KPMG

Insurance +SPACE

Orbiting opportunity: Insurance in the expanding space economy

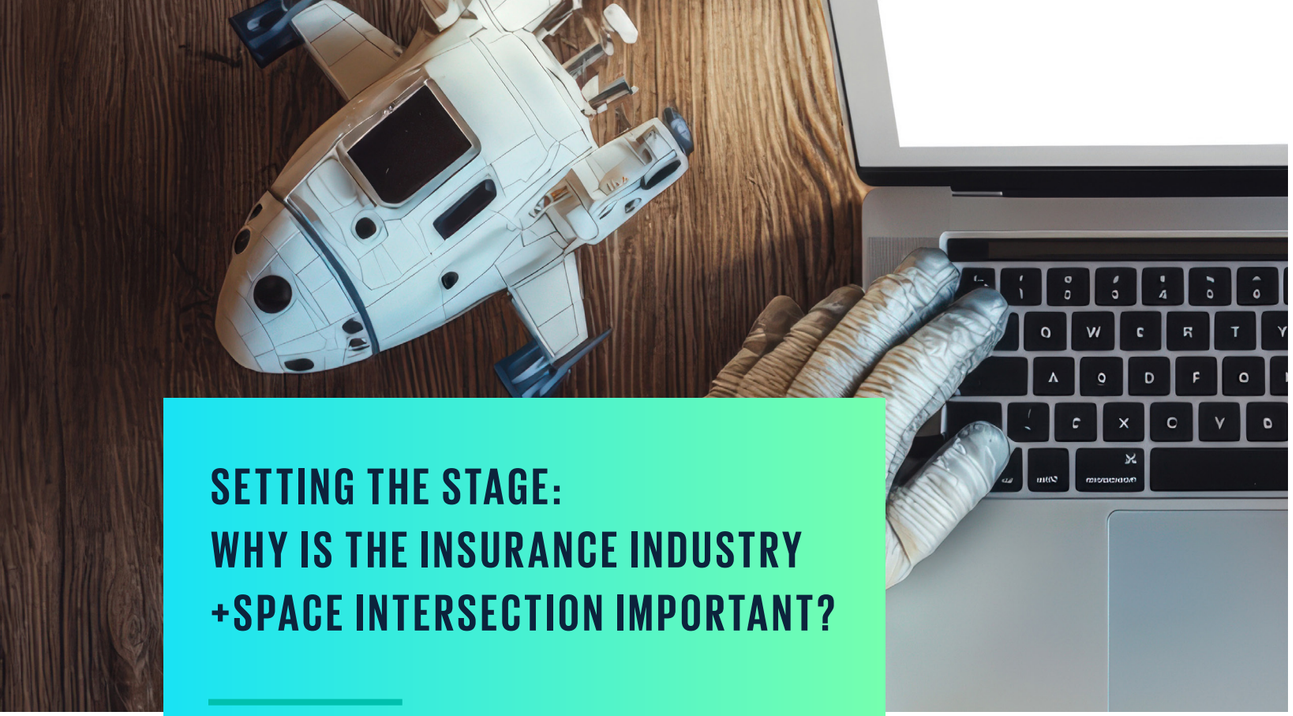
INTRODUCTION

The insurance industry stands on the brink of transformative change enabled by space-derived technologies. Many of the substantial challenges facing the industry, from the increasing complexity of underwriting to demands for faster claims adjustments, are being mitigated through the growing capabilities of satellites and space-derived data. These new capabilities are streamlining insurance operations and enabling new business models. The space economy itself is also creating new markets for insurance products and services, from opening up opportunities to serve new customers on Earth to the needs to insure the expanding range of space activity and infrastructure. By launching into the space economy, insurers can stay ahead of emerging risks, improve claims efficiency, and expand into new markets.

In the **NOW** phase (0–3 years), integrating satellite data into risk models is quickly transitioning from a niche practice to a mainstream necessity, driven by both market competition and emerging climate realities. Over the next three years, insurers will increasingly integrate space-based intelligence, especially in three core areas: improving **risk assessment** using high-resolution Earth observation (EO) data, providing more rapid and remote **claims processing** using satellite imagery, and expanding **parametric insurance** policies that automatically trigger payouts based on satellite-monitored conditions. As commercial space activity accelerates, insurers will also find new markets in space-based risk management—covering everything from satellite failures to orbital debris liability.

Looking ahead to the **NEAR** (3–5 years) and **NEXT** (5–10 years) phases, the insurance industry will undergo profound shifts as satellite capabilities grow and insurers refine their use of space-derived data. This combination will continue to shift insurance models from reactive risk management to proactive risk prevention, where insurers not only assess damages but also predict and mitigate risks before they escalate. The success of parametric weather insurance will extend into new markets—such as agriculture, where satellite-monitored soil health could trigger automatic payouts. Real-time EO data will allow insurers to offer adaptive policies with dynamic pricing models—for example, wildfire insurance premiums that fluctuate based on vegetation dryness and wind conditions. Insurers will leverage continuous satellite monitoring to provide proactive risk alerts to customers in real time—warning businesses of potential flood risks or structural stress on buildings due to snow load. The insurance industry's role will evolve from loss recovery to risk mitigation, transforming the customer experience.

Meanwhile, the space economy itself will establish new growth markets in need of insurance. The rapid proliferation of satellites and the growing congestion of Earth's orbit will necessitate expanded coverage for space-based assets, from collision insurance for satellite operators to liability policies addressing the risks of orbital debris. Beyond Earth, insurers will begin underwriting infrastructure projects on the Moon, in orbit, and beyond, supporting the development of lunar bases, space stations, and in-space manufacturing facilities. Space travel insurance for private individuals will transition from a novelty to a mainstream product as commercial spaceflight becomes routine. These emerging insurance lines—covering everything from lunar liability to space debris mitigation—will become essential pillars of the expanding space economy. By harnessing these advancements, insurers can move beyond traditional models, positioning themselves at the forefront of a rapidly changing risk landscape and playing a pivotal role in shaping the economic infrastructure of space.



SETTING THE STAGE: WHY IS THE INSURANCE INDUSTRY +SPACE INTERSECTION IMPORTANT?

The insurance industry is navigating heightened challenges

An era of escalating uncertainty. Risk assessments are becoming increasingly complex, shaped by factors ranging from climate change to financial volatility. Insurers are grappling with rising costs for repairs and replacements while adapting to an ever-growing volume of data that must be integrated into their models. The increasing frequency and severity of natural disasters have led to significant financial losses, forcing insurers to refine risk models and adjust pricing strategies.

