February 2024

LETO SPACE

Orbital Opportunities



Understanding the Structure & Dynamics of the Space Economy

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Foreword

Enabling a Transparent & Accessible Space Market

“At LETO SPACE, we are dedicated to unlocking the opportunities of Space for our clients, guiding them through a journey of unparalleled innovation and sustainable growth. To do that, we need ways to make the Space Market transparent and accessible to them. I would like to acknowledge the commendable efforts and contributions of organisations like OECD, EIB, Euroconsult, Know.space, and Space Capital in developing frameworks that have significantly advanced our understanding of the space market. Their amazing work, which we will discuss in the following pages, has laid a solid foundation for us to build upon. As we delve deeper into the space economy, we encounter unique challenges and opportunities that demand innovative solutions. We are excited to work on a new framework that addresses these challenges and takes advantage of these opportunities. We are confident that our approach will enhance the transparency and accessibility of the space market, leading to a deeper and more comprehensive understanding for all stakeholders involved.



Patrick Pils
Founder & CEO
LETO SPACE

The Space Economy.

The global space economy has undergone a remarkable transformation, evolving from the early days of the space race to a dynamic, commercially driven industry. This transition marks a significant shift from an era where space exploration and utilisation were predominantly government-funded initiatives. Today, we witness a diversified landscape where public initiatives coexist with, and are often augmented by, private sector investments and innovations.

The early space race laid the foundation for technological advancements and aspirational goals in space exploration. However, the modern space economy is characterised by its commercial viability and entrepreneurial spirit. The entry of private companies and numerous emerging startups has catalysed a new era of space activity. These entities are not only contributing to space exploration but are also revolutionising the industry with innovative business models, private launch services, and satellite constellations. This paradigm shift is indicative of a broader trend towards the commercialisation of space and the use of space technologies and services for on-earth benefit.

The economic impact of this expanding sector is substantial. The global space economy was valued at $464 Billion in 2022 (Euroconsult, 2023a), a testament to its growing significance and potential. Investments in the space sector are soaring, both in public and private contributions, with $298 Billion in private market equity investment between 2014 and 2023 (Space Capital, 2024). Government agencies continue to fund large-scale missions and research initiatives, as private investors and companies increasingly drive the industry's growth through venture capital, public-private partnerships, and direct investment in space-related projects. The influx of private capital has accelerated the pace of innovation in the sector and broadened the scope of what is considered viable in space economics.

This expansion is illustrated by the increase in the diversity and number of stakeholders involved in space activities, from traditional aerospace contractors to New Space startups. The global space economy now encompasses a wide range of activities, from satellite manufacturing, launch services and ground stations, to the development of space-based communication and data services, in-orbit logistics and even space tourism.

These transformations in the space landscape can be said to be enabled by and, simultaneously, enabling two overarching trends: technological innovation and changing market dynamics.

- **Technological Innovation** serves as both a catalyst for and a result of the changing space landscape. The development of reusable rockets has been enabled by the demand for more efficient access to space but has also further spurred the market on by making space more accessible.

- **Changing Market Dynamics & Business Models** that are both a response to and a driver of technological innovation. As new technologies lower barriers to entry and open up novel opportunities, they foster a more vibrant market. While competition is of course involved, cooperation plays a key role through the pooling of knowledge and resources for joint innovation, making cooperation synonymous with 'space.'

The Advent of New Space

The New Space phenomenon is characterised by private companies taking the lead in space. In this new era, private companies are not just participants but are driving forces in the space sector. Their innovative approaches have disrupted the traditional space industry model, focusing on cost reduction, technological advancements, and the development of scalable business models.

There has been a surge in space-focused venture capital, with investors recognising the vast potential of the industry. This influx of private funding is a testament to the confidence in the sector's growth prospects, driving innovation and fostering a competitive environment where entrepreneurial ventures can thrive. Space-focused startups and companies are attracting significant investments. According to Space Capital[1] (2024), from 2014-2023, 'emerging' industries have received $6.9 Billion in investment, with investment in commercial space stations at $3.9 Billion, in-space logistics at $1.6B, Lunar transportation and construction at $1.0B, and Industrials, such as mining and minerals, and manufacture and assembly, at $0.5B. These investments are being used to develop cutting-edge technologies and ambitious projects that were once the sole domain of government space agencies.

Satellite internet, for instance, is a rapidly expanding area, with companies deploying constellations of small satellites to provide global broadband coverage. This service has the potential to transform communication, particularly in remote and underserved areas. Even private space station ventures are no longer just concepts but are becoming tangible realities. Companies are exploring the potential of private space habitats for research, manufacturing, and even tourism, while others are setting their sights on the Moon and other celestial bodies for exploration, experimentation, and resource extraction.

Back Down To Earth and Into the Future

All of this has given rise to a growing universality of applications, where space technologies and data are increasingly integrated into all domains of life on Earth, presenting numerous business opportunities. This trend is best illustrated in the wide-ranging applicability of satellite data to augment and enhance operations on Earth.

In agriculture, precision farming has been revolutionised by satellite imagery and data, enabling farmers to optimise crop growth and resource usage, increasing efficiency and sustainability. Similar advancements in the production industry are seen through ESG initiatives, where satellite technology monitors manufacturing processes and supply chains, aiding in reducing environmental impacts and enhancing sustainable practices. In disaster response, satellite data plays a crucial role in monitoring natural disasters, aiding in early warning systems and facilitating efficient disaster management and relief efforts. In urban planning benefits from space technologies are being seen, with satellite imagery being instrumental in city planning, infrastructure development, and environmental monitoring. Meanwhile, in the insurance sector, satellite imagery transforms risk assessment, especially in natural disaster-prone areas, streamlining claims processing and improving risk models. These applications underscore how space technology transcends its traditional boundaries, offering solutions that address pressing global and local challenges.

1 Space Capital is a seed-stage venture capital firm investing in the space economy that manages over $100 million in assets, focusing on GPS, GEOINT, and SatCom, along with providing analysis on start-up activity and investment trends.

The influence of these technologies extends, also, into the daily and routine processes. Global Navigation Satellite Systems (GNSS)[2] have transformed how people travel, enhancing safety and convenience in transportation. Satellite television brings entertainment and information to audiences worldwide. Weather forecasting, driven by data from weather satellites, plays a critical role in everything from agricultural planning, to deciding to leave the house without a jacket. These examples illustrate how space-based technologies have become integral to routine activities, often taken for granted in their ubiquity.

These advancements and increasingly pervasive applications of space technology have begun opening the doors to a whole host of new business opportunities. Driven by the demand for space-derived data and services, new business models are emerging within the space sector. Companies are leveraging satellite data to tap into markets that were previously unexplored. The commercialisation of space has also led to the development of innovative products and services. These developments, while demonstrating the potential profitability of space-related endeavours, hint at the untapped nature of the possibilities that lie within the near future of the expanding space economy.

Unlocking the Space Economy's Potential

The potential of the space economy presents a unique set of opportunities and challenges. As the space industry evolves, a crucial hurdle emerges: a gap in knowledge and understanding. For businesses outside the traditional space sector, the relevance of space technologies may not be immediately apparent. This lack of awareness can result in missed opportunities for innovation and growth. Similarly, companies within the space sector may not fully grasp the broader applications of their products, limiting their market potential and scope of impact. This dual gap in comprehension and application underscores the need for a robust framework to conceptualise, explain and measure the space economy in its entirety.

The objective of this paper is to address this challenge head-on. In the following pages, existing frameworks that conceptualise and measure the space economy are investigated and discussed. On this base, this paper aims to understand these frameworks and develop principles to follow in conceptualising and measuring the space economy. The goal is to establish best practices in conceptualisation that are not just descriptive but serve as a toolset for multiple purposes: Enabling companies outside the space sector to identify and leverage space technologies relevant to their operations; allowing space sector businesses to uncover new markets and applications for their products; and assist policymakers and investors in understanding the broader economic implications and opportunities of space activities.

2 Global Navigation Satellite System (GNSS) refers to a satellite infrastructure that allows users with a compatible device to determine their position, velocity, and time by processing the receivable radio signals. Current systems include GPS (USA), GLONASS (Russian Federation), Galileo (EU), BeiDou (PRC).

1.

OECD

OECD: Handbook on Measuring the Space Economy



The Organisation for Economic Co-operation and Development (OECD) is an international entity known for setting global standards and providing a platform for policy dialogue and sharing of best practices. With a commitment to promoting policies that improve economic and social well-being worldwide, the OECD plays a central role in offering guidance and support to member state governments.

In the context of the space economy, the OECD recognises the sector's growing significance and complexity, and therefore the need for internationally recognised and robust standards and classifications. The organisation's approach reflects the need to develop a comprehensive understanding of the space economy's component parts, addressing the need for a structured and universally accepted framework amidst the diversity of activities and stakeholders in the sector.

Setting the Standard.

In 2012, the OECD publicly announced its efforts by publishing the first edition of the "Handbook on Measuring the Space Economy", marking an international effort to systematically define and measure this complex sector. The handbook's original definition of the space economy, with its diverse array of economic activities, gained acceptance among governments and private sector entities. However, the past decade has witnessed substantial changes in the space economy, driven by an increasing number of countries and business venturing into space activities.

Recognising these evolving dynamics and the necessity for updated standards, in 2022 the OECD introduced this second edition of the Handbook. It aims to address the informational needs of public agencies, which continue to fund a significant portion of space programs, and private-sector decision-makers, who can benefit from enhanced economic insights into the space sector.

This revised edition of the Handbook reflects the need to adapt frameworks to the changing landscape of space activities, technologies, and the evolving needs of stakeholders. By offering refined methodologies and practical guidance, the Handbook continues to shape the narrative and understanding of the space economy, reinforcing its place as the document of record on measurement and categorisation of the space economy.

The OECD Framework

The OECD "Handbook on Measuring the Space Economy" segments the space economy into three fundamental categories: Upstream, Downstream[3], and Space-derived Activities. This delineation simplifies the complex nature of space activities and provides an overview that encompasses the entirety of the industry.

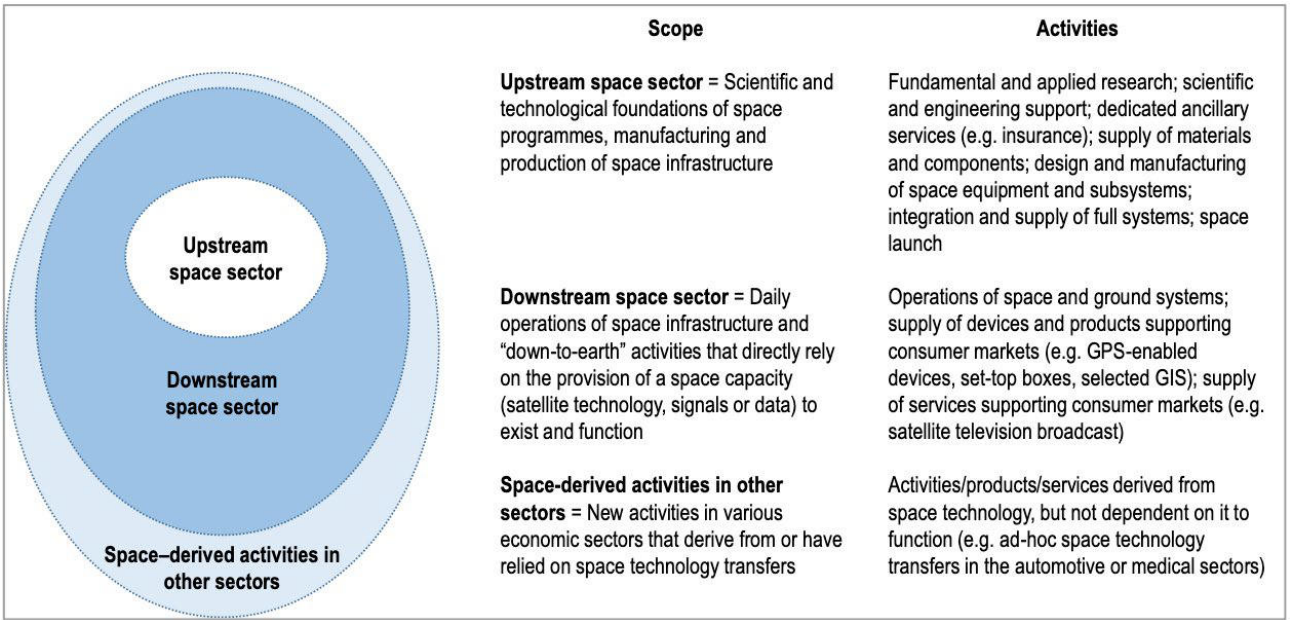


Figure 1 - Upstream, Downstream & Space-derived Activities (OECD, 2023)

3 The terms 'Upstream' and 'Downstream' are also widely used in the oil and gas industry to differentiate between exploration and extraction, and refining and distribution activities. They are derived from the flow of a river where "Upstream" refers to the direction the river comes from (towards its source), and "Downstream" refers to the direction the river is flowing towards (towards its mouth).

Upstream Segment

The "Upstream" segment, as defined by the OECD, encompasses the initial stages of the space economy, primarily focusing on the development, production, and deployment of space infrastructure. This segment includes a range of activities from research and development (R&D) to the manufacturing of satellites, launch vehicles, and ground control systems. The upstream segment is pivotal as it lays the technological and material foundation upon which the entire space economy is built.

The Upstream segment is marked by high capital intensity and significant barriers to entry, given the advanced technological expertise and substantial financial investment required. However, it is also an area where innovation thrives, driven by both public and private sector entities aiming to push the boundaries of space technology. The OECD's commentary on this segment highlights its dynamic nature and its critical role in driving the overall growth and sustainability of the space economy. The constant evolution of technology in this segment fosters the development of more advanced, reliable, and cost-effective space infrastructure.

The OECD's framework provides a selected list of activities, products, and services included in the Upstream segment:

- **Design and Production of Launch Vehicles** involves the development and manufacturing of rockets and spacecraft capable of transporting payloads into space. Innovations in this area are focused on enhancing the reliability, safety, and cost-effectiveness of launch services.

> ***"One of the key areas within the Upstream segment is the development and manufacturing of launch vehicles, a sector that has seen significant advancements in recent years. The push towards reusable launch systems, for instance, is a development aimed at reducing the cost of accessing space, and, in turn, opening new possibilities for the utilisation and exploration of space. Similarly, satellite manufacturing is another critical area within the Upstream segment, where innovation efforts focus on enhancing the capabilities of satellites in terms of communication, imaging, and navigation, while also reducing size and cost to enable a broader application spectrum.***

- **Satellite Manufacturing** includes the process of designing, building, and testing satellites for various purposes such as communication, Earth observation (EO), scientific research, and navigation. The ongoing miniaturisation of satellites and advancements in satellite technology are opening new frontiers for the industry.

- **Ground Station**[4] **Equipment** encompasses the development and deployment of ground-based infrastructure essential for communicating with and controlling space assets. This includes satellite dishes, receivers, and command centres that directly operation of space assets, along with the infrastructure of launch sites from which these assets are sent into space.

- **Operation of Launch Sites** involves managing and maintaining the facilities from which space missions are launched. It includes ensuring the safety, efficiency, and regulatory compliance of space launches.

- **Provision of Launch Services** includes the actual service of launching payloads into space. This has become an increasingly competitive and innovative market, with private companies playing a significant role.

The Upstream segment's contribution extends beyond its direct economic value. It is a catalyst for technological spillovers that benefit other sectors, driving broader economic and societal advancements. For instance, technologies developed for space missions have found applications in medical imaging, telecommunications, and material science, among others.

4 Ground Stations also exist to receive and distribute the data that space assets collect, with many of these stations also involved in the operation of these assets, blurring the Upstream/Downstream definition. For more see 'Mid-Stream Activities', page 8.

