

# THE WHITE PAPER PROJECT

*Scottish Space Agency*

*— A discussion on Scotland's place  
in the space industry*

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**COMMON WEAL POLICY**



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# Executive Summary

This report examines the condition of the Scottish Space Industry in a UK and global context, and from its current strong standpoint it looks into its options available in becoming an international leader in a fast and vastly growing industry.

## Key Points

- Scotland should develop a **Scottish Space Agency** to drive the Scottish space industry in the right direction
- Scotland needs to invest in the Scottish space infrastructure by developing a **Scottish Spaceport**, the first in the European Union before such infrastructure and jobs are developed elsewhere
- **18%** of all employees in the UK space industry are based in Scotland (7,000 jobs)
- UK labour productivity in the space sector is **2.7** times higher than the UK average, with Gross Value Added at £133,233 per employee
- The space sector currently provides **£134m** net value to the Scottish economy
- Investment in Research & Development as a percentage of total income has decreased sharply, from **90%** in 2012/13 to **3%** in 2014/15
- The **Brexit** and **Scottish independence** transitions may cause problems, but it is difficult to identify the exact nature of these problems until negotiations are completed
- **Cooperation** is vital to keep the Scottish space industry healthy, working with the ESA, UKSA and many other space industries
- **Glasgow** has recently sold the largest number of satellites out of all European cities
- To further enhance the Scottish nanosatellite market, the Scottish Space Agency should look to develop a **Federated Satellite System**

# Introduction

Scotland sits on a bedrock of a rich history in engineering, technology and innovation. As new industries have come and gone, Scotland continues to be a strong player not only within the UK, but across the globe. The space industry is fast approaching and Scotland has the opportunity to custom build its position within it.

Scotland has already shown itself as a global leader in nanosatellite technology, and it needs to be prepared to mirror this success across all disciplines of the space sector. There is plenty of potential for growth in the Scottish space industry, and having an ambitious growth target will help meet this potential.

Scotland needs a single voice to coordinate and direct Scotland's ambitions in a progressive, comprehensive way. The space cargo industry has advanced from the general view of three-stage vertical rockets, to rocket-planes with propulsion systems that operate in the horizontal plane on conventional runways.

Scotland is not able to run its own dedicated Scottish Space Agency as space comes under a dual jurisdiction of Civil and Defence, which is not devolved to the Scottish Parliament. Although many of the proposals in this report can be taken forward in a UK context, Scotland would be better served with a dedicated and bespoke space agency to fight for the needs of its own industry. The preparation for this must be in place for continuity of success, so that after independence, Scotland can be prepared to efficiently create this new and growing industry.

The objectives of this paper is to identify Scotland's place in the UK/European space industry, detailing strengths such as Scotland's success in the small satellite industry, weaknesses like its lack of infrastructure, and to start the discussion on how we overcome them, such as creating a Scottish Space Industry and building a dedicated spaceport. The report discusses how best to provide successful delivery as the industry becomes increasingly commercialised.

## Scotland's place in the UK

### Total Income

The global space industry turnover is estimated to be valued around £210 billion. The UK accounts for £13.7 billion in 2014/15, growing 6.5% in one year. UK exports stand at £5 billion. The growth plan is to raise the turnover to £40 billion.<sup>1</sup>

The calculated Gross Value Added (GVA) per employee stands at £133,233. This means that labour productivity sits at 2.7 times higher than the UK's average productivity in 2014.

According to the London Economics' paper *Development of the Scottish space Industry*,<sup>2</sup> The space industry is currently divided into four groups, making up the following total income;

- Space Applications (78%),
- Space Operations (12%),
- Space Manufacturing (8%),
- Ancillary Services (2%).

It should be noted however, that Space Applications are largely driven by direct-to-home broadcasting, totalling £7.1 billion.

Scotland is stronger than the UK in some areas;

- Space Applications (44%),
- Space Operations (33%),
- Space Manufacturing (23%),
- Ancillary Services (0%).

