 1 passenger</li> <li>• XCOR Aerospace technology not yet proven to public</li> </ul>
	<b>OPPORTUNITIES</b>	<b>THREATS</b>
	<ul style="list-style-type: none"> <li>• US legislators regulatory framework facilitating increase interest in space tourism</li> <li>• Market for suborbital flight is open and unexploited</li> <li>• High level of investors interest in entrepreneurial ventures</li> </ul>	<ul style="list-style-type: none"> <li>• Other companies may beat Space Adventures to market and gain position and higher market share</li> </ul>

<b>INCREDIBLE ADVENTURES</b>	<b>STRENGTHS</b>	<b>WEAKNESSES</b>
	<ul style="list-style-type: none"> <li>• Strategic partnerships with well established aerospace company: Rocketplane</li> </ul>	<ul style="list-style-type: none"> <li>• Rocketplane is still in development</li> <li>• Rocketplane needs financing<sup>9</sup></li> <li>• Pricing strategy: underestimating real cost</li> <li>• Capacity: allowance of only 2 passenger</li> </ul>
	<b>OPPORTUNITIES</b>	<b>THREATS</b>
	<ul style="list-style-type: none"> <li>• US legislators regulatory framework facilitating increase interest in space tourism</li> <li>• Market for suborbital flight is open and unexploited</li> <li>• High level of investors interest in entrepreneurial venture</li> </ul>	<ul style="list-style-type: none"> <li>• Other companies may beat Space Adventures to market and gain position and higher market share</li> <li>• Spaceport in Oklahoma (the firm is using) many not be operational by 2007</li> </ul>

<sup>7</sup> A major strength of Space Adventures is its ability to maintain an international reseller network with agent offices in several countries around the world, including Argentina, Australia, Canada, Germany, Israel, Japan, Mexico, or UK. Second, it has partnered with several leading existing and start-up aerospace organizations, including XCOR Aerospace and the Mysichyev Design Bureau (designers of the Soviet Space Shuttle Buran). Finally, Space adventures has developed relationships with governmental agencies including NASA, the Federal Aviation Administration, and the Department of Transportation (USA); The Russian Space Agency, RSC Energia, the Gagarin Cosmonaut Training Center; the Ministry of Science & Industry in Australia and JAXA and ESA, and the Japanese and European Space Agencies.

<sup>8</sup> Space Adventures is building relationships at different levels to promote its suborbital flight. Its customer base includes individual adventures; corporate buyers; celebrity clients; as well as media clients such as 60 minutes Granada Media, BBC, Pioneer Productions, Hat Trick Productions, and Endemol Entertainment.

<sup>9</sup> Space Adventures is currently seeking an equity investment of \$20 million to complete full-scale work on their XP program to commercial operation. It is also pursuing a number of public funding sources, including NASA, DARPA, and state and federal competitive grants and proposals. This situation may delay the Incredible Adventures plans of starting its operations in 2007.

### 2.3.2 Relevant Past Experience

There have always been men in history that have dreamt of traveling into space. With the emerging space tourism markets, this dream is becoming a real possibility for anybody thanks to the X-Prize. In 1994, Gregg E. Maryniak gave Peter H. Diamandis a copy of the Spirit of St. Louis, written by Charles Lindbergh. Dr. Diamandis read the book and realized that aviation prizes had been one of the critical forces in opening up today's aviation industry. Diamandis had the idea of creating a cash prize for space travel as a mechanism to implement his life-long dream of flying into space. In 1995, Diamandis established the X-Prize Foundation<sup>10</sup> with the assistance of Byron K. Lichtenberg, Colette M. Bevis and Gregg E. Maryniak. Originally, the foundation had its headquarters in Rockville, Maryland, but in 1996 it moved to St. Louis.

Before the official announcement, the X-Prize foundation had to prepare for the competition. It needed to appropriate briefings to NASA, the FAA and members of the leading space and aviation organizations, as well as recruiting international support of the competition. X-Prize Founders traveled to Paris to recruit Federation Aeronautique International, the Aero-Club de France, and the advising participation of Dr. Herbert Curien, who had been Minister of Science and Technology. Afterwards, the group traveled on to Sri Lanka where a personal message from Arthur C. Clarke was recorded, which would be used as a kick-off to the foundation event.

On May, 18<sup>th</sup>, 1996, under the Arch in St. Louis, in front of television cameras, reporters, and many citizens; the creation of the X-Prize competition was announced. The next major gala for the X-Prize was held on September 27<sup>th</sup>, 1997. The publicity generated from this gala brought X-Prize its first major corporate sponsor, FirstUSA. In 1998, the first \$5 million of the prize had been funded. In May 2004, the X-Prize was officially re-named the Ansari X-Prize to reflect the generous multi-million dollar donation from the Ansari family. By then, the X-Prize Foundation was able to offer \$10 million to the first private group to develop a sub-orbital reusable vehicle capable of carrying three people to 100 kilometers (62 miles) altitude twice within two weeks. The prize requirements were formulated to create vehicles that will serve the space tourism market after winning the prize.

The 26 participants in the X-Prize<sup>11</sup> were: American Astronautics, Acceleration Engineering, American Advent, ARCA, Armadillo Aerospace, Bristol Spaceplanes, Canadian Arrow, Da Vinci Project, Discraft Corporation, Fundamental Technology Systems, High Altitude Research Corp., Interorbital Systems, ILAT, Lone Star Space Access, Micro Space, Pablo de León & Associates, PanAero, Inc., Pioneer Rocketplane, Mojave Aerospace Ventures, LLC., Space Transport Corporation, Starchaser Industries LTD, Suborbital Corporation, TGV Rockets, Inc., and Vanguard Spacecraft. There are various countries represented in the X-Prize like the US, Canada, Argentina, Israel, etc.

Mojave Aerospace Ventures won the prize after its composite aircraft, SpaceShipOne, was able to fly into space twice in September and October 2004. Scaled Composites CEO, Burt Rutan got the financial support of Paul Allen, a billionaire who co-founded Microsoft, and formed a joint venture called Mojave Aerospace Venture (MAV) that owns the intellectual property of the Tier One program. The Tier One program consists on two vehicles: a carrier aircraft called White Knight and a rocket plane named SpaceShipOne. SpaceShipOne will never carry paying passengers as it will be displayed at the Smithsonian Museum.

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<sup>10</sup> X PRIZE Foundation, <http://www.xprizefoundation.com>, copyright 2004

<sup>11</sup> ANSARI X PRIZE, <http://www.xprize.org/teams/teams.php>, copyright 2004

## **2.4 Environmental Analysis**

The environmental analysis is more general than just the scope of this business model. Discussed here are the attractiveness of the industry and the macro environment.

### **2.4.1 Attractiveness of the Industry Environment: Five Forces**

There are five forces plus complementors that should be considered when entering a new industry. The five forces are Buyers, Suppliers, Competitors, Potential Entrants and Substitutes. Following is a breakdown of these areas and how they may or may not be attractive to those considering entering the space tourism industry.

#### **2.4.1.1 Buyers**

Currently, those interested in the space tourism industry must consider the size of the market. As previously noted, the average product buyer will have a minimum net worth of \$1 million. In 2001, only 3.2% of the people in the United States were millionaires.

After the initial launch, more entrants into the SRLV market within the space tourism industry could decrease the package price, thus, decreasing the profit margin for the first moving organizations. As noted earlier, there are other companies working to beat Virgin Galactic to the 2008 launch, but at the moment the possibility of this seems to be dwindling.

#### **2.4.1.2 Suppliers**

Since Virgin Galactic is privately owned and Richard Branson wanted a low cost and differentiated product, he contracted Scaled Composites and Mojave Aerospace Ventures to build Virgin Galactic's space craft. Mojave Aerospace Ventures was formed as a joint venture between Scaled Composites and Paul Allen to compete in the X-Prize competition. Many of these individuals invested in different teams during the X-Prize. Virgin Galactic gains a competitive advantage through using Scaled Composites as the supplier of spaceships. In addition, the contract with Mojave Aerospace Ventures gives exclusive intellectual property of Tier-One technology solely to Virgin Galactic. In the supplier/buyer relationship between Virgin Galactic, Scaled Composites and Mojave Aerospace Ventures, the suppliers have the bargaining power over Virgin Galactic.

Even though Virgin Galactic contracted Mojave Aerospace Ventures for their intellectual property, some of the technology used to create this prize winning vehicle was founded by other members of the Scaled Composite team who are no longer employed with Scaled Composites. These individuals now work for organizations competing for a place in the SRLV supply chain market. For example, the hybrid engine used for SpaceShipOne was partially created from a rocket motor design used by the Huntsville, Alabama L5 (HAL5).<sup>12</sup> One man who was employed by Scaled Composites' X-Prize team now works for a competitor in the competition called High Altitude Research Corporation. This individual owns his own organization called Orion Propulsion. Both of these companies work in space travel and are looking at entering the space tourism industry as possible suppliers. Huntsville, Alabama where both organizations are located is known for the largest concentration of aerospace technology. Over \$2.5 billion out of the \$6 billion spent on payroll for 70,000+ jobs pertaining to aerospace in Northern Alabama are spent in Huntsville, Alabama. It will not be long before companies other than Mojave Aerospace Ventures begin to compete for

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<sup>12</sup> Spries, Shelby, 27 June 2004, *Tourism in Space Closer to Countdown*, Huntsville, Alabama, Huntsville Times

a piece of the supply chain. The creation of competition would lower the costs allowing room for new entrants and tougher competition in the industry.

