The Business of Commercializing Space
by

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This paper stems from my research connected with my doctoral dissertation in the School of Business at Golden Gate University in San Francisco, CA. My dissertation, Evaluating the Business Potential, Costs, and Risks of Opportunities Resulting From the Commercialization of Outer Space, presents a business perspective approach to this topic. It is with this background that I examine both the principal issues and the merit of space based businesses.

Based on my research to date, the general non-space business community does not have a high level of interest in commercializing space except for those businesses currently operating in space with proven records. Nor is there a strong belief that space can or should be commercialized. There is even a lack of understanding as to how profits can be made in space, and there is considerable uncertainty with regards to the laws, regulations, and the role of government in space businesses.

Uncertainty is a concept which business does not like. When risks are taken, usually the risk/reward ratio is significant enough to warrant taking the risk. Investors and management understand the business and its risks, and have experience in these matters. Venture capital companies and wildcat oil drillers that finance businesses when they are most vulnerable for success or failure are examples of business taking risks. However, these risks are usually confined to business risks, i.e. financial issues, sales, market acceptability, or the management team. Other risks such as taxes, the role of government, and the regulatory environment are understood and known. However, this is not the situation facing today's space businesses.

Today's space businesses face significant uncertainty with government and regulatory agencies. Now that private enterprise is operating in space, many important legal issues need to be addressed. The United Nations treaties that most space faring nations have accepted and signed did not contemplate private sector space businesses or individuals claiming space as their own domain for living, working, and playing. Some space entrepreneurs believe that forcing some if not all of the issues arising from these treaties to the courts is the best way to resolve the

potential conflicts. Others believe that organizations should be formed to take over the business and legal planning aspects of those wanting to operate in space. The problem is even more local and basic than treaties. In the United States for example, there are potential jurisdictional conflicts involving NASA, the FAA, other agencies within the Department of Transportation, the Department of Commerce, the Department of Defense, the FCC and other federal agencies. These potential jurisdictional conflicts can create problems and run up the costs for businesses considering or operating in space.

Uncertainty and confusion are costly for businesses and our economy. The highest cost results in the avoidance or the unwillingness of the business to pursue operations in the affected field. With avoidance or the refusal to engage in a business, there is an absence of economic stimulation that would have resulted had the business been pursued. Even with a failed business, money, jobs, ideas, and other contributions are circulated within the economy. Nothing is circulated in the absence of a business undertaking. In addition, a steep price is assigned to the various risk/reward ratios with the businesses that do operate in the uncertain and potentially conflict ridden environment.

An example of this steep price is the regulatory control of private space launches. Largely because of the confusion that came about after the first private space launch of the Conestoga I[1], President Reagan created the Office of Commercial Space Transportation (OCST) within the Department of Transportation (DOT). By 1986, the OCST was already issuing regulations to govern launches by private companies and after the Challenger accident, the office became a key agency in both space policy and business.[2] The FAA, also in the DOT, was already involved in public and private launches, because all of the launches were and still are subject to FAA regulations in American airspace. Eventually, the OCST received the clear mandate as the agency to supervise private launches. When it was created, the OCST identified at least a dozen federal bureaus, plus states and other districts which could have some jurisdiction in regulating space activities.[3]

Potential conflicts can also come from legislation. The Federal Aviation Act imposes limits on States to make legislation regarding commercial air travel. The Commercial Space Launch Act of 1984 sets up the Federal licensing mechanism, but this Act notes that the "authority of States to regulate space launch activities within their jurisdiction, or that affect their

jurisdictions, is unaffected by this Act."[4] It can be costly for businesses to sort out these potential conflicts and it is often a deterrent to even engaging in the business.

