

***CENTER FOR SPACE
POLICY AND STRATEGY***



NOVEMBER 2019

END OF AN ERA? SATELLITE INSURANCE FACES CHANGING LANDSCAPE

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Summary

The insurance industry plays a pivotal role in enabling innovation, growth, and investment throughout the space enterprise. Without insurance, many smaller companies, and especially startups, would not be able to absorb the risk of doing business because the stakes can be very high—a single failed launch can result in payload losses of hundreds of millions of dollars. As military and civil space customers become increasingly reliant upon such companies, they must understand the commercial sector’s ability to sustain failures while maintaining solvency and operations. Although the government does not buy insurance for its own satellite launches (as the government turns to the private sector for launch and satellite services), it is important for government stakeholders to maintain heightened awareness of key drivers and issues facing the satellite insurance market.

Because of rapid changes across the space enterprise—new entrants, higher launch rates, new types and architectures of satellite constellations, and increasing on-orbit hazards, among other factors—the space insurance industry may be on the threshold of major changes that could affect the customer base, insurance suppliers, and insurance premiums. Here, we identify and examine emerging trends in both the space industry and the global economy that could contribute to these changes, focusing on insurance for satellites—not for launch vehicles.

State of the Industry

The role of an insurance company is to provide protection against the risk of financial loss. It could be the risk of a person dying (life insurance); a car accident (auto insurance, a form of property and casualty coverage); or, in the case of satellite insurance, the risk that a satellite will not perform the task it is built to do, which could happen because of a variety of circumstances (such as failure of the launch vehicle, failure to reach a proper orbit, or operational failure of the satellite itself). Satellite insurance falls within the broader property and casualty insurance market. While often bundled

within the same policy, property insurance covers losses by the insured (such as damage to one’s car in an accident), while casualty insurance covers losses for which the insured is liable (the damage one causes to another’s property). Types of satellite coverage are listed in Table 1.

While satellite insurance poses many unique challenges from an underwriting perspective, the core principles of risk management remain the same. Through an insurance contract, the satellite operator lessens the possibility of a catastrophic

Table 1: Types of Coverage for Satellites
 Insurers offer policies covering the satellite from manufacturing through launch and orbit.¹

Pre-Launch	Third-Party Liability	Launch	On-Orbit
		Launch Plus One Year	
Covers damage to the satellite or launch vehicle during manufacturing, transportation, assembly, and processing phases prior to launch	Protects satellite operators from claims from third parties for injury or property damages arising during the pre-launch, launch, or on-orbit phases	Covers loss, damage, or failure of the satellite between intentional ignition of the rocket and separation of the satellite from the launch vehicle	Covers complete or partial failure of the satellite during its operational lifetime after separation from the launch vehicle and is usually renewable annually

financial loss by transferring this possible cost to an insurance company in exchange for a smaller, known fee—the premium.¹ The insurer profits from this exchange so long as the premiums collected from the many who pay and the invested returns on those premiums outweigh claims incurred by the few who have losses plus the costs of operating.

Without the availability of insurance, private industry would likely have less incentive to push boundaries in space technology. However, the price of coverage can significantly affect a company’s bottom line: insurance often represents the third-highest cost for satellite operators after the cost of the satellite and the launch vehicle, making it a substantial component of a program’s capital expenditure.¹⁰

The most common form of satellite insurance covers launch through the first year on orbit.³ This policy, often referred to as *launch plus one*, covers the riskiest phase of a program when both the launch vehicle and the satellite are put to the ultimate test.

The Satellite Insurance Process

To acquire insurance, a satellite operator hires a specialized space insurance broker who acts as a liaison between the operator and the insurers. The broker sets up a request for bids with up to 40 insurers worldwide and outlines the coverage

needs for the given program. Two years to six months before the launch of large geosynchronous satellites, underwriters perform a detailed assessment of technical specifications of the satellite and launch vehicle, the mission plan, and all financial and contractual obligations associated with the program.³ The satellite operator often participates in a question-and-answer session with potential underwriters as part of this review. Insurers then submit bids with coverage, premium rates, and terms to the broker, who puts together the final insurance package in which many insurers cover a share of the total policy (a structure known as a syndicate). This time frame has been shortening as part of a trend for satellite operators to develop and launch smaller satellites faster than in the past.¹⁴

