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Entrepreneurship and Private Investment in the European Space Sector

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NEW SPACE TRENDS IN 2019

About New Space

Various studies have demonstrated that public investment in space enabled the emergence of a sizeable and dynamic market for space-based services and products and space capabilities which are now widely considered as a key lever for multiple economic, societal and environmental challenges. In this new context, a disruptive commercially driven approach to space has emerged, marked by ambitious announcements and endeavours aiming to engage in space markets with innovative schemes and business models. In this new ecosystem, private actors play a different, more prominent role both in the implementation of public programmes and the conduct of space business independently from governments.

This disruptive sectorial dynamic, often referred to as New Space, features various interrelated trends leading the space sector towards a more business and service-oriented step. Although no broadly accepted definition of New Space exists today, some major trends can be identified: [1]

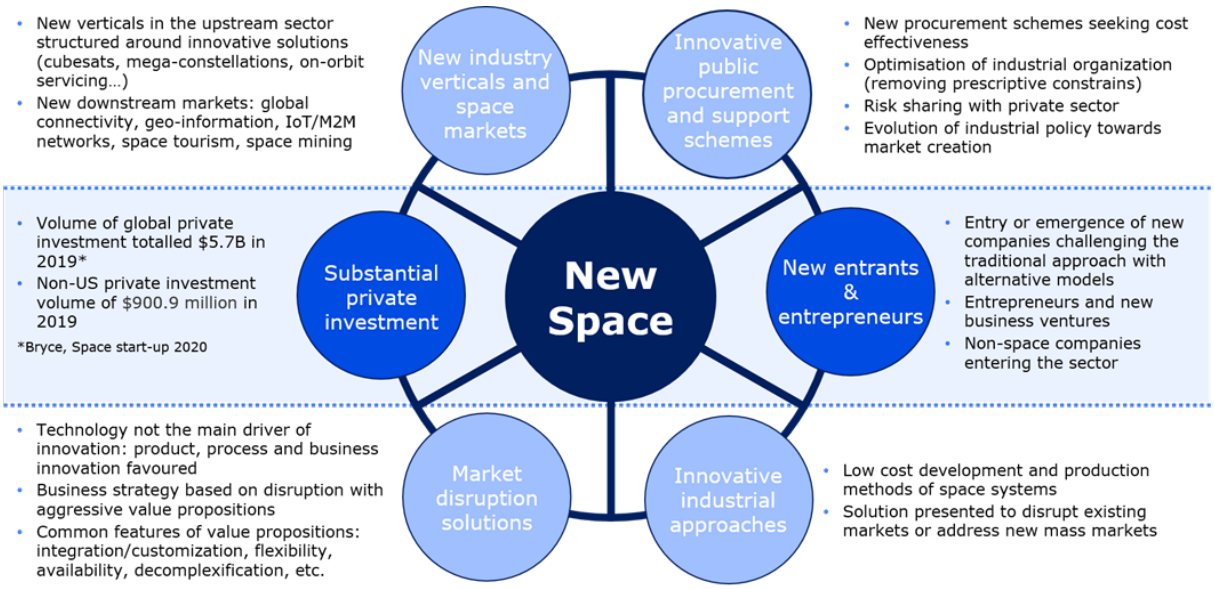


Figure 1: The New Space Ecosystem (ESPI definition)

Today, the majority of space activities are still driven by governments with private industries acting as contractors for public programmes and massively relying on public funding. Notwithstanding, a previous ESPI study[2] demonstrated that the trends observed recently are tangible and could lead to a deep transformation of the space sector characterised by a growing investment and involvement of private actors coupled with the emergence of a more business-oriented leadership.

This annual ESPI report aims at providing insights into the development of New Space trends in Europe, in particular with regards to private investment and entrepreneurship. Indicators and information provided in the Space Venture Europe series can aim to support a better understanding of the situation in Europe and how it can be further supported by public policies.

1 ESPI, The Rise of Private Actors, Executive Summary, 2017
2 Ibid.

Growing worldwide investment in 2019

Private investment in space companies continued to grow in 2019 reaching $5.7 billion with over 135 firms financed over the year according to the Bryce report Start-up Space 2020.[3]

This represents a significant 62% increase compared to 2018. The United States continue to attract most private funding with 84% of the total volume. Investment is highly concentrated and four U.S.-based companies received almost 70% of the total financing for the year. Together, SpaceX, Blue Origin, OneWeb and Virgin Galactic received a total investment of $3.9 billion in 2019 from various sources. Nevertheless, other newcomers have been able to attract significant amounts of investment in 2019 such as Relativity Space (U.S. rocket company) and Qianxun Spatial Intelligence (Chinese GNSS service company) with almost $140 million each.

Other sources, including Seraphim Capital and Space Capital estimate the global private investment in space companies at $4.1 billion and $5.8 billion respectively in 2019.[4,5] Discrepancies between available estimations can be explained by the use of different methodologies and perimeters of analysis. However, analysts converge on their assessment of a continued growth of the total private space investment.

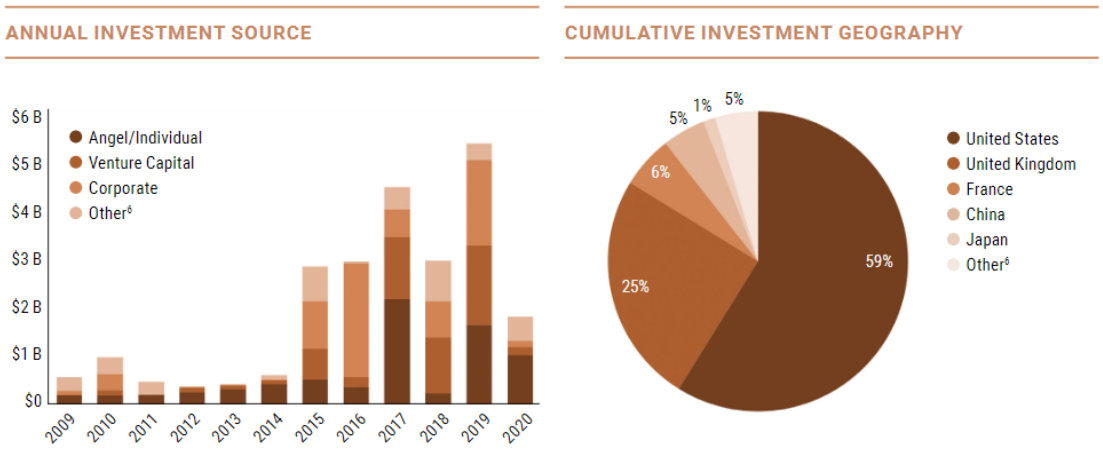


Figure 2: New Space investment 2019 (Source: Space Capital)

New public support instruments in Europe

The European Investment Bank and the European Commission introduced a fund of €200 million involving a mix of funding mechanisms to boost investment in the sector including:

- €100 million loan earmarked to partially support ArianeGroup's share of development costs through an innovative financing structure which will be contingent on Ariane 6's commercial success, once operational.
- €100 million investment in venture capital funds across the EU which support companies commercialising new products and services in the space sector. This Space Equity Pilot is funded under the EU InnovFin programme to support innovation and growth in European small and medium enterprises (SMEs).

[3] Bryce Space and Technology, Start-Up Space 2020
[4] Seraphim Capital, Seraphim Space Index (available at: https://seraphimcapital.co.uk/insight/news/seraphim-global-space-index-shows-21-year-year-growth-january-2019-december-2019)
[5] Space Capital, Space Investment Quarterly Q1 2020 (available at: https://www.spacecapital.com/publications/space-investment-quarterly-q1-2020)

Primo Space an Italian early stage tech investor was the first fund selected by the EIF under this pilot. According to the EIF, the fund has a target size of €80 million and "will invest at proof-of-concept, seed and other early stages projects or companies and will foster the commercialisation of breakthrough innovations in the space technologies in Italy and Europe." [6] Primo Space is among the first tech transfer funds focused on space-related technologies in Europe and the first one in Italy.

Introduced in 2018, Copernicus and Galileo Masters now count over 3100 participants from over 70 countries and led to almost €4.3 million in financial prizes. The masters have been a standout method to finance innovative EO and GNSS-based solutions, developments and business ideas.

From a more general perspective, the European Union is more prominently integrating objectives related to supporting private investment and entrepreneurship throughout its involvement in the space domain. For example, the European Commission considers "improving access to risk financing for space SMEs, including innovative start-ups, and emerging business models" as a core objective of the EU Space Programme.[7]

The European Space Agency also continues its long-standing support to start-ups in the space sector which encompasses incubators, competitions, funding and other support mechanisms.

- ESA's Business Incubation Centers (BIC) have long supported start-ups in the space sector. In 2019, the programme now counts 20 centers across Europe and over 300 start-ups currently in incubation. Historically, a total of 700 start-ups have been incubated and have been provided with financial, technical and business support. ESA'S BIC programme remains one of the primary sources of European start-up support.
- Multiple ESA funding schemes including "Kick-start activities" have also been launched since 2017 to help SME's or start-ups looking for early funding (up to 60 000€).

National actors are also proactively engaged in supporting investment and entrepreneurship in the sector.

The French space agency (CNES) launched the CosmiCapital fund which will be managed by CapDecisif Management and aims to raise €100 million which will then be invested in European space start-ups starting early 2019. This VC fund in partnership with ESA and IFREMER will focus on private companies related to the space economy. The first 5 investments are expected to occur in 2020.

Other countries such as Germany hold similar initiatives to accelerate the development of start-ups in accessing commercial viability. The INNOspace Masters initiated by DLR for example, provides an annual competition to promote the development of space technologies. In 2019, 316 participants submitted 117 ideas out of which 15 were selected as winners.

This is far from providing a comprehensive list of public initiatives. Supporting investment and entrepreneurship in the space sector has become a high-level objective of most European and national institutions and a plethora of diverse initiatives are regularly introduced.

Public programs with innovative approaches

The current New Space dynamic offers an interesting opportunity for governments to consider more ambitious partnerships with industry and to better share costs and risks with the private sector provided that a profitable business can be developed and that agencies can preserve their strategic role. Fostering the emergence of a more business-oriented leadership in the space sector is nowadays a dominant

[6] European Investment Bank (available at: https://www.eib.org/en/press/all/2020-013-european-commission-and-european-investment-bank-group-join-forces-to-boost-space-sector-investment-with-eur-200-million-of-financing)
[7] European Commission, The New EU Space Programme at a Glance (available at: https://ec.europa.eu/commission/sites/beta-political/files/budget-june2018-space-policy_en.pdf)

consideration for governments who are increasingly eager to explore new approaches and take advantage of new possibilities for space programmes. In 2019, space agencies continued to introduce new programmes building on new procurement schemes and public-private partnerships.

In Europe, ESA continues to explore new approaches to procurement involving a more prominent role for private actors. For example, following the SPACE19+ Ministerial Council, the Agency took the decision to engage in active space debris removal in an innovative way. ESA adopted a service-oriented approach, also to encourage the development of IOS solutions at large and demonstrate the feasibility of commercial IOS missions. ESA eventually awarded a space debris removal services contract in December 2019 to the Swiss start-up ClearSpace with the objective to deorbit a 100kg Vega Secondary Payload (Vespa) upper stage in LEO.

The USA

Building on the success of the COTS programme (Commercial Orbital Transportation Services), NASA implemented new projects relying on service purchasing in the frame of its Artemis programme:

- Gateway Logistics Services: Modelled after the COTS programme, NASA will rely on services provided by commercial companies to deliver cargo to the Lunar Gateway. SpaceX was awarded a contract by NASA in March 2020.
- Commercial Lunar Payload Services: NASA will also contract transportation services to send small robotic landers and rovers to the Moon's south polar region. As of April 2020, Masten Space Systems, Intuitive Machines and Astrobiotic Technology have all been awarded contracts.
- Human Landing System: for the development of the lander that will carry astronauts to the Moon surface, NASA has selected 3 U.S. teams for contracts worth a total of almost $1 billion.
    - Blue Origin will develop a lunar lander using its New Glenn rocket and ULA Vulcan launch system.
    - Dynetics will develop a system which will provide ascent and descent capabilities.
    - SpaceX is developing a fully integrated lander that will use their own super heavy rocket.

European prospects

In Europe, public actors are proactively seeking to explore new approaches for space programmes as well as new mechanisms to support growth and innovation in the sector. Examples are multiplying and objectives to stimulate private investment and entrepreneurship in the space sector are increasingly high on the European space policy agenda.

New Space trends will surely continue to develop in the future with the introduction of new public policies and instruments and the emergence of new business ventures and investments. Major events will certainly have a strong influence on these future developments. The implications of the COVID-19 crisis for space companies and markets are still difficult to evaluate, in particular on the long-term. Impacts on the sector will also have to be put in perspective with the far-reaching changes in the global and European economy and finance ecosystem affecting public policies and budgets, investment capacities and the overall business environment. In Europe, Brexit and the strategy that will be adopted by the UK government for the development of its domestic space sector will also have critical consequences on private space as investment and entrepreneurship trends in the country continues to make it a European “New-Space” leader.

1 PRIVATE INVESTMENT IN EUROPEAN SPACE START-UPS

1.1 Overview and key indicators

Over the period 2014-2019, 175 private investment deals concerning European space start-ups were recorded for a total amount of €766.4 million. In 2019 specifically, a total of 56 deals were made totaling €188 million. This is a conservative estimate as the value of 12 transactions was not disclosed.