### Employment

The regional employment of the space industry across the UK over the 2014/15 period was;

- London - 26%
- South East - 23%
- Scotland - 18%
- Other - 33%

This accounts for 38,500 people employed in the UK. There is 104 public and private companies in Scotland currently providing net £134 million to the Scottish economy. Scotland clearly has a strong place within the UK space industry in terms of employment and enterprise.<sup>3</sup>

### Spaceport

A spaceport has been discussed since it was announced by the UK Government in April 2014, and a list of candidates were drawn up with the expectation of one dedicated spaceport for the UK, the first of its kind in the EU. A shortlist was created and narrowed to six suitable candidates, four of which were located in Scotland;

- Glasgow Prestwick Airport,
- Newquay Cornwall Airport,
- Campbeltown Airport,
- Llanbedr Airport,
- Stornoway Airport,
- RAF Leuchars.

RAF Leuchars was eventually ruled out due to its military significance but it could be reconsidered if Scotland became an independent country. Glasgow Prestwick Airport was announced as the Scottish Government's preferred bid. The UK Government have since decided that it would afford all candidates the opportunity to become a spaceport with £10 million of funds available to each.<sup>4</sup>

### Education

The University of Strathclyde, Heriot-Watt University and the University of Edinburgh, sit 9th, 11th and 14th respectively in the UK league table of universities in Electronic & Electrical Engineering and St Andrews University, University of Edinburgh and the University of Strathclyde currently sit 2nd, 13th and

16th respectively in Physics and Astronomy, according to the independent Complete University Guide 2018.<sup>5</sup> These universities are providing strong academic support to the space industry, each with their own postgraduate courses involved in space engineering.

Scotland has the presence of higher education and research institutions, with a wealth of universities and infrastructure. This provides a knowledge base with further career growth in areas local to the universities. Glasgow has already shown itself to be a significant player in the small satellite industry.

## Research & Development (R&D)

The UK space industry currently receives £415 million in R&D expenditure in 2014/15 from private and public investment, which amounts to 3% of total income (previously 90% in 2012/13) of the space industry to the UK.

The UK's Space Innovation and Growth (IGS) Action Plan from 2010 defines a target for the UK space economy to capture 10% of the global market by 2030, which has been estimated to equate to £40bn of economic activity. The Space IGS also includes an interim target in 2020 of 8% of the global market, estimated to amount to £19 billion.<sup>6</sup>

# Scotland's Weaknesses

## Infrastructure

Scotland may have a strong 'small satellite' industry but it needs to have the infrastructure and investment in place to effectively compete against 'copy-cat' satellites, satellites that are as technologically competitive as the satellites we are currently producing but without bespoke design. With a decrease in R&D funding as a percentage of income, there is lack of investment and public funds to compliment an already strong and growing industry.

There is already a high cost to launching satellites into geostationary orbit. Without the infrastructure in close proximity, small satellites currently need to 'piggy-back' off of larger satellites, this can cause issues with difficulties in orbital transfer and scheduling, meaning that smaller satellites are secondary to the main satellite, which can delay the launch times for satellites, causing financial stress to the small satellite clients as they wait for their product to reach low earth orbit.<sup>7</sup>

## Manufacturing

Manufacturing in the space industry is broken down into five groups;

- Tier 1 – The design and assembly of spacecraft sub-systems,
- Tier 2 – Integration of major sub-systems and may include procurement,
- Tier 3 and 4 – Producing Electrical, electronic &

electromechanical components,

- Primes – The assembly, launching and infrastructure of space products,
- Other suppliers – Off-the-shelf raw material components and software.

Although Scotland does have a working economy within all of these tiers, there are very little original equipment manufacturers to help drive the industry. Scotland has a strong space manufacturing sector in the context of the UK (see section 2.1), yet it is lagging behind on a global scale, as global manufacturing makes up 33% of the total income.

## Support

With the lack of a physical Scottish Space Agency, Scotland is unable to deliver bespoke assistance. There is minimal government funding towards space-specific incubation support within the private and education sectors, meaning technology advancements are restricted and delayed.

