Research Papers

April 2026

# Grayburn: The UK's Future Small Arms Requirements

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RUSI Research Papers, April 2026

ISSN 2977-960X

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# Contents

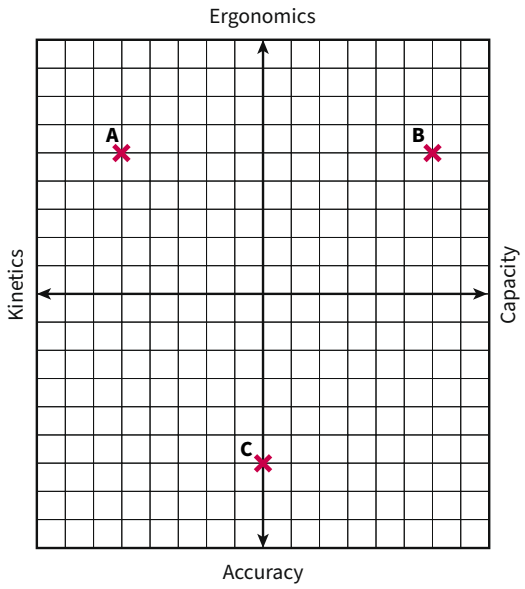
# Executive Summary

Project Grayburn is the British military's first effort for a wholesale in-service rifle replacement in over four decades. This paper outlines the characteristics, compromises and design trade-offs necessary to match the characteristics of a future rifle with the requirements imposed by the emerging operating environment. It deliberately does not advocate for a specific make, model or variant of rifle so that viable contenders can be assessed fairly.

The requirements identified are for a rifle that can effectively suppress targets at 400 m and reliably kill targets within 150 m. It is further assessed that the future operating environment will see fighting predominantly within complex terrain, from and into closed fighting positions, and off vehicles.

The British military needs to decide whether to seek to penetrate improved body armour by increasing the kinetic performance of their rifles, to improve accuracy sufficiently to circumvent armour reliably, or to fire more rounds to improve the statistical probability of bypassing armour.

**Figure 1:** Trade-Off Matrix Between Rifle Characteristics




Source: The authors.

This paper assesses that while the mechanical accuracy of a rifle can be improved sufficiently to circumvent armour, the practical accuracy of the rifle – taking into account the accuracy of the shooter – cannot. In addition, increasing the kinetic energy of the rifle entails moving to a larger-calibre round. This comes at the expense of capacity for rounds carried – although it is possible to make such a weapon relatively compact and ergonomic. If the effect of the weapon is achieved through a statistical approach, then the weapon can be made ergonomic but risks failing to be sufficiently lethal at close range.

Although the selection of the lower receiver, calibre and controls should be grounded in the requirements of the UK's close combat forces, users will span the Royal Navy, the Royal Air Force (RAF), Cadets and non-combat arms of the British Army. There is, therefore, value in having the option to use different length barrels and optics for different uses.

If the UK goes to war, the scaling of the force means that there should be sovereign industrial capacity to manufacture the rifle and its ammunition. The rifle should also be as simple as possible to maintain and thus not be dependent on an unrealistic length of training in wartime conditions. Reliability and maintainability under field conditions will be a key feature of the weapon if confidence is to be imparted to troops.

Although interoperability with Allies is often a driver of calibre selection in NATO, a survey of Allied decisions shows that there is already divergence between members. Thus, the UK should select the calibre and rifle that best suits its operational requirements rather than a less suitable weapon that only aligns with some Allies.

The eventual choice necessarily involves trade-offs. So, once a decision is made, it is important that the British military explains to users why some characteristics were prioritised over others, and how the rifle fits within a coherent system of combined arms fighting. This is essential if the force is to have confidence in its arms.

# Introduction

> *The rifle is more than a weapon. It becomes the tangible symbol of the bond between the state and its soldier … If the state cannot provide a reliable and effective rifle, then it has failed at upholding its side of this foundational bargain.*[1]

This paper sets out the trade-offs in weapon design in meeting requirements imposed by the future operating environment. These should inform the selection of a replacement rifle for the L85A3 in British service as the output of Project Grayburn.

Small arms have caused a minority of casualties in large-scale conventional war since the First World War. Artillery, air power, mines and more recently drones are all statistically more lethal. Small arms, however, shape the behaviour of combatants, offer personal protection and are often responsible for some of the most critical killing: that which enables a position to be finally occupied and held. Personal weapons are a foundational part of a force's fighting equipment. Small arms are also used by all troops at all levels, and the force universally interacts with these arms for a diverse range of purposes. The number of troops needing small arms means that they are a major investment for any military. Their effectiveness also affects the confidence of troops in their equipment and capabilities.

The current British service rifle, the L85A3, is reasonably accurate, compact because of its bullpup configuration, and an effective weapon, if somewhat heavy while suffering from poor ergonomics. The original L85A1 was a case study in how not to procure a weapon.[2] It had poor build quality and design flaws. These led to a weapon entering service that suffered from major reliability issues under field conditions and had fundamentally poor ergonomics and a tendency to break.[3] Although the underlying design was salvageable, and the L85A2 resolved the most egregious issues

1. Matthew Ford, 'The False Promise of New Technology: The British Army and the (New) Calibre Debate', Wavell Room, 11 June 2025, <https://wavellroom.com/2025/06/11/the-false-promise-of-new-technology-the-new-ammunition-calibre-debate/>, accessed 1 February 2026.
2. Matthew Ford, *Weapon of Choice: Small Arms and the Culture of Military Innovation* (London: Hurst, 2017).
3. Jonathan Marcus, 'Army Rifles: What's Gone Wrong?', *BBC News*, 31 July 2000.

with the weapon, the mistakes made in the original rollout did lasting damage to its reputation.

The L85 is approaching the end of its planned service life for frontline users and will be progressively phased out over the next decade. The decision to replace it has been deferred several times to save in-year costs, but the process of buying a replacement rifle for the whole force across the British Army, Royal Navy, the RAF and Cadets is expected to be completed imminently. This is being pursued under Project Grayburn. Several specialist units including the Royal Marines, Pathfinders, Ranger Regiment and a couple of others have managed to use their delegated budgets to purchase five different kinds of rifle with different spare parts.[4] Given the Ministry of Defence's (MoD) proclivity to defer costs until they accumulate to a point where they are neither avoidable nor affordable in-year, there is a risk that the urgency of need will result in a wide range of weapons being brought in piecemeal. Project Grayburn – by identifying a single base rifle around which different user groups can select task-specific options – is intended to prevent what would otherwise be widespread inconsistency across the force that would degrade training efficiency and undermine logistics and maintenance. Military units – if given discretionary funds – are prone to pursuing fads or diversity for the sake of being different. It is therefore important that Project Grayburn selects a rifle that underpins how the British military intends to fight. This paper aims to outline the trade-offs that must be confronted and the requirements imposed by the operating environment in making that decision.