This value does not include investment in space ventures after they have successfully reached maturity (see definition of start-up Annex A). Major deals in 2019 such as the acquisition of Hispasat by Red Eléctrica de España (€945 million), the acquisition of M7 Group SA by Canal+ (€1 billion) or that of Newtec by ST Engineering (€250 million) are not included. Considering these "megadeals", the total private investment value over the period 2014-2019 would reach €4.2 billion. In 2019 only, if megadeals were included, the annual investment value would reach €2.4 billion.

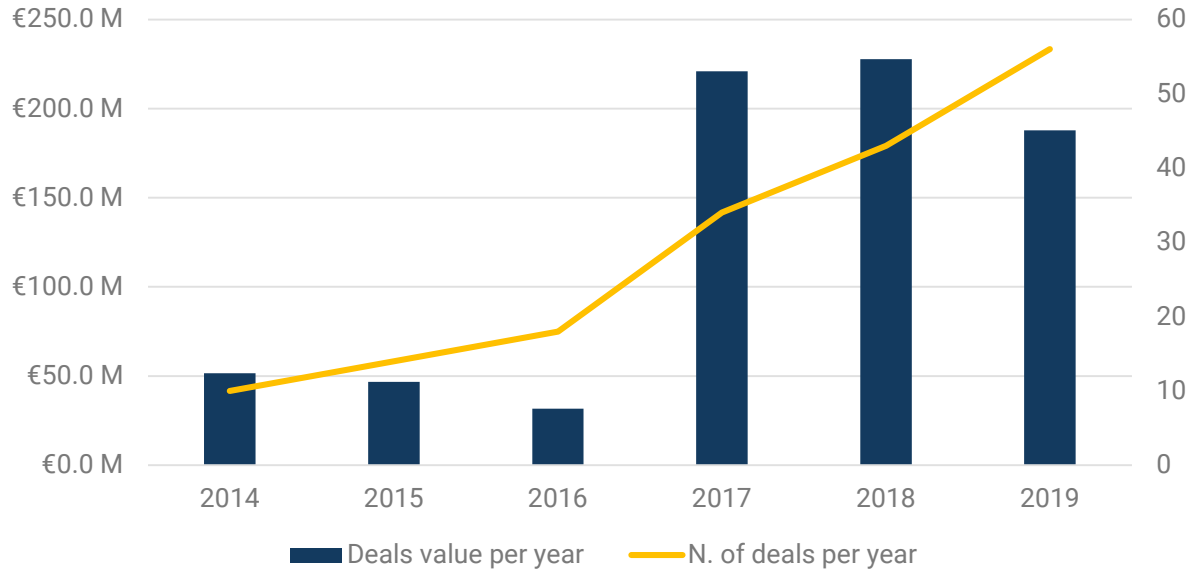


Figure 3: Private investment value and number of deals per year 2014-2019

The past three years have been marked by a plateauing of private investments in European space start-ups at around €200 million per year. 2019 confirmed the increase of private investments observed since 2014 in Europe but did not match the record high of €220 million in 2018. There was, however, a higher number of deals recorded (56) including 12 of undisclosed amounts. This confirms that private investment is now well-established in the European space sector complementing public support to foster innovation and growth.

A significant share of the 2019 investment volume was concentrated in a few top transactions but to a lesser extent than in previous years. In 2018, the top 5 deals all surpassed €20 million and totaled €141.3 million, corresponding to 62% of the total invested amount. In 2019, the top 5 deals totaled €71 million which represents 37 % of total private investments made in Europe during that year. Next year's statistics will allow to determine whether this fragmentation of large deals is an actual trend to consider.

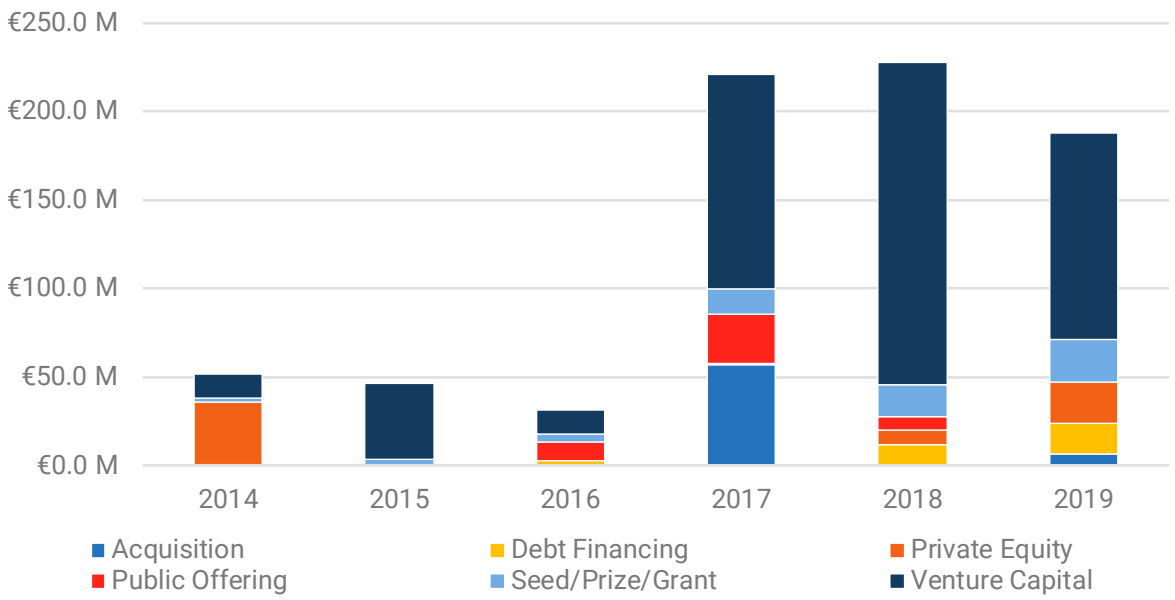


Figure 4: Private investment by category 2014-2019

Venture Capital accounts for a vast majority of the private investment in European space start-ups (66% between 2014-2019). In 2019 again, Venture Capital accounted for a total of 25 deals which represented €116.4 million or 62% of total investments. The second most used types of investment in 2019 were Seed/Prize/Grant with a total of 23 deals and an investment of €24.2 million (13% of the total) and Private Equity with only 4 deals but counting for €23.2 million (12% of the total). Some of the standouts in the Seed/Prize/Grant section are NanoAvionics which raised €10 million and Syntony GNSS which raised €6 million. Debt Financing in 2019 mainly includes the £14.7 million raised by Spire global from Scottish Enterprise and the Scottish Investment Bank to develop their business activity in Scotland. This deal actually includes a £6.7 million discretionary grant and an £8 million commercial convertible loan note. With 3 deals, acquisitions only accounted for 4% of total investments in 2019. Sat Service was acquired in 2019 for approximately €6.5 million.

Deal value in 2019	Number of deals in 2019

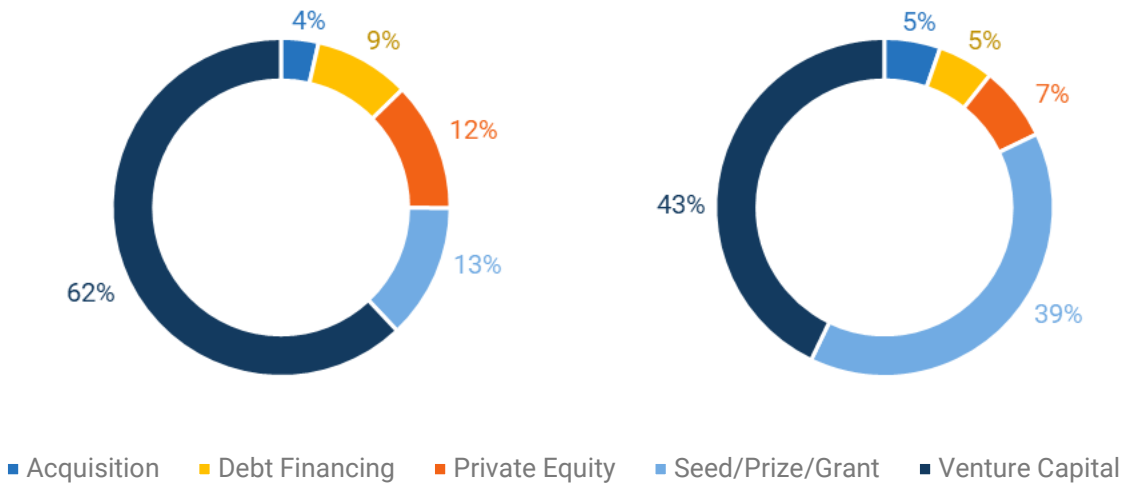


Figure 5: Distribution of investment by category in 2019

1.2 Top deals in 2019

2019 showed a slight decline in terms of the size of top deals. While the top 5 deals in 2018 amounted to a total of €141 million (62%), including deals with Orbex, Spire and Kayrros, the top 5 deals in 2019 only totaled €71 million (37%).

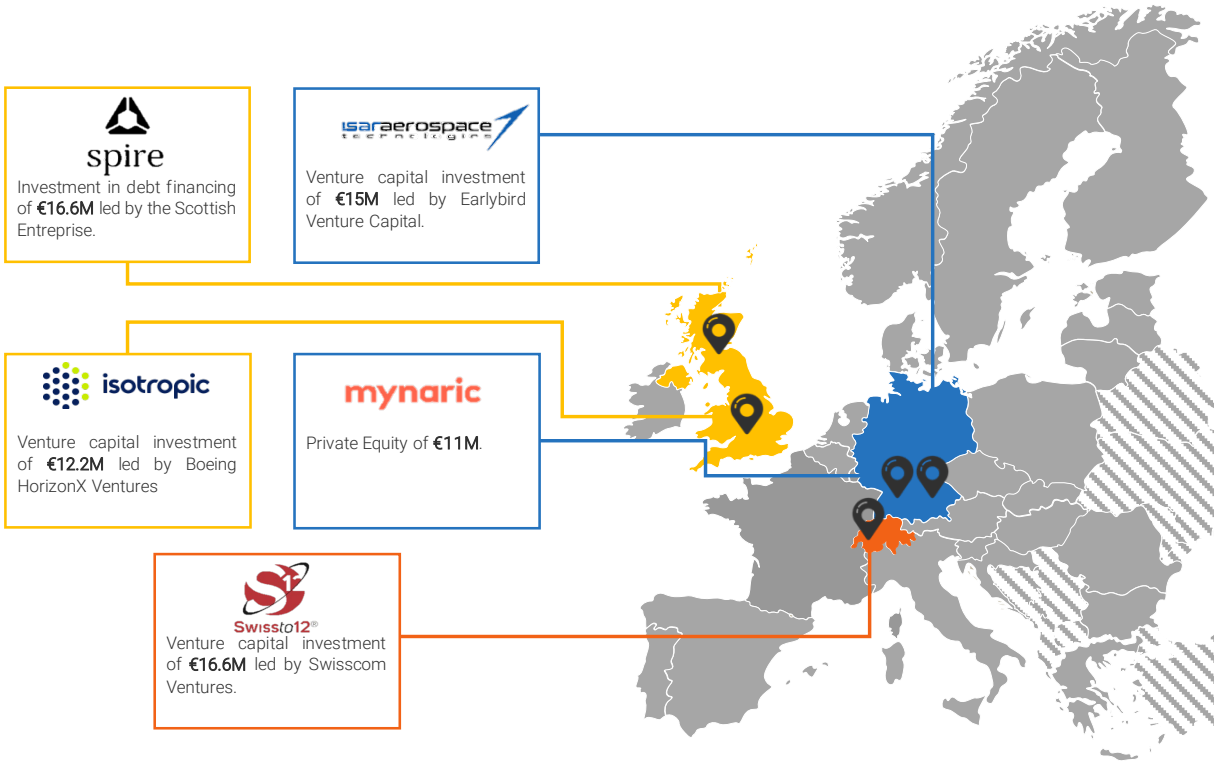


Figure 6:Top five European investment deals in 2019

Spire (€16.6 million): The Glasgow based satellite company received almost €17 million from Scottish Enterprise and the Scottish Investment Bank. By placing one of the largest packages ever provided, the investing organisations seek to generate over 260 jobs in Scotland's space sector. Spire will be located in the Skypark facilities in Glasgow.

Swissto12 (€16.6 million): The Swiss based provider of telecommunications components has raised close to €17 million through a series B financing round led by Zurcher Kantonalbank and Swisscom Ventures as well as returning investor Constantia New Business (CNB). The aim of this round is to accelerate industrialization and commercial deployment of its antenna products for satcom.

Isar Aerospace (€15 million): The German based start-up which focuses on developing an environmentally friendly low-cost launch vehicle has raised €15m through a Series A round which was led by Earlybird and Airbus Ventures. Existing investors like Vito Ventures and UVC partners also participated.

Isotropic (€12.2 million). London based Isotropic Systems Ltd which offers increased data transmission capabilities at a reduced cost for satellite service providers has led a Series A round in with Boeing Invests as primary investor but included the participation of WML and Space Capital. This investment will help the start-up in advancing the development of their terminal solutions.

Mynaric (€11 million). Munich based start-up Mynaric has raised €11million through post-IPO financing from a satellite constellation lead investor at €55 a share. The lead investor plans to use the Mynaric products including their CONDOR laser terminal and the investment will help them scale up and accelerate production.

1.3 Geographical distribution of investments

Distribution of recipients

The figure below shows the geographical distribution of the total value of private investment operations in space start-ups according to the location of their headquarters. The figure does not include recorded deals with an undisclosed amount.