Downstream Segment

The OECD defines the "Downstream" segment of the space economy as the part that involves the operation of space infrastructure and the delivery of space-based services and applications to end-users. This segment encompasses activities including satellite communication (SatCom), Earth Observation (EO), and positioning, navigation, and timing (PNT) services. The Downstream segment represents the direct interface between space technology and society, offering tangible benefits and applications that affect various aspects of daily life and economic activities.

The Downstream segment is more consumer-oriented and market-driven when compared to the Upstream segment. It's marked by a lower barrier to entry and a faster pace of innovation, largely due to the direct applicability of its products and services. The OECD highlights the transformative impact of the Downstream segment, noting its capacity to spur economic growth, foster innovation, and address societal challenges. From enhancing connectivity in remote areas through satellite internet, to supporting disaster management efforts with EO data, the Downstream segment translates space technology into practical solutions that have a profound societal impact.

The OECD's framework provides a detailing of the Downstream segment, highlighting the multitude of activities, products, and services that translate space technology into practical applications:

- **Satellite Broadcasting Services** include the transmission of television and radio content via satellites, offering global reach and reliability, enhancing the accessibility and quality of media consumption.
- **Telecommunications** provide critical infrastructure for voice and other data services, especially in remote and underserved regions, ensuring connectivity and supporting global communication networks.
- **EO and Imaging Services** offer insights for weather forecasting, environmental monitoring, agriculture, urban planning, and disaster response by leveraging satellites to gather data about the Earth's surface.
- **Global Navigation Satellite System** GNSS-based Applications have become integral in various sectors, beyond basic location services, including transportation, logistics, agriculture, and emergency services enhancing efficiency, safety, and convenience.

The OECD's description of the Downstream segment highlights its reach, into the creation of new markets and the disruption of traditional industries. It shows how space technology can drive innovation, catalyse new business models, and stimulate economic growth. The OECD's framework captures the breadth of space-derived applications and services and highlights the impact that space technology has on driving forward global economic and social development.

> ***"The Downstream segment stands out for its direct impact on economic and social progress. It is here that the technological advancements developed in the Upstream segment translate into tangible benefits and applications, weaving space technology seamlessly into the fabric of our daily lives. The rise of satellite internet services is revolutionising global connectivity, bridging the digital divide, and opening up new avenues; in agriculture, where satellite imagery guides precision farming, and in disaster management, where real-time satellite data becomes a lifeline during emergencies.***

Space-derived Activities

Space-derived activities encompass the broader economic and societal benefits derived from space technology and infrastructure. These activities do not directly involve the operation of space assets but leverage the data and capabilities developed by the Upstream and Downstream segments. The OECD defines space-derived activities as "new activities in various economic sectors that derived from or have relied on space technology transfers" (pp. 31). This includes companies that significantly utilise space technology or space-derived data to offer products or services. This can be seen most evidently in technology transfers to the automotive and medical sectors, and highlights the pervasive influence of space technology, driving innovation and contributing to economic growth beyond the traditional boundaries of the space sector.

Mid-Stream Activities

The concept of "mid-stream" activities has emerged as a distinct category within the space economy, signifying operations that bridge the gap between the Upstream and Downstream segments. These activities, crucial for the functioning of space and ground systems, include satellite command and control, data processing and distribution, and the operation of ground stations. They ensure the seamless transition of space technology into practical applications, playing a vital role in managing space assets and turning raw satellite data into usable information. However, the Handbook, while acknowledging these activities, predominantly places them within the Downstream segment, stating that they may be categorised as either upstream or downstream activities depending on methodological choices.

Overall Segmentation & Measurement

The Handbook acknowledges the inherent challenges in the segmentation and measurement of space-related activities, primarily due to the industry's rapid evolution. Space technology's presence in numerous industries complicates the clear delineation of activities, blurring the lines between what is considered a space activity and what is not. This integration is a testament to the space sector's significance but poses a challenge for consistent and clear categorisation and assessment.

In response to these challenges, the OECD emphasises the need for a framework that is not static but adaptive, capable of evolving alongside technological advancements and changing market dynamics. This adaptability is crucial for ensuring that the framework remains relevant and accurate in capturing the multifaceted nature of space activities, and in reflecting the industry's continuous innovation and growth.

The OECD presents its framework as a foundational tool, establishing a common understanding and a globally accepted methodology for assessing the space economy's scale, growth, and potential. The framework is designed to set international standards, offering a unified approach that can be widely adopted for analysing the space economy. Its significance lies in its consistency and comparability across different countries and sectors, facilitating international dialogue and collaboration. By establishing a methodology that is globally accepted, the OECD framework aids in overcoming the challenges posed by the diverse and integrated nature of space activities.

Thoughts & Observations on the Framework

The OECD's approach in conceptualising the space economy is foundational, setting a precedent for a consistent, internationally recognised method of categorisation and measurement. It serves as a starting point, offering a scaffold upon which more responsive and targeted framework models can be developed.

While the framework offers a high-level, and therefore simplified, segmentation of the space economy into upstream, downstream, and space-derived activities, this simplicity is one of its strengths. It ensures broader applicability and ease of adoption across various sectors and countries. The simplified model facilitates a common starting point for stakeholders, enabling them to build upon it according to their specific needs and contexts.

However, the high-level nature of the framework also introduces potential limitations. The broad categorisations do not adequately capture the nuances, specificities and overlapping nature of space activities. Space sector supply chains are not made transparent through this approach and whole subsectors, such as Space Situational Awareness, are not clearly captured. Due to the role of the OECD more generally, the categorisation in this framework represents the lowest common denominator between categorisations that exist globally. There is a need for further refinement to address the specific needs of the industry, to develop an integration of more granular categories, and the inclusion of emerging sectors within the space economy that are not currently well-represented.

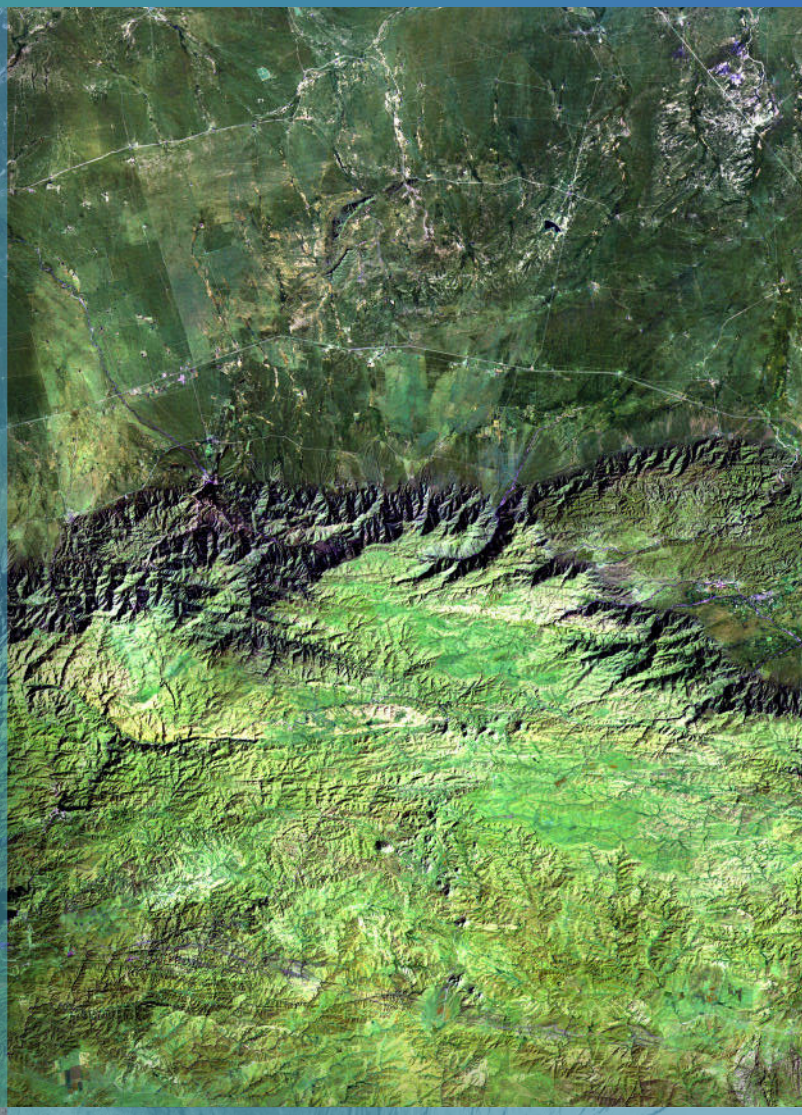
The utility of the OECD's framework centres around the role it plays in fostering international collaboration, advising policymakers, and in industry development. By providing a common language and structure for understanding the space economy, the framework facilitates dialogue and cooperation among countries, agencies, and companies. This shared understanding is crucial in forming international partnerships, harmonising regulations, and driving collective efforts towards sustainable and responsible space activities.

Additionally, the framework's adaptability to future changes in the space sector must be considered. The handbook offers just two references to 'New Space'. As new technologies emerge and market dynamics shift, the framework must evolve to remain relevant and useful. The 10-year gap between editions one and two of the handbook, highlights the depth of work the OECD conducts developing such a document. Its ability to adapt will determine its long-term efficacy in capturing the true scope and impact of the space economy.

2.

European Investment Bank

European Investment Bank: The Future of the European Space Sector



The European Investment Bank (EIB) engages in funding long-term investments that align with EU policy objectives. The EIB's involvement in the space sector is driven by the sector's potential to catalyse innovation, stimulate economic growth, and enhance Europe's technological leadership and strategic independence. As the EU's lending arm, the EIB's research necessarily adopts an investment-focused approach that centres on the economic and technological development of the space industry. Their role extends beyond financing, encompassing a broader vision of shaping markets through investments that align with the overarching goals of the EU.

Understanding Investment.

The EIB document, “The Future of the European Space Sector,” serves as a comprehensive guide for policymakers, industry leaders, and investors, offering insights into the current state and future trajectory of the European space industry. The underlying set of frameworks are developed through an investment-centric perspective, highlighting market dynamics, and investment risks and opportunities in the space economy. With a distinct European focus, the report situates the European space industry within the global market. This perspective is instrumental in understanding the unique position and challenges of the European space sector, especially in the context of global competition and collaboration. The approach assesses economic aspects but also underscores strategic policy implications. It emphasises the necessity of informed policymaking, focusing on innovation, competitiveness, and strategic autonomy. Through this lens, the EIB’s frameworks serves as a guide for stakeholders to navigate the evolving landscape of the space economy, aiming to facilitate informed decision-making and strategic investments that align with the broader goals of the European Union.

The EIB Frameworks

The EIB’s work on the space economy presents a multi-layered approach. The space industry, once the dominion of government-led mega-projects, is now increasingly defined by innovation and entrepreneurship. The EIB’s approach, acknowledges this, centred around three frameworks: the “Space Sector Value Chain”, the “Traditional & New Space Services Spectrum by Maturity” and the “Landscape of Business Services, Business Models & Segments”. Together, they offer a structured lens through which categorising and understanding of the myriad components that constitute the space economy can occur, encapsulating the breadth and depth of the industry.

Space Sector Value Chain Framework

The “Space Sector Value Chain Framework” provides a structured approach to understanding the complexities of the space industry. This framework is designed to encapsulate the entire range of activities and market segments involved in the space sector, presenting a comprehensive overview that is essential for stakeholders to navigate the industry.

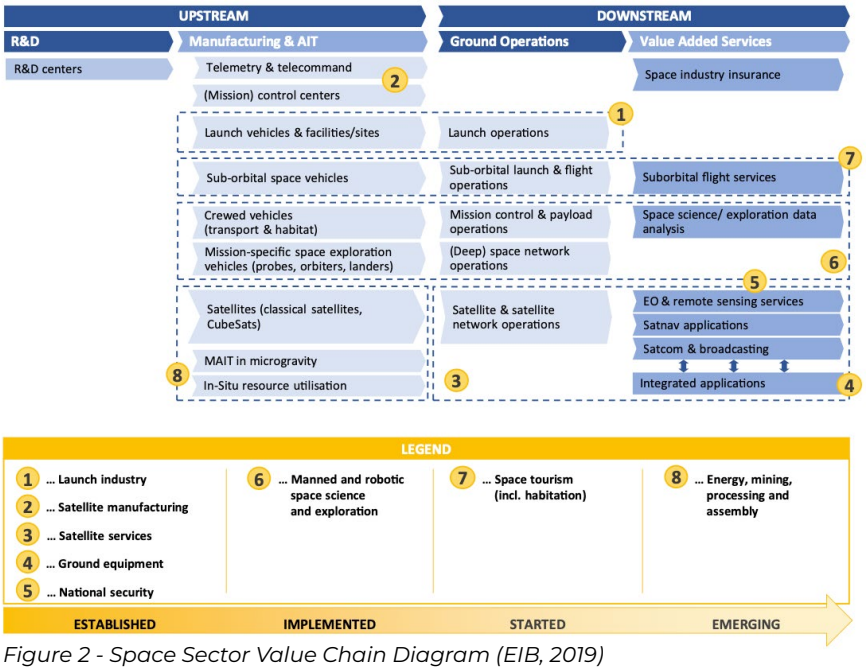


Figure 2 - Space Sector Value Chain Diagram (EIB, 2019)

The framework operates at four distinct levels, each offering a different conceptual perspective on the space sector.

The first level distinguishes between Upstream and Downstream activities[5], mirroring generally accepted distinctions between these segments. Upstream activities encompass the foundational aspects of space activity, including all activities "that lead to the development of space infrastructure, including R&D, production of satellites and launchers and the deployment of such infrastructure." Downstream activities involve operational aspects and "commercial activities based on the use of data provided by space infrastructure, such as broadcasting, communication, navigation and EO." This division provides clarity on the value chain, highlighting the different roles and contributions of various industry segments.

> ***The Upstream segment is not merely a collection of high-tech industries but a foundational driver of growth and innovation. It's a segment where the marriage of cutting-edge technology and bold engineering meets the ambition of humanity's quest for space exploration. The continuous advancements in this segment have not only reduced the cost of accessing space but also democratised space activities, enabling more countries and private entities to participate in what was once a domain reserved for a few.***

The second level of the framework identifies eight key Market Segments. These segments include the Launcher Industry, Satellite Manufacturing, Satellite Services, Ground Equipment, National Security, Space Science and Exploration, Space Tourism, and Energy, Mining, Processing, and Assembly. This segmentation enables a deeper understanding of the diverse activities that comprise the space sector, ranging from the technical aspects of manufacturing and launching satellites to the still more exploratory domains of space tourism and space-based energy initiatives.

The third level of the framework breaks down these market segments into 22 Market Domains. For instance, Space Tourism is divided into domains such as Sub-Orbital Vehicles, Launch & Flight Operations, and Flight Services. This granular view allows for a more nuanced understanding of each segment, providing insights into the specific areas of growth, innovation, and investment within the space sector.

The fourth and final level of the framework categorises the market segments into four Stages of Maturity: Fully Established, Implemented, Started, and Emerging. This categorisation provides a temporal perspective, offering insights into the development stage of each market segment.

- **Fully established** services are those with a strong market presence and multiple players, such as traditional SatCom and EO.
- **Implemented** services are those with a market but limited in scope, like certain space exploration initiatives.
- **Started** services are in their infancy, such as space tourism, where the market is being actively developed.
- **Emerging** services are at the conceptual stage, exploring future possibilities and innovations.

For example, sectors like the Launch Industry and Satellite Manufacturing are considered Fully Established, indicating a mature market with numerous players and a stable user base. In contrast, domains like Energy, Mining, Processing, and Assembly are labelled as Emerging, signalling nascent markets with significant potential for growth and innovation.