Research for this paper was conducted over an extended period between January 2024 and early 2026. It forms part of a RUSI project to support conceptual development within the British Army. The research was conducted independently, and all findings are the authors'. One of the authors is a serving officer and was therefore obliged to have the paper approved for release by the MoD, but this did not give the MoD the right to edit the paper. The paper was submitted on 2 February 2026 and approved for copy editing on 23 March 2026.

The evidence base for this paper is diverse. Analysis of the future operating environment has been premised on direct observation of combat operations in the Middle East and Ukraine, along with surveys of data held by the Israel Defense Forces (IDF) and Ukrainian General Staff on engagement ranges and characteristics. The authors have also observed and reviewed data from exercises using novel technologies in the US, Finland, the UK and elsewhere. Over the course of the research, the authors fired the various rifles that states have purchased or considered for their future forces

4. Briohny Williams, 'Exclusive: Royal Marines Hit the Range and Practise CQB with New KS-1 Assault Rifle', *BFBS Forces News*, 27 October, 2023, <https://www.forcesnews.com/technology/weapons-and-kit/ks-1-royal-marines-practice-cqb-and-shooting-their-new-rifle>, accessed 21 January 2026; Royal Navy, 'Royal Navy Procures New Rifle for Specialist Commando Operations', 8 March 2025, <https://www.royalnavy.mod.uk/news/2025/march/08/20250307-royal-navy-procures-new-rifle-for-specialist-commando-operations>, accessed 21 January 2026.

and have spoken to arms manufacturers about their ballistic analysis. A literature review was also conducted of the future of close combat and current doctrine within several NATO militaries, along with emerging military concepts. Interviews were carried out with those responsible for designing the future fighting system in the British Army and the US Army, primarily in the Soldier Lethality Cross Functional Team that was previously part of US Army Futures Command. Despite this diverse evidence base, specific technical data on ballistic performance or anticipated enemy target characteristics are often sensitive. Therefore, this paper avoids detailing specific performance characteristics of individual weapons. No AI was used in the research or drafting of this paper.

The paper is structured into three chapters. The first chapter discusses the trade-offs inherent in small arms design in meeting requirements. It explores how there are often multiple routes to meeting a requirement and that each route comes with its own compromises. The second chapter considers combined arms close combat in the future operating environment and where small arms fit into the fighting system. The aim is to bound requirements for small arms for the British Army. The third chapter then draws deductions about matching the trade-offs – explored in the first chapter – and the requirements – explored in the second chapter – to the UK. It should be noted that small arms are relevant for uses other than the combined arms close combat echelon. They are used by rear-echelon troops for self-defence and by cadets for training, for example. The assumption here, however, is that the fundamental requirements relating to the rifle calibre and controls are determined by the needs of the close combat arms, while barrel length and other attachments may be adapted for specific user communities. The requirements of rear-echelon troops should not undermine the practical utility of the weapon to fighting-echelon troops.

# Variables in Small Arms Requirements

The selection of the British Army's service rifle requires balancing competing technical characteristics, each of which influences battlefield performance in distinct ways. No weapon design will simultaneously maximise all desired attributes: improvements in one area typically force a compromise elsewhere. Understanding these trade-offs is essential to developing coherent requirements that align with tactical doctrine and are optimal for possible operational scenarios.

This chapter examines five critical variables in small arms design: kinetics, accuracy, ergonomics, capacity and legality. It explores how these characteristics affect combat effectiveness, the physical and engineering constraints that govern them, and the compromises inherent in different design approaches. Collectively, these variables form an interconnected system in which decisions taken about one variable cascade across the others. These categories can be broken down further, but a degree of aggregation is helpful as it groups characteristics of the weapon in relation to their relevance to battlefield performance, rather than their pure technical function.

## Kinetics

For the purpose of this paper, kinetics encompasses the kinetic energy a weapon can transfer to its target and thus the damage it can inflict. Contributing to this kinetic performance is the muzzle velocity of the bullet leaving the weapon, the flight characteristics of the bullet, its mass and its behaviour on impact. Calibre – the internal diameter of a rifle barrel and thus the projectile fired – is the nexus of these characteristics. Selecting a calibre stems from the desired kinetic characteristics, and this paper returns to calibre selection after having considered the other variables.

Muzzle velocity is the speed at which a projectile exits the rifle barrel, measured in metres per second (m/s). It ranks among the most important characteristics of a rifle, influencing both ballistics and terminal performance. The higher the velocity, the

flatter trajectory a projectile maintains over distance. This reduces the need for precise range estimation and firer adjustments (for example, to account for wind). This translates into increased hit probability over extended ranges, particularly when engagements occur rapidly with limited opportunity for deliberate aiming. Velocity also affects projectile kinetic energy and therefore terminal effect on a target. When a projectile hits a target at higher velocities, it transfers energy at a faster rate, creating larger wounds and increasing the probability of immediate incapacitation. The relationship between velocity and wounding is not linear.

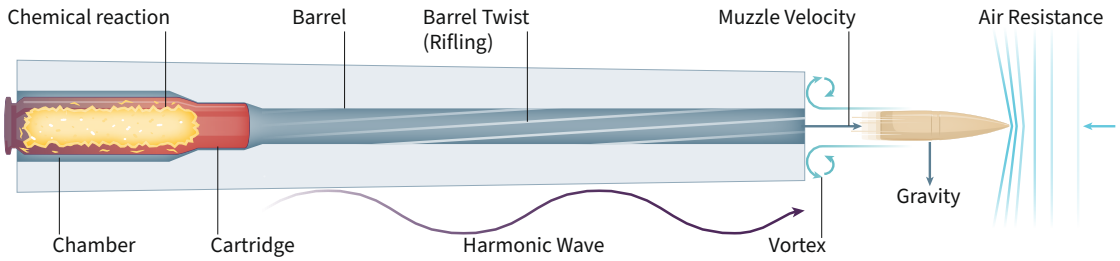
The principal determinant of muzzle velocity within a given calibre is barrel length. Full-length assault rifle muzzle velocity ranges between 900 and 960 m/s.[5] The L85A2 uses a bullpup design and fires the NATO standard 5.56-mm x 45-mm to achieve a muzzle velocity of 940 m/s.[6] The KS-1 has a shorter barrel and thus lower muzzle velocity. At the muzzle, a 5.56-mm round fired from an L85 has about 1,700 Joules of energy, while the same bullet fired from a KS-1 has about 1,300 Joules. Energy reduces as range increases and the projectile decelerates in flight. This equates to a range advantage – for an equivalent hit for the L85 compared with the KS-1 – of about 100–150 m.[7] A weapon with a barrel that is too short can functionally 'lose [its] ability to inflict wounds'.[8] However, increased velocity comes from either higher-power ammunition, which increases weight and felt-recoil, or a longer barrel, which affects ergonomics. Technological advances in cartridge and propellant manufacture promise to improve projectile velocity while reducing weight by replacing brass cartridges with other materials such as steel alloys, but this increases the cost of rounds.[9]