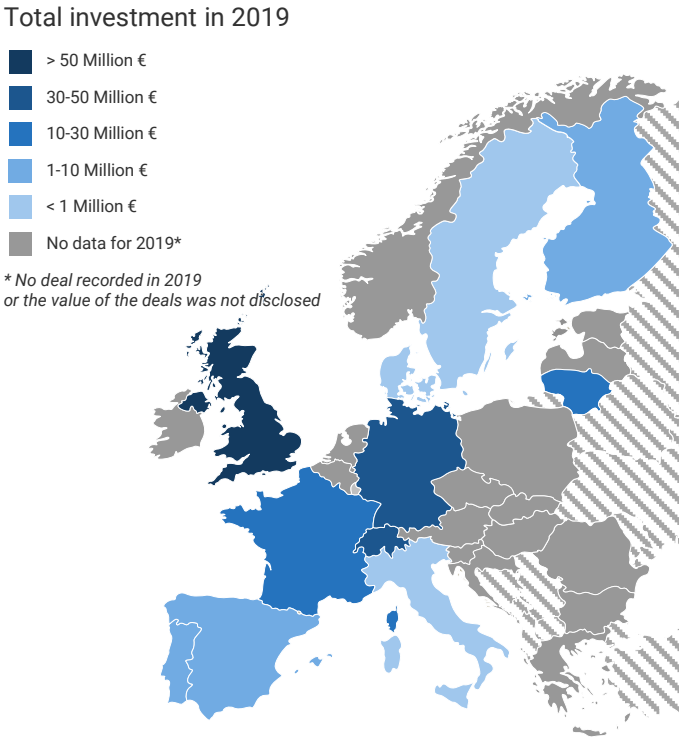


Figure 7: Geographical distribution of investment recipients in Europe in 2019

This year again, the distribution of investment by country shows a discrepancy between the level of entrepreneurship and public space budgets.

The UK continues to stand out in terms of investment received. Half of the top 5 deals in 2018 and 2019 were located in the UK. In 2019, 17 deals involving UK-based start-ups were recorded for a total of over €60 million. This year, the Scottish space cluster played a prominent role in UK leadership with the funding of Spire by Scottish Enterprise and the Scottish Investment Bank and a €2 million investment in Edinburgh-based Sofant technologies (31% of total UK private space investment). With 19% of the UK space workforce and a GVA of €880M in 2018, the Scottish space cluster plays an important role in the success of the private UK space economy.[8]

The second country with the highest amount of deals but also the largest investment in 2019 was Switzerland with 10 deals reaching almost €40 million. France and Germany, the two biggest funders of ESA and representing the largest European budgets also count a dynamic ecosystem: Germany totaled 6 deals accounting for €32 million in investment, while France received 4 deals for a total of €24 million.

With other important deals recorded in Belgium, Italy, Lithuania, Portugal, Spain and Denmark, entrepreneurship in the space sector is a widespread trend across Europe.

[8] The Scottish Space Cluster, London Economics 2020

Origin of lead investors

Beyond the geographical distribution of recipients, it is also important to look at the region where investments were made from. The figure below shows the geographical distribution of lead investors for European space start-up investments.

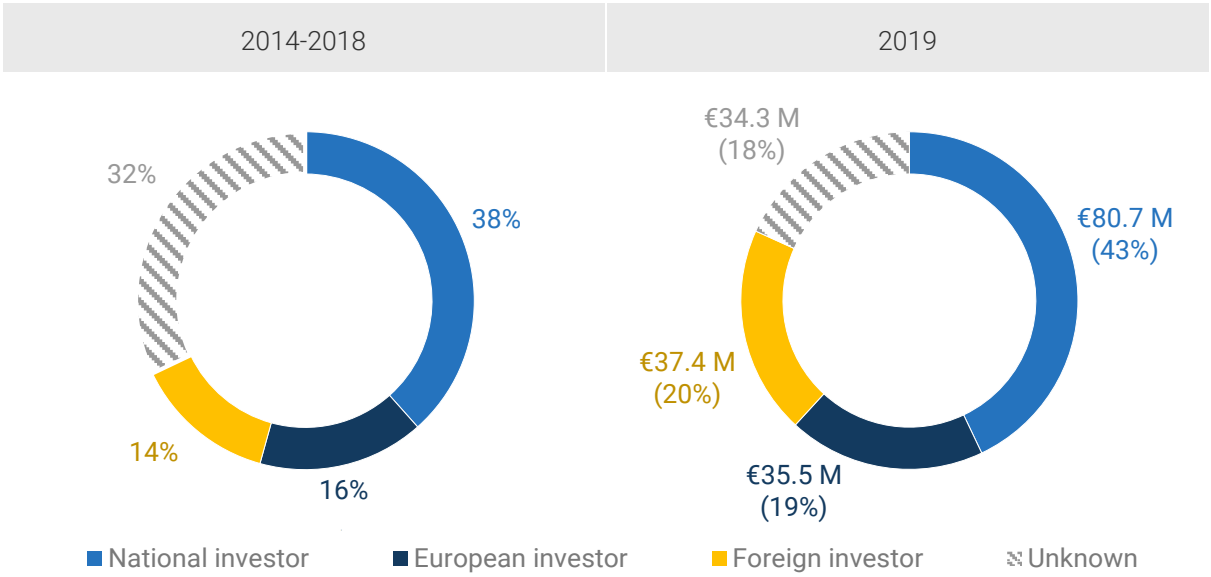


Figure 8: Geographical distribution of lead investors in 2019

Statistics underline that investors tend to predominantly fund start-ups in their own country. Between 2014 and 2018, 38% of all lead investors invested nationally and in 2019 this share grew to 43% for a total of €80.7 million. This trend is particularly marked in the UK (56%), Switzerland (50%) and France (75%). European space start-ups also attract investments from foreign sources, although to a lesser degree. In 2019 at least 20% of the investment came from foreign lead investors. The source of investment is often undisclosed: 18% of the investment value came from unknown organisations.

1.4 Investment across the Space value chain

Information on the space value segmentation are available in Annex A.

In 2019, the Upstream sector accounted for 50% of the total investment. This is a large decrease in comparison to 2018 where it totaled 70% of all investments. However, the upstream sector showed a large increase in the Build segment (i.e. development and manufacturing of space systems) which grew from 25% in 2018 to 31% in 2019 where it represented the biggest investment category across the entire value chain. Representative examples include Cailabs (€9 million) which develops optical components with applications for Earth-Space laser communication and LiDAR or PLD Space (€10 million) which develops cost-effective and reusable space launch vehicles.

The Downstream sector accounted for 48% of the total investment in 2019. This is a 65% increase compared to 2018 when it only accounted for 29%. The biggest segment was Downlink (i.e. ground support infrastructure and services) which totaled €32 million and represented 17% of total investments. The other two segments, Product (i.e. space-enabled products for end-users) and Analyse (i.e. value-adding solutions for data exploitation) represented around €28 million respectively accounting, each, for about 15% of total investments in 2019. Representative examples include SatService (€6.5 million) which offers a broad range of satellite-based communication technologies and Hummingbird Technologies (€7.8 million) which develops a proprietary machine learning algorithm to apply to remote sensing imagery.

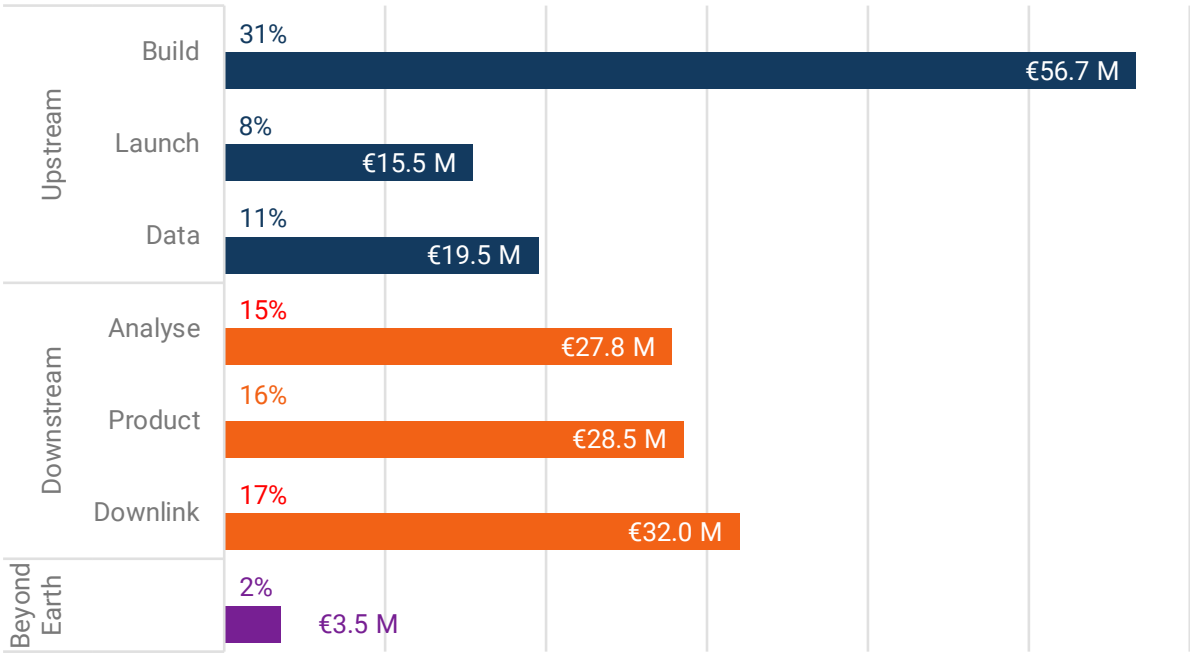


Figure 9: European space start-ups across the value chain in 2019

It is important to note that a strong bias exists due to the inherent difficulty to track investments in the downstream sector which involve companies whose service and product portfolio is not entirely embedded in the space value chain. As a result, a number of private investments in European space start-ups with some space-related business are not included here due to the difficulty to identify these companies and establish a clear link between the investment and the development of space products and services. This also suggests that the space sector probably also benefits from investments in other sectors, particularly in the downstream segment. With a growing cross-fertilization between space and terrestrial technologies, the distinction between investment within and outside the space sector is poised to become increasingly blurred.

1.5 European investments in a global context

The value of private investment in European space start-ups can seem rather small in comparison to the multi-billion figures reported globally and particularly in the United States. Several aspects should be considered when understanding how this estimation fits in a general context:

- Different boundaries of assessment: Estimations provided in this report are limited to a narrower definition of "space start-ups" which excludes companies having reached business maturity and companies with limited links to the space sector.
- Prominence of the Big 4: Global investment is highly concentrated in a few high-profile companies. This was especially visible in 2019 where close to 70% of the worldwide investment in private space companies was concentrated in four U.S.-based companies. SpaceX, Blue Origin, OneWeb and Virgin Galactic combined for a total investment of $3.9 billion over the year. These companies, which do not fall in the definition of "start-ups" given the size of their business, weigh substantially on global investment estimations.
- Size of the sector: European space budgets and relative size of the sector are at least 4 to 5 times smaller than in the United States. However, Big 4 put aside, estimations suggest that Europe tends to also perform very well to stimulate private investment in the sector.

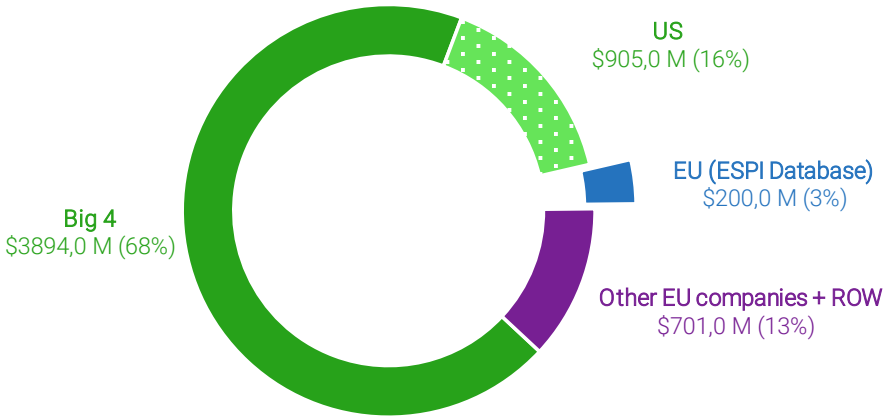


Figure 10: Reviewed global space investments (Source: Bryce, ESPI)

Qualitative factors:

European initiatives to stimulate private investment in space are not as long established as their American counterparts. This circumstance combined with the fact that socio-economic and cultural conditions in Europe offer less incentives to entrepreneurship plays a role in overall investment size. In addition, while there is more private capital in the US, the security net linked to governmental anchor tenancy allows private investors to take more risk. This can be seen by the emergence of a few industry success stories (Virgin Galactic, SpaceX), which in turn foster the incentive for further entrepreneurship.

Furthermore, unlike in the EU, US institutional demand is sizeable, foreseeable and stable. This gives birth to the necessary conditions to develop a stable and perennial business plan. As such, the role of institutional demand accelerates the development of modern business models.

2 EUROPEAN SPACE ENTREPRENEURSHIP SURVEY

2.1 European space start-up profiles

Geographical distribution of respondents

This chapter provides an overview of the results of the ESPI Space Entrepreneurship Survey 2019. The survey was issued to 300+ European space start-ups and ESPI received more than 100 responses.

ESPI entrepreneurship survey consisted of 30+ questions addressing 4 themes:

- *Business organisation*: location, core business, workforce, foundation;
- *Business situation and prospects*: target markets, revenues, development priorities; factors for growth;
- *External support*: financial and non-financial support received and planned;
- *Business environment*: views on the European entrepreneurial ecosystem, expectations for governmental support.

