

Written Evidence submitted by Lockheed Martin UK**Executive Summary**

- Armoured infantry fighting vehicles support all mission types, including high intensity warfighting, peacekeeping, peace enforcement, counter insurgency, conventional deterrence, and the deterrence of sub-threshold activities. Warrior infantry fighting vehicles are currently deployed as part of NATO's conventional deterrent. Analysis confirms the deterrent effect of forward deployed heavy armour. As potential adversaries upgrade their armoured and counter-force capabilities, continued commitment to the Army's armoured infantry modernisation programmes is needed to ensure their utility.
- Digitised turrets are a core element of the Army's modernisation programmes. Their open architecture allows the insertion of on-platform capabilities, such as Cyber Electromagnetic Activities (CEMA), Intelligence, Surveillance and Reconnaissance (ISR), novel weapons, and air defence. This expands vehicle mission utility, enabling the delivery of a diverse range of effects, such as cyber and electronic warfare at scale. The turrets form a digital backbone that can enable Multi-Domain Integration and human-machine teaming.
- Lockheed Martin UK (LMUK) is the prime contractor for the Warrior Capability Sustainment Programme (WCSP) demonstration contract, awarded in October 2011. It is contracted to deliver a development phase involving 11 upgraded vehicles. LMUK is also a subcontractor to General Dynamics on the AJAX Programme, providing digitised turrets, and pursuing export opportunities. It has the UK's only facility capable of designing and manufacturing digitised turrets and holds unique Intellectual Property and manufacturing capabilities.
- The Ministry of Defence (MoD) is, in effect, the systems integrator for WCSP. It provides the legacy Warrior platform for conversion, sets system requirements, contracts multiple parties, supplies key components (notably the CT40 Cannon System), approves safety cases, and sets and assesses the qualification process.
- Design acceptance under LMUK's WCSP demonstration contract was originally due to be completed by 31 December 2016. This date is now 25 August 2021, a change of four years and eight months. Approximately a year of that delay (20%) can be attributed solely to LMUK. This was caused by first-time design issues, at a cost to Lockheed Martin of over £100 million. The longest delays have been caused by challenges in the provision of Government Furnished Assets (GFX), the impact of the sale of the Defence Support Group (DSG), and, most significantly, the MoD changing the specification of the Cannon System in 2016 (which resulted in a contract amendment). LMUK assesses that these account for approximately 50% of the total delay. 30% has been caused by the complexity of the safety and qualification processes, and legacy equipment failures during trials.
- LMUK is on track to achieve design acceptance by the revised contractual date. Trials of the upgraded vehicles are in their final phase and progressing well, and production phase negotiations are underway. LMUK commissioned an independent economic impact analysis from KPMG,¹ which estimates that, between 2021 and 2029, production could contribute over £1 billion in Gross Value Added to the UK economy and generate, at its

¹ The analysis was commissioned by LMUK. KPMG undertook the analysis, based on data and information provided by LMUK relating to an assumed 275 vehicle upgrades and LMUK's initial pricing estimates against the Invitation to Negotiate. The exact number of vehicles to be upgraded through the WCSP production phase may vary dependent on future government decisions and funding. LMUK's initial pricing estimates are also subject to change. This would affect the overall results of the analysis. The results should therefore be viewed as indicative. Any questions relating to the economic impact analysis should be directed to LMUK, which is responsible for it.

OFFICIAL

peak, 1,951 annual Full Time Equivalent (FTE) jobs and, at a minimum in 2021, 105 annual FTE jobs.

- LMUK strongly believes the UK needs a Land Sector Industrial Strategy. Sustaining the industrial base is necessary for enabling “digital fighting vehicles”, which will require frequent spiral upgrades, and developing other land systems. Failure to develop a strategy is likely to result in the industrial base shrinking and a loss of responsiveness for future capability development and enhancements.