5 Of the organisations mentioned in this paper, Know.space and Space Capital are the only ones that do not clearly emphasise this distinction. Upstream and Downstream are established terms that form the basis of most segmentation across the space sector.

The “Space Sector Value Chain Framework” serves as a tool for developing a deep understanding of the space economy. It systematically segments the industry, providing clarity on the components at various levels and their developmental stages. This comprehensive approach provides an excellent instrument for investors, policymakers, and industry stakeholders to assess opportunities, risks, and trends within the space sector, thereby enabling informed decision-making and strategic planning.

Traditional & New Space Services Spectrum by Maturity

The “Traditional & New Space Services Spectrum by Maturity” offers a development-oriented perspective on the space sector, categorising services based on their maturity stages. This framework is crucial for understanding the evolution of space services and technologies, differentiating between established practices and emerging innovations. This spectrum divides space services into two primary categories: Traditional Space and New Space.

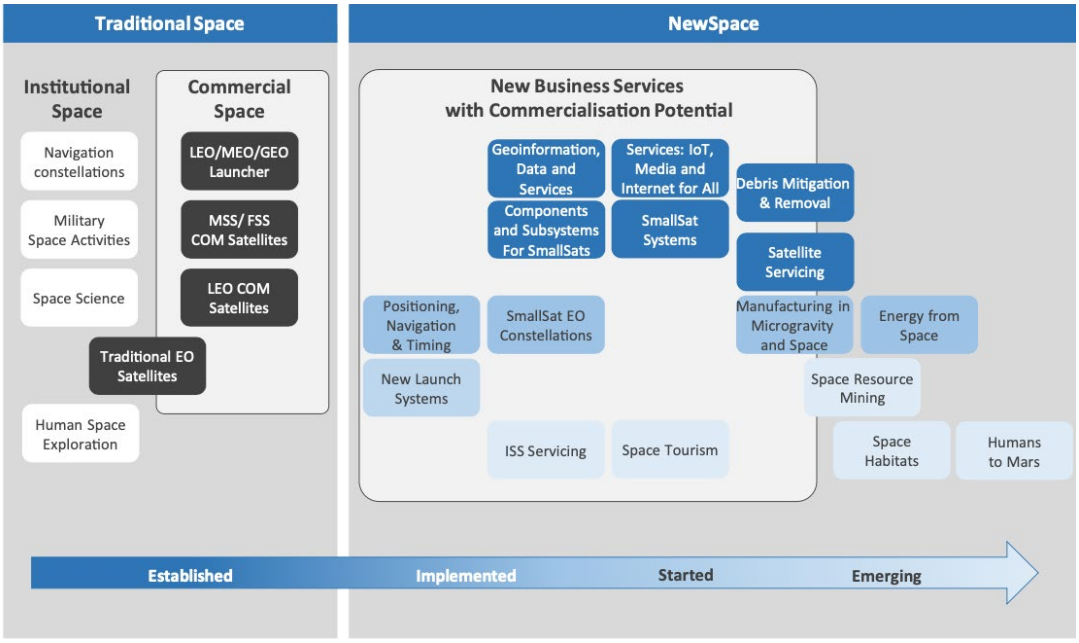


Figure 3 - Tradition & New Space Business Services Spectrum Diagram (EIB, 2019)

Traditional Space services are those that are ‘established’ and have been the backbone of the space industry for decades. These include institutional and military space activities, space science, human space exploration, and traditional EO satellites. These segments are characterised by their maturity, stability, and well-defined market dynamics. They represent the historical foundation of the space sector, dominated by government-funded programs and large-scale industrial projects.

New Space, on the other hand, represents a more dynamic and evolving category. It encompasses a range of technologies and services that are ‘implemented’, ‘started’, or ‘emerging’. This segment reflects the recent shifts in the space industry, characterised by private sector innovation, reduction in costs, and the development of new business models. New Space services are not yet fully established but show significant potential for commercialisation and growth. This includes segments like SmallSat[6] constellations for communication and observation, space tourism, and ambitious projects like asteroid mining and space-based energy harvesting.

This spectrum by maturity is useful in understanding the current landscape and future trajectory

6 ‘SmallSats’ are satellites weighing under 600kg, (BryceTech, 2023). They are often used in EO, where a moderate resolution (2.5-5 metres) is required, suitable for tasks including forest management, urban planning, and insurance data collection.

of the space economy. It helps stakeholders to identify areas ripe for investment and development, to understand the risk profile of different segments, and to anticipate future trends. The framework also serves as a guide for policymakers and industry leaders, aiding in strategic planning and decision-making.

The "Traditional & New Space Services Spectrum by Maturity"-Framework offers a comprehensive view of the space sector, highlighting the contrast between established practices and innovative ventures. It provides valuable insights into the evolution of space services and technologies, aiding in the understanding of the sector's dynamic nature.

> ***Our return to the first island off the coast of Earth, our Moon represents both a new era in space exploration and in economic opportunity. This next phase of lunar exploration is not just about scientific discovery, it is more than ever about establishing a lunar economy. From mining valuable resources to potentially setting up sustainable bases, the Moon is set to become a key location for expanding our activities and presence in space. This exciting venture promises advancements in space technology that can open the door to a future where the Moon plays a broader role in our social and economic development back at home.***

Landscape of Business Services, Business Models & Segments

The "Landscape of Business Services, Business Models & Segments"-Framework in the EIB document provides an intricate view of the space sector's business ecosystem. This landscape merges various elements of the space economy, offering a multi-dimensional understanding of business activities and models within this domain.

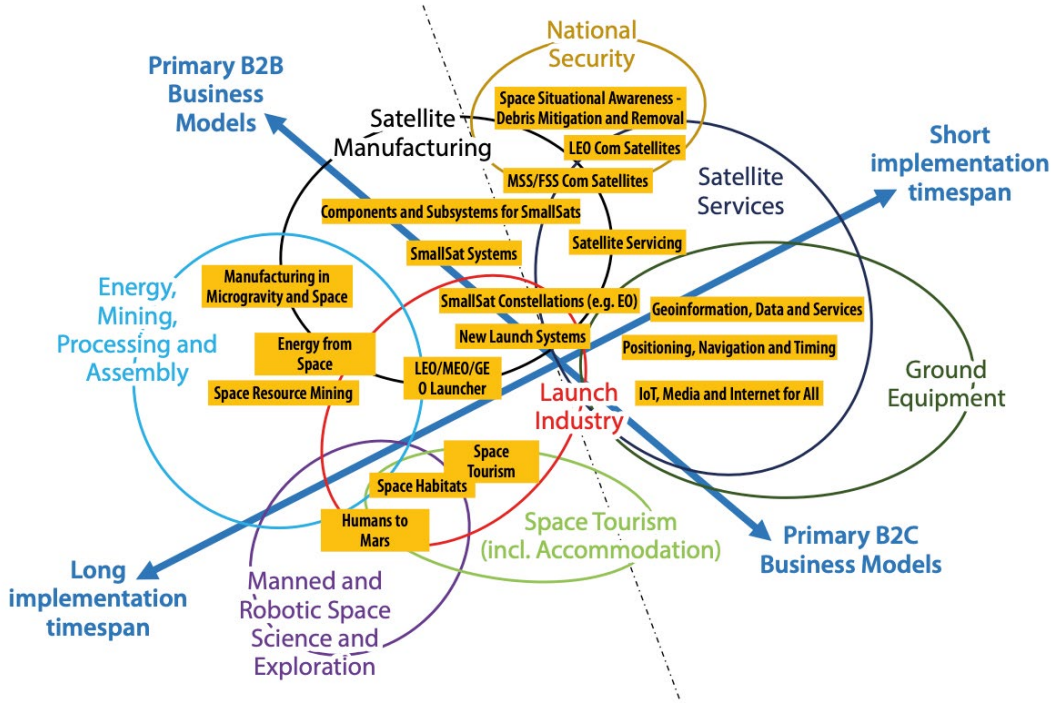


Figure 4 - Landscape of Business Services, Models, & Segments Diagram (EIB, 2019)

The framework integrates three primary components: Market Segments, Business Services, and Interdependencies. It considers the diverse range of market segments identified in the space economy, such as satellite services, space tourism, and national security. Each segment is further dissected to reveal specific business services, encapsulating the variety of offerings within the space sector. This approach allows for a detailed view of the space industry, identifying the breadth and depth of services available.

A unique aspect of this framework is its focus on the interdependencies between different activities in the space sector. It recognises that various segments and services are not isolated but are interconnected in multiple ways, influencing, and supporting each other. This addition is critical in understanding the complex nature of the space economy and the synergies that drive its growth.

Additionally, the framework categorises these activities based on two dimensions: Business Character (B2B/B2C) and Implementation Time Span. This classification provides insights into the target market of each service - whether it is business-to-business or business-to-consumer - and the time frame required for their implementation. Such categorisation allows for the assessment of risk and potential of different market segments and services.

The EIB highlights the landscape framework's utility in risk assessment, indicating how certain segments and business models might present more significant risks based on their market orientation, implementation timelines and interdependencies. This is particularly valuable for investors and decision-makers who need to understand the risk-return profile of various initiatives within the space sector.

The landscape framework offers a holistic view of the space economy's business elements. It does not simply map out the variety of services and segments but provides critical insights into their interdependencies, market orientation, and implementation timelines. This comprehensive approach is crucial for stakeholders looking to navigate the complex and interwoven landscape of the space industry.

Overall Segmentation & Measurement

Together the framework, spectrum and landscape models offer an in-depth understanding of the space economy at multiple levels of fidelity and from different vantage points. The "Space Sector Value Chain Framework" structure allows for a clear delineation of the various roles and contributions within the industry, from the development of space infrastructure to the commercialisation of space-based data. It combines a relatively easy-to-understand division of activities with a comprehensive aggregation of perspectives – stream, segment, activity, and maturity.

Further specifying the real activities of the space economy, the "Traditional & New Space Services Spectrum by Maturity" differentiates between established and emerging business services. It highlights the industry's evolution, acknowledging the dynamics at play between traditional space services and innovative New Space ventures. This categorisation, again, underscores the importance of understanding the maturity levels of different market segments.

> **"A growing number of innovative space startups are highlighting the potential and relevance of space technology in our daily lives. These startups are harnessing data and insights from space to drive advancements in sectors from agriculture and logistics to telecommunications and disaster management. Their work transcends traditional space activities, translating high-tech space data into practical, everyday applications. With their creative approaches, these startups are making space technology more accessible, in turn opening new markets and opportunities. The potential they hold is immense as they continue to evolve and expand, they are set to play a pivotal role in shaping the future of technology, business, and how we interact with our world.**

The "Landscape of Business Services, Business Models & Segments" further enriches this understanding. It describes the interdependencies within the industry, analysing how different segments and services are interrelated. By categorising these based on business character and implementation time span, it provides valuable insights into the target markets and potential risks associated with various space-related activities.

Collectively, these frameworks underscore the importance of accurately segmenting and measuring the industry to keep pace with rapid technological advancements and evolving market dynamics. The relative complexity of these frameworks reflects the broader challenge of conceptualising and measuring the space economy. This complexity is indicative of the sector's rich potential and diversity, highlighting the need for adaptable and comprehensive tools to navigate its intricacies. The EIB's integrated approach serves as a crucial guide for investors, policymakers, and industry players, facilitating informed decision-making and strategic planning in the space sector.

Thoughts & Observations on the Framework

The EIB's frameworks for the space sector demonstrate a commendable level of depth and comprehensiveness. These frameworks effectively address various dimensions such as technological advancements, market segments, and business models. This multi-layered approach is instrumental for stakeholders seeking a thorough understanding of the space industry's component parts. The focus on investment and business services means that these frameworks are particularly beneficial for investors and policymakers. The frameworks cater to the needs of these stakeholders by providing a clear structure to identify potential investment opportunities and market trends. However, this investment-centric approach does not limit the frameworks' broader applicability. The approach lends itself to a more logical and, therefore, understandable breakdown from very high-level segmentation to service-specific description.

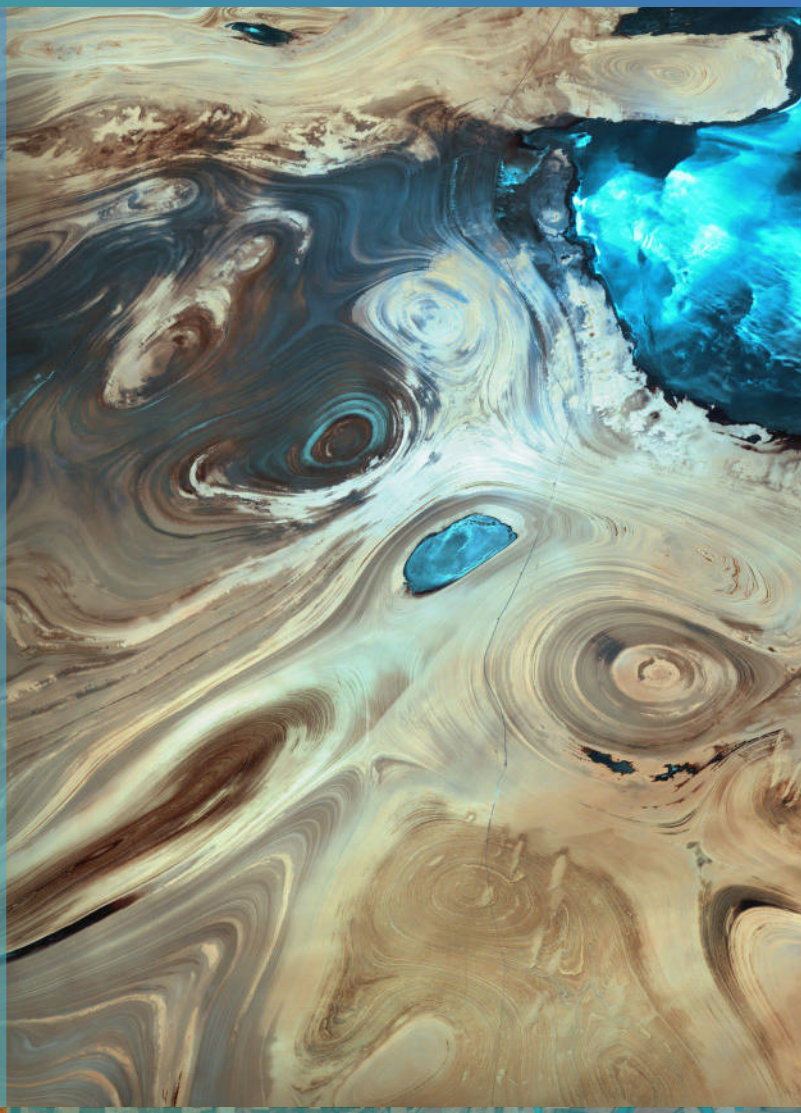
A notable limitation of the EIB's frameworks is their intricate and separated nature. A clear line can be drawn between the frameworks, however this requires a certain level of knowledge about the space economy or investment analysis more broadly. Providing a roadmap by which this system of frameworks can be navigated, could ensure accessibility to a wider range of stakeholders, enhancing the frameworks' broader applicability and overall utility.

