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Defence Committee

Defence Space: through adversity to the stars?

Third Report of Session 2022–23

Report, together with formal minutes relating to the report

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Summary

The space domain is essential to Defence in the Information Age. Satellites deliver systems which underpin modern warfare including secure communications; intelligence, surveillance and reconnaissance; and position, navigation and timing services.

With this reliance comes risk. Space systems are under threat of deliberate attack from our adversaries and accidental damage from collisions in an ever-more contested and congested space environment. Establishing agreed norms for responsible behaviours in space should be a priority for the international community and the UK must continue to play a leading role in taking this forward.

Cross-Whitehall governance on space lacks coherence. As a result, progress on crucial Government-wide programmes such as the development of new position, navigation and timing capabilities has been unacceptably delayed. Stronger, more central leadership is required: a Minister for Space should be appointed within the Cabinet Office to drive forward implementation of the vision set out in the National and Defence Space Strategies.

The Government will need to address skills and recruitment challenges in the broader space sector as well as tackling those issues specific to Defence. Work to establish a Space Academy and ensure space literacy is embedded across Defence must be taken forward at pace.

The vastness of the space domain means that close collaboration with Allies and partnerships with the commercial sector are essential if the Government's defence space ambitions are to be realised. In further developing these relationships the Ministry of Defence will need to make crucial decisions about where the UK should retain sovereignty. These decisions must be made transparently and be open to Parliamentary scrutiny.

The MoD plays a vital role as an anchor customer for the UK's defence space sector. Its funding of new capabilities will shape the industrial base in the coming years. The Department must ensure that it maximises opportunities for this investment to contribute to a sustainable and thriving UK space sector.

The rapid pace of technological advances in the space sector offers opportunities for innovation but also presents additional challenges for an MoD procurement machine which has repeatedly failed to deliver major projects on time and to budget. The Department must swiftly publish, and regularly report against, clear milestones and timescales for development of its defence space programmes so that progress can be closely monitored. Recent failures must not be repeated.

1 Context

1. Space plays an essential role in modern life. Government, business, and the public rely on satellites for services as diverse as smartphones, traffic control, weather forecasting, and banking. The cost of a potential disruption to Global Navigation Satellite Systems (GNSS) has been estimated at approximately £1 billion per day,[1] and space is recognised as an element of the UK's Critical National Infrastructure.[2]

Satellites: an overview

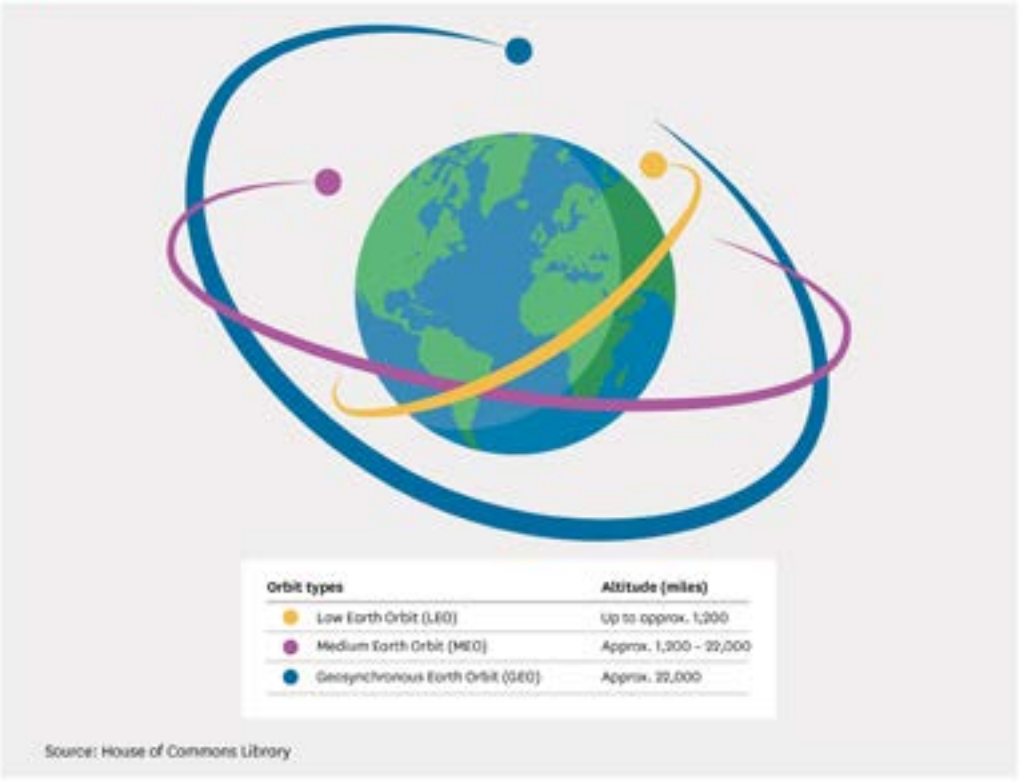
2. The number of satellites has increased dramatically in recent years. While space was once the domain of a handful of state actors, advances in technology have reduced the cost of developing and launching satellites and have made the sector increasingly commercial. The most recent figures from the European Space Agency (ESA) estimate that there are approximately 6,600 functioning satellites in space,[3] a number which is expected to grow by an order of magnitude as new "mega-constellations", such as SpaceX's Starlink communications network, come online.

Satellite orbits

3. Satellites are positioned in different orbits depending on their intended use. Low Earth Orbit (LEO) is the closest to the earth's surface: satellites in this orbit take only 90–120 minutes to complete a circuit of the Earth, making them well-suited for intelligence, surveillance and reconnaissance purposes. Satellites in the more distant Geosynchronous orbit (GEO) move at a speed which matches that of the Earth and can therefore provide continual coverage of a broad area of its surface: the UK's Skynet military communications satellites operate in GEO. Finally, satellites in Medium Earth Orbit (MEO) cover a wider area than those in LEO but with shorter transmission times than GEO. This orbit is used by Global Navigation Satellite Systems such as GPS.[4]

1 Government Office for Science, *Satellite-derived Time and Position: A Study of Critical Dependencies* (2018), p7
2 Centre for the Protection of National Infrastructure, Critical National Infrastructure, accessed 4 October 2022
3 European Space Agency, Space debris by the numbers, accessed 26 September 2022
4 GEO, MEO and LEO are the most common satellite orbits. Other orbits include Polar Orbit, Sun-synchronous Orbit and Graveyard Orbit, where satellites in GEO may be relocated once they come to the end of their operational life.

Typical satellite orbits



Defence Space

4. Space has come to play an increasingly important role in Defence. Many of the systems intrinsic to modern defence capabilities rely heavily on satellites—for example secure communications; intelligence, surveillance and reconnaissance (ISR); and position, navigation and timing (PNT) services.

5. 2021's Integrated Review of Security, Defence, Development and Foreign Policy, *Global Britain in a Competitive Age,* recognised space as a military domain in its own right,[5] and the subsequent Defence Command Paper, *Defence in a Competitive Age*, noted that

> Space, and our assured access to it, is fundamental to military operations. Loss of, or disruption to, the space domain could severely impact our ability to undertake most Defence tasks, and have a catastrophic effect on civilian, commercial and economic activity.[6]

The Defence Command Paper committed £1.4 billion to the development of new defence space capabilities.[7]

6. Recent organisational changes within Defence have also reflected the increased focus on space in the military context. A Space Directorate has been established within the MoD,

5 HM Government, The Integrated Review of Security, Defence, Development and Foreign Policy: Global Britain in a Competitive Age, Cm 403, March 2021
6 Ministry of Defence, Defence in a Competitive Age, Cm 411, March 2021, p44
7 ibid

responsible for Defence Space policy, strategy and cross-government and international coordination.[8] At the operational level, a new Joint Command, Space Command, was established in April 2021 and declared Initial Operating Capability in April 2022.[9]

Box 1: UK Space Command

Space Command is a Joint Command staffed from the Royal Navy, British Army and Royal Air Force, the Civil Service and key members of the commercial sector. It brings together 3 functions under a single 2-Star military commander: space operations; space workforce training and growth; and space capability (developing and delivering space equipment programmes). Once fully operational, it will provide command and control of all of Defence's space capabilities, including UK Space Operations Centre (SpOC), SKYNET Satellite Communications, RAF Fylingdales, and other enabling capabilities.[10]

Source: Ministry of Defence, UK Space Command, accessed 4 October 2022

Our inquiry

7. It was against this background that we decided to inquire into the role of space within Defence. We published terms of reference in May 2021 and invited written submissions of evidence. We subsequently held four oral evidence sessions. The first was with Dr Mark Hilborne, Lecturer in Defence Studies at King's College London, and Dr Mark Presley, Director and Space Policy and Strategy Analyst at MAP Analytica. In the second session we heard from Nick Shave and Nik Smith representing the trade body UKspace; Anita Bernie, Strategy and Execution lead at KISPE Space Systems Ltd; and Richard Franklin, Managing Director, Airbus Defence and Space UK. Our third session was with former British ESA astronaut Major Tim Peake and Justin T. Johnson, formerly performing the duties of Assistant Secretary of Defense for Space Policy in the United States Department of Defense. In our final session we took evidence from the Minister for the Armed Forces, James Heappey MP, and the MoD's Director Space, Air Vice-Marshal Harvey Smyth, alongside the then Minister for Science, Research and Innovation, George Freeman MP, and Rebecca Evernden, Director for Space at the Department for Business, Energy and Industrial Strategy (DBEIS). In addition, we received 29 submissions of written evidence. We are grateful to everyone who offered their time and expertise to assist us, and we thank Alexandra Stickings in particular for her work as Specialist Advisor to the inquiry.[11]

8 Ministry of Defence, UK Space Command, accessed 4 October 2022

9 UK Space Command marks one-year anniversary, Ministry of Defence press release, 1 April 2022

10 Other countries have integrated military space in different ways. For example, the US has a Space Command and also a Space Force, a separate branch of the Armed Services. France has a Space Command and has renamed its Air Force to the Air and Space Force. China has created a Strategic Support Force, which includes cyber and information alongside space.

11 As a Specialist Advisor, Alexandra Stickings declared her interests, which can be found in the Committee's formal minutes.

