



National Audit Office

Report

by the Comptroller
and Auditor General

Ministry of Defence

Carrier Strike – Preparing for deployment

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Carrier Strike – Preparing for deployment

Report by the Comptroller and Auditor General

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Gareth Davies
Comptroller and Auditor General
National Audit Office

18 June 2020

In this report, we examine how the Department has managed the programme since 2017 and how it is addressing the risks towards achieving the full capabilities of a carrier strike group.

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Key facts

£6.4bn

forecast build costs of two new Queen Elizabeth Class aircraft carriers, £193 million (3%) above the revised budget

£6.0bn

expenditure to date on new Lightning II jets, out of an approved project budget of £10.5 billion

Not forecast

the Ministry of Defence (the Department) has not estimated the full future costs of Carrier Strike

December 2020

date when the Department expects to declare initial Carrier Strike capability

December 2023

date the Department expects to declare full operating capability for Carrier Strike

March 2026

date the Department expects to declare that Carrier Enabled Power Projection has full operating capability

18 months

expected delay to developing the initial operating capability for the new airborne radar system, critical for protecting a carrier strike group

48

number of Lightning II jets the Department expects to have by 2025, out of its intention to buy 138 jets

1

number of solid support ships available to resupply a carrier strike group for the foreseeable future, instead of the three that will be required at full operating capability

Two milestones which we discuss in this report are Initial Operating Capability (IOC) and Full Operating Capability (FOC). The definitions are:

- **IOC** is the minimum level at which the capability or service is usefully deployable.
- **FOC** is the level of military capability which is intended for a particular project.

Summary

1 Carrier Strike provides the ability to launch fixed-wing aircraft from a ship to undertake a range of military tasks. It is central to the government's plans for the country's armed forces and the first step towards Carrier Enabled Power Projection (CEPP), which is the government's ambition to be able to respond to conflicts and support humanitarian relief efforts anywhere in the world at short notice. It intends Carrier Strike to be interoperable with NATO allies. The UK has been without such a capability since 2010, when the Ministry of Defence (the Department) retired the Harrier aircraft that had operated from its Invincible Class aircraft carriers.

2 Carrier Strike will be based around two Queen Elizabeth Class aircraft carriers – the largest warships ever built for the Royal Navy – together with Lightning II jets, which are being bought through the United States (US) Department of Defense's international programme. The Department is also buying a new airborne radar system, Crowsnest, to help protect a carrier strike group. Depending on the type of deployment, the carriers will be accompanied by at least one destroyer, an anti-submarine warfare frigate, and ships for support and resupply.

3 As at April 2020, the Department had two new aircraft carriers and 18 Lightning II jets. It has conducted sea trials to ensure its new aircraft and helicopter fleet (including those used for Crowsnest) can operate safely from the carriers. The Department expects to have an initial Carrier Strike capability by December 2020 and is working towards its first operational deployment, with the US, in 2021. Its next milestone is to achieve full operating capability for Carrier Strike in 2023 – at which point it will be able to support two UK Lightning II squadrons (up to 24 jets) from one of the carriers. The Department's longer-term aim is that, by 2026, it can undertake a wide range of air operations and support amphibious operations worldwide.

4 Since 2011, we have reported four times on the Department's progress on Carrier Strike.¹ Our early reports covered the decisions about the type of carrier and jets that the Department bought. In 2017, we highlighted that the phase to 2020 would be crucial and there was little room for manoeuvre in the delivery schedule. In this report, we examine how the Department has managed the programme since 2017 and how it is addressing the risks towards achieving the full capabilities of a carrier strike group. We set out:

- the background to Carrier Strike and what the Department has achieved since we last reported (Part One);
- the Department's progress in managing the elements of the programme that are still needed to provide the full Carrier Strike capabilities (Part Two); and
- how the Department is addressing the challenges to achieving its ambitions for Carrier Strike (Part Three).

5 Our report focuses on the Department's approach to addressing the risks to achieving the capabilities of Carrier Strike. We do not evaluate the military or wider capabilities that Carrier Strike will provide, or the plans for its operational use.

Key findings

Progress since 2017

6 The Department has made considerable progress since 2017. It has built two new carriers in line with its overall timetable and at a forecast cost of £6.4 billion, which is £193 million (3%) above the revised budget agreed in 2013. It has successfully applied lessons from building *HMS Queen Elizabeth* to *HMS Prince of Wales* and has accepted both aircraft carriers into service. As at April 2020, the Department had spent £6.0 billion on the Lightning II project and received 18 jets, in line with its delivery schedule.² It has also completed the infrastructure necessary to berth both carriers simultaneously at Portsmouth, and most of the facilities for the Lightning II jets at RAF Marham (paragraphs 1.9 to 1.16 and 1.20).

¹ Comptroller and Auditor General, Ministry of Defence, *Carrier Strike*, Session 2010–2012, HC 1092, National Audit Office, July 2011; Comptroller and Auditor General, Ministry of Defence, *Carrier Strike: Supplementary Report*, Session 2010–2012, HC 1657, National Audit Office, November 2011; Comptroller and Auditor General, Ministry of Defence, *Carrier Strike: The 2012 reversion decision*, Session 2013–14, HC 63, National Audit Office, May 2013; Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016–17, HC 1057, National Audit Office, March 2017.

² This includes the design and development of the jets, infrastructure and training facilities.

Delivering the full capabilities of a carrier strike group

7 The new Crowsnest system is 18 months late, which will affect Carrier Strike’s capabilities in its first two years. The Crowsnest airborne radar system will provide a crucial element of protection for a carrier strike group, but the initial contracted capability will not be available until September 2021, 18 months later than planned. The Department did not oversee its contract with Lockheed Martin effectively and, despite earlier problems on the project, neither was aware of the sub-contractor’s lack of progress until it was too late to meet the target delivery date. It subsequently concluded that the sub-contractor working on the project, Thales, failed to meet its contractual commitments to develop the equipment and had not provided sufficient information on the project’s progress. The Department and its industry partners have since implemented a recovery plan and enhanced monitoring arrangements. However, further delays mean that it does not expect to have full airborne radar capability until May 2023 (paragraphs 2.2 to 2.8).

8 The Department has not yet made funding available for enough Lightning II jets to sustain Carrier Strike operations over its life. From 2015, its intention has been to buy 138 Lightning II jets, which will sustain Carrier Strike operations to the 2060s. The Department initially ordered 48 jets but has not yet committed to buying any more. In response to wider financial pressures, it will also receive seven of the 48 jets in 2025, a year later than planned. Since we reported in 2017, the approved cost of the Lightning II project has increased from £9.1 billion to £10.5 billion (15%), reflecting approvals for capability upgrades, integration of UK weapons and sustainment costs. There will be further cost approvals to upgrade the existing fleet with new software and weapons, and there is a continued risk of cost increases due to exchange rate fluctuations. The Department plans to reassess the number and type of Lightning II jets that it needs in the Integrated Review,³ but its ability to use Carrier Strike will be constrained if it has fewer jets than planned (paragraphs 1.14 to 1.18).

³ The Integrated Review of Security, Defence, Development and Foreign Policy.

9 The Department has been slow to develop the solid support ships which are crucial to operating a carrier strike group. Carrier Strike relies on the sustained availability of munitions and stores, such as ammunition and food. However, the Department has only one ship able to resupply a carrier group, which slows the tempo and reach at which this can be done. It has long been aware that this will restrict the operational freedom of Carrier Strike but has not yet developed a solution. In November 2019, the Department stopped the competition to build three new support ships due to concerns about value for money. It believes this will delay the introduction of new ships by between 18 and 36 months, making it uncertain the first new ship will be operational before the existing support ship leaves service in 2028. The Department will also incur additional maintenance costs while it uses its existing support ship as an interim solution (paragraphs 2.15 to 2.17).

10 The Department has still not provided the necessary funding for logistics projects and munitions. We highlighted the importance of these requirements in our 2017 report,⁴ but the Department still does not have funding to develop a long-term capability to move people and goods, including Lightning II parts, to or within a carrier group. Nor has it developed a stockpile strategy capable of supporting CEPP, or identified the consequent funding requirements. The responsibilities for developing some support requirements have been unclear, while others are split across the front-line commands,⁵ contributing to the slow progress in developing these capabilities. The creation of a logistics team increased awareness of these issues, but the team was established too late to influence the design of support requirements and has had no authority to develop solutions (paragraphs 2.10 to 2.14).

Progress towards programme milestones

11 The Department expects to meet its target of declaring initial operating capability for Carrier Strike in December 2020, but with a basic radar capability. ‘Initial operating capability’ is a single, trained Lightning II squadron (up to 12 jets), able to embark on a joint warfighting mission with appropriate support and maritime protection. The Department has undertaken a successful programme of sea trials and conducted significant work with its counterparts from the US to prepare for the first joint deployment in 2021. However, as stated in paragraph 7, Carrier Strike will not have the level of airborne radar capability that it originally expected at this point (paragraphs 1.3, 1.9, 1.10, 2.7 and 2.18 to 2.20).

4 Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057, National Audit Office, March 2017.

5 The Royal Navy (Navy Command), Royal Air Force (Air Command) and Strategic Command manage projects in the CEPP programme.

12 The Department faces a tight schedule in developing the full capability of Carrier Strike. Achieving the initial operating capability is the first step to developing the full capabilities of Carrier Strike. The Department faces a tight timetable to develop full operating capability by 2023. It needs to monitor the delivery of multiple projects and coordinate the integration of supporting capabilities at times when the ships are operational, with more limited time available in the UK for maintenance and enhancement works. It will also have to respond to ongoing challenges and financial pressures, which create uncertainty in developing and enhancing the range of capabilities that are needed. The Department is developing a programme plan to manage the new challenges it faces and achieve full operating capability. It expects to endorse this in September 2020 and is assessing the impact of the COVID-19 pandemic on future capability milestones (paragraphs 1.4, 2.21 to 2.24 and 3.5 to 3.8).

Achieving the ambition for Carrier Strike

13 The Department’s policy ambition for Carrier Strike will be reviewed.

The 2015 Strategic Defence and Security Review set out the long-term ambition for Carrier Strike. The Department translated this into plans and an operating model to guide its development and use. It planned to publish a policy statement but subsequently decided to reassess its ambition as part of the Integrated Review which, due to the COVID-19 pandemic, has now been delayed. The Department expects to set out its ambitions for Carrier Strike as part of a new defence strategy. It will assess the impact of ongoing financial pressures and determine its defence priorities, including whether it can fund all the original roles of Carrier Strike, including supporting amphibious capabilities (paragraphs 3.2 to 3.4).

14 The Department faces investment prioritisation decisions to maintain and enhance the Carrier Strike capability over the longer term. The aircraft carriers have a 50-year lifespan but many capabilities in a carrier strike group will retire before then. However, the Department has not established a consolidated view of the enhancements that are needed to continue to develop Carrier Strike’s capabilities, or their cost. It will need to make funding decisions in the next 10 years, such as deciding how to replace or extend Merlin helicopters, which are due to go out of service in 2030. These decisions will create added funding pressures at a time when the Equipment Plan is already unaffordable.⁶ We have seen examples of commands reassessing their investment in capabilities due to financial pressures (paragraphs 3.5 to 3.8).

⁶ Comptroller and Auditor General, Ministry of Defence, *The Equipment Plan 2019 to 2029*, Session 2019-20, HC 111, National Audit Office, February 2020.

15 The Department is developing a fuller understanding of what Carrier Strike will cost to operate and support in the future. Given the strategic importance of Carrier Strike, we would expect the Department to develop a clear view of support and operating costs. It estimated the additional costs of Carrier Strike in 2017, but this did not include all elements of a carrier strike group. It plans to update this estimate after the first deployment in 2021 and is developing a better understanding of the maintenance and logistics activities that are needed. The commands routinely include forecasts of operating and support costs for the different elements of a strike group in their future budgets. However, we found:

- the initial budget for the carriers' spare parts was set too low and recent trials have shown that demand is likely to be higher than expected. In 2020, it began a 'support improvement' programme to improve its approach to maintenance and provision of spares;
- the forecasts of future support costs for some equipment may be underestimates. We identified issues with the quality of some data and the optimistic treatment of risks; and
- the Department has modelled scenarios for using Carrier Strike according to its baseline planning assumption. It explored the costs of other deployment patterns in 2017, and plans to update this analysis in 2021 (paragraphs 3.9 to 3.20).

16 The Department may not have made sufficient provision in later years' budgets to reflect the full costs of operating Carrier Strike. Failure to make realistic cost estimates creates a risk that the Department will face increased financial pressure in the future, perpetuating the cycle of short-term decision-making that we have seen in our reports on the Equipment Plan.⁷ Navy and Air Commands have made provision for Carrier Strike through their normal budgeting process and the Department is confident that it can fund Carrier Strike's deployment in 2021. However, there is a risk that budget provisions may not cover all of Carrier Strike's future needs; for instance, there are doubts that budgets for future years will be sufficient to fund routine deployments and keep both carriers ready for use at short notice (paragraph 3.19).

⁷ Most recently, Comptroller and Auditor General, Ministry of Defence, *The Equipment Plan 2019 to 2029*, Session 2019-20, HC 111, National Audit Office, February 2020.

17 The Department needs to ensure the revised governance arrangements establish clear responsibilities and cross-command coherence for developing Carrier Strike. The Department's small programme team has provided effective oversight of the programme to date, reporting risks to the Defence Board and engaging commands to take the actions needed. It has enabled the Department to better understand the progress towards programme milestones. However, the team relies on the commands to manage and fund individual projects and, as the programme transitions into the operational phase in 2021, the Department will face new challenges. It will be important that the new governance arrangements support the long-term development of Carrier Strike by providing strategic oversight of commands' equipment and support plans, and manage the practical challenges of developing and maintaining Carrier Strike alongside its operational deployments (paragraphs 3.21 to 3.24).

