

## COVERING THE INCREASED LIABILITY OF NEW LAUNCH MARKETS

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### ABSTRACT

The next generation space race prize is the integration of space dependent technology reliably in modern society. This paper is offered as an examination of an expanding diverse space launch industry as well as the necessity for increased capacity of resources in the underwriting space. Consumers are already space application dependent. There are 1 billion GPS receivers already deployed and expected to grow to 7 billion by 2022. As an example, satellites transformed 800 analogue channels in 1991 to more than 25,000 digital channels today. Without GPS, money isn't accessible from an ATM. Space plays a greater role in day-to-day life and liability coverage will become more important. If a satellite fails for example, businesses relying on satellite services to function may want to claim for lost income or expenses incurred. Growth of space business has been characterized by a shift away from military and the public over to the private sector. Space activity was largely funded through government bodies such as NASA, the European Space Agency or the Japanese Space Agency. With recent estimates by the Satellite Industry Association placing cumulative satellite industry revenues at over \$195.2 billion, a number of private companies are successfully entering the space industry and space application world. Governments and space agencies, which were ordering and building space hardware themselves, are now shifting towards buying services from private companies. Additional operators are close to adding to the number of launch providers which again, will mean new opportunities and underwriting challenges.

### INTRODUCTION

In 1750 BC, the Babylonians developed a system for merchant sailing ships that history records in the Code of Hammurabi. If a merchant received a loan to fund his shipment, he would pay the lender an additional sum in exchange for the lenders guarantee to cancel the loan if the shipment was stolen or lost at sea. Fast forward from the Babylonians to the formation of Lloyds of London in 1688. From insuring ocean cargo shipments to the first airplanes and automobiles, investors throughout history have been there with their check book in hand. Many far-sighted thinkers have played an integral part in the space insurance market place. For nearly forty years, government launch vehicles and orbital systems were self-insured, or tax-payer insured. The advent of privatization and commercial launch has created new markets as well as new liabilities. Certain aspects of these new ventures create "excess and contingent" liabilities for a variety of participants involved. These liabilities can be joint and several when the lines of possible fault or error become blurred. The future of space exploration will be facilitated by creative financing of future risks. After all is said and done, insurance is just another form of financing. Financing future failures successfully and economically facilitates success in space. Controlling costs of such reverse financing methods is the goal.

### PERCEIVED PROBLEM

The commercial launch industry is evolving. The purpose of this paper is to examine the recent history of and the current space related insurance markets, identifying the challenges and opportunities and to explain what factors can cause insurance market changes. It attempts to illustrate why this market moves over time in order to better predict the future outlook for space insurance.

## **OVERVIEW OF SPACE INSURANCE**

Insurance is the transference of risk to another party for a fee. The insurance market for the commercial space transportation industry is a global one, with satellite owners, satellite manufacturers, launch services providers, insurance brokers, underwriters, financial institutions, reinsurers, and government agents worldwide cooperating in order to coordinate an insurance package for any given commercial satellite launch.

### ***Space Related Insurance Categories***

Within the space insurance market, many different types of coverage are available. Some of the key ones are noted here:

- Pre-launch insurance covers damage to a satellite or launch vehicle during the construction, transportation, and processing phases prior to launch.
- Launch insurance covers losses of a satellite occurring during the launch phase of a project. It insures against complete launch failures as well as the failure of a launch vehicle to place a satellite in the proper orbit.
- In-orbit policies insure satellites for in-orbit technical problems and damages once a satellite has been placed by a launch vehicle in its proper orbit.

Third-party liability and government property insurances protect launch service providers and their customers in the event of public injury or government property damage, respectively, caused by launch or mission failure. In the United States, Federal Aviation Administration regulations require that commercial launch licensees carry insurance to cover third-party and government property damage claims that might result from launch activity. In the United States, these insurances are obtained from a different pool with separate licensee financial responsibility requirements, liabilities, and a U.S. liability risk-sharing regime.