The effect on target is determined by the extent to which kinetic energy at the muzzle is retained during flight. This is a function of the flight characteristics of the bullet, the amount of drag or air resistance created by its shape and the material from which it is constructed and its aerodynamic stability at different speeds, including as it transits the sound barrier. The latter is heavily affected by the harmonics of a given barrel length,[10] and the rate of spin on the bullet imparted by the twist rate of the rifling in the barrel.[11] It should also be noted that while increases in terminal velocity increase the

5. Alan Catovic, 'Comparison of Penetration Capability of Several Contemporary 5.56×45 mm Projectiles into Hard Targets', *Advances in Military Technology* (Vol. 19, No. 1, 2024), p. 76.
6. Duncan Stewart, 'NATO and the Next Generation Squad Weapon – NGSW', Wavell Room, 17 September 2024, <https://wavellroom.com/2024/09/17/nato-and-the-next-generation-squad-weapon-ngsw/>, accessed 1 February 2026.
7. Author interview with British Army subject matter expert (SME), London, 18 January 2026.
8. Royal Society, *Understanding Ballistics: A Primer for Courts* (London: Royal Society, 2021), p. 22.
9. Jake Kauffman, 'Revolutionizing the Battlefield: How Lighter Ammo Saves Troops' Lives and Reduces Casualties', *Defense and Munitions*, 2 January 2025, <https://www.defenseandmunitions.com/news/revolutionizing-the-battlefield-lighter-ammo-saves-troops-lives-reduces-casualties-shell-shock-technologys/>, accessed 1 February 2026.
10. A Mallock, 'Vibrations of Rifle Barrels', *Proceedings of the Royal Society* (Vol. 68, No. 442–450, 1901), pp. 327–44.
11. Roy E Rayle, 'Gun Barrel Design', *Ordnance* (Vol. 46, No. 252, 1962), pp. 836–38.

imparted energy to the target exponentially, velocity necessarily decreases over distance, whereas the mass of the bullet remains constant.

**Figure 2:** Factors Contributing to Energy of a Round




Source: The authors.

The lethality of the rifle – a weapon's ability to incapacitate enemy combatants, rendering them unable to continue fighting – is ultimately determined by how the bullet interacts with its target on impact. This is frequently the most misunderstood characteristic in small arms discourse, complicated by incomplete wound ballistics data and the difficulty of isolating terminal effects from shot placement, engagement distance and target protection. It is important to note that whereas lethal force in a civilian context is generally defined in terms of the minimum force necessary to kill, in a military context it is the level of force guaranteed to kill.[12] Despite decades of research, there is still significant uncertainty over the optimal approaches to maximising lethality within legal and practical constraints. The central challenge in designing for lethality is that the conditions determining whether a round kills or incapacitates a target (strike location, impact velocity and target presentation) are unpredictable. Procurement must therefore focus on maximising the probability of a hit rather than engineering for a specific terminal effect.

Terminal ballistics – the study of projectile behaviour on striking a target – distinguishes between permanent and temporary wound cavities.[13] Permanent cavitation is tissue directly crushed or torn by the projectile and its fragments. Temporary cavitation occurs as tissue is damaged and displaced as a projectile passes through.[14] Shot placement remains the dominant factor in immediate incapacitation: a well-placed shot from a less powerful cartridge consistently outperforms a poorly placed shot from a more powerful one. This is why advancing body armour technology

12. Matthew Ford, 'The Epistemology of Lethality: Bullets, Knowledge Trajectories, Kinetic Effects', *European Journal of International Security* (Vol. 5, No. 1, 2019), pp. 77–93.
13. Royal Society, *Understanding Ballistics*, p. 24.
14. Martin Andrew, 'Missile Injuries: High Velocity Missile Wounding Using Military Projectiles', *Australian Military Medicine* (Vol. 14, No. 2, 1994), p. 52.

with 'improved ballistics and stab resistance performance' is proving so challenging on the modern battlefield: it decreases the likelihood of incapacitation.[15]

Modelling lethality requires a clearly defined target, which informs the optimum weapon and ammunition, allowing consideration of the best suited rifle. In the British Army, this is doctrinally overlayed against the Lethal Splinter Distance and Safe Splinter Distance from artillery. These two ranges are considered the points at which small arms replace indirect fire suppression on an enemy position during an assault. Taking this approach means there is weapon-range overlap between indirect and direct fire capabilities on the battlefield. This overlap denies an enemy a window of opportunity to engage assaulting forces.

Suppression represents an alternative perspective on weapons effect against a target. It provides nuance to an otherwise binary assessment. An effective weapon need not kill to achieve tactical effect, if it renders the enemy unable to fight effectively. The perceived threat of death from the weight and volume of fire, accuracy and noise all contribute to a suppressive effect rather than actual lethality.[16] From this perspective, flatter trajectories and reduced recoil that enable higher hit probability may contribute as much to tactical effectiveness as raw terminal ballistics. The psychological effect of fire, however, is shaped by the morale, cohesion and training of the target,[17] which are neither constant nor easy to model.

If adversaries routinely employ effective body armour, it is critical to achieve barrier penetration and armour defeat. If engagements primarily occur at distances where velocity-dependent ammunition remains effective, intermediate cartridges suffice. Over-emphasising lethality – particularly by adopting heavier calibres – without considering the system-level effects on ammunition load, logistics, recoil management and weapon weight – risks degrading overall combat effectiveness even as individual shot lethality increases.

Identifying the necessary kinetics for the Grayburn rifle, therefore, requires the British Army to determine the characteristics of its anticipated target, the range at which it must be engaged, and therefore the kinetic energy requirements to defeat the target. Achieving the necessary kinetic performance determines the required rifle calibre, power, length and twist rate of the barrel, and the material construction of the bullet.