Conclusion on value for money

18 Since we last reported, the Department has received two new aircraft carriers into service, now has 18 Lightning II jets and has developed much of the UK infrastructure to support them. It has delivered the carriers for £6.4 billion, which is just 3% above the revised figure announced to Parliament in 2013. The Department has conducted successful sea trials and is working closely with the US to be ready for its first joint deployment in 2021. It has also established plans for using Carrier Strike in its early years.

19 The Department is, however, making slower progress in developing the crucial supporting activities that are needed to make full use of a carrier strike group, such as the Crowsnest radar system and the ability to resupply the carriers. In addition, it has not established a clear view on the future cost of enhancing, operating and supporting Carrier Strike, which creates the risk of future affordability pressures. The Department will not achieve value for money from its investment to date unless it provides clarity on its future ambitions; develops its understanding of future development and operating costs; and ensures cross-command coherence and collaboration to develop the full capabilities of Carrier Strike.

Recommendations

20 The Department faces significant challenges if it is to build on its progress since 2017 and develop the full capabilities of a carrier strike group. Our recommendations are intended to support the Department in the next phase of the programme. It should:

- a** **develop a full understanding of the costs of running and supporting Carrier Strike.** This should be updated to reflect data from forthcoming deployments and include modelling on a range of operational scenarios. It should use these estimates to inform major decisions and understand the consequential impact on the Armed Forces as a whole. It should also test whether future funding provisions are realistic, including by improving the quality and governance of its financial planning forecasts;
- b** **restate its ambition and objectives for Carrier Strike when the Integrated Review is published.** It should use this Review to form a revised plan to achieve its milestone of full operating capability for the Carrier Enabled Power Projection programme in 2026. At the strategic level, it should consider the extent of interoperability with allies and ensure its priorities are reflected in command plans. At an operational level, it should develop a detailed programme schedule, identifying interdependencies and critical path;
- c** **establish a clear view on the future enhancement costs of a carrier strike group.** It should develop a consolidated long-term investment plan covering all capabilities in a carrier strike group, identifying out-of-service dates and when decisions are needed. It should also ensure commands are making coherent investment decisions to support the continued development of Carrier Strike. This should include identifying funding shortfalls that inhibit achieving its ambition and making strategic cross-command decisions about how to resolve them;
- d** **monitor the new governance arrangements for the Carrier Enabled Power Projection programme to ensure they are working effectively.** The new arrangements need to provide cross-command oversight of funding commitments, a coherent approach to managing developments, and clear responsibilities for decision-making on Carrier Strike operations. These arrangements should address any potential conflicts within or between commands, and ensure long-term development or operational needs are not undermined by short-term financial pressures; and
- e** **conduct in-depth lessons-learned exercises on the Carrier Enabled Power Projection projects.** The Department should ensure that it assesses the factors that lead projects to succeed or fail, including the root causes, and disseminate the lessons so that they are reflected in its management of other programmes. It should also look to disseminate lessons more widely across government.

Part One

Programme performance since 2017

1.1 Carrier Strike is the ability to launch fixed-wing aircraft from a ship to carry out a range of military tasks. This Part explains the strategic importance of Carrier Strike and examines the Ministry of Defence's (the Department's) progress since 2017. In particular, we focus on the Department's achievements to date, notably delivery of the Queen Elizabeth Class carriers, purchase of Lightning II jets and construction of supporting facilities.

The Carrier Strike capability

1.2 The Department has bought two new aircraft carriers and is buying Lightning II jets as part of the United States' Department of Defense's international programme.⁸ These are the largest warships and most technologically sophisticated jets purchased by the UK. The Department is also buying a new airborne radar system, Crowsnest, which will be fitted to Merlin helicopters flying from the carriers. It has rebuilt infrastructure in the UK to accommodate the carriers and jets, and is developing the necessary supporting capabilities to operate a carrier strike group, such as new supply ships.

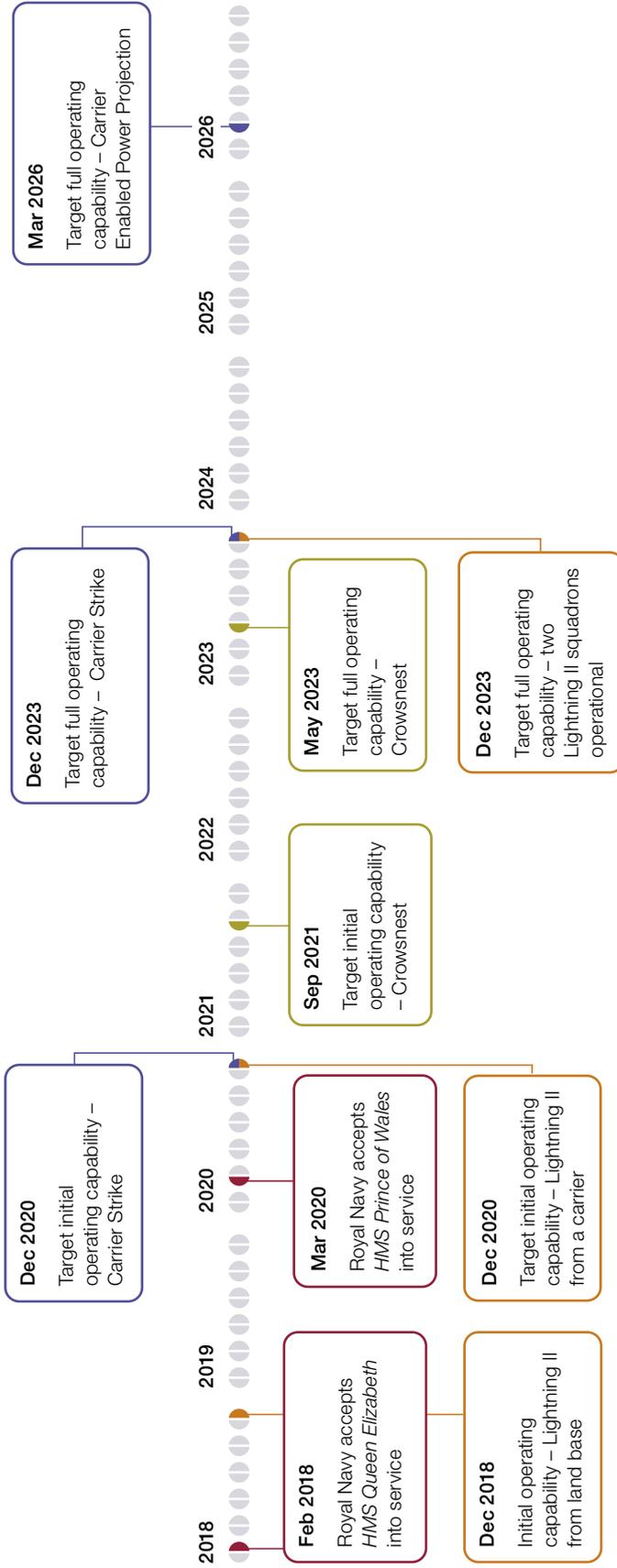
1.3 By December 2020, the Department aims to have an initial operating Carrier Strike capability.⁹ This level of capability consists of a squadron of up to 12 Lightning II jets flying from one carrier fitted with the Crowsnest radar system, with supporting infrastructure, logistics, communications and surveillance in place. The UK has been without a Carrier Strike capability since 2010, when the Department retired the Harrier aircraft operating from Invincible Class carriers.

1.4 The government sees Carrier Strike as central to the UK's future defence strategy and as the first step towards a Carrier Enabled Power Projection (CEPP) capability. To achieve this, between 2020 and 2026, the Department plans to introduce a second carrier and another squadron of jets, and complete sea trials and training (**Figure 1** overleaf). Ultimately, this will allow the carriers to perform a range of roles, including acting as helicopter carriers.

⁸ F-35 Lightning II Program (also known as the Joint Strike Fighter program).

⁹ Initial Operating Capability is the minimum level at which the capability or service is usefully deployable.

Figure 1 Timeline for the main Carrier Enabled Power Projection projects, 2018 to 2026
 The Ministry of Defence (the Department) aims to achieve full Carrier Enabled Power Projection capability in 2026



- Carrier Enabled Power Projection programme
- Crowsnest airborne radar project
- Lightning II jet project
- Queen Elizabeth Class carriers project

Notes

- 1 Initial operating capability is the minimum level at which the capability or service is usefully deployable.
- 2 Full operating capability is the intended level of military capability.
- 3 As at June 2020, the Department was considering changing the December 2023 milestone for the Lightning II project from full operating capability (concurrent operations) to initial operating capability. The Department told us that this change would not affect its ability to achieve Carrier Strike full operating capability in December 2023 and that it still expects to have two operational squadrons by this date.

Source: National Audit Office analysis of Ministry of Defence data

1.5 The Department’s aim for CEPP is to project the UK’s maritime power internationally. It will have a range of uses, allowing the Department to undertake military action in response to conflicts and support wider defence tasks, such as humanitarian relief, anywhere in the world. The Department intends the carriers to be interoperable with NATO allies and provide the UK with greater flexibility to act without needing to use other countries’ air bases.

1.6 The carriers cannot be used on their own. Depending on the type of deployment, a carrier will be accompanied by at least one destroyer, an anti-submarine warfare frigate and auxiliary vessels for support and resupply (**Figure 2** overleaf). A carrier strike group also needs logistics and communications so that its equipment works effectively together, and suitable infrastructure at base to allow maintenance and resupply.

1.7 Deploying Carrier Strike will require a significant proportion of the Navy’s fleet, requiring it to maintain the availability of destroyers and frigates. Navy Command faces financial pressures over the next 10 years which could impact on availability and is assessing how to address funding shortfalls across the Type 31, Type 26 and Fleet Solid Support ships programmes. Financial pressures include the following factors:

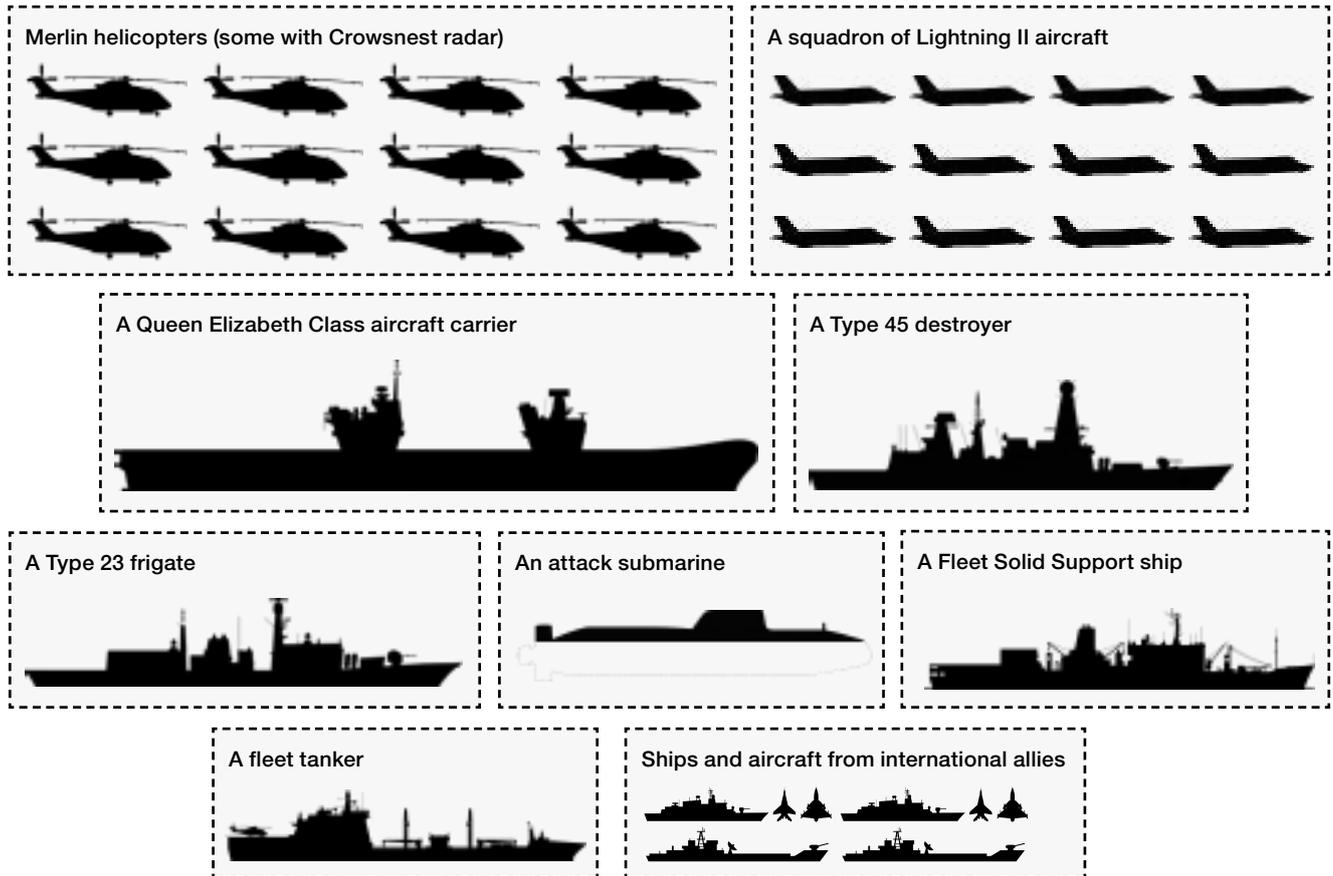
- In 2017, we reported on technical problems with the propulsion system on the six Type 45 destroyers, which provide air defence for a carrier group. In January 2020, the government announced the first destroyer will receive power improvement upgrades in spring 2020 and return to sea trials in 2021. It plans to upgrade all the ships by the mid-2020s.
- Anti-submarine duties are undertaken by eight Type 23 anti-submarine frigates. These will begin to leave service, one each year, from 2023. The Department has ruled out further life extensions because they are already operating beyond their design life.
- The anti-submarine role will fall to new Type 26 specialist frigates. The government has committed to buying eight and signed a contract for the first three in July 2017. The in-service date of the first is 2027. The Department expects to approve the purchase of a second batch by 2022.¹⁰
- The Department plans to buy five general-purpose Type 31 frigates to replace five Type 23 general-purpose frigates. These cannot undertake anti-submarine duties for a carrier strike group. It anticipated the first Type 31 would enter service in 2023, but in October 2019 the Department approved a revised in-service date for the first ship of May 2027, placing additional demands on the Type 23s. The Department also increased the budget for the Type 31 programme by £0.52 billion (36%) from £1.46 billion to £1.99 billion.

