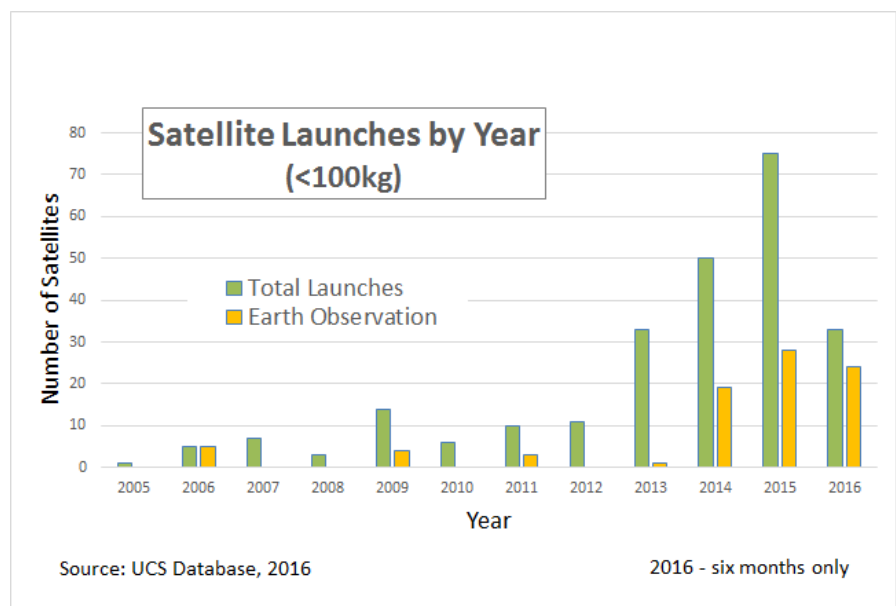


Anticipating Commercial Space Futures

The commercial space sector is undergoing rapid and fundamental change. The growth in the number of actors in space, multiple trends that are morphing quickly, and the overall expanding nature of modern space activities are disrupting traditional thinking and the existing government-industry landscape. International developments only add to the complexity. Simply put, the space environment is increasingly complex, congested, competitive, and contested. Those companies that fail to anticipate the potentialities of the future will be adrift.

With so much change, thinking about what will come next is difficult. There are no lack of forecasts and projections, but which ones should you use for planning and investment? No one prediction can provide the deeper insights into the specific opportunities and risks that each company faces. But faulty or incomplete analysis of future developments can undermine company strategies and plans. Corporate leaders are then left playing catch-up because competitors had a better approach to thinking about how future trends, uncertainties, and risks could play out.



Staying ahead of the curve, though, is not just about crystal-ball gazing to pick any single ideal projection. Instead, it is about understanding what is driving the future and scoping the range of the things that might plausibly happen. Expert opinion and simple futures projections, such as scenario-based analysis, have proven useful over the years. But more advanced analytic techniques, such as those that leverage computational power and vast increases in quantities of digital data, are showing promise, and are highly complementary to long-standing methods. Combining analytic approaches and leveraging their respective strengths, in tailored efforts, is the new wave of analytic support for business decision-making.

Fig. 1

The Non-Linear Path from the Past to the Present

The evolution of the space environment over the past two decades illustrates the challenges of prediction. Straight-line extrapolations from the past to the present would have failed to accurately and precisely capture the scale, scope, and dynamism of changes in the space environment. Think back to developments at the turn of the 21st Century, for example, including:

- Big plans for large LEO comsat constellations. High expectations that a series of new global communication systems (e.g., Globalstar, Iridium, Orbcomm, Teledesic) would successfully ride the dot.com growth.
- Advent of U.S. commercial remote sensing satellites. Several U.S. firms (e.g., Earthwatch, OrbImage, Resource 21, Space Imaging) were preparing to launch commercial observation satellites following the USG policy change that permitted private companies to operate high-resolution imaging satellites for the first time.
- High expectations for commercial space launch. There would be continued strong demand for future commercial space launch capabilities.

However, the bursting of the “dot.com” investment bubble in early 2000 dashed the optimistic expectations for major growth of the commercial space activities. Most of the satellite constellations were scrapped or scaled back significantly. Between 2000 and 2015, the space environment did not turn out as most expected.

Back to the Future? Or a Quantum Leap Forward?