Possible solutions to these and other potential conflicts have been discussed. One suggestion has NASA becoming a cabinet level agency, thereby creating a Department of Air and Space. This cabinet model has the newly formed department absorbing the FAA and the National Transportation Safety Board (NTSB), plus other space related activities within the Departments of Commerce and Transportation.[5] Critics are quick to point out that giving NASA additional regulatory and operational duties may adversely affect NASA's obligations in research and development.[6]

Other consolidation plans have been discussed because having a Department of Space as a cabinet-level department would have significant symbolic value, showing that it was important to the U.S. Government.[7] This would send a clear message to the business community and to those interests working with space inside and outside the United States. Still, it is a concept that is not without controversy. Political scientists who have looked into similar reorganizations point out that they are often not successful. Any benefits from reorganizations for symbolic reasons only and without substantive policy changes are almost always temporary.[8]

For the business community, having potential agency conflicts eliminated and elevating the status of commercializing space to the cabinet-level would be positive. It would bring about a new level of awareness for the general business community, helping to open it to the benefits of doing business in space. As the political scientists point out however, if the changes are only symbolic, when the honeymoon period ends, it will be back to business as usual.

Commercializing space extends our terrestrial business environment from earth to several hundred miles above it and beyond. The deciding factors for doing business in space should be similar to those on earth. If there is an advantage to doing business in space, then we should be able to capitalize on that advantage. Getting to this point requires development in many areas, including the ability to obtain long term, low cost financing. Two important potential sources for obtaining this financing are discussed in this paper.

First, the business of commercializing space will require substantial capital. Knowing both the ease and how this capital will be obtained, and the cost for obtaining and using it is

important for the space commercialization progress. One idea that addresses this important issue is the concept of a Space Development Bank.

A United States Space Development Bank could help overcome the lack of financing for large commercial space ventures. Dr. Thomas Matula in his paper on this subject, points out that space commercialization and developing nations share the problem of a lack of long-term, low cost financing.[9] Development banks are fairly successful with their assistance to developing nations. The same principals can be applied to developing commercial space industries. Financed by the sale of specific space bonds issued by the federal government, a low cost source of long-term funding would be available to businesses interested in doing business in space. The capital markets would assign a low risk to the bonds since they would be backed by the U.S. Government. Variations on this might include state funded and organized Space Development Banks to support space businesses in specific states. Similar development banks could be formed on an international basis and in specific countries for their own space business development.

Second, venture capital is another often talked about source of funding for commercial space ventures. Exploring the relationship of the venture capital industry to the potential commercial space industry is important. Therefore, as part of my dissertation research, I conducted a random survey of over 600 venture capital firms across the United States to ascertain their interest, awareness, understanding and experience in doing business in space. The amount of funding this industry can provide commercial space entrepreneurs and businesses is significant. Also, this industry represents a primary source of seed, early growth, and development financing.

Table I below summarizes the number of venture capital companies surveyed and the number responding. Companies were randomly surveyed from 46 states. Most of the companies contacted were in Massachusetts, California, New York, Texas, Connecticut, and Illinois.

Table I
Statistical Response to Study

1. Total of all companies comprising study pool:	1,082
2. Total number of companies surveyed:	640
3. Percent of companies surveyed:	59.14%
4. Total number of responses to the survey:	64
5. Survey Response rate:	10%

Among the many survey findings, common understandings and views held by the responding venture capital companies were revealed. When asked what they thought the most exciting and potentially lucrative commercial space businesses were, the companies reported back with the following statements:

> "Space transportation to orbit for non-satellites; More advanced communications; Remote sensing; Scientific applications; Ventures with a large, untapped market with a realistic business plan; Space travel and tourism; Lower cost, higher efficiency launch vehicles; Space businesses that use existing infrastructure or easily deployed infrastructure to deliver high-volume, high-value-added products & services to large, commercial markets; Owning and operating satellites; Growth and technology transfer; Manufacturing or technology in a space vacuum environment; Growth of crystals, semi-conductors, and all types of technology exploitation."