Re-launch guarantees are a form of launch insurance in which a launch company acts as an insurance provider to its customers. When a launch fails and a customer has agreed to accept a re-launch in lieu of a cash payment, the launch services provider re-launches a customer's replacement payload. The launch services provider often will protect itself by purchasing insurance for a series of launches, thus spreading risk over a number of events and receiving better rates than could be obtained for a single launch event.

## **SPACE RELATED INSURANCE FINANCE**

Space related insurance is usually a small, specialty line of insurance business within a larger multinational entity. Some of these umbrella companies are headquartered in tax haven environments (like Bermuda and the Cayman Islands) and offer various specialty insurance, reinsurance, and financial services to a variety of international clients. Most of these umbrella insurance companies are publicly traded. Insurance conglomerates typically have large premium bases to protect themselves in the extremely volatile insurance market.

Commercial Space and Launch Insurance underwriters invest premium income and can return high profits on their investments, especially when located in favorable tax environments. After negotiating a space insurance policy, many underwriters also seek additional financial backing. Reinsurers and financial institutions can buy participation in any insurance package from an underwriter. Generally, reinsurers and financiers take on the same risks as underwriters and are similarly affected by mission successes and losses. The participation of these additional financial backers allows underwriters to spread risk throughout many layers of the insurance industry. Reinsurers do not analyze any technical information, but instead depend on underwriters' evaluations of risk to determine their level of involvement.

### UNDERWRITING PROCESS

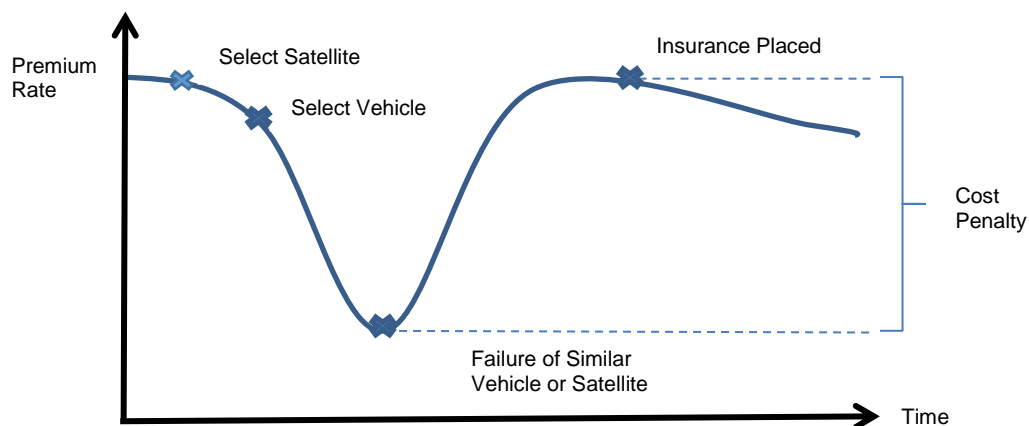
The process of insuring a satellite is a complex one. Typically for a given launch project, either the satellite owner or manufacturer begins by choosing an insurance broker. This broker becomes the primary agent responsible for transmitting information between the insured party and the underwriters. The underwriting process for a project begins when the broker presents technical reports and contractual and financial information to a number of international underwriters. In order to decide what kind of coverage they can offer, the various underwriters conduct in-depth technical analyses of the satellite and the launch vehicle. The respective reliabilities of the launch vehicle variant, satellite model, and the satellite's intended orbit are evaluated. Details such as launch site location, contract specifics, and satellite finance and value are also taken into account. When the various evaluations are complete, potential underwriters present the broker with bids containing information regarding capacity, premiums, and terms and conditions that they feel that they can offer the insurance client.

#### **Capacity**

Capacity for a single satellite launch equals the entire amount of coverage that insurance companies are willing to underwrite for the project. Total yearly space market capacity is the theoretical amount of coverage available for all commercial space activities in a given year. Available capacity shrank for the first decade of the twenty first century but the near term has evolved into a buyer's market. New launch providers have entered the market and stated capacity for the entire space insurance industry stands at approximately \$1 billion.

