

## **SPACE TOURISM AND RLVs: YOU CAN'T HAVE ONE WITHOUT THE OTHER!**

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### ABSTRACT

Affordable space access is essential to the development of new space businesses, especially space tourism. Properly designed Reusable Launch Vehicles (RLVs) hold the promise for low-cost access to space, yet financing for the research and development of RLVs requires a market with profit potential. The existing market research on space tourism indicates a sufficient demand to support RLV development and to provide the growing market needed to enable investors to earn acceptable returns. This paper examines the market that RLVs have targeted, which to date has not enabled RLV companies to completely succeed in their financing efforts. The existing market research that has been used to validate the potential market for space tourism is also examined. Suggested changes and improvements are offered for new market studies in space tourism. Financing and investor requirements for business ventures in these industries are also discussed based on the author's three previous surveys of venture capitalists regarding investments in outer space commerce. Finally, recommendations are offered for a symbiotic relationship between the RLV and space tourism industries to enable a new era of commercial ventures in outer space.

### INTRODUCTION

Most RLV companies have pursued the launching of satellites as the primary market. This market was targeted because of the potential offered by the constellation satellite segment of

the industry, which at one time was thought to be capable of launching hundreds, if not thousands, of clustered LEO satellites to orbit. With the

bankruptcies of Iridium and ICO in 1999, the delays with Teledesic, and the current problems facing Globalstar, the future of the constellation satellite business is in doubt. This doubt carries over to the RLV companies since their business plans focus on the satellite launch market.

RLV companies claimed that they would be able to assume a portion of all the satellite launch business, not only the commercial market, but some of the government and military launches as well. Commercial launches number about fifty per year, placing approximately 125 payloads into orbit. In 1999 there were only seventy-four commercial, military, and scientific launches worldwide.<sup>1</sup>

Except for a few notable exceptions among the entrepreneurial RLV companies, capturing market share in the satellite launch market formed the basis of RLV financial efforts. While space tourism was listed as a possible use for their space transportation vehicle, it was never considered a primary use. In fact, Gary Hudson, the former CEO of one of the major RLV companies, said at the 1999 Space Transportation Association Conference: "I never mention space tourism on Wall Street. I have enough problems as it is."<sup>2</sup>

Since the constellation satellite problems are so apparent that even the most die-hard launch market advocates can't hide from them, a change

in market strategy has begun for the RLV companies. At the Silicon Valley Space Enterprise Symposium on June 10, 2000, the CEO of Kelly Space & Technology, Robert M. Davis, Jr., described his company's efforts to bring its version of an RLV, the Eclipse, to market. Davis commented that the Eclipse was being designed for consumer markets and that Kelly was working on having a version of the vehicle for space tourism by 2002. Not once during his presentation did he mention the original Kelly concept of using the Eclipse to launch satellites and small payloads to LEO. From his comments, if one were not familiar with Kelly and its program, one would not have known that cargo and satellite launches were the focus of Kelly Space & Technology since its inception several years ago. This shift in the company's focus suggests that if Kelly is to succeed in developing the Eclipse, then new markets supported by substantial demand, such as space tourism, must be exploited.

Speaking at the same symposium was Mitchell Burnside Clapp, the CEO of Pioneer Rocketplane. Pioneer is attempting to secure financing for its Pathfinder RLV. Like Kelly, the company originally focused on the need for launching satellite payloads to LEO. Clapp too has realized that these markets can't support RLV development and commented on this during his prepared remarks. While not abandoning the satellite launch market for space tourism markets, Clapp mentioned space tourism as a significant possibility, but did not endorse it.

### THE EXISTING LAUNCH MARKET

Currently, all the major launches, whether commercial, government, or military, employ Expendable Launch Vehicles (ELVs). ELVs were designed, developed, built, and tested using public money. Even the new Evolved Expendable Launch Vehicles (EELVs), which were contracted for by the U.S. Air Force and which will soon be entering the marketplace, are being built with government money. Furthermore, EELVs, which are based on updated ELV technologies, are mandated to

reduce launch costs by twenty-five to fifty percent.<sup>3</sup> In many instances, some of the older ELVs have already recouped their R&D costs as well as their original investment as a result of revenues generated by sales to both the government and the public sectors.