¹⁰ Ministry of Defence, *The Defence Equipment Plan 2019*, February 2020.

Figure 2

An illustrative UK carrier strike group

The composition will vary depending on the type of location and deployment



Notes

- 1 The Ministry of Defence will begin retiring Type 23 anti-submarine frigates from 2023, and their role will be assumed by Type 26 anti-submarine frigates.
- 2 An attack submarine and international allies are both optional parts of the group.
- 3 This excludes infrastructure and other optional assets, including unmanned air surveillance or other types of helicopter.

Source: National Audit Office analysis of Ministry of Defence data

The Department's progress since 2017

1.8 The CEPP programme involves three core equipment projects (the carriers, Lightning II jets and Crowsnest), plus infrastructure and support projects to operate Carrier Strike. We set out below the Department's progress since 2017, and in Part Two we examine the ongoing challenges that it faces (including the Crowsnest project).

Carriers

1.9 When we reported in 2017, the Department was on track to accept *HMS Queen Elizabeth* from the supplier but faced a tight schedule with limited contingency. As at April 2020, it had accepted both carriers into service:

- *HMS Queen Elizabeth* in February 2018, two months later than the target date. It has undertaken sea trials and successfully achieved its first fixed-wing flying trial in August 2018, two months ahead of schedule. The Department completed further sea trials in December 2019, testing the ship's capabilities by performing different operating scenarios and deploying both fixed- and rotary-wing aircraft.
- *HMS Prince of Wales* in March 2020, delivered by target date. The Department successfully completed its first sea trials in September 2019.

The Department and its industry partners in the Aircraft Carrier Alliance¹¹ have worked together effectively to bring the carriers into service. The level of outstanding work from the build contracts was also in line with the Department's expectations. Both carriers will continue with trials leading up to the first deployment with the US Marine Corps in 2021.

1.10 Preparing for the joint deployment of Carrier Strike with the US has involved a high level of international collaboration. The Department has worked closely with its counterparts in the US, holding regular meetings to allow data-sharing, identification of risks and alignment of a joint action plan. It has made modifications to the carriers and conducted joint training and trials.

¹¹ An alliance with BAE Systems, Thales UK and Babcock to deliver the Queen Elizabeth Class carrier project.

1.11 In April 2020, the Department forecast that it will complete the carriers build project for £6.405 billion, an increase of £193 million (3%) from the £6.212 billion agreed in the re-baselined project in 2013. This reflects its share of the overall cost increases on the project, in accordance with the ‘pain-share’ agreement it signed with its industry partners in 2013 and amended in 2019. The increase was mainly due to industry underestimating the complexity of the works, leading to over-optimism in initial cost forecasts, and the need to respond to unforeseen technical issues and poor-quality work from earlier phases (**Figure 3**).

Figure 3

Changes to the approved costs of the Carriers project, 2017 to 2020

Costs have increased by £193 million (3%) since they were re-baselined in 2013

Date	Total approved cost (£m)	Approved cost increase (£m)	Description
March 2017	6,212		2013 re-baselined project cost reported in the National Audit Office's report <i>Delivering Carrier Strike</i> , March 2017.
March 2017		27	Changes including thermal spray on the carrier flight deck, establishing the Aircraft Carrier Alliance as the design authority for <i>HMS Prince of Wales</i> .
June 2018		122	The Ministry of Defence's share of the cost growth above the target price and additional risk provision.
April 2019		44	Cost growth above the target price, schedule risk and contingency.
June 2020	6,405		

Notes

- 1 Numbers have been rounded.
- 2 Each approval is an additional spend on the project.
- 3 Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057-I, National Audit Office, March 2017.

Source: National Audit Office analysis of Ministry of Defence data

1.12 The Department has performed well to manage project costs since 2013. It has used a range of measures, including:

- closely examining the contract specification – which led it to remove £348 million from the industry estimate – and the inclusion of a 50:50 ‘pain-share’ agreement on cost increases above a target price;
- providing subject matter experts to improve industry’s cost forecasting and introducing a bottom-up costing methodology;
- reviewing contract expenditure three times a year. In April 2019, the Department rejected £35 million costs proposed by suppliers as not being fair and reasonable. It also amended the contract to reduce its share of cost increases; and
- setting cost reduction targets with clear accountability for their delivery.

We have seen evidence that the design freeze has led to obsolescence management earlier than originally planned for some equipment, and some capability insertions have been deferred in response to affordability pressures.

1.13 The Department has applied lessons from building *HMS Queen Elizabeth* to *HMS Prince of Wales*. For example, it amended its design for *HMS Prince of Wales* to address problems that it encountered on the other ship, such as flooding. It also applied lessons from its first build programme, such as the decision to remain in dry dock longer to better sequence the fitting of equipment, reducing the time taken by 60%. Overall, the Department achieved a 39% reduction in the time taken to complete the testing and commissioning programme.

Lightning II

1.14 The Lightning II is a sophisticated stealth jet produced by Lockheed Martin in the USA. In 2015, the Department announced that it intended to purchase 138 jets and committed to operating two Lightning II squadrons (up to 24 jets) from the carriers, allowing operations to be conducted in two locations simultaneously. It is purchasing the jets in blocks under a memorandum of understanding with the US Government. It initially ordered 48 jets for delivery by 2024 and, as at April 2020, had received 18 jets.

1.15 Lightning II jets will be used for land and carrier-based operations.¹²

In December 2018, Air Command declared initial operating capability for flights from land. This means it can deploy Lightning II jets held at very high readiness from RAF Marham and conduct operations with suitably qualified and trained personnel. The Department signed off this declaration despite identifying 67 exceptions and problems with the global support solution.¹³ However, these have not prevented the Department from conducting its first operational deployment in June 2019 and undertaking sea trials in October 2019, when it flew Lightning II jets from the carriers for the first time.

1.16 As at April 2020, the Department had spent £6.0 billion on the Lightning II project, out of an approved budget of £10.5 billion.¹⁴ The Department has increased the approval limit four times since we reported in 2017, an increase of £1.4 billion (15%). It has a strategy of incremental acquisitions, and the approvals were for capability upgrades, integration of UK weapons and sustainment costs (**Figure 4**). In 2013, the Department estimated that the total cost of 48 jets over their whole life – to 2048 – would be £18.425 billion.

1.17 Future costs remain uncertain and could increase because of:

- the number of jets ordered by partner nations, which may change. The UK's share of the costs of the international programme is determined by the proportion of the total number of jets it purchases. This can vary if other nations change their order. The recent suspension of Turkey from the programme will increase the UK's costs by approximately £80 million over the life of the programme;¹⁵
- foreign exchange rate fluctuations, as project costs are in US dollars. The Department has mitigated foreign exchange rate volatility until 2022-23 by using forward purchase contracts with the Bank of England. However, in January 2020, Air Command found that if the then current exchange rates persisted, costs would be £0.8 billion higher; and
- additional funding needed to upgrade the fleet with the new software, weapons and training. The Department has already increased programme costs to include some upgrades and integrate weapons. But there have been delays in making funding provisions which mean the jets will have the full suite of weapons later than originally planned.

12 There are three variants of the F-35. The UK is buying the 'B' variant, which is capable of short take-off and vertical landing.

13 As at 7 April 2020, six exceptions remained and were due for closure by the end of 2020.

14 This included the UK's contribution to development costs, the purchase and initial support for 48 aircraft, supporting infrastructure and administration costs.

15 The UK agreed to meet 4.47% of the costs of the international Lightning II programme, based on the number of jets it is committed to purchase (138 jets out of a global total of 3,088). The suspension of Turkey has increased the UK contribution to 4.62%.

Figure 4

Changes to the approved costs of the Lightning II project, 2017 to 2020

By June 2020, the approved cost of the Lightning II project had increased by £1.4 billion since March 2017

Date	Total approved cost (£m)	Approved cost increase (£m)	Description
March 2017	9,132		Reported in the National Audit Office's <i>Delivering Carrier Strike</i> , March 2017.
July 2017		36	Capability upgrade to the air system for block one to meet UK full operating capability requirement. Includes foreign exchange risk.
October 2018		186	The UK's share of the modernisation programme for 2018 to 2021. Includes foreign exchange risk.
July 2019		520	Funding for five UK-specific weapons for UK Lightning II jets. Includes foreign exchange risk.
November 2019		625	To continue in-service support through the global support solution and UK support contracts from 2019-20 to 2022-23. Includes foreign exchange risk.
June 2020	10,499		

Notes

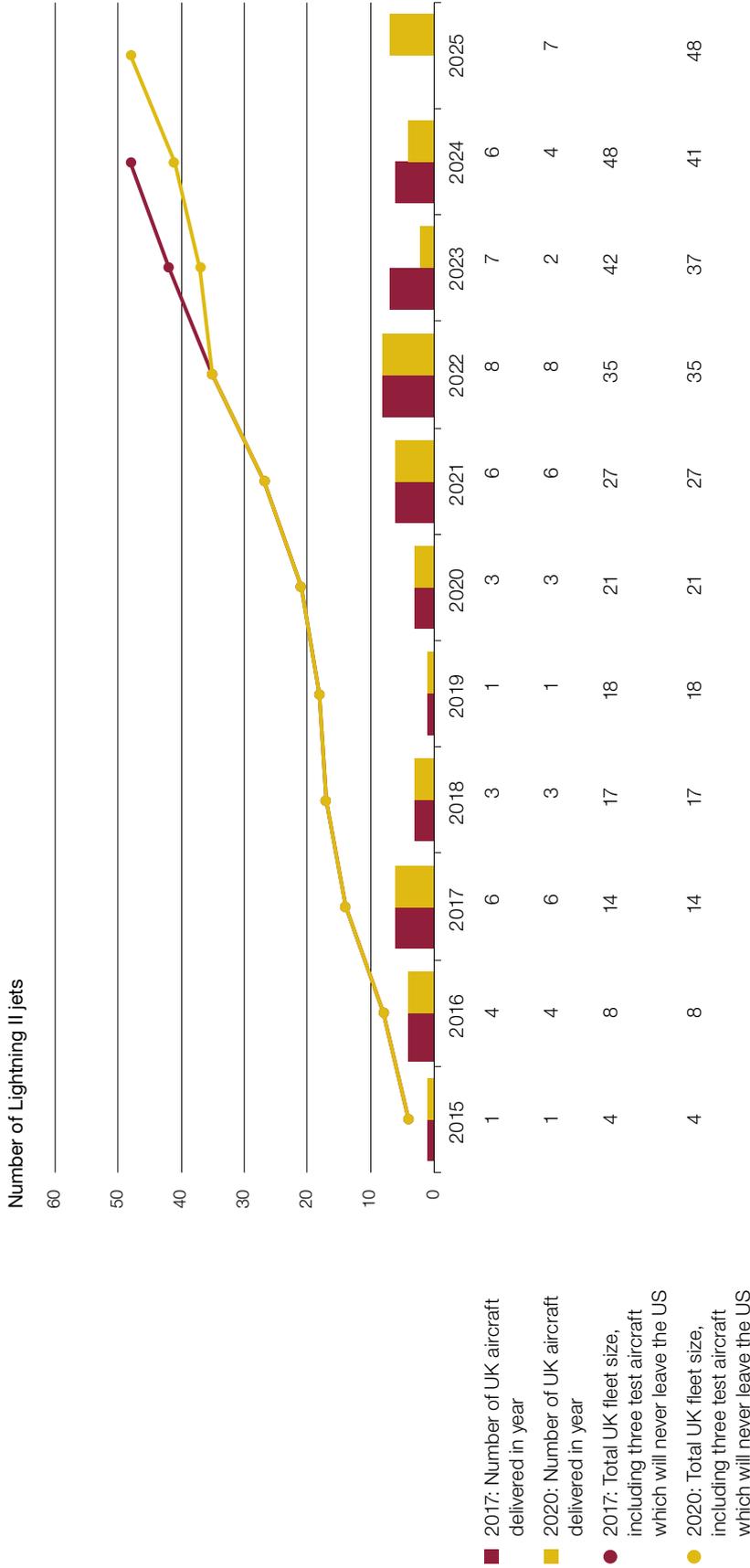
- Numbers have been rounded.
- Approved costs are not comparable with those reported by the Ministry of Defence in its annual report on the defence Equipment Plan as the table presents different cost elements and time period.
- Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057-I, National Audit Office, March 2017.