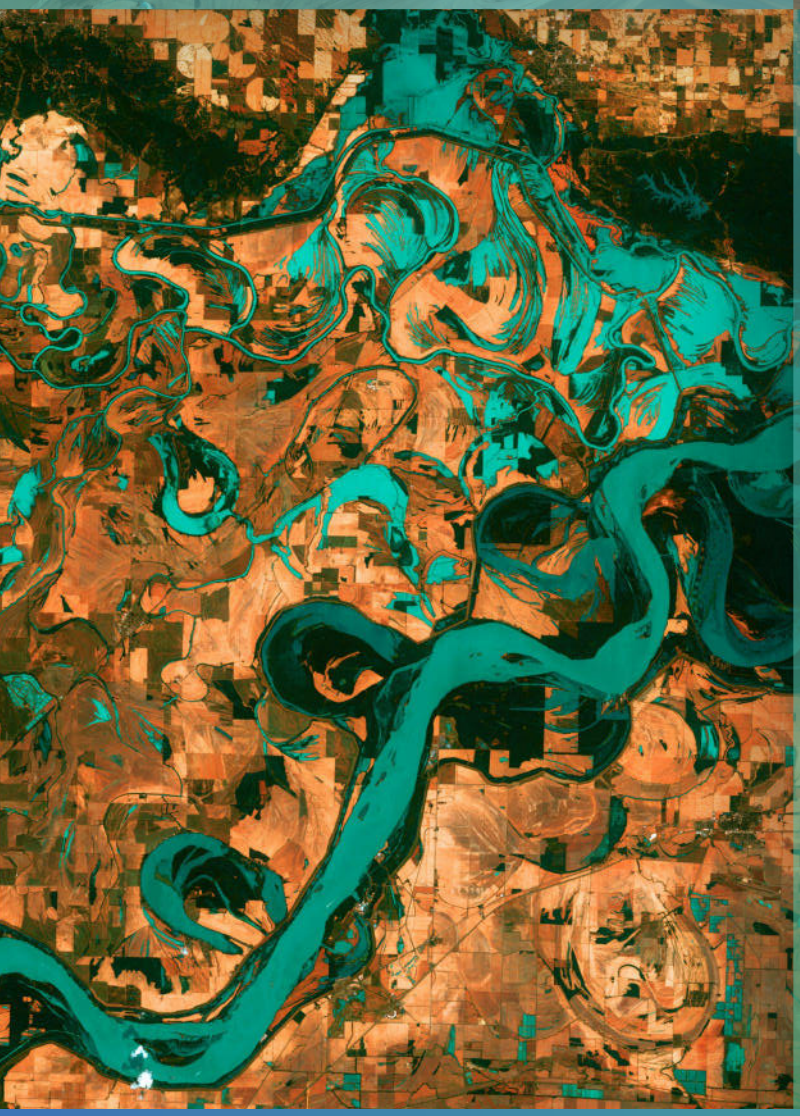
Overall, the EIB's frameworks serve as a valuable set of tools for understanding and navigating the space economy. Their detailed approach aids in strategic planning, risk assessment, and decision-making. Their complexity, however, necessitates a certain level of space economy knowledge, and a more joined-up process for their use could make them more effective. Despite this, the frameworks' in-depth coverage and structured analysis offer crucial insights for stakeholders within the space sector. For future iterations, balancing complexity with accessibility could broaden their appeal, making them more useful to a diverse range of stakeholders within and without the space economy.

3.

Euroconsult

Euroconsult: Space Economy Report





Euroconsult is a privately owned consulting and market intelligence firm for the space sector, with a particular focus on the satellite industry. The firm engages in four activity areas: executive events & training, strategic consulting, market intelligence, and technology consulting (through their subsidiary Satconsult). With a focus on market dynamics, Euroconsult provides reports that investigate market, industry, policy, programme, and financial information in the international space economy. The group is well established in the European space sector, with several institutional bodies consistently using Euroconsult analysis in their decision-making processes.

Peering inside the Space Bubble.

Euroconsult's position as a space consulting and market intelligence firm situates it well to provide an authoritative framework for conceptualising and measuring the space economy. Their clients vary from corporations to governments to supranational bodies. Their approach therefore is characterised by a need for coverage of all perspectives on the space economy, from commercial ventures to government initiatives.

Despite its European roots, Euroconsult's framework adopts a global outlook, recognising the international nature of the space sector. This is evident in their operational reach, which extends beyond Europe, with offices in several key global locations. Such a broadened perspective ensures that the framework does not limit itself to a singular regional focus but rather embraces a comprehensive international view. This inclusive approach is crucial in a field as dynamic and globally interconnected as the space economy, where regional developments can have far-reaching implications.

The framework's global perspective allows it to effectively capture the intricate dynamics of the space economy, making it a valuable tool for a wide range of stakeholders looking to navigate the complexities of this evolving industry.

The Euroconsult Framework

The Space Economy

Euroconsult's broadest conceptualisation is that of the Space Economy. For this, its definition is in line with that of the OECD definition, taking the economy to be "the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space" (OECD, 2022). This definition is extremely broad and offers little in the way of targeted understanding. Therefore, Euroconsult divides this definition into two parts:

The Space Market

The Space Market's defining feature is that it is made up of revenue-generating activities. These activities are conceptualised as the value of the procurement, delivery and contracting of systems and services by commercial players, government civil agencies, and defence agencies.

Non-contracted Activities

These activities are non-revenue-generating but support or are involved with the space economy to some degree. Non-contracted activities are government-centric and include the internal costs of running government agencies and R&D that is funded through public finances.

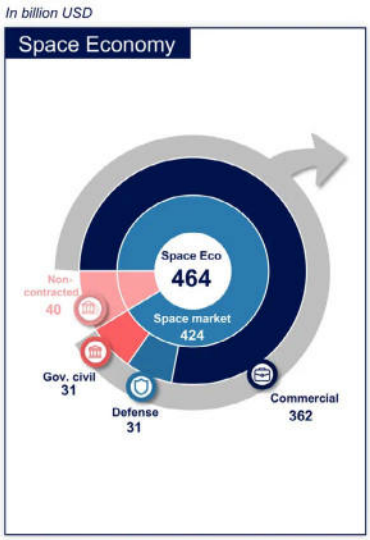


Figure 5 - Space Economy 2022 Diagram (Euroconsult, 2023b)

While acknowledging the role of private investments, Euroconsult does not provide forecasting of these figures. Regardless of this, private investments fall under the commercial space sector, enabling the innovation and provision of services we see throughout the market.

The Space Market Framework

Euroconsult's framework sits within the Space Market and operates at three levels of categorisation. The focus here is on measurement within these categories, to understand the value of these segments and activities.

The first of these is the familiar Upstream/Downstream division. The framework, however, allocates five verticals to this division.

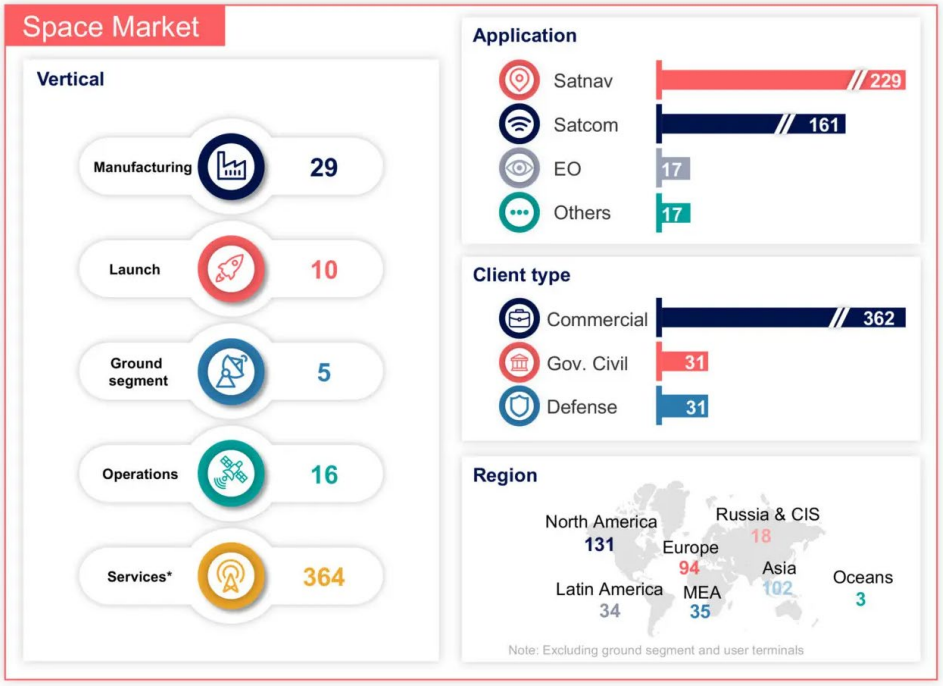


Figure 6 - Space Market 2022 Diagram (Euroconsult, 2023b)

The upstream sector of the Space Market encompasses fundamental space activities:

- **Manufacturing** focuses on the production of spacecraft and satellites.
- **Launch** activities involve the actual process of sending space assets into orbit. This segment includes not just satellite launches but also cargo and manned space transportation services.
- **Ground Segment** refers to the infrastructure on Earth that supports the operation of space assets and the delivery of their services, including commercial teleports for SatCom and EO applications.

The downstream sector deals with the exploitation of space assets to deliver services and generate revenue.

- **Operations** cover the management and utilisation of satellites, including the sale of satellite capacity for SatCom and EO or the operation of satellite or other spacefaring systems, often outsourced to private actors. This is crucial in translating space assets into practical applications.
- **Services** include the delivery of satellite-based services, including communication services, reselling of EO data, and navigation services derived from GNSS signals. This segment is the direct interface between space assets and societal benefits.

This application of the Upstream and Downstream segments illustrates a comprehensive lifecycle of space assets, from the initial stages of development to the delivery of services. The sequential flow highlights the integrated nature of the space economy, where each segment relies on the preceding one to create value and benefits from space activities.

The second level within the Space Market focuses on the applications that these verticals enable. These applications can exist in both Upstream and Downstream, and interdependencies exist between each of the verticals and applications. Of all the application segments that Euroconsult acknowledges, SatCom and EO – within Upstream – are the most significant, accounting for the largest share of investment.

- **Satellite Communications** encompass the activities related to the manufacturing, launching, and operational support of communication satellites. It accounts for the revenues from operators and subscriber fees, including the sale of receiving terminals.

- **Earth Observation** addresses EO satellite systems from creation to application. It includes the value of imagery and the extraction of value-added services from the collected data.

- **Satellite Navigation** focuses on the lifecycle of navigation satellites, including device sales and services enabled by GNSS signals. This segment highlights the impact of navigation technologies on various consumer and commercial applications.

Euroconsult also defines other applications. These broaden the scope to encompass commercial activities that contribute to the space economy. They include space exploration, security, logistics, technology demonstration and emergent activities like space tourism, with revenues for these activities almost exclusively within the Upstream segment. These applications showcase the evolution in the landscape of the space market beyond traditional domains.

The third level situates the activities of the space market. It identifies the types of customers and regions, contextualising space market activities:

- **Types of customers** can be generally categorised into commercial entities, civil government bodies, and defence agencies. The space market has a diverse customer base with each customer having distinct needs and objectives that influence the demand for specific space technologies and services.

- **Regions** also play a role in the types of interests and investments that are made in the space market. Differing market dynamics, regulatory environments and technological access exist between regions. A notable inclusion is 'the oceans' as a region[7].

The structure of Euroconsult's framework is very much built on direct knowledge of the space sector's inner workings. It uses well-established divisions and segments and caters to large commercial and government clients. It provides an understanding of the Space Market's dynamics from the development and deployment of space assets to their varied applications and the customer base they serve. This is borne out in analysing Euroconsult's market intelligence catalogue. The reports and analyses in this catalogue emphasise four main areas: government space, satellite communications, SatCom, the space industry, and EO. Each of these areas is comprised of specific topics that are congruent with the design of their framework:

- **Government Space** centres on the roles of governmental entities in shaping not only regulation but specific programs. This area highlights the interplay between national security interests and space-based technologies and services.

7 In the Ocean domain, EO data allows for the tracking of ocean health, the management of marine resources, and environmental and conservation monitoring; GNSS and SatCom provide essential maritime navigation and communication services, optimise global shipping routes and relay information about safety issues and conditions.

- **Satellite Communications** include traditional and emerging satellite services including fixed (FSS), mobile (MSS) and other platforms that enhance global connectivity. This area also includes the integration of satellite technology with the Internet of Things (IoT)[8], and direct-to-device and optical communications.

- **The Space Industry** encompasses the entire spectrum of core space activities, focusing on the technological and economic trends in the industry. Topics highlighted include the SmallSat market, space logistics, software-defined satellites, and financing trends.

- **Earth Observation** focuses on the various EO satellite and distribution systems in existence and the market for their data and services.

The focus here is very much on space-for-space and established downstream segments. These areas have all reached critical mass to one degree or another and numerous governments and commercial entities are competing in these areas. Euroconsult provides a comprehensive structure to conceptualise the core space industry and the established added-value applications that it provides, making it a useful framework to peer inside the 'space bubble.'

Overall Segmentation & Measurement

Euroconsult's approach to dissecting the space economy provides a clear, structured insight into the core of the industry. The framework follows well-established segments that are the vernacular within the space industry. Furthermore, the five verticals – manufacture, launch, ground segments, operations, and services – reflect the recognised division of activities that enable the space market to exist and illustrate the lifecycle of space assets, from development to application. This segmentation also underscores the foundational role that SatCom, EO and satellite navigation are playing in the current space sector landscape.

The framework is most focused on space-for-space activities and established downstream applications, reflecting a strategic selection of the most significant market segments. By providing a framework that focuses on the major fields of play within the market, the framework caters to a large, established and expanding group of players within the industry. This focus reflects Euroconsult's prominent position as a 40-year-old consultancy firm for the space sector. These significant market segments have matured in tandem with Euroconsult's conceptualisations. This means that the framework is designed to meet the demands of recognised commercial and government entities.

The approach of this framework can be seen as a reference model for the space sector, one that is relatively conservative in its inclusion of activities. The difficulty with conceptualising the space economy is in the diversity of activities that can be included, and this framework aims to avoid overrepresentation or inclusion of fleeting New Space developments. This approach reflects Euroconsult's experience and position in the sector and allows it to provide tried and accurate conceptualisation and reporting of the significant space market realities.

Thoughts & Observations on the Framework

The Euroconsult framework for analysing the space market is a testament to the firm's longevity and established position within the space sector. This position shapes both the structure and the focus of the framework, where detailing core space and established downstream segments is prioritised. By distinguishing between revenue and non-revenue-generating activities the framework moves towards clarifying the issue of definition of the space economy. This distinction is especially useful in an increasingly market-driven sector and simplifies the process of developing further conceptualisations within the "Space Market."

8 IoT sensors are of growing interest to the space sector, with applications ranging from enhancing remote sensing of environmental data on Earth and diagnostics of space assets to monitoring health and physical conditions in human space transport and habitation.

Euroconsult's alignment of space activity verticals with the Upstream and Downstream segments effectively highlights their interconnectedness, facilitating a comprehensive understanding of the space market's processes. This distinction is particularly beneficial for those outside the 'space bubble,' providing a logical framework to comprehend the space market's intricacies.