After 2007/2008 when Virgin Galactic takes flight, it has been determined that more companies will enter the SRLV market in the space tourism industry. These entrants will need suppliers for research and development, equipment and fuel. This expansion will offer the SRLV buyers greater choices in suppliers. Therefore, as the suppliers expand the bargaining power may switch to the buyer. With the companies having buyer power over the suppliers, the cost spent to produce the product will decrease creating a possible larger profit margin.

#### **2.4.1.3 Potential Entrants**

Virgin Galactic is the first mover in the SRLV market. This gives them the advantage of setting the base for what a customer will expect in return for the costs paid. Richard Branson has a net worth of over \$9 billion. Among the many companies he owns, are his own music producing company and an airline. Therefore, in addition to the private limousine ride to the airport, the tourist will travel by Virgin Atlantic Airlines to a privately owned luxury hotel; these amenities will come at a low variable cost to Virgin Galactic. As of now, all potential entrants into the market are still searching for stockholders to cover the base entrance costs into the market. These entrants do not have the economies of scale that Virgin Galactic is afforded. Therefore it is possible that potential entrants into the market will need to gain their competitive advantage through differentiation or taking the lead as the low cost leader in the market and a close substitute by offering a less luxurious package for the tourist.

Virgin Galactic uses a combination of nitrous oxide and rubber as their fuel. The two are not combine until the vehicle takes flight reducing the chance of explosion and allow for a very low cost fuel. Entrants will be forced to either outsource Research and Development to find a similar low cost product or pay the exorbitant gasoline prices. In order to compete or even become a low cost substitute, the entrants must find a way to produce a low cost fuel.

Potential entrants may have an advantage by not being the first mover. This is possible through their observation of Virgin Galactic as the first mover. It is the goal of entrants to catch and surpass the leader. These entrants will not only be able to learn from Virgin Galactic in the advancement of their technology for the suborbital vehicles, but can look at their costs. Through observing the process of Virgin Galactic, the competitors can learn and find ways to cut costs even more. If competitors can create a lower cost, new entrants will be able to enter the industry easier. However, new entrants must be careful not to cause saturation of the market. Too much saturation will leave the entire industry in a race to the bottom and companies will be struggling to keep hold of their market share.

#### **2.4.1.4 Substitutes**

In 2001, an American businessman flew on a Russian rocket to the International Space Station proving that space tourism is possible. The flight cost Dennis Tito \$20 million showing that even though space tourism is possible it is only possible for the extremely wealthy.<sup>13</sup> It is Richard Branson's goal to eventually make space tourism affordable for everyone.

The Virgin Galactic initial business model must cover all of the high fixed costs. Therefore the cost to be one of the first to fly into space is very expensive. It is believed

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<sup>13</sup> *Space Adventures coordinated Dennis Tito's flight on a Russian Rocket* , <http://www.spaceadventures.com/media/releases/2004-04/157> , 28 April 2004

that Virgin Galactic is competing with other adventure vacations. These adventure vacations are focused to those who have a minimum net worth of \$1 million and hold a focused interest. An example of another adventure vacation would be flying in a military Russian helicopter to the North Pole where one can hike and explore the territory. This adventure is very comparable in price, potential danger and is a chance to experience something only a limited amount of people will be able to enjoy.

#### 2.4.1.5 Complementors

There is potential growth in the space tourism industry. While many look at SRLV, others look beyond the year 2008. Governments are beginning to look at leasing space stations while private companies look at constructing space stations through advertisements and renting space. For instance, Space Island is looking at entertainment and relaxation for tourists to partake in once the vehicles bring them into space. Space Island, priding itself on the goal to have ten thousand jobs in space by 2010, plans to offer travelers a luxurious resort constructed of recycled fuel tanks.<sup>14</sup> This design looks very similar to the design of the space stations in the motion picture *Space Odyssey 2001*.

To compliment the flight into space, companies will be able to land their tourists at the resort offering all amenities of an earthly resort. In addition to luxury rooms, fine dining and casinos, this resort will include a sports stadium. With the work of Gene Meyers, CEO of Space Island, and profits of indirect content sales, the sales of advertising, the zero-gravity games<sup>15</sup> will be introduced.



**Figure 1. Individuals Playing Zero-Gravity Games**

In April 2004, Space Island launched a contest among students for the invention of zero-gravity games that can be played in space. It is the goal to make these space games, similar to the X-Games, popular both in space and on earth. Space Island is working hard at developing vehicles for workers to be transported to their orbiting employment location, and the construction of the space station/resort. However, they too are in the developing stages with much left to be proven in their theories.

In summary, the market has the potential to be very attractive. After the first flight, organizations must study fast and work quickly to develop a product that will be attractive to the consumer. That product must be offered either at the same or lower

<sup>14</sup> *Space Island Adventures*, <http://www.spaceislandgroup.com>, accessed 5 May 2005

<sup>15</sup> *Space Island Adventures*, <http://www.spaceislandgroup.com>, accessed 5 May 2005

price as Virgin Galactic. Although there is high fixed cost for entrance into the industry of space tourism, the variable cost can be made relatively low. This means that once entered, the boundaries are limitless to buyers, suppliers, substitutes and complementors.

## **2.4.2 Understanding the Macro Environment**

In order to become profitable in the space tourism industry, an organization must look at the macro environment. The components that make up the macro environment include; economy, cultural/social change, demographic change, technology change, political/legal/regulatory change and globalization/International forces. Analyzing these forces help to understand the viability of the industry.

### **2.4.2.1 Economy**

In the last three years, the number of millionaires<sup>16</sup> has risen from \$3.2 to \$5.6 million in the United States of America. This trend seems to be on an upward slope and is fortunate for the space tourism market because this is the primary category for the customers.

### **2.4.2.2 Cultural/ Social Change**

With the introduction of the Internet, people no longer feel that they are restricted to one state, one country and now one planet. The fear of technology baby boomers experienced is now being replaced with a confidence and a reliance on technology. People want to experience the extreme adventures and go themselves where no one has gone before.

### **2.4.2.3 Demographic Change**

There has been a huge demographic change in the number of individuals under 50 years of age who have a net worth of over \$1 million. Those who were told growing up that when they were older people would be vacationing on the moon, now want to see it come true.

### **2.4.2.4 Technology Change**

As one can see from the time-line in Appendix C, it was only twelve years after the first man-made object orbited Earth that Neil Armstrong and Edwin "Buzz" Aldrin walked on the moon. Two years later, the introduction of reusable space vehicles began. In 1984, only three years after the first reusable vehicle landed, Columbia, papers were researching space tourism. Less than seventeen years later, the first tourist took flight into space. Now, in 2005, we examine the first commercial space tourism company who will take flight in less than three years. If anything, this timeline clearly shows that man's visions of the future lead the maturation of technology.

### **2.4.2.5 Political/Legal/Regulatory Change**

Following is the United States legislative timeline concerning space travel:

1957 - United States President, Dwight D. Eisenhower at the disarmament talks established that no nation may claim uninhabited lands in outer space.<sup>17</sup>

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<sup>16</sup> National Center for Policy Analysis, *Number Millionaires on the Rise*, <http://www.ncpa.org/pd/economy/pdeco/pdeco5.html>, copyright 2001

<sup>17</sup> "Space law" *Britannica Student Encyclopedia, Encyclopedia Britannica Online*, <http://search.eb.com/ebi/article?tocId=9337039>, accessed on 9 May 2005.