Source: National Audit Office analysis of Ministry of Defence data

1.18 In February 2020, the Department reprofiled the delivery of jets in response to ongoing financial pressures across its wider portfolio. It has slowed deliveries from 2023 onwards and will receive the last seven jets in 2025, a year later than planned (**Figure 5** overleaf). The Department will need to manage the operational consequences of this reprofiling.¹⁶ In November 2019, an Infrastructure and Projects Authority review highlighted concerns over Air Command's affordability pressures and emphasised the importance of making long-term decisions which match the number of aircraft to the pace of delivery of people, infrastructure and mission support.

¹⁶ As at June 2020, the Department was considering changing the December 2023 milestone for the Lightning II project from full operating capability (concurrent operations) to initial operating capability. The Department told us that this change would not affect its ability to achieve Carrier Strike full operating capability in December 2023 and that it still expects to have two operational squadrons by this date.

Figure 5
Expected number of Lightning II jets in the UK fleet, 2015 to 2025
The Ministry of Defence has delayed the purchase of seven Lightning II jets



Note

1 Alongside the 24 front-line jets, aircraft will be used for testing and evaluation, training front-line pilots and replacement aircraft for these activities.

Source: National Audit Office analysis of Ministry of Defence data

1.19 The Department's decision to buy 138 jets will enable it to support a continuous Carrier Strike capability to the 2060s. However, it has not yet decided whether to purchase more than its current commitment of 48 jets. Air Command is assessing its future force mix – including the number and type of Lightning II jets it needs – as part of its Combat Air Strategy. The Department will then consider options as part of the Integrated Review of Security, Defence, Development and Foreign Policy. Purchasing more jets will create additional financial pressures over the next 10 years as the Department has only set aside funding to 2025-26 to buy 48.

Infrastructure

1.20 Successfully delivering and using Carrier Strike depends on the timely provision of infrastructure to enable maintenance and support work to take place. Since 2017, the Department has developed several sites across the UK. In particular:

- RAF Marham in Norfolk provides facilities for the Lightning II force. As at April 2020, the Department had finished most work and was able to operate Lightning II jets and train personnel from the base. The forecast cost of work is £619.4 million, of which £446.4 million had been spent by May 2020;
- Portsmouth Naval Base has been upgraded to berth both carriers simultaneously. The Department prioritised work to accommodate *HMS Queen Elizabeth's* first visit in August 2017, building a new jetty (costing £60.4 million) and dredging Portsmouth harbour. The dredge was delayed by larger-than-expected volumes of unexploded ordnance from the Second World War, resulting in costs increasing from £30.2 million to £48.9 million. A second jetty was completed in September 2019, costing £45.6 million, an increase of £2.7 million compared with the original budget. The Department intends to complete a logistics centre for the carriers at Portsmouth in 2021-22, which it currently estimates will cost £9.4 million; and
- the Northern Ammunition Jetty at Glen Mallan, Scotland, provides a secure facility for loading and unloading ammunition for naval vessels, including the carriers. To match the expected 50-year service life of the carriers, the Department is replacing the existing jetty at a forecast cost of £90.4 million. Work started in July 2019 but was behind schedule in April 2020. The Department still expects to complete the works by February 2021, ahead of Carrier Strike's first operational deployment.

1.21 The Department is assessing options to provide docking facilities to accommodate the major refits each carrier will require every six years. These options include a bespoke facility at Portsmouth, with an initial high-level costing of around £500 million, or the redevelopment of existing commercial facilities.

Part Two

Delivering the full capabilities of Carrier Strike

2.1 Successfully achieving the full operational capabilities of Carrier Strike in 2023, and ultimately Carrier Enabled Power Projection (CEPP) in 2026, depends on the necessary supporting capabilities being available (**Figure 6**). This Part examines the Ministry of Defence's (the Department's) progress to date in developing these capabilities, including a radar system, communications and the ability to support the carriers by providing fuel and provisions. It highlights the issues the Department still needs to address and its progress towards the programme's future milestones.

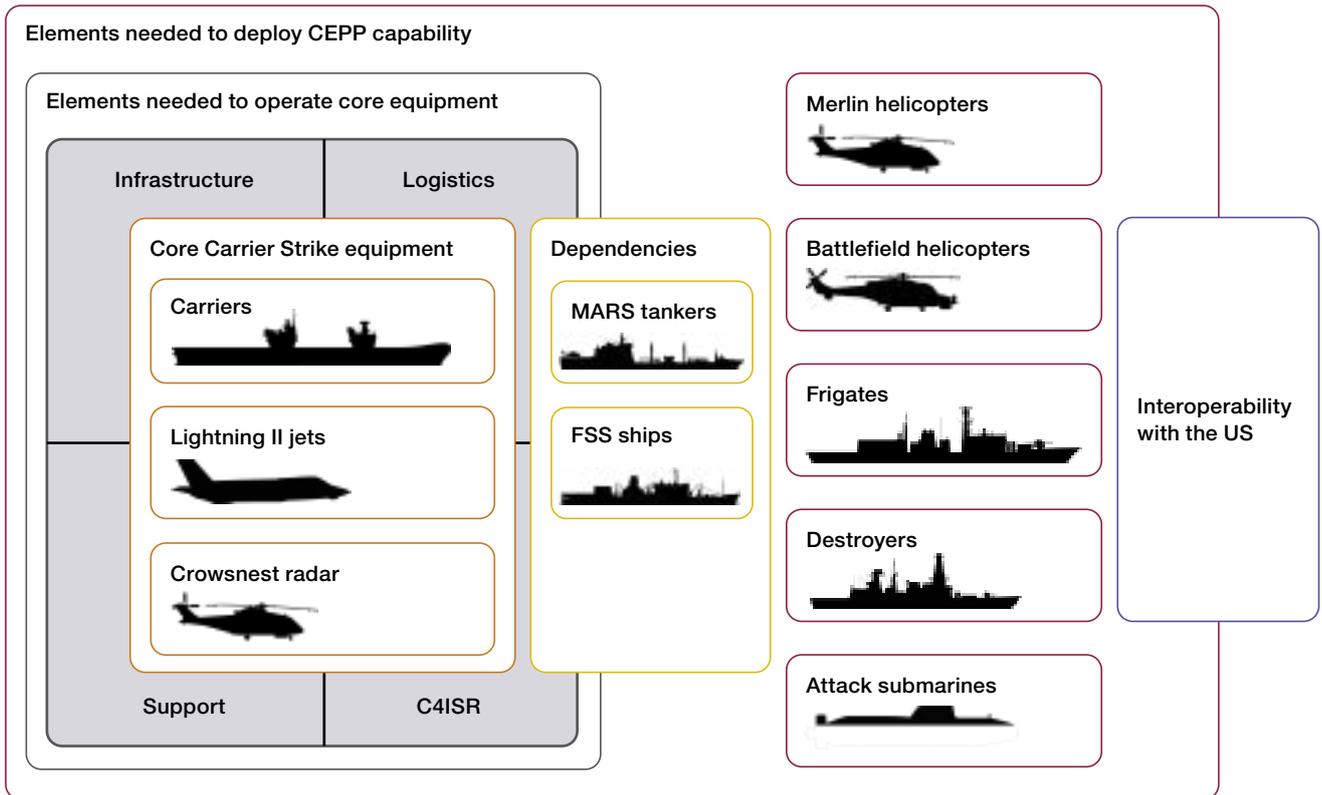
The Crowsnest radar system

2.2 Crowsnest provides critical radar protection for Carrier Strike. It is fitted to the Royal Navy's (the Navy's) Merlin helicopters and provides long-range air, sea and land surveillance, detection and tracking to identify threats beyond the horizon. Crowsnest is designed to work alongside air defences provided by Type 45 destroyers but, since the Navy will not complete the engine upgrade work on the six destroyers until the mid-2020s (paragraph 1.7), it will initially be even more important.

2.3 In November 2016, the Department agreed a fixed-price contract with Lockheed Martin. Thales and Leonardo Helicopters were sub-contracted to deliver the project. When the Department let the contract, it assessed there was a very high risk that industry would be unable to deliver the initial capability. The contractors subsequently encountered numerous problems between 2016 and 2018, which led the Department to raise its concerns with its industry partners and introduce measures to manage the risks. However, despite these interactions, the Department assessed that the project was deliverable throughout the period to December 2018 (**Figure 7** on page 26).

Figure 6
Elements of a Carrier Enabled Power Projection capability

Deploying a Carrier Enabled Power Projection (CEPP) capability requires many elements to be in place



Notes

- 1 C4ISR – Command, control, communications, computers, intelligence, surveillance and reconnaissance.
- 2 MARS – Military Afloat Reach and Sustainability programme, which provided four Tide Class tankers that entered service between 2017 and 2019.
- 3 FSS – Fleet Solid Support ships, for carrying food, ammunition and general stores.
- 4 Dependencies are separate projects needed to allow the carriers to operate.

Source: National Audit Office analysis of Ministry of Defence data

Figure 7

Timeline of events on the Crowsnest project, 2013 to 2020

The Ministry of Defence thought the project was on schedule until January 2019

Description of events	
2013	<p>May The National Audit Office report <i>Carrier Strike: The 2012 reversion decision</i> highlighted the delayed investment of Crowsnest had impacted the delivery of Carrier Strike by two years.</p>
2016	<p>November Design and manufacture contract signed with Lockheed Martin as the prime contractor and Thales and Leonardo as sub-contractors.</p>
2017	<p>March The National Audit Office report <i>Delivering Carrier Strike</i> highlighted the project was at a critical point with no allowance for delays, leaving limited time for integrated training and work-up, and warning there may not be enough radar-fitted helicopters and trained crew ready for deployment.</p> <p>December Commercial letter of dissatisfaction issued to industry.</p>
2018	<p>March Deep-dive conducted by Defence Equipment & Support due to Thales underperformance resulting in re-planning proposals and contract amendment discussions.</p> <p>August Major contract amendment signed and initial operating capability (IOC) date agreed – March 2020. Lockheed Martin embedded 17 personnel into Thales, Crawley, setting up a programme charter and several senior-level programme reviews.</p> <p>December Project reporting stated delivery of IOC was achievable.</p>
2019	<p>January The Department was informed of the Thales Corporate internal audit report stating that there were significant risks and others emerging that could not be mitigated by the current plan, and a re-plan exercise was needed.</p> <p>May Recovery plan agreed 14 weeks after declaring the project undeliverable.</p> <p>July Capability milestones were redrafted and 'inch-pebble' tasks were developed.</p> <p>December The first radar flight trial was postponed.</p>
2020	<p>February First radar flight trial was conducted.</p> <p>April Current schedule to IOC is delayed by 18 months.</p>

Notes

- 1 Shading indicates the Department's assessment of delivery confidence: Green – successful delivery of the project is highly likely; Amber – successful delivery appears feasible but significant issues exist and require management action; Red – successful delivery of the project is unachievable.
- 2 Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057-I, National Audit Office, March 2017.
- 3 Comptroller and Auditor General, Ministry of Defence, *Carrier Strike: The 2012 reversion decision*, Session 2013-14, HC 63, National Audit Office, May 2013.

Source: National Audit Office analysis of Ministry of Defence data

2.4 In January 2019, Thales reported it was unable to deliver its commitments within the agreed project timetable. The Department subsequently identified that Thales had not maintained the necessary certification documentation and its software maturity metrics failed to represent an accurate picture of work completed at that point, the work that was still needed and the associated risks. It also concluded that Thales had not provided sufficient information on the project's progress to Lockheed Martin. Consequently, neither the Department nor Lockheed Martin identified the lack of progress until it was too late to meet its initial operating capability milestone.

2.5 In May 2019, the Department implemented a recovery plan and new management arrangements. This included closer monitoring of industry performance, including regular senior-level and management meetings, and new project information. The contractors increased their resources, with Thales doubling its staff and Lockheed Martin increasing personnel numbers by one-quarter.

2.6 The Department has encountered further problems during the recovery plan:

- In February 2020, Lockheed Martin reported 83 tasks (19%) in the recovery plan had been delayed by between 30 and 322 days, including nine on the critical path. This included the first radar flight trial, which took place six weeks later than planned. Flight trials are essential for testing the radar and enabling the Navy to start training aircrew. The Department and its contractors are seeking solutions to mitigate the delivery risks in a compressed schedule, focusing on the essential tasks necessary to deploy Carrier Strike in 2021.
- The helicopter needed for trials, which was the responsibility of Leonardo Helicopters, had received insufficient care during outdoor storage, leaving it unsuitable for flying. It needed substantial maintenance to make it airworthy for flight trials and, instead, will be used for testing. The Navy has reassigned Merlin helicopters to support the flight trials but, in doing so, reduced its fleet availability. The compressed timeline and accelerated activity for testing Crowsnest has also created additional pressure on the provision of Merlin spare parts.

2.7 As at April 2020, the Department expected to achieve initial Crowsnest operating capability in September 2021, some 18 months later than planned (**Figure 8**). As this is later than the December 2020 milestone for declaring initial operating capability for Carrier Strike, the Department is working to provide a credible baseline radar capability for the first deployment with the United States in 2021. It expects to recover some lost time to declare full operating capability in May 2023, 11 months later than planned. However, the existing timetable contains no contingency to accommodate any further slippage. The delays will affect how the Department can use Carrier Strike during this period.

Figure 8

Future milestones remaining in the Crowsnest project, March 2020

The Ministry of Defence will not meet future capability milestones

Project milestone	Original delivery date	Revised delivery date	Forecast delay to delivery (months)
System training milestone	October 2015	May 2020	55
In-service date data cut-off	February 2019	May 2020	15
Logistic support date	April 2019	July 2020	15
Ready for Training number 6	September 2019	October 2020	13
Initial operating capability data cut-off	November 2019	June 2021	19
Crowsnest initial operating capability	March 2020	September 2021	18
Ready for Training number 7	July 2021	June 2022	11
Interim full operating capability data cut-off	July 2021	June 2022	11
Interim full operating capability	November 2021	September 2022	10
Crowsnest full operating capability	June 2022	May 2023	11
Project closure	September 2022	June 2023	9

Notes

- 1 Milestones are not always consecutive and cannot be totalled.
- 2 Forecast position as at 30 March 2020.
- 3 Crowsnest is a radar system that also provides target identification, an autonomous artificial intelligence tracking system and a mission recording and replay system.