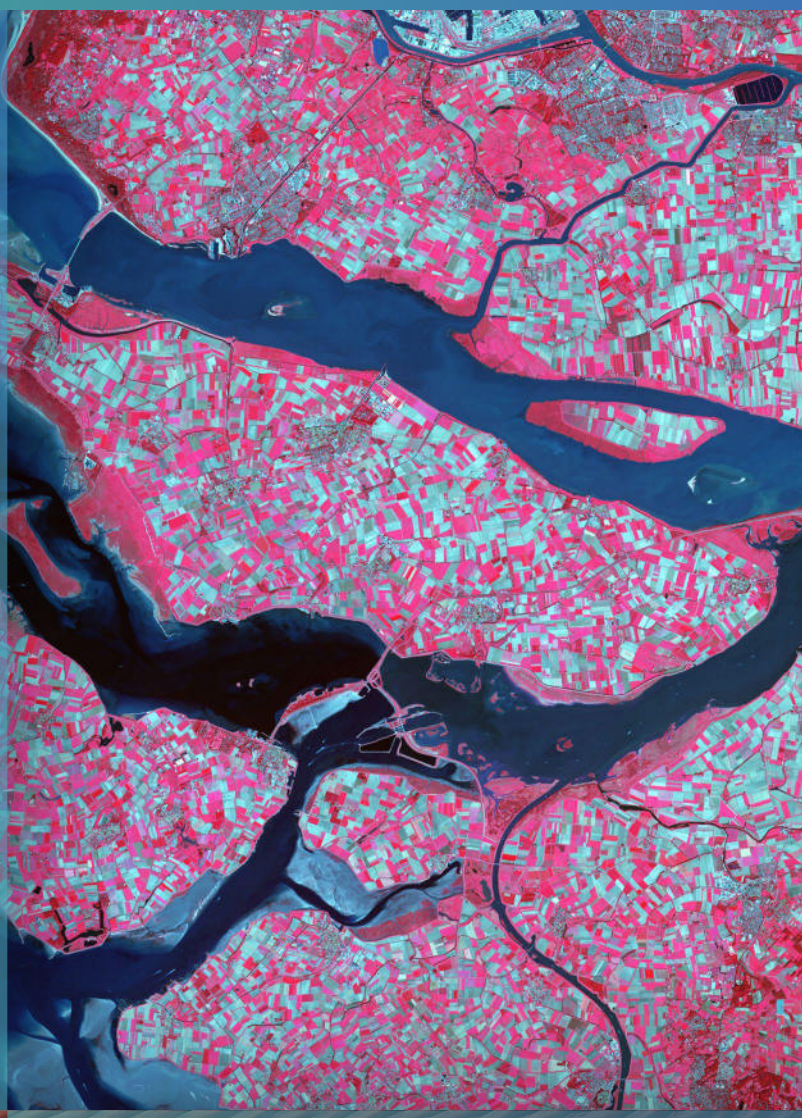
However, the framework exhibits a notable limitation in its focus. Its emphasis on significant, established activities indicates a catering primarily to large companies and government bodies, which are predominantly interested in proven space technologies and services. This focus may limit the framework's utility for stakeholders interested in the evolving frontiers of the space sector and the integration of space technologies across various non-space industries.

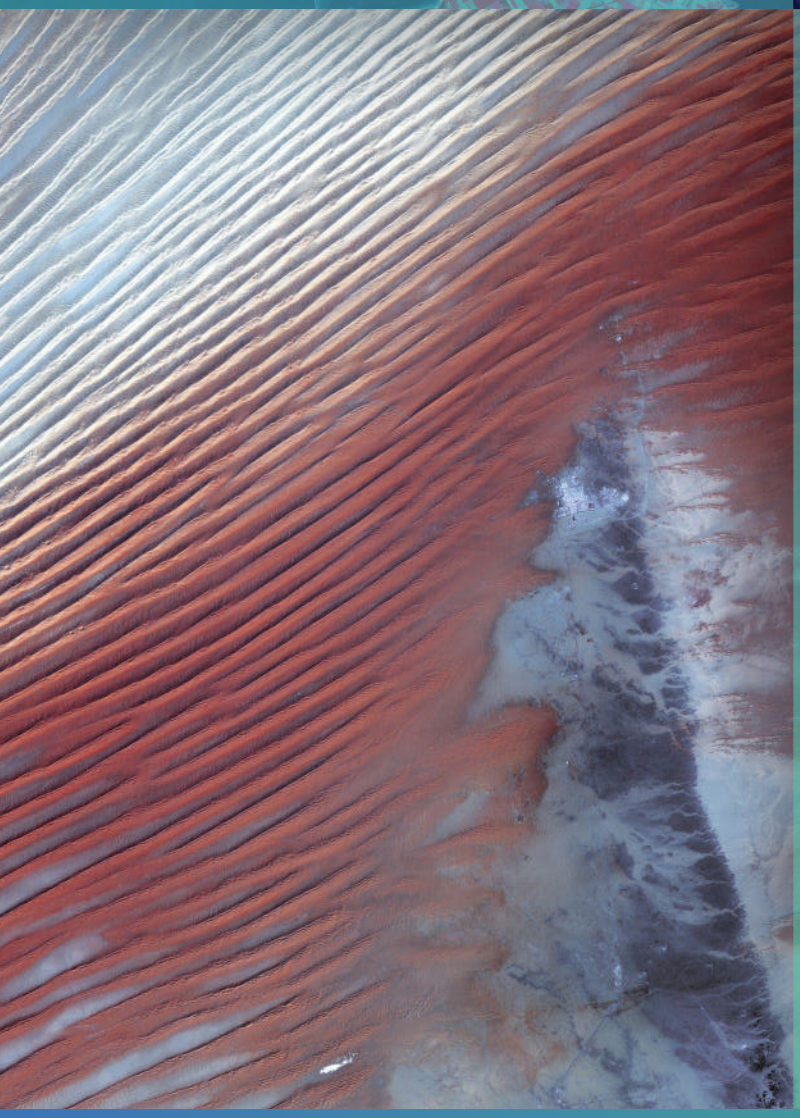
Overall, Euroconsult's approach can be seen as a space economy framework "for the space industry, by the space industry". It excels in mapping out the established areas of the space sector and providing a structured analysis of its component parts and processes. The inclusion of emerging sectors and the wider applications of space technologies across various industries, would offer a more holistic view of the space economy's potential and, in turn, would cater to a broader range of stakeholders interested in leveraging space for innovative applications beyond the traditional space establishment.

4.

know.space

know.space: The Case for Space





Know.space, headquartered in London and Edinburgh, is a consultancy specialising in space economics and strategy. Their expertise focuses on providing economic analysis and strategic insights for the space sector. Know.space's work includes policy evaluation for public bodies, market research for the space industry, and data analysis for applications and users. They also conduct commercial due diligence for private investors and support academia in space-related research. Known for their market and industry intelligence, they assist in securing funding for space projects and provide socio-economic impact analysis, leveraging their extensive experience in the space economy.

Revealing the Benefits.

The “Civil Space Economy” framework developed by know.space is designed to provide a comprehensive and process-led understanding of the Civil Space Economy for the UK. Their approach recognises the intricate ecosystem of advanced technologies, specialised services, in-space activities, and diverse Earth-based applications. This holistic view is central to their approach, focusing on how various components of the space sector interconnect and contribute to the broader economy.

While rooted in the context of the UK’s economic landscape and its particular space industry dynamics, the framework is constructed on principles and structures that are relevant to the global space economy. Its inclusive approach, which recognises the interplay between a nation’s internal capabilities and the international space market, allows for the model to be adapted and utilised by other countries. The framework is particularly notable for its logical, process-led structure, mapping the progression from supporting technologies that are often developed outside the space sector, through core space enablers and operations, to the eventual impact on Earth-based industries and activities.

Their framework acknowledges the dynamic nature of the space economy, where traditional boundaries between space and non-space activities are increasingly blurred. By integrating a wide range of technologies, operations, and applications, know.space’s framework offers a comprehensive and nuanced understanding of the space economy, making it a valuable tool for stakeholders seeking to navigate this evolving landscape.

The Civil Space Economy Framework

The “Civil Space Economy” is an ecosystem that integrates advanced technologies, specialised services, in-space activities, and a wide range of on-Earth applications. know.space aims to map these diverse elements through a logical, process-led approach, that aims to fully account for the wide range of technologies, operations, applications, and infrastructures that make up the space economy. Their framework is structured around five areas that build upon each other: supporting technologies, core space enablers, supporting space enablers, space technologies and services, and supported on-Earth activities.

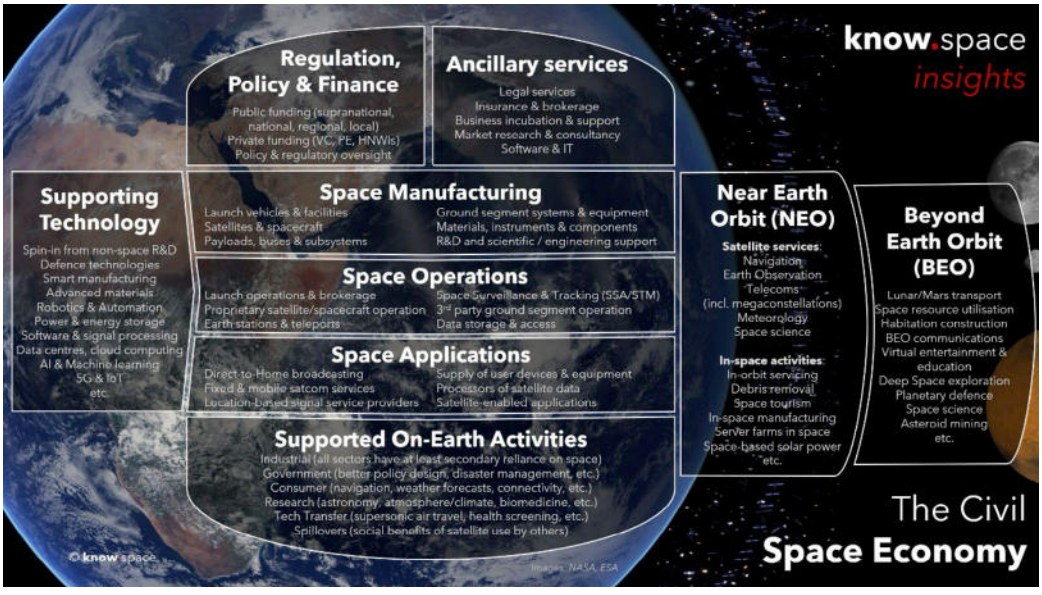


Figure 7 - Civil Space Economy Diagram (know.space, 2023)

Supporting Technologies
Firstly the "Civil Space Economy" is built on supporting technologies – innovations that originate from non-space research and development sectors. Advanced materials, robotics, and automation technologies, many of which come from the defence industry[9], are used in the design and operation of space assets. Energy storage systems and data processing software have become essential for long-duration missions and fast data handling needs of space operations. Recent advancements in AI, 5G, and IoT I said to transform how space missions are conducted and controlled, offering enhanced automation and improved communication. These supporting technologies illustrate how the space economy is deeply integrated into some of our most advanced terrestrial industries.

Core Space Enablers
The traditional space industry is characterised by three core activities that enable the exploration and utilisation of space:

- **Space Manufacturing** involves the design and production of launch vehicles, satellites, and their subsystems. From the construction of launch vehicles and facilities to the creation of ground segment systems, materials, components and instruments, this area produces the space-specific physical systems that enable space activities to be conducted.

- **Space Operations** compasses the launch and operation of these space assets. This area is central to mission delivery and service provision, while also including debris removal and in-orbit servicing and developing activities such as in-space manufacture and space tourism. In today's commercialised space economy these operations also include brokerage of launch services, space surveillance & tracking (SST), third-party ground segment services, and data storage and access.

- **Space Applications** utilise space signals and data, representing the interface of space operations with end-users. Space Applications include Direct-to-Home (D2H) broadcasting, FSS and MSS, signal and data providers, processors of satellite data, suppliers of user devices and equipment, and satellite-enabled applications. This division does not include on-Earth applications, such as resource management, logistics, and navigation services. (See Supported On-Earth Activities, page. 25).

Supporting Space Enablers
As in any sector, a framework of regulation, policy, and finance oversees, guides, and enables the space economy. Public funding from various levels of government is complimented by private investment that allows the Core Space Enablers to develop and implement space missions and services. Ancillary services, such as legal, insurance and brokerage, business incubation and support, market research and consultancy, and software and IT support, play a role in the smooth functioning and grow

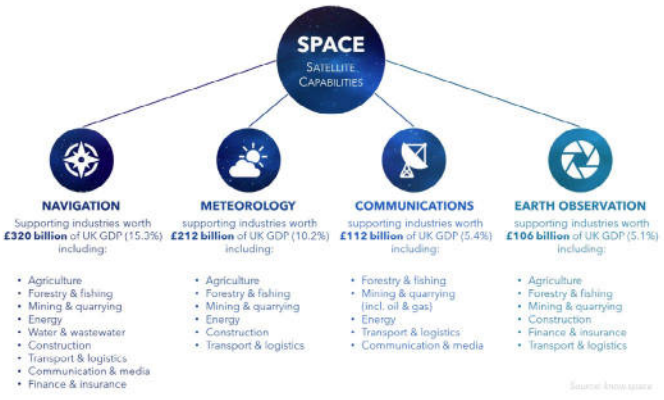


Figure 8 - Satellite Applications Diagram (know.space, 2023)

9 Many technologies central to the space sector are "dual use", meaning they have both civilian and military applications. Satellites provide navigation and communication to civilians, and surveillance and logistics support for the military entities. Launch vehicles that get space assets into orbit are also the base technology for intercontinental ballistic missiles (ICBMs). The dual-use nature of space technologies poses challenges for international relations, regulatory frameworks, and non-proliferation efforts.

Space Technologies and Services
Built upon the proceeding technologies and enablers, Space Technologies and Services are categorised based on the location in space where they operate or are provided.

- Near Earth Orbit (NEO)[10]
  Here satellite services provide functions such as navigation, EO, telecommunications, meteorology, and space science. In-space activities like satellite servicing, debris removal, in-space manufacturing, and space tourism are also conducted in NEO.

- Beyond Earth Orbit (BEO)
  Currently BEO consist of activities that are not in Earth's orbit and would traditionally fall under the category of space exploration. These ambitious endeavours include lunar and Mars transportation and habitat efforts, space resource prospecting, solar system exploration, and planetary defence.

Supported On-Earth Activities
The true measure of the space economy's value can be seen in its impact on Earth. Supported On-Earth Activities are comprised of industries with a reliance on space technology or data. Industries across the board, from agriculture to transport, rely on space technology. Governments utilise space-based assets for disaster management, and space data informs policy design and resource allocation. Consumers benefit from space-enabled applications that provide navigation information, weather forecasting and enhanced connectivity. Furthermore, technology transfers from the space sector to, for example, the automotive industry enable increased innovation in on-Earth sectors.

The "Civil Space Economy" framework illustrates a layered and interdependent network of technologies and services. It starts with the development of supporting technologies, extends through the core activities that enable space endeavours, and culminates in in-space activities and enhanced on-Earth operations.

Benefits Model

The "Benefits Model", as laid out by know.space, offers a panoramic view of the advantages arising from the space sector. It categorically breaks down the benefits into three principal domains: Design, Manufacture, Launch & Operations; Data and knowledge Transfer; and Scientific Advances, each contributing distinct value to the UK economy and society.

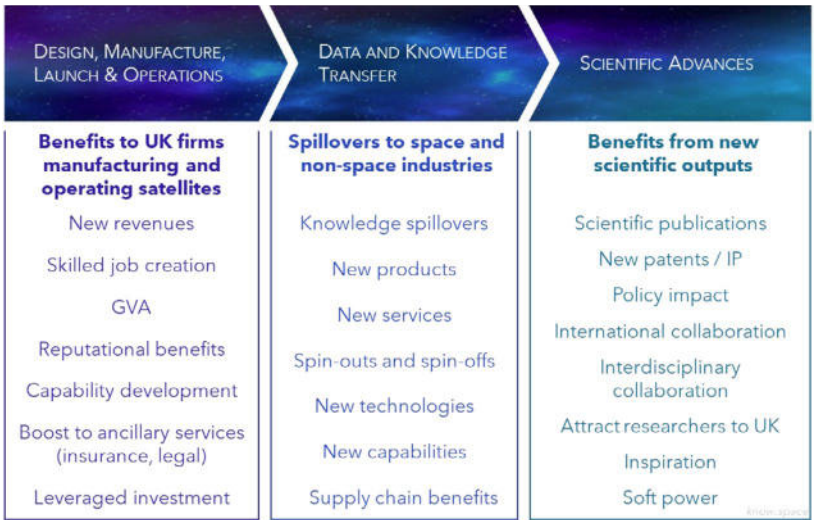


Figure 9 - Space Benefits in the UK Diagram (know.space, 2023)

10 Near Earth Orbit (NEO) usually refers to just Low Earth Orbit. know.space takes NEO as all orbits of Earth, made up of:

Orbit	*Abbreviation*	*Altitude range (km)*
Low Earth Orbit	LEO	160 to 2000
Medium Earth Orbit	MEO	2000 up to GEO
Geosynchronous Orbit	GEO	35,786
High Earth Orbit	HEO	Above 35,786

Design, Manufacture, Launch & Operations: UK firms engaged in the satellite sector experience direct economic gains, such as the creation of skilled jobs contributing to the Gross Value Added GVA), enhancing national productivity. These firms enjoy new revenue streams, capability development within the space sector, and reputational enhancement both domestically and internationally. There's also a significant boost to ancillary services like insurance and legal, with the space sector's growth prompting leveraged investment across related industries.

