



Rialtas
na hÉireann
Government
of Ireland

Tionscadal Éireann
Project Ireland

2040

National Space Strategy for Enterprise 2019-2025



Prepared by the Department of
Business, Enterprise and Innovation

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Minister for Business, Enterprise, and Innovation, Heather Humphreys, T.D.

Ministers' Foreword

Minister for Business, Enterprise, and Innovation, Heather Humphreys, T.D., and Minister of State for Training, Skills, Innovation, Research and Development, John Halligan, T.D.



Minister of State for Training, Skills, Innovation, Research and Development, John Halligan, T.D.

The more that we discover through the exploration of space, the more important space becomes to our society, our economy and our planet. Today, space places a crucial role in our everyday lives, enabling communication, travel and tackling climate change, among others. In recognising its importance, governments across the globe have stepped up their efforts to not only discover more about space, but also, to further understand how space research can improve the lives of citizens on earth. Ireland also recognises the potential of space and has increased national funding to support the development of space related capabilities and the growth of a thriving space related enterprise sector.

The Government, through the *Future Jobs Ireland* framework is now focusing on the next phase of Ireland's economic development, recognising the need to be prepared for the jobs of the future which will deliver secure, stable and long-term employment. Engagement with space develops skills and knowledge across a range of technological domains which will support the delivery of this ambition. Growing Ireland's space-active enterprise sector will prepare Ireland's workforce for a future increasingly geared towards the use of emerging technologies, such as those set out in Ireland's research priority areas, including artificial intelligence, machine learning, blockchain, robotics and smart manufacturing.

The Department of Business, Enterprise and Innovation with its agencies, Enterprise Ireland, IDA Ireland and Science Foundation Ireland will work with businesses and researchers to develop a strong expanding space-active enterprise base. Ireland must build on and enhance the progress already made to ensure Irish enterprises are equipped to seize new opportunities promised by the evolving global space market for business, research, society, the economy and the environment. The time is right for Ireland to implement its first National Space Strategy for Enterprise which will enable and accelerate the ongoing development and expansion of sustainable space-active enterprise and research capacity across Ireland.

The National Space Strategy for Enterprise will achieve this by strategically investing in space through the development of a new Space Technologies Programme, as provided for in *Project Ireland 2040*. The strategy will focus on harnessing new opportunities, supporting the development of a highly skilled and adaptable workforce, encouraging awareness of space among the public and private sector, developing and maintaining a strategic business

environment and building international linkages and awareness of Ireland's space capabilities.

The National Space Strategy for Enterprise will be reviewed and updated during its implementation between 2019 and 2025 to ensure that Ireland's space-active enterprise base evolves alongside the global space market, enabling us to seize the benefits and opportunities of space for our economy, our citizens and our environment.



“Seize the benefits and opportunities of space for our economy, our citizens and our environment”

Executive Summary

The Government's vision for the space-active enterprise sector is for Ireland to develop *'An economically sustainable and expanding space-active industry, delivering quality jobs for the economy of tomorrow'*.

There is already a strong base on which to build. Irish industry is successfully developing an increasing presence in the international space sector. This has been facilitated by Ireland's membership of the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Union (EU) space programmes, and more recently, the European Southern Observatory (ESO).

These memberships, in particular that of ESA, are used as a platform for technology development and innovation. They complement national supports to Irish industry and offer a unique pathway to access to highly specialised facilities and knowledge.

The international space sector is currently undergoing a rapid transformation due to an increasing demand for space-based services alongside the emergence of "Space 4.0"¹, which is generating a wealth of opportunities for both public bodies and private enterprise.

The ability of Irish space-active companies to exchange technologies between space and non-space sectors, where technology synergies exist, will be key in developing a sustainable and agile industry. Irish companies from related technology sectors are already engaging with the space sector to develop technologies with uses both in space and in other high reliability sectors such as automotive and aerospace.

Significant new opportunities are also emerging for enterprise to use satellite-derived data to develop high value services which can support policy making decisions, enterprise development and address global challenges.

The rapid development of the space market, in addition to the growing number of opportunities it presents for Ireland's economy and society, makes 2019 the opportune time to implement a National Space Strategy for Enterprise.

In realising Ireland's vision for space enterprise, the National Space Strategy for Enterprise aims to deliver the following results by 2025:

- Double the space related revenue and employment in space-active Irish companies;
- Support 100 companies to benefit from ESA engagement;
- Double the value of contracts won through the EU Horizon programmes in space-related activities;
- Increase industry, public and international awareness of space and Ireland's activities in space;

- Develop and attract talent for space-active and related industries; and
- Develop a sustainable Earth Observation services sector based on advanced data analytics capability.

Five core pillars will underpin the delivery of the National Space Strategy for Enterprise, recognising the fundamental importance of Investment, Strengths and Opportunities, Governance, Developing and Attracting Talent, and International Engagement.

Key actions, aligned under each pillar, will enable the National Space Strategy for Enterprise to realise Ireland's vision for space enterprise and achieve Ireland's goals for space enterprise by 2025.

The implementation of the National Space Strategy for Enterprise will be overseen by a newly established Space Enterprise Coordination Group and supported by a core Strategy Implementation Group.



"Develop and attract talent for space-active and related industries."

Introduction

1.1 Context for Ireland's Space Enterprise Strategy

Space technologies have integrated seamlessly into our lives. They enable services that we rely on daily such as location services, satellite-based media services and weather forecasting, to name but a few. In addition, they support advances across multiple sectors such as human medicine, communications, energy, marine and environmental protection. Space technologies also support the work of our emergency services during times of crisis by providing real-time satellite images, telecommunications and navigation services.

As a first consumer of, and investor in space research and technology development, the significant contribution of space to the lives of citizens has been a long-term focus of many governments. However, a paradigm shift has occurred in recent years, which has seen significant, and growing, private sector investment in commercial space technologies and activities. The global space economy grew to €309 billion in 2017, having grown by an average of 6.7% per annum between 2005 and 2017, almost twice the 3.5 % average yearly growth of the global economy¹. Furthermore, the commercial space industry has been estimated to grow to approximately €2.3 trillion by 2030².

Alongside heightened global interest and use of space, Irish industry involvement in space-related activities has developed in recent years to offer a wide range of products and services. The areas of technology which Irish companies are involved in are diverse and include avionics, electronics, propulsion subsystems, antennae, opto-electronics, structures, advanced materials, software data systems, data analytics, geo-science and astrophysics.

Spin-out Case Study

Through Ireland's membership of ESA, Radisens Diagnostics, a Cork-based medical diagnostics company, was contracted to develop microfluidics-based in-vitro diagnostics to be used by astronauts aboard the International Space Station. The technology developed by Radisens Diagnostics has applications for use on Earth, providing an easy-to-use diagnostics device for medical professionals at the point-of-care to rapidly and accurately monitor a patient's risk of diabetes and associated complications.

¹ "The future of the European space sector". EIB. 2019. http://www.eib.org/attachments/thematic/future_of_european_space_sector_en.pdf

² "The future of the European space sector". EIB. 2019. http://www.eib.org/attachments/thematic/future_of_european_space_sector_en.pdf

National investment in skills, research and development, innovation and business support infrastructure has been a significant factor in enabling Irish industry to become competent in these areas and moreover, in applying them to the development of relevant space systems.

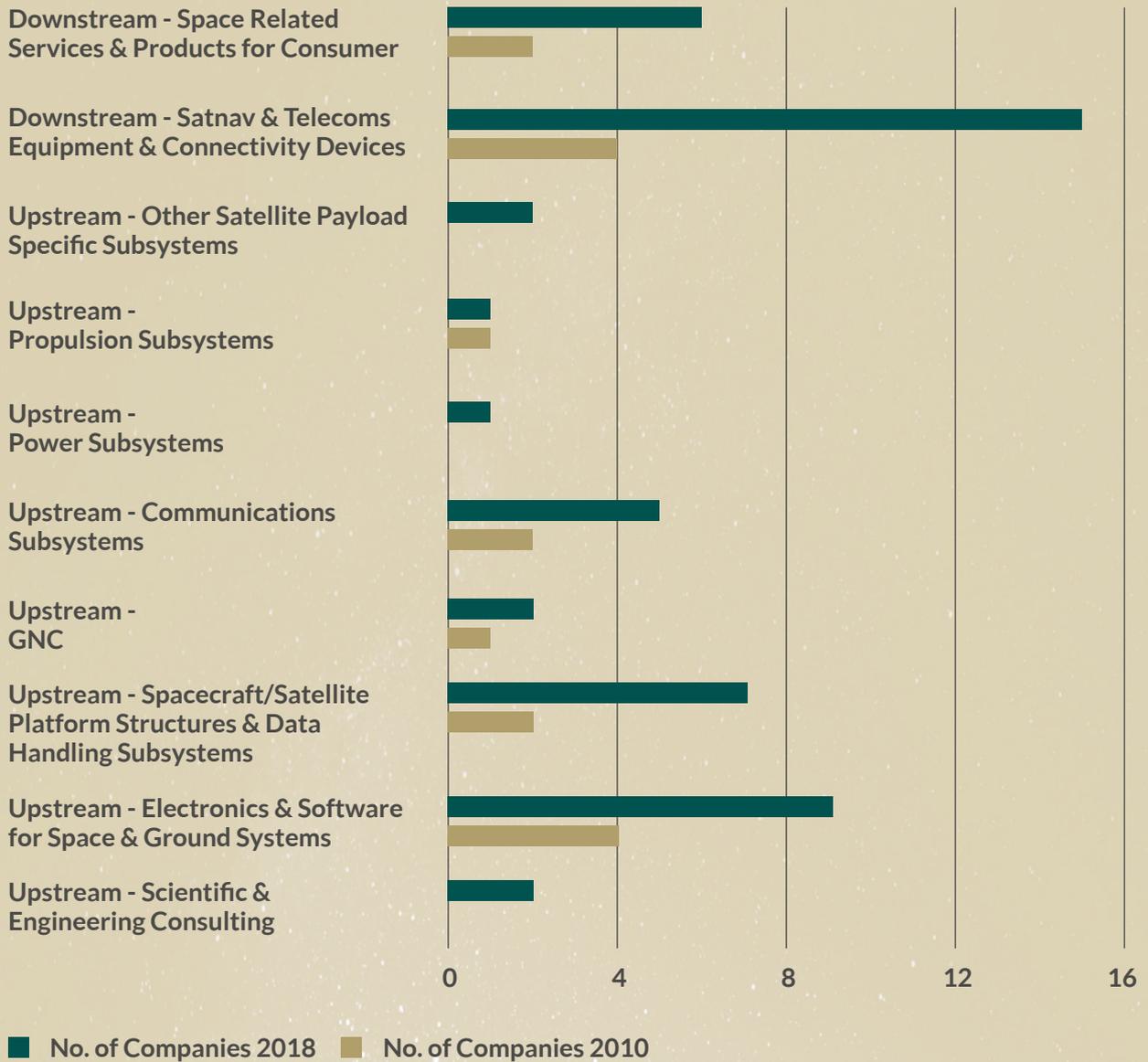
The uses of space-developed technologies are not limited solely to the space sector. Space derived data products can support the continued growth of the Irish economy in sectors of national importance, through the development of advanced applications for areas such as smart agriculture and the blue economy¹¹. They also support the development of key skills necessary for sectors that have been identified as strategically important to Ireland such machine learning, advanced manufacturing and Artificial Intelligence³. In addition, technologies developed for space are increasingly adopted by other domains such as automotive and aerospace, where there is a requirement for high quality products with a low tolerance for failure. Likewise, technologies developed for terrestrial applications can be used for the space sector.