Source: National Audit Office analysis of Ministry of Defence data

2.8 The Department has held Lockheed Martin to delivering the project against the agreed contract price of £339 million.¹⁷ As at April 2020, it had spent £277 million on the project.¹⁸ The Department has withheld payments to reflect the contractors' underperformance but has not imposed contract penalties. This resulted in an underspend of £88 million against annual funding provisions in 2018-19 and 2019-20. However, Navy Command now has a £71 million funding shortfall in the next four financial years and will have to absorb this by reducing expenditure on other projects. Overall, the Department expects to remain within the approved project limit.

Additional equipment needed to operate Carrier Strike

2.9 A carrier strike group needs supporting capabilities including logistics, communications and surveillance, and the ability to provide the carriers with fuel and provisions. This section examines the Department's progress in developing these capabilities.

Unfunded capabilities

2.10 The Department has still not funded some capabilities needed to deploy a carrier strike group. In 2017, we reported that the Department's plans to address these were at an early stage and would develop as it decided how Carrier Strike will be deployed.¹⁹ However, the commands have not prioritised funding for these projects, reflecting their tight financial position; current uncertainty over who should manage some capabilities and risks;²⁰ and uncertainty about the nature, quantity and frequency of demand (**Figure 9** overleaf). The Department has identified these unfunded capabilities as the main risk to achieving the programme's full operating capability in 2026, but it has not yet found a solution. It recognises that some central arbitration between commands to resolve disputes might still be required as the programme works towards full operating capability.

¹⁷ £339 million is for the design and manufacturing contract and includes VAT.

¹⁸ This includes costs incurred in the assessment phase.

¹⁹ Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057-I, National Audit Office, March 2017.

²⁰ The Department intends to allocate responsibility for all identified risks as part of its plans for achieving full operating capability, discussed in paragraph 2.23.

Figure 9

Unfunded capabilities needed by the Carrier Enabled Power Projection programme

The Ministry of Defence continues to have unfunded capabilities

Enabler	Requirement	Current situation
US/UK interoperability	Additional equipment and training to enable United States' Lightning II jets to fly from UK carriers and vice versa.	UK working to provide clearance for US munitions ahead of 2021 carrier strike group deployment.
Weapons stockpile	Sufficient weapons for Lightning II and helicopters.	Identified as a critical risk for Carrier Enabled Power Projection programme.
Maritime Intra-Theatre Lift	Ability to move people and goods, including Lightning II parts to and from a carrier task group at sea.	No funded permanent solution.
Tactical datalinks	IT software and hardware that allows exchange of command and control and tactical data between allies and within the task group.	Progress has stalled on developing a plan to produce architecture for information-sharing.
Integrated mission data	Further development of Lightning II computer system.	Only funded for assessment phase activity.

Source: National Audit Office analysis of Ministry of Defence data

2.11 Recognising that logistics were fundamental to the success of Carrier Strike, the Department set up a central team and assigned a senior responsible owner to lead on the integration of logistics capabilities for the programme. However, it did this in 2016, after the CEPP projects were well under way. The team has ensured that Carrier Strike’s requirements are better understood and identified the risks to the programme schedule. However, it has relied on influencing commands to progress projects to develop logistics capabilities.

Munitions

2.12 The Department has developed its understanding of the weapons stockpile it needs to facilitate military operations and resupply Carrier Strike. It has reviewed the safety clearances for deploying UK and US Marine Corps munitions on the carriers, the scale of munitions to hold onboard and the impact of the maritime environment on their degradation. However, in October 2018, the Department changed the risk to red, and some elements were unfunded in the 2019 budget. Developing a suitable long-term stockpile strategy remains a critical risk for the CEPP programme.

Information systems

2.13 The Department is developing the information systems it needs to support carrier operations. It has analysed infrastructure requirements for achieving full operating capability, held cross-command events to identify developing issues and is seeking to ensure the platforms have access to intelligence data. However, the Department has not always prioritised funding for this work, its ability to attract suitably qualified people has been a problem and there have been gaps in responsibility for managing this work. Strategic Command is taking the lead, working with Air and Navy Commands. However, work to develop networking and interoperability between air and maritime platforms has not yet identified a solution.

Maritime Intra-Theatre Lift

2.14 A Maritime Intra-Theatre Lift capability is crucial for the movement of people and goods (including Lightning II parts) to, from and within a carrier group. However, the Department's plans to develop a dedicated long-term capability have been limited by funding constraints and lack of data on the support that a carrier group will require. The Department considers it unlikely that it will be able to provide a long-term capability in the next 10 to 15 years. The Department's interim solution, using Merlin Mark 4 helicopters, ends in December 2021 but will need to continue. This relies on competing for spare capacity on helicopters which have other roles and restricts Carrier Strike's ability to operate where required because of the helicopters' limited range.

Support ships

2.15 Under the CEPP concept, the operational freedom of a carrier group relies on support ships providing munitions and stores where and when they are needed. The Department has long known that deploying Carrier Strike will depend on two types of support ship:

- tankers supplying oil and water; and
- solid support ships, carrying food, ammunition and general stores.

2.16 In 2013, we reported that the Department had delayed funding for the solid support ships.²¹ In 2017, we reported that it had decided on a fleet of three solid support ships, to enter service from 2026.²² It began the procurement in May 2018, but in November 2019 halted the competition because it was concerned about achieving value for money (**Figure 10**). In April 2020, the Department was reviewing its options and the impact on the delivery schedule. It has recognised that achieving full capabilities of a carrier strike group depends on the new support ships being available from the mid-2020s. However, the Department now expects there will be a delay of between 18 and 36 months to the new ships entering service, meaning the first ship would be operational between October 2027 and April 2029. The Department will need to assess the impact of any delay when it considers whether it has met the final CEPP programme milestone for full operating capability in 2026.

2.17 In the meantime, only one of the three current Royal Fleet Auxiliary solid support ships is capable of resupplying the carriers. *RFA Fort Victoria* entered service in 1994 and is due to retire in 2028, having already been extended beyond its 25-year service life. The Department has allocated £2 million to modify *RFA Fort Victoria* so it can replenish the carriers at sea and in 2016 budgeted up to £42 million to operate the ship to 2028. Having only one support ship with limited cargo capacity slows the tempo and reach at which the Department can replenish a carrier group. In addition, the Department will have restricted options for deploying the carriers for much of 2022 because *RFA Fort Victoria* will be unavailable due to major planned maintenance work.

21 Comptroller and Auditor General, Ministry of Defence, *Carrier Strike: The 2012 reversion decision*, Session 2013-14, HC 63, National Audit Office, May 2013.

22 Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057-I, National Audit Office, March 2017.

Figure 10

Progress against milestones for Fleet Solid Support ships, June 2020

The Ministry of Defence (the Department) does not know when new support ships will enter service

Procurement stage	Original plan (2016)	Revised plan (2020)
FSS was approved to enter assessment phase as part of the MARS programme	2005	2005
FSS became an unfunded requirement outside of the core programme, and only limited low-level concept work continued	2011	2011
Department agrees key user requirements for FSS	September 2015	May 2020
Contract notice and pre-qualification questionnaire issued	May 2018	April 2021
Procurement competition suspended	November 2019	
Contract award	June 2020	Not yet confirmed
First new ship in-service date	April 2026	Not yet confirmed
Second new ship in-service date	April 2027	Not yet confirmed
<i>RFA Fort Victoria</i> out-of-service date	April 2028	April 2028
Third new ship in-service date	April 2029	Not yet confirmed

Notes

- 1 FSS – Fleet Solid Support.
- 2 MARS – Military Afloat Reach and Sustainability programme, which provided four Tide Class tankers that entered service between 2017 and 2019.
- 3 *RFA Fort Victoria* is the only current solid support ship capable of resupplying the carriers.
- 4 The Department estimates that suspending the competition will delay FSS ships by between 18 and 36 months.

Source: National Audit Office analysis of Ministry of Defence data

Progress towards programme milestones

Initial operating capability

2.18 Initial operating capability is an important milestone which concludes the programme's build phase and means one carrier is ready for warfighting. In 2017, we reported there was considerable risk that the Department would not achieve its plans to deliver Carrier Strike initial operating capability by December 2020. As at April 2020, the Department reported it was on track to declare this milestone.

2.19 In April 2020, the Department also rated the successful delivery of the carriers and Lightning II projects as feasible if challenges are managed. However, it assessed that it would not achieve Crowsnest's capability milestones (**Figure 11**). This means Carrier Strike will not have the level of radar surveillance and protection that it previously expected at the point of declaring initial operating capability for Carrier Strike, or on its first deployment in 2021. We have recently reported that the Department has declared project milestones as achieved, without the intended capability always being delivered at that point.²³ It allows exceptions for a variety of reasons, but mainly because it had assessed that progress was good enough, despite criteria not being met.

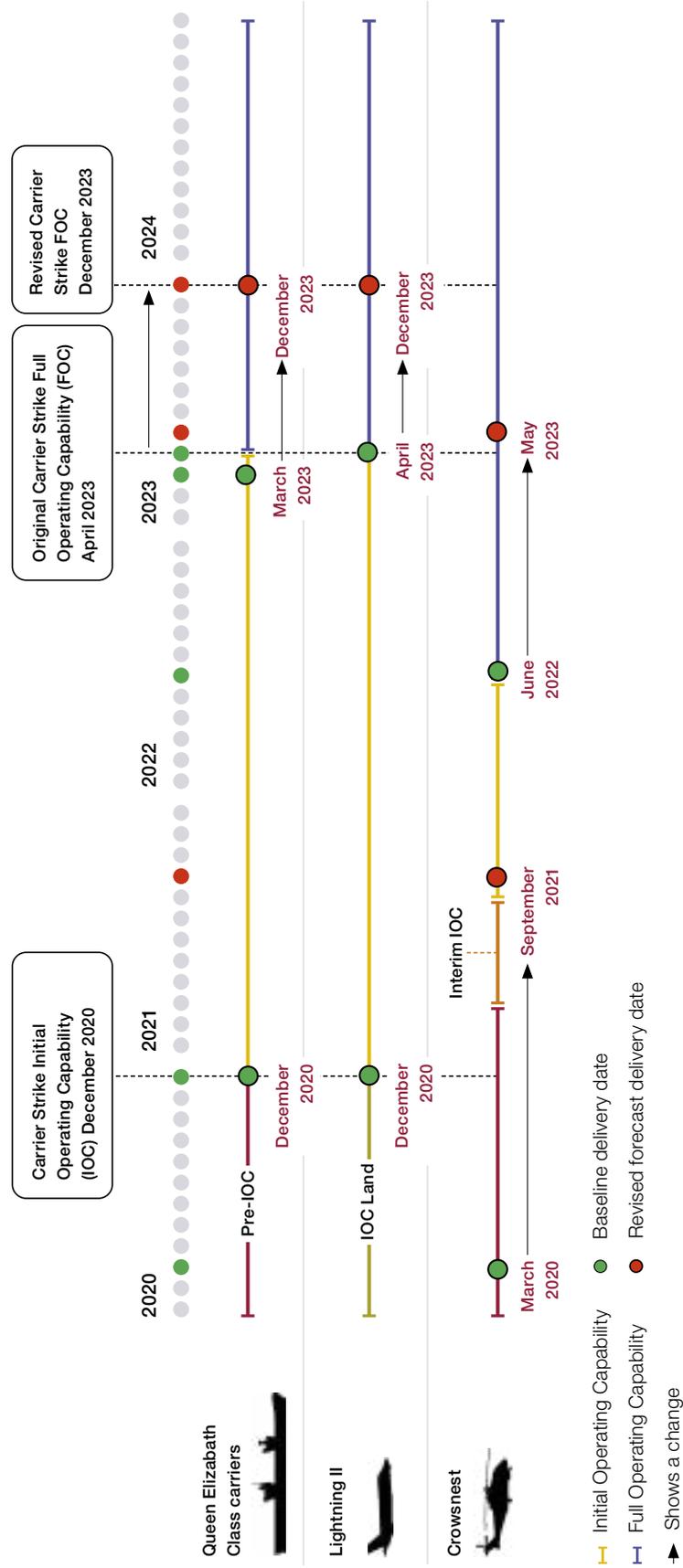
2.20 The Department also monitors programme-level risks (**Figure 12** on pages 36 and 37) and has identified two main risks which could affect Carrier Strike's initial operating capability:

- the ability to meet delivery schedules, given the volume of activities to be completed in a compressed timeline; and
- the recruitment and retention of suitably qualified personnel to operate the various elements of CEPP. Pinch-points include: a full complement of trained crew to operate the carriers and support ships; trained crew to operate Crowsnest and Lightning II jets; and gaps at the Defence Equipment & Support agency, which will limit progress with support activities.

²³ Comptroller and Auditor General, Ministry of Defence, *Defence capabilities – delivering what was promised*, Session 2019–2021, HC 106, National Audit Office, March 2020.

Figure 11
Changes to capability milestones for the main Carrier Enabled Power Projection projects, 2020 to 2024

Progress on the core Carrier Enabled Power Projection projects impacts on the delivery of Carrier Strike



Notes

- 1 Interim IOC for Crowsnest represents a 'deployable capability' but not the expected initial operating capability standard.
- 2 The Queen Elizabeth Class (QEC) project aligns to the Carrier Strike IOC/FOC dates. The change in FOC Carrier Strike date does not reflect a delay on the QEC project.
- 3 Forecast delivery dates as at April 2020.
- 4 The revised full operating capability date for Carrier Strike was reported in April 2020.
- 5 As at June 2020, the Department was considering changing the December 2023 milestone for the Lightning II project from full operating capability (concurrent operations) to initial operating capability. It expects to agree any mandate changes in autumn 2020.