As uncertainty grows, so do premiums. Insurers are introducing more exclusions and limitations and, in some cases, withdrawing from entire markets. This trend is particularly evident in regions like California, where stringent regulations and recurring wildfires have driven some insurers out of the state, reducing consumer choice and increasing financial burdens for homeowners.

At the same time, customers expect faster claims processing and more personalized policies, adding to operational complexity and costs. The industry is under pressure to enhance efficiency and customer satisfaction, requiring significant investments in technology and automation.

Space technologies and services are playing a pivotal role in helping insurers evolve

Enhanced risk assessment and underwriting

Geospatial intelligence powered by EO satellites provides insurers with high-resolution imagery and remote sensing data, enabling precise risk analysis. By leveraging satellite data, underwriters can more accurately assess flood zones, wildfire-prone areas, and structural vulnerabilities, leading to more informed underwriting decisions. Continuous monitoring of environmental changes allows for dynamic adjustments in risk assessments, improving both risk modeling and portfolio management. As climate-related risks intensify, space-derived data will become a standard input for catastrophe underwriting.

Faster claims processing and fraud detection

In the wake of natural disasters, satellite imagery enables insurers to rapidly assess damage, even when ground access is restricted. This capability accelerates claims verification and payouts while reducing administrative overhead. Additionally, historical and real-time satellite imagery helps detect fraudulent claims by providing verifiable evidence of a property's condition before and after an event.

The rise of parametric, dynamic, and preventive insurance models

Space technology is driving the evolution of new insurance products, including parametric policies, where payouts are triggered by predefined conditions rather than lengthy assessments. For example, in agriculture, satellite data can track rainfall levels and vegetation health, enabling index-based insurance policies that provide automatic compensation when predefined thresholds are met. As real-time monitoring becomes mainstream, dynamic insurance models will emerge, adjusting premiums in near real time based on satellite-derived climate, environmental, and orbital risk data.

DEVELOPMENTS TO BE AWARE OF

Major advances in space technology are dramatically lowering the costs and barriers to entry to space-based business. The advent of reusable rockets operated by commercial providers has been the game changer, driving down per-kilogram launch costs by up to approximately 95 percent in the last 10–15 years from approximately $65,000 per kg in the Space Shuttle era to under $1,500 per kg in 2024.[1] As a result, global launch activity is at record levels. 2024 saw an annual high of 254 successful orbital launches, an approximate 20 percent increase from the prior year's record number of launches.[2] We expect there to be more than 300 in 2025. This has triggered a boom of orbital payloads, with demand driven by the proliferation of small satellites (SmallSats) and standardized cubesats that have recently made satellite development easier and cheaper for new entrants. In 2023, a record of 2,664 objects (primarily SmallSats) were launched into space.[3] Today, there are more than 11,000 activate satellites in orbit.[4]

SmallSats are transforming Earth's orbit into a densely networked environment, enabling global broadband, geospatial intelligence, IoT activity, and more. As availability and scope of space-based data grows, new satellite and software companies are moving from simply selling raw data to delivering processed insights and market-specific solutions, making it easier for nonspace businesses—such as insurance—to integrate them into operations. The emergence of commercial spaceflight is further expanding opportunities, while space debris management is becoming an increasingly urgent challenge as orbital congestion rises.

Satellite technology is revolutionizing the insurance industry. Various types of satellites now provide critical data and services, including real-time imaging, climate modeling, and asset tracking. These capabilities are enabling insurers to enhance risk assessment, claims processing, fraud detection, and overall operational efficiency. EO and GNSS/GPS satellites are the most widely used by insurers today. EO satellites capture high-resolution images and environmental data, providing critical information for risk evaluation, disaster response, claims verification, and more. Meanwhile, IoT/M2M and Synthetic Aperture Radar (SAR) satellites are emerging as valuable tools for insurers seeking to leverage data-driven strategies. With the rapid expansion of low Earth orbit (LEO) satellite networks, data is becoming more accessible and cost-effective, further empowering insurers. Specialized satellite applications are also emerging, including automatic identification system satellites for global ship tracking, microsats for real-time weather monitoring, and navigation augmentation satellites to enhance GPS reliability.

Expansion into new markets

Managing the rising risk of space collisions

With over 30,000 tracked objects in orbit and millions of smaller debris fragments,[5] the growing congestion in LEO presents a new frontier for risk assessment. Traditional actuarial models based on historical satellite losses are becoming obsolete as mega constellations expand. Insurers are now integrating real-time orbital tracking and AI-powered predictive models to estimate collision risks and dynamically adjust premiums for satellite operators.

Insuring the next wave of space infrastructure

As commercial space stations, lunar bases, and asteroid mining ventures move from concept to reality, insurers are developing entirely new underwriting frameworks. Emerging areas of coverage include satellite constellations, launch vehicles, space tourism, and in-orbit manufacturing.

The increasing density of space assets has driven demand for specialized insurance policies that protect against launch failures, space debris impacts, and mission failures. In the coming years, insurers will play a crucial role in supporting the commercialization of space by mitigating financial risks associated with extraterrestrial ventures. Not all satellites and payloads require insurance, however. Therefore, it's important for organizations to proactively understand the liability insurance requirements for their mission.

TIMELINE OF POTENTIAL ADVANCEMENTS

INSURANCE +SPACE (2025–2035)

2025

Satellite-assisted risk assessment: Utilizing satellite data to enhance risk assessment models for natural disasters, improving accuracy and response times.

Space-based climate risk modeling: Developing advanced climate risk models using data from space missions to better predict and mitigate climate-related risks.

Space-enhanced cyber insurance: Leveraging satellite technology to monitor and protect against cyber threats, enhancing cyber insurance policies.

Satellite-enabled fraud detection: Using satellite imagery and data analytics to detect and prevent insurance fraud.

Space-driven agricultural insurance: Implementing satellite data to assess crop health and yield, improving agricultural insurance products.

2026

Space-based disaster response: Enhancing disaster response capabilities using real-time satellite data to assess damage and coordinate relief efforts.

Advanced space weather insurance: Developing insurance products to cover risks associated with space weather events, such as solar flares and geomagnetic storms.

Satellite-assisted property insurance: Using satellite imagery to assess property conditions and risks, improving property insurance underwriting.

Space-enhanced health insurance: Utilizing data from space missions to monitor health risks and improve health insurance products.

Space-based environmental liability insurance: Creating insurance products to cover environmental liabilities using data from space-based environmental monitoring.

2027

Space-driven catastrophe modeling: Developing advanced catastrophe models using satellite data to predict and mitigate the impact of natural disasters.

Satellite-enabled marine insurance: Using satellite data to monitor shipping routes and assess risks, improving marine insurance products.

Space-based life insurance: Utilizing data from space missions to assess health risks and improve life insurance underwriting.