15. Doaa H Elgohary, 'Technological Aspects of Body Armour Textiles for Ballistic Protection Application', *Journal of the Textile Institute* (Vol. 116, No. 12, 2024), p. 13.
16. Jim Storr, 'The Real Role of Small Arms in Combat', *RUSI Defence Systems* (Vol. 12, No. 1, 2009), pp. 44–46.
17. Anthony King, 'Combat Effectiveness in the Infantry Platoon: Beyond the Primary Group Thesis', *Security Studies* (Vol. 25, No. 4, 2016), pp. 699–728.

# Accuracy

Accuracy describes a weapon's ability to place rounds consistently on target, determined by mechanical precision and marksmanship. Precision is characterised by proximity grouping, while marksmanship incorporates human factors affecting the user, such as engagement conditions and environmental characteristics.[18] A firer can hit a target without being precise and they can miss precisely. For a military, accuracy under field conditions is the critical characteristic in selecting a new rifle.

Militaries must also evaluate user accuracy over time. Lighter overall rifle weight and shorter barrel length increase accuracy at close range by being easier to handle and bring to bear. Meanwhile, a heavy weapon tires the user and reduces accuracy over time, unless fired from a supported position, which is not typical for a personal weapon in many contexts. Accuracy requirements must be matched to tactical employment. Infantry that are expected to primarily engage within 300 m require less mechanical precision than designated marksmen engaging at 600 m. Over-emphasising accuracy at the expense of other characteristics – particularly ergonomics and weight – can be counterproductive. But for longer engagements, weight and a long barrel are advantageous because they contribute to stability.

Sight systems also profoundly affect accuracy at different ranges. These contribute to spotting targets, acquiring them and aligning the rifle to hit them. Iron sights are robust and require no batteries, but demand precise alignment of eye, rear sight, front sight and target which is difficult to do quickly under stress. Optical sights magnify the target and simplify aiming, significantly improving hit probability at extended ranges. Holographic sights can compensate for parallax error at shorter ranges, accelerating target acquisition. Higher magnification optics, meanwhile, make target acquisition at shorter ranges more difficult.

Recoil management directly affects accuracy, particularly in rapid or automatic fire. Rifles that generate less felt-recoil allow faster rates of fire and easier maintenance of sight picture. Muzzle brakes and compensators reduce felt-recoil and muzzle climb, but increase noise and blast, potentially degrading situational awareness and causing discomfort to those adjacent. Suppressors reduce both noise and felt-recoil but add length and weight and require additional maintenance. The addition of a suppressor also affects the choice of gas-recoil system that can be used for the rifle, as the ability of the weapon to dissipate gas quickly determines the amount of concussive gas that is likely driven back towards the shooter, which also affects accuracy over time.

18. Jan Erik Buskerud, Frank Eirik Abrahamsen and Paul André Solberg, 'Physical Stress and Determinants of Shooting Performance Among Norwegian Special Forces Operators', *Frontiers in Psychology* (Vol. 13, June 2022).

Ultimately, practical accuracy will not match mechanical accuracy under battlefield conditions. The human shooter is by far the largest contributor to shot error. They remain 'sensitive to a variety of [adverse] variables'.[19] Therefore, the critical measure of a rifle's accuracy within a military context is whether it can enable a soldier to hit a man-sized target at the range required within the combined arms system.[20] Within this framing, terminal placement (the precise anatomical location of the strike) is a secondary consideration to the probability of a hit at all, since any hit carries a meaningful probability of incapacitation. This places practical limits on how much additional mechanical precision is worth gaining at the cost of other variables – particularly ergonomics and weight.

## Ergonomics

Ergonomics encompasses how effectively a soldier can manipulate, carry and employ a weapon. Ergonomic excellence is difficult to quantify but immediately apparent to a soldier. Weapons that handle well inspire confidence and are employed more effectively. Given that soldiers carry their rifles for extended periods and use them when stressed, exhausted, wounded and in darkness, ergonomic design is a critical performance multiplier that transcends simple ballistic calculations. Even for non-combat arms, ergonomics is highly important. It is likely that a weapon that is easy to carry will be carried by a soldier when primarily performing other tasks. A weapon that is awkward to carry is liable to be left nearby while performing other tasks and will therefore probably not be to hand when needed.

Soldiers fire their service rifle in different scenarios, across varied environments. Poor ergonomics degrade rifle performance in ways that cannot be compensated for by superior ballistic characteristics. Research has found strong evidence that correlates 'poor ergonomics' as a contributing factor to 'muscle fatigue and reduced accuracy' on users that was 'detrimental to [their] shooting ability'.[21] Equally, control location and design fundamentally affect weapon handling. A weapon that handles awkwardly is slower to bring into action, harder to reload under pressure and difficult to maintain on a mission or operation. Vital functions such as cocking handles, bolt catches and safety selectors must be accessible and operable without breaking firing position or requiring excessive hand movement. They must remain so in extremes of hot or cold, including

19. Gregory K W K Chung, 'Review of Rifle Marksmanship Training Research', CRESST Report 783, National Center for Research on Evaluation, Standards, and Student Testing, January 2011, p. 19, <https://calhoun.nps.edu/server/api/core/bitstreams/95b4240f-e4b7-41c3-87f6-936773bb8af3/content>, accessed 12 March 2026.
20. Anthony King, *The Combat Soldier: Infantry Tactics and Cohesion in the Twentieth and Twenty-First Centuries* (Oxford: Oxford University Press, 2013), pp. 208–65.
21. Jemma L Coleman, Jodie A McClelland and Kane J Middleton, 'The Use of Muscle Activity Measures in Combat Shooting Assessments', *Ergonomics* (Vol. 68, No. 12, 2025), p. 2078.

when wearing gloves. Deficiencies in these areas directly reduce combat effectiveness and can prove fatal in close engagements where fractions of a second matter.

The British Army L85's awkwardly positioned charging handle and fire selector exemplify how poor control placement reduces operational efficiency. Soldiers have long reported difficulty clearing stoppages rapidly and conducting reloads smoothly, particularly when wearing gloves or body armour, despite iterative upgrades to today's A3 variant.[22] Reliability is a function of the tolerances in the weapon and the consistency of gas pressure even when the action is compromised by dust, water, extreme external temperatures or high internal temperatures from sustained firing. Mechanical reliability often comes at the expense of weight or felt-recoil, affecting ergonomics. Ambidextrous controls add some manufacturing complexity but, through good design which mitigates additional weight, offer advantages in confined spaces where firing from the non-dominant shoulder may be necessary.