Figure 12 The Ministry of Defence’s assessment of top 10 programme-level risks, 2016 to 2020

The Ministry of Defence (the Department) has regularly assessed risks to programme delivery

	October 2016	October 2017	February 2018	June 2018	October 2018	February 2019	June 2019	November 2019	February 2020
Insufficient trained people	1	7	8	7	7	7	2	2	2
Key unfunded capabilities	2	2	2	2	2	2	3	3	
2017 to 2020 schedule achievability	3	1	1	1	1	1	1	1	1
Early demand	4	6	5	5	5	5	7	7	
Infrastructure	5	8	9	9	9	9	9	9	
Inadequate support solution	6	4	6	6	6	6	6	6	3
Defence alignment	7	9	10	10	10	10	10	10	
Defence Safety Agency regulation and certification	8	10							
Information system coherence	9	3	4	4	4	4	4	4	5
Interoperability with allies	10	5	7	8	8	8	8	8	4
Clearances for ordnance, munitions and explosives			3	3	3	3	5	5	

Figure 12 continued
The Ministry of Defence's assessment of top 10 programme-level risks, 2016 to 2020

An assessment is made using the following definitions:

- Successful delivery of the projects on time, budget and quality appears highly likely and there are no major outstanding issues that at this stage appear to threaten delivery significantly.
- Successful delivery appears probable; however, constant attention will be needed to ensure risks do not materialise into major issues threatening delivery.
- Successful delivery appears feasible but significant issues already exist, requiring management attention. These appear resolvable at this stage and if addressed promptly, should not present a cost or schedule overrun.
- Successful delivery of the project is in doubt, with major risks or issues apparent in a number of key areas. Urgent action is needed to address these problems and to assess whether resolution is feasible.
- Successful delivery of the project appears to be unachievable. There are major issues with project definition, schedule, budget, quality and/or benefits delivery, which at this stage do not appear to be manageable or resolvable. The project may need rescoping or its overall viability reassessed.

Notes

- 1 The numbers indicate the ranking of the risks.
- 2 In February 2020, the Department reported the top five risks to achieving Carrier Strike initial operating capability.

Source: National Audit Office analysis of Ministry of Defence data

Full operating capability

2.21 The Department must meet an ambitious schedule for reaching full operating capability for Carrier Strike in December 2023 and CEPP in 2026. At April 2020, the Department assessed that it was on track to meet the programme's future milestones.

2.22 In 2021, the CEPP programme will transition from a build programme to an operational phase, in which the Department will face different challenges. It will need to resolve the issues with the supporting capabilities and integrate these into a carrier strike group while deploying the carriers on operations. We identified several challenges that could impact on the schedule for delivering Carrier Strike, and ultimately CEPP, including:

- slowing the purchase rate of Lightning II jets and the possible changes to the delivery of the Lightning II project. The Department told us that it still expects to have two operational squadrons by December 2023. This would coincide with Carrier Strike's full operating capability milestone, when it will be able to support up to 24 Lightning II jets operating from one of the carriers. The Department will, however, need to manage the consequences of any changes to the delivery of the projects in the CEPP programme, working closely with the commands;²⁴
- managing multiple projects to integrate the supporting capabilities, which have uncertain timelines (paragraphs 2.2 to 2.17). The Department will need to synchronise project schedules to organise the insertion and enhancement work required to integrate supporting capabilities;
- running two carriers concurrently, and managing maintenance schedules for the ships in a carrier strike group (Figure 1), including testing industry's capacity to deliver against revised schedules;
- aligning differing requirements inside and outside of the programme, such as the test requirements of Combat Air and carrier-related flying trials;
- training enough Lightning II pilots to achieve operational capability milestones and, as understanding of operating a carrier strike group improves, ensuring there are enough personnel with the necessary skills; and
- operating over the next five years with sub-optimal interim support solutions for both Fleet Solid Support ships and Maritime Intra-Theatre Lift.

²⁴ For example, in April 2020 the Lightning II programme board discussed proposals to delay the introduction of two operational squadrons until December 2024. If this went ahead, it would create a 12-month gap between Carrier Strike being able to operate two Lightning II squadrons and enough jets being available.

2.23 The Department has a detailed programme schedule for the period to December 2020, and a good understanding of the interdependencies and critical path up to then. It recognises that the schedule for the period from January 2021 will be taut and has begun developing a plan. The Department has run workshops to identify future risks and told us that it expects to endorse a revised schedule in September 2020. It is crucial that the Department firms up this schedule, so it can coordinate the limited time the carriers will be in port with the integration of supporting capabilities needed to achieve full operating capability.

Impact of COVID-19

2.24 In March 2020, the Department assessed that the COVID-19 pandemic had increased the risk of it not declaring initial operating capability for Carrier Strike in December 2020. The impact on departmental and contractor staff had affected most elements of the programme; for example, by restricting training, disrupting fitting and modification schedules on the carriers, and creating supply chain difficulties for spare parts. In June 2020, the Department told us that it was still on track to achieve its milestone in December 2020 but would continue to monitor and assess the impacts over the summer.

Part Three

Achieving the ambition for Carrier Strike

3.1 This Part considers the strategic and management issues that the Ministry of Defence (the Department) needs to address to achieve its future milestones for the Carrier Enabled Power Projection (CEPP). This includes re-stating its ambitions for Carrier Strike; understanding what it will cost to develop, use and sustain; and deciding how to manage the programme from 2021.

The government's ambitions for Carrier Strike

3.2 The 2015 Strategic Defence and Security Review set out the Department's long-term ambition for Carrier Strike. The Department has translated these commitments into operational requirements and developed a model for how it will use the carriers on routine operations. It has also started to examine how it can quickly switch a carrier group's composition to deal with unexpected events, such as a military confrontation or dealing with a humanitarian disaster. In 2018, guided by the 2015 review, it defined its strategy and policy for CEPP.

3.3 In May 2019, the then Defence Secretary announced the Department would publish a national carrier policy. Subsequently, in February 2020, the government launched the Integrated Review of Security, Defence, Development and Foreign Policy (the Integrated Review), which will reassess its ambition, priorities and approach to delivering defence policy over the next decade. Consequently, the Department will use this Review to reassess its ambitions and objectives for Carrier Strike as part of its wider defence strategy, and it no longer plans to publish a separate national carrier strategy. Due to the COVID-19 pandemic, the government has delayed the Integrated Review.

3.4 The Department is considering whether it can still fund all the operational roles originally intended for Carrier Strike. For example, the 2015 Strategic Defence and Security Review aimed to enhance one carrier to provide greater versatility as a helicopter platform, providing air support and accommodation for specialist amphibious forces. The Department assigned £60 million for this work.²⁵ It has since decided to assess alternative options for enhancing the Royal Navy's (the Navy's) capability to support amphibious operations. These include whether more modest investment could enhance the carriers' potential helicopter sortie rate by increasing the number of helicopter operating spots on the flight deck. By June 2020, no decision had been made, although in March 2020 the Department removed this enhancement as a requirement for CEPP achieving full operating capability.

Future investment in Carrier Strike

3.5 The Carrier Strike capability is a long-term investment, with the carriers expected to have a 50-year life. Other capabilities in a carrier strike group will need replacing before then. The Department is introducing Carrier Strike at a time of significant budgetary pressure but will need to make further investment to maintain and enhance the capability. However, it could not provide us with a consolidated view of the required longer-term enhancements and replacements, or their potential cost. It faces decisions on a wide range of capabilities, including:

- what funding will be available for Lightning II jets after 2025-26 – the fleet will need to be renewed as each aircraft has a finite number of flying hours;
- how to replace or extend the life of Merlin helicopters, due to go out of service in 2030. They fulfil several roles within a carrier group, including hosting Crowsnest, providing anti-submarine defence and transferring personnel and equipment;
- whether to extend the service life of *RFA Fort Victoria*, which is due to go out of service in 2028 (paragraph 2.17); and
- Navy Command's fleet regeneration programme, which will provide the ships needed to support a carrier strike group (paragraph 1.7).

²⁵ The planned alterations included: flight deck modifications and aviation support for more helicopters, and additional accommodation and services for two companies of Royal Marines.

3.6 These decisions will create added funding pressures at a time when the Department's Equipment Plan is already unaffordable, meaning that it will have to determine investment priorities across the armed forces.²⁶ The long lead-time for developing and buying increasingly complex military equipment means that delaying such decisions risks limiting the carriers' future operational capabilities. It is therefore important that the Department understands the level of investment needed when it undertakes the Integrated Review. There is less certainty in the longer term as the Department will want to retain flexibility to invest in, and use, technological advances, such as in electronic warfare.

3.7 All the commands are facing pressure to make savings in their equipment programmes, including the capabilities needed for Carrier Strike. There is a risk that, when faced with annual budgetary pressures, the commands make funding decisions that might affect the longer-term needs of Carrier Strike. For example, in November 2019 Air Command postponed buying a second Lightning II deployed spares pack for one year on affordability grounds. Air Command has also reassessed how frequently it can fly the jets, based on its experience of using them. It has reduced Lightning II's future flying hours by 20% as a savings measure.

3.8 Responsibilities for Carrier Strike straddle commands. The Department's head office reviews the commands' spending plans to help develop the defence plan and agree military objectives. The commands are responsible for making investment prioritisation decisions and agree these with head office as part of the annual financial planning round. Although head office regularly assesses the impact of the commands' spending plans on the development of Carrier Strike, we identified areas where the commands have not fully funded its future development. As a result, the Department faces a risk that its future enhancement and support needs are not considered fully.

²⁶ Comptroller and Auditor General, Ministry of Defence, *The Equipment Plan 2019 to 2029*, Session 2019-20, HC 111, National Audit Office, February 2020.

Estimating future operating and support costs

3.9 Given the strategic importance and scale of Carrier Strike, we would expect the Department to have a clear view of its support and operating costs. The failure to understand future costs may create financial pressures if they are underestimated. This increases the risk that the Department will continue to rely on short-term decision-making to manage in-year financial pressures which, as we have seen in our reports on the Equipment Plan, leads to higher overall costs and reduced capabilities.²⁷ In 2018, the Committee of Public Accounts recommended: “The Department must develop its estimate of the costs of supporting and operating Carrier Strike and we will expect more detailed estimates when we undertake a follow-up inquiry.”²⁸ Our review was conducted in spring 2020 and we recognise that, at this point, the Department is still developing its understanding of the costs of using Carrier Strike, and will collect data during its first deployment in 2021.

Understanding the requirement

3.10 The Department recognises the need to improve its understanding of Carrier Strike’s sustainment needs. A full understanding of these requirements will help ensure that these needs have been reflected fully in funding provisions and its plans to supply spare parts, which can have lead times of up to two years. In March 2019, the Department established a Support and Logistics working group to examine Carrier Strike’s requirements. As a result, it is developing a fuller understanding of maintenance and logistics activities needed to operate a carrier strike group, including its readiness for initial operating capability and deployment in 2021. In 2020, the Navy also began a support improvement programme for the carriers to improve its maintenance cycle and spares provision.

²⁷ Comptroller and Auditor General, Ministry of Defence, *The Equipment Plan 2019 to 2029*, Session 2019-20, HC 111, National Audit Office, February 2020.

²⁸ HC Committee of Public Accounts, *Delivering Carrier Strike*, Fourteenth Report of Session 2017-2019, HC 394, January 2018.

3.11 The Department has identified helicopter spares provision as a risk to achieving initial operating capability. It also continues to face uncertainty around the performance of the global support model for the Lightning II jets. In 2019 the United States' Government Accountability Office found:²⁹ “the F-35 supply chain does not have enough spare parts available to keep aircraft flying enough of the time necessary to meet warfighter requirements”.³⁰ The Department experienced similar problems in last summer's sea trials.

3.12 The Department also underestimated the carriers' and jets' initial spare parts requirements. Between 2015 and 2017, Air and Navy Commands modelled their initial spares needs. The Navy set the carriers' spares allowance at the level needed for 70% availability, instead of the 95% target it originally chose. It also only bought enough spares to keep one carrier ready for use at all times although, since November 2015, the government's policy requirement has been for two carriers at high or very high readiness. Air Command has funded the purchase of two deployed spares packs, rather than the three deployed spares packs its 2017 analysis recommended. In addition, recent trials and analysis show that the carriers and Lightning II jets may need more spares than initially predicted.

Estimating future costs

3.13 Estimating the total future cost of Carrier Strike is not a straightforward task. The components of a carrier strike group will change depending on the nature of the deployment and many elements of the group can also be used for other defence tasks. The Department does not routinely aggregate support and operating costs to establish a 'capability-level' view. Instead, it relies on the commands to make adequate financial provisions, based on robust cost forecasts, for their equipment.

3.14 In 2017, the Department estimated that the additional costs of operating CEPP would be £357 million per year.³¹ This provided an early indication of the costs of peacetime operating cycles. However, the estimate did not reflect the full costs of all the elements of a carrier strike group and recognised that some costs were still uncertain, such as the carriers' support costs. The Department has not updated its estimate since 2017 but told us that it plans to do this after Carrier Strike's deployment in 2021. We therefore reviewed the Department's current understanding of future costs, focusing on the carriers and Lightning II jets.

29 The United States' Government Accountability Office examines how taxpayer dollars are spent and provides Congress and federal agencies with objective, reliable information to help the US Government save money and work more efficiently.