Intel-Movidius Myriad 2 Evaluation Board. Photo credit CERN/Maimilien Brice

³ DBEI. Research Priority Areas 2018 to 2023. 2018. Available at: <https://dbei.gov.ie/en/Publications/Publication-files/Research-Priority-Areas-2018-to-2023.pdf>

Figure 1: Irish Space-active Enterprise Sector – Supply Chain (Upstream^{III} & Downstream^{IV})



1.2 Ireland's Space Enterprise Sector Engagement

To date, Ireland has invested in space primarily through membership of the European Space Agency (ESA). Ireland has been a member of ESA since 1975. ESA membership allows Irish companies and researchers access to a research-performing organisation with a €5 billion budget per annum. Irish membership is through an annual subscription that allows Irish companies and researchers to competitively bid for ESA tenders. The value of the resulting contracts is commensurate with Ireland's contribution to the overall ESA budget. Figure 2 illustrates the total of Ireland's annual ESA budgets for each programme between 2016 and 2020.

The primary rationale for Ireland's continued investment in ESA is to support innovative companies and researchers to develop leading-edge technologies for commercial exploitation in the global space market, to develop valuable research and business linkages with other space organisations, to spin out high-reliability and high-performance space technologies into non-space markets and to spin technologies in to the space market.

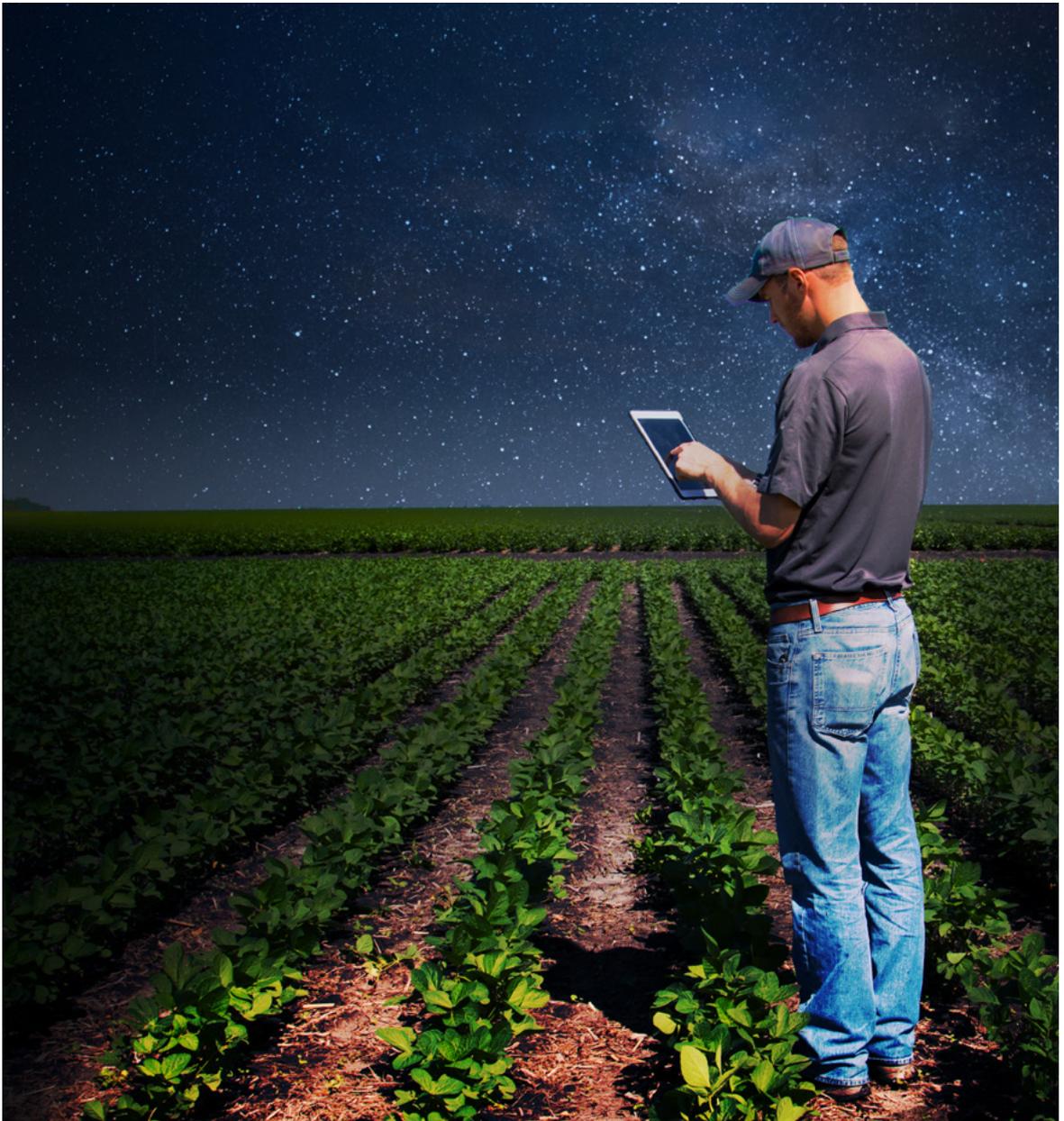
Additionally, the ESA Business Incubator Centre (BIC), which was established in 2017, focuses on supporting new and existing companies developing solutions based on the application of space technologies to non-space markets and vice versa. To-date, fifteen start-up companies have been approved for participation in this important programme.

Ireland's membership of the European Union provides access to the Union's two flagship space programmes, Copernicus and Galileo, and to the Horizon programmes. Ireland is also a member of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). Ireland's membership of the European Union provides industry and academia with access to both Copernicus and Galileo systems and to the wealth of space-derived data they offer. Access to these data provides enterprise with the opportunity to develop novel products, services and applications.

To facilitate companies and researchers to exploit the growing opportunities presented by space, Ireland has worked to maximise the impact of ESA and EU membership. to enable Irish industry to develop and qualify technologies for use in the commercial space and related markets. The ability of Irish companies to adapt their technologies for both space and non-space markets will help to maximise the economic value and ensure the long-term viability and sustainability of our space industry.

Ireland has successfully leveraged its memberships of these organisations to develop a capable, agile and diversified space industry. In 2018, 67 Irish companies and research bodies were working with ESA. Notably, a 2015 Technopolis evaluation of national involvement in ESA sets out the level of growth experienced by Irish space-active industry as follows:

- Commercial sales by companies in Ireland directly resulting from ESA support expanded from €43m in 2013 to over €75m in 2015 and is projected to grow to €133m by 2020;
- Companies in Ireland involved in ESA contracts had a combined turnover of €274m in 2013 and is projected to increase to over €0.5B by 2020; and
- Total employment in companies benefiting from ESA in Ireland is expected to more than double from 2,000 in 2014 to over 4,500 in 2020. ESA related employment is generally of high skill and high salary, providing long-term employment.



"Irish enterprise involved in space includes a diverse and wide range of companies with varying capabilities, opportunities and needs."