After careful review, involving company and coherence verifications, ESPI filtered 73 individual responses from space start-ups located in 21 European countries, providing an extensive sample. Comparably to private investment statistics regarding to their geographical distribution of recipients, the results of the survey show that entrepreneurship in the space sector is widespread across Europe.

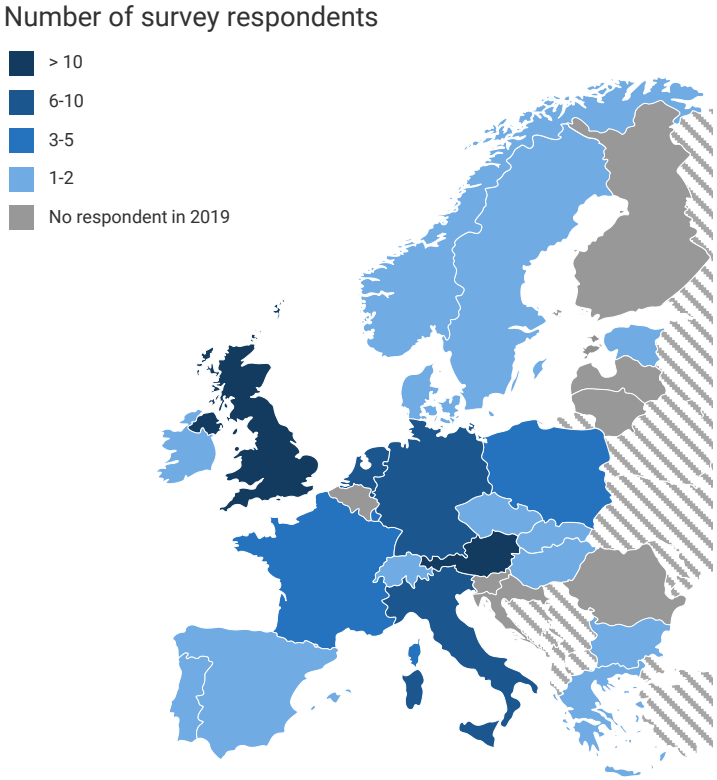


Figure 11: Geographical distribution of respondents to the ESPI survey 2019

This year, 52% of the responses received came from start-ups headquartered in 4 countries: 15% from the UK, 14% from Austria, 12% from Italy and 11% from Germany. Other countries with a significant number of respondents include Luxembourg and Poland with 5% each.

Workforce and recruitment plans

Most European start-ups are micro-enterprises with a workforce between 1 and 5 employees (30%) and only 11% of respondents rely exclusively on their founders. On the other side of the spectrum, 14% of start-ups have already reached a considerable size with more than 50 employees. The largest share of respondents (45%) employ between 6 and 50 staff. Altogether, respondents account for a total workforce of at least 1700 employees, excluding founders.

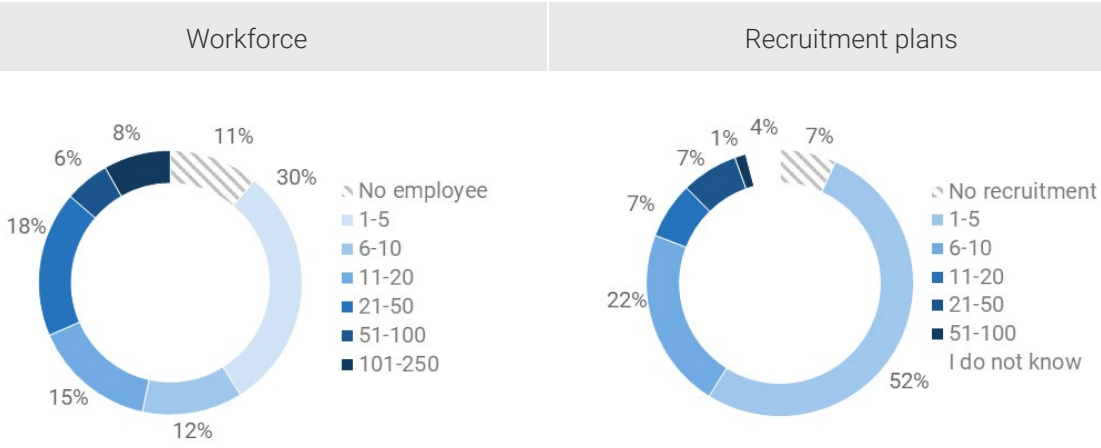


Figure 12: Number of employees (excluding founders) and recruitment plans in the next 5 years

The majority of European space start-ups (89%) intend to hire within the next 12 months with 350 to 800 planned recruitments corresponding to a 25% enlargement of their workforce. On average, start-ups from the survey sample plan to hire 6.2 employees in the next 12 months. As a comparison, the European start up monitor 2019[9] estimates that the average start-up in Europe plans to hire 7.5 people. While 52% of all start-ups are only expecting to hire between 1-5 people and 24% between 6-10, 17% are expected to hire anywhere between 11 and 100 people, suggesting a strong confidence in the future.

Age and business stage

In line with the results of 2018, the 2019 survey points out that most start-ups (56%) were founded independently. The academic environment still provides a fertile ground for the foundation of start-ups in Europe: 14% of all respondents originated from a university project. New business ventures can also emerge from spin-offs of existing companies and research institutions, which each account for 8% of start-ups. The remaining 14% include start-ups from various origins such as start-ups created in the context of not for profit organizations or established following a company takeover.

Out of 73 start-ups, half are less than 7 years old, including 15% founded less than 3 years ago. The other half includes older companies, some of which remained almost inactive for some years before rebooting/accelerating their business development more recently.

With regards to business stage, 40% of start-ups are still in the early phase of development (seed and early stage) meaning that the start-up activity is usually focused on concept and product development and that commercial operations have not yet started, or that the company has just started to address its target market and to generate revenues. At such an early stage, business profitability is not yet established, and risk of failure remains high.

[9] European Start-up Monitor, 2019

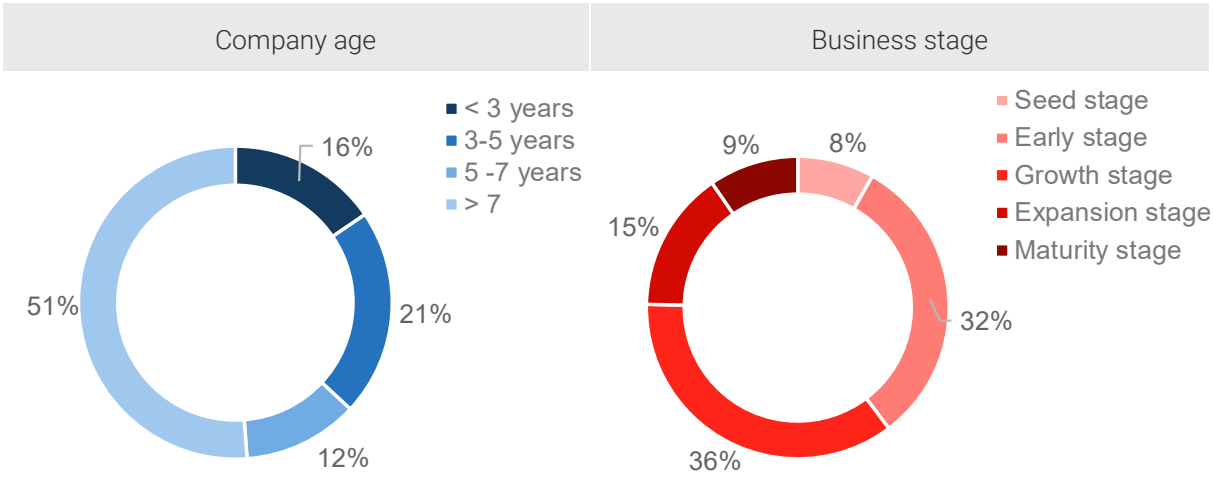


Figure 13: Business stage and company age

Despite their relative youth, 60% of respondents consider themselves to be already at later stages of business development including at growth, expansion or even maturity stage. A majority of companies are at expansion and growth stages (51%) which represents a critical phase for the development of steady, diversified sources of revenues. These more established start-ups have usually met one commercial success and are seeking growth, expansion (diversification, internationalisation) or stabilisation of their business model. Risk of failure at these later stages is usually lower, although it can remain significant.

It is difficult to create a typical development profile for space start-ups. Many factors are involved, and each start-up presents a different business profile. The evaluation of business stage also depends on the business strategy and objectives of each start-up. There is a typically high failure rate of young ventures during the first 2 years, but some extremely successful ventures may also experience a fast development and achieve reach maturity after only a few years.

Business and innovation

Respondents to the survey are well distributed across the space value chain with 38% in the upstream, 48% in the downstream and 14% in other business areas. The development and production of space systems and parts (i.e. "Build") and value-adding services related to space data exploitation (i.e. "Analyse") remain the most represented business areas for start-ups with almost 60% of the responses. The development of end-user products (i.e. "Product"), another important business area of the downstream sector, follows with 19% of respondents. The share of start-ups involved in the development of launch systems is likely underrepresented in the sample as many new endeavors were announced in Europe recently, particularly in the domain of micro-launchers (2020).

Another interesting point is the large share of companies (52%) that consider space only as a part of their business portfolio. Start-ups with a "partially space" business activity include companies in the upstream that sell systems/equipment that can be used by other sectors and companies in the downstream that use space capabilities in combination with other data and technologies. The share of start-ups focusing exclusively on space is higher in the upstream (71%) than in the downstream (34%). This situation is not necessarily specific to start-ups, but it underlines that most companies, even at an early stage of development, target multiple markets and/or rely on a cross-fertilization between space and terrestrial technologies.

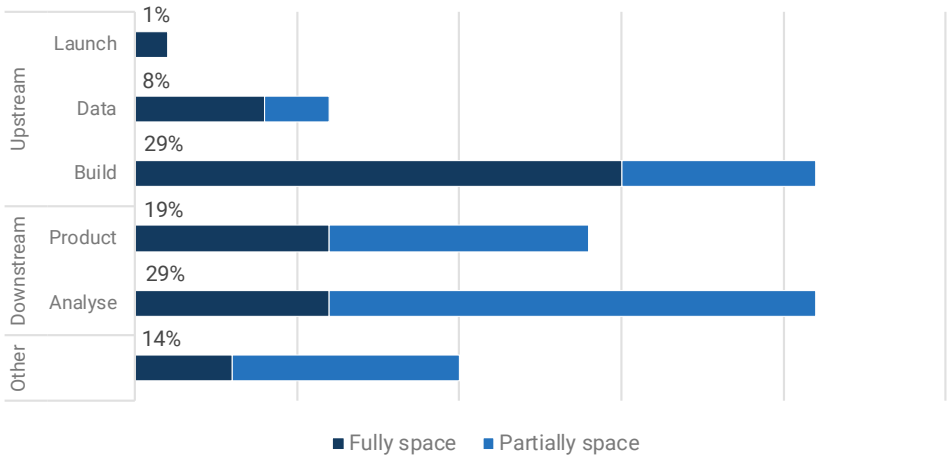


Figure 14: Core business of respondents and share of space-related business

The 2019 survey confirmed that European space start-ups are highly innovation driven. They build their business and value proposition mostly around new products and technologies. Most respondents consider themselves to be innovative, not only at a national or European level, but also at a global level.

- 74% of respondents offer a product that is a worldwide innovation;
- 74% use globally pioneering technologies;
- 28% consider their business model to be unique in the world;
- 31% implement highly innovative industrial processes;

When innovation is not at a global scale, it is at least at a European or national scale. Only a minority of start-ups offer a product or technology that already exists, focusing instead on differentiating factors. In the previous Space Venture Europe edition, it was underlined that innovation is even more vital for space start-ups than for other start-ups. In comparison, only 52% of all European non-space start-ups offer a product that is a global innovation.[10]

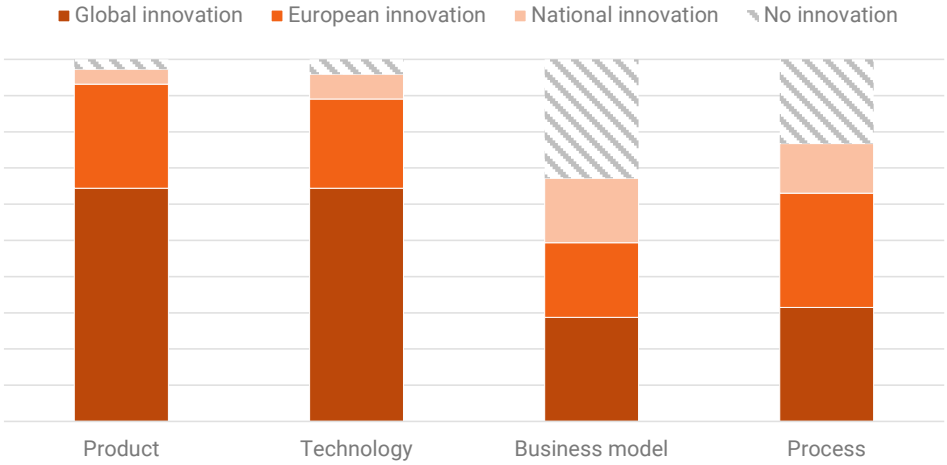


Figure 15: Companies' innovations in terms of Product/ Technology/ Business Model/ Process

A much smaller share of companies consider their business model and internal processes highly innovative (28%), suggesting a focus on technical aspects rather than business related concepts. With regards to innovation, start-ups derived from university projects stand out with highly innovative products (90%) and/or technology (80%).