Introduction

1. Lockheed Martin is the fifth largest supplier by revenue to the MoD with over 80 years of heritage in the UK. It directly employs approximately 2,000 people across 23 locations. On average, Lockheed Martin spends more than £1.5 billion in the UK each year, supporting over 1,000 companies in the supply chain, 80% of which are small and medium sized enterprises, and sustaining approximately 20,000 jobs.
2. This submission focuses on WCSP, for which LMUK is the prime contractor for the demonstration contract. For AJAX, General Dynamics UK is the prime contractor, with LMUK as a subcontractor providing turrets and related systems. LMUK continues to meet its contractual obligations for AJAX.
3. WCSP will extend the service life of the Warrior vehicles beyond 2040. The demonstration contract includes three elements, which will ensure platform lethality, survivability, and fightability:-
 - a. Warrior Fightability Lethality Improvement Programme (WFLIP): a fully stabilised 40mm case telescoped (CT40) cannon turret with modern targeting sights;
 - b. Warrior Enhanced Electronic Architecture (WEEA): an enhanced electronic architecture to integrate the onboard systems and provide upgraded power and environmental control systems. This enables full visibility around the vehicle so that soldiers understand the situation before they dismount. It also provides temperature-controlled environments for soldiers, allowing them to operate in extreme temperature environments. Finally, it provides a Generic Vehicle Architecture (GVA), enabling digital spiral upgrades and the insertion of other capabilities; and
 - c. Warrior Modular Protection System (WMPS): a modular armour protection control system with rapid mounting kits. This enables protection to be fitted to suit the unique demands of each operational environment.
4. LMUK was awarded the demonstration contract for WCSP in October 2011. The contract is for the delivery of 11 upgraded vehicles for Reliability Growth Trials (RGTs), and is supported by 31 major subcontractors and a wider supply chain of over 200 companies. RGTs test the performance of the upgraded vehicles through representative ‘Battlefield Missions’ (BFMs) and other qualification and verification activities. The delivery of the demonstration vehicles was completed by July 2018. By mid-July 2020, 59 BFM were successfully completed, earlier than scheduled, marking the end of phase one of the RGTs. The RGTs are now in their final phase.
5. The MoD is, in effect, the systems integrator for the WCSP demonstration phase. It is responsible for setting requirements, the provision of Warrior platforms for conversion, direct contracting of BAE Systems (now RBSL) as the Original Equipment Manufacturer and Design Authority for the in-service (pre-conversion) vehicles, selection of the base

OFFICIAL

vehicle (hull) overhaul organisation, supply of the CT40 Cannon System, provision of GFX, approval of the in-service Safety Case, approval of the converted vehicle Safety Case, and acceptance of qualification evidence.

6. In June 2020, LMUK received an Invitation to Negotiate (ITN) for the production phase of WCSP. Once awarded, this will deliver an enhanced capability that meets the demands of the future operational environment. It is forecast to make a significant contribution to UK prosperity. LMUK commissioned an independent economic impact analysis from KPMG,² which estimates that, between 2021 and 2029, WCSP production could:-
 - a. Contribute over £1 billion in Gross Value Added to the UK economy;
 - b. At its peak, generate 1,951 annual FTE jobs and, at a minimum in 2021, 105 annual FTE jobs; and
 - c. Support up to £276.2 million in tax payments through direct and indirect economic activity.³

[Q5] How flexible can the Army be in adapting its current armoured vehicle plans to the results of the Integrated Review?

7. Armoured infantry fighting vehicles contribute to all mission types, including high intensity warfighting, peacekeeping, peace enforcement, counter insurgency, and deterrence. They are currently deployed as part of NATO's Enhanced Forward Presence (eFP) mission, which aims to establish a conventional deterrent in Eastern Europe. Analysis confirms the deterrent effect of forward-deployed heavy forces.⁴ Forward deployments also deter sub-threshold activities.⁵ To be credible, heavy armour needs to be modernised, given the upgrade programmes and counter-force capabilities of potential adversaries.
8. A core element of the Army's modernisation programmes, including WCSP and AJAX, is a digitised turret. Their open architectures, including GVA, enable the insertion of additional on-platform capabilities, including (but not limited to) Cyber Electromagnetic Activities (CEMA), Intelligence, Surveillance and Reconnaissance (ISR), novel weapons, and air defence. This expands vehicle mission utility, enabling the delivery of a more diverse range of effects and missions. Digitised turrets would allow gaps in current eFP forces to be addressed, enable the Army STRIKE concept, and enable cyber and electronic warfare at scale at the tactical and operational levels. They provide a digital backbone for Multi