Advanced space debris insurance: Developing insurance products to cover risks associated with space debris and satellite collisions.

Space-enhanced travel insurance: Using satellite data to monitor travel conditions and improve travel insurance products.

2028

Space-based environmental risk assessment: Utilizing satellite data to assess environmental risks and improve environmental insurance products.

Advanced space tourism insurance: Developing insurance products to cover risks associated with space tourism.

Satellite-assisted crop insurance: Using satellite data to monitor crop health and assess risks, improving crop insurance products.

Space-driven health risk modeling: Developing advanced health risk models using data from space missions.

Space-based infrastructure insurance: Creating insurance products to cover risks associated with space-based infrastructure projects.

2029

Space-enhanced climate resilience insurance: Developing insurance products to enhance climate resilience using satellite data.

Advanced space mining insurance: Creating insurance products to cover risks associated with space mining operations.

Satellite-assisted auto insurance: Using satellite data to monitor driving conditions and assess risks, improving auto insurance products.

Space-based renewable energy insurance: Developing insurance products to cover risks associated with space-based renewable energy projects.

Space-driven environmental monitoring: Utilizing satellite data to monitor environmental conditions and improve environmental insurance products.

2030

Space-based risk transfer solutions: Developing innovative risk transfer solutions using data from space missions.

Advanced space infrastructure insurance: Creating insurance products to cover risks associated with space infrastructure projects.

Satellite-assisted health monitoring: Using satellite data to monitor health conditions and improve health insurance products.

Space-enhanced property risk assessment: Utilizing satellite imagery to assess property risks and improve property insurance underwriting.

Space-based environmental liability coverage: Developing insurance products to cover environmental liabilities using data from space-based environmental monitoring.

2031

Space-driven catastrophe risk transfer: Developing advanced catastrophe risk transfer solutions using satellite data.

Satellite-enabled marine risk assessment: Using satellite data to assess marine risks and improve marine insurance products.

Space-based life risk modeling: Utilizing data from space missions to develop advanced life risk models.

Advanced space debris risk management: Creating insurance products to manage risks associated with space debris.

Space-enhanced travel risk assessment: Using satellite data to assess travel risks and improve travel insurance products.

2032

Space-based environmental risk transfer: Developing innovative environmental risk transfer solutions using satellite data.

Advanced space tourism risk management: Creating insurance products to manage risks associated with space tourism.

Satellite-assisted crop risk assessment: Using satellite data to assess crop risks and improve crop insurance products.

Space-driven health risk transfer: Developing advanced health risk transfer solutions using data from space missions.

Space-based infrastructure risk management: Creating insurance products to manage risks associated with space-based infrastructure projects.

2033

Space-enhanced climate risk transfer: Developing innovative climate risk transfer solutions using satellite data.

Advanced space mining risk management: Creating insurance products to manage risks associated with space mining operations.

Satellite-assisted auto risk assessment: Using satellite data to assess auto risks and improve auto insurance products.

Space-based renewable energy risk management: Developing insurance products to manage risks associated with space-based renewable energy projects.

Space-driven environmental risk monitoring: Utilizing satellite data to monitor environmental risks and improve environmental insurance products.

2034

Space-based risk transfer innovations: Developing innovative risk transfer solutions using data from space missions.

Advanced space infrastructure risk management: Creating insurance products to manage risks associated with space infrastructure projects.

Satellite-assisted health risk monitoring: Using satellite data to monitor health risks and improve health insurance products.

Space-enhanced property risk management: Utilizing satellite imagery to manage property risks and improve property insurance underwriting.

Space-based environmental liability innovations: Developing insurance products to cover environmental liabilities using data from space-based environmental monitoring.

2035

Space-driven catastrophe risk innovations: Developing innovative catastrophe risk solutions using satellite data.

Satellite-enabled marine risk innovations: Using satellite data to develop innovative marine risk solutions.

Space-based life risk innovations: Utilizing data from space missions to develop innovative life risk solutions.

Advanced space debris risk innovations: Creating insurance products to manage risks associated with space debris.

Space-enhanced travel risk innovations: Using satellite data to develop innovative travel risk solutions.

Existing initiatives in the insurance sector

Leading organizations in the insurance sector are already leveraging space technology

AXA XL	**Geospatial imagery**	Uses satellite data for underwriting, risk engineering, and claims assessment
Allianz	**Satellite data**	Integrates satellite data for natural disaster risk assessment and claims processing
Swiss Re	**Remote sensing**	Utilizes satellite imagery for crop insurance and disaster response
Munich Re	**Satellite monitoring**	Employs satellite data to monitor natural disasters and assess risks in real time
Tokio Marine	**IoT and satellite data**	Uses IoT devices and satellite data for real-time risk assessment and management
Zurich	**Space weather data**	Leverages space weather data to assess risks related to solar storms and geomagnetic events

Perspective of early adopters' experiences and benefits

AXA XL's use of geospatial imagery

AXA XL has integrated geospatial imagery and sensory data from satellites throughout the insurance cycle, from underwriting to claims. This approach has significantly enhanced their ability to assess and manage risks.

Desired outcome

To improve the accuracy of risk assessments and expedite the claims process, particularly for natural disasters

Value delivered

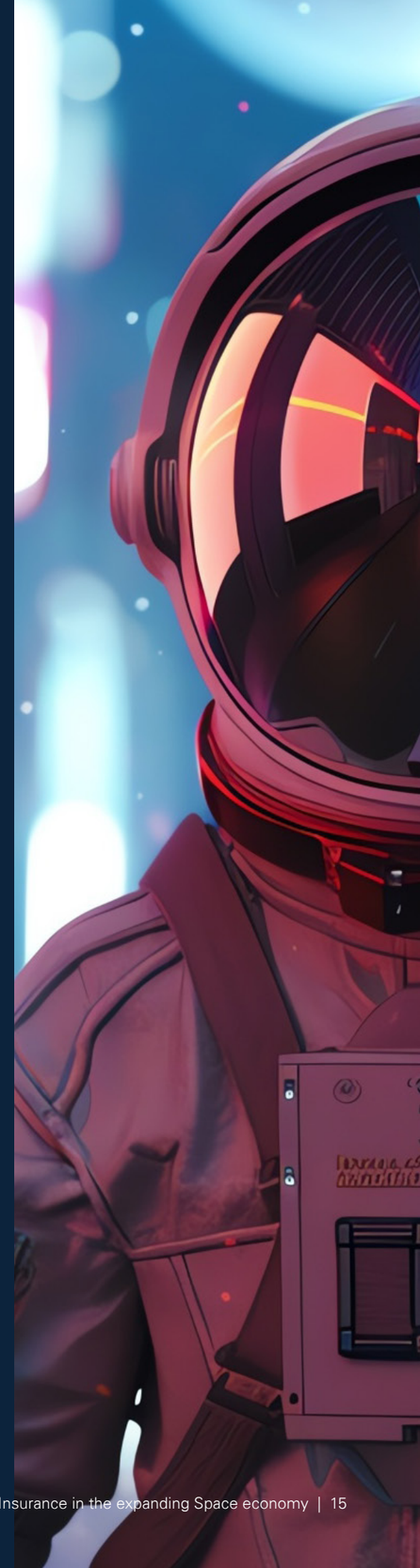
- **Enhanced underwriting:** Satellite data provides detailed insights into risk exposures, enabling more accurate underwriting decisions.
- **Efficient claims processing:** During natural disasters, satellite imagery helps quickly assess the extent of damage, speeding up claims processing.
- **Risk management:** Continuous monitoring of insured assets using satellite data allows for proactive risk management.