A major problem of selecting a rifle with optimal ergonomics is that a soldier's opinion is partly shaped by the battle drills where they use their weapons. Within NATO militaries, there is a tendency to mythologise drills used by special operations forces (SOF) as inherently better. Thus, equipment used by SOF has a 'seductive quality'.[23] Yet, SOF are highly trained and employed for specific, bounded tasks over short durations and are equipped accordingly. The vast majority of military personnel, by contrast, have far less range time, and spend extended periods in the field, using their weapon for more varied engagements over the course of an operation and they therefore require a more robust, simpler weapon and ancillaries that they can maintain on the battlefield. Ultimately, ergonomics and mechanical reliability under field conditions determine the success or failure of an in-service rifle. To overcome the allure of SOF-derived requirements, it is therefore necessary for the British Army to clearly articulate the logic of its design choices so that the ergonomics can be seen to match the intended use.

## Capacity

The capacity of a weapon is its ability to sustain its effect and is a function of the number of rounds a soldier can carry and the consistency with which they can be fired. This includes considerations of how many rounds are held in a magazine, the ergonomics of magazine changes, as well as the weapon's mechanical reliability. A

22. Julian Perreira, 'SA80 Rifle: Want To Know All of the Gen?', *BFBS Forces News*, 14 October 2019, <https://www.forcesnews.com/technology/weapons-and-kit/sa80-rifle-want-know-all-gen>, accessed 1 February 2026.
23. Michael Noonan, 'The Seductiveness of Special Ops?', *War on the Rocks*, 3 March 2015, <https://warontherocks.com/2015/03/the-seductiveness-of-special-ops/>, accessed 1 February 2026; Roger A Beaumont, *Military Elites: Special Fighting Units in the Modern World* (London: Bobbs-Merrill, 1975).

rifle's magazine capacity determines how many rounds a soldier can fire before having to reload and directly affects force protection, rates of fire and tactical flexibility.[24]

Higher-capacity magazines reduce the frequency of reloads, maintaining suppressive fire for longer periods and reducing vulnerability during magazine changes. However, higher-capacity magazines or higher-calibre rounds impose penalties in weight, bulk, reliability and weapon handling that must be carefully weighed against tactical benefits. A full 5.56-mm x 45-mm NATO magazine weighs approximately 460 g. A British Army infantry soldier with routine scales of ammunition therefore carries six magazines (weighing 2.76 kg) and a 150-round bandolier (1.83 kg). On contemporary battlefields – whether in Afghanistan, Gaza or Ukraine – individual soldiers have typically carried significantly more.

Magazine reliability affects weapon effectiveness as much as capacity. Magazines are the most common source of weapon stoppages, with feed lips that bend, springs that weaken and bodies that crack under impact. Aluminium magazines are lightweight but easily damaged; steel magazines are more durable but heavier; polymer magazines, such as those that were issued throughout British operations in Afghanistan, offer a middle ground.

Standard infantry rifle magazines have converged on 30-round capacity for intermediate cartridges as a practical compromise. Most magazines are reliable when loaded with 28 rounds. This provides adequate capacity for typical engagements while keeping magazine weight manageable and maintaining reliability. Magazine design – particularly feed lip geometry and follower design – critically affects reliability with different ammunition types and fouling. NATO standardisation through STANAG 4172 theoretically allows magazine interchangeability. However, reliability varies significantly across manufacturers, and units often restrict soldiers to specific magazine types.[25] Capacity requirements should therefore be derived from anticipated small arm engagement patterns and the rifle's role in the overall fighting system, rather than pursuing maximum capacity as an end in itself.

Calibre, and thus the weight of ammunition carried, also has implications for the wider last-mile resupply logistics system. Under current British planning assumptions, every Rifle Company is assumed to require 0.45 pallets of 5.56-mm ammunition for rifles, 0.58 pallets of 5.56-mm linked ammunition for light machine guns, and 3.04 pallets of 7.62-mm linked ammunition for general purpose machine guns per day. Pallets of 5.56-mm ammunition weigh up to 680 kg, depending on the ammunition boxes. The

24. Richard Fisher, 'Comparing Historic Military Capabilities: Apples with Apples', *RUSI Journal* (Vol. 169, No. 1–2, 2024), pp. 76–90.
25. NATO, 'Standard AEP-97: Multi-Calibre Manual of Proof and Inspection (M-CMOPI) for NATO Small Arms Ammunition', Edition A, Version 1, NATO Standardization Office, October 2020, p. 1–1, <https://diweb.hq.nato.int/naag/Public%20Release%20Documents/AEP-97%20EDA%20V1%20E.pdf>, accessed 1 February 2026.

increase in volume, despite 5.56-mm ammunition needing a lower number of rounds than 7.62 mm ammunition, points to the unavoidable reality that an increase in calibre necessarily expands the logistical burden of the force while decreasing the ready rounds available to the soldier. This reduces the amount of time they can spend in contact before requiring resupply. Regularity of resupply is an important doctrinal element that must match the tempo of how the force intends to fight. Flexibility of that supply is also an important consideration, partially determined by whether a force has common ammunition with its allies. This is partly determined by calibre, but also by the velocity of rounds and the construction of rounds, which raises legal issues – the subject of the next section.

# Legality

The British armed forces operate within the UK's interpretation of international law. This is not only a foundational element of the legitimacy of the UK's use of force but also endeavours to establish normative behaviours that encourage adversaries to moderate their behaviour and decisions on the battlefield. International humanitarian law enshrines certain principles relating to small arms design. These arise from some of the earliest bodies of treaties governing the conduct of armed conflict. The key legal framework is the 1899 Hague Declaration concerning expanding bullets. It prohibits projectiles 'which expand or flatten easily in the human body'.[26] The principle established is that weapons should not cause 'superfluous injury' through suffering that is disproportionate to legitimate military objectives.[27] Faced with trade-offs imposed by the need to incapacitate adversaries wearing body armour, it is important that Project Grayburn baselines options against what will be militarily necessary over the lifespan of the rifle, and not rigidly adhere to what has been militarily necessary in previous operating environments.