Figure 2: Ireland's ESA Budget Allocation

Total ESA Budget 2016 - 2020 = €97.8m

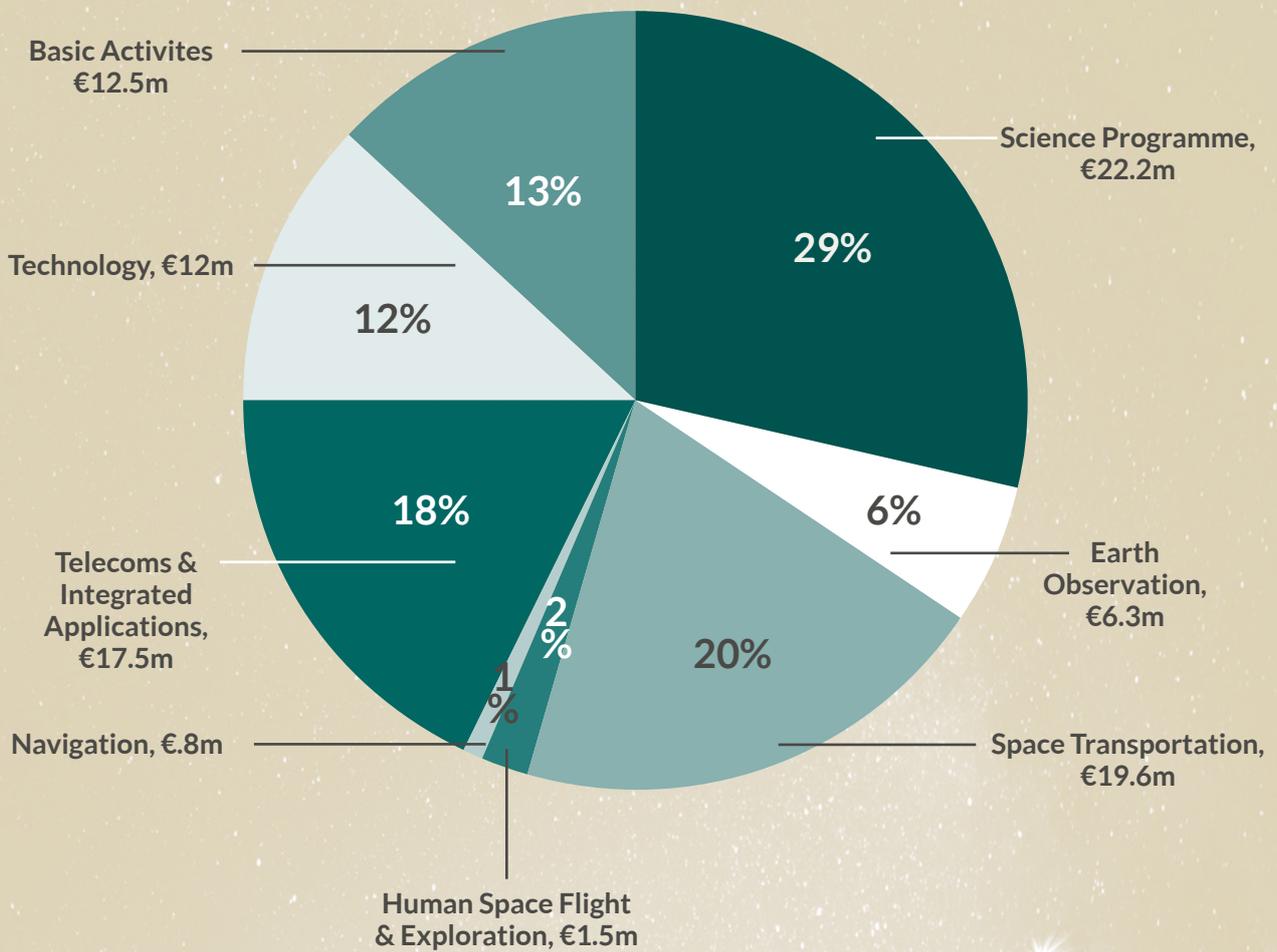
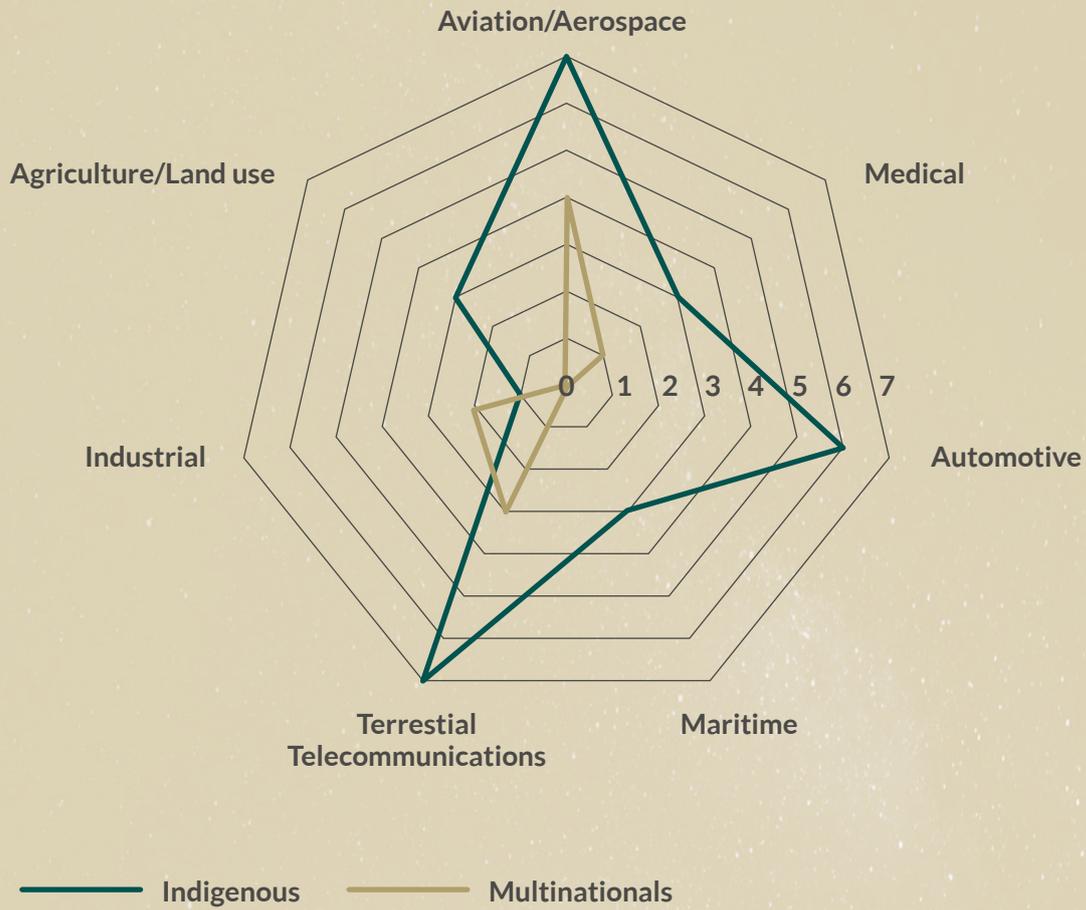


Figure 3: Space Spin-Out Technologies Developed by Irish Companies, with ESA Support

Space Spin Out Technologies, Developed by Irish Companies, with ESA Support



2. Rationale for a Space Strategy for Enterprise

2.1 Evolving Global Market and Space 4.0

The European space industry has, in recent decades, developed and matured at a considerable rate, providing increased opportunity for private industry to share both risk and investment opportunities with the public sector. In addition to its ambitious Horizon programmes, the European Union has augmented its position within the global space realm through its investment in two world-class space programmes: Copernicus and Galileo. The development and implementation of these two programmes provides the European space industry with an unparalleled opportunity to advance and develop novel space technologies.

Although national governments have been the early customers of space technology, there are growing opportunities in space for both the public and the private sector to develop entrepreneurial and start-up businesses, make new discoveries and make significant positive impacts on society. Recognising the growing opportunities within the global space market, an increasing number of States have joined ESA in recent years. Membership has increased from fifteen Member States in 2000 to twenty-two in 2018. Notably, these emerging space States have joined with clear and focused ambitions for their national space industries. Fundamental to this changing environment is an escalation in entrepreneurial activity; ramping up the pace of the space sector development and reducing production costs.

What is Space 4.0?

Space 4.0 represents the evolution of the space sector into a new era, characterised by increased private sector investment and interaction between governments, private sector, society and politics⁴. Space 4.0 will drive contemporary technologies in automation, miniaturisation, advanced manufacturing, machine-to-machine/human interaction, connectivity, big data, biotechnology and more, stimulating the interaction of different sectors⁵ and enabling increased levels of technology exchange between space and non-space domains.

⁴ "What is Space 4.0". ESA. 2019. Available at: https://m.esa.int/About_Us/Ministerial_Council_2016/What_is_space_4.0

⁵ Worner, Jan, "Space 4.0' can help EU overcome its challenges". The Parliament Magazine, 4 March 2016. Available at: <https://www.theparliamentmagazine.eu/articles/opinion/space-40-can-help-eu-overcome-its-challenges>

Within Space 4.0, there are a wealth of opportunities for agile countries, such as Ireland, to capitalise upon by exploiting current research, existing industry capabilities and commercial knowledge to create new, high-growth business opportunities. The opportunities are developing in both commercial upstream and downstream sectors, and through technology transfer into and out of related sectors such as the aviation, automotive, medical sector and data related services. The significant change indicated by Space 4.0 is that private industry is becoming the leading player and significant investor in a sector that was once dominated by government programmes.

In recognition of the growing opportunities alongside the increasing capabilities of Irish industry, *Enterprise 2025*⁶ - Ireland's National Enterprise Policy, identified the space sector as a new area of opportunity for Ireland. Additionally, the *National Development Plan 2018-2027*⁷ announced the establishment of a Space Technologies Programme as a Strategic Investment Priority, 2018–2027.

To capitalise on the opportunities presented by Space 4.0, Ireland must follow a coordinated and focused strategy to enable research and industry to grasp new opportunities, build on strengths and cultivate both national and international awareness of our space capabilities.

Spin-out Case Study

Limerick-based company, Arralis, have been contracted to develop a Ka-band communications antenna for ESA's Large Interferometer Space Antenna (LISA) mission. The technology developed by Arralis for this scientific mission will have commercial applications back on Earth, such as enabling the delivery of high-speed, low-latency internet bandwidth for 5G communications, connected vehicles, remote internet solutions, IoT and M2M communications and also in Inter-satellite mega-constellation communications in space.

2.2 Space Technology and its relevance for Ireland's Wider Economy

As Ireland reaches levels of near full employment, Government is now focusing on fostering quality jobs, improving productivity and building resilience through the *Future Jobs* Framework. Investment in space significantly supports the aim of *Future Jobs*, which is to secure sustainable economic success for Ireland through employment in long-term, well-paid jobs. Fundamentally, engagement with the international space sector and the development of space related competencies goes hand-in-hand with highly paid, sustainable careers.

⁶ DJEI, *Enterprise 2025 Ireland's National Enterprise Policy 2015-2025*. 2015. Available at: <https://dbej.gov.ie/en/Publications/Publication-files/Enterprise-2025-Summary-Report.pdf>

⁷ Government of Ireland. *Project Ireland 2040 National Development Plan 2018–2027*. 2018. Available at: <https://www.gov.ie/en/publication/83fec4-national-development-plan/>

Skills developed for the space sector can also be used in terrestrial domains such as software development, manufacturing, photonics, engineering, nano materials, data analytics and communications technologies, among others.