- 1963 - International agreement to only use outer space for peaceful purposes. Weapons of mass destruction are not to be placed on the moon, in space vehicles, or on space stations.<sup>18</sup>
- 1992 - National Aeronautics and Space Administration Authorization Act; “To authorize appropriations to the National Aeronautics and Space Administration for research and development, space flight, control and data communications, construction of facilities, research and program management, Inspector General, and for other purposes.”<sup>19</sup>
- 1998 - Commercial Space Launch Act of 1998; “To encourage the development of a commercial space industry in the United States, and for other purposes.”<sup>20</sup>
- 2000 - Commercial Space Transportation Competitiveness Act of 2000; “To promote the development of commercial space transportation industry, to authorize appropriations for the Office of Associate Administrator for Commercial Space transportation, to authorize appropriations for the Office of Space Commercialization, and for other purposes.”<sup>21</sup>
- 2004 - In December, the Commercial Space Launch Amendments Act of 2004 was signed by President Bush. In February 2005, it was published by the Federal Aviation Office of Commercial Space Transportation under the title *Suborbital Reusable Launch Vehicles and Emerging Markets*.<sup>22</sup> This federal agency licenses and regulates U.S. commercial space launches and reentry, as well as the operation of non-federal launch and reentry sites. This law also defines suborbital vehicles in order to separate them from aviation regulations and also makes clear that passengers are “spaceflight participants,” requiring that they be informed of the risks and sign waivers of liability.
- Commercial Space Transportation Liability Indemnification Regime Extension; “To extend the liability indemnification regime for the commercial space transportation industry.”<sup>23</sup>
  - Commercial Space Launch Amendments Act of 2004
  - Commercial Space Transportation Authorization Act of 2004
- 2005 - The following bills are currently being presented in Congress:
- |          |  |
|----------|--|
| February | “to enhance the safety of the commercial human space flight industry” <sup>24</sup>        |
| March    | “to provide for a prize to encourage development of space and aeronautics technologies and |

<sup>18</sup> “Outer Space Treaty” *Britannica Student Encyclopedia, Encyclopedia Britannica Online*, <http://search.eb.com/ebi/article?tocId=9332230>, accessed on 9 May 2005

<sup>19</sup> Lexis Nexis – 92 CIS PL 102588; 102 CIS Legis. Hist. P.L. 588, accessed on 9 May 2005

<sup>20</sup> Lexis Nexis – 98 CIS PL 105303; 105 CIS Legis. Hist. P.L. 303, accessed on 9 May 2005

<sup>21</sup> Lexis Nexis – 2000 CIS PL 106405; 106CIS Legis. Hist. P.L. 405, accessed on 9 May 2005

<sup>22</sup> Federal Aviation Administration Office of Commercial Space Transportation, *Suborbital Reusable Launch Vehicles and Emerging Markets*, [http://ast.faa.gov/files/pdf/Suborbital\\_Report.pdf](http://ast.faa.gov/files/pdf/Suborbital_Report.pdf), February 2005

<sup>23</sup> Lexis Nexis – 4 CIS PL 108428; 108 CIS Legis. Hist. P.L. 428, accessed on 9 May 2005

<sup>24</sup> Lexis Nexis -- 2005 Bill Tracking H.R. 656; 109 Bill Tracking H.R. 656 , accessed on 9 May 2005

establish an endowment to further and inspire the public's interest in space and aeronautics"

#### **2.4.2.6 Globalization/International Forces**

As mentioned earlier, the Russians were the first movers in the space tourism industry. Virgin Galactic is the first mover in the SRLV market. Currently, there are organizations in other countries interested in space tourism.

Today, countries work together in sharing space stations expenses. These space stations are now being considered for global "renting" to both governmental and non-governmental organizations.

Virgin Galactic founder, Sir Richard Branson said, "The deals with both their companies...are just the start of what we believe will be a new era in the history of mankind, making the affordable exploration of space by human beings real. We hope to create thousands of astronauts...allow every country in the world to have their own astronauts rather than the privileged few."<sup>25</sup>

### **3 Internal Assessment**

The internal assessment focuses on the Virgin Galactic's ability to provide the customer the services paid for. Discussed are the core competencies that Virgin has, the advantages and disadvantages of being a first-mover, the variety of complementary assets and the use of outsourcing.

#### **3.1 Core Competencies**

Virgin Galactic has something that its competitors do not. The company is part of a group of companies, Virgin, which has worldwide brand name recognition. Virgin has over 200 companies worldwide and employs over 25,000 people. Virgin stands for its hip, value for the money, quality, innovation, fun, consumer-friendly image, exceptional service, and a sense of competitive challenge. As a result, Virgin Galactic has been able to gain the attention and confidence from the media and the public. The media and the public believe Virgin Galactic will achieve its goals.

Also, based on multiple and varied businesses, Virgin has been able to develop synergetic effects that has put the company in an advantaged position over its competitors. First, using the resources of sister companies, Virgin Galactic will be able to achieve its marketing strategy at a lower cost than its competitors. Second, it depends on experienced pilots from its sister airlines to enter the training program to pilot the spaceships. Some of these pilots flew fast jets; experimental aircraft's and even were part of the RAF's "Red Arrows." The additional training required would be minimal compared to the competitors who must search for the right pilot to fly the spacecraft. Third, Virgin group has very successful businesses in traveling and entertainment that will allow it to offer a very high quality and attractive program at a much lower cost than its competitors. Virgin plans to charge \$200,000, which will be very difficult to beat. Fourth, all the companies in Virgin Group are considered a family, rather than a hierarchy. Each company is empowered to run its business its own way, but is part of an overall learning organization. Each company shares its ideas; values; interests and goals; and is encouraged to work with the other companies in the group to solve problems and pass along solutions.

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<sup>25</sup> *Virgin Group Sign Deal with Paul G. Allen's Mojave Aerospace; Licensing the Technology to Develop the World's First Commercial Space Tourism Operator*, [http://www.scaled.com/projects/tierone/092704\\_scaled\\_paul\\_allen\\_virgin\\_galactic.htm](http://www.scaled.com/projects/tierone/092704_scaled_paul_allen_virgin_galactic.htm), London, 27 Sept. 2004



Another privilege Virgin Galactic has is its exclusive agreement with Scaled Composites and Mojave Aerospace Ventures, who are the owners of the technology used in the new spaceships. This exclusivity, on a proven technology, has put the company in a very advantageous position over its competitors, which are not using proven technology. Moreover, the technology is one of a kind; it is environmentally friendly; it is more efficient because the ship is made of composite materials instead of metals; it uses a safer fuel (a combination of nitrous oxide and rubber); and it is cheaper and simpler than other technologies.

Financing is another core competence for Virgin Galactic. Sir Richard Branson has over \$9 billion in wealth and can put as much funding as needed to ensure that Virgin Galactic will succeed.

### **3.2 First-Mover Advantage**

Virgin Galactic is a first mover in the creation of commercial space tourism. It registered the “Virgin Galactic” trademark in space tourism during the mid 1990’s<sup>26</sup>. April 18, 2003 SpaceShipOne and White Knight was unveiled by Scaled Composites. The first flight of White Knight with SpaceShipOne was May of 2003 with the first glide test in August 2003. December of that same year, SpaceShipOne had its first powered flight, achieving a top speed of Mach 1.2. The follow year brought many additional firsts for Virgin Galactic in the space tourism business. It is the first company to be awarded a sub-orbital launch license from FAA/AST. In June of 2004, SpaceShipOne had its first commercial manned suborbital space launch and was awarded the FAA/AST commercial astronaut wings. By mid to late 2004, SpaceShipOne achieved national attention by winning the Ansarai X-Prize competition. The prize money for the competition was \$10 million.

Virgin’s brand name recognition worldwide has been instrumental in its success as a first-mover within the space tourism industry; it also has the ability to capitalize on its sister divisions. Using internal resources from these sister divisions has facilitated its ability to offer a large scale program at low costs. This also helps on the learning curve. Having achieved economics of learning by sending SpaceShipOne into space on three consecutive successes provides knowledge and know how within the industry.

The disadvantage of being a first-mover for Virgin is its competitors have the ability to learn from Virgin’s mistakes. In spite of the fact Virgin has an exclusive agreement with Scaled Composites; the competitors have a network relationship with several countries and aerospace organizations.

### **3.3 Complementary Assets**

Virgin Galactic has many complementary assets thanks to Virgin Corporation's owner Sir Richard Branson. In his career, he has established businesses in the following industries: media, communications, transportation, publishing, retailing and financial services. Offering an array of different products in different industries with world wide name recognition, the corporation has been instrumental in the startup of Virgin Galactic. These complementary assets, as well as the financial backing, facilitate Virgin Galactic in marketing and operations capabilities.

Marketing capabilities encompass Virgin’s sister division for media, publishing and retailing. Media can assist in advertising at a low cost and offer the ability to reach already existing customers. The publishing division can assist in flyers, bulletins, and articles in local and national papers and magazines. Its ability to write stories on the latest technology with teaming up with Scaled Composites facilitates the first-mover

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<sup>26</sup> Virgin Galactic, <http://www.virgingalactic.com>, Accessed on 12 April 2005

advantages through early recognition. Retailing assists Virgin Galactic in souvenirs before, during and after each flight experience. Spending such a high rate for a once-in-a-life time experience, customers will be looking for memorabilia.

Operation capabilities include Virgin's ability to capitalize on the sister divisions within the financial services industry and transportation industry. Financial services can assist Virgin Galactic by offering customers the ability to finance the trips if needed. Profiting from the interest adds margin not only to the space tourism industry but to Virgin's financial industry as well. Transportation allows Virgin Galactic the ability to either include flight to and from site as part of a package deal or separate travel.

Virgin's complementary assets set them apart from the competitors and the key factors to continued success.

### **3.4 Scope of the Business System and Outsourcing**

As previously mentioned, Virgin is well endowed with complementary assets, worldwide brand name recognition and financial stability. Within the Virgin Group, there are many resources and thus, there is very little need for outsourcing. The one major outsourcing that Virgin Galactic is doing outside of the Virgin Group is the R&D and manufacturing of the spaceships. The exclusive agreement with Scaled Composites allows the ability to team-up with a supplier to offer low cost value, as well as the ability to capitalize on sister divisions. Scaled Composites offers the research and development, product design and manufacturing technologies to support Virgin's need for low cost efficient space crafts. Virgin Galactic uses its sister divisions to market, distribute and promote the space tourism services.