[10] European Start-up Monitor 2016; this estimation was not updated in 2018 and 2019 editions of the European Start-up Monitor report

Revenues and target markets

Most European space start-ups already generate a revenue (93%) with 61% declaring a revenue below €1 million and 33% above. Only 7% generate no revenue yet, corresponding to the youngest companies generally in their seed stage. On the other side of the spectrum, companies declaring a revenue higher than €1 million are usually in their expansion or maturity stage.

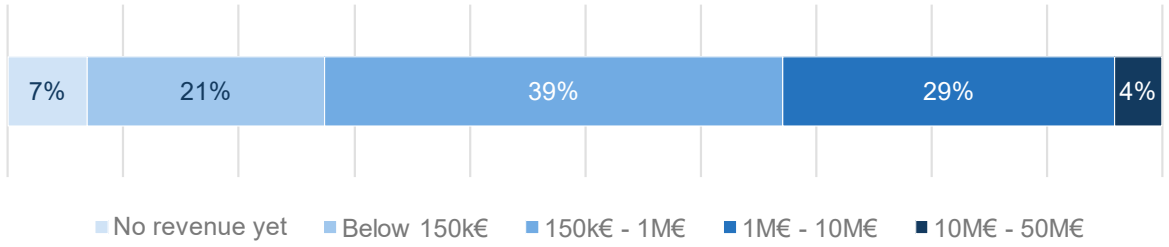


Figure 16: Start-ups revenues

Start-ups generate this revenue primarily in European markets. With 45% of survey respondents addressing European markets and 17% focusing on their national markets, European customers remain the core target of start-ups. In 2019, 38% of the respondents declared that they offer their solution to international markets. This is a significant decrease from the results of the 2018 survey, where 63% of respondents claimed to address global demand. This is still much higher than the 24% of non-space start-ups targeting international markets as reported in the European Start-up Monitor 2016.[11]

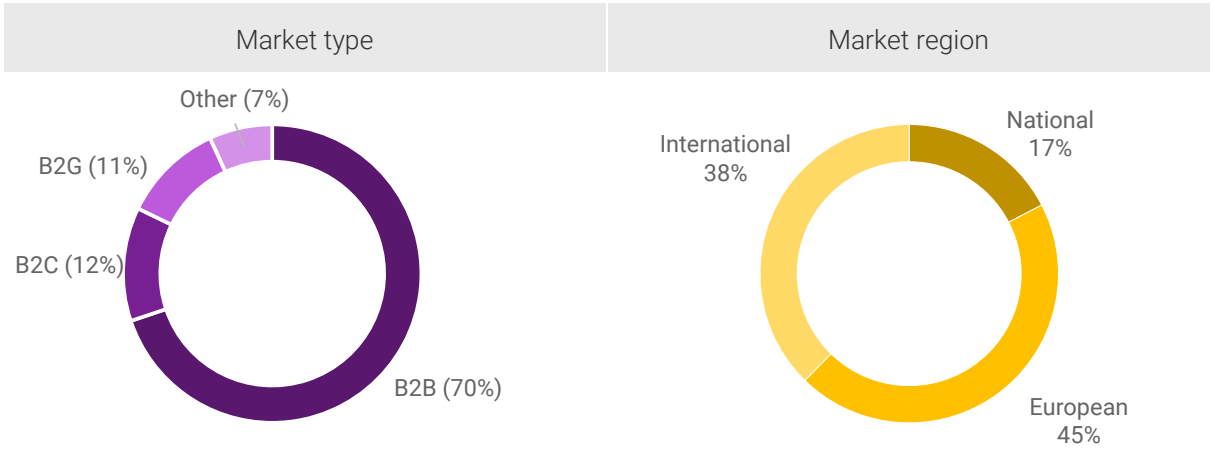


Figure 17: Target markets

In terms of business models, the European space start-up ecosystem is overwhelmingly dominated by B2B companies with 70% of all respondents concentrated in this category. This is comparable to other European start-ups according to the European start up monitor (71% of all European start-ups are B2B).[12] In contrast, only 12% of the respondents offer their products directly to consumers (B2C) or to governments (B2G/11%). A direct comparison between the situation in Europe and in the United States is not possible but the limited share of start-ups offering their solutions to governments in Europe contrasts with the situation in the United States, where public programmes regularly offer large public contracts through organizations like NASA, DARPA or even more recently Space Force.

[11] European Start-up Monitor 2016; this estimation was not updated in 2018 and 2019 editions of the European Start-up Monitor report
[12] European Start-Up Monitor 2018

Business outlook of space start-ups

European space start-ups have a rather positive outlook on both their current business situation and on their future economic outlook. The figure below provides the contrast of answers between the past, present and future situation of companies that answered the ESPI survey in 2019.

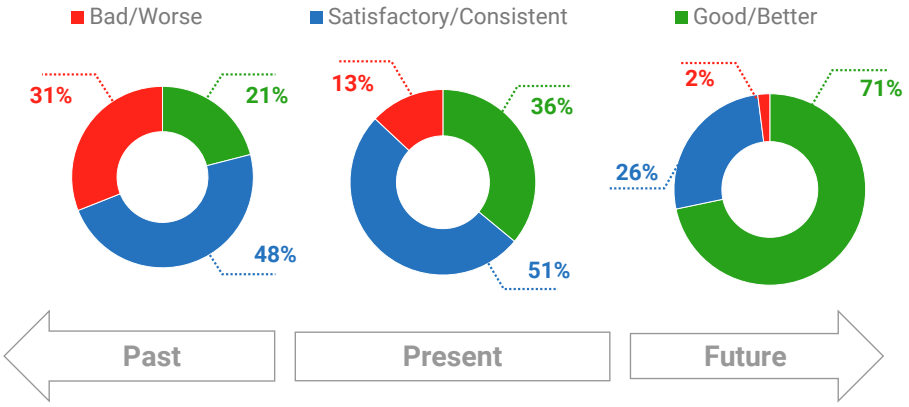


Figure 18: Perspectives on business situation

The outcome of the survey underlines the highly positive views European space start-ups upheld regarding their business situation.

- 87% of the respondents consider their current situation to be satisfactory or good and only 13% are not satisfied with the status of their business.
- With regards to the past, 31% of the start-ups declare that their situation deteriorated and 48% that it remained stable.
- In the future, 71% of respondents believe that their business situation will further improve and 26% that it will likely remain stable. Only 2% are pessimistic about their future business perspectives.

This positive development follows the outcome of the 2018 survey, where 73% of respondents foresaw a better economic situation in the future. This optimism is mirrored by the perception of abundant opportunities for innovation and profit on space markets shared by most respondents, despite an intense competition and a strong bargaining power of customers.

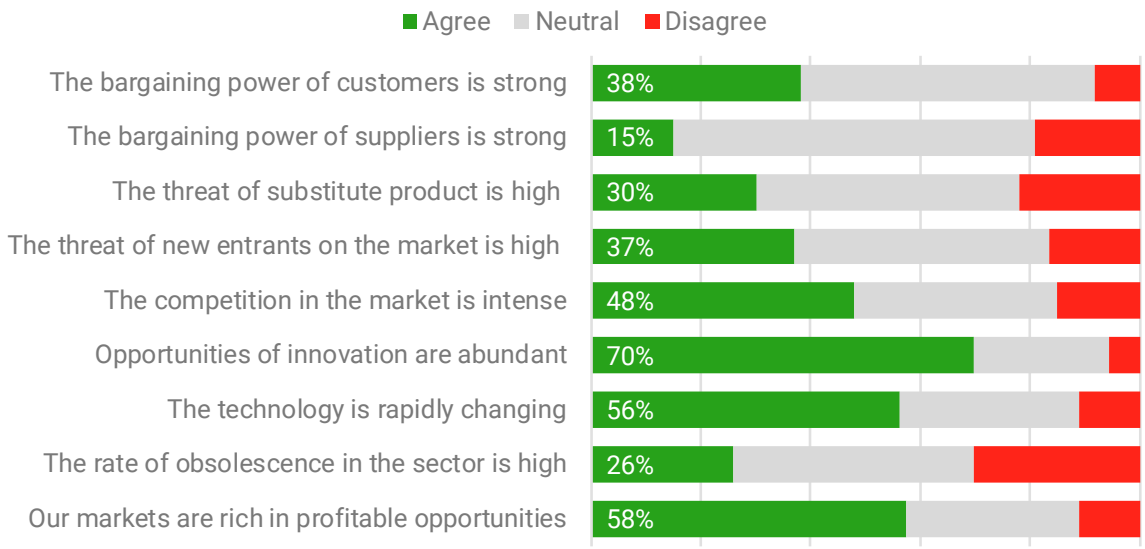


Figure 19: Start-ups' perspectives on the business environment

Business development priorities

Most survey respondents declared that product development remains their main priority for the upcoming year (58%). Of course, this is a more central priority for start-ups at early stages still focusing on the development of a marketable solution. 72% of companies at seed and early stage consider product development as their top priority. This suggests that early stage start-ups would likely welcome technical expertise and support.

Sales growth and customer acquisition are the second highest priorities for start-ups and more specifically for those at later stages (60%). This highlights the need for start-ups to establish steady revenues after having initiated commercial operations. Upstream companies give a higher priority to sales growth and customer acquisition than downstream companies (65% vs. 35%).

Interestingly, raising capital is a lower priority for start-ups, both upstream and downstream, who seem to prioritize sales and operating workflow as primary source of funding, before external investments. This is confirmed later survey results.

Priorities related to business expansion, such as accessing new markets, hiring staff, optimizing processes or scaling production appear to be secondary in comparison to structural business development priorities.

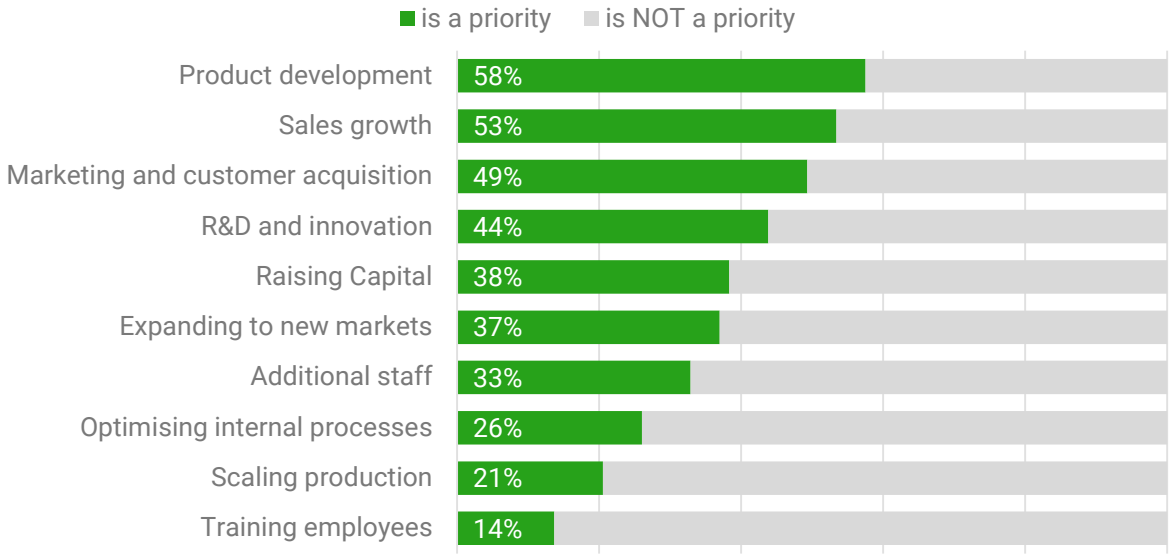


Figure 20: Business development priorities for start-ups

Key start-up challenges

When asked to rank their main challenges, European space start-ups highlighted their concerns regarding growing revenues (53%) and acquiring new customers (48%). Further challenges include cashflow liquidity (42%) and product development (33%). On the other side of the spectrum, start-ups tend to perceive profitability (18%), internationalisation (19%) and team development (22%) as less challenging.

Interestingly, while product development is the primary business development priority for start-ups, it is not necessarily considered a top challenge. Only half of companies considering product development a priority expect to face challenges. This suggests that European start-ups are rather confident in their capacity to develop viable technical solutions without facing major difficulties. On the other hand, revenue growth and sales/customer acquisition are considered both priorities and challenges by 35% and 40% of

the start-ups respectively. In this regard, they likely represent the most critical issues faced by most start-ups at all growth stages. This also probably translates to cashflow challenges reportedly faced by European space start-ups if they face difficulties to structure their business development around predictable and sizeable revenue streams. In comparison, raising capital is considered both a priority and a challenge by 25% of the start-ups.