Therefore, the development of these capabilities will also support future skills needs across a range of future-oriented sectors. Furthermore, the development and growth of activity in the space sector will allow Ireland to contribute to tackling global challenges such as climate change, while increasing the productivity and innovation of Irish SMEs. Importantly, engagement with the global space market will enable the Irish workforce to adapt and react to future technological and transformational changes and demands.



"Skills developed for the space sector can also be used in terrestrial domains such as software development and advanced manufacturing among others."

3. Ireland's Vision and Goals for Space Enterprise

3.1 Vision

An economically sustainable and expanding space-active industry, delivering quality jobs for the economy of tomorrow.

The Government's vision for the space-active enterprise sector is that by 2025 Ireland will have doubled the number of competitive and economically sustainable companies developing leading-edge commercial products, technologies and services for the evolving global space market.

Enterprise will be actively engaged in technology transfer, in and out of the space market, driving sustainable business, offering long-term quality employment and providing leading-edge solutions for the needs of both the space and complementary markets.

Enterprise will be enabled to harness new opportunities offered by Space 4.0, such as the development and use of Commercial Off The Shelf (COTS) products, and will be supported by an appropriate and responsive governance structure.

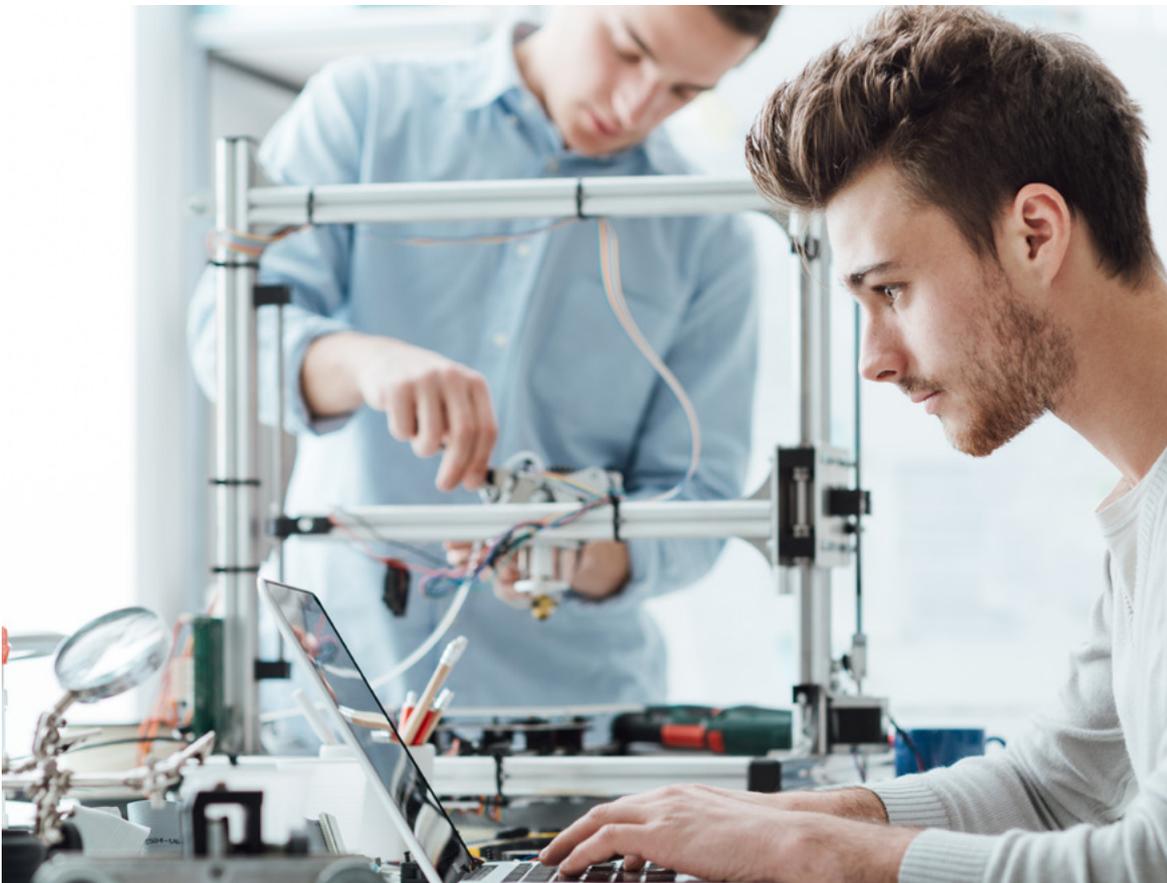
Businesses, researchers, entrepreneurs, students and citizens of all ages across Ireland will have a greater level of awareness of Ireland's space capabilities and involvement in international space missions. Ireland's involvement in space will be fostering a growing interest in Science, Technology, Engineering and Maths (STEM) education and providing greater visibility of exciting careers the space sector offers.

Ireland will be excelling in skills development in emerging areas, including data analytics supported by a national space data platform, providing access to large space data sets. The Irish Government will be a first consumer of this talent, utilising space data to its greatest potential to improve the lives of its citizens.

3.2 Strategic Goals

By 2025, we will:

1. Double the space related revenue and employment in space-active Irish companies;
2. Support 100 companies to benefit from ESA engagement;
3. Double the value of contracts won through the EU Horizon programmes in space-related activities;
4. Increase industry, public and international awareness of space and Ireland's activities in space;
5. Develop and attract talent for space-active and related industries; and
6. Develop a sustainable Earth Observation services sector based on advanced data analytics capability.



"Develop and attract talent for space-active and related industries"

4. Space Strategy for Enterprise

4.1 Strategy Pillars

The National Space Strategy for Enterprise will support Ireland's overriding principle with regard to space – to develop a strong and economically sustainable space-active industry in Ireland – and realise Ireland's vision and goals from 2019 - 2025. Five pillars have been identified to support the achievement of Ireland's vision and goals for space. These pillars are enabled by key strategic actions contained in Section 5.

Pillars of the National Space Strategy For Enterprise

1 - Investment

The strategic actions aim to support the development of an agile and sustainable space-active enterprise sector through increased investment in space.

2 - Strengths and opportunities

The strategic actions aim to support the strengthening of existing areas of activity where we are performing well and to identify and support the development of new opportunities.

3 - Governance

The strategic actions aim to raise awareness of the opportunities of space for Ireland and deliver an appropriate business environment.

4 - Attract and Develop Talent

The strategic actions aim to develop and attract talent with relevant skills for Irish space-active enterprises.

5 - International Engagement

The strategic actions aim to support the development of strong international linkages by Irish companies and research in Europe and beyond.

5. Strategic Actions

5.1. We will strategically invest to support strong and sustainable space enterprise

5.1.1 INVESTMENT TO DRIVE SUSTAINABILITY

The principle underpinning our investment in space research and development activity is economic sustainability. Fundamentally, Ireland's investment in space is to support innovative businesses and researchers in Ireland to develop leading-edge technologies for commercial exploitation, leading to increased exports, sales and employment.

There are a range of existing State initiatives and supports that are available to space-active enterprise at all stages of the development cycle. These include Enterprise Ireland's Commercialisation Fund, Technology Centres, Gateways, Innovation Partnerships, R&D Fund, Science Foundation Ireland's Research Centres, and ESA Business Incubation Centre (BIC) funding.

In addition, Ireland's annual investment in ESA membership is of unique benefit to space-active firms, as it provides access to specialised equipment and technical expertise as well as being the most effective path for Irish companies to qualify their technologies for space.

Public funded instruments are a central part of financing for high technology products such as space technologies. Indeed, the need to secure public funding as a prerequisite for gaining private capital was acknowledged by the European Investment Bank and European Commission in their policy paper *The Future of the European Space Sector*⁸.

Spin-in Case Study

Supported by Ireland's membership of ESA, O.C.E. Technology, Dublin, has begun the development of a real-time operating system called OCEOS to be used on microcontrollers for space applications. The technology developed for this space qualified operating system will be competitive on other terrestrial markets requiring high reliability, such as automotive and medical.

⁸ European Investment Bank. The future of the European space sector. 2019. Available at:

http://www.eib.org/attachments/thematic/future_of_european_space_sector_en.pdf The future of the European space sector

The need for state intervention arises in part due to the long development cycles involved in space hardware development. Despite the increasing involvement of private investment these long development cycles can reduce availability of private finance. Additionally, benefits arising from large scale space related investments often have societal benefits that cannot be retained by the investor alone, making them less attractive to private finance.

In order to achieve Ireland's vision to grow the number of agile and commercially focused space-active companies, key actions will focus on:

- National initiatives

A space enterprise focus will be applied to existing national supports and funding mechanisms in order to grow awareness and increase take-up among space-active companies.

A new Space Technologies Programme was announced as part of Project Ireland 2040's Strategic Investment Priorities, 2018–2027, to build a strong economy, supported by enterprise, innovation and skills. The Space Technologies Programme will be utilised to develop space enterprise focused initiatives, including funding mechanisms, delivered through DBEI Agency Programmes, driving investment in sustainable space-active enterprise.

- ESA Investment

National investment in Ireland's membership of ESA has grown by 24% in the period 2009 to 2019, bringing it from €14.8m to €18.3m per annum. This investment is divided between ESA's mandatory programme, from which basic activities and the science programme are funded, and optional programmes, within which Ireland can choose to participate in strategically important activities.