The primary value adding activity is the tour into space. Other potential value adding activities could include merchandising of goods and family members or friends staying at the resort.

## **4 Strategy Analysis**

Virgin has talked about space tourism before SpaceShipOne. Virgin first formed the company and registered the trademark in space tourism back in the mid 1990's. Richard Branson, the owner of Virgin Galactic, was looking at a number of projects that were underway to further the concept of space tourism, however he rejected all of them. In 1999, he discussed a tie-up with Gary Hudson's Rotary Rocket Company, but there was not deal.

### **4.1 Virgin Galactic Plans**

On September 27, 2004 Mojave Aerospace Ventures signed an agreement to license the Tier One program's proprietary technology to Virgin Galactic. The plan is to build five larger spacecrafts based on SpaceShipOne, with the ability to carry up to five passengers. The first spacecraft will be named VSS (Virgin Space Ship) Enterprise. After six months of intensive testing, the VSS Enterprise is expected to enter service in 2007 and start taking passengers in 2008. The second will be named VSS Voyager. These ships will be named after vessels from "Star Trek."

Virgin Galactic will use as its spaceport the Mojave Airport in California, which has its license as launch site operator, and is the home of Scaled Composites.

### **4.2 Virgin Galactic Product**

The core product of Virgin Galactic is a "two-hour flight to an apex beyond Earth's atmosphere, wrapped in a three-day astronaut experience."<sup>27</sup>

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<sup>27</sup> *Rutan's long shot*, Aircraft Economics, Jan/Feb 2005, Issue 79, p40. Available from Business Source Premier [4/6/2005]

For a low price of \$200,000 Virgin Galactic is offering its customers a three-day exclusive space flight experience. This experience begins with an extensive round of medical checks, detailed dietary work-up and informative pre-flight familiarization. The purpose of these checks is to ensure that a customer does not get sick during the flight. To help ensure the tourists comfort and to help reduce the risk of sickness, a foam seat is molded to each individual passenger's body. The seat is designed such that risks from motion sickness as well as the stress from G-Forces are reduced, otherwise these forces might cause some to pass out. The use of a rubber bungee, which attaches to the seat and tourist, will allow the tourist to experience weightlessness, but also keep the passengers from floating too far from the seats.

The entire program includes an upper class flight on Virgin Galactic's sister company, Virgin Atlantic. Transportation from the airport to the space resort will be on one of Virgin's executive jet. Once the customer arrives at the space resort, they will begin six days of flight preparation. This includes G-Force Tolerance training, talking to the experts in the space industry, flight simulation experience and then dinner with other flight customers. Each customer will have the opportunity to experience negative gravity, ride in fast jets and watch other launches leave the Earth. Some lucky passengers may even get a flight on the mother ship and watch another group of tourist rocket into space.

The Virgin Galactic space craft is carried under a mother ship an altitude of approximately 10 miles above sea level. As the countdown begins, the spaceship (VSS Enterprise will be the first one) is released from the mother ship. Immediately, the customer will hear the roar of the rock as the enormous power accelerates the ship at 4Gs. Through the panoramic individual windows, the customer will see the cobalt blue sky and a view of the stars. Finally, the rocket motors will stop and the "astronauts" (customers) are now in space and begin feeling true weightlessness for the first time. The pilot will maneuver the spaceship so each of the astronauts can look back at the Earth.

After soaking up the excitement of space, the pilot will start the decent back to earth. The customer's seats will recline, making the journey through the atmosphere comfortable. As the spaceship re-enters the atmosphere, at around 50,000 feet, the spaceship will return to a glider-like configuration for the landing back at the spaceport. Later, in the evening, at a gala dinner, the customers will be awarded their astronaut wings. They may even be given a part of the rocket motor used on the trip as a memento. Video and photographic images of the customer's moment in space history will be given to them to share with family and friends. All this, for the low price of \$200,000.

### **4.3 Technology**

SpaceShipOne represents a very different way to get into the space from the huge expendable rockets that have dominated space travel since the days of Sputnik. SpaceShipOne rides to high altitude underneath a larger aircraft (the White Knight), drops free and climbs the rest of the way by itself. After dropping free, SpaceShipOne ignites its own rocket engine and accelerates almost vertically towards the edge of the Earth's atmosphere.

White Knight is a conventional jet aircraft, powered by two General Electric J-85-GE-5 engines. In order to save some money both aircrafts, SpaceShipOne and White Knight are identical except for the engine. SpaceShipOne is the first spacecraft to use single hybrid rocket engine, which combines the convenience of a solid fuel motor with the controllability of a liquid rocket. It burns for 80 seconds with an average thrust of 7,500 kg.

SpaceShipOne's rocket was built by SpaceDev and uses hydroxyl-terminated polybutadiene (HTPB), which is a type of rubber that can be handled without special precautions, and nitrous oxidizer as fuel. The nitrous oxide – also known as “laughing gas” - is blown at high pressure out of a large tank, which takes up most of the space inside the fuselage, and through the block of HTPB inside the engine casing, where it is ignited and burns to produce thrust.

The re-entry of the SpaceShipOne to the Earth is very simple thanks to its adjustable wings.

#### 4.4 SWOT Analysis

The following table presents us with the SWOT analysis for Virgin Galactic.

<b>VIRGIN GALACTIC</b>	<b>STRENGTHS</b>	<b>WEAKNESSES</b>
	<ul style="list-style-type: none"> <li>• Well established brand name recognition</li> <li>• Strong financial support from its chairman Richard Branson</li> <li>• Support and publicity efforts from Richard Branson</li> <li>• People have confidence on real possibility of space tourism because it has licensed the SpaceShipOne's technology</li> <li>• Environmental friendly spacecraft</li> <li>• More efficient technology: use composite materials as opposed to metals</li> <li>• Safety is a number one objective<sup>28</sup></li> <li>• Low cost leader with expert experience</li> <li>• Firm commitment from suppliers and Virgin group sisters<sup>29</sup></li> <li>• More realistic pricing approach than its competitors</li> <li>• Focus on its product</li> </ul>	<ul style="list-style-type: none"> <li>• Space tourism program needs to be outlined</li> <li>• Lost credibility if program is not up and running by 2007</li> </ul>
	<b>OPPORTUNITIES</b>	<b>THREATS</b>
	<ul style="list-style-type: none"> <li>• US legislators regulatory framework facilitating increase interest in space tourism</li> <li>• Market for suborbital flight is open and unexploited</li> <li>• High level of investors interest in entrepreneurial venture</li> </ul>	<ul style="list-style-type: none"> <li>• Other companies may beat Virgin Galactic to market and gain position and higher market share</li> </ul>

#### 4.5 Strategic Plan

If Virgin Galactic keeps working hard side by side with Scaled Composites in the development of the first spaceship and is able to start operating it in 2008, the company will maintain its first-mover advantages. Virgin will be in the position of achieving

<sup>28</sup> The fuel used by the aircraft – nitrous oxide and rubber- is much safer than liquid propulsion systems or solid fuel rockets, which are being used by their competitors. This also facilitates their ability to carry people into space without first being trained for a long time at a very high cost.

<sup>29</sup> Burt Rutan and Scaled Composites are firmly committed to the success of Virgin's ship and they are working relentlessly to make Virgin's spaceship more robust, bigger, safer, and more efficient than the SpaceShipOne. Also, they have the advantage of experienced pilots of Virgin Galactic's sister airlines to enter into training to pilot its spaceships.

economies of scale and economies of learning, as more and more people are sent to the skies and provide feedback from their experiences. Virgin will also create entry barriers to new competitors, because of the large investment required for market entrance. Because of the valuable, uniqueness, rareness and hardness to imitate of Virgin Galactic's core competences, like SpaceShipOne, the synergies within the Virgin Group, or its brand name, the company is in the position of not only delivering a superior customer value while being a low-cost provider. As a result, Virgin will focus on offering a product, a suborbital flight, which is going to be a one-of-a-kind experience with full luxury treatment that many customers will consider to do again for \$200,000. If any other competitor wants to provide exactly the same product, it will incur higher costs and will not be able to match Virgin's price.

Virgin Galactic has already demonstrated it is in a position to allow it to appropriate much of the value that customers will enjoy. A sign that its potential customers have very low bargaining power is that all customers signing up for flights are paying a 10% refundable down payment. Even though Virgin Galactic deals with only one supplier for spaceships, and thus, might be in a low bargaining position with Scaled Composites, Virgin Galactic has a similar position over Scaled Composites by being its only buyer. At the same time, most of the possible complementary products already belong to the Virgin Group, and thus, there is no need for bargaining power.

To close its circle of power, Virgin Galactic needs to use its sister companies' customer base and implement an exceptionally designed promotional strategy that captures its potential customers' attention. Also, keep in touch with them, by regularly sending them information of the progress in the program and detailed bits of the final product.