Interconnected world

In today's economy, advancements in space technology are creating new strategic opportunities across various industries, with the insurance sector being no exception. The integration of geospatial intelligence, IoT, and remote sensing into insurance processes is enhancing the accuracy of underwriting and claims processing, while the development of parametric insurance and space debris insurance is addressing emerging risks. Early adopters like AXA XL and Allianz are already reaping the benefits of these technologies, demonstrating improved risk management and expedited claims processing. And Lloyd's of London, for example, provides third-party liability coverage for space missions to protect against potential collisions and damages. By staying abreast of these developments, insurance companies can not only mitigate risks more effectively but also seize new opportunities for innovation and growth in an increasingly interconnected world. These early adopters will be well positioned to seize opportunity as capabilities and integration of space tech into operations and business models mature.

Incorporating geospatial intelligence: Satellite utilization in the insurance industry

CATEGORY	CAPABILITIES	USE CASES	BENEFITS	ADOPTION
Earth Observation EO satellites capture high-resolution images and data about Earth's surface using optical, infrared, and radar sensors.	**Multispectral and hyperspectral imaging:** Captures detailed information beyond the visible spectrum, allowing insurers to assess vegetation health, detect water damage, and analyze soil conditions **Light Detection and Ranging (LiDAR):** Generates precise 3D maps to evaluate property elevation and flood risks **Synthetic aperture radar (SAR):** Uses radar to penetrate clouds and operate at night, ensuring continuous monitoring in all weather conditions **AI and machine learning integration:** Automates damage assessments, enhances fraud detection, and improves catastrophe modeling	**Home and property insurance:** Used for underwriting policies and remote damage assessment **Flood and climate risk insurance:** Monitors changing environmental conditions to assess long-term risks **Reinsurance:** Large-scale risk modeling for insurers covering catastrophic events **Agricultural insurance:** Helps evaluate crop health and predict yields; tracks crop health for agricultural insurance	**More precise risk modeling and underwriting,** leading to better pricing strategies **Reduced need for on-site inspections,** cutting costs and improving efficiency **Faster claims processing** by remotely assessing damages **Improved fraud detection** by verifying the state of assets before and after claims	**High** – Widely used by insurers for catastrophe modeling and claims assessment
Global navigation satellite system/GPS Global navigation satellite system (GNSS) and GPS satellites provide global positioning, navigation, and timing (PNT).	**Real-time kinematics (RTK) and precise positioning:** Enables highly accurate location tracking for vehicles and equipment **Geofencing and telematics:** Tracks vehicle movements and detects deviations from expected routes **Data fusion with AI:** Integrates GPS data with machine learning models for behavior-based insurance pricing	**Commercial and maritime insurance** Asset tracking for cargo and ships **Auto insurance (usage-based insurance [UBI] and fleet insurance)** Personalized premiums based on driving behavior **Stolen vehicle and asset recovery insurance** Enables real-time tracking and theft prevention	**Improved efficiency** in fleet insurance and logistics management. **Personalized pricing models** that benefit safe behaviors. **Reduced fraudulent claims** by verifying vehicle locations	**High** – Already integral to auto and fleet insurance models
IoT and machine-to-machine connectivity satellites IoT and machine-to-machine (M2M) satellites provide global connectivity for remote sensors and smart devices, enabling real-time monitoring.	**LEO satellite constellations:** Enables low-latency communication for connected devices **Remote sensing and telemetry:** Gathers continuous data from insured assets, tracking movement, temperature, humidity, and structural integrity **Edge computing and AI analytics:** Processes data in real time, providing actionable insights for risk management	**Commercial and industrial insurance –** Monitors equipment, factories, and supply chains **Marine and cargo insurance –** Tracks shipping containers and cargo conditions **Auto insurance (fleet and usage-based insurance, UBI) –** Tracks vehicle behavior, reducing fraud and enabling personalized pricing	**Real-time monitoring** of remote and high-risk assets **Improved accuracy and speed** of claims processing by leveraging real-time sensor data **Reduced fraud** by verifying asset conditions at all times **Enhanced risk prevention** through proactive monitoring	**Growing** – Adoption increasing in property, agriculture, and auto insurance sectors
SAR satellites SAR satellites use radar to create high-resolution images of Earth's surface, even through clouds and darkness.	**Interferometric SAR (InSAR) –** Detects land deformation and subsidence risks **Polarimetric SAR (PolSAR) –** Differentiates between water, vegetation, and urban infrastructure. **Automated image analysis –** AI-driven damage detection improves claims accuracy	**Flood and natural disaster insurance** Detects land subsidence, flood risks, and infrastructure damage; monitors flood zones and land shifts to predict future claims **Property and home insurance** Monitors construction quality and land stability **Agricultural insurance** Assesses soil moisture levels and crop damage	**All-weather, real-time risk assessment** and fraud detection **More accurate** flood and subsidence modeling **Cost savings** by reducing unnecessary payouts due to fraud	**Moderate** – Gaining traction in property and climate risk insurance



NEAR: 3–5 YEARS

Early-mover opportunities

As we look toward the near future, industry trajectory and external forces are poised to create early-mover opportunities for forward-thinking insurance companies. Now in the mid-2020s, commercial activity is broadening as more constellations are launched, and lunar missions and private space stations begin to become operational. This expansion will continue to be fueled by fully reusable heavy-lift rockets capable of carrying larger payloads at lower costs. As the number of active satellites in orbit increases into the tens of thousands, space traffic management and debris mitigation will become critical priorities.

The rapid proliferation of satellites will drive down data acquisition costs, making high-resolution imagery even more accessible to insurers. The expansion of satellite networks will also enhance temporal resolution, allowing for higher-frequency imaging that enables insurers to monitor environmental changes in near real time. EO satellite capabilities will continue to evolve, including advanced sensors such as infrared sensors that capture thermal imaging aiding in wildfire mitigation, and SAR sensors that can even capture images at any time of day or night, through clouds and smoke.