#### **Premiums**

Premiums are payments for an insurance policy made by the insured to the insurer. Premium prices are usually determined as a rate, or percentage of the total value of the policy. An insurer's revenues for a given project are determined by premiums received for that project, minus claims paid out. Premiums for both launch and in-orbit coverage have been rising steadily.



Note that there exists an inverse relationship between capacity and premiums. When economic conditions are generally favorable, insurance companies experience good financial results and are able to offer high capacity and low rates. Alternatively, when insurance companies experience poor financial results, capacity drops and premiums rise.

### **TECHNICAL AND UNDERWRITING REQUIREMENTS**

In addition to considerations of premiums and capacity, insurance customers in 2015 must deal with tighter underwriting and technical scrutiny. Technical examinations of vehicles and technology are more rigorous, and requirements are stricter. Exclusions for losses resulting from terrorism and generic defects in a particular model of satellite are now common in policies. New disclosure requirements and higher deductibles are implemented to ensure that clients do everything possible to reduce risk.

#### ***Coverage Periods***

In recent years, the coverage periods available to satellite insurance customers have been decreasing. The type of contract called "Launchplus" insures a satellite against damage occurring during launch plus a period of time following launch. Launch-plus five contracts for example have been available throughout the industry. Hard or soft markets as well as the incidence of launch and on-orbit losses impact the availability of launch-plus coverage periods.

### **CAUSES OF SPACE INSURANCE MARKETS**

Insurance cycles, general economic conditions, launch and in-orbit losses, and commercial space industry changes all combine to increase or decrease profitability for insurers and their willingness to assume risk.

#### ***Insurance Cycles***

Most insurance markets behave in a cyclical nature over time. At the start of a typical insurance cycle, insurers lower premiums charged in order to compete for business. The insurance industry experiences a "soft," or buyers', market as customers are able to shop around for the best premiums and coverage. The cycle turns when insurance profits begin to fall. The insurance market then enters a period of capacity shortage as firms retain earnings in order to cover current claims. Firms also begin to raise prices in order to increase revenues. The industry then enters a "hard" market, in which insurance buyers must accept limited coverage and high premiums. It is generally believed that a number of factors influence the insurance cycle. Interest rates (which affect insurance company premium and investment income) and time lags in information used to set pricing both contribute to the cyclical nature of the industry. More importantly, insurance markets are believed to be "capacity-constrained." In the capacity constraint model of insurance cycles, changes to supply and demand of capital cause changes in capacity. Insurance companies report lower capacity as the cost of raising external capital becomes higher than that of retaining earnings. One factor that can trigger this capacity crunch is an economic exogenous shock due to an unexpected loss.

Payment of claims resulting from such a loss reduces capital available to insurance companies. Revenues for that financial period fall, and internally generated capital becomes more attractive to insurance companies than capital from external sources. The pool of capital available to insurance companies shrinks, and these insurers are able to offer less capacity to insurance clients in the following financial period. As a result of the decreased amount of capacity, the need to raise internally generated revenue, and the falling revenues in the previous period, insurers must increase the prices on their policies. After a period of high prices and retained earnings, insurance profits begin to rise, and insurers are able to offer higher capacity. With more capacity available on the market for launches, insurance companies begin to lower their rates in order to compete for business. These trends continue until another shock to capital supply or demand occurs. The insurance cycle is easily visible in the space insurance market. A variety of factors make the market very volatile. The space market is a unique insurance market; it involves a relatively small number of underwriters and expensive catastrophic coverage. Technical requirements are necessarily very strict. Reliability is a crucial underwriting determinant but is also difficult to

gauge accurately with such a small number of annual commercial launches. Since a majority of the premiums paid on a policy applies to the launch portion of the coverage period, and since an accident at launch can result in

Instantaneous total mission failure, large amounts of money are either made or lost in the first half hour of any mission.