So what is driving the space environment today and where is it headed? A diverse set of trends whose interactions are almost certainly going to be as difficult to predict as previous eras are driving the space environment. These are among the macro-level trends that we are tracking on behalf of our clients:

- More and different space actors. From new U.S. and foreign commercial space enterprises, including multinational partnerships, to foreign governments, the number of actors has increased substantially and continues to grow. This represents a major shift from the traditional aerospace firms that account for much of the existing global infrastructure that supports government space programs.
- Growth of the commercial space sector. Driven, in large part, by the private sector’s strength in innovation of technology and production processes it is accounting for more and more of the space economy. But this trend is not without drag; its continued growth is reliant on continuing government cooperation, regulatory relief, and market development.
- Rapidly evolving relevant technologies. Smallsats and interlinked satellite constellations are projected to continue at a rapid pace with increasing availability and declining costs creating opportunity for space system innovation and sector disruption. Meanwhile, “on the ground” developments such as big data analytics

Nano/microsatellite launch history and forecast

Projections based on announced and future plans of developers and programs indicate as many as 3,000 nano/microsatellites will require a launch from 2016 through 2022.

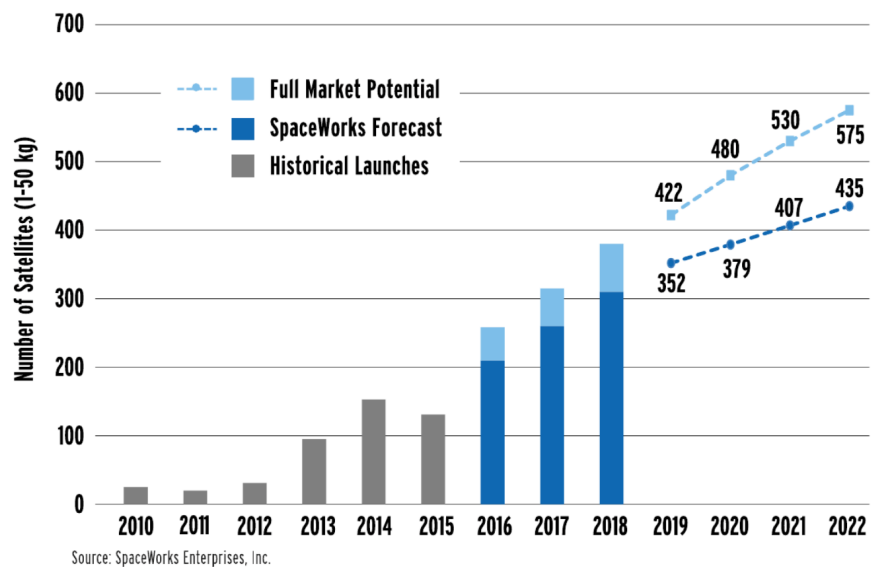
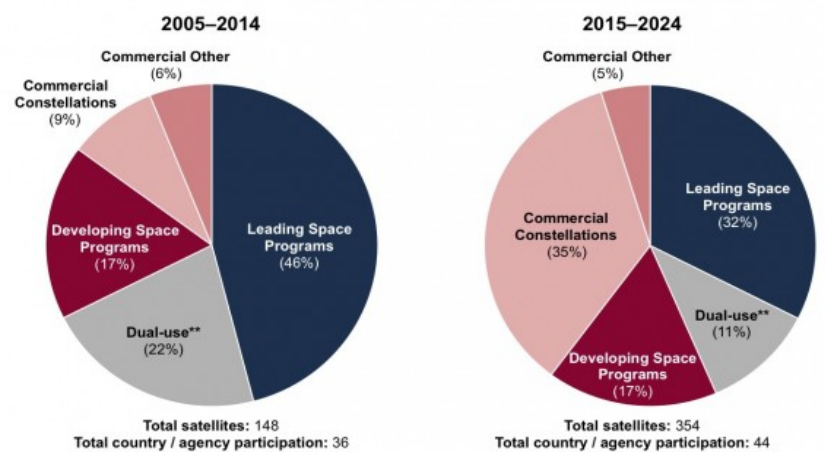


Fig. 2

and machine learning allow for leveraging of geospatial data in unprecedented ways. But not all advances will stick and become profitable.