There is not enough support for Small and Medium Enterprises (SME) in Scotland, with a weak supply chain to the space industry. There is a lack of supply to first tier and prime companies (see section 3.2) and weak performance from the supply chain. The Space Innovation and Growth Strategy: 2014-2030 Space Growth Action Plan has identified that there is not enough support to connect SME's in Scotland, although there are organisations that each support SME's in certain areas, there is a lack of full connectivity and direction.<sup>8</sup>

## Applications

The space applications industry is broken down into three groups;

- Type 1 – Space signalling and monitoring companies including Earth Observation imagery
- Type 2 – Satellite communication, navigation and direct-to-home services which provide access to space signals. This includes services such as Sky and Virgin
- Type 3 – Companies that manufacture access equipment to space signals

Scotland does have companies that work on all three types, however there is a lack of direction and coordination between each type to more efficiently run the space industry. The UK Space Agency doesn't constructively work with companies from each type to identify any industry specific issues. Although the work currently undertaken by the Scottish Centre of Excellence in Space Applications and Space Network Scotland is helping the industry, they have relatively recent launches providing small scale support, such as improving connections and opportunities with major customers.

## Impact of Brexit

The European Space Agency (ESA) is independent from the European Union, but it does receive investment from the EU. The effects of Brexit may not directly affect the relationship between the UK space agency and the ESA, but there could be indirect implications.<sup>9</sup>

Galileo and Copernicus, a global navigation satellite system and the world's largest earth observation programme — are designed by the ESA but are being built with EU funds. This money may have to be funnelled through member states of the single market only. The UK currently receives 15% of inward investment from the European space budget, however the contributions from the UK account for just 12%.<sup>10</sup>

It should be noted that the impact of Brexit are entirely dependent on the UK Government's negotiations with the 27 members of the EU, and thus the effects on the space industry may vary.

### Transition to Independence

As space is defined under a dual jurisdiction of Civil and Defence, Scotland is currently unable to create a space agency independent of the UK space agency, as these areas are not devolved to the Scottish Parliament. This leaves Scotland the options of trying to devolve Defence or discussing the separation between Defence and Aerospace. This would need to be granted by the UK Parliament and would be unlikely to be successful. Scotland as an independent nation would have full control over Civil and Defence, thus full control over the Aerospace industry.

Upon the move toward Scotland becoming an independent nation, membership of the Single Market would be the point in which a Scottish Space Agency and the ESA would cooperate on EU funded projects. The effects of becoming independent and Scotland's relationship to the Single Market over time will become clearer. (For further reading, see *Impact Assessment of Scottish Independence on the Space Sector*.)<sup>11</sup>

## Future for Scotland

### Creating a Scottish Space Agency

To create a long term economic, social and environmentally friendly Scottish space industry, there needs to be a sense of direction and guidance to steer the industry. To do this it is proposed that Scotland follows the UK in creating a Scottish Space Agency to provide this support. However there are more radical ideas that Scotland can consider with an industry in its infancy. This includes the creation and public ownership of a Scottish Spaceport and coordination with the industry to create a federated satellite system to provide efficiency to an already successful sector.

The Scottish Space Agency needs to be driven by the right people. It would be best served for a board to include representatives from the Scottish universities and government officials with experience in space, technology and engineering. This is to drive R&D in the right direction and to also provide cross-sector collaboration to identify what areas look set to have further growth.

A Scottish Space Agency can also draw on current support from the ESA's Integrated Applications Promotion Ambassador Platform for Offshore Energy, The Alba Innovation Centre

and the Scottish Investment Bank. Business incubation is also provided by the Higgs Centre for Innovation.

Scotland does already receive support from organisations such as the Scottish Centre of Excellence in Space Applications and the Space Network Scotland, but without the physical and guiding presence of a Scottish Space Agency it would not be possible to provide the same level of efficiency as major customers/funders do, such as NASA and the ESA.