² The analysis was commissioned by LMUK. KPMG undertook the analysis, based on data and information provided by LMUK relating to an assumed 275 vehicle upgrades and LMUK's initial pricing estimates against the ITN. The exact number of vehicles to be upgraded through the WCSP production phase may vary dependent on future government decisions and funding. LMUK's initial pricing estimates are also subject to change. This would affect the overall results of the analysis. The results should therefore be viewed as indicative. Any questions relating to the economic impact analysis should be directed to LMUK, which is responsible for it.

³ The analysis of the potential tax contributions covers the direct tax payments associated with LMUK's direct employment through the WCSP and estimates of corporation tax, employee PAYE payments, and employee and employer National Insurance (NI) payments that would be generated through the indirect and induced economic activity of the WCSP. The estimation of direct tax payments excludes the net effect of any wider tax payments LMUK makes linked to the WCSP beyond the estimated employment related tax payments captured within KPMG's analysis and any tax reliefs that it may receive.

⁴ Statistical analysis undertaken by RAND found '*consistent evidence for the deterrent effects of heavy ground forces...especially when deployed in the general theater of interest but not necessarily on the front lines of a potential conflict*'. RAND found no evidence that mobile forces have a deterrent effect and assessed that light ground forces are often associated with an increased likelihood of militarised disputes. It also found that forces deployed rapidly in response to a crisis can help limit escalation but '*do not readily translate into bargaining leverage or improved long-term positions for partner states*'. See Bryan Frederick *et al.*, *Understanding the Deterrent Impact of U.S. Overseas Forces*, RAND Corporation, February 2020.

⁵ On the deterrence of sub-threshold activities and benefits to public opinion of forward deployments, see Keir Giles, *Russia's 'New' Tools for Confronting the West: Continuity and Innovation in Moscow's Exercise of Power*, Chatham House Research Paper, March 2016, p. 68, and https://www.realcleardefense.com/articles/2019/09/03/the_positive_impact_of_natos_enhanced_forward_presence_114713.html.

OFFICIAL

Domain Integration and human-machine teaming, and can be incorporated in other Army vehicle programmes.

[Q8] To what extent does poor contractor performance explain the delays to the Warrior and Ajax programmes?

9. Approximately a year of the WCSP demonstration contract delay can be attributed solely to LMUK. This was caused by first-time design issues, at a cost to Lockheed Martin of over £100 million.
10. In total, the demonstration contract is delayed by four years and eight months;⁶ upon contract award, design acceptance was due to be completed by 31 December 2016, and this date has contractually been revised to 25 August 2021. LMUK is on track to achieve design acceptance for the upgraded vehicles by the revised date.
11. In addition to the delay solely caused by LMUK (which accounts for 20% of the total delay), the longest delays have been caused by challenges in the provision of GFX, the impact of the sale of the DSG, and, most significantly, the MoD changing the specification of the Cannon System in December 2016 (which resulted in a contract amendment). LMUK assesses that these account for approximately 50% of the total delay. Other factors have caused 30% of the delay, including the complexity of developing a composite safety case for the upgraded demonstration vehicles, the complexity of the qualification process, and legacy equipment failures during trials.
12. First-time design issues. The WCSP demonstration contract involves a complex design effort. LMUK experienced several first-time design issues. These included:-
 - a. Meeting the requirements of new Defence Standards for weapon system safety certification, electrical power installation accreditation, and human factors. The standards were revised by the MoD near to the award of the WCSP demonstration contract. This resulted in additional design changes and test evidence, which caused delays;
 - b. An inability to re-use legacy components. Re-use was expected upon award of the WCSP demonstration contract. However, it proved unviable to re-use some legacy components, due to excessive variability in their condition or lack of performance and certification data. This led to some major design changes and improvements, which were agreed with the MoD;
 - c. The length of time taken for LMUK to ensure the functionality of the CT40 Ammunition Handling System; and
 - d. Impacts to the overall design parameters for the firing systems and algorithms, due to a lack of information on the firing characteristics of the MoD's CT40 Cannon System and late qualification of that System.
13. GFX provision. As part of the WCSP demonstration contract, the MoD is required to provide GFX to LMUK. GFX includes information, facilities (including ranges), manpower,