2 The UK Space Sector: Strategy and Governance

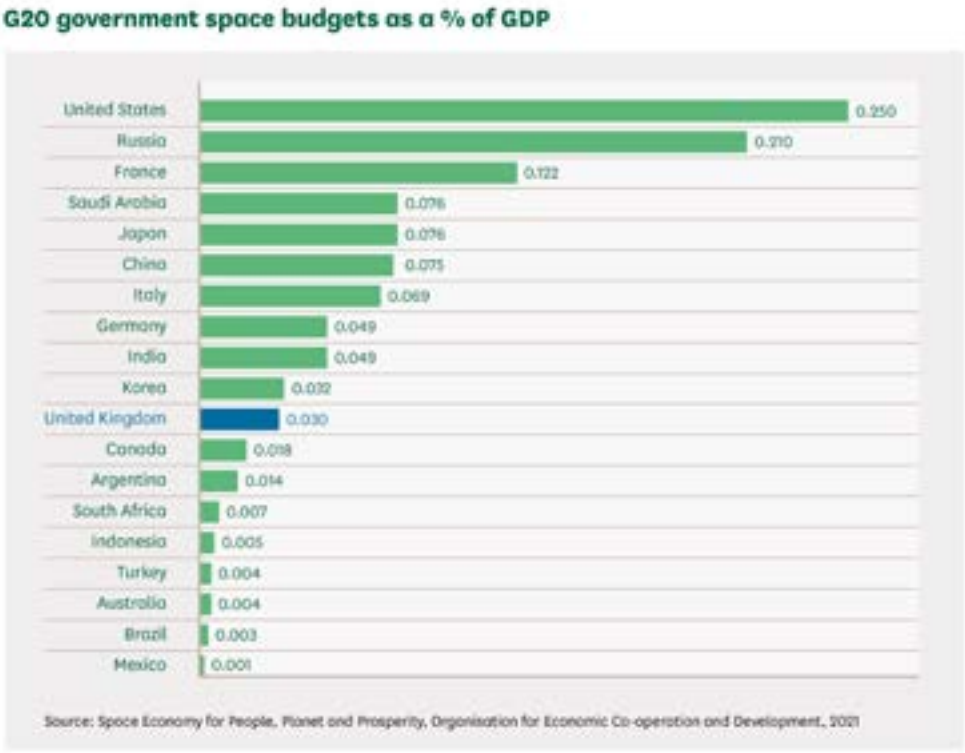
The UK space sector

8. In a reflection of the global shift towards an increased commercialisation of space, the UK space sector has grown rapidly in recent years. It makes an important contribution to the economy, producing £16.5 billion in 2019/20. 83% of this income relates to consumer and business transactions, with the remainder being accounted for by the public sector, including £1.4 billion (9%) by Defence.[12] The National Space Strategy, published during the course of our inquiry, set out a vision to build "one of the most innovative and attractive space economies in the world".[13]

9. Particular strengths lie in small satellites and telecommunications, and UK companies are also taking a lead in new and emerging technologies such as satellite quantum key distribution.[14] Nik Smith of trade body UKspace characterised it as "a strong sector" with "a very high level of productivity" and "huge potential."[15] Industry witnesses were keen to point out the economic benefits of investment in the sector, with Richard Franklin, Managing Director of Airbus Defence and Space UK, arguing that there was a "force multiplier" on every pound spent on space.[16]

10. The UK does not, however, compare favourably with peer nations in terms of spending. Figures from the Organisation for Economic Co-operation and Development place the UK within the bottom half of G20 nations when it comes to spending on space as a percentage of GDP:

12 UK Space Agency, Size and Health of the UK Space Industry 2021, April 2022, Pp4–5
13 HM Government, National Space Strategy, September 2021, p6
14 UK company to start sending secret quantum keys with satellites in 2023, Space.com, 23 June 2021
15 Q44
16 Q125



11.

12. Our witnesses were clear that the UK is some way from being considered a "top tier" space power. Nick Shave of UKspace ranked the UK as tier three, behind Russia, China and the US at tier one, and France, Germany, Japan and perhaps Italy in tier two.[17] Justin T. Johnson also placed the UK in tier three and highlighted the investment that France in particular had made in its space sector.[18]

National Space Strategy

13. In the December 2019 Queen's Speech, the Government set out its intention to create a new Cabinet-level National Space Council, which it said would "help put space at the heart of Government policy and help us deliver a UK Space Strategy."[19]

14. The National Space Strategy (NSS) was published almost two years later, on 27th September 2021. In a joint foreword, the Secretaries of State for Defence and for Business, Energy and Industrial Strategy said that the Strategy:

> sets out our vision and ambition for the UK space sector. It sets out how we will build one of the most innovative and attractive space economies in the world, creating the right conditions for space businesses to start, grow, innovate, and thrive, while giving them the confidence to do so. We will demonstrate leadership internationally, ensuring that space remains safe and sustainable as we enter the next exciting phase of exploration, and we will take steps to ensure that we can protect and defend the UK. The Prime

17 Q48
18 Qq182–3
19 Prime Minister's Office, The Queen's Speech 2019 - background briefing notes, 19 December 2019, p108

> Minister has called for the UK to become a meaningful actor in space, and for the first time this strategy brings together our civil and defence activities into one integrated approach to achieve this ambition.[20]

15. Witnesses criticised the delay in publication of the NSS. In written evidence received before the Strategy's publication, industry consortium Athena told us that industry development

> is being severely restricted by continual delays in the publication of the National Space Strategy and progress of national capability programmes. Companies are reluctant to invest and take strategic decisions without guidance from the Government as to the specific areas of priority.[21]

16. The long-awaited Strategy was also considered by some to be lacking in substance. Juliana Suess, Policy Lead on Space Security at the Royal United Services Institute, described it as "simply too vague, with specific details and tangible action plans few and far between."[22] Major Tim Peake said that it had "great ambition," but cautioned that

> What we now need to see is the operational delivery of that space strategy, more clarity on how we achieve it, and an incremental approach in ensuring that we hit the benchmarks at the right time to keep on track.[23]

Defence Space Strategy

17. Detail on specific defence programmes and capabilities was subsequently provided in a separate Defence Space Strategy (DSS) published on 1 February 2022.[24] Again, it had been subject to significant delay: a headline summary of its themes was first published in 2018 with an expectation that the full strategy would be published later that year.[25]

18. The Defence Space Strategy built on the principles and ambition set out in the National Space Strategy and provided details of the defence programmes that would be funded over the next ten years using the £1.4 billion allocated to new space technologies in the Defence Command Paper, as shown in the table below:

Table 1: New defence space investment

Capability	Budget
Intelligence, Surveillance and Reconnaissance (ISR)	£970 million
Space Control	£145 million
Space Command and Control	£135 million
Space Domain Awareness	£85 million
Secure Satellite Communication (on top of existing c. £5 billion funding for core Skynet programme)	£60 million

Source: Defence Space Strategy

20 HM Government, National Space Strategy, September 2021, p3
21 Athena (SPDF0002) para 20
22 Juliana Suess, Royal United Services Institute, The UK's First National Space Strategy, accessed 4 October 2022
23 Q149
24 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022
25 UK poised for take-off on ambitious Defence Space Strategy with personnel boost, Ministry of Defence press release, 21 May 2018

19. Notwithstanding the delays in its publication, the DSS was generally well received. UKspace said that it "demonstrates clear intent from the Ministry of Defence to develop and ensure access to new capability,"[26] whilst Gabriel Elefteriu, Head of Space Policy at Policy Exchange described it as a "focused, strategic and credible document."[27]

20. Gabriel Elefteriu did, however, go on to note that "the main challenge with this strategy is delivery"[28] and he was not alone in questioning the MoD's ability to deliver on the ambitions of the DSS. Douglas Barrie, Senior Fellow for Military Aerospace at the International Institute for Strategic Studies noted that space "has been a domain where in the past the UK has over-promised and under-achieved" and concluded that "[t]he defence strategy has, for the most part, clear goals; the main challenge now is meeting them."[29] Space Forge felt that "[n]ow what is needed is the granular detail of an implementation plan and sustained engagement with industry".[30]

Governance

21. Responsibility for space strategy, policy and delivery is spread across Whitehall. Overall responsibility for co-ordinating civil space policy rests with the Department for Business, Energy and Industrial Strategy (DBEIS). However, the National Space Strategy lists ten "principal" Government Departments and agencies with responsibility for its delivery, including Defra, the Cabinet Office, the Foreign, Commonwealth and Development Office and the MoD.[31] Major Tim Peake felt that the delay in publication of the NSS "highlighted some of the difficulties in trying to get consensus across so many different areas of Government."[32]

22. Some steps had already been taken to improve space governance both across Whitehall and within the MoD. The National Space Council, chaired by the Prime Minister, was established as a Cabinet Committee in June 2020 with the task of co-ordinating overall Government policy on space.[33] Within the MoD, a Space Directorate was created, responsible for Defence Space policy, strategy, and cross-government and international coordination.[34]

23. Evidence acknowledged that these developments reflected promising attempts to bring a more coherent approach to space policy but highlighted that they had not been a panacea and that problems remained. CGI said that the new governance demonstrated "good intent" but that "evidence of a joined-up, coherent, agile and decisive approach remains elusive" and that it "appears to have introduced or inherited systemic inertia inhibiting the pace and tempo needed to be competitive."[35] UKspace reported that "there is still a perception that there are two main agendas between the MoD and non-MoD…

26 UKspace welcomes publication of UK Defence Space Strategy, UKspace, accessed 4 October 2022
27 Gabriel Elefteriu, Policy Exchange, UK's Defence Space Strategy in Context, p5
28 Ibid. p15
29 Douglas Barrie, International Institute for Strategic Studies, UK Defence Space Strategy's orbital ambitions, accessed 4 October 2022
30 Space Forge Ltd (SPDF0024) para 3.4
31 HM Government, National Space Strategy, September 2021, p48
32 Q149
33 UKspace welcomes addition of National Space Council to Cabinet Committees, UKspace, accessed 4 October 2022.
34 Ministry of Defence, UK Space Command, accessed 4 October 2022
35 CGI (SPDF0015) para 9

which could lead to divergence in the UK space strategic intent and capability."[36] Similarly, Dr Mark Presley described the relationship between Government Departments as "still… quite fractured."[37] Space Forge said that recent changes had been "valuable and welcome… engagement with government and the MoD has become much easier" but still felt that the departments and agencies involved with the space sector each had "their own teams, agendas, and understanding", calling for a "joined up approach across government."[38]

24. In September 2022 the National Space Council was removed from the updated list of Cabinet Committees published by the Government.[39] It is unclear what new governance arrangements will take its place. It has also come to light in the latter stages of our inquiry that the MoD's Space Directorate is unlikely to continue in its current form.[40] Both of these developments raise concerns that efforts to improve co-ordination and oversight of space policy and delivery across Government have gone backwards at a time when they should instead be redoubled.