The Scottish Government needs to create a coordinated roadmap within the Scottish Space Agency to identify what areas of the Scottish space industry require investment. It should detail what internal sectors are best served from government investment, tax levies and public drives to spur private investment, and once this roadmap has been identified, the Scottish Government will need to work towards implementing the recommendations.

### Developing a Scottish Spaceport

A spaceport is a very valuable tool in a country's space industry infrastructure, as it provides support to local industry, decreasing the need to send space assets to launch sites across the world. The UK Space Agency has already identified the need for one in the House of Commons' Science and Technology Committees third report on *Satellites and Space*,<sup>12</sup> although it has suggested that all viable candidates can become a spaceport, which can saturate the infrastructure across the UK.

A dedicated spaceport would build a strong local space economy, where it can then send secondary launching services to other spaceports. This depends on the feasibility of having additional launching sites.

The initial construction of the spaceport would support activity to the supply of goods and services, which would then follow through to the operation. The logistical benefits would need to weigh in on the selection of a dedicated spaceport.

There would be a direct effect on the local economy upon creation of the Scottish spaceport, through the creation of employment and Gross Value-Added. There would also require to be services provided for sub-orbital commercial spaceflight and satellite launch servicing, which each would produce employment.

An induced effect on the local economy would come from the disposable income from employees spending their money which supports local businesses.

With the success of the industry, there may be an increase in tourism to the area, as space enthusiasts visit the spaceport and possibly spend money on tourist attractions that could be built up. This would mirror existing tourist attractions within NASA bases in the United States of America.<sup>13</sup>

The presence of a spaceport and the access to space can spur an increase in research & development.<sup>14</sup> This could see a similar effect within the education sector, with more focus on aerospace engineering. To boost Scotland's reputation as a effective carbon emissions reducer it is suggested that we identify green areas to funnel research & development, this may include the Federated Satellite System discussed below (Section 4.5).

London Economics' calculations for the total estimated benefits to a local economy of a spaceport are as follows:

Activity	Economic activity		Employment	
	£5m - £8m	£60m - £90m	30 - 50	400 - 450
Operations	<£1m	£3m - £5m	5 - 15	90 - 110
Tourism	<£0.1m	<£0.5m	<1	<5
<b>Total</b>	<b>£5m - £9m</b>	<b>£60m - £100m</b>	<b>35 - 65</b>	<b>490 - 550</b>

Foreign Direct Investment (FDI) may also supply funding to 'visitor centres, R&D facilities; a bespoke hangar space and maintenance; shops and restaurants within terminal facilities; and a conference centre for events.' It is also suggested that FDI is coupled with public investment rather than relying on a single investment plan.

Once the industry is successfully up and running, the Scottish Space Agency should produce a yearly review of the global competitiveness of Scotland's space industry, working closely with a National Scottish Regulator to efficiently allocate geo-orbital slots.

## Cooperation

Cooperation is one of the key pillars of success to a world leading space sector. It would be highly beneficial to the Scottish space industry to hold close ties with the UK Space agency which would help maintain national relations between the two countries.

Greater contribution to the ESA would further implement Scotland's place in the industry and maintain close relations with the rest of Europe. This would include a detailed plan for further ESA integration and cooperation by the Scottish Space Agency. This includes a contribution to the European Space Engagement Plan.

Cooperation with ESA, UKSA and private space companies within Scotland could ensure provision for company development and security of assets across borders, including ensuring government intervention (up to and including ownership) if a company with significant strategic national benefit fails. This would spur investor confidence in the Scottish space industry.

The Scottish Space Agency would push focus on space into our universities, there needs to be financial support and cooperation for a cross disciplinary Space Doctoral Training Centre that will support PhD Students that are moving into the Space sector to build relevant specialist and business skills that are needed in both the upstream and down-stream space sectors.

To further encourage skills and leadership within our school system, there should be a national schools challenge to engage school children, this will encourage children to pursue a career in the space sector and it will also provide the communication skills to graduates within the space industry that are looking to enhance their career progression development.