The financial and business risks were deemed to be high and in some cases excessively high to the point of negating any interest in space businesses. Some of the venture capital company responses included these statements:

> "Pure play - would be too high for most; Take whatever risk reward you would associate with/similar normal business, multiply by 5X; Government competition/regulation; The risks are high, but so too are the rewards for those that are first and successful; No revenues for several years; Probably higher risk due to large capital requirements and lack of management with long track records; Very low investment potential with astronomic associated risk demanding commensurate rates of return on commercial capital, financial; Relatively significant because of the high costs often involved; Business risks about average, high risk all around, huge amounts of capital required, long time to pay-off, no success models to compare; Possibility of profits nil; It will be a long time before anyone but NASA contractors make any money, if ever; Lack of commercial development; Requires substantial R&D; Uncertainties as to cost and revenues, Breaking new ground; Time horizon outside investment window; Risks totally outside the control of an investor."

All of the venture capital companies wanted very high returns on investments when considering these ventures. Some of their comments included the following:

> "Ten to one returns as a minimum; Returns ranging from >30% to >100% IRR; Greater than 30% IRR; Time period of 3-6 years needed; Hundreds of times the return of a normal business."

The companies expressed serious reservations and concerns over other issues including the following:

> "International rights/treaties over the use of space; The commercial suppliers to the industry; The minimization of the political part of the commercial equation; Taxation and tariffs; Understanding of distinct market, i.e. exploration vs. science; Interesting legal questions like can I provide phone or pager service in Ghana?; Large capital requirement; Entrenched large company competition; Public financing; Government dependency; What attractions to institutional equity capital are feasible?; Safety, liability exposure; Launch insurance."

As a result of researching this relationship, it is possible to see what the venture capitalist thinks about business in space. The businessman sees what is needed and can then tap into these financial sources. The venture capitalist is concerned with business and management experience, risks, and the usefulness of the product or service. The businessman is concerned that the venture capitalist be open minded. He wants to know that there exists a possibility of obtaining capital, and that quantitative and qualitative evaluation methodology is understood and applicable to the space based business being considered for investment. The businessman wants the venture capitalist to have an interest in commercial space and be supportive of these markets and investments. It will be interesting to note the changes that will have taken place in this relationship when this survey is updated in approximately three years when I revise this work.

New Space Industries (NSI) refers to a combination of private sector space based businesses that have potential commercial value and that are not currently in existence or in their very early stages of development. While many such businesses are discussed, a few seem to have the most potential, especially in the near to intermediate term. A partial list of these businesses includes: a) space manufacturing; b) space resources for both space and earth; c) space business parks; d)satellite and space transfer services; e) travel and entertainment (space tourism); f) R & D services in space; g) space transportation; h)space tethers; i) space infrastructure; j) space utilities; and k) space solar power. Rather than discuss each of these potential space businesses in detail, I would like to identify the needs that these New Space Industries have in common. Next, I will focus on one specific industry that has the potential to be highly successful and lead the others in their development.

Most, if not all, of these industries share key fundamental needs. They all require infrastructure for facilities and operations for their businesses. New and different technology and transportation vehicles are needed as well as financing. Low cost and dependable transportation is also essential. Safety, emergency, traffic control systems, and rescue methods are required. In-space transfer opportunities are necessary, large markets need to be identified and must be

attainable. Fuel and propellants need to be available in orbit. Space systems for servicing, repair, construction, maintenance, assembly and in-space transportation need to be created, along with standard interfaces. Policies on governance, zoning, administration and security need to be agreed upon and implemented.

Consequently, of the New Space Industries mentioned, space tourism and entertainment has the best near term potential. Space tourists are like terrestrial tourists, except that they want to go to space to meet their travel needs. They want to experience micro-gravity, see the views, and do many of the things that they would do in the terrestrial environment, plus those that can only be done in the micro-gravity environment. Looking at this potential NSI from the business perspective, one cannot help but wonder if a market exists and what size that market might be.

In 1993 in Japan, and in 1995 in North America, a marketing study was carried out by the National Aerospace Laboratory (NAL) in Japan, under the guidance of Patrick Collins, R. Stockman and M. Maita. This study first examined the Japanese consumer market, then the North American consumer market which is the largest such market in the world. The focus was on the willingness to travel to space for a vacation. These are the most comprehensive studies to date and they tell us why space tourism is a compelling industry that is now being paid attention to by the tourism industry and others.