The launch market is highly competitive with many vehicles competing for a finite number of launches each year. Aside from the variety of U.S. launch vehicles for various payloads and missions, Russian and Chinese ELVs provide reliable, low-cost launches. Nonetheless, the European Ariane ELV launches most of the commercial satellites. Two years before the EELVs are expected to enter service, the launch market is already experiencing declining prices with so many rockets competing for relatively few launches. Furthermore, satellite launches are not expected to pick up for several years. As launch prices fall and industry revenues decline, the fight for market share will become intense.

Most RLV companies expect to compete for market share in this economic environment. In a recent private conversation, an associate of an RLV manufacturer commented that his company would capture up to twenty-five percent of the total satellite launch market per year, but this goal appears unrealistic.

The investment requirements for the RLV industry will be significantly different from the requirements of the existing launch industry. Unlike the ELVs, which were developed with government money and are, for the most part, fully amortized, RLVs will be developed by private-sector capital demanding sufficient returns on investment, exit strategies that enhance the expected investment returns, and payback periods that compete with existing terrestrial investments. The pricing strategies of RLV companies will be vital during the early revenue-generating period.

It is important for any new launch system, especially an RLV with high R&D costs, to develop a successful pricing strategy. If the RLV company sets prices too far below existing launch market rates for commercial launches, it

runs the risk of losing valuable revenue that is needed in the early stages of RLV sales. The argument for doing this assumes that substantially lower prices are needed in order to gain market share for their new launch vehicle. While this may be valid for the long run, in the short run this strategy reduces the potential revenue stream for the RLV company. This early revenue stream is particularly important to investors who consider RLVs to be high risk and expect a short payback period.

Establishing below-market prices to win market share also assumes that the competition either can't or won't price competitively. Since the financial performance requirements for the ELVs are vastly different from the RLVs, it seems that ELVs could readily match or surpass any RLV pricing level to hold on to market share. ELVs do not have to produce the investment returns a new RLV will be pressured to meet, and exit strategies don't enter into an ELV company's decision-making process. ELV companies will do what is necessary to retain market share. Since the ELV companies control and own the entire launch market industry—another fact that separates them from the new single-purpose RLV companies—the ELV companies will have considerably more staying power at greatly reduced launch prices than will their RLV competitors. Not only do the ELV companies lack investor pressure for early returns, as is the case with the RLV companies, the ELV companies have many sources of revenues as they are not single-product companies. This affords them the ability to be tough competitors if another industry goes after their launch market share.

As if these factors were not enough for RLV companies to consider, one has only to look at the satellite companies that pay for the launches. It is unlikely that they will give a significant percentage of their launch business to one launch company using a particular vehicle. This conclusion is supported by the fact that the existing ELV launch industry is a highly competitive industry in which the satellite companies spread their business around to the

different launch companies based on price, launch vehicle capability, availability, and reliability. Since most satellite launches are insured against launch failure, against failure to reach the proper orbit, and against failure to last the expected number of years in service, the more reliable RLVs will not appear to be economically advantageous, at least not at first. Even if using an RLV, satellite companies will still be insuring their satellites for the launch and failure to reach the correct orbit risks. The risk for life expectancy is the same regardless of the vehicle used to launch the satellite. Until the RLVs have an established track record, their insurance premiums may be the same or higher than those of ELVs with established track records, an essential factor in determining the cost of an insurance policy.

The satellite companies factor in insurance costs, the price of the launch, and the potential loss of revenue if the satellite blows up as a result of the launch or does not reach its proper orbit. Even with these considerations, satellite companies are currently profitable. The question is, can RLV companies successfully market their potential advantages and will they earn a substantial piece of the market?