⁶ LMUK's Chief Executive acknowledged the delay in the WCSP demonstration contract in his oral evidence to the Defence Committee's inquiry *Defence industrial policy: procurement and prosperity* on 23 June 2020. He also wrote to the Committee on 29 June. The letter highlighted the following reasons for the delay: first-time design issues experienced by LMUK (at a cost of over £100 million to Lockheed Martin); delays in the provision of GFX to LMUK; the impact of the MoD's sale of their DSG; and the change in specification of the cannon for the upgraded Warrior vehicles, which had the most significant impact and resulted in a contract amendment in 2016. The letter was published as written evidence on 7 July 2020 (DIP0022).

OFFICIAL

and equipment. The contract defines the dates by which the GFX needs to be provided. There have been various challenges with the provision of GFX. These include facilities being unavailable on planned dates, sometimes because other Army activities take priority over the WCSP demonstration contract, and not always being equipped to perform the full range of acceptance testing required. This has caused the rescheduling of qualification activities.

14. In 2018, LMUK previously highlighted the issue of GFX to Parliament:-

Suppliers often have dependencies on the customer. However, there is very limited recognition of the impact these dependencies have on the overall success of a contract. An example in this respect is the provision of Government Furnished Assets (GFX) by the MoD, which should be treated as a formal obligation which is properly staffed with programme management skills to ensure the dependencies do not cause delays and become a cost driver, cause disputes or, indeed, lead to the failure of a programme. Responsibilities and accountabilities need to be defined such that all parties understand the interdependencies and, with those, the need for reciprocal assurances.⁷

15. Sale of DSG. Before LMUK could convert the 11 demonstration vehicles to the new design and build standards for WCSP, the vehicles were due to undergo a routine inspection, repair, and overhaul process by the MoD-owned DSG. The government decided to sell DSG to Babcock. During the sale process, the MoD maintained responsibility for the provision of this service. The repair and overhaul of the legacy vehicles was not completed on time.

16. Change in cannon specification. The CT40 Cannon System is mandated as the primary weapon system for WCSP by the MoD. Its development and release are under the control of the MoD, through the cannon supplier (CTAI). The CT40 Cannon System is managed and delivered via a separate Defence Equipment & Support (DE&S) project team to WCSP. The final technical baseline and configuration for the cannon were not established until over five years into the WCSP demonstration contract (December 2016), over three years later than expected. This resulted in a contract amendment, as LMUK had to re-engineer the integrated turret system and re-design the Cannon Control Unit and its interfaces.

17. Other. In addition to these primary reasons for delays, LMUK would highlight the following:-

- a. The time taken to develop and mature a composite Safety Case for the upgraded Warrior demonstration vehicles was longer than expected. This delayed the start of RGTs. The Converted Vehicle Safety Case had to bring together LMUK's Safety Case for the upgraded vehicles as well as the In-Service Safety Case for the legacy vehicles. Unfortunately, this did not prove workable, as the In-Service Safety Case was not constructed to the same standard and did not carry the same design-based evidence needed for today's level of scrutiny;
- b. The qualification process set for the WCSP demonstration contract involves the testing of the development vehicles against thousands of individual requirements. This has posed challenges for MoD capacity. The Programme has therefore been adjusted to have more reliance on system demonstrations; and

⁷ SSU0014, written evidence to House of Commons Committee of Public Accounts, *Strategic Suppliers*, Fifty-Eighth Report of Session 2017-19, HC 1031, 18 July 2018.