Data and Knowledge Transfer: The space industry acts as a catalyst for knowledge spillovers, fostering innovation not just within its own domain but also in non-space industries. The ripple effect of space technologies leads to the creation of new products and services, with spin-outs and spin-offs diversifying economic activity and stimulating the emergence of new sectors. The development and application of new technologies bolster productivity and efficiency across various industries, with supply chain improvements resulting in cost reductions and enhanced services.

Scientific Advances: The intellectual benefits from new scientific outputs extend beyond the immediate space sector. Publications of scientific research contribute to the global pool of knowledge, while the filing of new patents and the creation of intellectual property spur further innovation. Such advances influence policy and strategy at the government level, promote international and interdisciplinary collaboration, and enhance the UK's scientific stature. This not only serves as inspiration for future scientists and engineers but also enhances the UK's global reputation through the exercise of soft power, manifesting the influence of scientific achievements.

This "Benefits Model" from know.space underlines the space sector's role as a powerful engine for economic and intellectual growth, underpinning scientific progress and broad societal benefits.

Thoughts & Observations on the Framework

The "Civil Space Economy Framework" and the "Benefits Model" together present a comprehensive picture of the space sector's impacts. This combined approach is particularly insightful in how it interlaces the tangible with the intangible, offering a full spectrum analysis of the space economy's contribution to society, industry, and the broader scientific community.

The "Civil Space Economy Framework" breaks down the complex architecture of space activities into a clear structure, capturing the progression from supporting technologies to core space enablers, and ultimately to the effects on terrestrial applications. It recognises the inherent interconnectedness within the space sector and the dependence of Earth-based advancements on space-based activities and technologies.

The "Benefits Model" is an extension of this framework, illustrating the direct and indirect advantages of the space economy. It encapsulates the economic benefits to UK firms manufacturing and operating satellites, such as new revenue streams and the creation of skilled jobs, which feed into the national Gross Value Added (GVA). The model also spotlights the reputational benefits for firms and the broader UK space industry, emphasising the sector's role in catalysing ancillary services and attracting leveraged investment.

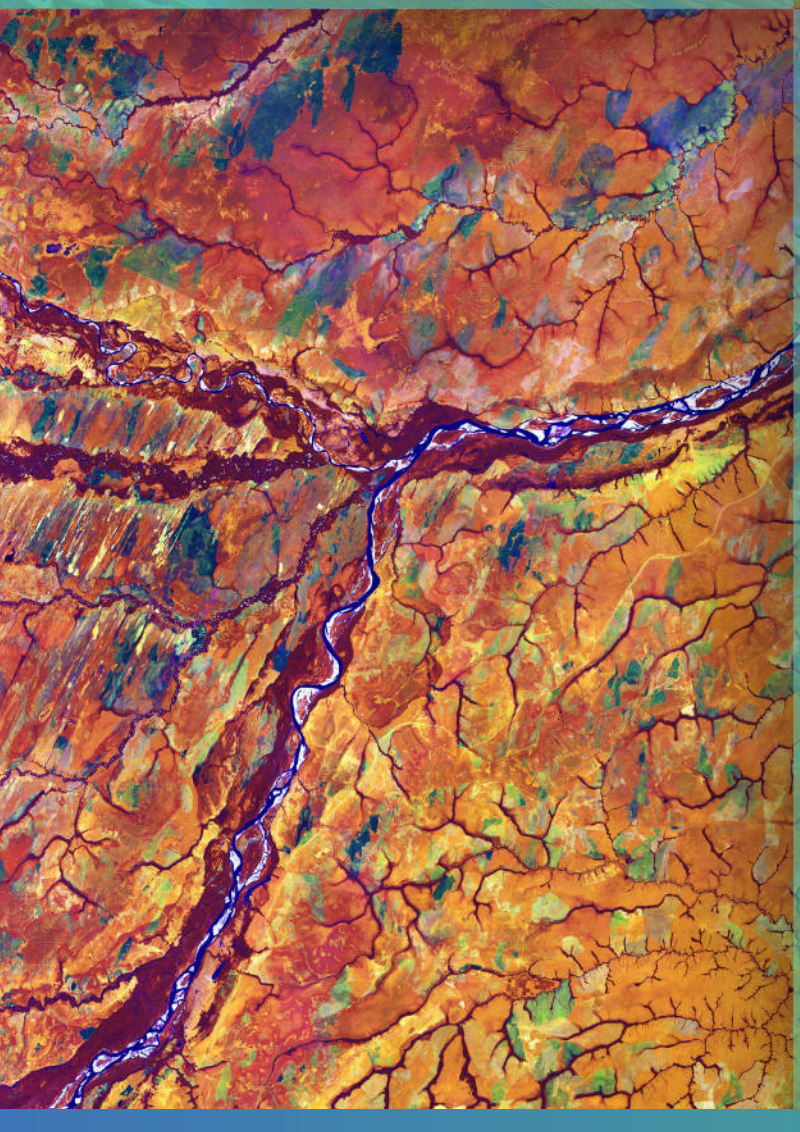
Despite these strengths, the framework and model, in their current high-level form, offer limited insight into the intricate interdependencies within the space sector. They excel in presenting a macro-level perspective but fall short in allowing for a detailed, interconnected drill-down analysis. The interconnectedness between manufacturing satellites and the downstream benefits, such as improvements in global communications or navigation, which in turn could lead to enhanced logistics and efficiencies in other industries, is not elaborated upon. As the space sector is highly dynamic and rapidly evolving, a more granular approach that can adapt to and reflect these changes would be beneficial.

Overall, the Civil Space Economy Framework and the Benefits Model provided by know.space offer a robust toolset for understanding the extensive reach of the space sector. They underscore the sector's economic and scientific importance and its cascading effects on numerous industries and on societal advancement. This comprehensive perspective is vital for stakeholders aiming to navigate the space economy's complexities and leverage its full potential.

5.

SPACE CAPITAL®

Space Capital: The GPS Playbook





Space Capital is a seed-stage venture capital firm investing in the space economy, with a particular focus on GPS, geospatial intelligence (GEOINT), and SatCom. Space Capital manages over $100 million in assets, along with providing insights and analysis on start-up activity and investment trends in the space economy. They are known for its investments in high-profile companies such as SpaceX, Planet and Made in Space.

Breaking Down Potential.

The framework developed by Space Capital in “The GPS Playbook” and presented in their Book “The Space Economy” is built on an investment-oriented perspective, grounded in industry knowledge. This perspective emphasises understanding and measuring the economic impact, cross-industry applicability, and future market potential of space-related endeavours. Notably, while the focus of “The GPS Playbook” is the GNSS sector, its underlying framework has a much broader applicability. It serves as a model for understanding how specific space technologies, like GNSS, can create substantial economic impact across various industries.

This primary focus, on the impact and potential of space technologies, is crucial for investors and policymakers, offering a lens through which the financial implications of space technologies can be discerned. This approach centres around understanding how technologies interact with each other and, therefore, how businesses can exist within both the space and global market generally. The framework extends its utility beyond GPS, providing a valuable perspective for dissecting and comprehending the overarching space economy. Its ability to link technological advancements to economic outcomes offers a pragmatic approach to understanding the space sector’s evolving landscape.

The Space Capital Framework

In “The GPS Playbook,” Space Capital introduces a comprehensive framework to analyse and understand the space economy. It effectively categorises the space economy into three distinct components: Infrastructure, Distribution, and Applications. This structure offers a clear and concise method for understanding the diverse set of activities and technologies that comprise the modern space economy.

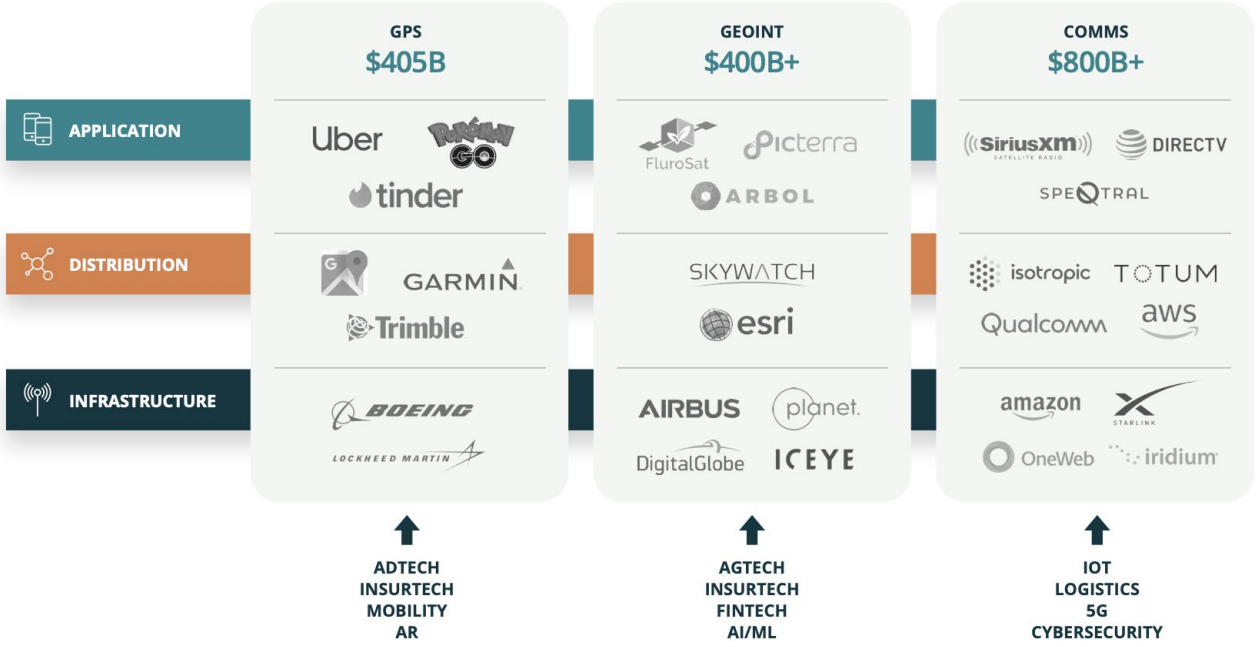


Figure 10 - Infrastructure, Distribution, Application Diagram (Space Capital, 2020)

Infrastructure forms the foundation of the space economy. It encompasses the hardware and software necessary for constructing, launching, and operating assets in space. This component is crucial as it lays the groundwork upon which all other space-related activities are built. It includes the physical rockets and satellites, as well as the less tangible software algorithms that guide them. The importance of infrastructure cannot be overstated, as it represents the tangible backbone of space endeavours, encompassing everything from the manufacturing of spacecraft to the complex logistics of orbital constellations.

Distribution, the second component, involves the systems and technologies necessary for the transmission, processing, and management of the data harvested from space assets. This segment bridges the gap between the space-based infrastructure and the end-users who leverage this data. Distribution systems include receiving stations and communication networks that collect satellite data back on Earth, processing it and making it usable and accessible. This is where the raw data collected by satellites becomes a usable commodity, transforming it into a form that can be utilised for both public and private ends.

Applications represent the third and perhaps most directly impactful component of the space economy. This segment encompasses the specialised hardware and software that utilise the data generated from space-based assets. Applications are the end products and services that directly affect daily life on Earth. From GNSS-enabled devices to weather forecasting models, the applications of space technology are vast and permeate an increasing number of economic domains. This sector is where the space economy becomes tangible and useful, augmenting business operations and delivering services impossible through a terrestrially exclusive model.

> ***A growing focus of space economic activity is the development of Space Situational Awareness (SSA) capabilities. These capabilities allow for an understanding of the environment in space, including tracking satellites, debris, and natural space objects to ensure safe operations. As the commercial space sector expands, the demand for SSA services from operators, insurers and space agencies has led to an increasing number of companies providing these services for both public and private sectors. Tackling space debris and avoiding Kessler Syndrome[11] are leading to calls for an international Space Traffic Management (STM)[12] agreement.***

In addition to defining the core components of the space economy, "The GPS Playbook" expands on this structure by incorporating various additional elements that further enrich each segment.

Investment Metrics

Within each segment of the framework, a range of metrics is employed to gauge the health status and investment trends of the space economy.

- Annual investment source
- Cumulative investment geography
- By Sector: Cumulative investment amount
- By Sector: Cumulative round share
- By Stage: Cumulative investment demand
- By Stage: Cumulative round share
- Top deals in the quarter
- Exit by industry

These metrics collectively provide a comprehensive view of the financial and developmental landscape of the space economy, offering crucial data for investors, policymakers, and industry stakeholders.

11 The Kessler Syndrome is a scenario in which the density of objects in Earth's orbit is high enough that collisions between objects could cause a cascading effect, with each collision generating more debris and increasing the likelihood of further collisions, rendering certain orbits unusable.

12 Space Traffic Management (STM) is a proposed set of technical and regulatory provisions that would ensure the safe and efficient movement of objects in orbit. Efforts are being led by the European Union to develop an approach that would be internationally recognised, ensuring that efforts are harmonised, and that space remains accessible and safe (HR/VP CFSP, 2022).

Visualisations

The Playbook further augments its analysis with visual representations, such as the investment and total number of companies over time, categorised by each stack and timeline of technology development across these segments. These visualisations offer an immediate and clear understanding of trends, growth areas, and potential saturation points within the market. The chronology maps the evolution of technologies within each component and highlights the interplay and dependencies among them.

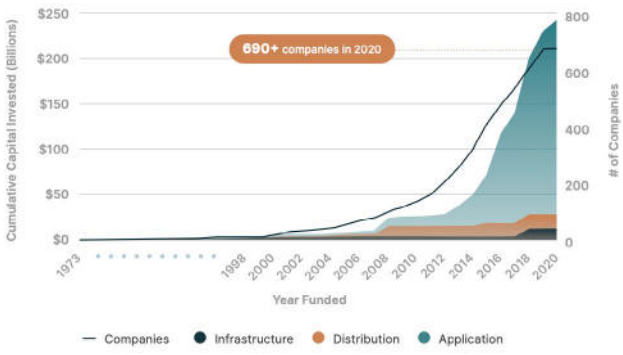


Figure 11 - Capital Investment in Infrastructure, Distribution, Application 1973-2020 (Space Capital, 2020)

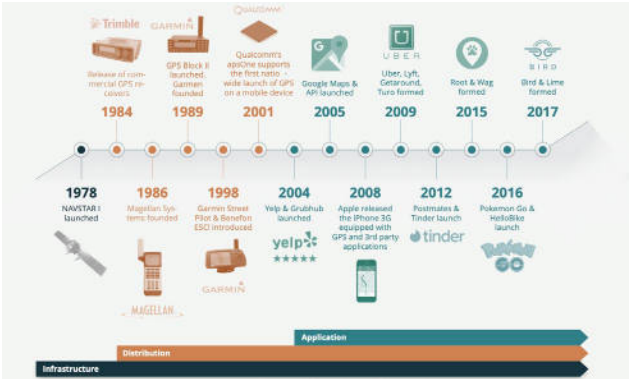


Figure 12 - Satellite and Satellite-enabled Developments 1978-2020 (Space Capital, 2020)

Industry and Sector Segmentation

Delving deeper, the framework, using the Infrastructure, Distribution, and Application stacks, identifies six industries, both established and emerging. Each industry is further broken down into its component sectors.