The RLV industry may possibly bring several competing RLV designs to market at the same time. For example, there are already sixteen contestants for the X Prize, which is a competition with the winner earning \$10 million. The X Prize is also a significant facilitator for the entrepreneurial RLV companies to actually design and fly their RLVs. While there will be only one winner, it is possible that more than one of the X Prize RLVs will eventually be built and made operational. As important as multiple RLVs are for competition within this segment of the industry, winning market share in a competitive ELV environment of oversupply and declining prices is a serious challenge for just one new RLV, let alone many. Therefore, it is important that a valid market with substantial demand exist for RLVs. When considering the potential markets that RLVs can serve, only

space tourism appears to have the demand potential that can support its development.

### EXISTING SPACE TOURISM MARKET RESEARCH

In 1993 Patrick Collins conducted market research on space tourism in Japan, and in 1995 conducted similar research in Canada and the United States. In 1994, leading aerospace companies evaluated the space tourism market for the Commercial Space Transportation Study (CSTS), and starting in 1997 the Space Tourism Association (STA), in conjunction with NASA, conducted limited market research on space tourism over a three-year period. Also in 1997, a modified space tourism survey was combined with an annual travel and tourism survey by Yesawich, Pepperdine & Brown for their National Travel MONITOR survey.

Other than the countries already mentioned, space tourism market research was also conducted in the United Kingdom, France, and Germany. Regardless of the particular population studied, the results consistently showed large significant numbers of people willing to take a ride to space.

All this research points to a sizeable space tourism market that varies in size by the price per ticket. These surveys show sufficiently large enough markets to support the investment in R&D for a new space launch vehicle. Since the space tourism industry has the detailed market research to support it, one can make the assumption that space tourism has the potential to drive the economic development of the RLV.

Advocates of space tourism cite numerous market studies to demonstrate that a large market with high demand exists for space tourism. The data will not be summarized in this paper, as it is readily available elsewhere. That credible studies on space tourism were conducted at all and that research findings exist distinguish the space tourism industry from other New Space Industries (NSIs).

### NEW MARKET RESEARCH NEEDED

These studies make the case for predicting significant global demand for space tourism. Yet even with all the studies that have been carried out from varying sources, neither the RLV industry nor the financial markets have considered space tourism to have the potential suggested by the studies. This is mainly because the projected market size is too large to be believable. Also, the questionnaires did not address issues of interest to the financial industry or RLV companies.

The RLV industry would be wise to partner with the space tourism industry to verify the demand potential. For maximum credibility and acceptance, the new research needs to be professionally conducted, independent of the RLV or space tourism industries. It needs to be independent in its design, implementation, and analysis. The marketing research company chosen to conduct this research, however, needs to have input from the concerned industries. This important input will help to ensure properly formulated questions that address the concerns of those who will be relying upon the data and the conclusions. Input needs to come from the space tourism industry, the RLV industry, the venture capital and finance industries, the aerospace industry, hotel and entertainment industries, and others that have an interest in the outcome of this research. The survey must address the issues and concerns that are used to discredit the existing research, or that the existing research does not cover.

Some issues that a new survey should address involve not only the information to be collected, but also the research methodology. Thus the market research company must structure its research program in a way that supports a high confidence level for the studies undertaken. Space tourism and RLV investment opportunities will be competing for finite investment monies, so the more reliable the research findings, the more likely funding can be obtained. The length of time to complete the survey, the groups and ages targeted by the

survey, and the method used to conduct the survey can all influence the outcome and even distort the findings.