Finally, in order to achieve a sustainable profitability, Virgin Galactic will pursue a blocking strategy to prevent others from entering its suborbital tourism market. This strategy has two big components. On the one hand, the exclusive agreement that Virgin Galactic has with Scaled Composites to use the SpaceShipOne technology for its spaceships will preserve the uniqueness of its product. On the other hand, the large investment that is required to buy several space ships and build the facilities to service both the ships and tourist is high. Virgin Galactic is in a unique position that it can achieve economies of scale by exploiting its sister divisions and that the owner, Sir Richard Branson, has cash available for the startup.

## **5 Financial Projections**

Many of the following projections are estimates due to the newness of the technology and the reluctance of individual companies to disclose exact projections.

### **5.1 Cost Drivers**

Industry, as well as resource, activity and position are cost drivers Virgin Galactic must consider. The activity drivers will be discussed in detail in the variable costs section.

#### **5.1.1 Industry Drivers**

One of the industry's cost drivers is technology due to the newness and high-technological demand of the SRLV market, as such, there are few suppliers in this industry. Virgin Galactic has, for the moment, chosen to do business with Scaled Composites, the only proven supplier of non-governmental spaceships. Fortunately for Virgin Galactic, the Virgin Group has a long standing relationship with Scaled Composites and it is more of a cooperative relationship than a competitive one.

The United States government, in the last couple years, has worked on defining the legal needs to provide space tourism for the public. These guidelines and

regulations have been designed to encourage not impede the industry; therefore, the Micro Environmental issues are advantageous for the industry.

### **5.1.2 Resource Drivers**

Being a luxury industry, the quality of all resources, ranging from the ship to customer accommodations, has to be of the highest quality. This is true for the entire industry. Virgin Galactic has a head start on the quality issue by being part of the Virgin Group and the reputation of Sir Richard Branson, as well as, the supplier of the ships, Scaled Composites.

Virgin Galactic plans on putting many people into space each year. This will eventually drive down the costs of the flights as the technology and scale of market improves.

### **5.1.3 Position Drivers**

Quality is also a position driver. Virgin Galactic, as part of the Virgin Group, already has a solid brand name reputation giving the customer a high expectation of quality.

## **5.2 Estimates of Annual Revenues**

After start-up, Virgin Galactic plans on sending 50 people into space each month. As Virgin Galactic's ships are designed to carry up to five tourist on each ship and with five ships going into space twice a month, this would be 600 tourist per year at a price of \$200,000 a person, thus a total yearly revenue of \$120 million.

According to the National Center for Policy Analysis<sup>30</sup>, in 2005, there is an estimated 5.6 million millionaires in the United States of America. Therefore, if even one percent of these people are going to take a sub-orbital space flight, there is a potential pool of 56,000 people in the market.

## **5.3 Estimated Variable Cost Structure**

In many cases, the cost structure is going to be like that of a cruise line. The fixed costs are the five space ships, the buildings for the resort, and the buildings for the space port. From a high level, Branson has stated that he is spending \$150 million on these fixed costs. This gives him the space port, a space resort (a luxury resort for the tourist to stay at during training) and five spaceships.

The variable costs are those that are incurred by each tourist and flight of the space ships. There have been no hard numbers released, but we can make some good conservative projections.

Round-Trip Transportation of Tourist – Virgin Galactic is outsourcing the transportation of the tourist to the resort to Virgin Atlantic (an airline in the Virgin Group). This will run the cost of a First Class ticket to Southern California. This on average will be around \$1,000 to \$2,000.

Resort Stay – Many resorts cost the customer around \$1,400 to \$3,500 a week. The cost to Virgin Galactic, who owns the resort, would be below this cost, thus a conservative estimate would be \$1,000 to \$2,000 a person per week.

Training and Testing – The training would be similar to that of any high-tech training that lasts a week. This would be in the order of \$2,000 to \$3,000 a person. To perform the medical and stress test involved would double this, a conservative estimate would be in the order of \$4,000 to \$6,000 a person.

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<sup>30</sup> National Center for Policy Analysis, *Number Millionaires on the Rise*, <http://www.ncpa.org/pd/economy/pdeco/pdeco5.html>, copyright 2001

Fuel and Maintenance on Ships –Virgin Galactic will not disclose exact costs, but a similar project, Bristol Aerospace’s Black Brant XII, costs around \$600,000 per launch.<sup>31</sup> Divide this figure by five tourists per launch, and we get a cost of \$120,000 per person.

This gives us a conservative variable cost of \$130,000 per tourist.

#### 5.4 Break-Even Analysis

The contribution margin for each tourist is  $(\$200,000 - 130,000) = \$70,000$ . The break-even point is 2,142  $(\$150,000,000 / \$70,000)$  passengers. Therefore, Virgin Galactic will need to put approximately 2,150 tourists into space before it covers its fixed costs. At 50 tourists a month, the estimated time-to-break-even point is approximately 43 months or just over three and a half years.

The above numbers are conservative. A more optimistic cost of fuel and maintenance based on economies of scale provided by having five ships would be a total cost of only \$100,000 per tourist, thus giving a contribution margin of \$100,000 per tourist. This would have a break-even point of 1,500 tourist or a time-to-break-even at two and a half years.

#### 5.5 Risk Analysis

The biggest risk would be the loss of a spacecraft. This risk would not only be financial, but also, depending on the type of loss, a deterrent to potential client pool, even though the market surveys showed that the potential clients know the risks involved. The craft itself would only cost \$5 million to \$10 million to replace.

Most of the costs in this model are fixed; therefore, if sales drop, the time-to-break-even point will be pushed further out. The advantage that a company like Virgin Galactic has over others is that the risks can be buffered by the Virgin Group, which has over \$9 billion in assets.

Another risk is that of new technology. When, not if, the technology to perform low-cost orbital flights or low-cost visits to the space station arrives, there will be a shift from this sub-orbital tourism to those technologies. Virgin Galactic and others in the market need to be able to shift to the new markets as time progresses. More importantly, Virgin Galactic with its resources needs to be the mover in these new technologies.

The above risks are financial. There is also a liability risk the company must face if a customer is injured or dies in an accident. This could be covered by the purchase of insurance.

#### 5.6 Cash Flow Analysis

Appendix B contains the projected cash flows for Virgin Galactic using the conservative and optimistic numbers from above. As can be seen from these two tables, the optimistic and conservative net present values are negative when using a cost of capital of 17.6%<sup>32</sup>. Both the Internal Rate of Return (IRR) and the Modified Internal Rate of Return (MIRR) are below 17.6% cost of capital.

MODEL	TOTAL PRESENT VALUE (IN MILLIONS)	IRR	MIRR
Optimistic	(\$21.13)	14	16
Conservative	(\$54.91)	9	14

<sup>31</sup> Burt Helm, *Virgin Galactic's Space Odyssey*,

[http://www.businessweek.com/bwdaily/dnflash/oct2004/nf20041015\\_2589\\_db039.htm](http://www.businessweek.com/bwdaily/dnflash/oct2004/nf20041015_2589_db039.htm), 15 Oct. 2004

<sup>32</sup> F. Eilingsfield and D. Schaezler, *The Cost of Capital for Space Ventures*,

[http://www.spacefuture.com/archive/the\\_cost\\_of\\_capital\\_for\\_space\\_ventures.shtml](http://www.spacefuture.com/archive/the_cost_of_capital_for_space_ventures.shtml), 26 Oct. 2000 – This article calculates a cost of capital at 17.6% compared to the figure of 6% used by many analyst currently.

Optimistic /w 10% down	\$3.76	18	18
Conservative w/ 10% down	(\$30.02)	12	15

The number used for cost of capital, 17.6%, is based on the company Space Ventures. The Virgin Group has a history of aircraft operations in its Virgin Atlantic operations and Virgin Galactic is using proven technology from Scaled Composites. This, along with the drive of the owner, Sir Richard Branson, would suggest a lower cost of capital or the use of an Options Base Analysis. Even given the conservative value of 17.6%, we could use this as the cost of the option for Virgin Group to enter the space tourism market. In that light, the \$55 million would be the “cost” of the option.

## 6 Conclusion

Space Tourism is a new field that has potential to be a vast new market. Even at the high cost to start, there are tens-of-thousands of potential customers clamoring to take a flight into space and many potential companies to provide them the services they want.

This report has outlined one of the possible business models currently being explored and shows companies like Virgin Galactic or others in a similar position can make a go in this market.

As the technology evolves, the model will either evolve or be replaced with a more extensive one. Today, sub-orbital space flights, lasting for a short period, are being organized. In just a few years, flights will be taking passengers into orbit, docking with space stations, and possibly taking them to the moon.

These models have a potential to provide a strong revenue flow that could cover the high fixed costs and thus a substantial profit. For this reason, this model is a worthy investment.

This bodes for an exciting 21<sup>st</sup> century.