Satellites	GPS, GEOINT, SatCom, Manufacturing & Components
Launch	Small, Medium, Heavy, Brokerage, Spaceport Operations
Stations	Habitats, Services
Logistics	SSA, On-orbit Servicing, Debris Mitigation
Lunar	Transport, Construction, Deep Space Satellites
Industrials	Manufacturing & Assembly, Mining & Minerals, Energy Generation & Storage

This segmentation is crucial for understanding the diversification and specialisations within the space economy. It offers a granular view into industries and sectors and provides a roadmap of the space economy's complex ecosystem, offering clarity on how different technologies and services interlink and contribute to the overall landscape.

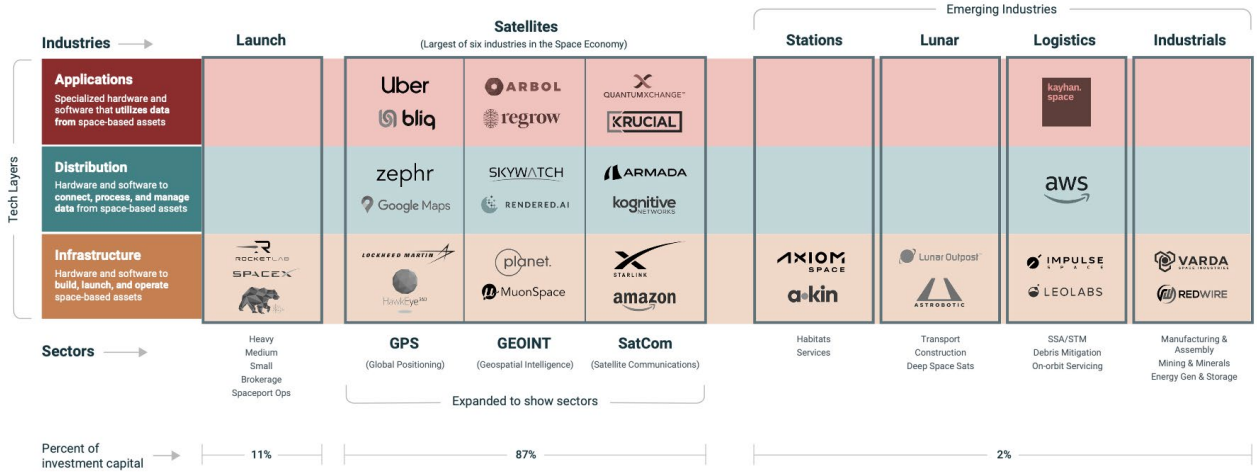


Figure 13 - Tech Layers, Industries & Companies (Space Capital, 2024)

This overall structure is not a simple classification; it represents the lifecycle of space economy products and services. Starting from the creation of the infrastructure, moving through the processing and distribution of the data, and culminating in the development of applications that harness this data for practical uses. This linear progression from Infrastructure to Applications underscores the interdependent nature of the space economy, where each component is reliant on the others for its functionality and success.

Overall Segmentation & Measurement

Space Capital presents a structured framework that offers a nuanced understanding of the space economy's composition. Central to this framework are the three pivotal components: Infrastructure, Distribution, and Applications, which collectively provide a focused yet situated view of the space industry's activities and technologies. The framework allows for the comprehensive mapping out of a landscape that covers the entire spectrum of the space economy. From the crucial infrastructure to the applications that translate space technology into practical solutions, the framework encapsulates the value chain of the space industry.

It further categorises the space economy into industry and sector segments, dissecting it into granular domains of activity. This segmentation highlights the specialisations within each industry, from satellite manufacturing to spaceport operations, offering stakeholders a detailed roadmap of the composition of the space economy's ecosystem.

In terms of measurement, "The GPS Playbook" introduces a set of investment metrics that are mapped to the framework's central division. These metrics are indicators that reflect the health, growth, and potential of the space economy. Visualisations of these metrics can be augmented by the three framework components to offer an illustration of investment trends and technological developments.

Collectively, the framework's structured approach, coupled with further industry and sector delineation, measurement tools and visualisation applicability, provides a clear, detailed, and adaptable model for analysing the space economy. It is a framework that goes beyond categorisation to measure and explain, offering a valuable tool for stakeholders to navigate the complex dynamics of the space industry.

Thoughts & Observations on the Framework

The Space Capital framework presents a structured and intuitive tool for dissecting and understanding the space economy. Its design, characterised by simplicity and modularity, allows stakeholders with varying levels of expertise to grasp the complex dynamics of the space industry effectively.

The framework is an accessible tool for analysing the space economy. Its simplistic yet comprehensive structure ensures that stakeholders can easily navigate through the different segments of the industry. Furthermore, the framework's modularity is one of its key strengths. This modularity means that it can be used at varying fidelities, from getting an overall idea of the value chains of the emerging space sector industries, to understanding the companies involved in the distribution layer of a specific sector activity. This feature provides flexibility to incorporate future developments and trends as they emerge and speaks to its long-term relevance and utility.

A standout use of this framework is in examining a company or technology's degree of space-relatedness. By delineating clear distinctions between Infrastructure, Distribution, and Applications, the framework can offer a perspective on how different components interact and contribute to the overall space economy. This aspect is particularly beneficial for stakeholders looking to understand the specific roles and dependencies within the industry, from foundational space-specific elements to more distant end-user applications.

Despite its strengths, the framework in its current form does not entirely capture the full expanse of the global space economy, its ranging interdependencies, supply chain dynamics or technology and service maturity levels. Expanding its scope to encompass these broader aspects would enrich the framework's analytical depth and enhance its practical utility for a wider range of stakeholders. The framework also does not reference the established Upstream/Downstream division. This division is a foundational one in the space sector and its omission may hinder its use by space sector professionals whose real-world tasks may follow this separation. While problems exist with the Upstream/Downstream categorisation, completely disregarding its centrality to space economy activities limits its adoption potential.

Space Capital's framework offers a clear, adaptable, and comprehensive tool for analysing the space economy. Its intuitive design, coupled with the potential for expansion and adaptation, makes it a valuable asset for stakeholders aiming to navigate this dynamic industry. However, its investment focus and lack of inclusion of established space sector terminology are defining limitations. Acknowledging and addressing these limitations will ensure its effectiveness and relevance in the evolving landscape.

6.

Spotlight
Dealroom Space Tech Platform

Dealroom

Dealroom is a leading data platform globally recognised for its extensive databases on startups, early-stage, and growth companies, with a focus on Europe and global ecosystems. As a provider of transparency, analysis, and insights into venture capital activity, Dealroom collaborates with investors, entrepreneurs, and government organisations. Its role in the space tech sector involves providing data-driven insights and analytics, crucial for understanding venture capital dynamics within the space industry.

European Space Agency (ESA)

ESA plays a central role in Europe's space exploration and utilisation. With 22 member states, as of February 2024, ESA leverages their collective resources to execute programs beyond the capacity of individual countries. Under its agenda 2025, ESA is taking steps to catalyse the commercialisation of space technology, by investing in talent development, facilitating access to capital, and accelerating innovation through time-to-contract reductions, increasing the share of industry-driven technology development in its portfolio, and simplifying access to programs and activities for start-ups and NewSpace companies. This is part of a broader strategy aiming to make Europe a hub for space commercialisation.

Fondazione E. Amaldi

Established by the Italian Space Agency and the Hypatia Research Consortium, the E. Amaldi Foundation is a leading entity in applied research and technology transfer. With its focus on the space sector as a driver for economic development and innovation, the foundation promotes scientific research aimed at technology transfer. Open to companies and research institutes, its objective is to enhance competitiveness, productivity, and employment through space technology.

Interacting with the Space Market.

The “Dealroom Space Tech Platform” segments the space tech sector in a clear and simplified manner to aid stakeholders in their understanding and decision-making. This segmentation first differentiates between ‘Core’ space tech startups – companies with space technology as their principal business – and ‘Space Related’ tech startups, which include entities that are only partially focused on space or utilise space-derived technology alongside other ventures.

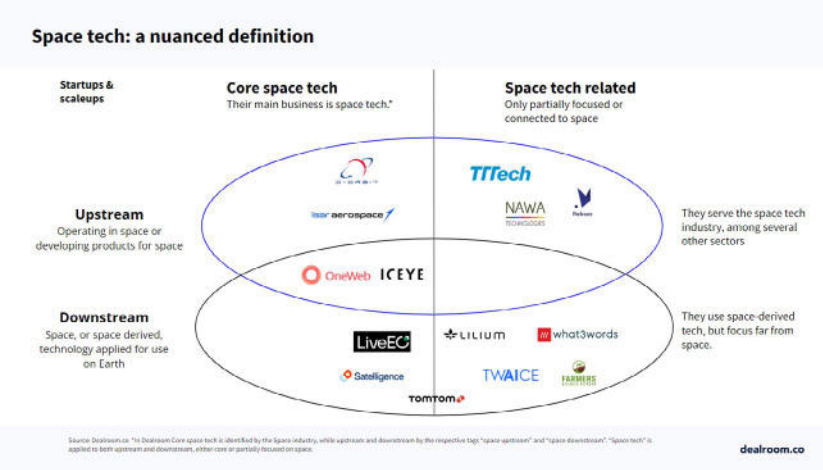


Figure 14 - Space Tech Definition Diagram (Dealroom, 2024)

As with the majority of frameworks we have seen, the Upstream/Downstream divide remains.

In the ‘Upstream Space Tech’ component, the focus is on companies that are actively involved in space operations or dedicated to creating products designed for space. This encompasses a broad spectrum of activities, from the development and operation of satellites and launch vehicles to the manufacturing of spacecraft components and payloads. Notably, it also includes entities whose primary business may not be space-oriented but who contribute significantly to the sector, such as companies specialising in 3D printing or advanced materials technology that have applications in space.

The ‘Downstream Space Tech’ component includes technologies initially developed for space applications but that are now being utilised on Earth. This includes advancements in materials and sensors that, having been developed for space missions, have found applications on our planet. It also covers companies that operate their satellite constellations to provide Earth-based services – such as EO data for agriculture and energy.

Due to Dealroom’s position as a startup & venture capital intelligence platform, it employs a recognisable classification of companies. This provides a uniform approach to understanding the space tech industry’s ecosystem. It defines the funding rounds and stages of company growth – from startups to scaleups and further into mature companies, known as grownups. The platform also includes the concept of a ‘unicorn,’ a term designated for rapidly scaling, tech-enabled companies that have reached or exceeded a valuation of €1 billion, of which we have seen several in the rapidly expanding space economy.

The “Dealroom Space Tech Platform” framework provides a relatively granular view of the space tech sector, enabling stakeholders to navigate the industry with greater precision. It reflects a commitment to transparency and a strategic approach in presenting the vast and complex space tech ecosystem. This structured segmentation ensures that various stakeholders can engage with the space sector in a manner that aligns with their specific interests and objectives, whether they are investors, entrepreneurs, researchers, or policy advisors.

Interactive Platform Overview

The platform (spacetech.dealroom.co) serves as a hub for gathering insights and data related to space tech startups, investors, and the broader space ecosystem. It does this through a number of interactive tools that cover all of the aspects of the space tech ecosystem. The platform in general includes a dashboard, allowing users to tailor their experience, offering a personalised space to track the developments, trends, and investments that matter most to them.

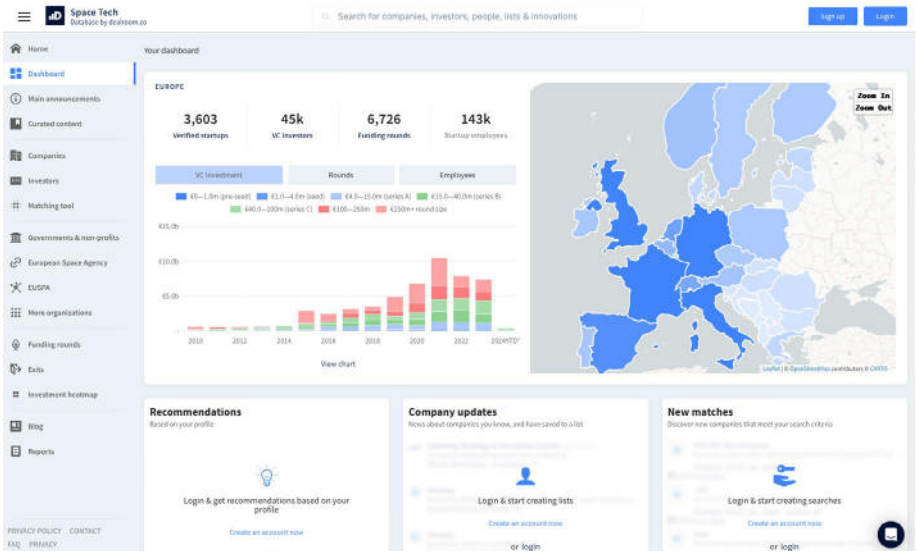


Figure 15 - Dealroom Space Tech Dashboard (Dealroom, 2024)

Competition & Investment

The central utility of the platform is in its comprehensive company database. This enables users to explore over 8.000 space tech startups. This company database includes general business information such as revenue, growth stage, employees, and funding rounds and sources, along with space-specific indicators such as market and industry information and a tagging system that highlights the space aspects of each company. This offers an overview of the ecosystem combined with analysis of competition in specific areas. Furthermore, an investors section highlights the sources of capital in the space sector, providing a comprehensive look at the organisations that enable the entire ecosystem. Paired with a matching tool this offers companies the ability to both understand investment trends and seek out funding. Overall, this toolset is very useful for gaining a targeted understanding of the ecosystem and provides a practical basis on which to engage with the space tech sector.

Partnerships & Opportunities

Dedicated sections are available that highlight government & non-profit organisations, ESA, the European Union Space Programme Agency (EUSPA) and other accelerators and service providers. These areas of the platform show the institutional players and programs that are involved in helping to develop the space tech landscape. They are broken down further into the various grant and incubation programs that are offered, and the private accelerators that companies could avail of. Furthermore, a service provider area highlights those companies that provide enabling technologies or services upon which new companies can build.

Expert Curation

The “Dealroom Space Tech Platform” mirrors the established framework in the European Space Tech Report, segmenting the space tech sector into Upstream, Downstream, and other categories that include ESA Business Incubation Centre (BIC) Startups, EUSPA CASSINI Business Accelerator and EUSPA-supported companies. Each curated segment on the platform, such as ‘Satellite Operations’ or ‘Space Transportation,’ corresponds to a tailored set of advanced filters. This approach ensures that each segment fully captures the collection of companies that make up their respective domains within the space tech ecosystem.