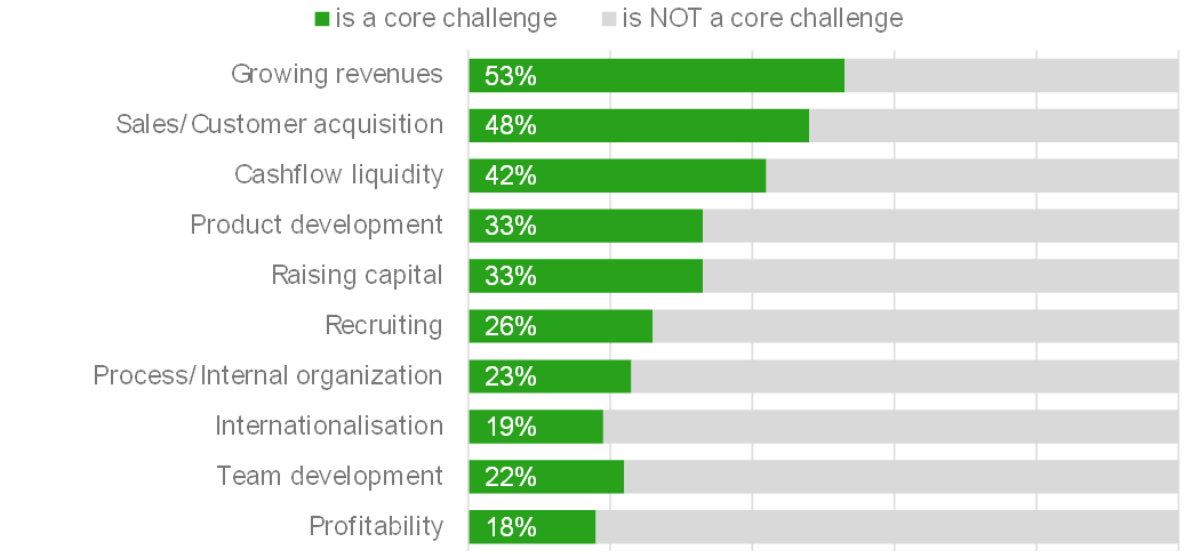


Figure 21: Key Challenges

Benchmarking space start-ups' views with other European start-ups (ESM 2019)[13] underlines a similarity in the perception of challenges. Key challenges identified in the ESM 2019 also include product and service development for start-ups at seed stage and sales and customer acquisition at early, growth and expansion stage. Similarly, internal processes, profitability and internationalization consistently rank as the lowest challenges for all start-up stages.

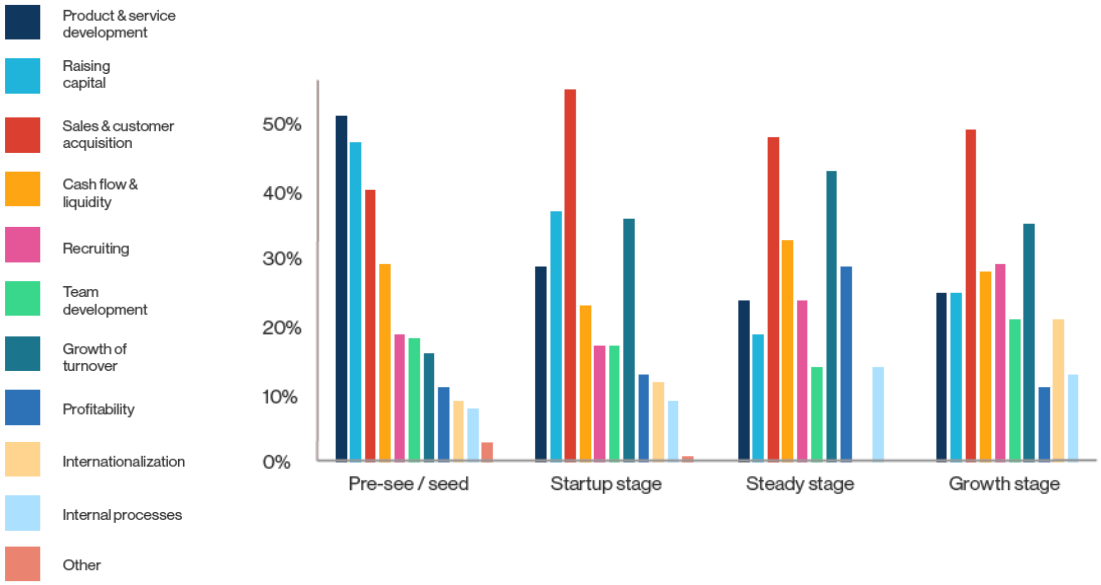


Figure 22: European start-ups' business challenges (source: European Start-up Monitor 2019)

[13] European start-up monitor (ESM), 2019

2.2 Support to entrepreneurship and start-up expectations

Financial support

75% of the start-ups sampled in the survey declare having already received some kind of external financial support including governmental subsidies, bank loans, funding from incubator/company, venture capital, business angel, crowdfunding or others. Public subsidies and loans are the most common source of external financial support. Among those having benefited from external financing, 35% were supported by multiple investment sources often involving a mix of public and private funding. Self-funding through private savings of founders remains the main source of initial start-up financing. 75% of start-ups were started using personal funds and only 22% did not have the recourse of self-fund or fund through family and friends. A vast majority of start-ups do not intend to use self-funding in the future.

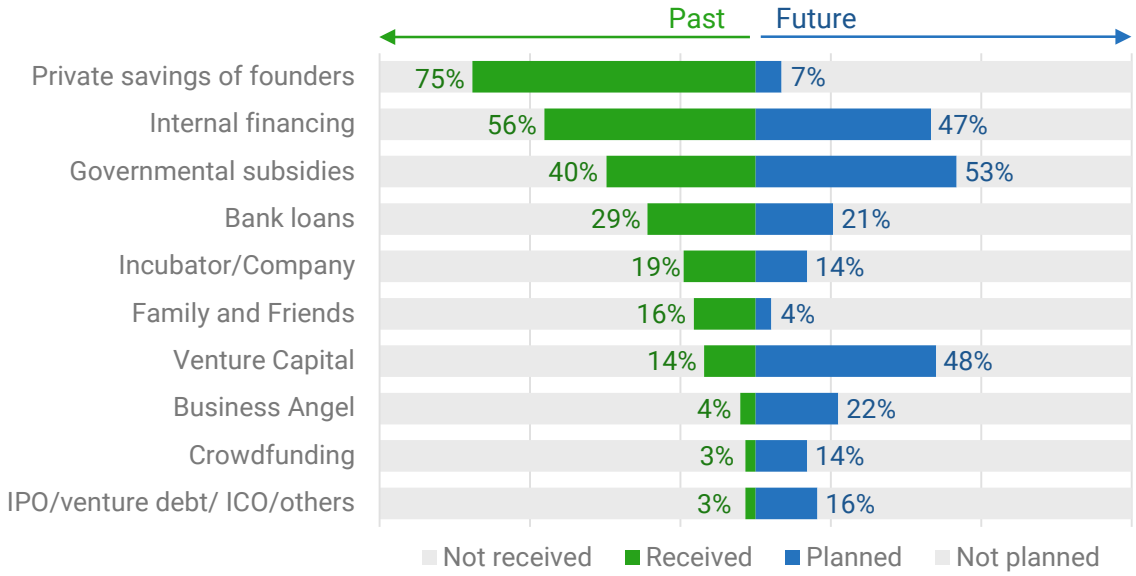


Figure 23: Received and planned financing

The main sources of financing sought by start-ups for future business developments include external support, particularly through governmental subsidies (53%) or venture capital (48%) but also internal financing. Indeed 47% of start-ups count on their operating cashflow to finance their development. The importance of internal financing is mirrored by the high priority given by most start-ups to revenue and sales growth. With 56% of start-ups having already benefited from governmental subsidies and 47% expecting to do so in the future, access to public funding appears to be an essential financial support for European space start-ups.

Reaching out to potential investors is the main difficulty faced by start-up to raise capital. Many point out the limited number of investors ready to accept the level of risk that new space businesses may represent, particularly since they are usually not familiar with the sector. The importance of first commercial contracts to convince potential investors was also highlighted.

What do you consider to be the biggest challenge(s) in raising capital or access funding?	
Reaching out to potential investors	46%
Associated burden and delays	29%
Lack of knowledge of available options	22%
Agreeing on terms and conditions	21%
Lack of business expertise	17%
Difficulties to comply with requirements	14%

Figure 24: Start-ups challenges to raise capital

Non-financial support

Out of 73 start-ups having replied to the survey, only 3 had not received any type of non-financial support so far. 85% have already received a dedicated support through independent expertise, mentoring/training or access to facilities/labs.

Networking events and independent expertise stand out as the two types of non-financial supports most commonly received by start-ups.

Access to facilities/labs and mentoring/training, although less often received, have the greatest potential to be highly impactful. 22% and 16% of start-ups having received this type of support consider it to have had a great impact on the company. In comparison, networking events and independent expertise are considered highly impactful by only 9 to 10% of the start-ups.

Except for advertisement, which is both the least received and least impactful, all other types of backing are considered impactful (moderate to high impact) by at least half of the start-ups having benefited from them.

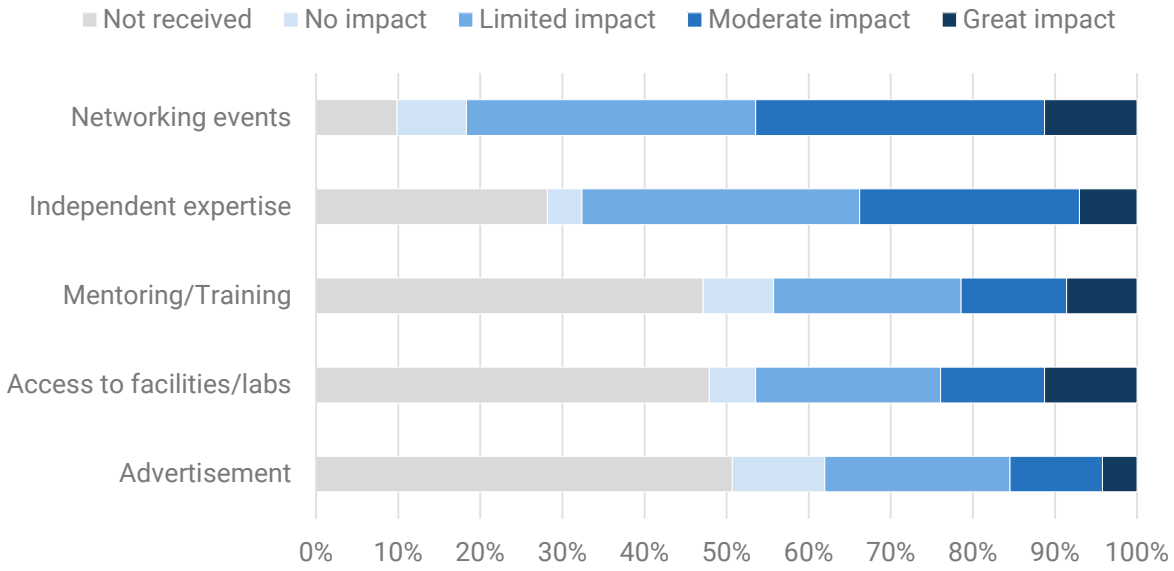


Figure 25: Non-financial support received and impacts

Interestingly, start-ups at early stages tend to find non-financial support much more impactful than those at later stages (60% vs. 36%). This is even more significant for networking events. For example, 70% of the youngest start-ups find networking events impactful compared to only 30% of more mature companies.

Future drivers of growth and expectations from public actors

Reflecting on their priorities and challenges, respondents estimate that the main driver of growth for their business will be access to new customers and markets. Building a high-quality team, accessing capital and additional research and development are other important factors but to a lesser extent. External factors such as changes in industry regulation, in labour code, in tax environment, or in intellectual property protection are considered much less important.

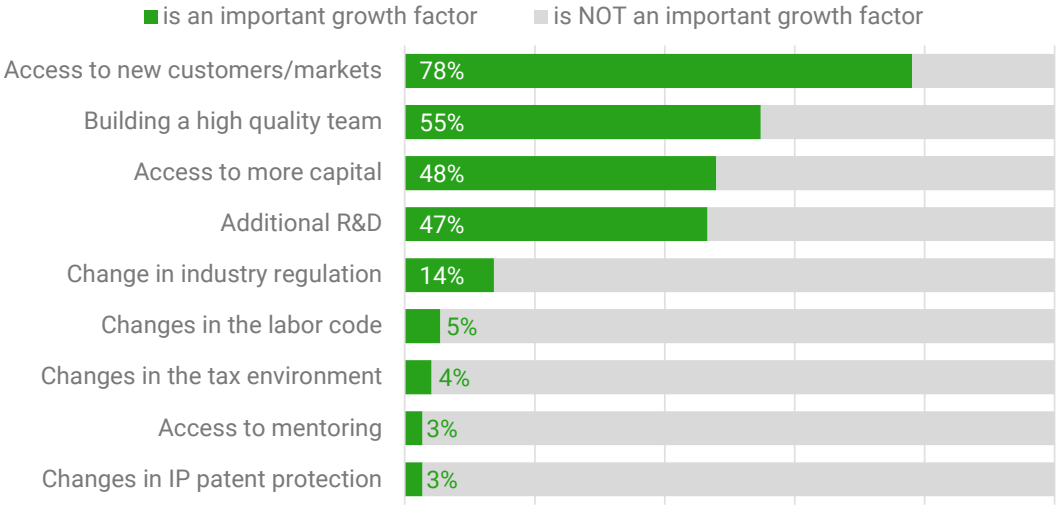


Figure 26: External/Internal drivers of growth

As a direct consequence, space start-ups shared high expectations from the public sector to play a more ambitious role on the demand side through a growth of public markets and/or by acting as an anchor customer. More than 65% of start-ups, from early to mature stage, expect such developments, with the highest level of expectation recorded in the downstream segment (75%). Reduction of red tape and support to raising capital, which are often presented as the main requests of start-ups actually rank lower, together with tax incentives/reduction and better exchanges with politics and networks. The level of expectation regarding support with raising capital is much higher for start-ups at an early stage.