## Appendix A. Demographics Tables

**Table A-1 Survey Demographics**

<b>AGE</b>	<b>% OF SURVEY RESPONDENTS</b>
18-29	1%
30-49	18%
50-64	58%
65+	22%
<b>GENDER</b>	<b>% OF SURVEY RESPONDENTS</b>
Male	70%
Female	30%
<b>MARITAL STATUS</b>	<b>% OF SURVEY RESPONDENTS</b>
Married	86%
Single	2%
Divorced/Widowed/Separated	10%
Other	1%
<b>DEPENDANTS</b>	<b>% OF SURVEY RESPONDENTS</b>
Dependent Children	32%
Other Dependants	27%
Both	9%
<b>NET WORTH</b>	<b>% OF SURVEY RESPONDENTS</b>
Less than \$1 Million	12%
Greater than \$1 Million	88%
<b>ANNUAL INCOME</b>	<b>% OF SURVEY RESPONDENTS</b>
Less than \$250,000	61%
\$250,000 to \$500,000	30%
\$500,000 to \$1 Million	7%
\$1 Million to \$2 Million	1%
Greater than \$2 Million	0.4%
<b>EMPLOYMENT STATUS</b>	<b>% OF SURVEY RESPONDENTS</b>
Full-Time	35%
Retired	29%
Self-Employed	24%
Part-Time	6%
Other	6%

**Table A-2 Risk Perception Demographics**

<b>ACTIVITY</b>	<b>PARTICIPATION</b>				<b>PERCEPTION OF RISK</b>		
	<b>NEVER</b>	<b>RARELY</b>	<b>SOMETIMES</b>	<b>REGULARLY</b>	<b>HIGH</b>	<b>MEDIUM</b>	<b>LOW</b>
Skydiving	94%	4%	1%	1%	72%	18%	10%
Mountain Climbing	68%	15%	14%	2%	57%	27%	15%
Flying in a Private Aircraft	42%	28%	23%	6%	45%	27%	24%
Skiing/Snowboarding	32%	20%	29%	19%	12%	26%	61%
Sailing or Boating	13%	26%	37%	24%	2%	8%	90%

**Table A-3 Surveved Vacation Times**

<b>TIME PERIOD</b>	<b>MAXIMUM</b>	<b>AVERAGE</b>
6+ Months	2%	0%
3+ Months	6%	5%
1+ Months	26%	32%
2-3 Weeks	56%	43%
1 Week	8%	15%
Less Than a Week	1%	5%

## Appendix B. Projected Cash Flows

### Conservative Projected Net Cash Flows

dollar values in millions

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expected Customers per Month	0	0	0	50	50	50	50	50	40	30	20	10	5	5
Yearly Sales (12 * monthly sales)	0	0	0	600	600	600	600	600	480	360	240	120	60	60
Sales Price (per customer)	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20
<b>Total Sales</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$96.00</b>	<b>\$72.00</b>	<b>\$48.00</b>	<b>\$24.00</b>	<b>\$12.00</b>	<b>\$12.00</b>
<b>Fixed Costs</b>	<b>(\$150.00)</b>													
Estimated Cost of Service (conservative)	\$0.00	\$0.00	\$0.00	(\$78.00)	(\$78.00)	(\$78.00)	(\$78.00)	(\$78.00)	(\$62.40)	(\$46.80)	(\$31.20)	(\$15.60)	(\$7.80)	(\$7.80)
<b>EBITDA</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$42.00</b>	<b>\$42.00</b>	<b>\$42.00</b>	<b>\$42.00</b>	<b>\$42.00</b>	<b>\$33.60</b>	<b>\$25.20</b>	<b>\$16.80</b>	<b>\$8.40</b>	<b>\$4.20</b>	<b>\$4.20</b>
Depreciation (of Fixed Cost over 5 years)	\$0.00	\$0.00	\$0.00	(\$15.00)	(\$27.00)	(\$21.00)	(\$18.00)	(\$13.50)	(\$10.50)	(\$10.50)	(\$10.50)	(\$10.50)	(\$9.00)	(\$4.50)
<b>EBIT</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$27.00</b>	<b>\$15.00</b>	<b>\$21.00</b>	<b>\$24.00</b>	<b>\$28.50</b>	<b>\$23.10</b>	<b>\$14.70</b>	<b>\$6.30</b>	<b>(\$2.10)</b>	<b>(\$4.80)</b>	<b>(\$0.30)</b>
Pre-Tax Profit	(\$150.00)	\$0.00	\$0.00	\$27.00	\$15.00	\$21.00	\$24.00	\$28.50	\$23.10	\$14.70	\$6.30	(\$2.10)	(\$4.80)	(\$0.30)
Taxes (estimate of 40%)	\$0.00	\$0.00	\$0.00	(\$10.80)	\$0.00	(\$8.40)	(\$9.60)	(\$11.40)	(\$9.24)	(\$5.88)	(\$2.52)	\$0.84	\$1.92	\$0.12
<b>Net Operating Profit After Taxes (NOPAT)</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$16.20</b>	<b>\$15.00</b>	<b>\$12.60</b>	<b>\$14.40</b>	<b>\$17.10</b>	<b>\$13.86</b>	<b>\$8.82</b>	<b>\$3.78</b>	<b>(\$1.26)</b>	<b>(\$2.88)</b>	<b>(\$0.18)</b>
Add Back Depreciation	\$0.00	\$0.00	\$0.00	\$15.00	\$27.00	\$21.00	\$18.00	\$13.50	\$10.50	\$10.50	\$10.50	\$10.50	\$9.00	\$4.50
<b>Operating Cash Flow</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$31.20</b>	<b>\$42.00</b>	<b>\$33.60</b>	<b>\$32.40</b>	<b>\$30.60</b>	<b>\$24.36</b>	<b>\$19.32</b>	<b>\$14.28</b>	<b>\$9.24</b>	<b>\$6.12</b>	<b>\$4.32</b>
Present Value (based on 17.6% and a current date of Jan 1, 2005)	(\$150.00)	\$0.00	\$0.00	\$19.18	\$21.96	\$14.94	\$12.25	\$9.84	\$6.66	\$4.49	\$2.82	\$1.55	\$0.87	\$0.53
<b>Total Present Value</b>	<b>(\$54.91)</b>													
IRR	9%													
MIRR	14%													

## Optimistic Projected Net Cash Flows

dollar values in millions

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expected Customers per Month	0	0	0	50	50	50	50	50	40	30	20	10	5	5
Yearly Sales (12 * monthly sales)	0	0	0	600	600	600	600	600	480	360	240	120	60	60
Sales Price (per customer)	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20
<b>Total Sales</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$96.00</b>	<b>\$72.00</b>	<b>\$48.00</b>	<b>\$24.00</b>	<b>\$12.00</b>	<b>\$12.00</b>
<b>Fixed Costs</b>	<b>(\$150.00)</b>													
<b>Estimated Cost of Service (Optimistic)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$48.00)</b>	<b>(\$36.00)</b>	<b>(\$24.00)</b>	<b>(\$12.00)</b>	<b>(\$6.00)</b>	<b>(\$6.00)</b>
<b>EBITDA</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$60.00</b>	<b>\$60.00</b>	<b>\$60.00</b>	<b>\$60.00</b>	<b>\$60.00</b>	<b>\$48.00</b>	<b>\$36.00</b>	<b>\$24.00</b>	<b>\$12.00</b>	<b>\$6.00</b>	<b>\$6.00</b>
<b>Depreciation (MACRS-10 year)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>(\$15.00)</b>	<b>(\$27.00)</b>	<b>(\$21.00)</b>	<b>(\$18.00)</b>	<b>(\$13.50)</b>	<b>(\$10.50)</b>	<b>(\$10.50)</b>	<b>(\$10.50)</b>	<b>(\$10.50)</b>	<b>(\$9.00)</b>	<b>(\$4.50)</b>
<b>EBIT</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$45.00</b>	<b>\$33.00</b>	<b>\$39.00</b>	<b>\$42.00</b>	<b>\$46.50</b>	<b>\$37.50</b>	<b>\$25.50</b>	<b>\$13.50</b>	<b>\$1.50</b>	<b>(\$3.00)</b>	<b>\$1.50</b>
<b>Pre-Tax Profit</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$45.00</b>	<b>\$33.00</b>	<b>\$39.00</b>	<b>\$42.00</b>	<b>\$46.50</b>	<b>\$37.50</b>	<b>\$25.50</b>	<b>\$13.50</b>	<b>\$1.50</b>	<b>(\$3.00)</b>	<b>\$1.50</b>
<b>Taxes (estimate of 40%)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>(\$18.00)</b>	<b>\$0.00</b>	<b>(\$15.60)</b>	<b>(\$16.80)</b>	<b>(\$18.60)</b>	<b>(\$15.00)</b>	<b>(\$10.20)</b>	<b>(\$5.40)</b>	<b>(\$0.60)</b>	<b>\$1.20</b>	<b>(\$0.60)</b>
<b>Net Operating Profit After Taxes (NOPAT)</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$27.00</b>	<b>\$33.00</b>	<b>\$23.40</b>	<b>\$25.20</b>	<b>\$27.90</b>	<b>\$22.50</b>	<b>\$15.30</b>	<b>\$8.10</b>	<b>\$0.90</b>	<b>(\$1.80)</b>	<b>\$0.90</b>
<b>Add Back Depreciation</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$15.00</b>	<b>\$27.00</b>	<b>\$21.00</b>	<b>\$18.00</b>	<b>\$13.50</b>	<b>\$10.50</b>	<b>\$10.50</b>	<b>\$10.50</b>	<b>\$10.50</b>	<b>\$9.00</b>	<b>\$4.50</b>
<b>Operating Cash Flow</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$42.00</b>	<b>\$60.00</b>	<b>\$44.40</b>	<b>\$43.20</b>	<b>\$41.40</b>	<b>\$33.00</b>	<b>\$25.80</b>	<b>\$18.60</b>	<b>\$11.40</b>	<b>\$7.20</b>	<b>\$5.40</b>
<b>Present Value (based on 17.6% and a current date of Jan 1, 2005)</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>\$25.82</b>	<b>\$31.37</b>	<b>\$19.74</b>	<b>\$16.33</b>	<b>\$13.31</b>	<b>\$9.02</b>	<b>\$6.00</b>	<b>\$3.68</b>	<b>\$1.92</b>	<b>\$1.03</b>	<b>\$0.66</b>
<b>Total Present Value</b>	<b>(\$21.13)</b>													
<b>IRR</b>	14%													
<b>MIRR</b>	16%													