30 United States Government Accountability Office, *F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges*, GAO-19-321, April 2019.

31 This is the cost of supporting, upgrading and operating the two carriers, one Fleet Solid Support ship and helicopters. It also includes the additional costs of operating Lightning II jets from sea instead of from land. It does not include the costs of escort ships, nor the cost of deploying Lightning II jets.

3.15 The Department relies on the commands to estimate operating costs for their own equipment.³² This includes the cost of buying fuel, port and transit fees, overseas allowances for staff deployed abroad, stock costs and laundry. Air and Navy Commands have included the following provisions in their budgets:

- Air Command estimated the operating costs of 48 Lightning II jets will be £167 million for aviation fuel over 10 years, plus £203 million to run the base at RAF Marham.
- Navy Command has budgeted £314 million over 10 years to operate the aircraft carriers, plus £124 million for stock. The Navy takes a top-down approach to forecasting its fleet operating costs, which has proved accurate in previous years. There is a risk that the carriers' operations are under-funded. As Carrier Strike enters its cycle of regular deployments, the Navy's spending on operational activities is likely to increase by more than 15%.

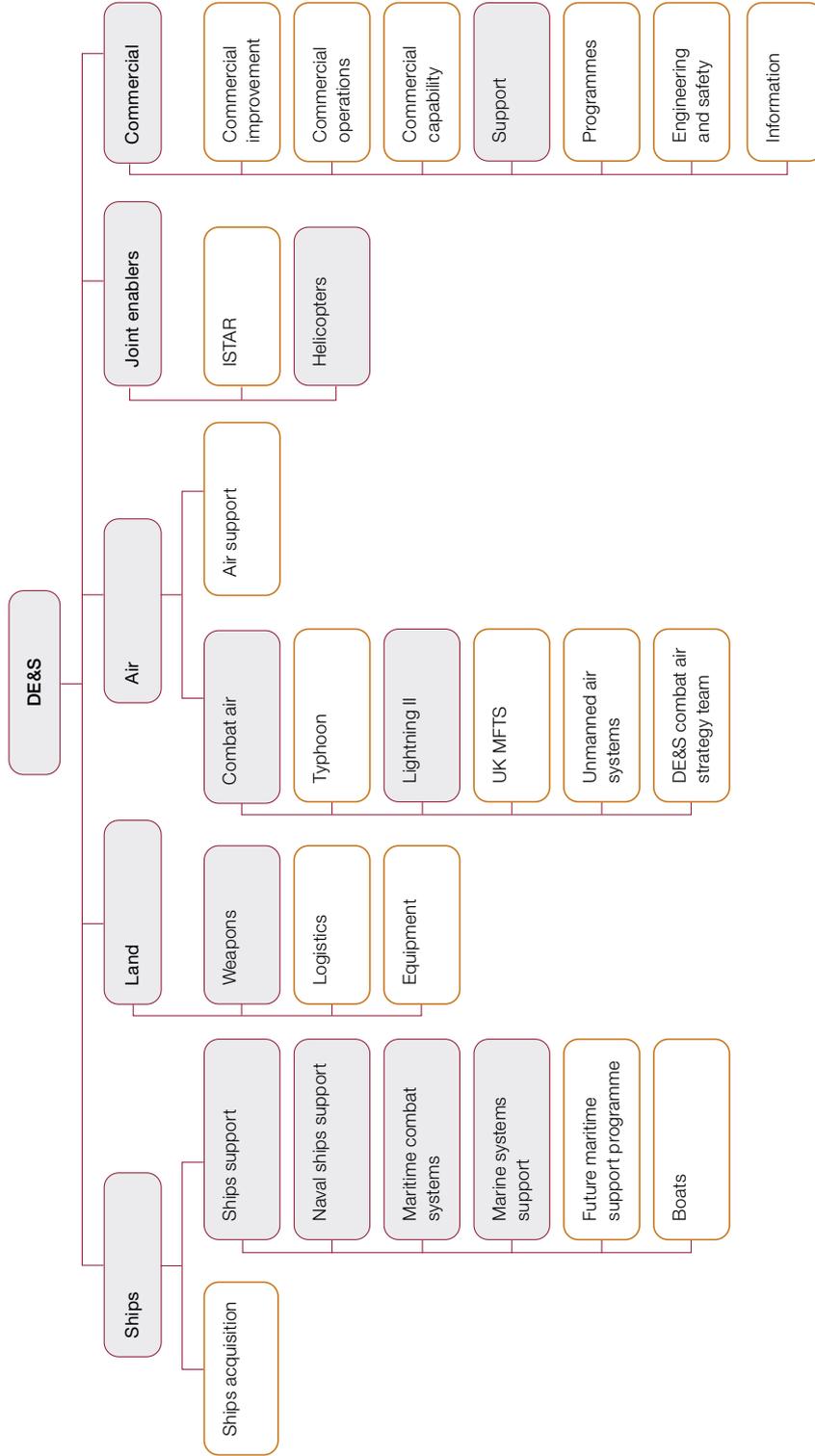
3.16 Support costs include the cost of maintaining, repairing and upgrading equipment. Because the Department's cost information is based on contractual arrangements spanning several types of ship or aircraft, it can only identify some of the support costs of a carrier strike group. It cannot, for example, provide separate costs for combat systems on the aircraft carriers, if those same systems are also installed on other classes of ship. As **Figure 13** overleaf illustrates, information on the costs of a carrier strike group are also spread across teams in Defence Equipment & Support.

3.17 The Department was not able to provide a consolidated estimate of the support costs of a carrier strike group. It could, however, provide the following estimates for the main CEPP projects:

- The Department has identified that it will cost at least £735 million for platform support costs over the next 10 years. It told us it has included these costs in its funding estimate for its whole fleet, although it could not identify the carrier-specific costs of the on-board systems and spares.
- Lightning II will cost £1.98 billion over 10 years, although this includes land-based operations as well as Carrier Strike. Weapons systems will cost an additional £50 million.
- Crowsnest radar will cost around £150 million over 10 years, excluding helicopter support costs.

³² Does not include routine personnel costs such as salaries, nor the costs of repairs and safety certifications.

Figure 13 Parts of Defence Equipment & Support responsible for forecasting Carrier Strike support costs
 Many parts of Defence Equipment & Support (DE&S) forecast support costs for Carrier Strike



- Responsible for some Carrier Strike support costs
- Other

Notes

- 1 DE&S procures and places support contracts for the equipment for the Armed Forces, covering all types of equipment except nuclear items and IT systems.
- 2 MFTS = military flying training system.
- 3 ISTAR = intelligence, surveillance, target acquisition and reconnaissance.
- 4 Navy, Defence Digital and the Defence Infrastructure Organisation are also responsible for forecasting some Carrier Strike support costs.

Source: National Audit Office analysis of Ministry of Defence data

3.18 The Department has used cost models to estimate future support costs. We reviewed two of these cost models used for the carriers and Lightning II jets. We found the Department has extensive quality assurance processes for models it sees as ‘business critical’, such as the cost forecasts supporting major contract approvals. However, its definition of business critical is narrower than that used in other parts of government and its long-term cost forecasts for the carriers and Lightning II jets were subject to lower standards of quality assurance. As a result, we found some weaknesses in these models which could undermine the reliability of the estimates they produce. For example:

- the Department faces uncertainty over the future support costs of the Lightning II project because of the international programme for buying the jets. It also depends on this programme to maintain the jets. The nature of the programme means that it does not have full sight of the basis – and therefore the reliability – of the cost data it receives from the United States. Around 90% of total Lightning II project support costs are based on these data. In November 2019, the Government Accountability Office stated that the United States Department of Defense also “lacks information about the technical characteristics and costs of the F-35”,³³ and
- although the Department includes provisions for risk and uncertainty in its cost forecasts, some of its estimates for the carriers and Lightning II jets are optimistic. This means that it is likely to have underestimated future costs. The Department’s Cost Assurance and Analysis Service has also highlighted potential over-optimism in the support cost forecasts for Tide Class tankers and warships, commenting that the level of risk and uncertainty appeared low.

33 United States’ Government Accountability Office, *F-35 Aircraft Sustainment: DOD Faces Challenges in Sustaining a Growing Fleet*, GAO-20-234T, November 2019.

Future funding provisions

3.19 The Department is confident it can fund Carrier Strike's deployment in 2021 from its existing budget. However, the commands may not have made sufficient funding provision in future years for operating and support costs. For example:

- the Navy has identified a shortfall in funding for the carriers' operating costs, which may create additional financial pressures across its portfolio or affect how the carriers are used. It is working to resolve these and has funded a project to improve support and spares provision over the next three years;
- Air Command has responded to wider budgetary pressures by reducing its investment to the minimum necessary to support the aircraft. There is also a risk that financial pressure across Air Command's portfolio (paragraphs 1.18 and 3.7) will lead to further delays in obtaining approvals for expenditure on sustainment and spares; and
- to achieve its aspirations for Carrier Strike, the Navy will need to adapt its fleet-wide support arrangements. It has recognised the need to review industry capacity and future funding provisions to meet the government's long-term requirement for two carriers at high readiness or above.

3.20 We would also expect the Department to consider a range of operational scenarios to understand how future costs may vary. It undertakes regular scenario planning for Carrier Strike, focusing on policy and strategy, but works on the basis that the use of Carrier Strike will stay within planning assumptions. The Department evaluated a full range of options in 2017, before either carrier had entered service, and plans to update its cost model after the first operational deployment in 2021.

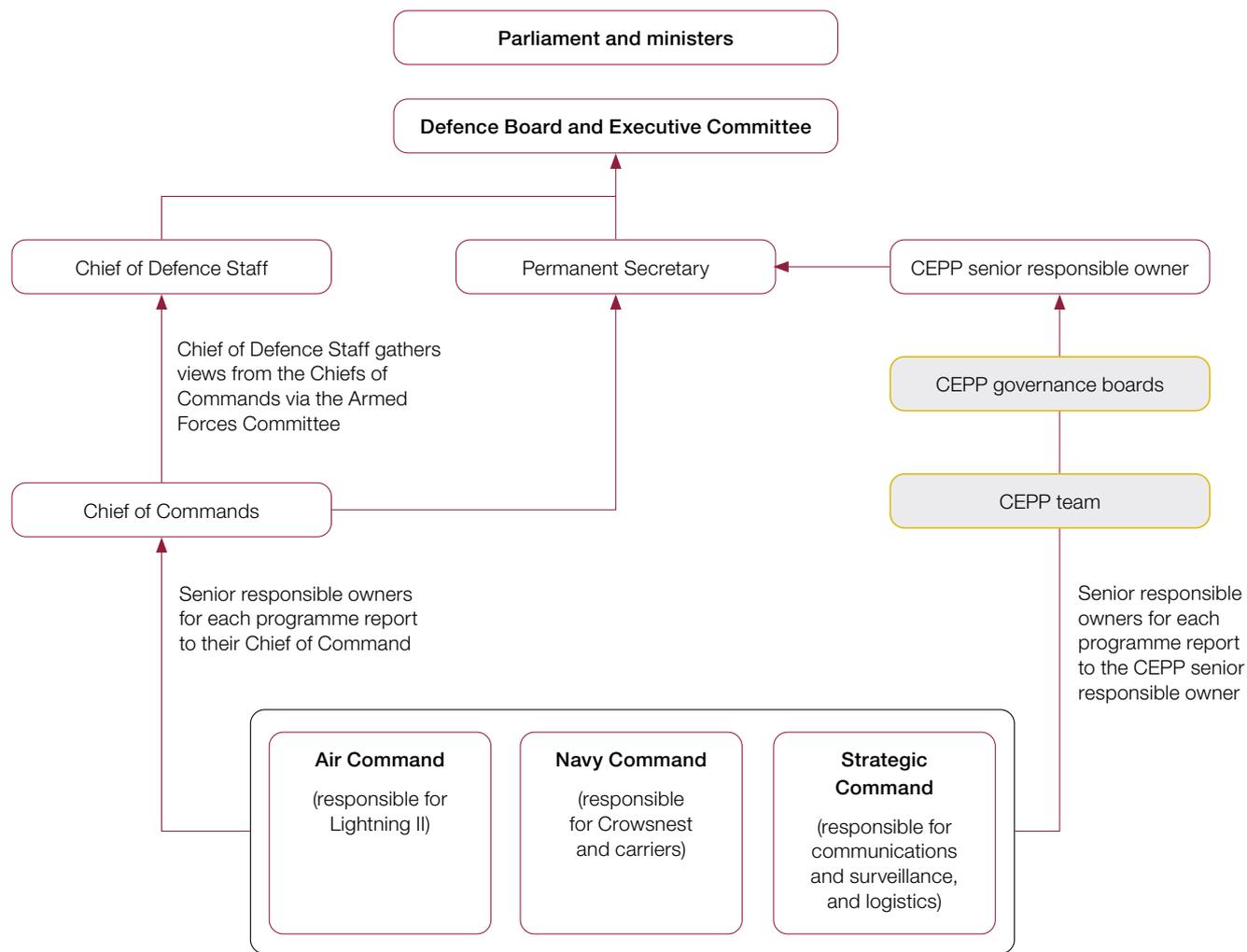
Programme management

3.21 The Department has appointed a senior responsible owner for the CEPP programme. He is supported by a senior military officer as programme director, who leads a small programme management team. The Department has two programme boards, which include senior representatives from the commands, to examine programme delivery, tackle risks and escalate issues when needed (**Figure 14**). The Department uses these boards to hold the senior responsible owners for the carriers, Lightning II jets and Crowsnest to account and reports regularly on progress to the Defence Board and Permanent Secretary. Under the Department's delegated model, the commands are responsible for project delivery and budget management.