A Minister for Space

25. UKspace told us that they advocated for a Minister for Space, ideally located within the Cabinet Office, to provide central leadership on space, and cited the example of Japan, which has a Minister of State for Space Policy.[41] Athena also argued for a Minister for Space,[42] as did Major Tim Peake, who told the Committee that as well as helping to co-ordinate space activity across Whitehall, it would also send a "very strong message" to industry, academia, the scientific community and international partners.[43]

26. The Minister for Science was lukewarm on this suggestion, telling us that

> Nothing is ever perfect in Whitehall, but I think we're able to achieve a lot. We've set out a lot of things that we have to deliver now. I think that must be the focus.[44]

27. **Recent years have seen welcome, if only partially successful, attempts to bring more coherence to space activity both across Whitehall and within the Ministry of Defence. The creation of the National Space Council and the MoD's Space Directorate were recognised by witnesses as being positive developments in this regard. As we came to the end of our inquiry, we were therefore both surprised and concerned to note that the Government has removed the National Space Council from the list of Cabinet Committees, and that the Space Directorate looks set to be disbanded. *In its response to this report the Department must provide an explanation for these changes. It should set out what new governance arrangements have been put in place and why it believes they will be more effective at swiftly implementing the vision set out in the National and Defence Space Strategies.***

36 UKspace (SPDF0010)
37 Q14
38 Space Forge Ltd (SPDF0024) para 5.2
39 Cabinet Office, List of Cabinet Committees, accessed 27 September 2022
40 As set out in a footnote to Joint Doctrine Publication 0–40: UK Space Power, p64
41 Qq 55–58
42 Athena (SPDF0002) para 25
43 Q156
44 Q250

28. **Even before these recent developments, which seem to be a backward step, cross-Whitehall governance on space lacked sufficient clarity and direction. The delays to publication of the National and Defence Space Strategies frustrated industry and other stakeholders and suggest that despite the previous Prime Minister's stated personal commitment to making the UK "a meaningful player in space", the Government is currently unable to drive changes through at pace, or even to meet its own deadlines. Nowhere is this better illustrated than by the continued delay and inertia surrounding space-based position, navigation and timing services, which we examine in detail later in this report.**

29. **Vision must be backed up with delivery, and with space set to become ever more critical to the national interest it is clear that stronger, more cohesive leadership is required.** ***We recommend that a Minister for Space should be appointed within the Cabinet Office to provide clear centralised direction and accountability in taking forward the UK's civil and defence ambitions in space. This new position must be sufficiently resourced and should be given appropriate authority to effectively co-ordinate and drive forward policy and delivery.***

3 Skills and recruitment

30. The UK space sector is an area of rapid growth, with the number of space organisations growing on average 21% year-on-year since 2012.[45] This growth has seen a commensurate increase in demand for skilled employees: employment in the UK's space sector has tripled in the last 20 years.[46]

31. A 2021 report commissioned by the UK Space Agency highlighted that the increased demand for skilled employees is outstripping supply.[47] Subsequently, the National Space Strategy set out an ambition to "Upskill and inspire our future space workforce" as one of its ten priority areas for immediate action.[48]

32. Witnesses told us that the "skills pipeline" had to begin at school. Anita Bernie, Strategy and Execution Lead at KISPE Space Systems Ltd, argued that "space is cool - that is one of the things that always gets young children excited. It is about building on that enthusiasm for the wonders of space and turning it into capability."[49] Major Tim Peake, who has been involved in educational outreach activities with the UK Space Agency, described space as "an incredibly inspiring topic" and said that engagement at an early age carried through to GCSE and A-level. He noted, however, that "the pace of the space industry, and engineering and technology in particular, is such that the education system sometimes struggles to catch up."[50]

33. Tim Peake also observed that the space industry faces stiff competition for STEM graduates: "[f]or a long time, some of our brightest minds in technology, engineering and STEM have been snatched up by the financial sector or other areas of tech that can offer greater salaries."[51] Anita Bernie told us that the space sector was "feeling the pain of not having sufficient trained and skilled expertise" and that SMEs in particular "seem to be competing for an ever-dwindling supply of skilled and experienced talent."[52]

Military space recruitment and career development

34. Alongside these sector-wide recruitment difficulties, Defence faces additional challenges in attracting suitably qualified and experienced personnel (SQEP) into space-based roles; an issue that is more acute in the newer domains of space and cyber than across the rest of the Armed Forces. It cannot compete with the salaries on offer in the private sector, as the Minister for the Armed Forces acknowledged:

> I have been briefed by… brilliant people who are working in space, all of whom could earn more than the Chief of the Defence Staff if they were working in… the civilian space industry.

He felt, however, that "the call to serve your nation still resonates and… to serve in uniform is still special."[53]

45 UK Space Agency, Size and Health of the UK Space Industry 2021 (April 2022), p10
46 Ibid p13
47 UK Space Agency, Space Sector Skills Survey 2020 (February 2021), p2
48 HM Government, National Space Strategy, September 2021, p43
49 Q103
50 Q158
51 Q160
52 Q102
53 Q270

35. Witnesses believed that military space careers should be more proactively promoted within the Armed Forces, with Dr Bleddyn Bowen, Lecturer in International Relations at the University of Leicester, arguing that "space-centric careers should be desirable and prestigious across the MoD if it wishes defence personnel to take space seriously"[54] and that "[s]pace needs to be promoted and treated as a serious career path within the MoD."[55]

36. Air Vice-Marshal Smyth accepted that the space domain has historically been "a little bit of a niche area" within the military, but said that the establishment of Space Command had been "a good start" in promoting space as an attractive military career option, noting that "there is now a proper command structure, so that people can aspire to go up through the ranks and continue their way to the top."[56] Anita Bernie acknowledged that progress had been made, telling us that "Until 18 months ago, space was not really seen as a valid career path within the forces. Now that is starting to change."[57]

37. But successfully developing space specialism within Defence risks being hampered by rigid and inflexible traditional career structures, as Dr Mark Hilborne explained:

> If you bring in someone, say, at OF-5 level, it can be quite difficult if they have not been through officer training or had superior command… As warfare becomes more information based, how we bring people in will be quite different; their backgrounds will be quite different…. The challenge is as much cultural as anything else".[58]

38. This challenge was not disputed by the Minister for the Armed Forces:

> …we have to recognise that our career structures need adjustment. You come across these ridiculous situations where you meet an incredible flight sergeant who is delivering training in the space domain at Fylingdales and then has to go off and become a squadron sergeant-major somewhere because that is what you must do when you become a warrant officer.[59]

39. The MoD has conducted a Defence space workforce Training Needs Analysis and is considering adopting a Unified Career Management[60] approach for space specialists, as it has done for cyber.[61] Ukspace suggested cross-postings between industry and defence to broaden experience and provide expertise,[62] and Richard Franklin of Airbus told us that "we have been pushing for many years for co-location, job sharing and job role sharing" with the MoD on the Skynet programme to support long-term careers in space.[63]

54 Dr Bleddyn Bowen (SPDF0001) para 34
55 Ibid para 36
56 Q267
57 Q103
58 Q36
59 Q270
60 Unified Career Management centralises the career management of certain specialists across Defence with the aim of improving their retention and development. Strategic Command currently manages a "Cyber Cadre" of specialists using this model. See Ministry of Defence launches Unified Career Management, Ministry of Defence press release, 3 June 2021
61 MoD (SPDF0029)
62 UKspace (SPDF0010); see also the joint submission from Skyrora Ltd and Northern Space & Security Ltd (SPDF0025)
63 Q107

Space literacy across Defence

40. The Defence Command Paper contained a commitment to establish a Space Academy to develop the skills of Defence space specialists.[64] This received support in the evidence to our inquiry, although some witnesses cautioned that an understanding of the domain ("space literacy") must also be embedded across Defence. Dr Mark Presley argued that:

> Space also needs to be part of the broader professional military education, not just a space academy or a geek school where people go and do space stuff. It needs to be integrated into the whole defence piece.[65]

41. The MoD's Joint Concept Note on Multi-Domain Integration (MDI), dated November 2020, recognised the importance of this wider education piece and its crucial role in achieving effective MDI. It described the space, cyber and electromagnetic domains as "critical enablers and effecters, yet… the least understood domains in UK Defence."[66] It called for an "early and substantial improvement" in understanding of the domains, cautioning that developing the educational foundation for this would present "a much-increased demand on professional military education."[67]

42. The MoD told us that "[t]he Change Programme is working with the Defence Academy to shape our future education offer, with an explicit focus on Cyber and Space, across our staff courses and across the wider Defence Academy curriculum."[68] In September 2022 the Department published its first Joint Doctrine on Space Power, which the Chief of the Air Staff said should be "essential reading for a wide audience across Defence".[69]

43. **There is a clear challenge for the Government in addressing skills shortages and recruitment and retention difficulties in the space sector. Meeting this challenge will require a long-term, holistic approach to education and workforce development. Encouraging an interest in STEM subjects and space careers from a young age will be vital.**

44. **Defence faces particular challenges in recruiting and retaining space specialists. We were encouraged by the Minister for the Armed Forces' support for a more flexible approach to recruitment and career management within Defence, and we support the use of secondments to and from industry. But changes must be made at pace if we are not to fall further behind both our adversaries and our peers.**

45. **Space literacy must also be embedded across Defence if multi-domain integration is to succeed. *As well as establishing a Space Academy for defence space specialists, the MoD must ensure that wider professional military education comprehensively covers the role played by space in modern warfare. In its response to this report the Department should update us on its progress towards establishing a Space Academy and should set out target dates for the inclusion of space education on staff courses and across the Defence Academy curriculum.***

64 Ministry of Defence, Defence in a Competitive Age, Cm 411, March 2021, p45
65 Q37
66 Ministry of Defence, Joint Concept Note 1/20: Multi-Domain Integration (November 2020), p18
67 Ibid pp56–57
68 MoD (SPDF0029)
69 Ministry of Defence, Joint Doctrine Publication 0–40: UK Space Power (September 2022), piii

4 Threats and Hazards

46. In recent years, space has become more *contested*, with states recognising the importance of the domain for defence and national security purposes and seeking to develop their own defence space capabilities (and their ability to deny the use of space to their adversaries). Space is also ever more *congested*, with advances in technology making space more accessible to both state and non-state actors and leading to an ever-expanding number of satellites in orbit. These developments have increased the risk both to our space assets and to the services which depend on them.

Threats

47. Space is now intrinsic to Defence. Giving evidence in 2020 to our inquiry on *The Integrated Review: Threats, Capabilities and Concepts*, Todd Harrison of the Center for Strategic and International Studies told us that:

> being able to fight in modern warfare is increasingly about being able to see your adversary before they can see you, communicate that information throughout your forces, make decisions faster than your adversary, and prosecute targets faster than your adversary. To do that at greater and greater distances in a more highly contested environment, space is a critical enabler.[70]

Counterspace capabilities

48. This dependence has seen states seeking not only to bolster their own space systems but also to deny opponents the use of their own satellites through the development of counterspace capabilities, which can be broadly categorised into four types:

- *Kinetic physical* – using direct physical force to damage or destroy a satellite. This includes anti-satellite (ASAT) missiles which can either be launched from Earth ("direct ascent") or originate from another satellite in orbit ("co-orbital").
- *Kinetic non-physical* – physically damaging a satellite without making direct contact, for example through the use of lasers or electro-magnetic weapons.
- *Electronic* – interfering with the radio signals that carry data to and from satellites.
- *Cyber* – using cyber-attacks to target satellites directly as well as their ground systems.[71]

49. The US-based Secure World Foundation carries out an annual open-source assessment of global counterspace capabilities. It is apparent from their summary in the table below that Russia, China, and the US possess substantial counterspace capabilities, and that the UK does not:

70 Oral evidence taken on 29 September 2020, HC (2019–21) 834 Q18

71 For a more detailed analysis of space threats see *Defence of space-based assets*, POSTnote 654, Parliamentary Office of Science and Technology, September 2021.