A historical perspective helps to illustrate modern insurance cycles. In the mid-1980s, a string of launch failures dramatically reduced industry capacity. As a result, premiums rose, and technical requirements became more strict. The 1990's saw an expansion in number of launches and available capacity. With the increasing profitability of the insurance industry and the entry of new capital, soft market conditions returned. After a slight decline mid-decade, the space insurance market again softened in the late 1990's with launch-plus-one premiums as low as seven percent and total market capacity soaring to levels well above \$1 billion. Since that time, the market has changed a few times. In response to a variety of causes, cyclical market forces have contributed to the market downturn observable in 2002. In the months prior to September 11, commercial insurance markets were hardening as insurance companies experienced poor financial results following the low pricing of prior periods. By mid-August 2001, insurance companies began raising prices. The devastation resulting from the events of September 11 cost an already hardening market \$40-\$70 billion. Available funds were tapped to pay these claims and perceptions of risk changed. The ensuing capacity crunch particularly hurt space insurance, which shared a common capital pool with aviation. In addition to the strain resulting from insurance cycle and general market conditions and September 11 repercussions, the space insurance market felt pressure from many commercial launch industry-related changes.

#### ***Number of Launches***

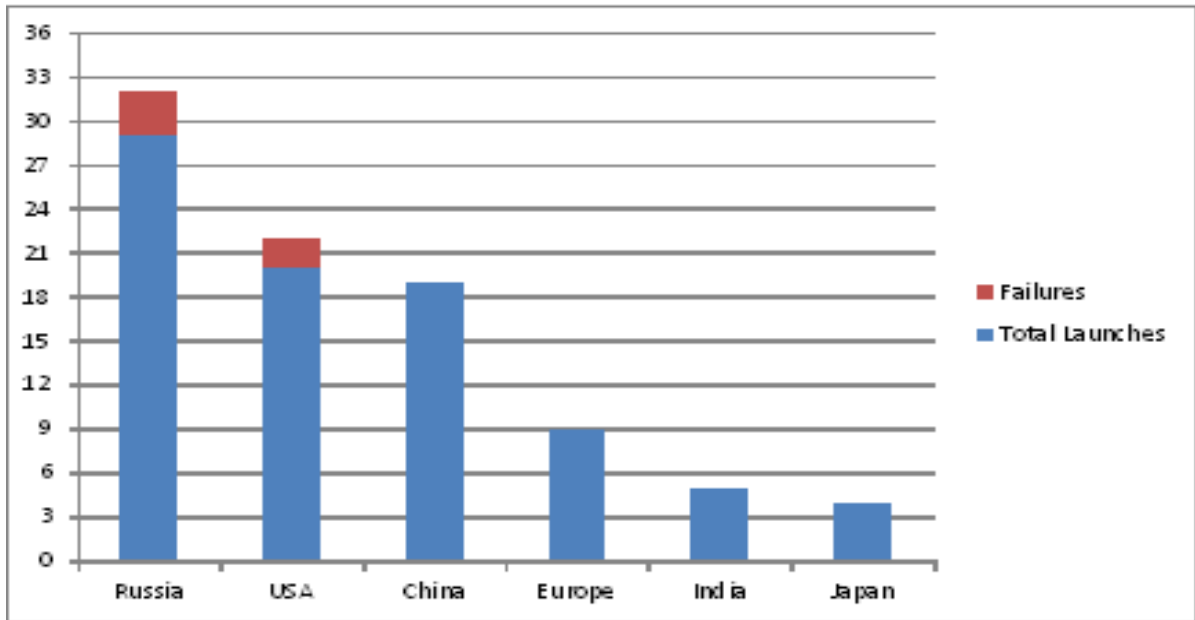
The annual number of insured commercial launches has increased. This general increase of launch activity drastically improves the amount of premium income available to insurers and causes capacity offered to insurance customers to rise and premium rates paid by policyholders to decline.