Global IoT connectivity via satellite will become the norm, facilitating integration across terrestrial industries. Ubiquitous satellite IoT will enable the remote tracking of assets, vehicles, and infrastructure in previously inaccessible regions, including oceans, deserts, and polar territories. AI-powered algorithms will process the growing volume of satellite imagery and data, expediting damage assessments following natural disasters and accelerating claims processing. Meanwhile, machine learning models will analyze historical and real-time EO and IoT data to identify risk patterns, improving underwriting accuracy and proactive risk management. These advancements will continue to push operational improvements for personal and commercial insurance products on Earth.

In the coming years, external forces will also impact the development of insurance products serving the space industry and their payload customers. Regulations currently require insurance for some current space operations, such as US launch licenses mandating third-party liability coverage. We should expect these requirements to extend into additional categories as the space economy expands; for example, there is a growing advocacy for space debris insurance policies that would require satellite operators to post financial guarantees or bonds to cover deorbiting costs.

By proactively embracing these advancements, insurance companies can enhance risk assessment capabilities, develop specialized products, and form strategic partnerships to stay ahead in this rapidly evolving landscape.

Early-adoption strategies

Potential steps and investments for insurance sector companies:

Insurance companies are increasingly recognizing the potential of space technologies to transform their operations. Large insurance firms are leading the charge by integrating advanced technologies such as AI, ML, and satellite data into their risk assessment and claims processing systems. This integration enhances the precision and efficiency of their underwriting processes. Additionally, these companies are pioneering the development of specialized insurance products tailored to new space activities, including space tourism and lunar missions. By forming strategic partnerships with space and tech companies, they gain access to the latest innovations and share the associated risks.

Midsized insurance companies are also making strides by leveraging existing satellite data and geospatial analytics to improve their risk assessment capabilities. They are carving out niches by creating insurance products that address specific space-related risks, such as space debris. Collaborations with insurtech firms allow these companies to adopt innovative solutions and streamline their operations. On the other hand, small insurance companies are focusing on parametric insurance models, which use satellite data to offer coverage for climate and weather-related risks. By joining industry consortia and outsourcing their technology needs, these smaller firms can access advanced technologies and industry insights without significant capital expenditure. These diverse strategies across different sizes of insurance companies underscore the industry's commitment to harnessing space technologies for enhanced risk management and operational efficiency.

Large insurance companies

Invest in technology

- Allocate funds for integrating AI/ML and satellite data into risk assessment and claims processing.
- Focus on enhanced accuracy and efficiency in underwriting and claims management.

Develop specialized products

- Create insurance products for emerging space activities like space tourism and lunar missions.
- Capture new market segments and diversify product offerings.

Form strategic partnerships

- Collaborate with space companies and tech firms to leverage their expertise.
- Prioritize access to cutting-edge technologies and shared risk.

Allocate investment for monitoring the space industry, product R&D, tech stack, and joint venture.

Midsized insurance companies

Leverage existing technologies

- Utilize available satellite data and geospatial analytics for risk assessment.
- Drive improved risk management without significant capital expenditure.

Focus on niche markets

- Develop insurance products for specific space-related risks like space debris.
- Capture new market segments and diversify product offerings.

Collaborate with insurtech firms

- Partner with insurtech companies to integrate innovative solutions.

Allocate investment for strategic foresight, product development, and tech partnerships.

Small insurance companies

Adopt parametric insurance models

- Use satellite data to offer parametric insurance for climate and weather-related risks.
- Simplified claims process and reduced administrative costs.

Join industry consortia

- Participate in industry groups focused on space insurance.
- Membership fees or professional services briefings
- Access to industry insights and collaborative opportunities.

Outsource technology needs

- Partner with tech providers for satellite data and analytics.
- Establish cost-effective access to advanced technologies.

Allocate investment for target operating model design, industry group memberships, and service agreements.

Potential hypotheses of partnerships and collaborations

As the space industry continues to expand, the need for innovative insurance solutions is becoming increasingly apparent. Because the space environment is so unique and specialized knowledge is required, close collaboration between space companies and insurance providers can help define new services and markets that meet the needs of customers at the right time.

By addressing emerging risks and opportunities in space tourism, satellite constellations, and space debris management, insurers can cover a wide breadth of tailored products that cater to the unique challenges of the space sector. Through strategic pairings, both space companies and insurers can leverage each other's expertise to create comprehensive coverage solutions, enhance risk management, and tap into new markets.

Space tourism insurance

Growing demand for space tourism insurance as commercial spaceflights become more common. Space companies gain access to insurance expertise, while insurers tap into a new market.

Potential outcomes: Development of tailored insurance products for space tourists and increased market share for insurers

BY ADDRESSING EMERGING RISKS AND OPPORTUNITIES IN SPACE TOURISM, SATELLITE CONSTELLATIONS, AND SPACE DEBRIS MANAGEMENT, INSURERS CAN COVER A WIDE BREADTH OF TAILORED PRODUCTS THAT CATER TO THE UNIQUE CHALLENGES OF THE SPACE SECTOR.

Satellite constellation insurance

Expansion of satellite constellations for global broadband and EO. Space companies receive coverage for satellite deployments, while insurers gain new clients.

Potential outcomes: Increased demand for satellite insurance, and enhanced risk management for satellite operators

Space debris management

Growing need for technologies to track and remove space debris. Space companies benefit from insurance coverage for debris-related risks, while insurers offer innovative products.

Potential outcomes: Reduced collision risks, lower insurance premiums for satellite operators

NEXT: 5–10 YEARS

Transformative technologies

By the late 2020s to early 2030s, we may begin to see a self-sustaining space economy with multiple private space stations in orbit, a functioning lunar base, and initial crewed missions to Mars. This expansion will move orbital activity beyond satellites, incorporating human-tended platforms, microgravity research labs, and even large-scale in-space construction. At this point, orbital activity will increasingly include a permanent human presence beyond Earth.

With a surge in global launch capacity, frequent, lower-cost launches will enable entirely new industries and large-scale space infrastructure projects. Private space stations will lease their space for commercial research, space tourism, and industrial operations, establishing a scalable customer base for in-space activities and crew habitats. Space supply chains will emerge, supporting regular bulk cargo transport to the Moon and orbital stations. In-space manufacturing of large structures, microgravity manufacturing of materials in space to be sent back to Earth, and resource extraction from asteroid mining could become viable industries.