Source: Global Counterspace Capabilities Report 2022, Secure World Foundation

The nature of the threat

50. ASAT missile tests, most recently Russia's destruction of one of its own satellites in November 2021, have received widespread media coverage but there have been no reported instances of a satellite being deliberately destroyed by an opponent. Dr Mark Hilborne reflected on how this could be attributed to the changed nature of the domain:

> The direct-ascent anti-satellite missile systems made a certain amount of sense in the cold war perhaps, when we had a fraction of the number of satellites in orbit, but today there are so many that any kind of intercept would create the risk of fratricide. I think that for states like China, the more reliant they are on space—this is a personal opinion—the less likely they are to conduct those kinds of attacks in space, and perhaps similarly, Russia.[72]

51. Instead, he argued, non-kinetic attacks such as jamming satellite signals or cyber-attacks were more attractive:

> I tend to think that is the kind of threat we will see more of, either in so-called peacetime or in conflict, because it is deniable and it is hard to respond to. How can you deter an actor from something you cannot really attribute, or it takes you a long time to attribute?[73]

72 Q6
73 Q7

52. Todd Harrison said that this reflected a wider move towards sub-threshold, "grey zone" warfare:

> I think the character of warfare is changing, and space is part of that. We are seeing many more grey zone types of aggression around the world from Russia and China, where they are taking actions that they believe fall below the threshold of overt conflict. We are seeing that in space, and space is a prime ground for that type of grey zone aggression, with reversible forms of attack, non-destructive forms of attack, and forms of attack where attribution can be difficult. We are seeing that happen more and more.[74]

53. Justin T. Johnson, former head of space policy at the Pentagon, highlighted cyber-attacks as a particular concern:

> I think probably one of the ones that everyone in the US national space community worries about is cyber. Protecting against cyber-attacks and space capabilities continues to be undervalued and under-prioritised.[75]

54. By their nature, "grey zone" activities in space are hard to attribute. However, a House of Commons Library note reports that Russia is believed to have carried out electronic warfare attacks on satellites over the last decade[76] and that China is believed to have been behind cyber-attacks on US satellites in 2007 and 2008.[77]

55. It is not only satellites which can be targeted. Their ground infrastructure, which Athena described as "often the most vulnerable elements of any space capability"[78] can also come under attack. This was recently demonstrated at the start of Russia's full-scale invasion of Ukraine, when a cyber-attack on the Viasat satellite network saw tens of thousands of satellite modems taken offline, causing what a senior Ukrainian cyber-security official reportedly called "a really huge loss in communications in the very beginning of war."[79] The attack has not yet been officially attributed (illustrating the difficulties in attributing sub-threshold aggression), but it was reported that US intelligence analysts had concluded it was carried out by the Russian military.[80]

56. Russia's invasion of Ukraine has also drawn attention to the possible implications of the increasingly blurred boundaries between civil/ commercial and military space assets. The commercial SpaceX Starlink satellite network has been used to support Ukraine's military operations,[81] leading Russia to warn that "[q]uasi-civilian infrastructure may become a legitimate target for retaliation."[82]

74 Oral evidence taken on 29 September 2020, HC (2019–21) 834 Q18
75 Q186
76 *The Militarisation of Space*, Research Briefing 9261, House of Commons Library, 14 June 2021, p21
77 Ibid p23
78 Athena (SPDF0002) para 18
79 Satellite outage caused 'huge loss in communications' at war's outset", Reuters, March 15 2022
80 "Russian military behind hack of satellite communication devices in Ukraine at war's outset, U.S. officials say", The Washington Post, 24 March 2022
81 "Elon Musk's Starlink helping Ukraine to win the drone war", The Telegraph, 18 March 2022
82 Statement by the Head of the Russian Delegation at the second session of the Open-ended Working Group established pursuant to UN General Assembly resolution 76/231, 12 September 2022.

57. In September 2022, Admiral Sir Tony Radakin, Chief of the Defence Staff, warned that any Russian attack on satellites forming part of critical national infrastructure would provoke a strong response from NATO.[83]

Outpaced?

58. We heard that as China in particular had made rapid advances in developing its counterspace capabilities, the West had not kept pace with the threat. Justin T. Johnson argued that the US and its allies had taken their eyes off the ball:

> We had a couple of decades of uncontested advantage in space, and I believe that China and Russia both saw that space was a critical enabler for our ability to project power around the world… I think we have the underlying competitive advantages to endure and stay ahead over the long term, but in the short term we have lost a step, and our competitors and adversaries are moving faster than we are.[84]

59. A recent report from US defence experts acknowledged the possibility that the US could lose space superiority to China within the next decade.[85] In October 2022, the head of GCHQ warned that China's BeiDou Global Navigation Satellite System was an example of its efforts to use science and technology to embed global influence and exert control both at home and abroad.[86]

Hazards

60. Alongside the deliberate threat to space-based assets posed by our adversaries, satellites are also at risk of accidental damage through collision with space debris or with other satellites. This risk is expected only to become more acute as the number of satellites in orbit continues to grow at pace.

61. Space debris is also a significant problem. Larger items such as obsolete satellites can be tracked, but smaller pieces of debris are much harder to monitor and can still cause catastrophic damage. The ESA's statistical models suggest that there may be as many as 1 million objects in orbit between 1cm-10cm in size, and up to 130 million between 1mm-1cm.[87] Major Tim Peake described these smaller pieces of debris as "a major threat", saying that they were "incredibly hard to track".[88]

62. The dangers posed by the increasingly contested and congested nature of the domain were highlighted during the course of our inquiry when in November 2021 Russia carried out an ASAT test which destroyed one of its own defunct satellites. The test created a debris cloud that caused astronauts aboard the International Space Station to take precautionary measures,[89] with UK Space Agency analysis suggesting that 1,500 trackable pieces of debris

83 Russia could carry out attacks in space, warns British Armed Forces head Tony Radakin, The Telegraph, 30 September 2022
84 Q174
85 J. Olson, S. Butow, E. Felt and T. Cooley, "State of the Space Industrial Base 2022", August 2022, p9
86 UK spy chief says China's tech aims are "a threat to us all", The Independent, 11 October 2022
87 European Space Agency, 'Space debris by the numbers', accessed 4 October 2022
88 Q143
89 Russian anti-satellite missile test draws condemnation, BBC News, 16 November 2021

were created.[90] The test was condemned by US Secretary of State Antony Blinken[91] and Defence Secretary Ben Wallace.[92] Major Tim Peake told us that the debris "will impact various different orbits and launch capabilities for a number of years."[93]

Responsible behaviours in space

63. Operations in an increasingly congested and contested domain are made yet more hazardous by the lack of established norms and principles around space activity. International law on the militarisation or weaponisation of space is minimal. The 1967 Outer Space Treaty prohibited the placing of weapons of mass destruction (including nuclear weapons) in space,[94] but there is no general prohibition on the placing of other weapons and military equipment in space, nor on the use of ground-based counterspace capabilities.

64. In 2020 the United Nations adopted a General Resolution introduced by the UK: *Reducing space threats through norms, rules and principles of responsible behaviours*.[95] The UN General Assembly's First Committee subsequently established a working group to take this work forward, a move that was supported by the US but opposed by Russia and China.[96] Since the working group's formation, the US, Germany, New Zealand, Canada and Japan have all undertaken not to carry out destructive direct ascent missile tests,[97] and in October 2022 the UK made the same commitment.[98]

65. We heard that the development of norms was an area where the UK could and should continue to play an influential role, with UKspace commenting that the UK had shown "global leadership."[99] Justin T. Johnson explained why this remained important despite Russia and China's lack of engagement:

> First, if there are countries on the margins that build capabilities and consider whether to pursue a reckless approach—like Russia with its recent ASAT test—or a responsible approach, we want to be able to articulate what that responsible approach looks like. Secondly, I think it is important to articulate what responsible behaviour in space looks like so that we—all of our partner and ally countries together—can call out irresponsible behaviour when we see it… It is very important that we push forward, even if China and Russia continue to be reckless and irresponsible.[100]

This view was echoed by Air Vice-Marshal Smyth, who said of the UN initiative that

90 UK Space Agency, Russia ASAT Test: UK Space Agency response and analysis of the debris, accessed 4 October 2022
91 "Russia Conducts Destructive Anti-Satellite Missile Test," US Department of State Press Statement, accessed 26 September 2022
92 Ministry of Defence, Twitter, accessed 4 October 2022
93 Q136
94 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, UN General Assembly resolution 2222 (XXI), 19 December 1966
95 UN General Assembly, Resolution 75/36
96 First Committee of the UN General Assembly, Report 76/442
97 "Japan, Germany declare moratorium on anti-satellite missile tests," SpaceNews, September 14 2022
98 Responsible space behaviours, Foreign Office and UK Space Agency press release, 3 October 2022
99 UKspace (SPDF0010)
100 Q177

> It is about establishing a baseline… At the moment we see nations like Russia try to establish new norms in space, and without a baseline that we can hold them to account against, it is very difficult to attribute actions.[101]

66. **The response to Russia's invasion of Ukraine has underlined the importance of the international community taking a united approach in the face of irresponsible and aggressive behaviour. We welcome the UK's leading role at the United Nations in seeking to achieve a consensus on responsible norms and behaviours in space and we support and encourage the Government in continuing to drive this work forward. *An update on progress to date should be included in the Department's response to this report.***

Space Domain Awareness

67. Crucial to safe operations in space are the ground and space-based sensors which track and monitor satellites and other objects in orbit, and the analysis of the data that they provide. These Space Surveillance and Tracking (SST) and Space Situational Awareness (SSA) capabilities underpin both civil and military space operations. Witnesses also highlighted the role played by Space Domain Awareness (SDA) in identifying hazards and attributing threats in the space domain. SDA draws on data provided via SST and SSA capabilities, but is threat-focused, allowing attacks to be attributed and threats modelled. The MoD defines it as "the provision of security-focused, decision-quality information that can be used to successfully mitigate adversary space effects while supporting the integration of allied space effects into multi-domain operations."[102]

68. The Defence Space Strategy described SDA as a "fundamental enabler of all other space capabilities, and critical to our ability to protect our interests in space"[103] and the Minister for the Armed Forces observed that situational awareness and "the degree to which we understand what is there, what it can do, and what threat it poses" was key to protecting the UK's space assets.[104] The UK currently relies on the US for its SDA, although it has some sovereign capability through its ballistic missile radar at RAF Fylingdales. Data from Fylingdales is analysed at the UK Space Operations Centre at High Wycombe and sent to the US, with data from US assets made available to the UK in return. The Defence Space Strategy allocated over £85 million to further developing the UK's SDA programme.[105]

69. We heard that SDA was an area where the UK could strategically contribute to Allied defence space capabilities for a relatively low cost. Witnesses highlighted existing UK expertise in this area, which Skyrora Ltd and Northern Space & Security Ltd described as "an unexploited wealth of knowledge and skills."[106] Dr Mark Hilborne and Dr Mark

101 Q202

102 The recent Joint Doctrine Publication 0–40: UK Space Power defines and examines the relationship between SST, SSA and SDA in detail at Chapter 2. The definitions included therein have been adopted as formal UK terminology.