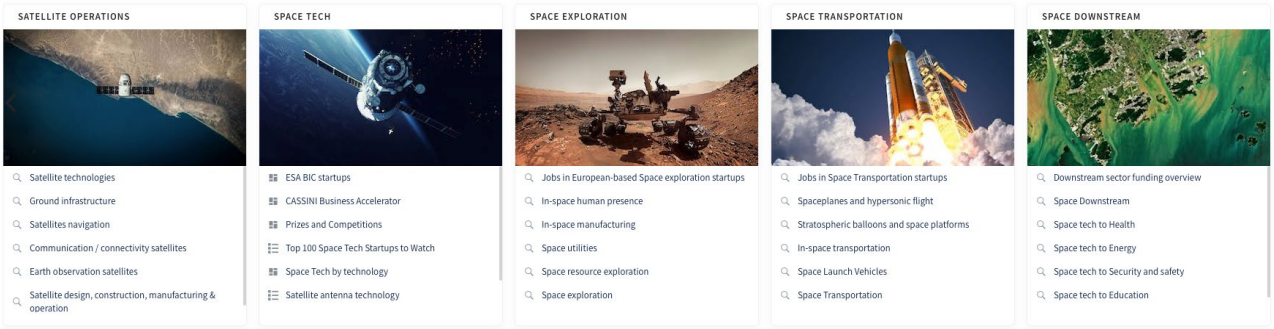


Figure 16 - Space Tech Curated Content Sections (Dealroom, 2024)

There is a feature for filtering with carefully selected tags to query the Dealroom company database and display all of the companies that relate to that segment. For instance, selecting 'Space mission planning and control' applies filters 'Space Tech', 'In-space Operations' and 'Mission Planning and Control', along with excluding 'Government/Non-Profits', 'In-space Research', 'Space Cybersecurity 'and 'Spacecraft Services and Debris Removal'. This offers real benefits for users in querying the Dealroom database.



Figure 17 - Space Tech Curated "Mission Planning & Control" Filterset (Dealroom, 2024)

- Combinations of advanced filters, developed by experts, provide curated expertise, simplifying the process for users by eliminating the need for them to create these filters on their own.
- The categorisation is tailored to space-related topics, enabling users to easily navigate and explore segments that align with their specific interests or areas of expertise.
- Positioning companies within specific segments categorises them accurately, offering clear context about their function and significance in the broader space technology industry.

The example below follows a user journey. In this hypothetical case, the user is interested in finding providers of stratospheric balloon services to be able to test its suborbital technology. Having **(1)** found the correct curated space tech segment, the user is brought to the company page where, with **(2)** the correct filters applied, **(3)** the seven companies that provide these services are displayed. The user can then visit these companies to begin their own research to investigate which provider their company needs. In this user journey, the indicators – which are predominantly investment-focused – can tell the user the health and size of each company, which may be a factor in their selection of a provider.

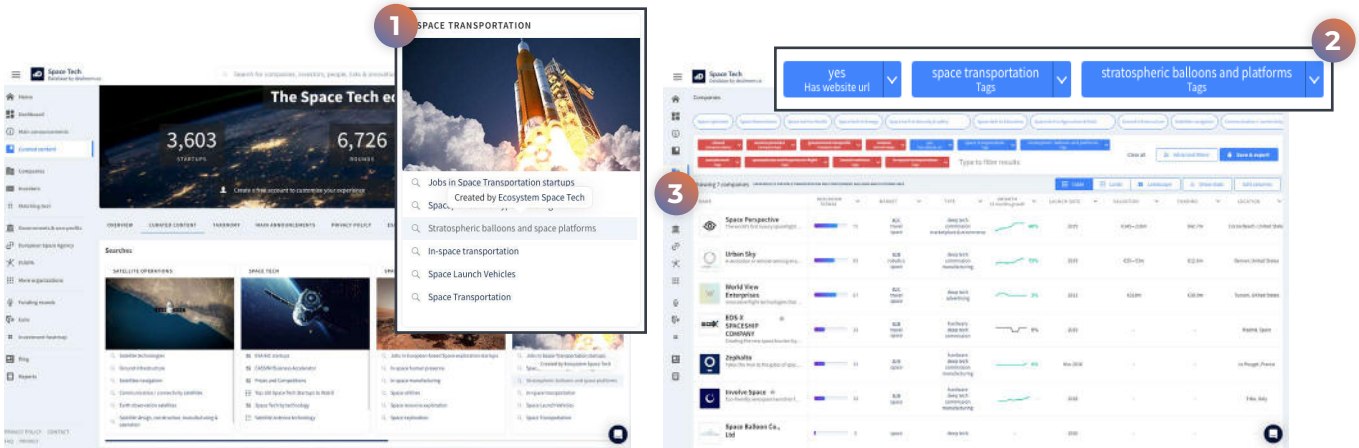


Figure 18 - Space Tech User Journey for "Straospheric Ballons & Space Platforms" (Dealroom, 2024)

This approach enables stakeholders to engage with the platform in a more meaningful way, allowing for a nuanced understanding of the space economy and aiding in strategic decision-making regardless of their current level of understanding of the players involved in that specific segment. Through this structure, the platform informs its users, situating companies within the space sector.

Customisation

The platform's customisation features provide a user-centric interface that adapts and focuses on data relevant to a user's needs. This is particularly beneficial for stakeholders who require dynamic and up-to-date data on specific areas of the space sector.

The Dashboard is the centre of the user experience and allows a high degree of personalisation. Users can manipulate the dashboard to track various key metrics. A user can add a card to monitor 'New Startups,' providing a snapshot of new entrants, a card for 'Recent Rounds' that keeps users informed about the latest funding activities, or a 'Hiring Startups' card that offers insights into the job market and company growth. These cards can be further personalised using the set of advanced filters to drill down into specific segments, technologies, and company types. This level of customisation ensures that the dashboard serves as a tailored strategic tool.

Custom lists further enable users to navigate the space economy's complexity. By creating bespoke compilations of companies, users can segment the landscape according to unique categories such as technological specialisation, geographic location, or investment rounds. This feature allows for tracking the evolution of specific market segments or preparing for targeted outreach.

Custom searches are another central feature of its customisation capabilities. Users can construct and save searches using a collection of advanced filters compiled by them, aligning with their research needs and interests. This is particularly useful for users who conduct recurring analyses or track specific market changes over time, allowing them to retrieve relevant data with efficiency.

The platform's customisable dashboard and advanced filtering options provide personalised monitoring and targeted investigation to users. This tailored approach allows users to focus on the latest trends and opportunities relevant to their interests. In-depth analysis is facilitated by the ability to dive into very niche subsectors, ensuring that detailed market analysis is viable. Furthermore, the ability to save and export custom searches equips users with an efficient information retrieval tool, that is indispensable for building upon previous work and ensuring continuity in analyses. This streamlined research process is crucial for effectively reporting and sharing insights, thereby saving valuable time, and enhancing collaborative efforts. With these features, users are well-equipped to analyse and strategise within the space sector, harnessing data to drive informed decision-making.

Thoughts & Observations

Dealroom's platform is commendable for its granularity, providing users with detailed, specific data on startups, investments, and growth trajectories in the space tech sector. This level of detail is invaluable for investors and entrepreneurs who need to understand the micro aspects of the industry. However, the platform may fall short in offering a modular design that dynamically represents the interdependencies within the space economy. A more modular approach would allow users to dissect and reassemble various components of the sector, offering a holistic understanding of how different elements, such as policy, technology, and market trends, interact and influence each other.

The platform's focus on investment and venture capital dynamics is a significant strength, particularly for stakeholders directly involved in these areas. It offers insights into funding rounds, investor activities, and the financial health of space tech companies. This investment-centric orientation does not fully cater to the broader array of stakeholders in the space economy. Additionally, this perspective excludes the more nuanced operational dynamics and supply chains within the

space economy. Stakeholders interested in understanding production processes, technological advancements, or logistical challenges may find the platform's offerings limited in this regard. Communicating these complex operational dynamics in an accessible format for users of varying expertise levels can be crucial for a platform seeking to offer comprehensive insights into the space sector.

Dealroom's information-rich environment illustrates its capability as a data platform. However, its utility as a comprehensive mapping tool of the entire space economy is limited. For example, the advanced filter set is detailed, but the 'tagging' system is not transparent. These tags are the key to developing an integrated mapping of the space economy. For users seeking to understand the broader scope and future trajectories of the space economy, the platform may not provide the necessary insights. An overarching mapping tool that offers a comprehensive and integrated view of the space economy is needed.

The interactive nature and customisable features of the Dealroom platform are notable strengths, enhancing user experience and engagement. These features allow users to tailor their research and analysis according to their specific interests. It is, however, worth examining whether these features fully engage users in a way that promotes an in-depth understanding and offers them the full potential utility. While customisation allows for targeted research, it may not necessarily ensure that users gain a holistic or strategic perspective of the space economy.

The "Dealroom Space Tech Platform" excels in offering detailed data and a user-friendly experience. Its focus on investment dynamics and a lack of a modular design limits its utility for a broader range of stakeholders. Its capabilities as a comprehensive mapping tool and in representing complex operational dynamics also present areas for potential enhancement to fully cater to the diverse needs of the space economy's stakeholders. Dealroom's platform is an excellent first step towards enabling transparency in the space economy, and, in turn, continuing to enable the sector's full potential.

7.

Transparency & Accessibility: *The Need for a New Framework*



In an evolving landscape, frameworks of conceptualisation and measurement play an important role, shaping our understanding and guiding strategic decision-making. However, while these frameworks offer structured insights, they also come with inherent limitations that may impede their effectiveness and applicability. Below, we dissect these limitations under four major themes, offering a critical perspective on areas that require attention for space economy frameworks to remain relevant and practical.

Challenges and Growth.

Complexity and Accessibility

The complexity inherent in frameworks for the space economy can be a double-edged sword. On one hand, intricate segmentation and categorisation capture the multifaceted nature of the industry. On the other hand, this complexity may deter stakeholders who are new to the space economy, creating a barrier to entry. The specialised terminology and detailed breakdowns necessitate a certain level of prior knowledge, limiting the frameworks' accessibility to a broader audience. For these frameworks to be truly impactful, they must strike a balance between depth and comprehensibility, ensuring that they are not just repositories of information but tools that empower a wide range of stakeholders to make informed decisions. *In response to this...*

Broad Categorisation vs. Nuanced Understanding

There is often a tendency to resort to broad categorisations to structure the vast space economy. This approach does offer a macroscopic view of the industry, but it may gloss over the intricacies of space activities. The challenge lies in the frameworks' ability to adapt and encapsulate the entire global space economy, especially considering the complex interdependencies, like supply chain dynamics. Moreover, a predominant focus on investment and business services, as observed in some frameworks, might not resonate with the diverse needs of various stakeholders. To enhance their utility, frameworks must evolve beyond broad categorisation, offering a nuanced, yet accessible understanding that captures the dynamic and interconnected nature of the space economy. *Due to this...*

Modularity & Expansion

The need for modularity is clear. As the industry continues to advance and diversify, frameworks must evolve to reflect these changes. They must allow stakeholders to get a sense of the entire ecosystem, while also being able to magnify the supply chains of the most niche space activities. This should enable stakeholders from different industries to investigate and understand the space sector from the perspective of their sector, field, or knowledge base. The incorporation of more granular categories and a comprehensive mapping of interdependencies is imperative for these models to be able to provide this. Furthermore, the infrequency of updates poses a significant challenge causing frameworks to lag behind the fast-paced developments in the space sector. For this reason also, frameworks must adopt a modular approach, enabling them to integrate new information and trends promptly, thereby maintaining their applicability and value to stakeholders. *If this is implemented...*

Future Trend Identification

A capacity to anticipate and incorporate future trends and market opportunities can be built into frameworks. While they are currently adept at categorising existing segments of the space economy, their predictive capabilities often fall short. The ability to not just analyse the present but also map future developments is crucial for stakeholders to navigate the ever-changing landscape of the space industry. Frameworks must therefore evolve beyond mere categorisation tools to become predictive instruments that offer foresight and strategic guidance, enabling stakeholders to make proactive and informed decisions in an industry characterised by rapid innovation and growth.

Building a Dynamic & Innovative Framework.

Frameworks for conceptualising and measuring the space economy offer valuable insights; they also come with limitations that need to be addressed. By recognising and tackling these challenges, frameworks can evolve into more robust, accessible, and forward-looking tools, capable of guiding stakeholders from both inside and outside the 'space bubble' through the complexities and opportunities of the Space Age.

Some small steps forward...

It is clear in our view that existing frameworks have shown limitations in capturing the space economy's dynamic and multifaceted nature, and do not fully provide stakeholders with the tools they require to query and engage with the sector meaningfully. As we envision a new approach that effectively conceptualises the space economy, the concept of interactivity emerges as a fundamental enabler and innovation. In a transformative era, we must embrace transformative approaches, ones that can overcome identified challenges and shortcomings, enhancing understanding, accessibility, and adaptability, to unlock the full value of this incredible domain.

1 **Interactive**

2 **Dynamic**

3 **Modular**

4 **Multidimensional**

5 **Strategic**

Interactive

Effectively communicating the benefits and intricate processes of the space economy is central to all frameworks. Interactive elements, however, bring to life the complexities of space activities. Through interactive visualisations and explanatory tools, an interactive framework can break down intricate processes into actionable segments and demonstrate tangible benefits, enabling stakeholders to fully grasp the operational dynamics and the value proposition of space-related activities.

Dynamic

Incorporating dynamics into a framework transforms it into a living representation of the space economy's full range. By embracing a dynamic model, continuous updates and adaptations can be ensured, reflecting the latest developments, and maintaining real-time relevance. Such a framework invites stakeholders to interact with a constantly evolving depiction of the industry, guaranteeing access to the most current information. Transitioning from a static to a dynamic model revolutionises the approach to understanding and quantifying the space economy, aligning perceptions with the sector's swift progress and changes.

Modular

A modular design would offer stakeholders the flexibility to focus on distinct parts of the space economy, from supply chains to interdependencies, and from technologies to applications. This would enable stakeholders to focus on specific component parts of the space economy. Detailed segments of interest and holistic views of the entire ecosystem can exist together through this model, ensuring its adaptability to diverse needs and contexts.

Multidimensional

An interactive and dynamic framework would also allow stakeholders to view the space economy from multiple dimensions – be it a specific non-space industry perspective, a space technology relationship, or specific outcomes and benefits. This capability would serve a broad range of users, from space industry experts to stakeholders in non-space sectors seeking to understand the relevance of space activities to their fields.

Strategic

To address the need for future trend identification, a framework should include mechanics for predictions and scenario exploration. Stakeholders should be given tools to interact with future market predictions, explore opportunities and their enabling aspects, and gain foresight into emerging trends.

Interactivity is the central missing element in providing stakeholders with tools that can allow them to fully understand and unlock the tremendous potential of the space economy. By embedding interactive elements into our conceptualisations, we can achieve a tool that is informative and comprehensive and also adaptable, engaging, and capable of keeping pace with the developments of the sector. It provides the opportunity to start from a high-level representation of the viewer's perspective and drill down on the details of relevant market segments and players. This interactive framework would not just keep track of the current state of the space economy but would serve as a guide, an educator, and a predictor.

LETO SPACE is currently developing...

...a new, straightforward, and interactive framework, which will be central to its consulting services, market intelligence and software product. This new approach will leverage the latest software technology and AI advancements to give users current information, future trends, and an interactive way to explore space market data. It is designed to be much more than a simple data tool, enabling users to gain comprehensive, in-depth insights, and understanding of the space economy – from the broadest mapping to the most targeted query. This matches LETO SPACE's goal of making the space market transparent and accessible for everyone. It will help in making smarter choices, enhancing competitiveness, and reducing risks. If you are interested in the new framework, let us know:

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Who We Are

At LETO SPACE, we are a dynamic team of management consultants, IT experts, and space enthusiasts, united by our passion for integrating space technology into business solutions. Our team brings together a wealth of knowledge from the realms of business strategy, cutting-edge technology, and the possibilities of space. We pride ourselves on being at the forefront of digital transformation, where the innovation of the tech world meets the leading edge of space advancements.

Our expertise not only lies in understanding the latest trends and technologies but in translating them into actionable strategies that propel businesses forward. As space visionaries, we are constantly exploring new ways to harness the power of space data and technology, ensuring our clients are always several steps ahead in the market. We are your trusted advisors in navigating the exciting intersection of IT, management, and the wonders of space.

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