The study shows that all age groups have a strong desire to go to space with the interest tapering off as people get older. Most important, when the price per person approaches about $10,000 for a five day stay at a space hotel in Low Earth Orbit, including the ride up and back, the market will consist of approximately one million passengers per year. At $10,000 per passenger, this market will generate approximately $10 billion per year![10]

In case there is doubt that such a large space tourism market can exist, think about the already existing terrestrial space market. This is a market that functions daily around the world, especially in the United States, but also in other major countries. This market consists of those who visit space centers, go to launches, space museums, meetings and conferences, and buy space related items from toys to clothing. This market also includes the space related entertainment business, from Hollywood movies to video games and space related television programming. This market is estimated to annually represent well over ten million people spending in excess of one billion dollars per year![11]

There are many challenges and difficulties that must be overcome and resolved for space tourism to flourish. Perhaps the major one is getting the launch cost down to a reasonable level so the $10,000 per person ticket price can be realized. To do so, a new fleet of launch vehicles is needed. In all probability, the launch vehicle that will initially do the job is the Reusable Launch Vehicle (RLV). This may also be a Single Stage to Orbit (SSTO) vehicle or variation of the SSTO model. What are RLV's and why is space tourism so crucial to the RLV program?

Table 2 reflects the probable size of the launch industry for the next decade without space tourism, as estimated by Arianespace. To handle this capacity, Expendable Launch Vehicles (ELV's) can probably do the job and this presents an inherent conflict between the ELV and RLV manufacturers and markets. Note that the total launch industry is not expected to grow substantially from its current level of about $3 billion per year. For perspective, according to Fortune Magazine's 500 Largest U.S. Corporations for the year 1997 as reported in the April 27, 1998 issue, there were 472 U.S. corporations with annual revenues larger than the entire launch industry.[12] Long Island Lighting in Hicksville, NY has revenues approximating the annual revenues of the launch industry. General Motors, the largest company on the list, has annual revenues almost 57 times those of the launch industry.

Geostationary satellites	14-16
LEO	< 6
Space station	8
Earth observation	3
Science & technology	1
Total launch market	< 34

Table 2: Launch demand over next 10 years, in US$ billions (10). Courtesy of Patrick Collins

In looking at Table 3, we see a comparison of the two launch vehicles, the ELV and the RLV. In this particular table, the time period is only five years. If 50 launches a year are necessary to handle the capacity estimated in Table 2, 50 ELV's are required to do the job. When we look at RLV's, assuming a quick turn around time and acceptable reliability, one RLV can handle the 50 launches on its own! It is absurd to think that the R&D investment into RLV's will be made for the deployment of only one vehicle. No rational investor, financier, or business person would embark on that course. So for the RLV to become a reality, it needs a market that grows, that is very large, and that is sustainable. The only commercial space industry that has this market potential is space tourism.

Year	1	2	3	4	5
2 (a) Expendable Launch Vehicles					
Vehicles made	50	50	50	50	50
Launches	50	50	50	50	50
2 (b) Reusable Launch Vehicle: 50 flights/yr.					
Vehicles made	1	0	0	0	0
Flights	50	50	50	50	50
2 (c) Reusable Launch Vehicles: 50 flights/yr.					
Vehicles made	50	50	50	50	50
Vehicles operating	50	100	150	200	250
Flights	2500	5000	7500	10000	12500

Table 3: A comparison of expendable & reusable launch vehicles. Courtesy of Patrick Collins.

The industry is waking up to this fact and to the potential that this huge market represents. Many companies are talking about and designing space hotels for the space tourists. Recently Hilton International disclosed a plan for a hotel on the moon with a beach in an April 19, 1998 article in the London Sunday Times. In addition, over a dozen companies are working on RLV designs, including a team from Stanford University. To help spark the development of a successful RLV, the X-Prize Foundation is sponsoring a $10 million competition for the winning RLV design.