The level of Ireland's investment in the mandatory programme is determined by a scale based on Gross Domestic Product (GDP), which is reviewed by ESA every three years. The remainder of Ireland's ESA funding is invested in optional programmes, based on Irish

Technology Development Case Study

In 2018, Réaltra Space Systems Engineering, a Division of Irish company Realtime Technologies, established to address the growing commercial space market, signed a contract with OHB System AG to develop a Payload Interface Unit (PLIU) for ESA's PLATO (PLANetary Transits and Oscillations) science mission. The PLIU plays a fundamental role in the thermal control system of the scientific telescope payload on the PLATO spacecraft. This will help underpin the mission's objective of understanding how our Universe was formed and the potential existence of life outside our solar system. The contract reflects the quality of the solution proposed by Réaltra and will support an increase in high-quality employment in design, engineering and manufacturing in Réaltra's Irish supply chain companies, while also opening new opportunities in the commercial "New Space"^V market.

industrial capacities and growth opportunities. This allows Ireland to strategically invest in programmes which offer greater potential for Irish enterprises to develop and grow economically sustainable businesses through their engagement with ESA.

Industrial activities within ESA’s mandatory programme are fully funded through Ireland’s investment in ESA. An increasing proportion of industrial activities within ESA’s optional programmes that Ireland participates in are co-funded with industry. Within these co-funded programmes, the level of industry co-funding varies from 25% to 50% depending on the level of technology and market maturity. In the three years from 2016 to 2018 the average intensity level of co-funding achieved across all optional programmes with a co-funding element was 43%, which resulted in a co-investment of €9.4m from industry.

In order to grow the number and capacity of space-active firms, Ireland will aim to increase public and private investment in ESA programmes by 50% by 2025. The increased investment will be primarily focused on co-funded optional programmes in order to leverage the State’s investment and maximise the supports available to space-active companies.

Focusing the increased investment on co-funded programmes will enable Ireland to grow the number of Irish enterprises engaging with ESA and facilitate the development of an expanding base of economically sustainable businesses, in addition to increasing employment levels, exports and sales.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> Aim to increase public and private investment in ESA by 50% by 2025. 	[DBEI, EI, IDA, Industry]	2025
<ul style="list-style-type: none"> Utilise the Space Technologies Programme to develop space focused initiatives, including funding mechanisms, delivered through DBEI Agency Programmes. 	[IDA, SFI, EI]	Ongoing

5.1.2 NEW FORMS OF INVESTMENT

In order to harness the emerging opportunities in space, new forms of investment will be explored with international partners including ESA, the European Investment Bank (EIB), the European Innovation Council and the European Commission, to develop new forms of financing for Irish companies.

Additionally, Ireland’s National Development Plan, Project Ireland 2040, introduced several new funds. Two of these funds, the Climate Action Fund and the Disruptive Technology Innovation Fund (DTIF), offer significant opportunity for private enterprise to advance their engagement with space.

The Climate Action Fund, led by the Department of Communications, Climate Action and Environment aims to leverage investment by public and private bodies in climate action

measures, offering the opportunity to utilise Ireland’s space resources such as near real-time Earth Observation data provided through the EU’s Copernicus programme.

The DTIF, led by the Department of Business, Enterprise and Innovation offers enterprises with the opportunity to compete to develop innovative solutions for national and global challenges. Space-active enterprises can play a key role in solving these challenges. These new funds offer significant funding and space active enterprises in Ireland will be supported and encouraged to engage with these new funds.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> Collaborate with international partners including ESA, EIB and the European Commission, to mobilise new forms of investment. 	[DBEI, EI]	2020
<ul style="list-style-type: none"> Support and encourage the space active enterprise sector through the new Project Ireland 2040 Funds. 	[DBEI, EI, IDA]	Ongoing

5.2 We will build on our strengths and actively pursue new opportunities to develop agile and sustainable space enterprise in Ireland

5.2.1 BUILDING ON OUR STRENGTHS

Ireland’s industry and researchers have developed capabilities in a wide range of technology domains relevant to the space market such as electronics, propulsion subsystems, antennae, opto-electronics, advanced materials, software data systems, data analytics and geo-science. The development of these capabilities has been enabled through national investment in Science Foundation Ireland, Enterprise Ireland, ESA, the Irish Research Council and Tyndall National Institute, among others.

Ireland’s investment decisions have been guided by the National Research Priority Areas, which align the majority of competitively awarded public investment in research with 14 priority areas, many of which are relevant to the space market.

These priority areas represent the first step in the decision-making process for selection of activities to be supported through national investment in ESA.

Technology Development Case Study

Through the ESA Business Applications programme, Verifish, Cork, are developing a service, “AquaEYE”, which will allow certified aquaculture production facilitates to verify their physical location and also enable the recording and monitoring of water quality data. This is achieved through the use of sensor and data is transmitted using satellite technology to a cloud-based database.



Ireland will continue to invest in programmes and activities that support enterprises across technology domains and applications, in both upstream and downstream segments, with economic sustainability on commercial markets being the core criterion applied. Further details of this approach are set out in Appendix 2.

As a small and diverse industry, Irish enterprise must remain responsive to opportunities in a range of sectors in order to successfully grow. Therefore, Enterprise Ireland will support the development of an agile space-active enterprise sector by:

- Pursuing an open innovation model, including technology spin-in^{vi} and spin-out^{vi};
- Supporting space qualification and Technology Readiness Level (TRL) progression for the commercial space market;
- Building supply-chain relationships with space systems integrators and
- Ensuring non-dependency on agency and institutional support.

5.2.2 PURSUING NEW OPPORTUNITIES

The global space market is undergoing a pivotal evolution and Irish industry must be poised to maximise its share of the emerging opportunities within Space 4.0.

As new opportunities emerge Ireland will continue to support economically impactful and strong commercial opportunities in both the upstream and downstream space sectors.

A key new opportunity for Ireland has recently emerged on foot of a 2017 agreement between Enterprise Ireland and ESA. The agreement allows access an unprecedented volume of near real-time data about planet Earth and its environment captured by the EU's Copernicus programme.

It has estimated that the Copernicus programme could generate a financial benefit of approximately €30 billion, in addition to over 50,000 new jobs, by 2030⁹. Moreover, the midstream sector, including data sales, data acquisition, data processing, data archiving and data distribution and delivery has been forecast to grow by 11% CAGR in the period 2012-2022¹⁰. Ireland is ideally positioned, given our strong heritage in ICT, to seize this opportunity and develop Copernicus data to respond to opportunities including:

- Global challenges

The increasing quality and volume of Earth Observation data collected from space is providing valuable insights into the health of our planet. Earth Observation data, derived from the EU's Copernicus programme, extends beyond simple imagery, offering dedicated tools that monitor land, marine, atmospheric and air quality. These tools provide a wide range of data for example ocean temperature and topography, radiation, vegetation and soil monitoring. Possible applications of these datasets include climate change mitigation and food security.

The *Public Service Data Strategy 2019 – 2023* recognises the value of such data for government as it “provides the means to organise and deliver the answer to both national and global challenges, including sustainable development and environmental management”¹¹.

- Commercial opportunity

Although Governments have been identified as primary consumers of Earth Observation services, it has been recognised by the European Commission that the consumer base is developing from an institutional an increasingly commercial base¹². Hence, the development of data related applications and sustainable services offer a growing opportunity to Irish industry. Commercial applications of the Copernicus data are relevant to economically important sectors for Ireland including smart agriculture, marine, and planning.

- Skills

As the volume of Earth Observation data will continue to grow in the future, the ability to analyse this data and extract useful knowledge has been identified as a key competitive

9 European Commission. Big Data in Earth Observation. 2017. Available at: https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Big%20Data%20in%20Earth%20Observation%20v1.pdf

10 European Commission. Big Data in Earth Observation. 2017. Available at: https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Big%20Data%20in%20Earth%20Observation%20v1.pdf

11 Department of Public Expenditure and Reform. Public Service Data Strategy 2019-2023. 2019. Available at: https://data.gov.ie/uploads/page_images/2019-01-03-110200.740673Public-Service-Data-Strategy-2019-2023.pdf

12 European Commission. Big Data in Earth Observation. 2017. Available at: https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Big%20Data%20in%20Earth%20Observation%20v1.pdf

advantage¹³. Further spill over value will be derived from the Big Data sets available to Ireland through the development of advanced data analytics skills. These skill sets, whilst being highly relevant to Earth Observation, also have multiple further uses in the applications of Industry 4.0^{VII} such as Data Management, Automated Processing and Artificial Intelligence.

In order to facilitate the use of this resource, Enterprise Ireland, working with Government departments and agencies, industry and Research Performing Organisations will establish a Space Data Hub, allowing users to access and process data from European and other 3rd party space missions.

This hub will form the core around which a vibrant internationally traded services sector, based on converting Earth Observation data into commercially valuable information, will be built.

These services will be delivered through advanced ICT expertise, including among others, automated processing and deep learning. The Space Data Hub will drive the development of skills which can be applied to other industrial applications such as Industry 4.0.

Additionally, enterprise can utilise Ireland's Copernicus Relay to further engage with opportunities offered by the Copernicus Programme. The Copernicus Relay is a European Commission led network which coordinates and promotes activities around the Copernicus Programme, the benefits it provides and the opportunities it presents for citizens and businesses.

The Copernicus Relay will be supported to stimulate the creation of a vibrant, sustainable Earth Observation services sector, bringing value to industry and the community through the creation of commercial value from space derived data.

Spin-in Case Study

Dublin City University based start-up Pilot Photonics has adapted its Photonic Integrated Comb Laser technology, initially developed with EI support, for space applications including satellite communications. The company has, with the support of the European Space Agency, began working on de-risking its technology to evaluate whether it could be used in other high value Space based applications such as high frequency optical metrology, high-performance gravimeters, magnetometers and atomic clocks. This evaluation has been successfully completed with follow-on development activities already initiated, supported through ESA's General Support Technology Programme (GSTP).