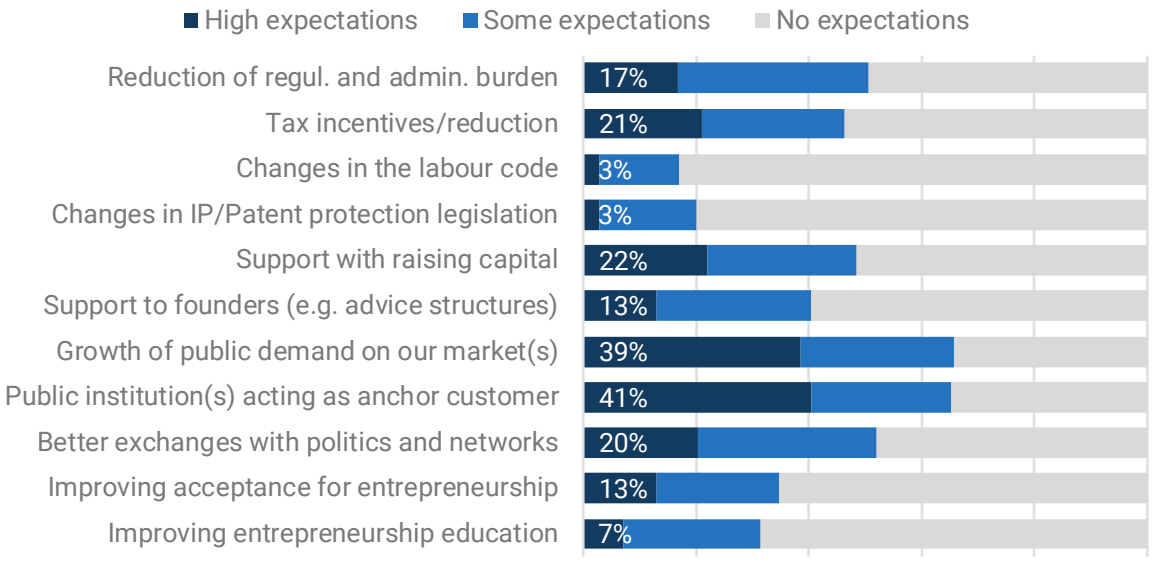


Figure 27: Start-ups expectations from public actors

3 TAKEAWAYS

Statistics and key indicators





€187M raised by European space start-ups in 2019	56 European investment deals were recorded in 2019	37% of private investment is concentrated in the top 5 deals	62% of private investment is from venture capital	65% of start-ups expect a growth of public demand

Findings

The 2019 ESPI survey reinforced the key findings upheld in the 2018 edition. While private space economy investments saw a slight decline in 2019, the increase in deals and transactions combined with modern public incentives cements the idea that New-Space economy is here to stay in Europe.

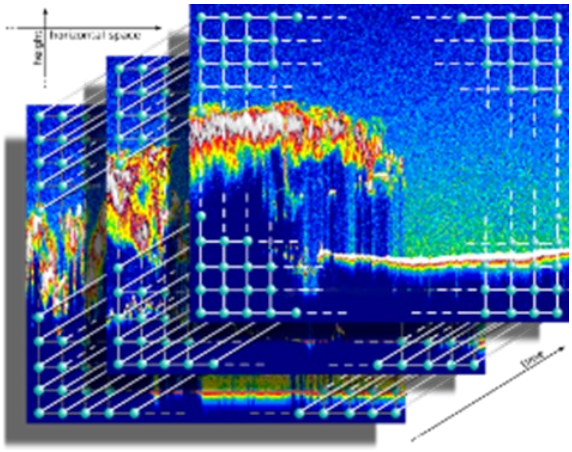
1-Widespread European investment with specific success stories.	• 14 European countries have had startups which received investment, showing a widespread European space ecosystem • The UK is once again leader in terms of investment received (€60M, 32% total) over 17 deals. The Scottish space cluster played a large role with a total investment of €30M, or 1/3 of all UK investments. • ·Switzerland stood out in 2019 with €40M received through 10 deals. • Statistics strongly underlined the fact that investors primarily focus nationally, secondly European and lastly Globally.
2 -Start-up trends are a continuation of those established in 2018	• European start-ups are micro enterprises between 1-5 employees (30%). • A majority of start-ups plan on hiring within the next 12 months (89%) with a total of between 400 and 800 recruitments corresponding to a 25% enlargement of the workforce. • European start-ups are highly innovative and offer globally innovative products.
3-Support from public actors through both demand and offer is sought after by most Space start-ups.	• Both 2018 and 2019 editions point out the vital role of public support in the emergence and sustainability of European start-ups. • Start-ups seek the support of public actors as anchor tenancy until viable commercial markets and demand takes shape. • Start-ups are seeking the emergence of a modern industrial policy to aid the sector in the implementation of a public aggregation of demand.
4-Customer acquisition is a key factor for both growth and raising of capital.	• Revenue growth and customer acquisition are top challenges and growth priorities for European space start-ups. • More than 65% of start-ups expect the public sector to play a more ambitious role on the demand side. • A majority of start-ups point the need of public capital to access private capital.

4 European Start-up Stories

4.1 Rasdaman

Founded by Jacob University Professor Dr Peter Baumann, German hi-tech company rasdaman GmbH is a research spinoff commercializing enabling technology for analytics and fusion of massive multi-dimensional arrays, often called "datacubes". Based on research dating back to the early 90s where it has coined the field of Array Databases" and awarded with a series of international innovation awards rasdaman also forms a blueprint for modern datacube standards. Today, rasdaman is in operational use on multi-Petabyte satellite and climate data assets, federating international super-scale archives into a single, seamless information plane.

Much of today's big data comes as a gridded data "arrays", such as spatio-temporal sensor, images, simulations and statistics data. With its groundbreaking idea of a datacube analytics language it is substantially easier to access data, and powerful acceleration mechanisms have been developed for servers to increase the pace of access and analytics to Terabyte processing in fractions of a second.



Credit: Rasdaman

Strictly based on open standards for data access and server-side "Big Data" processing rasdaman can be accessed by a variety of clients, from visual tools to high-end analytics languages like R and python. The datacube analytics language of rasdaman meantime has been adopted by ISO as an extension to the database query language, SQL. The Open Geospatial Consortium (OGC) spatio-temporal datacube analytics language standard, Web Coverage Processing Service (WCPS) reflects the insights of the rasdaman query language.

The rasdaman technology is available in two compatible editions. The rasdaman community edition is available as free and open source code. The rasdaman enterprise edition builds on it and adds in all aspects of scalability, such as multi-core parallelization, distributed processing, federation, and direct tapping into large existing archives. Further, advanced security and quota mechanisms are provided. This altogether opens up opportunities for scaling up services seamlessly from laptops to clouds, server farms, and planetary-scale federations. Not surprisingly, among the customers of rasdaman are international research institutes, agencies, as well as small and multi-national businesses.

So far, Dr Peter Baumann has secured overall project funding of +6m Euros and in projects amounting to +40m Euros in total funding. Among the recent projects are EU PARSEC, a business accelerator for startups where rasdaman provides the datacube infrastructure, and DeepRain where the intelligence of Machine Learning is coupled with the scalability of datacubes to enhance local rain forecasts in mountaneous areas. In the ORBiDANSe project, rasdamanhas been ported to run on board a satellite which can receive datacube queries and reports back the analytics result from freshly acquired imagery, without having to send down all the massive picture

4.2 BlackShore

BlackShore was founded in 2009 and is an independent venture foundation. Today situated in the European Space Business Innovation Centre, in Noordwijk Netherlands, they still remain small (5 employees) but offer some of the most interesting downstream analysis seen in the European sector.

BlackShore delivers map-products and training data for machines at low cost using crowd source interpretation of satellite data and aerial imagery. The interpretation is developed by something unique in the industry which is game-based crowd sourcing. The gamers enhance the map profile following the game rules and logic offering a better output than if using a software.

Specifically, the advantage of using human mappers rather than machine learning is that above and beyond the visual recognition of elements, human mapper set the maps based on the context of the surrounding region and additional factors that may not be purely visual.

Late 2019, developed in cooperation with ESA as an IAP demonstration project the most novel version of the Cerberus crowdsourcing platform included a state of the art e-learning component for training . In addition, as a game Cerberus has now been released for both mobile devices and the PC making itself a competitor in the social gaming market. Today, halfway through 2020, the Cerberus crowd consists of over 43 000 players globally lending their brains to solve world problems.

Using both optical and multi spectral satellite data, their key aim is to solve world issues involving food security, sanitation, and of course Cerberus has the capability to react to natural disasters in the blink of an eye. Cerberus handles all sorts of Copernicus sources and as such can help in mapping large and a variety of areas.

Credit: Blackshore

4.3 SKYRORA

Founded in 2017, SKYRORA is a business to consumer upstream company based in Edinburgh, UK. The company specializes in the development and launches of small satellites and emphasizes its modern method to do so.

In a market dominated by private industry giants such as SpaceX, Blue Origin or Rocket Lab, Skyrora aims to achieve the first ever orbital launches from Western Europe. Having already completed a successful sub-orbital launch in August 2018, and quickly advancing the development of bigger launch vehicles, it is well on track to launch the first rocket launched from the UK since Black Arrow in 1971.

Skyrora's rocket engines are novel not only because of their use of 3D printing but also due to modern type of fuel that is used to power them. The company has developed a fuel derived from plastic waste called "Ecosene" which makes the startup but also their rocket's much more ecologically sound than the rest of their competition.

The company states that it can create up to 600kg of kerosene from 1000kg of plastic waste and that the fuel release 45% less greenhouse gas emission. Furthermore, with ecosene requiring no cryogenic freezing, it can be stored for large periods of time at a lower cost and requiring less costly infrastructure. This offers Skyrora a higher freedom for when choosing its spaceport.

Beyond the method of production, Skyrora is developing different types of rockets for different types of needs, with as ultimate goal the development of the SYRORA XL. Skylark Nano and Micro

Which have the possibility to reach 5K altitude and with a payload of 1kg is practical for in-situ data collection as well as for engineering testing.

- The SKYHY which is a two-stage hybrid suborbital vehicle and that can perform testing in microgravity situations.
- The SKYLARK L which is a single stage suborbital rocket that can carry up to 50KG in payload build mainly for testing the subsystems of the SKYRORA XL.
- The SKYRORA XL which is aimed to be their flagship product with a three-stage launch vehicle that should be capable of placing payloads into a Sun synchronous orbit anywhere in a range between 200km and 1000km.

All their rockets are assembled and built in the United Kingdom.

Credit: Skyrora

4.4 Sen

Founded in 2014, Sen is a UK start-up created by British entrepreneur Charles Black. Sen's vision statement is to democratize space using videos to inform, educate inspire and benefit all of humanity. This will be done by streaming real time videos from space to billions of gathering news and information about Earth and space and making it universally accessible.

Although there are already companies that offer still imagery and radar at different resolutions, live video streams from space are not available. There is also no existing Earth Observation model aimed directly at the consumer. Sen is therefore addressing the video streaming market with unique content proposition. In addition to the need to learn and understand more about Earth, Sen will also tell the story of humanity's exploration of space as humans inevitable reach beyond Earth. Humanity as a whole will have a common interest in visualizing the exploration of our Solar system.

With big upcoming events such as the Artemis missions planned for 2024, there will be an increasing demand for real time live video. Furthermore, with humankind still aiming to set foot on Mars, the possibilities of having Sen in place to document the arrival of future Nasa and SpaceX missions is very real.

Credit: Sen

This ambitious goal will be done by developing a constellation of small satellites (Nano) that will be less than two meters across and will have a variety of cameras to view Earth with different perspectives. These nanosats will be launched in a Sun-synchronous orbit to remain in constant sunlight for Earth observation. Black has stated that Sen is aiming to have operational camera abilities for the Moon in the mid 2020's and for Mars by 2030 onwards.

Sen has already demonstrated its core video streaming platform in space, with six video cameras and its core video processing system installed on a satellite which launched in in February 2019. The satellite was launched in LEO orbit and 4K video of their cameras was then streamed demonstrating the high 4K quality of the footage. The Russian space company RSC Energia developed and launched this satellite. As of May 2020, Sen has signed a launch and orbital deployment contract with MOMENTUS for its first EarthTV satellite which is being built by NanoAvionics. Under this contract, the EarthTV spacecraft will be launched atop a SpaceX Falcon 9 rocket in summer 2021.

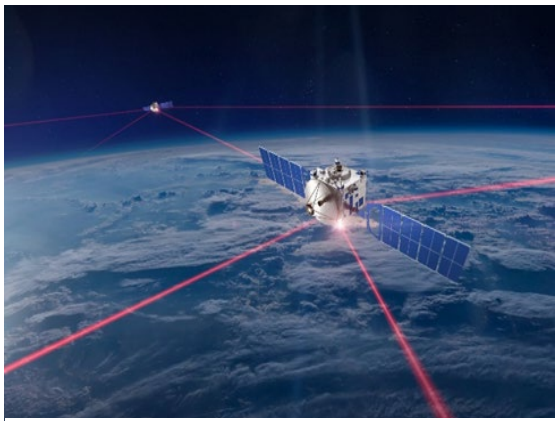
Financially, Sen has raised £2.8M pounds over 4 rounds. Two angel rounds where £350K were invested, one Pre-Seed round where £900K was invested and since then further funds have been raised. Sen is also generating revenues from its hosted cameras for spacecrafts self-inspection. Sen is based in London.

4.5 Mynaric

Founded in 2009 by ex DLR employees, Mynaric is a business to business company that focuses on laser communication to increase the speed of data transmission in space, in the air and from and to Earth and in space.

Even though Mynaric develops multiple products, the product specifically related to space is the "CONDOR". The CONDOR is a flight terminal that provides backbone inter-satellite connectivity in low Earth orbit (LEO). What it is specifically capable of doing is establishing links between satellites independently of motion (with coarse pointing assembly) and intraplane connections (without coarse pointing assembly) using laser technology.