103 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022, p30

104 Q200

105 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022, p30

106 Skyrora Ltd and Northern Space & Security Ltd (SPDF0025)

Presley told us that the UK has "a long tradition and deep expertise in space surveillance,"[107] and Dr Bleddyn Bowen agreed that it was "an area of existing UK space expertise both in the MoD and the private sector."[108]

70. The UK was also recognised as having geographic advantages which could be better exploited: Drs Hilborne and Presley suggested that strategically located sensors in British Overseas Territories could fill in gaps in existing LEO coverage, identifying the Falklands as "a particularly useful location."[109] UKspace also described the positioning of SDA capabilities on overseas territories as "a global advantage that we should use more" and said that development of the UK's SDA capabilities "could lend great weight and credibility to both our own sovereign aspirations and the role we aspire to play with our Allies and partners."[110]

71. In June 2022 the UK Space Agency published a Space Domain Awareness Study. With contributions from over 100 experts from across the UK space sector, the report noted that although the NSS and DSS highlighted SDA as a priority area for the UK, they "do not provide insight or direction into the UK's ambitions in SDA and therefore generate uncertainty between government and industry."[111] The study concluded that "A cross-Government SDA strategy and vision is required to cohere academia, industry, civil and military entities and provide clarity on intended aims for the UK in SDA."[112]

72. **Space Domain Awareness capabilities are rightly recognised by Government and stakeholders as being critical to safely operating in an increasingly contested and congested space environment.** ***A cross-Government SDA strategy should be produced and implemented as soon as possible: the Department should confirm in its response to this report that work on this is already underway and should give a target date for its publication.***

73. **Considered and strategic investment in the UK's SDA capabilities offers an opportunity to improve the UK's standing and contribution to Allied defence space efforts.** ***The Department should set out how it will ensure that the Defence Space Strategy's promised investment in Space Domain Awareness maximises the advantages offered by the UK's existing pockets of expertise and the location of its Overseas Territories.***

107 Dr Mark Hilborne and Dr Mark Presley (SPDF0007)
108 Dr Bleddyn Bowen (SPDF0001) para 8
109 Dr Mark Hilborne and Dr Mark Presley (SPDF0007)
110 UKspace (SPDF0010)
111 UK Space Agency, SDA Study (May 2022), p27
112 Ibid p5

5 Position, Navigation and Timing

74. Perhaps the most well-known satellites are the Global Navigation Satellite Systems (GNSS) networks which provide space-based position, navigation and timing (PNT) services. Most people are familiar with the US GPS system; other space-based PNT networks include the EU's Galileo network, China's BeiDou, and Russia's Glonass. Space-based PNT is essential to modern life, enabling activities as diverse as banking, traffic control and smartphone use; it has been estimated that a five-day disruption to GNSS would cost the UK £5.2 billion.[113]

75. Space-based PNT also plays a crucial role in defence and security. Alongside an open signal, which is available for civil, public and commercial use, satellites also provide a secure, encrypted signal which can be used for military operations. The Defence Space Strategy noted that "PNT signals underpin almost every military activity, delivering critical Defence capabilities, including precise navigation and targeting across the globe"[114] and Airbus described PNT as "a truly essential enabler of force in the modern era."[115]

Galileo

76. Before the UK's withdrawal from the EU, the UK was a leading participant in the EU's Galileo programme. The UK Government contributed £1.2 billion to the programme and UK industry also played a key role, with Surrey Satellite Technology Ltd building the first test satellite for the network and manufacturing the navigation payloads for all 34 satellites.[116] Participation in the programme enabled the UK to use the network's secure signal for defence and security purposes, offering an alternative to the US GPS system.

77. During Brexit negotiations, it became clear that the UK's exit from the EU would have implications for its continued involvement in Galileo, with the European Commission barring UK industry from continuing to participate in the programme on security grounds. In December 2018 the then Prime Minister Theresa May announced that the National Cyber Security Centre and Ministry of Defence had concluded it would not be in the UK's security interests to use the system's secure elements if it had not been fully involved in their development and that the UK would consequently depart the programme on leaving the EU.[117]

The implications for Defence

78. Evidence on the defence implications of the UK's exit from Galileo (and its subsequent reliance on GPS as the sole provider of secure space-based PNT) was mixed. Athena described it as having "severely reduced resilience"[118] and Airbus argued that "national reliance on one foreign owned and operated system surely raises the risk level."[119] Others were less critical, with Dr Mark Hilborne suggesting that "…there isn't necessarily a gap to fill. We have access to GPS… In that respect, there isn't a fundamental failure there for

113 Government Office for Science, Satellite-derived Time and Position: A Study of Critical Dependencies (2018), p7
114 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022, p32
115 Airbus (SPDF0011) para 6.1
116 UK industry bids farewell to EU's Galileo system, BBC News, 14 January 2021
117 Prime Minister's Office, UK to tell EU it will no longer seek access to secure aspects of Galileo, 1 December 2018
118 Athena (SPDF0002) para 12.c
119 Airbus (SPDF0011) para 6.4

us."[120] The Minister for the Armed Forces described a sovereign GNSS as "a nice to have", adding that

> While …in extremis, there are circumstances one could envision where a sovereign capability would be useful, I just think we are in a very, very extraordinary place when the US are denying us access to GPS.[121]

UK space-based PNT

79. During negotiations on the UK's continued membership of Galileo, the Government stated that it would explore options to build a UK sovereign GNSS. In August 2018 £92 million was assigned for the UK Space Agency to undertake a feasibility study into its development.[122]

80. In September 2020, in an apparent acknowledgement that a like-for-like Galileo replacement would not be taken forward, the Government announced that this work would be "reset" with the creation of a Space Based Position, Navigation and Timing Programme (SBPP) to "explore new and alternative ways that could be used to deliver vital satellite navigation services to the United Kingdom".[123] At the time of writing this report, the SBPP has not published any conclusions.

81. The National and Defence Space Strategies did not take matters any further forward: despite underlining the importance of PNT and describing PNT systems as "inherently vulnerable" the DSS said merely that the MoD would "continue to support" existing cross-government work on the issue.[124] A Policy Exchange paper subsequently described PNT as a "missing piece" in the DSS.[125] UKspace had previously told us that it was "incumbent on Government to make a decision soon."[126]

82. The Minister for Science did nothing to counter the impression that there is little political or other pressure to take this work forward within Government:

> BEIS and MoD teams have worked up a series of options… it comes down to some quite big decisions about finance and some of the geopolitical issues that we were talking about earlier. I think my best read of the situation is that, right now, given everything else that is going on, the judgement has been taken that this is not the time to have that conversation.[127]

83. **The events surrounding the UK's expulsion from the EU's Galileo programme were deeply unsatisfactory and demonstrated a failure of statecraft on all sides. The European Commission's decision was deeply regrettable given the extensive contribution, including financing of £1.2 billion, that the UK had made to the Galileo programme since its inception.**

120 Q24
121 Q261
122 HM Government, Space sector to benefit from multi-million pound work on UK alternative to Galileo, 29 August 2018
123 Government to explore new ways of delivering "sat nav" for the UK, DBEIS press release, 24 September 2020
124 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022, p32
125 Gabriel Elefteriu, Policy Exchange, UK's Defence Space Strategy in Context, p13
126 Q62
127 Q258

84. **Against this backdrop of political failure, it is simply unacceptable that almost four years on, and with tens of millions of pounds spent, the Government appears no closer to coming to any conclusions about development of the UK's own space-based Position, Navigation and Timing (PNT) capabilities. Most recently the Space Based Position, Navigation and Timing Programme (SBPP), led by the UK Space Agency, seems to have disappeared without a trace. Given the vital need for a resilient PNT network both for Defence and for other aspects of Critical National Infrastructure we are deeply concerned by the complacent attitude towards PNT within Government, and by the seemingly low priority which the MoD attaches to this work.** ***Government must publish the conclusions of the SBPP and should set out a clear timetable for producing and taking forward the UK's PNT strategy in its response to this report.***

6 Sovereignty and collaboration

Allied collaboration

85. The UK has only limited sovereign defence space capabilities, the most notable of which is Skynet, a network of military communications satellites providing near-universal global coverage. Consequently, UK space defence capabilities and operations are dependent on and highly integrated with allies. The UK participates in several alliances across the defence space sphere, most notably NATO, and the US-UK relationship is of particular importance for the UK. Intelligence sharing relating to space takes place through the Five Eyes network. The UK assigns personnel to the Combined Space Operations Center (CSpOC) in California,[128] and UK personnel also participate in the US-led Operation Olympic Defender, an initiative intended to strengthen deterrence against hostile actors in space and reduce the spread of debris in orbit.[129] AVM Smyth told us that "the narrative on space, particularly in the last five years, has really gained traction across NATO… We are almost being inundated with invitations for future collaboration and partnering."[130]

86. Evidence to our inquiry acknowledged that a collaborative approach was in the UK's interests. RAND Europe noted that

> For smaller space powers, like the UK, that lack the resources to develop a comprehensive suite of space capabilities in a fully sovereign way, collaboration is critical for successful access to and exploitation of the space domain.[131]

87. However, the evidence also reflected a sense that the UK has fallen behind its peers and should look to develop its contribution to the Allied network if it is to retain influence and "soft power" in the space domain. Dr Mark Hilborne felt that

> [w]e have seen a slight change of tone from the US in the past few years. There is a call for allies to do more to help bring that composite set of capabilities to space, as we see challenges for instance of a rising space power in China.[132]

Similarly, Bleddyn Bowen argued that many European states "bring more to the table" in space for the NATO alliance than the UK.[133]

88. Witnesses agreed that in developing its own defence space capabilities, it was important for the UK to consider how it could most effectively contribute to the wider Allied network by filling in gaps and adding resilience. Dr Mark Presley felt that