- ***Rapidly evolving business models.*** A wide range of new capabilities – space weather, space situational awareness, satellite servicing, and others – demand new business models and regulatory efficiency. Remote sensing and other space providers seek clear understanding of the analytic verticals (agriculture, financial services, insurance, others) for maximum business effect. But only time and tailored investment throughout the entire value chain will reveal the most profitable and efficient models.
- ***Prospect of reduced cost to space.*** The cost barriers to placing large numbers of smaller satellites into space are diminishing rapidly as less expensive space launch systems and methods are deployed. While there is heavy investment in new launch concepts, not all of the launch innovators will succeed.
- ***Political and policy change.*** The recent U.S. presidential election brings added uncertainty as U.S. space program priorities and budgets are likely to change in ways that are difficult to foresee at this point. New policy and regulatory thinking requires some development and can have both direct and indirect effects that reverberate throughout the space environment for many years.

EARTH OBSERVATION SATELLITES* TO BE LAUNCHED BY OPERATOR TYPE
(WORLD, 2005–2014 AND FORECAST TO 2024)



* Meteorology satellites not included
 ** Including Chinese Yaogan program (2005-2014: 21 satellites, 2015-2024: 20 satellites)

Anticipatory Analysis: Key to Staying Ahead of the Competition

Fig. 3

For commercial firms, the rapid and often non-linear change of the emerging space environment presents both challenges and opportunities. Decisions regarding investment choices, regulatory requirements, space system operations, and global marketplace strategies must be made. What can a company do to reduce the uncertainty across this range of decisions to pick the best approach for the long-term?

In the face of this uncertainty, more nuanced and robust analysis of the future is warranted. Wherever firms lie in the overall space industrial ecosystem, they have a strong need to anticipate future developments to help them avoid or mitigate potentially serious risks. Likewise, they need to identify and promptly take advantage of opportunities. The dynamic nature of the space business places a premium on adopting a systematic approach that creates actionable insights that can adapt to rapid change and additional uncertainty. The problem is simply trying to narrowly predict an exact future is so often wrong that it can lead companies astray. Instead, the goal should be to significantly reduce uncertainty through a comprehensive and rigorous approach to assessing the future.

We call this approach to thinking about the future *anticipatory analysis*.

Anticipatory analysis is comprised of a wide range of analytic techniques that bring rigor and empiricism (to varying degrees) to assessing the future. While trying to predict the future is admirable, anticipatory analysis entails a broader approach to help organizations strategize and plan for the chaos and unpredictability of reality.

Anticipatory analysis takes a more systematic approach that can provide a wide range of insights, from identifying and characterizing the drivers of a particular issue to positing how those drivers might interact to create various outcomes (generally known as scenarios) to assessing the implications of the scenarios.

Insights provided by anticipatory analysis can easily flow into long-term planning and investment: are there scenarios that offer big challenges? What assumptions are explicitly and tacitly inherent in a company strategy about the future? What trends could lead to the non-linear success or failure of business lines or the entire business? How do relations with partners and suppliers create dependencies in the future? Beyond the first order answers, what are the underlying drivers and impediments behind each of them? By leveraging anticipatory analysis, companies can make better business decisions in the near-term, and better planning strategies, while creating contingency plans for other potential outcomes. Psychologists advise that just having focused cognitively on an outcome leaves an organization better prepared to deal with it.

IAT Tailors Anticipatory Analysis to Our Clients Needs

The commercial space sector is characterized by dynamic change and deep uncertainty, and a complex mix of government and industry actions, at home and abroad, that demand deliberate thinking about the future and how it might change. By applying some fundamentals of customized anticipatory thinking, it is possible to create a range of relevant, plausible outcomes, with attention to both the risks and opportunities for specific companies. Rather than solely relying on internal expertise, it is important for commercial space firms to leverage the wide range of futures analysis techniques incorporated into anticipatory analysis, which often requires drawing on various kinds of outside expertise.

Innovative Analytics and Training (IAT) has worked with U.S. government and commercial clients on anticipatory analysis and emerging technology markets over the past several years, including commercial space companies and others interested in a structured approach to anticipating the future. Within this area, we also leverage our work on big data analysis, cloud computing, and machine learning. Our efforts are discreet and expertly tailored to client needs.

For additional information, please contact us at contactiat@innovative-analytics.com.

Image Credits: 1: Dennis Nazarenko, LinkedIn.com, "Is it a Smallsat World?", Oct. 26, 2016.

2: Jeff Foust, SpaceNews Magazine, "How Big is the Market for Smallsat Launch Vehicles.", Apr. 11, 2016

3: Adam Keith, Earth Imaging Journal, "Significant Supply Expansion for EO Industry :Data Demand Driven by Defense and Emerging Markets." Feb. 2, 2016