New research questions should be formulated to address the availability and cost of life insurance since that may affect a person's willingness to travel to space. Space sickness issues also need to be addressed in some format. Since space sickness affects approximately seventy percent of NASA astronauts, it might well be that the same percentage of space tourists is adversely affected. Space sickness is difficult to predict and does not distinguish between a well-trained astronaut and a space tourist from the general population. Space sickness could ultimately be detrimental to the tourism business and its financial backers

The people being surveyed should be asked to rank space tourism when compared to other adventure travel opportunities. It is one thing to say that the adventure travel market is flourishing, with so many people paying \$100,000 per year to climb Mt. Everest or visit the North Pole. It is another to list several adventure travel opportunities to determine where most people would rank space tourism. While people may want to visit space, if it is shown that space tourism actually ranks low on a list of available competing travel opportunities, then the demand estimates for space tourism need to be adjusted to reflect this information.

### SPACE BUSINESS PLANNING

In researching this topic, numerous financial, marketing, and concept plans were reviewed, all of which are readily available in literature searches on the subject and various space conference proceedings over the past decade. In the vast majority of the studies examined, heavy reliance was made upon the numbers generated by the market research on space tourism already discussed. Using simple extrapolations from this data, it is shown how many fifty-, eighty-, or one hundred-seat RLVs would be needed to accommodate passengers in the early years of space tourism. The plans usually contain an

extensive technical discussion about the RLV's propulsion engineering, the fuel that it will burn, and the advantages of burning the specific fuel combination mentioned. RLV costs are estimated, but seldom are the underlying assumptions provided.

The reality is that the financial markets are not so interested in technical discussions about RLV fuels, liquid oxygen, or other propulsion issues for the RLV. They assume these issues are resolved, and while knowing the advantages and disadvantages of the particular RLV being considered for investment is important, the bottom line is how it all affects the risk and potential for profitability. In the investment community, even among "angel" investors, there are no shortages of investment opportunities promising substantial returns. The competition for finite investment resources is fierce. Unless a company or individual is so committed to investing in space tourism or an RLV, the space tourism and RLV opportunities will most likely have to show that their projected profits must be sufficiently higher than terrestrial alternatives to compensate for the added risk.

As part of the research for my doctoral dissertation on high-risk commercial ventures in outer space, I surveyed the U.S. venture capital industry three times from 1996 to 2000 regarding attitudes and requirements for making commercial space investments. While space tourism ranked high among the most plausible new space ventures, the investment requirements expressed in the most recent findings from the December 1999-February 2000 survey actually increased, making it more difficult to meet general objectives of the venture capital industry. Notwithstanding the one or two venture capital companies that *will* make an investment in an RLV or space tourism venture, venture capital requirements are demanding and in most cases will kill a deal.

My latest survey showed that venture capitalists continued to be mostly concerned about the lack of management experience and depth in new space ventures, as well as the high business and

political risks associated with new space business ventures. Market size was also a concern, as was the probability of high investment and capital costs. Internal rates of return higher than fifty percent were cited as mandatory, as were acceptable exit strategies and payback periods ranging from three to six years. Also mentioned was the degree of management control that would have to be abdicated in return for venture capital investment. Most felt these conditions would be too extreme for the majority of companies to handle, thereby making venture capital unattractive as a source of financing for NSIs.

A serious concern expressed by the venture capital respondents was the issue of competition for the investment dollar with terrestrial businesses. NSIs can successfully compete for these funds, providing the investment merit of the space project equals or surpasses the alternatives. This is a potential obstacle in space tourism and RLV financing, especially in the early phase of this industry's development.

To avoid a serious communication gap between space tourism operators and the financial industry, space entrepreneurs need to make a convincing argument for financing. It is one thing to have superb engineers and scientists associated with the company, but it is quite another to have executives with experience in consumer and industrial marketing, and in managing capital equipment that only generates revenues when in use. Having a former executive from a successful airline or similar business will go a long way in building bridges and confidence with the financial community.