> I don't think we have to look to do everything, nor should we look to try to replicate what already exists. What we are looking for in space, which is very much a global enterprise, is to find those areas where we can make a contribution that is then valued across the globe internationally.[134]

128 Australia and Canada partner with the UK and US on CSpoC, with France, Germany and New Zealand also collaborating.
129 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022, p13
130 Q214
131 RAND Europe (SPDF0020) para 1.1.2
132 Q5
133 Dr Bleddyn Bowen (SPDF0001) para 7
134 Q5

89. Nik Smith, speaking on behalf of industry body UKspace, made a similar point, saying that the question was:

> … how do we work with our allies to make sure that we deliver the piece of capability that either they cannot deliver or we are better placed to deliver, and therefore we become a crucial partner?[135]

Commercial partnerships

90. The head of the US Space Force, General John "Jay" Raymond, recently noted that the Ukraine war was "the first war where commercial space capabilities have really played a significant role",[136] and evidence to our inquiry emphasised the inevitability of increased reliance on the commercial sector. CGI argued that "the Space sector is at an inflexion point, as it becomes increasingly driven by commercial operations…. In the long-term, the UK Defence budget will not be able to compete."[137] RAND Europe observed that this shift offered opportunities:

> Given the dominance of commercial players in the space market today, there is also an opportunity for the UK Government to tap into a wide range of mature solutions… The dual-use nature of many space technologies and the enhanced opportunity to work closely with industry also means that UK Defence can potentially develop from its low-level capabilities (outside of Skynet) relatively quickly…[138]

91. The development of the UK's launch capabilities is an example of this collaboration in practice.

Box 2: UK launch

In May 2022 the Government announced that the first ever satellite launch from UK soil would take place in Newquay in Cornwall later in the summer. The "Prometheus 2" mission is a collaboration between the MoD and international partners. A Virgin Orbit launcher rocket will deliver two shoebox-sized satellites (designed with Airbus Defence and Space and built by Hampshire-based In-Space Missions Ltd) into orbit to provide a test platform for new concepts.[139] Other UK launch sites are also being developed, including the SaxaVord Spaceport on the island of Unst in the Shetland Isles.

During our inquiry we heard that development of the UK's launch capability could play an important role in increasing the resilience of our space assets and delivering strategic security for the UK.[140] The Minister for Science told us that the commitment to developing UK's launch capability was due "in no small part because we want to reduce dependency on launch out of America as well as Russia. We see that as an important part of our space economy as well as our resilience."[141]

We note with disappointment that as we agree this report, several weeks into the autumn, the promised summer launch has yet to take place.

135 Q82
136 Space, the unseen frontier in the war in Ukraine, BBC News, 6 October 2022
137 CGI (SPDF0015) para 8
138 RAND Europe (SPDF0020) para 2.3.4
139 First UK satellite launch in summer 2022, Ministry of Defence and UK Space Agency press release, 10 May 2022
140 Council on Geostrategy (SPDF0018), para 4. See also Lockheed Martin UK (SPDF0006) para 21.
141 Q206

A question of sovereignty

92. Collaboration undoubtedly offers benefits, but it is not without risk. Reliance on third parties, whether commercial operators or international partners, may reduce costs and increase flexibility, but it also removes agency and control. For Defence, making the correct decisions around which space capabilities can be delivered by third parties and which must remain sovereign will be of paramount importance in delivering secure, resilient and cost-effective defence space capabilities. BAE Systems felt that "[t]here is a need for certainty and clarity around which sovereign capabilities ought to be retained, and developed domestically, and those which Government would be happy to partner with other countries on".[142]

93. In the Defence Space Strategy, the MoD said that such decisions would be made using the "Own-Collaborate-Access" (OCA) model first set out in the Integrated Review.[143]

Box 3: The Own-Collaborate-Access framework

> **Own**: where the UK has leadership and ownership of new developments, from discovery to large-scale manufacture and commercialisation. This will always involve elements of collaboration and access.
>
> **Collaborate**: where the UK can provide unique contributions that allow us to collaborate with others to achieve our goals.
>
> **Access**: where the UK will seek to acquire critical S&T [science and technology] from elsewhere, through options, deals and relationships.[144]

Source: Global Britain in a Competitive Age, pp38–39

94. Gabriel Elefteriu of Policy Exchange noted that "How this OCA framework will be used to drive programme decision-making has the potential to make or break Britain's prospects of becoming a major space nation in the 21st century" and argued that "the OCA mix should be a matter of wider political and strategic debate, not just internal assessment, given its potential impact on Britain's national space interests going forward."[145]

OneWeb: a case study

95. The complexities and risks arising from reliance on commercial and international partners for delivery of space services are illustrated by events surrounding the OneWeb satellite network. OneWeb is a satellite communications provider which plans a network of 648 satellites delivering broadband services in Low Earth Orbit in its first-generation constellation.

96. In 2020 the UK Government partnered with Bharti Global to successfully bid for acquisition of OneWeb after it filed for bankruptcy, taking a $500 million stake in the company on behalf of the taxpayer.[146] The purchase was not without controversy, with

142 BAE Systems plc (SPDF0017)
143 Ministry of Defence, The Defence Space Strategy: Operationalising the Space Domain, 1 February 2022, p18
144 An MoD-commissioned report from the RAND Corporation, Realising the Ambitions of the UK's Defence Space Strategy, examined how the Own-Collaborate-Access model could be applied to space capabilities and provided guidance for the Space Directorate and Space Command in navigating decisions around capability ownership.
145 Gabriel Elefteriu, Policy Exchange, UK's Defence Space Strategy in Context, p10
146 UK government to acquire cutting-edge satellite network, DBEIS press release, 3 July 2020

the acting permanent secretary of DBEIS questioning whether it met value-for-money requirements and requesting a ministerial direction before finalising the acquisition.[147]

97. Evidence to our inquiry suggested that it would be feasible for OneWeb satellites to deliver capabilities such as PNT,[148] and Rebecca Evernden, Director for Space Policy at DBEIS, confirmed that this and other potential national capabilities were under consideration for the second generation of OneWeb satellites.[149]

98. In March 2022, shortly after Russia's full-scale invasion of Ukraine, Russia impounded 36 OneWeb satellites that had been due to be launched from its Baikonur cosmodrome in Kazakhstan, after demanding assurances that they would not be used for military purposes and, later, that the UK sell its share in the company.[150] The CEO of OneWeb has since described the impounded satellites as being "essentially lost"[151] and the episode is reported to have cost the taxpayer-backed company £199 million.[152]

99. Asked whether security issues around the use of Baikonur had previously been raised with OneWeb, Rebecca Evernden told us that "those discussions have been purely between the company and its launch contractor, Arianespace."[153] The Minister for Science argued that "I don't think anyone 18 months ago, with the benefit of hindsight now that I might say was obvious, would have thought that there was that risk of an invasion in Ukraine and the level of tension we now have."[154]

100. On 26 July 2022 DBEIS announced plans for a merger between OneWeb and the French satellite operator Eutelsat. They described the merger as "positive news for UK taxpayers" and said that the UK Government would maintain its stake in the company and would retain national security controls over the network.[155] Press reports have since suggested that the Government may come under pressure to "reinterpret" this "golden share" in the company so that it can bid for a lucrative EU satellite broadband programme.[156]

101. Following the announcement of the proposed merger, the Chair of the Business, Energy and Industrial Strategy Select Committee wrote to DBEIS seeking assurances about scrutiny of the deal under the provisions of the National Security and Investment Act and raising concerns about the China Investment Corporation's holding in Eutelsat, as well as its broadcasting of Russian television channels during the Ukraine conflict.[157]

102. **The Ministry of Defence will have to carefully balance competing priorities in determining which defence space capabilities must be "owned" by Government and which can be provided by collaboration with Allies or through a commercial contract. Russia's recent impounding of OneWeb satellites at the Baikonur cosmodrome demonstrates the potential dangers of making the wrong call, and the subsequently**

147 DBEIS, Correspondence: Ministerial direction for the purchase of OneWeb, accessed 27 September 2022
148 Northrop Grumman (SPDF0008); Thales and Thales Alenia Space (SPDF0014)
149 Q259
150 OneWeb: UK rejects Russian demand to sell share in satellite firm, BBC News, 2 March 2022
151 OneWeb boss sees the stars align for his dream of getting the world online, The Times, 5 August 2022
152 Taxpayer-backed OneWeb takes $200m hit after Russia blocks satellite launches, The Telegraph, 2 September 2022
153 Q208
154 Q204
155 DBEIS, Government statement on the planned merger of OneWeb and Eutelsat, 26 July 2022
156 The UK faces an awkward choice over its golden share in OneWeb, Financial Times, September 21 2022
157 Letter from the Chair of the BEIS Select Committee to the Secretary of State for BEIS, 29 July 2022; See also the Secretary of State's response, 12 August 2022.

announced proposed merger of the OneWeb with Eutelsat has raised further questions concerning sovereignty and national security. ***The planned merger between OneWeb and Eutelsat must be subject to the most stringent scrutiny under the National Security and Investment Act. More broadly, it is critical that decisions affecting the sovereignty of the UK's defence space capabilities are made transparently. The MoD should confirm in its response to this report how it plans to make details of these decisions available for scrutiny by Parliament.***

7 The UK's Defence Space Capabilities: Opportunity and Challenge

103. The Government's £1.4 billion investment in new defence space technologies is a significant sum, but we heard that it may not be enough to deliver against the ambitions of the Integrated Review and Defence Command Paper.[158] In their written evidence, the MoD told us that it "marks the start of our journey to operationalise the space domain" and that additional funding would be required in future Spending Reviews to provide enduring capabilities in the long term.[159] The Minister for the Armed Forces explained that

> this first IR is about getting into the domain with exploratory prototype capabilities—stuff that will catalyse a nascent industry. That feels achievable with that amount of money. When we see what works and what sticks, that is the time to go after it at scale.[160]

Opportunity

104. This spending, along with the c.£5 billion already allocated to the next generation of Skynet, nonetheless represents a significant investment which will offer the MoD an opportunity to make a positive contribution to the sustainability and productivity of the UK space sector. Nik Smith of UKspace told us that:

> …the MoD has a key role in being an anchor customer for the sector. These programmes… have the opportunity to really stimulate some significant growth, and that is incredibly important.[161]

Box 4: ISTARI

By far the most significant new investment set out in the Defence Space Strategy was an initial £970 million commitment to a new sovereign UK intelligence, surveillance and reconnaissance (ISR) satellite constellation: "ISTARI".