#### ***Claims/Losses and Reliability***

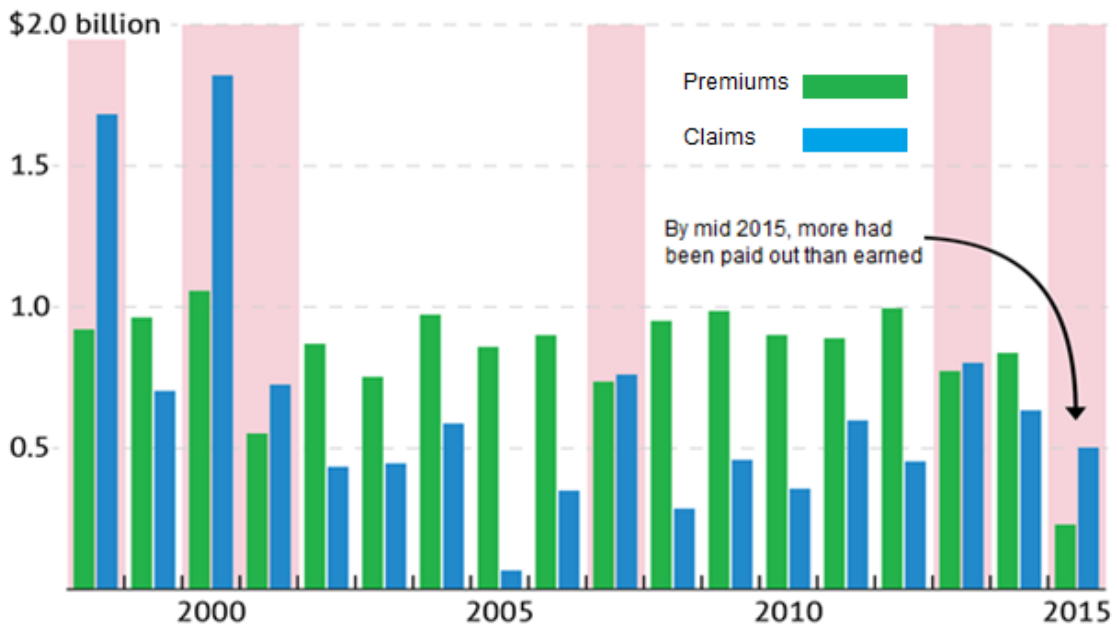
As previously mentioned, launch vehicle and satellite reliability are important rate determinants for underwriters. Ordinarily, an increase in launches will improve establishing reliability. However, increasing the number of new launch providers also increases the variables and difficulty of the process. A launch vehicle or satellite failure is costly to all involved parties. For example, the manufacturer of a failed vehicle and its current and future contracted clients face additional insurance difficulties as a result of the associated decline in reliability of the failed launch vehicle. As perceived reliability decreases, available coverage drops and premiums rise. Anomalies dramatically affect capacity and premiums for all those seeking space insurance.

A \$300 million Mexican communications satellite was lost over Siberia and several weeks later, a SpaceX rocket was destroyed two minutes into flight from Cape Canaveral. One hundred and ten million dollars-worth of NASA's supplies for the International Space Station were a complete and total loss. With enormous amounts of money necessary to get things into space, most launches, especially those putting commercial satellites into orbit, are covered by space insurance policies to prevent catastrophic financial losses. Approximately 1-in-20 launches will fail but that statistic can change during selectively defined intervals.

## 2015 Successes and Failures



Considering a market where approximately \$750 million in premiums covers an average of 50 insured launches, only a couple of unfortunate accidents has the ability to wreak havoc. The rocket business can be as volatile as the fuels that power its engines. Accidents are surprisingly rare but the losses however are for the most part catastrophic. It is this catastrophic enormous potential loss nature, combined with too few launches each year that can make the science of actuary math significantly more difficult than other types of insurance. It only takes a couple of unfortunate events to cause the rate of failure to swing drastically.