By developing this flight terminal, the Condor will enable faster than radio data transmission all while increasing the volume of data being transmitted. Furthermore, the data will be secured, against jamming, spoofing and electromagnetic interference. This would enable the terminal to connect individual satellites in constellations of hundreds and thousands to provide high speed broadband for all.



Credit: Mynaric

Above and beyond the technological implications of laser connection, it allows companies to skip the policy requirement of applying for a license in every country radio frequency are to be beamed down to. The process can take sometimes years and is independent for every country. As such with laser telecommunications being unregulated by the ITU it can be used without restriction and expensive licenses.

While Mynaric has existed for more than a decade, it's major rounds of financing are relatively recent. The company has raised a total of €60 m both pre and post IPO since 2016. As of the 3rd of April 2020, the company's CONDOR terminal is being tested and assembled in Mynaric's facility in southern Germany with plans to produce over a dozen products this wear. The first scheduled deliveries are for H2 2020.

ANNEXES

Annex A – ESPI Private Investment Database

Dataset and sources

The assessment of private investments provided in this report is based on information collect by ESPI in a proprietary database. The dataset includes publicly available data on announced operations and deals and information is collected by screening a high number of sources including investment firms', incubators' and accelerators' portfolios, articles and specialized news outlets or specialized sources such as CrunchBase. Furthermore, due diligence was made to appropriately filter all press and governmental releases as well as events. Cross checking was systematically performed. The ESPI private investment database includes all deals for the period 2014-2019.

Perimeter and definitions

This study focuses on European space start-ups and aimed to collect data on private investment received by these companies and to gather views of these companies on their business, on the environment in which they evolve and on their expectations from public actors. The following definitions and categories were applied to delineate the perimeter of analysis.

European space start-ups

- Start-up: A start-up is defined in Europe as a company younger than 10 years, whose business tend to feature innovative concepts and models and who has not yet reached business maturity (defined according to business stage: Public Offering, annual turnover or number of employees). For the purpose of this study and given the usually longer timeframe required in the space sector to reach business maturity (as compared to other industrial sectors), ESPI included companies founded after the year 2000. Business maturity (end of the start-up stage) is considered achieved if the company meets one of the following criteria (adapted from start-up and SME definitions by the European Commission):
    - Acquisition or Public Offering: the company has been acquired or listed on a stock market.
    - Turnover: the annual turnover of the company exceeds €50 million or the annual balance sheet total exceeds €43 million.
    - Number of employees: the total number of employees exceeds 250.
- Space company: A company is considered a space company if the main business of the company (in revenue share) is part of the space value chain. For this definition, the study followed the space market segmentation provided by Seraphim's Spacetech Market Map 2019, which divides space activities into three segments:
    - Upstream: Build, Launch, Satellites;
    - Downstream: Downlink, Analyze, Store, Product;
    - Beyond Earth: Space Exploration, Space Resources, Space Logistics, Space Research.
- European company: A company was considered European when the headquarters of the business organization are based in Europe (EU Member States + ESA Member States), or if a majority of its business operations is conducted in Europe, a feature that implies, for instance, the eligibility for EU funds as those provided by the Horizon2020 program. Some exceptions exist for companies with multiple headquarters.

In a number of cases, the classification of a company as a European space start-up required an arbitration because of the business setup (e.g. multiple headquarters addressing different regional markets), the situation of the company (e.g. dormant company founded before 2000 but with a net business acceleration after 2000 and following a start-up behaviour) or the na-ture of business (e.g. space is part of the prod-ucts and services portfolio but not a core mar-ket).

For example, the study partially includes, or totally excludes, deals involving companies that reached business maturity during the period considered (2014-2018). This is for example the case of O3b Networks (today part of SES as SES Networks): the company is counted for a single investment in 2014 despite additional invest-ment in 2016 and 2017. According to the defini-tion adopted for this study, the company reached business maturity in 2015, because of annual revenues exceeding by far €50 million. Comparably, companies like GOMSpace and AAC Microtec were excluded after 2016, as they both started to be publicly traded, and that their business structure did not match anymore a start-up model. The British company Reaction Engines was included despite its age, as the company is still actively trying to develop the product for which it was founded, the SABRE engine.

To ensure coherence with existing authoritative studies, ESPI selected the categories used in Bryce's Start-Up Space report series to classify sources and types of investment.

Investor categories

- Angel Investors: individuals or families (to include family offices) that have accumulated a high level of wealth and seek potentially high returns by investing in ventures during their early stages. Such investors may also operate with venture capital firms or other so-called angels. They will typically invest via straight equity, ranging in value from $50,000 to over $1,000,000. There is also a class of "super angels", who work in deals of $100 million or more (Jeff Bezos, as one example).
- Venture Capital Firms: VC firms represent groups of investors that invest in start-up, early stage, and growth companies with high growth potential, and accept a significant degree of risk. The trade of risk for potential high returns results in a high failure rate. Their investment form is equity, typically preferred stock, and comes in a series of rounds, traditionally Series A, B, C, etc.
- Banks: Banks are financial institutions that can support investment through a variety of instruments including, in particular but not only, loans and debt financing.
- Private Equity Firms: Private equity firms or groups are formed by investors to direct-ly invest in companies. They typically invest in established companies, rather than start-ups, through large transactions and often acquire an entire company or a group of related companies that can merge.
- Corporations: Corporations have different methods of engaging in investment. They frequently provide the funding necessary to bring space-based programs to initial operating capability, as well as to sustain on-going programs; they can also fund ventures, typically via straight equity, but also debt, and in the latter case with the option to convert to equity; and they also sometimes act via a corporate venture fund. Lastly, corporations may likewise acquire firms, including start-up space ventures, of which there have been several examples in recent years.
- Accelerators & Incubators: Although they are ultimately distinct types of actors, accelerators and incubators are similar in several core ways. Both aim to support start-ups, offer mentoring in developing their business, and both offer means to at-tract investment. Broadly concerning their differences, "accelerators 'accelerate' growth of an existing company, while incubators 'incubate' disruptive ideas with the hope of building out a business model and company".

Investment categories

- Seed/Prize/Grant: Funding received by a start-up typically at an early stage of development. This category includes a variety of funding instruments that are usually obtained as the result of a selection process (application, competition) and involve limited obligations from the company.
- Acquisition: Situation whereby one company purchases most or all of another company's shares in order to take control. An acquisition occurs when a buying company obtains more than 50% ownership in a tar-get company.
- Debt Financing: Process of raising money by selling debt instruments to individuals and/or institutional investors (e.g. banks). In return for lending the money, the individuals or institutions become creditors and receive a promise that the principal and interest on the debt will be repaid.
- Private Equity: Investment consisting of capital that is not listed on a public ex-change. Private equity is composed of funds and investors that directly invest in private companies.
- Public Offering: Process of offering shares in a private corporation to the public. The first time, the operation is called an Initial Public Offering (IPO).
- Venture Capital: Funds invested by VC firms, usually with medium-term stakes, for high profit, high risk activities.

Space value chain segmentation

The space value chain can be divided into segments. ESPI selected the Seraphim SpaceTech Ecosystem Market Map (available at: https://seraphimcapital.co.uk/insight/news-insights/introducing-seraphim-spacetech-market-map) to organize start-ups business along the value chain.

The upstream part of the space value chain includes all business activities related to the development, production, deployment and operation of space systems. This includes:

- Build: development and manufacturing of space systems (incl. sub-systems, equipment, components and materials) and/or provision of related software and engineering services;
- Launch: development and manufacturing of launch systems and/or provision of launch services;
- Data: operation of space systems to lease or sell satellite capacity data.

The downstream part of the space value chain includes all business activities related to the exploitation of space systems' capabilities or data to provide space-enabled products and services to end-users:

- Downlink: development and manufacturing of the ground support infrastructure and services required to exploit a space system (e.g. relay systems, communications, ground terminals, cryptography);
- Store: provision of solutions for satellite data storage and processing:
- Analyse: provision of value-adding solutions for satellite capabilities and data exploitation (e.g. big data analytics, machine learning and artificial intelligence, algorithms);
- Product: provision of space-enabled products to end-users (e.g. mapping & 3D, data platforms, location and tracking, insight and monitoring).

Seraphim also include in a separate segment companies whose business involve activities beyond Earth orbit including services and products for space exploration, space resources, space logistics or space research.

Annex B – ESPI Space Entrepreneurship Survey

About the survey

This analysis of the European entrepreneurial ecosystem is based on the results of the ESPI Space Entrepreneurship Survey 2019. The survey was issued to 300+ European space start-up and ESPI received more than 100 responses this year.

After careful review, ESPI filtered 73 individual responses from space start-ups located in 21 European countries, providing an extensive sample.

ESPI entrepreneurship survey consisted in 30+ questions addressing 4 themes:

- *Business organisation*: location, core business, workforce, foundation;
- *Business situation and prospects*: target markets, revenues, development priorities; factors of growth;
- *External support*: financial and non-financial support received and planned;
- *Business environment*: views on the European entrepreneurial ecosystem, expectations for governmental support.

Responses have been aggregated through multiple answers questions, scores and open comments of the respondents providing additional insights on their reply.

Survey respondents in 2019

ESPI is grateful to the many European space start-ups who took part to the survey and provided substantial information for this report.

The following table excludes the names of 10 start-ups who wished to remain anonymous.

Company	Headquarters	Core business
Aerospace & Advanced Composites GmbH	Wiener Neustadt, Austria	Other
AlphaLink	Berlin, Germany	Upstream / Build
Asgard Space	Barcelona, Spain	Upstream / Data
AST Advanced Space Technologies GmbH	Osterholz-Scharmbeck, Germany	Upstream / Build
AWST GmbH	Vienna, Austria	Downstream / Analyse
Berlin Space Technologies GmbH	Berlin, Germany	Upstream / Build
BlackShore	Noordwijk, Netherlands	Downstream / Analyse
Blue Dot Solutions	Gdansk, Poland	Downstream / Analyse
Bright Ascension	Dundee, United Kingdom	Upstream / Build
C3S Electronics Development LLC.	Budapest, Hungary	Upstream / Build
CisLunar Industries	Luxembourg, Luxembourg	Upstream / Build
CloudFerro sp. z o.o.	Warszawa, Poland	Downstream / Analyse
Earth-i	Guildford, United Kingdom	Downstream / Analyse
ENPULSION GmbH	Wiener Neustadt, Austria	Upstream / Build

ENVEO IT GmbH	Innsbruck, Austria	Downstream / Product
EOX	Vienna, Austria	Downstream / Product
FadeOut Software srl	Genova, Italy	Downstream / Product
Fibersat SA	Luxembourg, Luxembourg	Upstream / Data
Gradel sArl	Ellange, Luxembourg	Upstream / Build
HeraSpace	Darmstadt, Germany	Other
I-CONIC Vision	Stockholm, Sweden	Downstream / Product
insar.sk s.r.o.	Presov, Slovakia	Downstream / Product
ISIS - Innovative Solutions In Space	delft, Netherlands	Upstream / Build
ISP International Space Propulsion Ltd	Swindon, United Kingdom	Upstream / Build
Kayrros	Paris, France	Downstream / Analyse
Klepsydra Technologies GmbH	Zurich, Switzerland	Upstream / Data
know.space	London, United Kingdom	Other
latitudo40 srl	Naples, Italy	Downstream / Analyse
lens research & development	Noordwijk, Netherlands	Upstream / Build
Libre Space Foundation	Athens, Greece	Upstream / Build
LiveEO	Berlin, Germany	Downstream / Analyse
Magellium	Ramonville St Agne, France	Upstream / Build
MDA Space and Robotics Ltd	Harwell, United Kingdom	Upstream / Build
MEEO	Ferrara, Italy	Downstream / Analyse
Mozaika	Sofia, Bulgaria	Other
NEUROMATION	Tallinn, Estonia	Downstream / Analyse
ODYSSEUS Space	Esch-sur-Alzette, Luxembourg	Upstream / Build
PHI DRIVE S.R.L.	Vimercate, Italy	Upstream / Build
PICOSATS SRL	Trieste, Italy	Upstream / Build
PIXSTART	Toulouse, France	Downstream / Product
Printech Circuit Laboratories Ltd	Chelmsford, United Kingdom	Other
QuadSAT	Odense, Denmark	Other
rasdaman GmbH	Bremen, Germany	Downstream / Analyse
S&T	Delft, Netherlands	Downstream / Analyse
Satellite Vu	Walton on thames, United Kingdom	Upstream / Data
SatRevolution	Wroclaw, Poland	Upstream / Build
Science [&] Technology AS	Oslo, Norway	Downstream / Analyse
Sen Corporation Ltd	London, United Kingdom	Upstream / Data
Sharplayers s.r.o.	Praha, Czech Republic	Other

SISTEMA GmbH	Vienna, Austria	Downstream / Analyse
Skyrora	Edinburgh, United Kingdom	Upstream / Launch
Space Structures GmbH	Berlin, Germany	Upstream / Build
Space Ventures Investors Ltd	Frankfurt am Main, Germany, United Kingdom	Other
Spacearth Technology srl	Rome, Italy	Downstream / Analyse
STARGAZERS.space	Paris, France	Downstream / Product
STRA, S.A.	Coimbra, Portugal	Downstream / Product
SYENTEC GmbH	Kirchschlag/Linz, Austria	Upstream / Build
Taitus Software Italia Srl	Monte Porzio Catone, Italy	Downstream / Product
TechWorks Marine	Dublin, Ireland	Downstream / Analyse
Ticinum Aerospace s.r.l.	Pavia, Italy	Downstream / Product
Tinkerers	Castelldefels, Spain	Downstream / Analyse
VRVis GmbH	Vienna, Austria	Other
Wasat Sp. z o.o.	Gdańsk, Poland	Downstream / Product

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