This will address a significant gap in UK capabilities which was highlighted in the evidence to our inquiry. Airbus noted that the UK was the only permanent member of the UN Security Council not to have its own national ISR constellation and that "[c]onsequently, there is no freedom of action, as the UK is 'at the back of the queue' when requesting data from other countries".[162]

UKspace said that the development of the UK's ISR capabilities would play to national industrial strengths such as small satellites and UK launch from a strategic perspective, and that it would also provide an opportunity to burden share with allies.[163]

158 Q45
159 MoD (SPDF0029)
160 Q256
161 Q45
162 Airbus Defence and Space (SPDF0011) para 7.1
163 UKspace (SPDF0010)

105. It was disappointing, therefore, that pressed on whether the investment in new capabilities would be spent in the UK rather than abroad, the Minister for the Armed Forces was unable to reassure the Committee:

> I do not know that there is any guarantee that it will be spent in the UK; there is clearly a hope and an expectation that it would be. We need to be clear-eyed about the priority being military capability.[164]

UK defence space sector

106. The UK's defence space sector has to date been dominated by Airbus in its role as prime contractor for the Skynet military communications satellite system. The award of the c.£5 billion contract to develop the next generation of Skynet satellites will thus have significant implications for industry.

Box 5: Skynet

A family of satellites in GEO, Skynet provides a secure communications network with near global coverage. The MoD is currently developing its requirements for the next generation of Skynet, Skynet 6.

Skynet 6 includes several different elements which together make up the MoD's Future Beyond Line of Sight Programme (FBLOS). The most significant is the development of Skynet 6 Enduring Capability, the replacement for the existing Skynet 5 network. Other aspects include Skynet 6A, a single satellite procurement already awarded to Airbus Defence and Space, and the Skynet 6 Service Delivery Wrap, a contract for support services to the existing Skynet network.[165] The MoD expects to spend £5 billion on the Skynet program over the next ten years.[166]

The Skynet 6/FBLOS programme received an Amber/Red Delivery Confidence Assessment (DCA) in the Infrastructure Project Authority (IPA) Annual Report on Major Projects 2020–21. In 2021 the IPA's DCA ratings were streamlined to remove the Amber/ Red category, and the programme subsequently received an Amber rating in the 2021–22 report,[167] meaning that "successful delivery appears feasible but significant issues already exist".

107. Airbus argued that their continued leadership of the programme would be of benefit to the domestic industrial base:

> Without Airbus leadership in Skynet, the UK will be unlikely to continue to manufacture large satellites in 2040. Put simply, the UK space manufacturing base will be gutted, and work will go elsewhere.[168]

108. Unsurprisingly, their competitors suggested that a more diverse supplier base should be encouraged. Lockheed Martin said that

> …the UK's space industrial base currently lacks diversity, particularly for onshore satellite manufacturing, including at prime level. This impacts operational independence, competition, and innovation… the MoD…

164 Q255
165 Ministry of Defence Departmental Overview 2019–20, National Audit Office, December 2020, p18
166 Ministry of Defence (SPDF0021)
167 Infrastructure and Projects Authority Annual Report on Major Projects 2021–22, p69
168 Airbus (SPDF0011) para 4.6

> should use the [Skynet 6] procurement to encourage inward investment to grow and diversify the sector, providing greater choice for upstream capabilities, increased export opportunities, and scaled-up Research & Development.[169]

SME

109. BAE Systems said that increased competition and choice in the industrial base would be welcomed by new entrants and investors and would also help facilitate ongoing growth in the SME base, which they described as "a vital source of innovation."[170] We took evidence from Anita Bernie, Strategy and Execution Lead at KISPE Space Systems Ltd, a Farnborough-based start-up. She called for the MoD to engage more meaningfully with SMEs, saying that "very little" of its investment in the sector goes directly to them and that:

> [m]ost of our engagement with MoD is through [the key] strategic suppliers, and there are not many routes in where we can have the face-to-face conversations with the end users and be part of developing the solution. There is a lot of talent and problem-solving capability within the SME community… I would ask the MoD to come to us with a problem statement. Let us think about what the driving requirement should be before we think about the solution.[171]

110. **The investment in new space capabilities set out in the Defence Space Strategy, and the procurement of the next generation of Skynet communications satellites, will provide a clear opportunity for the MoD to make a positive long-term impact on the sustainability and productivity of the UK's space industry. *The Department should explain in its response to this report how it will ensure that its investment in the sector maximises benefits to the UK by growing and sustaining a skilled workforce, attracting investment, rewarding innovation, providing meaningful engagement with SMEs and adding social value. The Department should also provide an update on Skynet 6, including expected contract award dates for the Service Delivery Wrap and Enduring Capability strands of the programme.***

Challenge

111. The space sector presents unique acquisitions challenges for the MoD. The rapid pace of technological advances in the space domain means that traditional lengthy procurement processes could see new capabilities outdated before they are even delivered. The slow speed of the MoD's current procurement processes was criticised by witnesses as being ill-suited to space acquisitions. Ukspace told us that there was a need "to take a few more risks on some of those things and not just wait for the next level of approval—which seems to take so long within the MoD."[172]

169 Lockheed Martin UK (SPDF0006) paras 22–23
170 BAE Systems plc (SPDF0017)
171 Q129
172 Qq83–84

112. The UK is not unique in facing these challenges, and as a relative latecomer to the defence space arena it has the advantage of capitalising on the experience of its peers and competitors, as the Minister for the Armed Forces acknowledged:

> [t]here is an approach to space that is quite liberating, because we are able to get into the market having seen others succeed and others fail.[173]

113. We took evidence from Justin T. Johnson, former head of space policy at the Pentagon, on the recently established Space Development Agency (SDA), the US Department of Defense's self-described "constructive disruptor" for space acquisitions which, he explained, took "a completely different approach to acquisition - to run fast and be a competitive force inside the space system for trying and delivering different things."[174] The SDA, he told us, is "specifically focused on leveraging new space and on speed over basically anything else".[175]

114. Asked whether it had been effective, he was positive:

> The systems are not in orbit yet, so it will probably be another year or 18 months before we can know just how effective, but I think the signs are encouraging. They are moving probably an order of magnitude faster than almost any other part of the US national security space ecosystem.[176]

115. UKspace said that "there was a lot to learn" from the SDA in procuring "smaller fast-spin opportunities".[177] Air Vice-Marshal Smyth told us that the MoD was "working closely with the US Space Rapid Capabilities Office to learn lessons and apply those to how we do procurement."[178]

116. **In order to meet the challenges posed by the rapid pace of technological advancement in the space domain, the MoD will need to take every opportunity to learn from the experiences of Allies. The pioneering approach taken by the US Space Development Agency will be of particular relevance.**

117. Questioned about how the MoD would adapt its acquisitions processes to meet the challenges posed by the space domain, Air Vice-Marshal Smyth accepted that it was "a very valid challenge". He told us that Space Command was adapting "a rapid capability approach" to cut out "some of the layers of process associated with our historic procurement processes",[179] and said that:

> The way we have built our programme allows us to make decisions as we go along in the three-to-five-year cycle, invest in concept demonstration and leverage new tech as it comes on to the market… the stuff we are putting into space will be software-definable, so we can reprogramme it from Earth.[180]

173 Q253
174 Q187
175 Q189
176 Q190
177 Q85
178 Q264
179 ibid
180 Q265

118. With speed, however, comes increased risk. Reflecting on the US experience, Justin T. Johnson observed that "striking the balance, between risk and confidence that every dollar—or pound—will be spent appropriately, is a constant challenge".[181]

119. Unfortunately, the MoD does not enter the challenging space acquisitions arena from a position of strength. We and others have repeatedly highlighted the failings in its existing procurement processes, and its track record in delivering major projects can only be described as absymal, with vast amounts of taxpayers' money wasted by the Department in procuring capabilities which are eventually delivered years behind schedule and millions of pounds over budget.

120. Against this backdrop of failure, progress will need to be closely monitored. At the time of publication of the Defence Space Strategy, it was noted that it did not contain indicative timescales or milestones for the new programmes it announced.[182] The MoD subsequently told us that "[o]ver the coming financial year, UK Space Command will lay out indicative milestones for the key elements of the Defence Space Portfolio".[183] Early publication of these milestones, including timescales, and regular reporting against them, will be essential in enabling this Committee and others to hold the Department to account.

121. RAND Europe told us in their evidence that the development of new defence space capabilities offers the MoD "the chance for a fresh approach in a 'new' operational domain where it is relatively unencumbered in terms of legacy structures, platforms, or decisions."[184] We endorse this view and urge the Department not to squander the opportunity that this presents.

122. **Space acquisitions require an innovative and flexible approach to procurement, but the MoD will need to balance this against ensuring value for money for the taxpayer. This will not be an easy task, and the Department's endemic failure to robustly manage major projects does not inspire confidence that they will be able to meet this challenge. *The Department must meet its commitment to set out clear milestones for the significant infrastructure projects announced in the Defence Space Strategy by the end of this financial year. Timescales should also be included, and progress should be reported every six months.* We will write to the Comptroller and Auditor General asking him to increase his oversight of these new projects to provide additional assurance and we intend to scrutinise their progress closely. In this emerging domain the Ministry of Defence has a real opportunity to learn from its past failings: history must not be repeated.**

181 Q191
182 Juliana Suess, Royal United Services Institute, The UK Defence Space Strategy, accessed 4 October 2022
183 MoD (SPDF0029)
184 RAND Europe (SPDF0020)

Conclusions and recommendations

The UK Space Sector: Strategy and Governance

1. Recent years have seen welcome, if only partially successful, attempts to bring more coherence to space activity both across Whitehall and within the Ministry of Defence. The creation of the National Space Council and the MoD's Space Directorate were recognised by witnesses as being positive developments in this regard. As we came to the end of our inquiry, we were therefore both surprised and concerned to note that the Government has removed the National Space Council from the list of Cabinet Committees, and that the Space Directorate looks set to be disbanded. *In its response to this report the Department must provide an explanation for these changes. It should set out what new governance arrangements have been put in place and why it believes they will be more effective at swiftly implementing the vision set out in the National and Defence Space Strategies.* (Paragraph 27)

2. Even before these recent developments, which seem to be a backward step, cross-Whitehall governance on space lacked sufficient clarity and direction. The delays to publication of the National and Defence Space Strategies frustrated industry and other stakeholders and suggest that despite the previous Prime Minister's stated personal commitment to making the UK "a meaningful player in space", the Government is currently unable to drive changes through at pace, or even to meet its own deadlines. Nowhere is this better illustrated than by the continued delay and inertia surrounding space-based position, navigation and timing services, which we examine in detail later in this report. (Paragraph 28)

3. Vision must be backed up with delivery, and with space set to become ever more critical to the national interest it is clear that stronger, more cohesive leadership is required. *We recommend that a Minister for Space should be appointed within the Cabinet Office to provide clear centralised direction and accountability in taking forward the UK's civil and defence ambitions in space. This new position must be sufficiently resourced and should be given appropriate authority to effectively co-ordinate and drive forward policy and delivery.* (Paragraph 29)