Space insurance is also uncorrelated with other types of insurance, so even if a hurricane wipes out hundreds of seaside homes all at once, the space insurance market remains serenely independent. The huge premium payments are also attractive to companies. Uniquely, the immediate loss or gain nature of a launch is attractive to investors. Space insurance operates within a vacuum and unrelated to the rest of an insurance company's book of business.

### **ITAR**

In evaluating risks, many non-U.S. space insurance underwriters face obstacles in the form of International Traffic in Arms Regulations (ITAR). When a client or broker is unable to obtain a license from the United States State Department to share a launch vehicle or satellite's technical details with non-U.S. underwriters, international insurers are forced to either decline the risk or else to offer policies based on insubstantial technical information. In the instance that international insurers are unable to participate in underwriting a particular risk, capacity available for the vehicle in question is reduced.

### **TRENDS AND OUTLOOK**

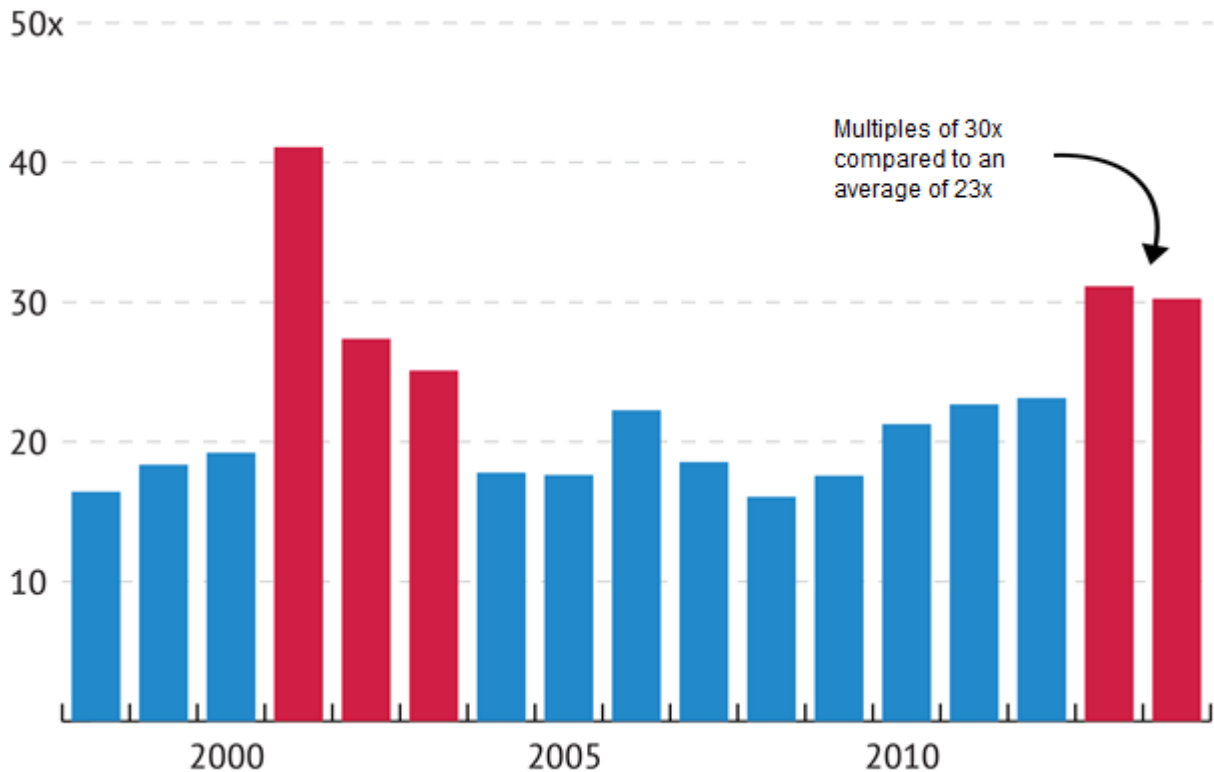
As is the case of all commoditized markets, space related insurance markets can be labelled as buyer's market, soft market, hardened market, seller's market etc. The current and future insurance markets must accommodate new technologies entering the marketplace. In the past, new technologies have been subject to intense scrutiny from underwriters. Establishing reliability is an uphill battle that all launch vehicles must initially face, and usually three to four successful launches are required in order for a vehicle to be considered commercially insurable at reasonable terms.