Figure 14

Governance of the Carrier Enabled Power Projection programme, June 2020

Each of the projects reports through both their respective Command hierarchy and Carrier Enabled Power Projection (CEPP) arrangements



- Relevant parts of Departmental governance
- ◻ CEPP-specific governance
- Reporting line

Source: National Audit Office analysis of Ministry of Defence data

3.22 The programme team has tracked progress and monitored risks across projects, producing risk registers to identify interdependencies and the critical path towards achieving Carrier Strike’s initial operating capability in December 2020. This has enabled good visibility of the risks to the programme schedule and identified the actions needed, including practical issues such as aligning project timelines to enable better coordination. The team has engaged continually with commands, although it has had to rely on influencing as it does not have formal authority or budget responsibility to take project-level decisions.

3.23 The Department plans to introduce new governance arrangements from January 2021, as the programme transitions into the operational phase. The next phase of CEPP will require the Department to respond to issues arising from trials and integrate a wide range of supporting capabilities. It plans to reduce the role of the central programme team. It will need to establish clear responsibilities for decision-making and funding to ensure coherence between commands. Until the Department addresses its ongoing financial pressures, it will have to ensure that commands balance the need to develop affordable programmes that meet their own priorities with the need for longer-term investment in Carrier Strike. It will also need to retain central oversight as it manages the integration of several challenging projects (paragraphs 2.10 to 2.17).

3.24 The Department has also established governance arrangements and a tasking plan to manage the use of Carrier Strike from January 2021.³⁴ The Deputy Chief of Defence Staff for Military Strategy and Operations will have responsibility for scheduling deployments under the Department’s Force Generation Order and in accordance with its carrier strategy. The Department has a fixed delivery schedule up to the deployment with the US in 2021. In 2022 and 2023, the Department will manage deployments around the need to bring *HMS Prince of Wales* into operational service and build up the Lightning II and Crowsnest forces. Beyond the planned declaration of full operating capability in 2023, the Carrier Strike capability will be governed by the UK Carrier Activity governance framework.

34 The Joint Commitments Strategic Steering Group is chaired by Deputy Chief of Defence Staff Military Strategy and Operations and includes senior representatives from Army, Navy, Air, ISTAR and Cyber. It has cross-government membership (intelligence services, Foreign & Commonwealth Office, Cabinet Office). It attributes forces to operations and the Defence Exercise Plan.

Appendix One

Our audit approach

1 This study assessed the Ministry of Defence's (the Department's) progress in managing the equipment projects, and other equipment, infrastructure and support needed to achieve an initial Carrier Strike operating capability in December 2020. We assess how it is handling the technical, cost and schedule risks since we last reported in 2017.³⁵ We also consider the Department's preparations for establishing a full Carrier Enabled Power Projection capability in 2026. We reviewed whether the Department has:

- progressed the programme as planned since we last reported;
- made appropriate provisions to fund the future operations of a carrier strike group; and
- established appropriate arrangements to manage the remainder of the programme and deliver its ambition for Carrier Strike.

2 Our audit approach is summarised in **Figure 15** overleaf. Our evidence base is described in Appendix Two.

³⁵ Comptroller and Auditor General, Ministry of Defence, *Delivering Carrier Strike*, Session 2016-17, HC 1057, National Audit Office, March 2017.

Figure 15

Our audit approach

The objective of government

To reintroduce a Carrier Strike capability to give the UK government political flexibility and the ability to deploy forces without reliance on agreement from other countries for use of their airbases. It plans to introduce an initial Carrier Strike capability in December 2020 (one carrier, one squadron of fast jets and an airborne radar system called Crowsnest) and develop a fuller capability by 2026 known as Carrier Enabled Power Projection (CEPP).

How this will be achieved

The Ministry of Defence (the Department) has built two aircraft carriers – the largest warships ever built for the Royal Navy – and is purchasing technologically sophisticated F-35B jets (Lightning II) from the United States to fly from them, and integrating Crowsnest. The Department is also putting in place the necessary infrastructure, support and trained personnel.

Our study

We examined whether the Department is on track to operate and sustain the Carrier Strike capability.

Our evaluative criteria

- The Carrier Strike programme has progressed as planned since we last reported.
- The Department has made appropriate provisions to fund the future operations of a carrier strike group.
- The Department has established appropriate arrangements to manage the remainder of the programme and deliver its ambition for Carrier Strike.

Our evidence
(see Appendix Two for details)

- Carrying out interviews with senior officials in the Department and other stakeholders, including the Infrastructure and Projects Authority.
- Reviewing departmental documents including programme status reports and risk registers.
- Undertaking financial analysis of individual programmes constituting Carrier Strike and reviewing cost, time and performance data.
- Reviewing minutes and attending CEPP governance board meetings.
- Site visits to review progress of equipment construction and new infrastructure.

Our conclusions

Since we last reported, the Department has received two new aircraft carriers into service, now has 18 Lightning II jets and has developed much of the UK infrastructure to support them. It has delivered the carriers for £6.4 billion, which is just 3% above the revised figure announced to Parliament in 2013. The Department has conducted successful sea trials and is working closely with the US to be ready for its first joint deployment in 2021. It has also established plans for using Carrier Strike in its early years.

The Department is, however, making slower progress in developing the crucial supporting activities that are needed to make full use of a carrier strike group, such as the Crowsnest radar system and the ability to resupply the carriers. In addition, it has not established a clear view on the future cost of enhancing, operating and supporting Carrier Strike, which creates the risk of future affordability pressures. The Department will not achieve value for money from its investment to date unless it provides clarity on its future ambitions; develops its understanding of future development and operating costs; and ensures cross-command coherence and collaboration to develop the full capabilities of Carrier Strike.

Appendix Two

Our evidence base

1 We reached our conclusions on how the Ministry of Defence (the Department) is managing the delivery, in December 2020, of an initial Carrier Strike operating capability, based on our analysis of evidence collected between January and April 2020.³⁶ The final stages of our planned fieldwork in March 2020 were circumscribed by the restrictions arising in response to the COVID-19 pandemic.

2 Our audit approach is outlined in Appendix One. We applied an analytical framework with evaluative criteria to our analysis, which considered: how the programme has progressed since we last reported; whether the Department has made appropriate provisions to fund future operations of Carrier Strike; and whether the Department has established appropriate arrangements to manage the remainder of the programme. We based our analytical framework on examining whether the Department has:

- made expected progress since 2017 by comparing forecasts and milestones over time;
- provided suitable cost control and contract management by examining progress in delivering key components of the programme, including the carriers, Lightning II jets, Crowsnest radar and supporting infrastructure;
- established appropriate risk management by reviewing risk registers and board minutes; and examining whether the programme has progressed as planned to provide the additional equipment needed to operate Carrier Strike;
- made appropriate provisions to fund the future operation of a carrier strike group by reviewing the basis of its cost estimate and how it has developed this over time, including the robustness of its cost models; and
- established appropriate governance arrangements for the remainder of the programme by considering whether it has arrangements in place to manage and integrate the component projects.

³⁶ Initial operating capability includes providing carriers, Lightning II jets and Crowsnest airborne radar system. Crowsnest is a radar system that also provides target identification, an autonomous artificial intelligence tracking system and a mission recording and replay system.

3 We examined the Department's progress against programme baselines and forecasts, and its contract management:

- We undertook semi-structured interviews with senior stakeholders within the Department responsible for delivery of the projects, including Navy, Air and Strategic Commands, as well as officials from the Department's procurement and support arm (Defence Equipment & Support). We interviewed members of the following teams: Carrier Enabled Power Projection programme; Queen Elizabeth Class carriers project; Lightning II project; Crowsnest project; Fleet Solid Support; Logistics; Information Systems; Maritime Intra-Theatre Lift. We used these interviews to inquire about progress, the challenges encountered and how these have been addressed. Evidence gathered during interviews was triangulated with supporting documents.
- We met with representatives from the Infrastructure and Projects Authority, which has undertaken regular reviews of the Lightning II and carrier projects.
- We reviewed strategic documents to understand the Department's oversight of progress of the projects. These included programme documentation, programme board papers and minutes, and reviews by the Infrastructure and Projects Authority. We triangulated evidence from these reviews during our semi-structured interviews.
- We undertook financial analysis and reviewed cost, time and performance data. This allowed us to understand and analyse the status of the projects and how the Department is managing the risks we have reported on previously. We discussed the costs of the programme with the Department's Cost Assurance and Analysis Service.
- We undertook site visits to RAF Marham (where the Lightning II jets are based) and the Royal Naval Base at Portsmouth. These enabled us to see progress with developing the necessary infrastructure to support the jets and the ships in the future. We triangulated evidence obtained during our visits through follow-up data requests.

4 We examined whether the Department has effective arrangements for managing the programme and its risks, and its provision to fund future operations of Carrier Strike:

- We undertook semi-structured interviews with stakeholders, including several senior responsible owners for the three core projects. This enabled us to examine the effectiveness of governance arrangements and to gain their views on the quality of management information.
- Using our framework for examining models, we reviewed documentary evidence, such as spreadsheet models and quality assurance records, and interviewed stakeholders involved in creating, assuring and using operating and support cost forecasts for the carriers and Lightning II jets.³⁷ This allowed us to examine to what extent the Department cost forecasting follows good practice, such as the guidance in HM Treasury’s *Aqua Book*, and to understand how it handles risk and uncertainty in its financial planning.³⁸
- We also undertook semi-structured interviews with the Department’s central financial planning team, and with the head office team responsible for coordinating CEPP. This helped us understand the current financial planning and governance arrangements for Carrier Strike, and how these are likely to evolve in future.
- We reviewed documentary evidence, including programme board minutes and papers. This allowed us to understand whether senior officials were presented with complete and consistent information from which to make decisions.
- We observed a meeting of the CEPP governance board in February 2020. The purpose was to see at first hand the working of the board and how risks are escalated to the Defence Board and Armed Forces Committee.

5 Our review of the Department’s approach to cost modelling did not cover all of its cost models for support and operating costs. Given resource constraints and the restrictions created by the COVID-19 pandemic, we focused our review on the cost models used for forecasting carriers and Lightning II support costs, which will comprise a significant proportion of their total support costs. We did not review models for all of their costs, for instance we excluded the carriers’ equipment support. We engaged widely across teams in Defence Equipment & Support, Navy and Air Commands to examine the approach to forecasting costs, the adequacy of the input data and how these models were used. We also engaged with Navy and Air Commands to examine how operating costs were estimated. We have placed some reliance on the Department’s internal controls to review the models for calculation errors. We believe that we were able to collect sufficient evidence to draw reliable conclusions on the Department’s approach and its level of understanding of future costs.

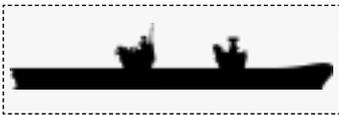
37 Comptroller and Auditor General, *Framework to review models*, National Audit Office, March 2016.

38 HM Treasury, *The Aqua Book: guidance on producing quality analysis for government*, March 2015.

Appendix Three

Further information on the core CEPP projects

Queen Elizabeth Class carriers



Description of project	<i>HMS Queen Elizabeth and HMS Prince of Wales</i> are the largest warships ever built for the Royal Navy. The carriers will displace 66,600 tonnes and measure 280 metres by 70 metres. They are designed to operate with up to 40 aircraft (fixed and rotary wing). The Ministry of Defence (the Department) plans to deliver the Carrier Strike capability using Lightning II (F-35B) fast-jets. The carriers will (after modification) also provide a base for other types of aircraft. The Department believes that this will offer greater flexibility.		
Military command	The Royal Navy (Navy)	Prime contractor	BAE Systems
Project start date	December 1998	Project end date	March 2023
Initial operating capability	31 December 2020	Full operating capability	31 December 2023
Forecast whole-life cost	£6.7 billion ¹	Latest project approval total	£6.4 billion

Lightning



Description of project	The UK is buying the Lightning II, or F-35, a fifth-generation stealth aircraft, which will provide the UK with a multi-role combat aircraft able to fly in contested airspace. Lightning II jets include advanced sensors and integrated mission systems and can be equipped with air-to-air and air-to-ground weapons.		
Military command	Royal Air Force (Air)	Prime contractor	Lockheed Martin via the US Department of Defense
Project start date	2001	Project end date	2035 (Assumed end of F-35B production)
Initial operating capability	Land: December 2018 Maritime: December 2020	Full operating capability	December 2023 ²
Forecast whole-life cost³	£18.4 billion	Latest project approval total⁴	£10.5 billion

Crowsnest

Description of project Crowsnest is a helicopter-borne radar system that provides long-range airborne surveillance, control and early warning capability. The Crowsnest radar system will be fitted to 10 of the 30 Merlin helicopters currently in service with the Royal Navy. The remaining 20 Merlin helicopters will also be modified to allow them to be fitted with the Crowsnest radar system in future if required. Crowsnest will replace the current helicopter-borne radar capability provided by the Sea King Mk7.

Military command	The Royal Navy (Navy)	Prime contractor	Lockheed Martin UK Ltd
Project start	March 2012	Project end	June 2023
Initial operating capability	September 2021	Full operating capability	May 2023
Forecast whole-life cost	£435 million	Latest project approval total	£455 million

Notes

- 1 Includes partial costs for infrastructure and historical costs around the reversion decision.
- 2 As at June 2020, the Department was considering changing the December 2023 milestone for the Lightning II project from full operating capability (concurrent operations) to initial operating capability. The Department told us that this change would not affect its ability to achieve Carrier Strike full operating capability in December 2023 and that it still expects to have two operational squadrons by this date.
- 3 The Department last forecast the whole-life cost of the Lightning II project in 2013.
- 4 The latest approval includes foreign exchange risk.

Source: National Audit Office

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