The Adventure Travel industry already knows this. Three adventure travel companies are now selling tickets for sub-orbital flights, ranging from $3500 per person to approximately $100,000 per person. None of the three companies have a vehicle to use, but all think that their vehicle will be available within five years. Of the three companies, only The Civilian Astronaut Corps (CAC) plans on using a traditional rocket, The Mayflower II, which is being designed by Advent Launch Company. Space Adventures, a specialized adventure travel company, plans on using multiple launchers, possibly the Pioneer Rocketplane and the Kelly Space Transportation vehicle. Zegrahm Space Voyages, also part of a large and experienced adventure travel company, has worked on developing its own craft which is similar to the X-15 and is called the Sky Lifter by Vela Technology Development, Inc. The CAC program is the least expensive while the other two companies are selling complete space tourism training packages with the ride for an estimated price of $100,000.

For the present, space tourism is in the domain of adventure travel. This will change however, as the size and power of this market comes to fruition. As the future RLV's make it both affordable and common place to go to space for a few days or weeks, the space tourism market will be identified less with adventure travel and more with the routine, high end tourism market. As the price for getting into space is reduced and a fleet of passenger carrying vehicles is realized, the commercialization of space will be well underway.

It is no longer in doubt that we will soon find ourselves with real opportunities for living, working, and playing in space. The groundwork is already being established. As public sector funding for space exploration and activities takes on new characteristics and becomes more scarce, the private sector is seen more and more as the savior for space activities. With the increasing involvement of the private sector, the development of New Space Industries, and passenger space planes, we will be able to extend our civilization out to the moon, Mars, and beyond. With this comes responsibilities. These responsibilities include the concern for the nature and quality of the business we export to space. It is important to note that not everything about business deserves to be exported from this planet, or to be used in seeding the future generations that will be working and operating in space.

These concerns are hardly new, but in the past they were more specifically directed towards social and political conditions instead of business practices and operations. In 1977, Paul L. Csonka, Director of The Institute of Theoretical Sciences at The University of Oregon, wrote about the social and political concerns of colonizing space in a paper titled Space Colonization - Yes, But Not Now. Later that year, he had a similar article published in the October 1977 issue of The Futurist and then his work was referenced in Hearings Before The Committee on Science and Technology of the U.S. House of Representatives, Jan. 24-26, 1978. His concerns stemmed from the G.K. O'Neill models for space colonization that were popular at the time. Now, twenty years later, we have the technology to live, work, and play off this planet. We have a private sector that can make the financial investment, thus doing more than just filling in the gaps from the once dominant public sector. It is relevant to ask what the character of our business environment in space will be and are our concerns warranted? Do we just go into space doing business as usual and what is meant by "business as usual" in 1998?

As a conservative businessman with twenty-five plus years experience, I've seen and experienced changes in our business environment which even I believe are cause for concern and

alarm. The greed and the lack of respect for customers, employees, and investors has become all too real and common in the business community of today.

To cite an example of a business that fuels my concern, I would like to use my son's medical insurance company. Since my son's birth 14 years ago and his Cystic Fibrosis diagnosis, my family has lived a nightmare with the medical insurance industry and the company that insures him. Delayed payments, rejected reimbursements, deferred reimbursements, rejected prescriptions, refused authorizations, intimidated health care professionals, and more. I've watched this company and industry evolve during the past 14 years and sometimes I'm certain that these business executives and industry leaders studied a different American history and different business school concepts than what I studied. Even with numerous complaint letters to the company CEO, the difficulties have been so numerous, so frustrating, and at times so painful that I can only wonder if we live on the same planet.