¹³ European Commission. Big Data in Earth Observation. 2017. Available at: https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_Big%20Data%20in%20Earth%20Observation%20v1.pdf

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> Establish a Space Data Hub to provide access to data from European and other 3rd party space missions. 	[EI]	2019
<ul style="list-style-type: none"> Support industry in Ireland to develop advanced data analytic skills and deliver commercial services using the national Space Data Hub. 	[EI]	Ongoing
<ul style="list-style-type: none"> Help the space-active enterprise sector in Ireland to identify and access the most relevant research performing organisations to assist with their development needs. 	[EI]	Ongoing

5.3 We will create an appropriate environment for business

To date, Ireland has managed its investment in space primarily through the Department of Business, Enterprise and Innovation, and Enterprise Ireland. The Department is responsible for managing international and financial policy issues as well as enforcing EU and national export controls. Enterprise Ireland's core role is supporting enterprise development and growth.

The current governance structure, with Enterprise Ireland at the centre, has proven to be successful in terms of industry growth. The number of companies benefitting from ESA contracts has grown from 35 in 2008 to 67 in 2018, while a 2015 Technopolis evaluation of national involvement in ESA projected a CAGR of 19% in ESA derived sales over the period 2012 to 2020, from €32m in 2012 to €133m in 2020, an increase by a factor of 4 over the period.

Enterprise Ireland supports Irish industrial interests at EUMETSAT and the EU Space Programmes, represents Irish industrial interests on ESA programme boards, and operates as a key support to space-active companies in Ireland. Through this structure, Irish companies access timely information on relevant upcoming ESA procurements.

Enterprise Ireland also supports the participation of space-active companies on relevant trade missions as well as proactively identifying new market opportunities for companies as candidates for technology transfer into and out of the space sector.

As the opportunities of space for industry, research and society have expanded, there is a growing need for wider coordination in order for Ireland to fully exploit the benefits and associated opportunities of our investments through ESA and the EU space programmes. To address this need, the governance structure will be revised to include the development of a Space Enterprise Coordination Group, which will be supported by a Strategy Implementation

Group. Enterprise Ireland will retain their role working with ESA, other international organisations, and Irish industry. Continued alignment between Irish enterprise and future space needs is of principal importance.

5.3.1 THE SPACE ENTERPRISE COORDINATION GROUP AND THE STRATEGY IMPLEMENTATION GROUP

Government and public bodies are engaged in activities that could significantly benefit from the use of space products.

In recognition of the need for better coordination, the broad scope of the sector, and the underutilisation of the potential of space technologies on both economic and environmental grounds, a Space Enterprise Coordination Group will be established.

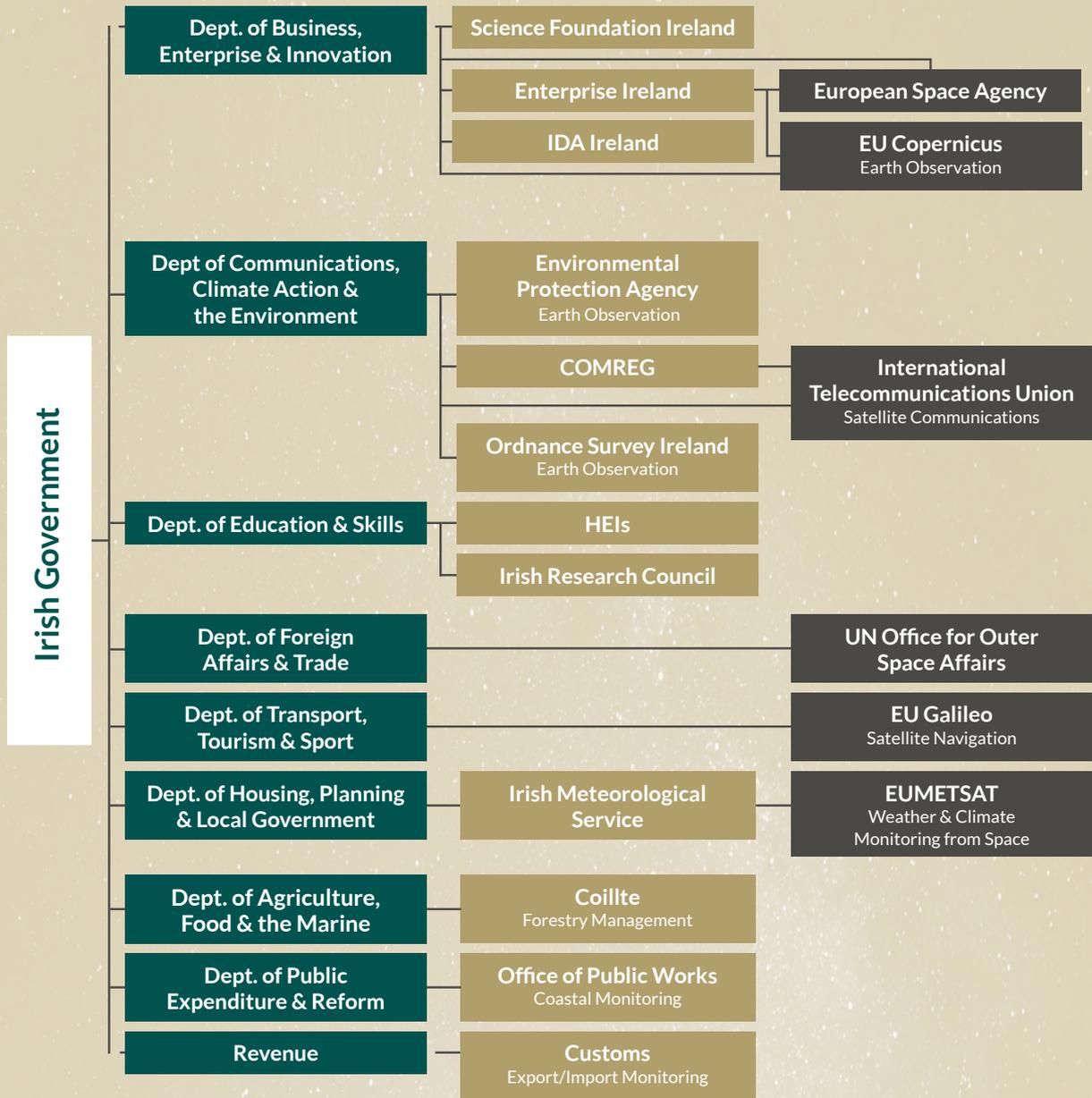
The Space Enterprise Coordination Group will be an interdepartmental group comprised of departments with a policy interest related to space. Figure 4 below shows the current structure of government departments and public-sector bodies with an involvement in space or space-based data and technologies. The Space Enterprise Coordination Group will consult with appropriate representative bodies and experts to understand the evolving needs of industry and to further advance Ireland's engagement with and use of space.

By bringing together these key stakeholders, Ireland will be able to better utilise our investment in space to support informed decision making, advances in industries of national importance, such as smart farming/marine, as well as contributing to solutions for global social and environmental issues such as climate change.

Technology Development Case Study

Cork based SME, Treemetrics, develops forest management software solutions to maximise the yield from managed forest plantations. Supported by Ireland's membership to ESA, Treemetrics has incorporated both Earth Observation data and in-situ measurement systems into their solutions, enabling foresters to monitor the health and growth of trees. Additionally, Treemetrics use of satellite communications systems ensures continuous access to data regardless of the forest's location or availability of wireless internet.

Figure 4: Current Structure of Government Departments and Agencies Involved in Space



The Space Enterprise Coordination Group will be established for the period of the strategy. As the space industry develops, and Ireland’s uptake and commercialisation of downstream space data and upstream space technology increases, the role of the Space Enterprise Coordination Group will be reviewed and the optimal governance structure to meet the needs of the space industry in Ireland will be reassessed.

The Space Enterprise Coordination Group will be chaired by the Department of Business, Enterprise and Innovation and will report annually to the Minister with responsibility for Research and Development.

The role of the Space Enterprise Coordination Group will include:

1. Oversight of the implementation of the Strategy.
2. Raising awareness across the public sector of the potential value and use of space enabled technologies and datasets.
3. Consideration and recommendation of an appropriate legislative framework for the space industry in Ireland on the basis of industry needs and potential opportunities.
4. Review the appropriate governance structure as Ireland’s engagement with the space sector.

To support the work of the Space Enterprise Coordination Group, an expert working group, the “Strategy Implementation Group” will be established. The Strategy Implementation Group will be comprised of State bodies responsible for the implementation of the strategic actions of the strategy. The Strategy Implementation Group will meet on a regular basis and will carry out the key actions of the strategy. They will also engage with appropriate representative bodies and experts to understand the evolving needs of industry and to further advance Ireland’s engagement with and use of space. The Department of Business, Enterprise and Innovation will Chair the Strategy Implementation Group and will inform the Space Enterprise Coordination Group of progress of the strategy and inform them of key issues.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> • Establish a Space Enterprise Coordination Group. 	[DBEI]	2019
<ul style="list-style-type: none"> • Establish a Strategy Implementation Group. 	[DBEI]	2019

5.3.2 THE SPACE ENTERPRISE WEBSITE

In addition, Enterprise Ireland will develop and coordinate a dedicated website which will act as a single point of reference for any entity that wishes to understand the level of space activity across research, enterprise and skills domains in Ireland.

The website will strive to make opportunities related to space technologies and services increasingly visible to the public and industry. It will clearly map out the space governance structure in Ireland, providing information on industrial activity, signposting supports available to researchers and industry in addition to educational resources such as ESERO

and Space Week websites. The website will also provide up to date information in relation to international opportunities such as EU Horizon calls, EU Space Programmes and ESA open procurements.

As an almost exclusively export driven industry it is of utmost importance that national and international stakeholders can access this information with ease. Furthermore, increasing the profile of space nationally will support the objective of growing awareness of Irish engagement in space and its potential nationally.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> Establish a dedicate space enterprise website. 	[EI- lead] [DBEI, SFI, IDA, Blackrock Castle Observatory (BCO) ISIG]	2019

5.4 We will foster a pipeline of capable graduates and postgraduates, and enable upskilling within space enterprises

Public awareness of national successes in space and the development of a capable work force to harness opportunities are closely linked.

Increasing awareness of Irish involvement in space through all levels of education, in addition to support upskilling for enterprise, is of crucial importance to Ireland’s future success in space.