In discussing proper business planning for the space tourism and RLV industries, it is important to stress the need for fully costing out and projecting revenues based on a plan that does not exclude ground-based or passenger-based infrastructure. This includes takeoff and landing facilities, communications equipment, airspace rights, and more. In addition, passenger support facilities, possibly even medical support teams, will need to be available, even for suborbital

flights. The costs for this overhead must be calculated and worked into the revenue analysis and projections. The assumptions underlying the projections must be clearly explained to satisfy potential investors. To make the business case for RLVs and space tourism companies, the details must be available to interested parties. At this point, it is simply naïve to conclude that substantial revenues will result in a profitable investment. Yes, a \$25,000 ticket price and 30,000 potential space tourists would theoretically generate \$750 million in revenue. But without the payroll, maintenance, certification, insurance, and debt costs, to name a few of the overhead expenses that must be projected into the analysis, a reasonable measure of profitability can hardly be estimated. The amount invested still has to be discounted using the return for a comparable risk-related business to determine the internal rate of return (IRR) and net present value (NPV) of the investment. Furthermore, the exit strategies have to be examined for downstream pressure on the business. At the end of this process, it is finally possible to make an investment decision regarding an RLV and space tourism business.

One area that has yet to be discussed is that of safety certification for RLVs. In this case, the reference to this subject is from a cost perspective. For a commercial airplane, FAA certification and airworthiness standards require that each safety-critical system have a minimum reliability of .0999999999—"nine 9's"—per flight hour, which means that the probability of any safety-critical system failure would be no more than one in a billion per flight hour.<sup>4</sup> A similar standard will most likely be adopted for certifying an RLV to carry passengers. This standard implies lots of test-flight data on the vehicle before passenger certification is authorized.

Flying a test vehicle for one hundred flights to obtain test data is not unusual and may be the standard applied to the RLV. If this or something similar is the standard, it is important to put it in perspective using the Space Shuttle. Since the first flight of the Space Shuttle in 1981,

the fleet of Space Shuttles has made ninety-eight flights. While the RLV will certainly fly more often, with considerably faster turnaround times and significantly reduced maintenance and overhead operations, the fact is that collecting data over one hundred test flights is an expensive and time-consuming proposition. This type of comprehensive test program must be made part of the analysis in the business plan for an RLV or a space tourism business.

It would be helpful if the test-flight data could be obtained while earning some revenues to help defray the expenses involved. This brings us back to the satellite launch market discussed earlier in this paper. The RLV should be able to garner some portion of the satellite launch market, even if multiple RLV companies enter the market at or about the same time. From the earlier discussion of RLV companies targeting this market, it is doubtful that enough of the market can be captured to provide the type of investment returns necessary for developing the RLV. However, if RLV companies accept that space tourism is their ultimate market, then launching satellites or servicing fast-package delivery using an RLV could serve as a means of earning some revenues while obtaining test-flight data. Consequently, pressure on the RLV company and the investors would be more manageable.

### A LIMITING PERSPECTIVE

Common within the commercial space industry and the financial community is the view that space tourism may be a big market someday but it won't drive the development of RLVs. It is believed that only NASA can do that because building RLVs will require investor support, and investors look to NASA for everything related to space.

Unfortunately, this limited perspective is fueled by aerospace executives, the NASA director, the press, and by others in leadership positions. This view must be reversed if RLVs and space tourism are to materialize into a new and growing industry. This view shapes not only the

thinking, but the understanding, that investors and financiers bring to commercial space investments. A question in my latest venture capital survey confirmed this orientation. The question asked if there was a significant difference in investing in one type of commercial space business over another. Overwhelmingly the responses indicated no difference, regardless of whether the investment was for space tourism or asteroid mining. This perception of space business ventures suggests that space is always too expensive for the private sector to develop. .

### RECOMMENDATIONS

Space tourism and RLVs can work together to develop a new space industry. Of crucial importance among the suggestions is an up-to-date market research study for space tourism, to be conducted in the same countries where surveys were carried out in the 1990s. If possible, additional countries or regions should be included. The new market study should consist of not only a well-thought-out and well-designed questionnaire, but should include focus groups and other methodologies that will help determine the true character and potential of the space tourism market.