Seeing this company change classifications from non-profit to profit and reviewing the annual reports says it all. Growing executive salaries and benefit packages, statements showing increasing sales and profits, shareholder reports glorifying the success of the business and statements attempting to demonstrate the company's high regard and concern for the medical needs of its policy holders, are all there to make me believe in the course chartered by company management. I am a policy holder, however, and I deal with their policies and impact on a regular basis. I know the truth behind their success, their profits, and how they can continue to increase salaries and benefits as they do. I also know about their public relations efforts to portray the company as being genuinely concerned about its customers, the policy holders. Good, solid financial and business performance is important, but I question it when it is made at the expense of others, especially those in need.

Medical insurance companies are not the only companies in America that pursue greed and put success above the needs of their customers, employees, and investors as in the above example. I'm confident that virtually everyone if asked could provide their own horror story regarding an experience with a specific company or industry. Today's abuses are not just limited to companies. Our politicians, and our political, legal, economic and social systems all show signs of moving towards the dark side of human nature.

When we talk about commercializing space, about making profits and returning those profits to investors here on earth and maybe someday to investors living in space, are we talking

about the medical insurance model of corporate concern and behavior? Or are we talking about a different model, one perhaps we have not even thought or talked about yet.

There are different business models. Each of us can also tell stories about our positive experiences with individual businesses and industries. Our selection of model businesses and industries is not a black and white selection. Variations and shades of gray exist and may largely be subjective. Because of this, we will see the choices from many different perspectives.

Why even bring this issue up, especially since there are no answers at this time, only questions? I bring it up because I would honestly hate to think that our future space settlements on the moon and Mars are driven by the self-centered decision makers, and that their decisions will stem from the same source as those associated with the medical insurance company approach to business. I would hope that the foundation we build in these important and formative years of commercializing space does not mirror the greed, absence of morality and ethical behavior that is now so common in our business community and society.

Questions as to how to guard against this need to be asked, studied, and answered. In the coming years, we don't want to find that healthcare on the moon and Mars settlements is simply an extension of today's HMO's here on earth, do we? Are we to form respected international panels to screen the businesses that operate in space for their behavioral history and track record, along with their employees? Are there other methods to guard against exporting our darker side to space? In the recent hit movie Contact, there was an esteemed international panel which was to select the "right" person to travel in the machine to Vega. In the Contact model, a belief in God was the key for traveling to Vega. What will be our key for taking our businesses to space?

One thing is for sure. Our future generations will be working, living, and playing in space, on the moon, Mars, and beyond. The initial space residents and pioneers will be from earth, but as future generations are born in space and expand outward, their own identity will evolve over time. What springs forth from the seeds that we plant is something that I believe we should all be concerned with today. By addressing these concerns now, we can make sure that when we get going in space, we get going in a way that represents the best we business men and women have to offer.

NOTES

1. Goldman, Nathan C., American Space Law: International and Domestic, 2nd.edition, p.193, Univelt, Inc., San Diego, CA. 1996.

2. Ibid 194.

3. Ibid, p. 195.

4. Reynolds, Glen H. & Merges, Robert P., Outer Space: Problems of Law and Policy, 2nd. edition, p.280, Westview Press, A division of Harper/Collins Publishers, Boulder, CO., 1997.

5. Kay, W.D., Can Democracies Fly in Space?, p.172, Praeger Publishers, Westport, CT., 1995.

6. Goldman, Nathan C., American Space Law: International and Domestic, 2nd edition, p. 209, Univelt, Inc., San Diego, CA 1996.

7. Kay, W.D., Can Democracies Fly in Space?, p. 172, Praeger Publishers, Westport, CT., 1995.

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9. Matula, Thomas, The Potential Role Of A Space Development Bank In Accelerating The Commercial Development of Space, The Space Studies Institute, Inc., 1997.

10. Collins, Patrick, Stockmans, R., Maita, M., Demand for Space Tourism in America and Japan, and its Implications for Future Space Activities, a market research project sponsored by the National Aerospace Laboratory, Japan, 1995.

11. Rogers, Tom, Director, Space Transportation Association, quote from remarks made in Albuquerque, NM, April 1998.

12. Fortune Magazine, "The Fortune 500 For 1998," p.211, April 27,. 1998, published by Time-Life Publishers.[13]

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