Considerations for Satellite Insurance Premiums

When underwriting space operations, insurers must consider a multitude of factors, which include technical and nontechnical aspects of the individual program in question, as well as the broader space industry and insurance market.⁸ All considerations listed in Table 2 have either a direct or indirect effect on premium rates for a given launch. Internal considerations relating to a specific space program seeking insurance would directly affect the given program’s premium. External considerations

Table 2: Satellite Insurance Premium Considerations
 Factors affecting premiums can be internal to the mission or external in the broader market and can be both technical and nontechnical.^{3,10}

	Technical	Nontechnical
Internal considerations	<ul style="list-style-type: none"> ◆ Mission requirements and concept of operations <ul style="list-style-type: none"> ▪ Operating environment (orbit) ▪ System architecture, subsystem design, and redundancy systems ◆ Experience of the operator, manufacturer, and launch provider ◆ Anomaly resolution process in place 	<ul style="list-style-type: none"> ◆ Contractual considerations <ul style="list-style-type: none"> ▪ Spacecraft purchase and launch services agreements ▪ Performance specifications ◆ Financial considerations <ul style="list-style-type: none"> ▪ Business plan ▪ Exposure analysis ▪ Asset valuation ▪ Loss calculation, policy terms, and conditions
External considerations	<ul style="list-style-type: none"> ◆ New commercial entrants <ul style="list-style-type: none"> ▪ Less experienced satellite operators and launch service providers with new development philosophies ◆ New technology <ul style="list-style-type: none"> ▪ Electric propulsion ▪ Phased-array antennas ▪ Onboard processing ▪ Optical intersatellite links ◆ New architectures <ul style="list-style-type: none"> ▪ Larger constellations of smaller, less expensive satellites 	<ul style="list-style-type: none"> ◆ Insurance market considerations <ul style="list-style-type: none"> ▪ Quantification of potential loss scenarios ▪ Perceived risks and recovery bias ▪ Frequency vs. severity of losses ▪ External events that could drain insurance capital: natural disasters, and terrorism ▪ Political policies and environment ◆ Macroeconomic considerations <ul style="list-style-type: none"> ▪ Global interest rate environment

relating to the broader space market, insurance industry, and economic climate affect capacity (the supply of insurance coverage available), which in turn affects premiums.

Analysis

A Specialized Market

While the general constructs of insurance apply to space, the circumstances of satellite and launch activities create a highly specialized market. Compared with other lines of insurance for high volume consumer markets such as health or auto,

space has a comparatively miniscule amount of data for insurers to evaluate when determining premiums.¹² While auto insurers can access hundreds of thousands of vehicle records on a single car model, space insurers often have a sample size of only several dozen or fewer for a particular rocket or satellite model. In addition, the rapid evolution of launch vehicles and satellites has created a large variance in the historical data: the newer launch vehicles and satellites cannot be easily compared with older rockets and spacecraft. This evolution also challenges underwriters from a technical

perspective, as new, largely untested technologies often pose a higher risk than tried-and-true technologies. As a market, space insurance experiences infrequent but high losses from claims.

Despite these challenges, the market offers advantages uncommon to other lines of insurance. For instance, space offers a short tail—insurers generally know if they will have to pay claims in a matter of minutes during launch and after a year once the satellite reaches orbit. In addition, space risks rarely correlate with other earth-bound risks; insurance companies would face significant correlated losses if damage from a major natural disaster were to trigger claims in multiple lines such as health, auto, and property, but their space lines would remain relatively unaffected. As an uncorrelated risk, space represents a favorable business line for insurers seeking to diversify their portfolios.⁸

Supply and Demand

In a syndicated insurance market, insurance premium rates vary inversely with the underwriter’s capacity—the supply of coverage that insurers are willing and able to provide. When capacity is high, rates are low, and vice versa. Factors that affect capacity for the space industry include general insurance cycles, macroeconomic trends, launch and satellite failures, and changes in the commercial space industry.

Currently, the theoretical capacity—the total supply of insurance coverage available for a given launch—hovers around \$750 million per risk.⁸ Most launches only need from approximately \$100 million to \$150 million of coverage per risk. In 2018, roughly two-thirds of launched satellites globally carried some form of insurance—a ten-year high for the market.