5.4.1 EDUCATION

Space inspires for many an interest in Science, Technology, Engineering and Maths (STEM). It is imperative that Ireland continues to foster interest in these subject areas to provide a pipeline of capable and talented graduates to progress Ireland’s future space and related capabilities. This will be achieved by investment in space related education programmes at all levels, including taught and research graduate levels, to ensure the economy has the necessary availability of skilled people to take advantage of the growing opportunities presented by the

Spin-in Case Study

Dublin City University-based company Jaliko, in partnership with Ubotica Technologies, Dublin, have worked to characterise the Intel-Movidius Myriad 2 artificial intelligence chip for space applications through an ESA co-funded project. The Myriad 2 harnesses artificial intelligence for high-performance, low-power vision processing. This space characterised chip can be programmed with pre-trained data to recognise features and patterns, or to perform in-depth 3D sensing depending on the customers’ needs.

emerging space sector. Ireland currently invests in a number of space related education programmes including:

- Ireland's ESA membership, together with Science Foundation Ireland, funds the European Space Education Resource Office (ESERO). ESERO provides resources and supports to inspire students to engage with space and STEM subjects. In addition, space is included as a theme in the existing SFI Discover programmes such as Discover Primary Science and Smart Futures. ESA's Education office provides outstanding training programmes in industry-relevant topics such as testing and operations, and access to their facilities, all of which are open to Irish 3rd and 4th level students.
- ESA's programme for space science experiments and payloads, known as PRODEX. Ireland's participation in this programme offers Irish research institutes and industry the opportunity to work on scientific missions and experiments. Ireland's third-level space science research community are the main beneficiaries of participation in PRODEX. Recent examples included contributions to payload instruments on the Solar Orbiter and James Webb Space Telescope missions, participation in human spaceflight experiments on parabolic flights, materials testing in microgravity, and bed rest studies. A number of recent national investments in International Research Organisations including membership of the International LOFAR (LOw Frequency ARray) telescope and the European Southern Observatory (ESO). These memberships will allow Irish researchers and students to be involved in world class research projects in modern astronomy.
- The Copernicus Academy, coordinated by Maynooth University. Recognising the emerging opportunities in the downstream space sector, Irish third level institutions recently gained access to this initiative. The Academy connects European universities, research institutions and business schools with the goal of developing lectures, training sessions, traineeships as well as educational and training material. The Academy's goal is to develop the skill sets required to use Copernicus data and information services to their full potential.
- Ireland's higher education system is supporting the development of capable graduates for space through dedicated space and other relevant taught Masters programmes. Qualifications by research, namely Research Masters and Ph.D. programmes in space-related fields, supports the development of high-level skills and cutting-edge knowledge for industry and enhance opportunities for HEI-space industry collaboration.

Ireland's future success in the space market will be underpinned by the capabilities of our graduates. The resources above will play a key role in driving awareness of Ireland's activities in space and, importantly, in developing the required skills in Ireland's graduates and future workforce.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> Build awareness of national space education resources such as ESERO Ireland and Ireland's recent memberships of LOFAR and ESO. 	[SFI, DBEI, EI]	Ongoing
<ul style="list-style-type: none"> Drive awareness and engagement with space through promotion of National Space Week activities. 	[BCO, DBEI, EI]	Ongoing
<ul style="list-style-type: none"> Grow the enterprise capabilities of the space research community with appropriate funding for ESA's PRODEX programme, and national research programmes. 	[EI, SFI, IRC]	Ongoing

5.4.2 INDUSTRY UPSKILLING

The size of the emergent space-active industry in Ireland means that the critical mass is not yet achieved to require a broad range of dedicated space related third level educational programmes. The absence of a Large System Integrator (LSI) or "Prime" company in Ireland, and the size and variety of disciplines active in the sector mean that much of the training for the individual needs of enterprise is carried out in-house or co-operatively within small groups of enterprises through the Space Industry Skillnet, which provides a dedicated training network for the space sector.

The Space Industry Skillnet have a unique knowledge of the skills needs of Irish industry and are ideally placed to advise on skills shortages and associated challenges. In order to meet the growing skills needs of space-active enterprise sector, the Strategy Implementation Group will consult with industry to agree skills shortages and develop a Detailed Description of Needs (DDN). The DDN will support the development of space focused programmes and courses by relevant training and education providers. Additionally, the Space Industry Skillnet, supported by Irish Space Industry Group (ISIG) and Higher Education Institutions (HEIs), will develop targeted training programmes.

In addition, there are a number of funded knowledge transfer programmes in place that can be used to leverage knowledge from outside of Ireland to support the development of a pool of talent with space specific skills for industry.

Spin-out Case Study

Eblana Photonics, Dublin, working with industry and research partners from Ireland and Switzerland, have begun a two-year co-funded project with ESA to develop novel narrowband laser sources for next-generation optical atomic clock satellite systems. This technology will be applicable for use in future satellite-based systems including global navigations satellite systems (GNSS), driverless cars and telecommunications.

- The Science Foundation Ireland Fellowship programme is a funded programme that provides successful candidates with the opportunity to develop their skills through a placement in many areas such as industry, research funding and administration.
- The Irish Research Council’s Enterprise Partnership Scheme (EPS) and the Employment-based Postgraduate Programme (EBP). These programmes provide opportunities for talented graduates to undertake a funded Masters programme by research or a PhD in collaboration with an industry partner in the space sector. The programmes support the talent and skills pipeline for enterprise. In the case of EPS, opportunities go beyond postgraduate level to include postdoctoral research assignments.
- The Irish Research Council-European Space Agency Traineeship is a scheme organised jointly by the Council and the ESA. The Council fully funds science, engineering and technology graduates to undertake traineeships in ESA centres across Europe. The IRC currently fund two graduates per annum.
- Ireland’s recent membership to the European Southern Observatory will offer traineeship and research opportunities to Irish engineers. The Directorate of Engineering welcomes trainees in a variety of engineering disciplines; including software and electronic engineering. Irish citizens can also apply for permanent positions at ESO.

Continued investment in these programmes will play an important role in enabling industry upskilling and supporting the development of skills required by space-active enterprise to scale in Ireland and take advantage of the emerging opportunities presented by space.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> • The Strategy Implementation Group to consult with industry to agree skills shortages and develop a Detailed Description of Needs (DDN) to support the development of space focused programmes/courses by relevant training and education providers. 	[DBEI]	2020
<ul style="list-style-type: none"> • Space Industry Skillnet to develop and coordinate the delivery of suitable courses supported by HEIs and other relevant training providers. 	[Space Industry Skillnet, HEIs]	2020
<ul style="list-style-type: none"> • Promote awareness of international programmes available to space-active industry to support knowledge development. 	[EI, SFI, IRC]	Ongoing

5.5 We will promote international awareness of Ireland's space enterprise capabilities

As Space 4.0 emerges, an increasing number of States are becoming involved in the global space market to capitalise on new opportunities, resulting in an increasingly competitive environment. As space is an exclusively export driven market, it is fundamentally important that Ireland actively promotes its space capabilities to the global market and builds relationships across borders.

The EU has recognised the growing opportunity space presents and as part of the next EU long-term budget (MFF 2021 – 2027), the European Commission has proposed a [€16 billion] programme which will coordinate all of its space activities into a single space programme. In addition, a further €15 billion is proposed under the Horizon Europe, Digital and Industry cluster Programme, of which space is a part of.

Ireland can increase our international presence by:

- Influencing the agenda at EU and international fora and growing Ireland's profile in relation to space;
- Supporting the development of leading-edge technologies through international collaborative works;
- Utilising networks through SFI, IDA and EI to promote Ireland's space capabilities to an international audience; and
- Promoting the diverse capabilities and range of space-active companies operating in Ireland through the development of an online directory.

Ireland must seek out linkages across borders to seize new opportunities. As Space 4.0 gains momentum, Ireland must ensure that we engage with key international players to raise awareness of our industrial capabilities and maintain international competitiveness.

Key Actions	Responsibility	Timeline
<ul style="list-style-type: none"> • Support 80 Irish companies to participate at international trade events focusing on integration in global space supply chains. 	[EI]	2025
<ul style="list-style-type: none"> • Develop the online directory to promote Ireland's space industry capabilities to the global space market. 	[EI]	2019
<ul style="list-style-type: none"> • Develop Ireland-global collaborations through bi-lateral agreements, with space industry development organisations including NASA. 	[EI, SFI]	2025

6. Next Steps

The Space Strategy for Enterprise has identified necessary actions and associated level of resources, using both existing and new initiatives to achieve our vision by 2025. Improved coordination across government departments and agencies will be key in driving awareness of the relevance and benefits of space. Furthermore, these departments and agencies will play a key role in implementing the actions called out above.

The Space Enterprise Coordination Group and the Strategy Implementation Group, as envisaged in 5.3.2. will drive the implementation of the strategy. The Strategy Implementation Group, will implement the key strategic actions and monitor performance using the Key Performance Indicators (KPIs) set out in Appendix 1. The Group will also recommend changes to the strategy to ensure Ireland's vision for space remains relevant.

The Space Enterprise Coordination Group will report on the progress of the strategy to the Minister with responsibility for Research and Development annually.

6.1 Implementation Staging

2019

The key stages of the strategy will be carried out in 2019 when the core initiatives will be developed and put in place including:

- Establishing the Space Enterprise Coordination Group and the Strategy Implementation Group;
- Commencement of activities to develop the Space Data Hub;
- Building on current initiatives; and
- Commencing the development of Space Website.

2020-2024

The interim stages will be crucial for measuring the impact of these initiatives against the Key Performance Indicators, set out in Appendix 1, to enable a decisive review of the strategy in 2025. The Space Enterprise Coordination Group will report to Minister with responsibility for Research and Development, recommending any required changes to the strategy annually.

2025

During 2025 the governance structure will be reviewed and the optimal governance structure to meet the needs of the space industry in Ireland will be reassessed.