It is commonly understood that the 1899 Hague Declaration bans hollow-point ammunition for military use, but it does not explicitly prohibit fragmentation, and states have chosen to interpret the Declaration in various ways. Some argue that any projectile designed to increase wounding beyond what is necessary to incapacitate violates this principle. Others contend that more effective incapacitation reduces overall suffering by ending combat more quickly and preventing wounded combatants from continuing to fight and potentially requiring multiple shots to kill. These competing interpretations reflect different philosophical approaches to the laws of

26. Robin Coupland and Dominique Loye, 'The 1899 Hague Declaration Concerning Expanding Bullets. A Treaty Effective for More than 100 Years Faces Complex Contemporary Issues', *International Review of the Red Cross* (Vol. 85, No. 849, 2011), pp. 135–42.
27. International Committee of the Red Cross, 'Rule 70: Weapons of a Nature to Cause Superfluous Injury or Unnecessary Suffering', Volume II, Chapter 20, Section A, <https://ihl-databases.icrc.org/en/customary-ihl/v1/rule70>, accessed 1 February 2026.

armed conflict. The UK – alongside Canada, Australia and Germany – have traditionally taken a relatively stringent approach on fragmenting ammunition. By contrast, the US has consistently stated that 'expanding bullets are not necessarily unlawful' and acknowledge their utility in counterterrorism situations and close-quarters battle.[28] The US also uses a construction of the 5.56-mm bullet that the UK and some other European states have determined to be non-compliant with their current interpretation of the principles of international humanitarian law. It should be noted that these differences limit interoperability across NATO, even if different states' rounds are mechanically interoperable. Determining what constitutes superfluous injury, therefore, remains contentious and open to interpretation.

The risk for Project Grayburn is that bureaucracies often treat policy derived from previous legal positions as settled law. However – because of increased protection – changes can occur in both battlefield conditions and what is technologically necessary to incapacitate. Therefore, even within a particular philosophical interpretation of the law, the determination of what is militarily necessary alters what is permissible. It is thus important that the performance requirements to achieve the necessary effect are determined and then presented to lawyers to derive guidance on what is permissible. Ethical considerations and tactical effectiveness should offer complementary frameworks for evaluating lethality characteristics. Armour-piercing ammunition designed to defeat body armour and light materiel is permissible under international humanitarian law, provided it is not designed primarily to increase anti-personnel effects through expansion. There is also a question over whether a fragmenting layer is required to achieve the necessary effect on a target.

This chapter has outlined several variables that must be assessed against one another in designing a rifle. Larger calibre increases kinetic effect but necessarily comes at the expense of carrying capacity. A longer barrel produces greater effect but at the expense of ergonomics. Length, weight and sights can be adjusted to improve accuracy but are generally optimised for specific ranges and can reduce accuracy outside those optimal range brackets. Choosing among these variables requires clearly defined requirements, which are derived from knowing the intended target and tactical framework within which the weapon is to primarily be used. This, therefore, is the subject of the next chapter.

28. Carmen Chas, 'Against the Laws of Humanity: Expanding Bullets and the 1899 First Hague Peace Conference', *International Review of the Red Cross* (Vol. 107, No. 930, 2026), pp. 999–1019.

# The Context of Future Dismounted Close Combat

Determining the requirements of a future rifle necessitates an understanding of the intended engagement ranges, tactical role and relationship with other weapons in the force. This chapter, therefore, outlines how personal weapons affect how a force fights, the weapons mix that is likely to characterise the future operating environment, the engagement ranges for which the Project Grayburn rifle are likely to be optimised, and contextual factors arising from the broader operating environment.

## Matching Personal Weapons to Role

The role of personal weapons in combat is extremely varied because soldiers have this equipment to hand most of the time. Nevertheless, the deliberate employment of personal weapons to their greatest effect generally fits within a broader fighting system. The short Roman gladius, for example, was an effective sword when used in close formation by troops equipped with large shields. The long swords of the Gauls, by contrast, required a more open battle order and smaller – usually round – shields because of the ergonomics of swinging the weapon.[29] Weapons can also become specialised because of how they relate to other weapons in a unit. A pike, for example, is unwieldy because of its length and weight. It is therefore inferior to a spear as a personal weapon in most circumstances. But, in the early period of gunpowder weapons, it was the musket that delivered the damage, while pikemen would protect the musketeers from the enemy closing on them too quickly. Thus, weapons became longer.[30]

29. Flavius Vegetius Renatus, *De Rei Militari* [*Concerning Military Tactics*] (Heidelberg: Winter Universitätsverlag, 1988).
30. Niccolò Machiavelli, *Dell'arte Della Guerra* [*The Art of War*] (St Ives: Viking Penguin, 1979).

The weapons mix in a modern infantry unit has been through several iterations. During the Second World War, the most lethal part of any infantry squad was its machine gun, with the section's riflemen delivering only a fraction of the machine gun's weight of fire. Thus, tactics emphasised the placement, protection and movement of the machine gun. Moreover, the centrality of the machine gun meant that infantry rifles and machine guns generally used a common full-power cartridge. The wider adoption of submachine guns allowed infantry to have a high rate of fire but at short range. This meant tactics shifted, with rifles protecting the machine gun, the machine gun delivering suppression and the submachine gun closing to engage.[31] The adoption of select-fire rifles with intermediate cartridges and a higher magazine capacity allowed riflemen to deliver suppressive weight of fire and be able to move and fire. Squad tactics therefore moved towards symmetrical fireteams that were able to fire and manoeuvre more rapidly.

Current projections of the future battlefield have been somewhat simplistic. The US Army determined that its Dismounted Close Combat forces required a weapon that was able to defeat modern Russian and Chinese body armour at 600 m.[32] The 600-m requirement was derived from two variables. First, 600 m is the Danger Close Distance for 155-mm artillery shells, and therefore theoretically demarcates the boundary at which the US Army assesses that small arms may need to take over suppression of the enemy. This is determined by the Safe Splinter Distance for air-burst 155-mm shells for unprotected troops, which is 500 m, with a 100 m margin for error.[33] Second, 600 m is roughly the maximum practical engagement distance for fire from small arms (not from machine guns or sniper rifles). While 600 m is historically not a likely range for accurate fire, the US concluded that improvements in optics would compensate for this. Thus, the US adopted the M7 Rifle firing 6.8-mm x 51-mm ammunition, which involved significant compromises for weight and ammunition carrying capacity.[34]

## The Future Weapons Mix

It is useful to describe the direct fire, fire support, indirect fire and loitering munitions that are likely to comprise the weapons mix in British units in the foreseeable future. This enables an evaluation of the weapons alongside which the Project Grayburn rifle will be employed.

31. Stephen Bull, *World War II Infantry Tactics: Squad and Platoon* (Oxford: Osprey, 2004).
32. Todd South, 'Army Chooses Sig Sauer to Build its Next Generation Squad Weapon', *Army Times*, 19 April 2022, <https://www.armytimes.com/news/your-army/2022/04/19/army-chooses-sig-sauer-to-build-its-next-generation-squad-weapon/>, accessed 24 January 2026; Ford, *Weapon of Choice,* pp. 39–48.
33. Current doctrinal planning assumption.
34. Guido Rossi, 'Choices of a Higher Caliber: NATO, the US Army's New Service Rifle, and Visions of Future Warfare', *Small Wars Journal*, 11 April 2025, <https://smallwarsjournal.com/2025/11/04/choices-of-a-higher-caliber/>, accessed 24 January 2026.