Over the past two decades, space insurance has become a buyer’s market. *Launch plus one* rates for a risk perceived as mature have decreased from

20 percent of the amount insured in 2003 to 2–3 percent in 2019 as the market has become increasingly competitive for insurers. While aggregate premiums collected have generally outweighed annual losses since the early 2000s, the difference between premiums collected and maximum exposure (the value of the single largest policy for that year) has decreased over time. Since 2016, total premiums collected annually could not have covered claims on the largest policies in any of those years, opening up insurers to potentially

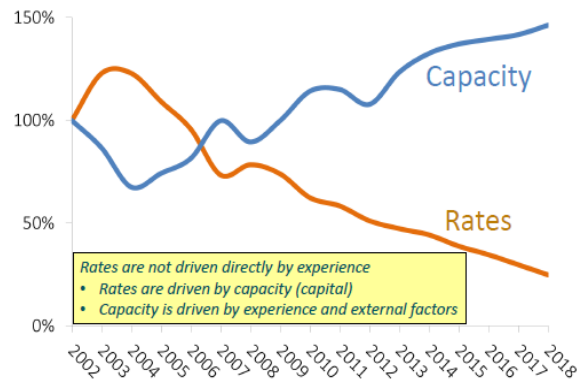


Figure 1: Change in Capacity and Rates Since 2002. As rates decrease, capacity has historically increased. (Source: Kunstadter, Christopher. “Space Insurance Update 2019,” International Union of Aerospace Insurers)

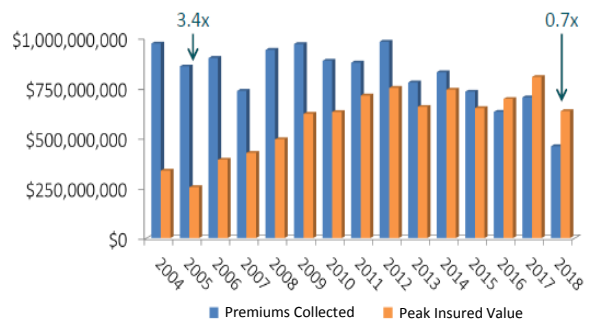


Figure 2: Aggregate Premiums Collected vs. Maximum Exposure. The gap between peak insured value and market premiums has narrowed since 2004, and premiums have not been sufficient to cover the peak insured value since 2016. (Source: Kunstadter, Christopher. “Space Insurance Update 2019,” International Union of Aerospace Insurers)

substantial losses had these large claims occurred. This development represents a turning point in the stability of the industry. This is an issue for low-frequency/high-risk lines of business such as satellite insurance. Conversely, the largest claim during a given year in auto or health insurance is nowhere close to the total premiums collected by the entire industry.

With limited data on evolving satellite technology, insurers must still assess risks and make informed underwriting determinations. If the worst happens and insurers must pay out a peak insured value, a negative-supply shock could occur, and premiums could increase across the insurance market.

A space insurance executive emphasized the need for and approach to data in the twenty-first century: “Given the changing technology environment, space underwriters create customized databases of satellite and launch vehicle heritage. Space underwriters also strive to supplement their data with external actuarial databases and more visits to manufacturing sites and testing facilities. They rely on extensive databases to give them the tools they need to respond to the fast-moving space technology environment of the twenty-first century.”⁹

Higher premiums could hurt satellite operators’ bottom lines, and a significant rate increase would be an incentive for some operators to self-insure, especially as satellites become smaller, cheaper, and more expendable. A move to self-insurance has been seen in other industry sectors, especially health insurance at companies with a large employee base.

An individual company cannot spread its risk over many potential claims, as is the case for health insurance at a large company with thousands of employees. However, a single company could set up a reserve fund to cover potential satellite losses. In this case, a company that opts for self-insurance remains entirely financially exposed to future failures.

Emerging Issues in Space Insurance

New Entrants

The increased participation of private companies in satellite and launch operations—a domain once reserved for governments—represents a paradigm shift in space activity. NASA’s commercial cargo program and other federal contracts have helped fuel the growth of the commercial launch sector, which has also attracted significant venture capital backing.⁴ Heavy competition in both satellite operations and launch services over the past two decades has led to innovation in space technology and a lower cost of entry into orbit, especially with the advent of small satellites. A company seeking to create and launch a satellite into orbit can do so faster and for less than ever before.

While these developments represent breakthroughs for an industry that has traditionally embraced the status quo, the increasing number of less-experienced operators and untested technologies poses new challenges for insurers. Including tests, new launch vehicles fail 25 percent of the time on each of their first and second launches.⁸ In the midst of the current launch industry transition, new domestic and international rockets such as ULA’s Vulcan, SpaceX’s Starship, and China’s Smart Dragon series are poised to supplant older systems like the Atlas and Delta families. A few large losses during this transition period could drive some insurers out the market and push up premiums due to the lowered market capacity.