The potential for 100,000+ active satellites in the coming decades suggests that space-based data will be fully integrated into a digital twin of Earth—a high-resolution, live model of the planet used for climate modeling, urban planning, and infrastructure management. Insurers will leverage real-time data processing via edge computing, allowing satellites to deliver instant insights for risk management. Additionally, integrating satellite data with drones, IoT devices, and ground sensors will enable comprehensive risk profiles, further enhancing underwriting accuracy and predictive modeling. To manage rising orbital congestion, debris removal missions may be deployed.

EARTH OBSERVATION DATA IS ALREADY RADICALLY CHANGING THE ABILITY TO UNDERSTAND EXISTING RISKS AND TO ASSESS LOSSES, BUT THE SPACE SECTOR ITSELF PRESENTS NEW INSURANCE MARKETS AS MANKIND EXPLORES, CLOSELY MIRRORING THE INDUSTRY'S ORIGINS IN LLOYD'S COFFEE HOUSE.

—NEIL RAE, UK HEAD OF SPACE

Spotlight on transformational technologies

AI and ML technologies are expected to mature significantly, becoming more advanced and integrated into various aspects of space operations, such as autonomous spacecraft navigation, predictive maintenance, and data analysis. For the insurance sector, this evolution holds transformative potential. AI/ML can enhance risk assessment by analyzing vast amounts of data from satellites and other space assets, providing more accurate and comprehensive evaluations. In claims processing, AI-driven automation can significantly reduce processing times and improve accuracy, leading to faster and more reliable outcomes for policyholders. Furthermore, predictive analytics powered by AI can forecast potential risks and failures, enabling insurers to offer more tailored and proactive coverage.

This integration of AI/ML into insurance processes promises to revolutionize the industry, making it more efficient, responsive, and capable of addressing the unique challenges posed by the rapidly evolving space sector.

Emerging business models and market dynamics:

- **Personalized insurance:** AI/ML enables insurers to offer highly personalized insurance products based on individual risk profiles.
- **Usage-based insurance:** Real-time data from IoT devices and satellites can be used to offer usage-based insurance products.
- **Proactive risk management:** Predictive analytics allow insurers to proactively manage risks and offer preventive solutions.

Quantum computing is poised to revolutionize data processing capabilities, enabling complex simulations and optimizations that are currently beyond the reach of classical computers. This technological leap is expected to have a profound impact on the insurance sector. Enhanced cybersecurity through quantum encryption will provide unprecedented levels of security for sensitive insurance data, safeguarding it against increasingly sophisticated cyber threats. Additionally, quantum computing will enable more accurate and comprehensive risk modeling and simulations, significantly improving the precision of underwriting and pricing. This will allow insurers to better assess and manage risks, leading to more tailored and competitive insurance products. Furthermore, advanced algorithms powered by quantum computing will enhance fraud detection capabilities, enabling insurers to identify and mitigate fraudulent claims more effectively. Overall, the integration of quantum computing into the insurance industry promises to drive significant advancements in data security, risk management, and operational efficiency.

Quantum computing–driven insurance models:

- **Advanced risk modeling:** Quantum computing enables more accurate and complex risk modeling, leading to better pricing and underwriting.
- **Enhanced fraud detection:** Quantum algorithms can detect fraudulent claims more effectively, reducing losses.
- **Cybersecurity insurance:** Quantum encryption provides a new level of security for cybersecurity insurance products.

Space-based solar power (SBSP) is anticipated to mature significantly, involving the harvesting of solar energy in space and its transmission to Earth, thereby providing a continuous and reliable energy source. This advancement will have substantial implications for the insurance sector. Insurers will need to develop specialized products to cover the construction, operation, and maintenance of SBSP infrastructure, addressing the unique risks associated with these large-scale projects. Additionally, new insurance products will be required for energy companies that adopt SBSP technology, ensuring comprehensive coverage for their innovative operations and the risk to Earth's infrastructure of any single points of failure in the energy grid. The environmental impact of SBSP projects will also necessitate insurance solutions to manage potential liabilities and mitigate risks associated with environmental damage. Overall, the maturation of SBSP technology will drive the creation of new insurance products and strategies, enabling the industry to support and safeguard this groundbreaking energy innovation.

SBSP-driven insurance models:

- **Infrastructure insurance:** Specialized insurance products for SBSP infrastructure, covering construction, operation, and maintenance.
- **Energy sector insurance:** New insurance products for energy companies utilizing SBSP technology.
- **Environmental liability insurance:** Coverage for potential environmental impacts and liabilities associated with SBSP projects.

Overall, the next decade's orbital ecosystem will be far busier, with a mix of crewed and uncrewed assets that support an array of services blurring the line between "space" companies and traditional industries that use space infrastructure. By embracing these innovations, insurers can remain at the forefront of this evolving landscape, leveraging space technology to develop next-generation risk models, enhance claims processing, and unlock new revenue streams.