## Conservative Projected Net Cash Flows With 10% Advance

dollar values in millions

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expected Customers per Month	0	0	0	50	50	50	50	50	40	30	20	10	5	5
Yearly Sales (12 * monthly sales)	0	0	0	600	600	600	600	600	480	360	240	120	60	60
Sales Price (per customer)	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20
<b>Total Sales</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$117.60</b>	<b>\$115.20</b>	<b>\$112.80</b>	<b>\$88.80</b>	<b>\$66.00</b>	<b>\$44.40</b>	<b>\$21.60</b>	<b>\$10.80</b>	<b>\$10.80</b>
<b>Fixed Costs</b>	<b>(\$150.00)</b>													
Estimated Cost of Service (conservative)	\$0.00	\$0.00	\$0.00	(\$78.00)	(\$78.00)	(\$78.00)	(\$78.00)	(\$78.00)	(\$62.40)	(\$46.80)	(\$31.20)	(\$15.60)	(\$7.80)	(\$7.80)
<b>Total Costs</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>(\$78.00)</b>	<b>(\$78.00)</b>	<b>(\$78.00)</b>	<b>(\$78.00)</b>	<b>(\$78.00)</b>	<b>(\$62.40)</b>	<b>(\$46.80)</b>	<b>(\$31.20)</b>	<b>(\$15.60)</b>	<b>(\$7.80)</b>	<b>(\$7.80)</b>
<b>EBITDA</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$42.00</b>	<b>\$42.00</b>	<b>\$39.60</b>	<b>\$37.20</b>	<b>\$34.80</b>	<b>\$26.40</b>	<b>\$19.20</b>	<b>\$13.20</b>	<b>\$6.00</b>	<b>\$3.00</b>	<b>\$3.00</b>
Depreciation (of Fixed Cost over 5 years)	\$0.00	\$0.00	\$0.00	(\$15.00)	(\$27.00)	(\$21.00)	(\$18.00)	(\$13.50)	(\$10.50)	(\$10.50)	(\$10.50)	(\$10.50)	(\$9.00)	(\$4.50)
<b>EBIT</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$27.00</b>	<b>\$15.00</b>	<b>\$18.60</b>	<b>\$19.20</b>	<b>\$21.30</b>	<b>\$15.90</b>	<b>\$8.70</b>	<b>\$2.70</b>	<b>(\$4.50)</b>	<b>(\$6.00)</b>	<b>(\$1.50)</b>
Pre-Tax Profit	(\$138.00)	\$12.00	\$12.00	\$27.00	\$15.00	\$18.60	\$19.20	\$21.30	\$15.90	\$8.70	\$2.70	(\$4.50)	(\$6.00)	(\$1.50)
Taxes (estimate of 40%)	\$0.00	\$0.00	\$0.00	(\$10.80)	\$0.00	(\$7.44)	(\$7.68)	(\$8.52)	(\$6.36)	(\$3.48)	(\$1.08)	\$1.80	\$2.40	\$0.60
<b>Net Operating Profit After Taxes (NOPAT)</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$16.20</b>	<b>\$15.00</b>	<b>\$11.16</b>	<b>\$11.52</b>	<b>\$12.78</b>	<b>\$9.54</b>	<b>\$5.22</b>	<b>\$1.62</b>	<b>(\$2.70)</b>	<b>(\$3.60)</b>	<b>(\$0.90)</b>
Add Back Depreciation	\$0.00	\$0.00	\$0.00	\$15.00	\$27.00	\$21.00	\$18.00	\$13.50	\$10.50	\$10.50	\$10.50	\$10.50	\$9.00	\$4.50
<b>Operating Cash Flow</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$31.20</b>	<b>\$42.00</b>	<b>\$32.16</b>	<b>\$29.52</b>	<b>\$26.28</b>	<b>\$20.04</b>	<b>\$15.72</b>	<b>\$12.12</b>	<b>\$7.80</b>	<b>\$5.40</b>	<b>\$3.60</b>
<b>Present Value (based on 17.6% and a current date of Jan 1, 2005)</b>	<b>(\$138.00)</b>	<b>\$10.20</b>	<b>\$8.68</b>	<b>\$19.18</b>	<b>\$21.96</b>	<b>\$14.30</b>	<b>\$11.16</b>	<b>\$8.45</b>	<b>\$5.48</b>	<b>\$3.65</b>	<b>\$2.40</b>	<b>\$1.31</b>	<b>\$0.77</b>	<b>\$0.44</b>
<b>Total Present Value</b>	<b>(\$30.02)</b>													
IRR	12%													
MIRR	15%													

## Optimistic Projected Net Cash Flows With 10% Advance

dollar values in millions

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Expected Customers per Month	0	0	0	50	50	50	50	50	40	30	20	10	5	5
Yearly Sales (12 * monthly sales)	0	0	0	600	600	600	600	600	480	360	240	120	60	60
Sales Price (per customer)	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20	\$0.20
<b>Total Sales</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$120.00</b>	<b>\$120.00</b>	<b>\$117.60</b>	<b>\$115.20</b>	<b>\$112.80</b>	<b>\$88.80</b>	<b>\$66.00</b>	<b>\$44.40</b>	<b>\$21.60</b>	<b>\$10.80</b>	<b>\$10.80</b>
<b>Fixed Costs</b>	<b>(\$150.00)</b>													
Estimated Cost of Service (Optimistic)	\$0.00	\$0.00	\$0.00	(\$60.00)	(\$60.00)	(\$60.00)	(\$60.00)	(\$60.00)	(\$48.00)	(\$36.00)	(\$24.00)	(\$12.00)	(\$6.00)	(\$6.00)
<b>Total Costs</b>	<b>(\$150.00)</b>	<b>\$0.00</b>	<b>\$0.00</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$60.00)</b>	<b>(\$48.00)</b>	<b>(\$36.00)</b>	<b>(\$24.00)</b>	<b>(\$12.00)</b>	<b>(\$6.00)</b>	<b>(\$6.00)</b>
<b>EBITDA</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$60.00</b>	<b>\$60.00</b>	<b>\$57.60</b>	<b>\$55.20</b>	<b>\$52.80</b>	<b>\$40.80</b>	<b>\$30.00</b>	<b>\$20.40</b>	<b>\$9.60</b>	<b>\$4.80</b>	<b>\$4.80</b>
Depreciation (MACRS-10 year)	\$0.00	\$0.00	\$0.00	(\$15.00)	(\$27.00)	(\$21.00)	(\$18.00)	(\$13.50)	(\$10.50)	(\$10.50)	(\$10.50)	(\$10.50)	(\$9.00)	(\$4.50)
<b>EBIT</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$45.00</b>	<b>\$33.00</b>	<b>\$36.60</b>	<b>\$37.20</b>	<b>\$39.30</b>	<b>\$30.30</b>	<b>\$19.50</b>	<b>\$9.90</b>	<b>(\$0.90)</b>	<b>(\$4.20)</b>	<b>\$0.30</b>
<b>Pre-Tax Profit</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$45.00</b>	<b>\$33.00</b>	<b>\$36.60</b>	<b>\$37.20</b>	<b>\$39.30</b>	<b>\$30.30</b>	<b>\$19.50</b>	<b>\$9.90</b>	<b>(\$0.90)</b>	<b>(\$4.20)</b>	<b>\$0.30</b>
Taxes (estimate of 40%)	\$0.00	\$0.00	\$0.00	(\$18.00)	\$0.00	(\$14.64)	(\$14.88)	(\$15.72)	(\$12.12)	(\$7.80)	(\$3.96)	\$0.36	\$1.68	(\$0.12)
<b>Net Operating Profit After Taxes (NOPAT)</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$27.00</b>	<b>\$33.00</b>	<b>\$21.96</b>	<b>\$22.32</b>	<b>\$23.58</b>	<b>\$18.18</b>	<b>\$11.70</b>	<b>\$5.94</b>	<b>(\$0.54)</b>	<b>(\$2.52)</b>	<b>\$0.18</b>
Add Back Depreciation	\$0.00	\$0.00	\$0.00	\$15.00	\$27.00	\$21.00	\$18.00	\$13.50	\$10.50	\$10.50	\$10.50	\$10.50	\$9.00	\$4.50
<b>Operating Cash Flow</b>	<b>(\$138.00)</b>	<b>\$12.00</b>	<b>\$12.00</b>	<b>\$42.00</b>	<b>\$60.00</b>	<b>\$42.96</b>	<b>\$40.32</b>	<b>\$37.08</b>	<b>\$28.68</b>	<b>\$22.20</b>	<b>\$16.44</b>	<b>\$9.96</b>	<b>\$6.48</b>	<b>\$4.68</b>
<b>Present Value (based on 17.6% and a current date of Jan 1, 2005)</b>	<b>(\$138.00)</b>	<b>\$10.20</b>	<b>\$8.68</b>	<b>\$25.82</b>	<b>\$31.37</b>	<b>\$19.10</b>	<b>\$15.24</b>	<b>\$11.92</b>	<b>\$7.84</b>	<b>\$5.16</b>	<b>\$3.25</b>	<b>\$1.67</b>	<b>\$0.93</b>	<b>\$0.57</b>
<b>Total Present Value</b>	<b>\$3.76</b>													
<b>IRR</b>	<b>18%</b>													
<b>MIRR</b>	<b>18%</b>													