Smaller satellites have fewer redundancy systems, increasing the risk of on-orbit failure during the first year. Electric propulsion systems can raise a satellite into orbit with a fraction of the propellant of chemical systems but do so at a slower rate, lengthening the historically high-risk period in the early life of a satellite.⁸ New architectures involving large constellations of small satellites create more complexity in mission planning and operations. And while mass production of satellites could increase

reliability through better quality control processes, large constellations could still be vulnerable to multiple correlated failures due to faulty components.

Although these industry developments pose new risks, they also represent a long-term industry trend toward cost-effectiveness, efficiency, and resilience that is unlikely to reverse as competition increases. If these new technologies reduce the potential financial losses of launch vehicle or satellite failure, some operators—especially legacy companies with large capital reserves—would likely have less incentive to purchase insurance. They would in effect become self-insured. However, smaller startups entering the space market could still benefit from the safety net of insurance coverage, particularly if a small number of satellites represents a large part of a company's total assets. This dynamic would shift the costs of insurance disproportionately to smaller companies, instead of a cost distribution model shared by both space startups and larger legacy firms.

Changes in the Interest-Rate Environment

Space activity and the insurance industry that supports it have been inexorably tied to global economic trends, including the interest-rate environment. Insurance companies act as institutional investors, generating more revenue by investing premiums in bonds, equities, and other assets. This strategy allows insurers to profit despite breaking even or experiencing a limited amount of loss on premiums. Between 2007 and 2017, the overall property and casualty insurance industry generated almost \$440 billion in net income despite a net loss of nearly \$60 billion in underwriting (the difference between premiums collected and claims paid).⁷

As real interest rates (which take inflation into account) have fallen to historic lows over the past 20 years¹¹, firms have been seeking higher-yield opportunities in markets like satellite insurance,

which experienced relatively few claims between 2002 and 2017.¹⁰ On top of high cash flow during this time, the satellite business had a short tail and did not correlate with other risks, as previously discussed. These factors positioned the business as an ideal money-making opportunity as bond yields declined. As a result, a large influx of new underwriters entered the market and incumbent insurers increased their allocation to the sector.

With an increasing amount of capital competing to provide syndicated coverage for a limited number of insurance events (around 30 each year⁸), premiums decreased due to heightened competition and higher underwriters' capacity. This development has been highly favorable for commercial space, as lower premium rates and greater availability of coverage have enabled a historically risk-averse industry to innovate and push new technological boundaries. However, this influx of new underwriters also lowers profit margins, making underwriters more sensitive to satellite or launch failures. In fact, a trend toward reduced capacity may already be in progress. Swiss Re, the world's second largest reinsurance company, announced it would exit the launch and satellite market following a July 10 launch failure of the Vega launch vehicle estimated to have been insured for more than \$400 million.⁶

Risk of External Shocks

While space activities do not strongly correlate with other insured risks, space insurance capacity does not exist in a vacuum. Some of the largest insurance providers in the world cover launches and satellites but often have the majority of their risk exposure in mass market insurance lines such as health, life, and casualty. Theoretically, should these companies become more intensely involved with their other lines of insurance due to more severe natural disasters, for example, they could decide that the satellite insurance business is not worth the potential risk or the effort.

While space insurance brokers say there is little to no evidence that mass market insurance activity currently affects satellite premiums, the space market may not be immune to world catastrophes.¹⁴ *The Global Risks Report 2019*, published by World Economic Forum, lists extreme weather as the greatest concern by respondents to its Global Risks Perception Survey.¹³ Other top concerns are “failure of climate-change mitigation and adaptation,” biodiversity loss, and cyberattacks.

Whether these risks and others (such as rising sea levels, geo-political and geo-economic tensions, and biological threats) will affect the willingness of insurance companies to provide satellite insurance is yet to be seen. Because relatively few insurers cover space, the loss of even a small number of providers could significantly reduce capacity, which in turn would put upward pressure on premium rates.

Future Considerations

In order to remain viable in this changing space landscape, insurance companies must gradually adjust capacity to match demand for insurance to avoid sudden spikes in premiums, which could provide an incentive for satellite operators to self-insure.

Government bodies can help mitigate space risks by introducing policies that reduce orbital debris, which increases collision risks, and by supporting the development of new technologies and processes such as on-orbit satellite servicing.¹⁵ Where appropriate, insurers and commercial satellite operators should work collaboratively with government stakeholders to support these policies and engage with regulators to create best practices and standards for space activity. Such standards, policies, and regulations will eventually be included in premium considerations for satellite insurance underwriters.