In addition to large coverage costs arising from their relatively unproven technologies, these vehicles will also need more high-priced insurance because they will be carrying larger, more valuable payloads. This next generation of heavy-lift launch vehicles is capable of carrying more than one payload, making the potential cost to insurers of a launch failure even greater. Launch vehicle manufacturers are able to adopt different approaches to deal with the current market conditions. Re-launch guarantees for instance can be a way for launch services providers with vehicles that are expensive to insure, to reduce insurance costs.

Certain launch providers have operated as self-insure when insurance market offerings are insufficient. Satellite operators may also be considering self-insurance. In-orbit backup rather than securing insurance has been explored after estimating that the cost of all insurance expenses for one satellite launch could just as easily pay for a second launch of an equivalent backup.

Insurance coverage rates were approximately twenty percent in the 1990's. The new space race and rejuvenated interest in all things space related has helped to increase coverage capacity and driven rates down to as low as six percent recently. This phenomenon has left underwriters and customers scratching their heads even as cumulative premiums collected have been only fifty percent for total claims. It is not universally profitable and that has the capability of changing enthusiasm.

When a Russian Proton rocket and SpaceX's Falcon rocket were grounded during 2015 while failures were investigated, underwriters, investors, the launch providers and their customers were eager for launches to resume with the potential of offsetting losses. Rates are not likely to readjust. Claims don't affect rates immediately because policy rates are contracted for a couple of years in advance. Unlike years past, rate increases may be isolated to the specific offending vehicles only.



Undeniably, programs need insurance to offset risk and rocket science is inexact. Rockets have evolved since the 1940's, and while the technology and safety has drastically improved the nature of these high energy systems is volatile. They are still a controlled explosion seeking the weakest structural point in the canister through which to escape. Accidents will happen but global investment capital continues to seek value in returns and prices likely will remain low.

### Conclusion

The satellite insurance market (for launch and in-orbit risks) has seen more than a decade of positive results, which has attracted significant market capacity and driven down premium rates each year. There is, however, substantial differentiation between launch risks, with the best performing launch vehicles attracting rates that are roughly a third of those applied to launch vehicles with recent performance issues. For in-orbit risks, one-year policies are at historical lows, with standard GEO satellites now attracting premium rates in the region of 0.5% or less.

The space insurance market has been profitable over the long-term, but recent margins have become increasingly thin. This competitive space insurance market requires even more diligent underwriting standards. New applications and technologies, emerging risks, and increasing hazards in the space and ground environments are stressing satellite operators, manufacturers, launch providers, space ports, end-users and the insurers that the risks are transferred to.

Covering the new and increased liabilities of expansion in the commercial launch and orbital future will require creative bold concepts in the centuries old methods of the insurance business. Explorations of what was considered "space daydreams" such as space tourism or mining for rare resources like helium 3 will require new questions to be answered and new policy languages to be invented. For instance: Does your Life Insurance Policy coverage follow you into space? Horizontal Launch Vehicles as well as Re-usable Launch Vehicles present



increased liability exposures to ground based interests and people. Nano Satellites and increased "Space Junk" become a risky hazard as well as a liability for those who put the asset in orbit.

Excess liability limits of coverage that reach far above the F.A.A. required coverage of \$100 million are hard to underwrite with the increasing values of one single satellite approaching half of a billion dollars. While it is the collective goals of all involved in the new space race to economically finance the future successes in space, it is the collective goals of all insurers which are underwriting these endeavors to finance the anomalies and the failures. We must finance these future failures economically in order to support the future successes.

Good results in the space business sometimes come from experience. . .  
Experience in the space business sometimes comes from bad results.

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