For direct fire weapons, although the British Army is looking to replace the General Purpose Machine Gun through Project Cairns, the new system is likely to fulfil the same essential functions. So, a section support weapon will remain in British service. Even a shift in calibre will not fundamentally alter the role of the weapon within infantry tactics. No military is looking to remove this capability; indeed, weapons in this class continue to be modernised and procured. Marksman rifles are also liable to persist in their current role, although improved optics may increase the ranges at which they can reliably be employed.

At the same time, infantry units will probably field a higher density of support weapons integrated at a lower level. Historically, heavy machine guns and automatic grenade launchers have been too heavy for infantry units to move rapidly. Therefore, they have either been vehicle-mounted or have struggled to keep pace with infantry. The proliferation of uncrewed ground vehicles into units, however, mean that this firepower can more readily keep pace with infantry without the noise and signature associated with crewed vehicles.[35] Automatic grenade launchers will probably play a particularly important role because they straddle direct and indirect fire weapons and offer highly accurate and responsive explosive firepower, contributing to shock action.[36]

The importance of short-range explosive firepower is liable to increase because of the shifts in indirect fire support brought about by the prevalence of UAVs on the battlefield. Persistent observation of the battlefield delivered by UAVs and the enduring threat of strike by artillery necessarily drives the dispersion of infantry.[37] But observation of the battlefield and the availability of strike UAVs suppress or significantly reduce the rate of sustained fire that can be maintained with heavy-calibre guns. Thus, the availability of close support artillery is probably reduced, to be replaced by deliberate artillery strikes against identified priority targets and strongpoints.

UAS are important in the context of small arms because they are integral to platoon tactics. They can allow commanders to closely synchronise the movement and fire of their troops, suppress the movement of the enemy by hovering over them and identify and strike their firing posts, similar to but more effectively than the use of rocket launchers in previous engagements.[38] The small payloads carried by UAS allow these to suppress and destroy point targets even as ground forces close on a position from tens

35. The author has observed such systems being used in Ukraine to great effect. See Jack Watling, 'Emergent Approaches to Combined Arms Manoeuvre in Ukraine', *RUSI Insights Papers* (October 2025), <https://www.rusi.org/explore-our-research/publications/insights-papers/emergent-approaches-combined-arms-manoeuvre-ukraine>, accessed 24 January 2026.
36. Jim Storr, 'High Explosive: Shock Effect in Dismounted Combat', *RUSI Defence Systems* (Vol. 12, No. 3, 2010), pp. 56–60.
37. Jack Watling, *The Arms of the Future: Technology and Close Combat in the Twenty-First Century* (London: Bloomsbury, 2023), pp. 125–42.
38. A few examples of these previous engagements include Goose Green and on the hills before Stanley during the Falkland Islands conflict. See Max Hastings and Simon Jenkins, *The Battle for the Falklands* (London: W W Norton, 1983), pp. 233–53, 285–314.

of metres.[39] By doing so, they cover the gaps between direct and indirect fires coverage. They can also, to some extent, replace the effect historically delivered by snipers.

It should also be noted that pervasive observation and reliable blue-force tracking allows for indirect fires to be used in much closer proximity to friendly forces than has been historically normal. Although the Danger Close Distance for 155-mm artillery is 600 m, the actual casualty radius of a 155-mm shell is shorter. The Lethal Splinter Distance is below 100 m while the Safe Splinter Distance for troops in even basic cover is less than 300 m. The 600-m danger-close assumption – used by the US Army in its Next Generation Squad Weapon programme – reflects the anticipated spread in the fall of shot and endeavours to account for errors in generating grid coordinates by fire controllers, or errors by the gun crew in calibration.[40]

Extant Danger Close Distances also account for the challenges of tracking where friendly forces are as they move forward on the attack. Pervasive UAV coverage means that artillery crews can reliably maintain real-time footage of their targets, reducing the risks of misdirected fire.[41] Moreover, owing to the use of fewer artillery rounds – prioritised to destroy strong-points rather than deliver general suppression – many artillery munitions will be laser-guided, reducing the risk of a significant deviation in the fall of shot.[42] Blue force tracking down to the level of the platoon or call-sign is now a realistic prospect, such that there is much less ambiguity as to the position of troops.[43] These means of tracking have allowed the IDF, for example, to successfully and repeatedly employ 120-mm mortars against targets just 150 m from its own troops in cover or in vehicles, and the IDF has even dropped 2000-lb bombs on targets within 350 m of friendly forces. This has not led to a noticeable increase in friendly fire. It is realistic to bring down heavy indirect fire on to an enemy with friendly forces around 300–400 m from a target using modern means.[44] Thus, the future operating environment is likely to see a denser array of direct and indirect fires supporting manoeuvre, and it is within this context that the Grayburn rifle will be used.

39. Author observations of assault tactics in Ukraine, August 2025.
40. Distances are derived from British Army doctrinal planning ranges.
41. This has been reliably achieved in Ukraine despite a saturated electromagnetic spectrum. Author observations, Donbas and Kharkiv, January to August 2025.
42. Author observations in Ukraine, August 2025 and Gaza, December 2025.
43. Author observations of Hunter/Torch C2 system, Israel, Gaza and Syria, December 2025.
44. Examination of Israeli data from Israel's operations in Gaza and Lebanon reveal that safe engagement distances can be brought much closer than current planning assumptions suggest. Author observations, Israel, December 2025.

# Engagement Ranges in Recent and Future Conflicts

Engagement ranges in recent wars indicate consistent patterns across conflicts, even though each is quite distinct in character. During Russia's full-scale invasion of Ukraine, engagement ranges have been truncated because of the poor training and equipping of troops, with many preferring to remain concealed and calling for UAV strikes to engage targets rather than using their small arms. The lethal use of small arms has been disproportionately concentrated among assault troops, who are often clearing buildings or trenches and thus fighting at close range. Thus, a higher proportion of small arms kills have been at ranges between 40 m and 150 m.[45] Beyond this distance, the probability of hitting a target versus the inevitable identification of the firing position and subsequent attack by UAVs has generally discouraged infantry from opening fire. It may be reasonably argued that engagement ranges can be extended with better training. However, even in the open fields of Ukraine, engagements rarely exceed 300 m with personal weapons.