The cost of this research study will be substantial. Since it will be useful in opening up an entirely new industry and will possibly make it easier to get an RLV operating, the cost of the study should be funded by the parties that will benefit most from the findings. Strategic investment partners represent the target group to approach for funding this research. Such partners include, but are not limited to, cruise ship companies, hotel chains, airlines, tour operators, the media, and the entertainment industry.

Even if the new market research yields positive findings, limited views about space tourism have to change as well for space tourism to become a reality. Focusing for the moment on the RLV companies, since the need for financing these vehicles is so crucial and as yet so doubtful, a shift in the way these investment opportunities

and business plans are presented is in order. If the scenario prevails with NASA in control of the development of the RLV and space tourism, then there can be no doubt that the development of both of these New Space Industries will be on a longer timetable than what might be possible with a successful market-driven effort.

RLV companies should start seeing space tourism as their most substantive, and likely, market. Already a few RLV companies do this, including Bristol Aerospace in the U.K. and Vela Technology Development, Inc. of Vienna, Virginia. The Japanese RLV-concept vehicle known as the Kankoh-Maru is also a passenger-only vehicle.

Being able to work the political process for the benefit of the space tourism industry is another component affecting space tourism. Executives in established space business know how to lobby politicians and work the political system. The industry executives also have managerial experience at all levels in dealing with space-related issues and market strategies. RLV and space tourism companies will have to quickly learn all these practical aspects of doing business. Mastering relationships in these categories must not be overlooked.

A professional business approach is needed to make the case to nonspace business and finance communities. Here, again, having a former airline CEO, or similarly trained executive, working with an RLV or space tourism company would add credibility to the business because these people know finance, tourism, consumer marketing, and the effective use of capital equipment. Bringing this talent to the space tourism industry would be most helpful.

RLV companies must take a hard look at their business plans to see if the market they are aiming for is a real market. While there is a need for satellite launches, is it a market that can inspire investors to invest hundreds of millions, if not a billion dollars or more for research and development costs to bring their vehicles to operational status? Accepting space tourism as the market can help them realize their business

plans, but it will require a shift in the way they perceive their business.

Space tourism and RLV companies need to be specific about the benefits that people will have from their successful operations. For example, the Space Shuttle employs about 25,000 people in high-paying jobs at three NASA centers.<sup>5</sup> That is a very specific tangible benefit. What are the tangible benefits for building an RLV? The industry needs to be specific and make its case using quantifiable data.

Business planning, including financial forecasting and market research, is crucial to any business, especially fledgling space businesses. Space tourism proponents, in conjunction with RLV manufacturers, should pay particular attention to what the market tells them is needed to make a venture successful. These businesses need to understand the requirements and do sufficient planning and problem solving so that their ventures are competitive and can be financed. The smooth trajectory of tourists into space depends as much on traditional business planning and analysis as it does on innovative technological improvements in rocket, orbital, and space sciences.

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<sup>1</sup> Frank Sietzen, Jr., "Launch Failures and Recovery Shape 1999's Space Competition," *space.com*, 28 December 1999, <http://www.space.com>.

<sup>2</sup> Jeff Foust, "Barriers to Space Tourism," *SpaceViews*, 1 July 1999, <http://www.spaceviews.com>.

<sup>3</sup> Frank Sietzen, Jr., "Air Force Evolved Rocket May Restore U.S. Launch Leadership," *space.com*, 12 July 1999, <http://www.space.com>.

<sup>4</sup> Committee on Aircraft Certification Safety Management, Aeronautics and Space Engineering Board, Commission on Engineering and Technical Systems, and National Research Council, *Improving the Continued Airworthiness of Civil Aircraft: A Strategy for the FAA's Aircraft Certification Service*,



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Chapter 2: Role of the Aircraft Certification Service  
(Washington, DC: National Academy Press, 1995).

The text is also available at

<http://www.nap.edu/readingroom/books/airworthines/ch2.html>.

<sup>5</sup> Dana Andrews, from a speech to the Space Frontier Foundation at its annual meeting, Los Angeles, September 1999.