Appendix 1 – How we will measure our performance

The Space Enterprise Coordination Group will review performance of the National Space Strategy for Enterprise in achieving its goals against related Key Performance Indicators (KPIs). The Space Enterprise Coordination Group will provide a report to the Minister with responsibility for Research and Development annually, reporting on the performance of the strategy and recommending changes to the strategy, including suggested new KPIs for improved measurement

Goal 1: Double the revenue and employment in space-active Irish companies.

KPIs:

1. Annual revenue from Enterprise Ireland and IDA Ireland supported Irish space-active companies benefitting from ESA, European Union Horizon programmes and other national space specific funding programmes.
2. Total employment in Enterprise Ireland and IDA Ireland supported Irish space-active companies benefitting from ESA, European Union Horizon programmes and other national space specific funding programmes.

Goal 2: Support 100 companies to win contracts with ESA.

KPIs:

3. Number of new companies benefitting from ESA engagement per year.

Goal 3: Double the value of contracts won through the EU Horizon programmes in space-related activities.

KPIs:

4. Value on contracts won per year.
5. Number of contracts won per year.

(This Goal will be reviewed once agreement has been reached on both the new EU Space Regulation and the Horizon Europe Programme)

Goal 4: Increase industry, public and international awareness of space and Ireland's activities in space.

KPIs:

6. Number of hits on the space enterprise website per year.
7. Number of media articles primarily focused on Ireland's involvement in space per year.
8. Number of Department and Enterprise Ireland press releases and tweets regarding space per year.

Goal 5: Develop and attract talent for space-active and related industries.

KPIs:

9. Number of Space Week events per year.
10. Level of attendance at ESERO training sessions per year.
11. Number of Space Industry Skillnet hosted training sessions per year.

Goal 6: Develop a sustainable Earth Observation services sector based on advanced data analytics capability.

KPIs:

12. Number of users per year of the national space data archive.

Appendix 2 – Evaluation criteria for Irish support of ESA programme activities

As set out in Section 5.2.1., Ireland will invest in programmes and activities that support enterprises across the spectrum of technologies and applications in both upstream and downstream segments, with long-term sustainability on commercial markets being the core criterion applied.

The criteria considered when evaluating a candidate project are set out below. Where insufficient resources are available to support all projects meeting the evaluation criteria, a joint panel of DBEI, EI and IDA (where appropriate) will make a final funding decision.

1. Alignment with specific (space) agency and space sector priorities and goals.
2. Potential to develop a sustainable business opportunity leading to growth in export sales and employment.
 - a) Demonstrable commercial viability e.g. a clear commercial roadmap with potential customers involvement:
 - (i) Evidence of user need addressed, USP validated, pilot activities;
 - (ii) Sustainability in a commercial environment;
 - (iii) Demonstration of Understanding of value chain;
 - (iv) Commercialisation roadmap.
 - b) Potential to consolidate existing value chain or add new supply chain.
3. Technical:
 - a) Degree of technical and business risk involved.
 - b) Potential for supporting step-change/ disruptive technology development.
 - c) Potential to pivot the development into other markets.
 - d) Anticipated technology readiness level and/or market readiness of project outcome.
 - e) Sustainable/legacy competencies to be developed during the course of the project.
4. Other:
 - a) Extent to which private-sector and non-exchequer funding will be leveraged.
 - b) (Credibility of) Contribution by Economic Operator.
 - c) Potential for contributing to national promotion of STEM education and career building opportunities.
 - d) Balance between foreign direct investment companies and indigenous companies benefitting from ESA.
 - e) Contribution to national strategic objectives e.g. climate action.

Appendix 3 – Glossary

- I. **Space 4.0:** Space 4.0 is a new era in which space is an enabler of knowledge, jobs and growth, policy making and inspiration and motivation of the next generation. Space will drive contemporary technologies in automation, miniaturisation, advanced manufacturing, machine to machine/human interaction, connectivity, big data, biotechnology and more, stimulating the interaction of different sectors. Space 4.0 can be used as a tool to tackle global challenges such as climate change, demographic development, migration, shortage of resources, conflicts and catastrophes, energy, digital divide, health and curiosity¹⁴.
- II. **Blue Economy:** The sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health. It includes activities such as waste management, maritime transport, renewable energy, climate change and tourism.
- III. **Upstream:** Technology developed for sending objects into space and for space exploration, for example launchers and satellites.
- IV. **Downstream:** Products and services developed through the use of data collected from space, for example Earth Observation data.
- V. **New Space:** New Space comprises a global industry of private companies and entrepreneurs who primarily target commercial customers, are backed by risk capital seeking a return, and seek to profit from innovative products or services developed in or for space.
- VI. **Spin-in/Spin-Out:** Spin-in and spin-out relates to the application of technology, expertise or techniques to a purpose not originally intended for it¹⁵. Spinning-in relates to transferring technologies from the non-space market into the space market and spinning-out relates to transferring technologies developed for the space market into the non-space market.
- VII. **Industry 4.0:** Global manufacturing trends and technologies which are disrupting the industry are resulting in the 'Fourth Industrial Revolution', known as 'Industry 4.0'. These disruptive trends and technologies include the Internet of Things, cybersecurity, cloud computing, big data and analytics, and new technologies such as additive manufacturing, advanced robotics, digital design, and smart and connected products¹⁶.

14 Worner, Jan, "Space 4.0' can help EU overcome its challenges". The Parliament Magazine, 4 March 2016. Available at: <https://www.theparliamentmagazine.eu/articles/opinion/space-40-can-help-eu-overcome-its-challenges>

15 "Space Science". ESA. 2003. Available at: http://www.esa.int/Our_Activities/Space_Science/Spin-off_technologies

16 "Industry 4.0 and High Value Manufacturing Kick-Start Activities". ESA. 2018. Available from: <https://business.esa.int/funding/invitation-to-tender/industry-40>

Appendix 4 – Public consultation key findings

Driven by the increasing opportunities presented by Space 4.0 and the expanding capabilities of Irish enterprise, the Department of Business, Enterprise & Innovation and Enterprise Ireland conducted a public consultation during 2018 to inform the development of a National Space Strategy for Enterprise.

The consultation process, which obtained the views of industrial enterprises, R&D organisations, development agencies and other relevant organisations, has informed this strategy which has been developed by the Department of Business, Enterprise & Innovation (DBEI) and Enterprise Ireland (EI).

Broadly, the consultation process found that:

- Irish enterprise involved in space includes a diverse and wide range of companies with varying capabilities, opportunities and needs;
- Ireland's strategy must focus on broad national action to enhance the abilities and sustainability of the diverse range of Irish enterprise active in space;
- Ireland's governance structure and initiatives for space enterprise should be internationally benchmarked actions against countries with a similar space-active industrial mix;
- Awareness of Ireland's activities in space and the opportunities presented by space is insufficient among the public sector, private enterprise and the public. Ireland's Space Strategy for Enterprise should strive to increase this awareness;
- It is essential to recognise the interdependence between upstream and downstream technology;
- Ireland's Space Strategy for Enterprise must be agile and flexible to adapt to the evolving commercial market;
- There are numerous opportunities for Ireland to expand within the context of Space 4.0, including commercial off the shelf components (COTS) and technology standardisation.
- Many national enterprises and other sectoral organisations perceive the need for a greater level of coordination among public organisations regarding space, including consideration for the creation of a National Space Office in the future when appropriate;
- Ireland's investment through ESA is among the lowest of all member States and is significantly out of line with the opportunity that is available; and
- Availability of key space-related skills, including technical marketing and business skills will be a critical factor for the future development of space enterprise in Ireland

Using the findings of the consultation process and the experience of DBEI and EI, a number of strategic decisions were made to identify the five pillars of Ireland's National Space Strategy for Enterprise and the required key strategic actions to realise Ireland's vision and goals for space by 2025.

Figure 5: Consultation Process

Public Consultation

- Public consultation published July 2018.
- 52 public consultation responses received by September 2018.

Consultation Workshop

- Stakeholder day attended by approximately 70 attendees in October 2018.
 - Stakeholders took part in a workshop to consider key questions for the strategy.

Consultation Report

- A consultation report was completed in November 2018 by external consultants.



Figure 6:
Strategy Development Stages



Appendix 5 – Strategy Decisions

Strategy Decisions

Economic and Societal Logic – What is Ireland’s Economic and Societal Logic for Space Investment?

Ireland’s engagement with space is driven by strong economic and societal logic. A 2015 Technopolis evaluation estimated a 3:1 direct return on Irish investment in ESA. Ireland’s investment also supports talent development for future-oriented high value jobs in both space and non-space domains. In addition, engagement with space offers governments an opportunity to better tackle societal and global challenges such as global warming.

Differentiators – How Will Ireland Differentiate from International Competitors?

Ireland’s core focus is on developing a space-active industry that is economically sustainable. To achieve this, Irish researchers and industry must either demonstrate a distinct capability to exchange knowledge and skills between space and non-space domains, or demonstrate the capability to develop innovative technologies for the quickly expanding commercial space market.

Arenas – Which Markets will Ireland Support Irish Enterprise to Target?

As the space industry rapidly transitions from being a largely Government driven sector to being increasingly commercially driven, it is difficult to predict which technologies and markets will emerge as dominant. Therefore, Ireland will continue to use our investment in ESA as a platform for technology development and innovation, supporting enterprises across technology domains and applications, in both upstream and downstream segments, with economic sustainability being the core consideration.

Vehicles – What Tools and Initiatives Will Be Implemented?

Current and new initiatives will be mobilised to enable the National Space Strategy for Enterprise. These initiatives will drive awareness, improve coordination across government for space, support an appropriate business environment for space and facilitate the development of a space capable future workforce.

Staging – In what Sequence Will the Strategy Be Implemented?

The key stages of the strategy will be carried out in 2019 when the core initiatives will be developed and put in place. The interim stages will be crucial for measuring the impact of these initiatives to enable a decisive review of the strategy in 2025. This review will determine key changes required to advance Ireland’s success in space, including consideration of a renewed governance structure.

Figure 7: Space Strategy for Enterprise Elements



Appendix 6 – Steering Group

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