Integration prospects

Integration of key technologies into the insurance sector

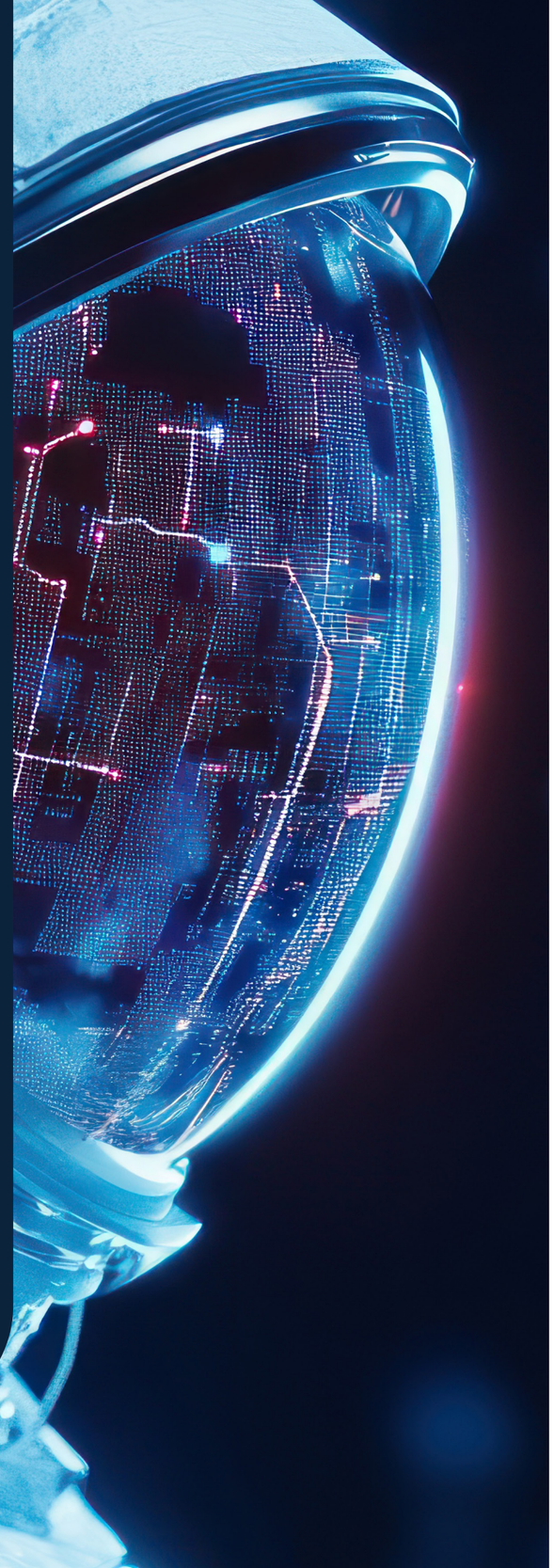
	Hypotheses	Considerations	Challenges
AI/ML integration	**Hypothesis:** AI/ML technologies will be integrated into the insurance sector through advanced data analytics platforms, automated claims processing systems, and predictive risk assessment tools. **New revenue opportunities:** Offering AI/ML-based risk assessment and predictive analytics services to other industries	• **Investment in AI/ML infrastructure:** Insurers could invest in AI/ML platforms and hire data scientists to develop and maintain these systems. • **Partnerships with tech firms:** Collaborate with technology companies specializing in AI/ML to leverage their expertise. • **Training and development:** Train employees to work with AI/ML tools and interpret the data generated.	• **Data privacy:** Ensuring the privacy and security of sensitive data. • **Regulatory compliance:** Adhering to regulations governing the use of AI/ML in insurance • **Integration costs:** High initial investment and integration costs
Quantum computing integration	**Hypothesis:** Quantum computing will be integrated into the insurance sector for enhanced cybersecurity, complex risk modeling, and fraud detection. **New revenue opportunities:** Providing quantum computing–based risk modeling and cybersecurity services	• **Research and development:** Invest in R&D to explore quantum computing applications in insurance. • **Collaboration with quantum computing firms:** Partner with companies developing quantum computing technologies. • **Pilot programs:** Implement pilot programs to test quantum computing applications in risk modeling and fraud detection.	• **Technical expertise:** Lack of expertise in quantum computing within the insurance industry • **High costs:** Significant investment is required for quantum computing infrastructure • **Regulatory uncertainty:** Unclear regulatory landscape for quantum computing applications
SBSP integration	**Hypothesis:** SBSP technology will be integrated into the insurance sector through the development of specialized insurance products for SBSP infrastructure and energy companies. **New revenue opportunities**: Developing and selling specialized insurance products for SBSP projects and energy companies	• **Product development:** Create insurance products tailored to the unique risks associated with SBSP projects. • **Risk assessment models:** Develop risk assessment models specific to SBSP technology. • **Collaboration with energy companies:** Partner with energy companies to understand their insurance needs and develop appropriate coverage.	• **Technological uncertainty:** Uncertainty around the maturity and reliability of SBSP technology • **Regulatory hurdles:** Navigating the regulatory environment for SBSP projects • **Market acceptance:** Gaining acceptance and trust from energy companies and other stakeholders

BRINGING IT TO LIFE: THE FUTURE VISION

Possible future scenarios incorporating space-derived tech

As we venture further into the future, the integration of space-derived technologies into the insurance sector will lead to new products and more customer-centric services without customers realizing how space technology is enabling them. Further, scenarios of insurance products supporting economic growth in space help envision future roadmaps for insurers.

These two opportunities for growth—as both a customer of and owner of space-derived data, and a vendor to space operators—represent opportunities for business model and operational innovation. **What might that future look like?**

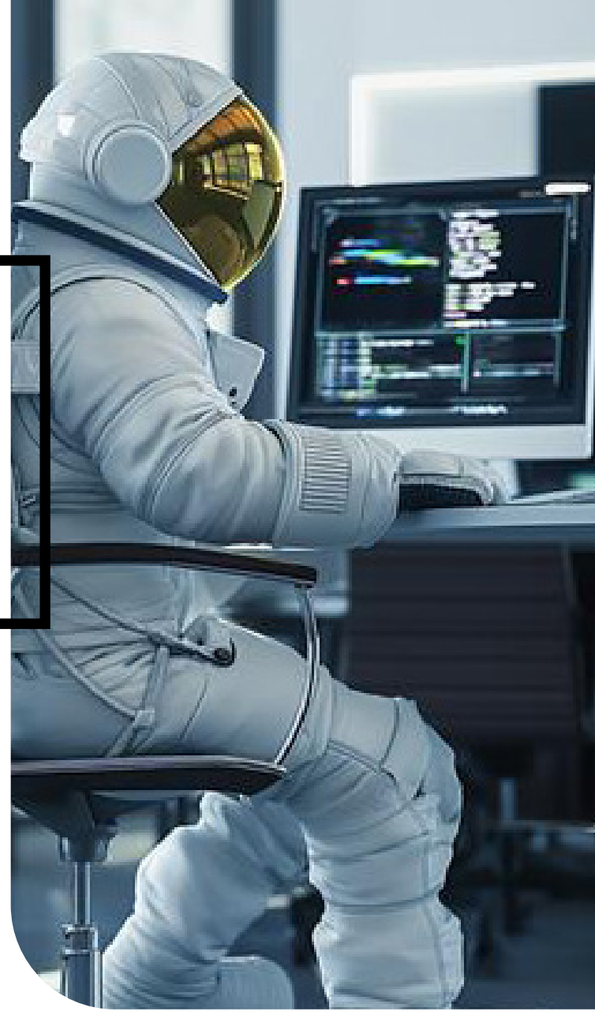


EXPECT A SURGE OF INNOVATIONS OVER THE COMING YEARS THAT WILL INTEGRATE SPACE TECHNOLOGIES INTO THE INSURANCE INDUSTRY.

AI-driven risk assessment: In 2028, an insurance company uses AI/ML algorithms to analyze satellite data for real-time risk assessment. A major hurricane is predicted to hit the Gulf Coast, and the AI system alerts policyholders in the affected area, providing them with personalized risk mitigation strategies. This proactive approach reduces claims by 30 percent and enhances customer satisfaction.

Quantum-enhanced cybersecurity: By 2030, a leading insurer integrates quantum encryption to secure its data. A cyberattack targets the company's servers, but the quantum encryption prevents any data breach. This technology not only protects sensitive information but also builds trust with customers, leading to a 20 percent increase in new policy sign-ups.