OFFICIAL

- c. During the operationally realistic trials programme, it is expected that some design issues will be identified and rectified on the upgraded demonstration vehicles. In addition, some aspects of legacy equipment have failed (such as the power pack and suspension system), resulting in remedial work and delays to the test programme.
18. Finally, COVID-19 caused a temporary pause in RGTs in March 2020, in agreement with the MoD. At the end of April, approval was given for LMUK to access the trials facility and implement a safety plan for recommencing trials. From mid-May, phased trials recommenced, with appropriate safety measures in line with government guidance. LMUK has also continued to support its WCSP demonstration contract supply chain throughout COVID-19, including by providing consistent work, exceeding prompt payment practices, and making advance payments.
19. As explained in LMUK's letter of 29 June 2020 to the Defence Select Committee, the WCSP demonstration contract is a fixed price.⁸ Lockheed Martin therefore does not recover cost impacts arising from matters which are not the responsibility of the MoD. As of 31 December 2019, cumulative losses to Lockheed Martin from the WCSP demonstration contract are over £100 million, on a contract value of approximately £300 million. Any changes to the contract made by the MoD are costed and implemented accordingly. Strict reviews are undertaken by DE&S to ensure that MoD-initiated variations are at a fair price.
20. As described in paragraph 5, the MoD acts as the systems integrator for WCSP. Where the MoD acts as a systems integrator, it is important for it to have the necessary resources, capacity, and focus to perform that role, including continuity in technical staff.
21. There remains a complex procurement and qualification process for WCSP. Despite this, significant progress has recently been achieved on the development phase, reflecting greater collaboration between the MoD and industry, driven by strong leadership on both sides.

[Q9] Should the UK have a land vehicles industrial strategy, and if so what benefits would this bring?

22. The UK needs to have a Land Sector Industrial Strategy. This strategy should build on the investments made by companies, ensuring the long-term sustainability of a state-of-the-art industrial ecosystem and helping focus investment on future capabilities. Failure to develop a strategy is likely to result in the land industrial base shrinking, as industry will prioritise other parts of defence where future requirements are clearer. This would lead to reduced value for money and a lack of responsiveness in undertaking capability enhancements for land systems, through the fading and loss of workforce skills.
23. Sustaining the industrial base will be vital for enabling the through-life capability management of what will be "digital fighting vehicles". Upgraded (and new) software-enabled vehicles will require more frequent spiral upgrades, rather than the traditional approach of major hardware recapitalisations once a generation. A live industrial base will be required to deliver rolling capability enhancements, including by giving industry the certainty to invest in disruptive technologies that will further enhance the operational utility of land vehicles and other platforms, such as artificial intelligence, machine learning, cyber, and electronic warfare. An active and sustainable industrial base will also be required to provide resilience and support for changing operational demands, providing "surge capacity".

⁸ See written evidence DIP0022, published on 7 July 2020 as part of the Defence Committee's *Defence industrial policy: procurement and prosperity* inquiry.

[Q10] What sovereign capability for the design and production of armoured fighting vehicles does the UK retain?

24. Lockheed Martin acquired its site in Amptill, Bedfordshire in October 2005. It has invested £12 million in developing the UK's only sovereign turret production facility. The sovereign facility is capable of designing, developing, and manufacturing digital turrets end-to-end, from citadel fabrication through to assembly and testing. It has the capacity to support full rate production for WCSP, AJAX, and other potential programmes (including export opportunities).
25. LMUK has unique Intellectual Property in the design of modern weapons systems, particularly in the integration of high-performance fire control systems with open architecture interfaces (GVA) and the wider communications infrastructure that create a seamless weapon system suitable for modern warfare.
26. As part of the WCSP demonstration contract, LMUK has also pioneered new manufacturing techniques, notably the 3D printing of large metal structures through an additive manufacturing process called 'Wire + Arc Additive Manufacturing' (WAAM). WAAM was developed in conjunction with Cranfield University, involving approximately 30 staff and MSc/PhD students as well as partner universities in Birmingham, Manchester, and Nottingham. It has since been applied to other capability areas, including the production of aspects of space capabilities and Strategic Systems.

17 September 2020