Skills and recruitment

4. There is a clear challenge for the Government in addressing skills shortages and recruitment and retention difficulties in the space sector. Meeting this challenge will require a long-term, holistic approach to education and workforce development. Encouraging an interest in STEM subjects and space careers from a young age will be vital. (Paragraph 43)

5. Defence faces particular challenges in recruiting and retaining space specialists. We were encouraged by the Minister for the Armed Forces' support for a more flexible approach to recruitment and career management within Defence, and we support the use of secondments to and from industry. But changes must be made at pace if we are not to fall further behind both our adversaries and our peers. (Paragraph 44)

6. Space literacy must also be embedded across Defence if multi-domain integration is to succeed. *As well as establishing a Space Academy for defence space specialists, the MoD must ensure that wider professional military education comprehensively covers the role played by space in modern warfare. In its response to this report the Department should update us on its progress towards establishing a Space Academy and should set out target dates for the inclusion of space education on staff courses and across the Defence Academy curriculum.* (Paragraph 45)

Threats and Hazards

7. The response to Russia's invasion of Ukraine has underlined the importance of the international community taking a united approach in the face of irresponsible and aggressive behaviour. We welcome the UK's leading role at the United Nations in seeking to achieve a consensus on responsible norms and behaviours in space and we support and encourage the Government in continuing to drive this work forward. *An update on progress to date should be included in the Department's response to this report.* (Paragraph 66)

8. Space Domain Awareness capabilities are rightly recognised by Government and stakeholders as being critical to safely operating in an increasingly contested and congested space environment. A cross-Government SDA strategy should be produced and implemented as soon as possible: the Department should confirm in its response to this report that work on this is already underway and should give a target date for its publication. *A cross-Government SDA strategy should be produced and implemented as soon as possible: the Department should confirm in its response to this report that work on this is already underway and should give a target date for its publication.* (Paragraph 72)

9. Considered and strategic investment in the UK's SDA capabilities offers an opportunity to improve the UK's standing and contribution to Allied defence space efforts. *The Department should set out how it will ensure that the Defence Space Strategy's promised investment in Space Domain Awareness maximises the advantages offered by the UK's existing pockets of expertise and the location of its Overseas Territories.* (Paragraph 73)

Position, Navigation and Timing

10. The events surrounding the UK's expulsion from the EU's Galileo programme were deeply unsatisfactory and demonstrated a failure of statecraft on all sides. The European Commission's decision was deeply regrettable given the extensive contribution, including financing of £1.2 billion, that the UK had made to the Galileo programme since its inception. (Paragraph 83)

11. Against this backdrop of political failure, it is simply unacceptable that almost four years on, and with tens of millions of pounds spent, the Government appears no closer to coming to any conclusions about development of the UK's own space-based Position, Navigation and Timing (PNT) capabilities. Most recently the Space Based Position, Navigation and Timing Programme (SBPP), led by the UK Space Agency, seems to have disappeared without a trace. Given the vital need for a

resilient PNT network both for Defence and for other aspects of Critical National Infrastructure we are deeply concerned by the complacent attitude towards PNT within Government, and by the seemingly low priority which the MoD attaches to this work. *Government must publish the conclusions of the SBPP and should set out a clear timetable for producing and taking forward the UK's PNT strategy in its response to this report.* (Paragraph 84)

Sovereignty and collaboration

12. The Ministry of Defence will have to carefully balance competing priorities in determining which defence space capabilities must be "owned" by Government and which can be provided by collaboration with Allies or through a commercial contract. Russia's recent impounding of OneWeb satellites at the Baikonur cosmodrome demonstrates the potential dangers of making the wrong call, and the subsequently announced proposed merger of the OneWeb with Eutelsat has raised further questions concerning sovereignty and national security. *The planned merger between OneWeb and Eutelsat must be subject to the most stringent scrutiny under the National Security and Investment Act. More broadly, it is critical that decisions affecting the sovereignty of the UK's defence space capabilities are made transparently. The MoD should confirm in its response to this report how it plans to make details of these decisions available for scrutiny by Parliament.* (Paragraph 102)

The UK's Defence Space Capabilities: Opportunity and Challenge

13. The investment in new space capabilities set out in the Defence Space Strategy, and the procurement of the next generation of Skynet communications satellites, will provide a clear opportunity for the MoD to make a positive long-term impact on the sustainability and productivity of the UK's space industry. *The Department should explain in its response to this report how it will ensure that its investment in the sector maximises benefits to the UK by growing and sustaining a skilled workforce, attracting investment, rewarding innovation, providing meaningful engagement with SMEs and adding social value. The Department should also provide an update on Skynet 6, including expected contract award dates for the Service Delivery Wrap and Enduring Capability strands of the programme.* (Paragraph 110)

14. In order to meet the challenges posed by the rapid pace of technological advancement in the space domain, the MoD will need to take every opportunity to learn from the experiences of Allies. The pioneering approach taken by the US Space Development Agency will be of particular relevance. (Paragraph 116)

15. Space acquisitions require an innovative and flexible approach to procurement, but the MoD will need to balance this against ensuring value for money for the taxpayer. This will not be an easy task, and the Department's endemic failure to robustly manage major projects does not inspire confidence that they will be able to meet this challenge. *The Department must meet its commitment to set out clear milestones for the significant infrastructure projects announced in the Defence Space Strategy by the end of this financial year. Timescales should also be included, and progress should be reported every six months. We will write to the Comptroller and Auditor General asking him to increase his oversight of these new projects to provide*

additional assurance and we intend to scrutinise their progress closely. In this emerging domain the Ministry of Defence has a real opportunity to learn from its past failings: history must not be repeated. The Department must meet its commitment to set out clear milestones for the significant infrastructure projects announced in the Defence Space Strategy by the end of this financial year. Timescales should also be included, and progress should be reported every six months. (Paragraph 122)

Formal minutes

Tuesday 11 October 2022

Physical meeting

Members present

Tobias Ellwood, in the Chair

Dave Doogan

Mark Francois

John Spellar

Defence Space

Draft Report (*Defence Space: through adversity to the stars?*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 122 read and agreed to.

Summary agreed to.

Resolved, That the Report be the Third Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available (Standing Order No. 134).

Adjournment

Adjourned till Tuesday 18 October 2022 at 2.00pm.

Witnesses

The following witnesses gave evidence. Transcripts can be viewed on the inquiry publications page of the Committee's website.

Tuesday 13 July 2021

Dr Mark Hilborne, Lecturer in the Defence Studies Department, Kings College London; **Dr Mark Presley**, Consultant on Space Policy and Strategy, MAP Analytica Q1–42

Tuesday 07 September 2021

Nik Smith, Vice-Chair, Security and Defence Committee, UKspace; **Nick Shave**, Chair, UKspace Q43–135

Anita Bernie, Strategy and Execution, KISPE Space Systems Ltd; **Richard Franklin**, Managing Director, Airbus Defence and Space Ltd Q43–135

Tuesday 14 December 2021

Major Tim Peake CMG, British ESA Astronaut Q136–191

Justin T. Johnson, Senior Vice President, Meta Aerospace Q136–191

Tuesday 08 March 2022

George Freeman MP, Minister for Science, Research and Innovation, Department for Business, Energy & Industrial Strategy; **James Heappey MP**, Minister for the Armed Forces, Ministry of Defence; **Air Vice-Marshal Harvey Smyth**, Director Space, Ministry of Defence; **Rebecca Evernden**, Director for Space, Department for Business, Energy and Industrial Strategy Q192–274

Published written evidence

The following written evidence was received and can be viewed on the inquiry publications page of the Committee's website.

INQ numbers are generated by the evidence processing system and so may not be complete.

1 AWE (SPDF0019)

2 Airbus (SPDF0011)

3 Airbus Defence and Space (SPDF0028)

4 Airbus Defence and Space (SPDF0023)

5 Astroscale Ltd (SPDF0013)

6 BAE Systems plc (SPDF0017)

7 Bowen, Dr Bleddyn (Lecturer in International Relations, University of Leicester) (SPDF0001)

8 CGI (SPDF0015)

9 CND (SPDF0005)

10 Council on Geostrategy (SPDF0018)

11 Fraser, Mr Neil (Director Defence & Space Programmes, NSSLGlobal) (SPDF0003)

12 Harlette Capital Ltd (SPDF0004)

13 Haydn Belfield (Academic Project Manager, Centre for the Study of Existential Risk, University of Cambridge); and Tildy Stokes (External Consultant, Centre for Long-Term Resilience) (SPDF0016)

14 Hilborne, Dr Mark (Lecturer, King's College London); and Dr Mark Presley (Director, MAP Analytica) (SPDF0007)

15 L3Harris Technologies (SPDF0022)

16 Lockheed Martin UK (SPDF0026)

17 Lockheed Martin UK (SPDF0006)

18 Ministry of Defence (SPDF0029)

19 Ministry of Defence (SPDF0021)

20 Northrop Grumman Corporation (SPDF0008)

21 RAND Europe (SPDF0020)

22 Reaction Engines (SPDF0027)

23 Skyrora Limited; and Northern Space and Security Ltd (SPDF0025)

24 Space Forge Ltd (SPDF0024)

25 Team Athena; Lockheed Martin UK; CGI UK; Serco; and Inmarsat (SPDF0002)

26 Thales (SPDF0014)

27 UKspace (trade association) (SPDF0010)

28 Viasat UK (SPDF0009)

List of Reports from the Committee during the current Parliament

All publications from the Committee are available on the publications page of the Committee's website.

Session 2022–23

Number	Title	Reference
1st	The Treatment of Contracted Staff for The MoD's Ancillary Services	HC 187
2nd	The Integrated Review, Defence in a Competitive Age and the Defence and Security Industrial Strategy	HC 180
1st Special	Operation Isotrope: the use of the military to counter migrant crossings: Government response to the Committee's fourth report of Session 2021–22	HC 267
2nd Special	The Treatment of Contracted Staff for the MOD's Ancillary Services: Government Response to the Committee's First Report	HC 702

Session 2021–22

Number	Title	Reference
1st	Russia and Ukraine border tensions	HC 167
2nd	Women in the Armed Forces	HC 154
3rd	"We're going to need a bigger Navy"	HC 168
4th	Operation Isotrope: the use of the military to counter migrant crossings	HC 1069
1st Special	Obsolescent and outgunned: the British Army's armoured vehicle capability: Government Response to the Committee's Fifth Report of Session 2019–21	HC 221
2nd Special	Manpower or mindset: Defence's contribution to the UK's pandemic response: Government Response to the Committee's Sixth Report of Session 2019–21	HC 552
3rd Special	Russia and Ukraine border tensions: Government Response to the Committee's First Report	HC 725
4th Special	Protecting those who protect us: Women in the Armed Forces from Recruitment to Civilian Life: Government Response to the Committee's Second Report	HC 904
5th Special	"We're going to need a bigger Navy": Government Response to the Committee's Third Report	HC 1160