The Scottish Space Agency should work with clients with space assets and manufacturers to provide a strategic growth strategy to develop an export group and a promotion plan. This includes identifying possible new overseas partnerships in fast-growing 'hot-spots' to help trade and investment.<sup>15</sup>

Academia and the Scottish Space Agency should be looking to create efficiency throughout the industry and running demonstrator projects and feasibility studies to prove new and high risk technologies. High risk technologies, with a focus on game-changing technologies to allow Scotland to establish leadership. This includes pioneering the development of high risk technologies and materials that would otherwise be commercially unviable.

The *Space Innovation and Growth Strategy 2014-2030: Space Growth Action Plan* has provided five recommendations which could be just as relevant in terms of the Scottish space industry.

## Satellites Applications

To increase the number of SMEs in Scotland, the Scottish Space Agency should be responsible for running a Manufacturing and Service Supply Challenge, this would target the supply chains in Scotland and enhance the supply to Tier 1 and Prime companies. It should highlight the opportunities for suppliers and improve supplier performance.

A single point of contact will be established with the Scottish Space Agency that provides national space skills. This will increase support to SMEs business and specialist skills training for their staff. This allows one stop information about training providers to staff allowing them to succeed and grow their businesses.<sup>16</sup>

The National Space Technology Programme has set out additional projects that may be mirrored in Scotland.<sup>17</sup>

## Federated Satellite Systems

Although Scotland is already a market leader in nanosatellite technology there is always areas that we can improve on. Staying ahead of technology trends is a great way to increase efficiency and having an innovative marketplace.

Federated approaches are already revolutionising industries such as smart grid technology and cloud computing. It is proposed that the Scottish Space Agency works with private enterprise to create a Federated Satellite System (FSS).

FSS is an approach where satellite systems are designed to collaborate within a constellation to maximise utilization efficiency of space assets. This allows a group of satellites that are interlinked to provide missions for the client, providing a service that is potentially traded between spacecraft for resource utilization. The sustainability, reliability, cost efficiency and mitigation of demand uncertainty can all be increased when satellites are capable of communicating amongst themselves.

Environmentally this is a benefit as it decreases the need for more satellites to potentially be launched, which also decreases the space clutter within low earth orbit of existing dead or live satellites and space junk.<sup>18</sup>



The technology has yet to be fully developed to provide this service, however it would be in the Scottish Space Agency's interest to invest in the 'network of networks' so that Scotland can remain competitive and become leading service providers. Prof. A Golkar's recent study illustrates the effectiveness of FSS and has detailed some issues the technology currently faces.<sup>19</sup>

## Conclusion

An independent Scotland must aspire to build a space sector that is capable of leading the way in innovative ideas. Providing a platform for the experts in the space sector to lead Scotland's industry is the best option, as long as we invest efficiently.

Scotland is already successful in its fight against climate change, and an eco-centric space industry can bolster Scotland's reputation as a world leader in reducing carbon emissions. R&D that focuses on increasing the efficiency of spaceflight propulsion systems, and trying to move towards carbon neutral technologies are important aspects of this. This cannot happen without structures in place to guide the industry in that direction.

A Scottish Space Agency is a vital part of a successful space industry, but it needs to have a more hands on approach than the UK Space Agency; a more direct focus on building an environment for the private and public spheres to thrive. I have previously discussed the support already received from the Scottish Centre of Excellence in Space Applications and the Space Network Scotland, and they should be given the platform to continue that success.

The Scottish Spaceport is a major tool in developing space infrastructure. The construction alone provides a benefit to local economies, but also being the only country in Europe to have such infrastructure will build the success of the industry, as well as strengthening national relationships.

The space industry is likely to increase exponentially over the years to come, and the earlier Scotland harnesses the industry and provides the right infrastructure so that the growth can be as efficient as possible, the more successful it can be. Scotland is already an outward looking country, and it has the potential to be a vital component of the global space industry.

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