SBSP insurance: In 2029, an insurance firm offers specialized policies for companies investing in SBSP. A major SBSP project successfully transmits energy to Earth, and the insurer's coverage ensures that any technical failures or environmental impacts are mitigated. This new product line generates $500 million in annual premiums.



Space tourism coverage: By 2032, space tourism becomes mainstream, and insurers provide comprehensive coverage for space travelers. A family embarks on a vacation to a lunar resort, and their insurance policy covers everything from launch risks to medical emergencies in space. This niche market grows rapidly, contributing significantly to the insurer's revenue.

Autonomous spacecraft insurance: In 2027, an insurance company develops policies for autonomous spacecraft used in asteroid mining. A mining mission encounters unexpected technical issues, but the insurance coverage ensures that the mission continues without financial losses. This innovation attracts more clients in the burgeoning space mining industry.

As technology continues to advance, the integration of new products and services into daily life is becoming increasingly seamless and impactful. This section presents narratives that showcase how innovative insurance solutions are being woven into everyday experiences, enhancing safety, convenience, and financial stability. From personalized health insurance that leverages satellite data and wearable devices to smart home insurance that integrates IoT technology, these stories illustrate the transformative potential of modern insurance products. By highlighting real-world applications, we can better understand how these advancements are not only improving individual lives but also driving the evolution of the insurance industry as a whole.

Personalized health insurance

In 2026, a health insurance company uses satellite data and wearable devices to monitor policyholders' health in real time. John, a policyholder, receives an alert about elevated pollution levels in his area and advice to stay indoors. This proactive health management reduces hospital visits and improves overall well-being.

Smart home insurance

By 2028, insurers offer smart home policies that integrate IoT devices and satellite data. Sarah's home is equipped with sensors that detect a gas leak, and the insurance system automatically dispatches emergency services. This quick response prevents a potential disaster and lowers claim costs.

Autonomous vehicle insurance

In 2027, insurers provide coverage for autonomous vehicles using satellite navigation and AI. Tom's self-driving car avoids a collision thanks to real-time data from satellites. His insurance policy covers any potential technical failures, ensuring a safe and seamless driving experience.

Agricultural insurance

In 2029, farmers use satellite imagery and AI to monitor crop health. An insurance company provides parametric insurance that triggers automatic payouts based on satellite data. When a drought hits, farmer Alex receives an instant payout to cover his losses, ensuring financial stability.

Climate risk insurance

By 2030, insurers use advanced climate models and satellite data to offer climate risk insurance. Maria's coastal property is at risk of flooding, but her policy includes real-time monitoring and early warning systems. This technology helps her take preventive measures, reducing damage and claims.

Practical implications for businesses in the insurance sector

NOW (0–3 YEARS)

Satellite data integration: Insurers are beginning to leverage satellite imagery and EO data to enhance underwriting and risk assessment.

Claims automation: Space-based data is improving postdisaster claims processing, enabling faster verifications and payouts.

Climate risk modeling: Insurers use space-derived climate analytics to refine flood, wildfire, and extreme weather risk models.

Space infrastructure coverage: Insurers are starting to offer policies covering satellite deployments, launch failures, and in-orbit assets.

Regulatory compliance monitoring: Growing international regulations on space debris and licensing require insurers to adapt liability policies.

NEAR (3–5 YEARS)

Parametric insurance expansion: Satellite-triggered automatic payouts will gain mainstream adoption for climate, agriculture, and disaster-related risks.

Collision liability coverage: As satellite constellations grow, insurers will need to underwrite space debris collision risks.

AI-driven underwriting: AI and geospatial analytics will enhance real-time risk modeling, reducing reliance on historical data.

Commercial spaceflight insurance: The rise of private space travel will create demand for crew and passenger liability policies.

Space cybersecurity risks: Increasing reliance on satellite communications and cloud-based infrastructure necessitates cyber liability products.

NEXT (5–10 YEARS)

Dynamic risk pricing: Insurers will adopt real-time risk adjustments using AI-driven satellite monitoring of environmental hazards.

Space-based IoT insurance: Policies will evolve to cover global IoT networks enabled by satellite connectivity for asset tracking and fleet management.

Lunar and orbital infrastructure coverage: Insurers will develop policies for lunar habitats, space stations, and in-orbit manufacturing facilities.

Debris removal incentives: New financial models will emerge to insure active debris removal technologies and incentivize safe deorbiting.

Supply chain disruption insurance: Space-based tracking of cargo and logistics will enable predictive coverage for supply chain disruptions.

Leadership considerations for the insurance and +Space intersection

Recognize emerging opportunities

Space companies need specialized insurance products to mitigate unique risks.

Develop and offer insurance solutions tailored to satellite launches, in-orbit operations, and space tourism.

Invest in innovation

The space industry is evolving rapidly, creating new insurance opportunities. Invest in R&D to create products for space tourism, space mining, and space infrastructure.

Form strategic partnerships

Collaboration with space companies can drive innovation and market expansion.

Partner with space firms to develop comprehensive insurance packages.

Scenario planning

Future scenarios illustrate the integration of space-derived tech. Use scenario planning to anticipate and prepare for future developments. AI-driven risk assessment and quantum-enhanced cybersecurity.

Practical implications

Space-derived technologies will transform the insurance sector.

Outline practical steps for integrating new technologies.

Adoption of satellite data and AI/ML for risk management.

Monitor the space economy

Monitor the change across the space sector—and broader economy—to stay agile and responsive to emerging trends and innovations.

NEXT STEPS

As the space economy continues to expand, the urgency for the insurance industry to capitalize on these opportunities cannot be overstated. The advancements in space technology present a unique chance for insurers to develop innovative products, enhance risk management, and tap into new revenue streams. The **NOW** phase is already witnessing significant integration of space-derived technologies, but the real transformation lies in the **NEAR** and **NEXT** phases. Insurance companies that act swiftly to invest in AI/ML, quantum computing, and space-based infrastructure will be well positioned to lead the market and set new industry standards.

The time to act is now. By embracing space capabilities for their Earth-based markets, and exploring new products for space activities, insurance companies can not only secure their place in the evolving space economy but also contribute to a more resilient and sustainable future. The potential benefits extend beyond financial gains, offering improved disaster response, personalized insurance products, and proactive risk management. The insurance industry must seize this moment to innovate, collaborate, and adapt, ensuring they are not just participants but pioneers in the final frontier.

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Authors

Brian Miske
Americas Space Lead
National Ignition Leader, KPMG
bmiske@kpmg.com

David Pessah
Discovery Ignition Leader, KPMG
dpessah@kpmg.com

Contributor

Jacob Hacker
Head of Strategy and Enablement, KPMG
jhacker1@kpmg.com.au

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