## Appendix C. Time-Line

The following timeline is a combination of information retrieved from:

- <http://www.hq.nasa.gov/office/pao/History/Defining-chron.htm>
- <http://www.spacefuture.com/tourism/timeline/shtml>
- <http://my.execpc.com/~culp/space/timeline.html>

**Table C-1 Space Time-Line**

<b>1957</b>	- <i>Sputnik 1</i> – 1 <sup>st</sup> man-made object to orbit Earth (U.S.S.R.)
<b>1958</b>	- National Aeronautics and Space Administration (NASA) began operation - <i>Pioneer 1</i> – first NASA launch (U.S.A.)
<b>1959</b>	- <i>Project Score</i> – communications satellite launch, & aired President Eisenhower’s Christmas message (U.S.A.) - Liquid-hydrogen used to launch an air force satellite (U.S.A.)
<b>1961</b>	- <i>Mercury 2</i> – test mission of the Mercury-Redstone capsule-launch vehicle combination with the chimpanzee Ham aboard the 16 minute flight (U.S.A.) - Astronaut “Gus” Grissom takes sub-orbital mission (U.S.A.)
<b>1962</b>	- <i>Friendship 7</i> – orbits Earth 3 times carrying John Glenn (U.S.A.)
<b>1962</b>	- <i>Telesat 1</i> – first privately built satellite launch (U.S.A.)
<b>1964</b>	- <i>Saturn SA-5</i> – sends 5 tons into orbit, largest launch vehicle yet (U.S.A.)
<b>1966</b>	- <i>Luna 10</i> – first vehicle to achieve lunar orbit (U.S.S.R.)
<b>1967</b>	- <i>Apollo 4</i> – first combination of launcher and spacecraft launched (U.S.A.)
<b>1969</b>	- Apollo 11 – landed on the moon, Neil Armstrong and Edwin “Buzz” Aldrin set foot on the surface
<b>1970</b>	- NASA and Air Force combine to test high-speed, high-altitude flights (U.S.A.)
<b>1971</b>	- Design for the reusable vehicle published by Dietrich Koelle at annual congress of International Astronautical Federation (IAF)
<b>1973</b>	- <i>Skylab</i> - workshop launched & maintained by three crews (U.S.A.) - <i>Skylab 2</i> - launched to repair damages of <i>Skylab</i> in space (U.S.A.)
<b>1974</b>	- <i>Salyut 3</i> – first military space station launched (U.S.S.R.) - <i>Salyut 4</i> – first civilian space station launched (U.S.S.R.)
<b>1975</b>	- Apollo- Soyuz Test Project was the first international human space flight. This was to open the way for international space rescue and future joint missions.
<b>1981</b>	- Columbia – first airplane-like craft to land from orbit for reuse (U.S.A.)
<b>1984</b>	- President Regan announces to build a space station within a decade (U.S.A.) - Space tourism introduced in series of papers by David Ashford (England)
<b>1985</b>	- <i>Phoenix</i> – design published by Gary Hudson of Pacific American Launch Systems (PALS) for the passenger vehicle - PALS & Society Expeditions, travel company, start “Project Space Voyage”. This would offer low Earth orbit flights for \$50,000. Several thousand deposits of \$5,000 were collected, but not enough money was raised for product development.
<b>1986</b>	- <i>Mir</i> – space station launched (U.S.S.R.)

- National Commission on Space issues a report on U.S. civil space program (U.S.A.)
- 1989** - A design for an orbital hotel is presented in Feasibility of Space Tourism – Cost Study for Space Tour.” At IAF Congress by a major construction company
- 1990** - “Your Spaceflight Manual: How you could be a tourist in space within 20 years by David Ashford & Patrick Collins published
- 1991** - US Department of Defense announces funding of the McDonnell Douglas reusable test-rocket
- 1993** - Japanese Rocket Society (JRS) began a study program on the feasibility of setting up a space tourism business and began design on a passenger vehicle (Japan)
- First flights of reusable test rockets. These demonstrated that operating a rocket-powered vehicle was no more complex than operating an aircraft. (U.S.A.)
- 1994** - *Kankoh-maru* – Design of space tourism vehicle was presented at IAF Congress
- 1995** - *Kankoh-maru* - JRS starts second phase of *Kankoh-maru* for estimated cost to develop and manufacture (Japan)
- Space Transportation Research Committee in cooperation with NASA start a study of Space tourism (U.S.A.)
- *Kankoh-maru* – study of operations proved that airports would not have difficulty accommodating space tourism vehicles. (Japan)
- 1996** - X-Prize project was publicly launched (U.S.A.)
- Barbara Stone, NASA, presents a paper at the 20<sup>th</sup> ISTS “Space Tourism: The Making of a New Industry”. This showed that space tourism has the potential to be the next major space business. (U.S.A.)
- NASA announces the award of a \$900 million contract to Lockheed-Martin for the building and flying of the “X-33” unpowered, reusable rocket test-vehicle to speeds of Mach 15 (U.S.A.)
- 1997** - Cheap Access to Space (CASTS) conference held in Washington D.C. jointly sponsored by NASA and the Space Frontier Foundation.
- 1998** - International Space Station agreement among 15 countries
- *Zarya* – first component of the International Space Station Launched
- Japan’s first space travel company, Spacetopia, Inc. founded
- Conference in Phoenix explores the efforts made to date on companies developing reusable launch vehicles and those trying to create supportive legal support (U.S.A.)
- FAA starts the study of low Earth orbit traffic management (U.S.A.)
- 1999** - *Roton* – First test of the Atmospheric test vehicle at Rotary Rocket Mojave Center
- First flight of reusable rocket demonstrator by engineers from ISAS (Japan)
- Formation of Virgin Galactic Airways announced
- First time civilians may encounter the same training received by Russians going to the International Space Station (Russia)
- UK & Japan space tourism workshop, London (England)
- 2000** - *Kankoh-maru* – illustrations appear on NASA website (U.S.A.)
- International Space University includes design project on space tourism
- 2001** - *Mir* – returned to Earth (Russia)
- Dennis Tito an American became the first space tourist (Russia)
- NASA spends funds to ask US citizens if would like to take a trip to space (U.S.A.)
- EZ Rocket is the world’s first privately built rocket powered airplane (U.S.A.)



- Space Adventures commissions market survey on space tourism (U.S.A.)
- Nova – Starchaser Industries first unmanned single-seat launch reaches 1688.8 meters in a race to win the X-Prize.
- 2003** - Starchaser Industries test-fired engine for RLV vehicles (England)
- XCOR Aerospace announced it qualified for the Department of Defense program to Match their private capital four to one in developing suborbital RLV (U.S.A.)
- Scaled Composites unveiled “Tier One” and flew the first glide test of SpaceShipOne
- FAA published a notice in the Federal Register officially defining suborbital RLVs
- 2004** - Rocket Ltd. Announced it broke ground on facilities in Oklahoma to build and operate a suborbital RLV (U.S.A.)
- FAA/AST awarded launch license to Scaled Composites for SpaceShipOne and XCOR Aerospace for Sphinx, Mojave Airport received a license for launch site Operator (U.S.A.)
- X-Prize announces Ansari donation (U.S.A.)
- Scaled Composites won the X-Prize
- Rocketplane Ltd. announced that it had entered into an agreement with Incredible Adventures (U.S.A.)