Ultimately, a proactive approach to underwriting capacity, using the economic levers at insurers’ disposal as well as education and collaboration between the government stakeholders and commercial operators, will be the best prescription for a continuing and healthy space and satellite insurance industry.

Conclusions

As military and civil customers become increasingly reliant on commercial companies for space-based services, they must stay abreast of how their contractors manage risk, whether through insurance or through alternative forms of mitigation. Although space insurance has historically been integral to innovation, growth, and investment throughout the space enterprise, multiple indicators of future supply and demand point to a likely changed and potentially diminished role of insurers in the commercial space business in the long term.

While roughly two-thirds of launched satellites currently carry some form of insurance, this figure could decrease if changes in the space industry affect demand for coverage. As increased competition lowers the cost of entry to space, fewer companies could require insurance if the financial consequence of an individual satellite failure within a mass constellation becomes relatively negligible.

Acknowledgments

Special thanks to Christopher Kunstadter of AXA XL, Denis Bensoussan of Beazley, Richard Rankin of Brandywinecreek LLC, and Fredric Baker for their input. The authors also appreciate contributions from Akhil Gujral, Rebecca Reesman, Karen Jones, Jim Vedda, Jamie Morin, Scott Isara, and Wei Chen of The Aerospace Corporation.

References

- ¹ AON Risk Solutions, “Insuring Space Activities.” Aon.com, Aon plc, October 2016, http://www.aon.com/russia/files/Insuring_Space_Activities_whitepaper.pdf.
- ² BNY Mellon. “The Race for Assets.” BNYMellon.com, The Bank of New York Mellon Corporation, November 2017, https://www.bnymellon.com/_global-assets/pdf/our-thinking/the-race-for-assets-alternative-investments-surge-ahead.pdf.
- ³ Bensoussan, Denis. Personal Interview. July 3, 2018.
- ⁴ Canis, Bill. “Commercial Space Industry Launches a New Phase.” Fas.org, Federation of American Scientists, December 12, 2016, <https://fas.org/sgp/crs/space/R44708.pdf>.
- ⁵ Gleeson, Patrick. “How Do Insurance Companies Invest Money?” Zacks, Zacks Investment Research, May 7, 2018, <https://web.archive.org/web/20171012095305/http://finance.zacks.com/insurance-companies-invest-money-11120.html>.
- ⁶ Henry, Caleb. “Space Insurer Swiss Re Leaves the Market.” SpaceNews.com, *SpaceNews*, August 1, 2019, <https://spacenews.com/space-insurer-swiss-re-leaves-market>.
- ⁷ Insurance Information Institute, “Facts + Statistics: Industry Overview.” III.org, Insurance Information Institute Inc., [https://www.iii.org/fact-statistic/facts-statistics-industry-overview#Property/Casualty%20Insurance%20Industry%20Income%20Analysis,%202013-2017%20\(1\)](https://www.iii.org/fact-statistic/facts-statistics-industry-overview#Property/Casualty%20Insurance%20Industry%20Income%20Analysis,%202013-2017%20(1)).
- ⁸ Kunstadter, Christopher. Personal Interview. June 22, 2018.
- ⁹ Interview Richard Rankin, Brandywinecreek LLC; August 20, 2019.
- ¹⁰ Kunstadter, Christopher. “Space Insurance Update 2019,” International Union of Aerospace Insurers, https://iuai.org/IUAI/Study_Groups/Space_Risks/Public/Study_Groups/Space_Risk.aspx.
- ¹¹ “Real Interest Rate.” World Bank Group, <https://data.worldbank.org/indicator/FR.INR.RINR?locations=US>.
- ¹² Walsh, K. and Williams, R. “Covering the Increased Liability of New Launch Markets,” Space Foundation (2016); <https://www.spacefoundation.org/wp-content/uploads/2019/07/Williams-Robert-COVERING-THE-INCREASED-LIABILITY-OF-NEW-LAUNCH-MARKETS.pdf>
- ¹³ World Economic Forum. The Global Risk Report, 13th ed., World Economic Forum, 2018, p. 2.
- ¹⁴ Marsh & McLennan, Marsh Space Projects, Personal Interview. April 18, 2019.
- ¹⁵ Reesman, Rebecca. “Assurance Through Insurance and On-Orbit Servicing,” The Aerospace Corporation Center for Space Policy and Strategy, February 17, 2018.