The IDF's recent operations in Gaza, Lebanon and Syria are a slightly different story. The IDF has better trained and equipped troops, and there is not a persistent threat from a high density of enemy strike systems in Gaza. In Lebanon, this threat could have materialised but did not in practice. In Gaza, IDF personnel faced restricted sight lines and an enemy fighting from ambush positions such that small arms engagement fell into two categories. When engagements occurred during the clearing of tunnels or buildings, they were usually at a range of less than 40 m. Outside structures, engagements were generally within 150 m, and almost never beyond 350 m over open ground. In Lebanon, the IDF faced longer engagement distances, but these were almost always from indirect fire, UAVs or anti-tank guided missiles. The IDF's own response would similarly be carried out from closed positions. Hezbollah did not heavily contest IDF ground operations, but the few direct fire engagements and ambushes recorded saw small arms used at ranges between 100 m and 350 m. A similar dynamic was reported in Syria.[46]

To put engagement ranges in a future context, the UK has committed to a 'NATO first' posture, with Russia identified as its most likely adversary.[47] The UK has also suggested

45. Author observations in Ukraine between 2023 and 2026. Data on engagements held by Brave One, a Ukrainian government entity, and the Ukrainian General Staff, reviewed by the author.
46. Author survey of IDF lessons data from operations in Gaza, Lebanon and Syria; and author interviews with commanders in these theatres, December 2025.
47. HM Government, *Integrated Review Refresh: Responding to a More Contested and Volatile World*, CP 811 (London: The Stationery Office, 2023); MoD, 'The Strategic Defence Review 2025: Making Britain Safer: Secure at Home, Strong Abroad', 2025.

that it may send a force to Ukraine following a ceasefire between Kyiv and Moscow.[48] In the former case, the most likely flashpoints are in Estonia, Finland and Lithuania. Eastern Estonia and Finland's Karelia are characterised by dense forests and broken terrain. Other than along roads, sight lines are short, rarely beyond 300 m. Along the roads, sight lines can be up to 2 km, but they are probably covered by heavier weapons rather than small arms. In Lithuania, the forest is less dense, but there is more undulation in the ground and there are also urban settlements. Here, too, engagement ranges are short. In Ukraine, engagement ranges are generally constrained by treelines and by the risks of opening fire against an enemy which can go to ground and call for support when there are relatively few places to hide.

British forces can be expected to be deployed further afield than Europe. Non-combatant evacuation operations are plausible, as occurred in Afghanistan and Sudan,[49] or – possibly in the future – from Lebanon, for instance. These operations, however, have been characterised by complex and cluttered environments where troops are intermingled with civilians and are operating in dense urban littoral environments that are liable to grow over the coming years.[50] Thus, engagement ranges would be short.

It is true that there is terrain – particularly mountainous terrain in Norway or similar to that encountered in Afghanistan – where sight lines can exceed 600 m and enemy marksmen may engage at such distances. It remains doubtful, however, that small arms are the best response. It is likely that marksmen or machine guns – which are already part of the section's weapons mix – and UAVs, which will be increasingly available through a platoon or company group, will be more appropriate. In summary, therefore, the evidence suggests that most small arms engagements will remain within 400 m.

## Contextual Factors in Weapons Employment

Weapons employment in the future operating environment is not only affected by engagement ranges, but also by the broader context of use, which includes the level of mechanisation of the force, the regularity of resupply, the rate of fire dictated by types of engagement and the lighting conditions prevailing during engagements. The increasing threat of extended precision fire from beyond line-of-sight shapes how soldiers move and interact with the environment.

48. Jaroslav Lukiv and Wyre Davies, 'UK and France to Send Troops to Ukraine If Peace Deal Agreed', *BBC News*, 6 January 2026.
49. MoD, 'Military Operation Established to Support the Drawdown of British Nationals from Afghanistan', news story, 13 August 2021, <https://www.gov.uk/government/news/military-operation-established-to-support-the-drawdown-of-british-nationals-from-afghanistan>, accessed 24 January 2026; HM Government, 'UK Completes Largest and Longest Western Evacuation from Sudan', press release, 4 May 2023, <https://www.gov.uk/government/news/uk-completes-largest-and-longest-western-evacuation-from-sudan>, accessed 24 January 2026.
50. David Kilcullen, *Out of the Mountains: The Coming Age of the Urban Guerrilla* (London: Hurst, 2013); Anthony King, *Urban Warfare in the Twenty-First Century* (London: Polity, 2021).

First, for transit to and from the close battle area, troops either need to be moved by protected mobility platforms or rely on speed to reach their fighting positions. This means that even light infantry are liable to be increasingly dependent on movement by vehicles when moving between complex terrain. Entering and exiting, or fighting from vehicles, makes compact weapons a decided advantage.

On the fighting positions, digging has been an important contributor to survivability for centuries, but the need for closed positions with overhead protection is increasing due to the growing density of observation and precision fires. Fighting from closed positions, like fighting from vehicles, requires the ability to move through and work in closed spaces. The same is true during offensive action. If the enemy is liable to favour buildings and closed fighting positions, clearing them requires the ability to fight through restricted terrain. This too favours a more compact weapon.

Another aspect of the emerging operating environment is the challenge of resupply. Although UAVs can shuttle consumables forward to fighting positions, this can be disrupted by electronic warfare, climatic conditions or enemy fires. Given the challenges associated with the movement of logistics behind the direct fire zone and the risk of tactical interdiction, there is a premium on extending the endurance of troops forward.[51] This makes the volume of ammunition that can be carried for a given weight paramount. In Ukraine, assault infantry routinely carry 12–15 magazines of approximately 28 rounds of 5.56-mm ammunition. In Afghanistan, patrols would routinely carry 12 magazines and one in the rifle. The IDF generally operated with between six and eight carried magazines, with one in the rifle, but this was in an environment where the enemy lacked the fires to interdict resupply.[52] Conversely, given that the duration of exposure is a key determinant of survivability, the speed at which infantry can move is an important consideration, so minimising the weight of magazines and ammunition is highly desirable.[53] This suggests that there is an advantage in minimising the calibre of rifle so long as the round can deliver sufficient terminal effect.

Another consideration is when infantry are liable to fight. Doctrine has placed a heavy emphasis on night fighting as an area where skill can confer disproportionate advantage over technology. This assumption is much weaker today.[54] The slow movement and challenges in coordination caused by nighttime actions are more

51. Jack Watling and Si Horne, 'Assuring the Tactical Sustainment of Land Forces on the Modern Battlefield', *RUSI Occasional Papers* (April 2024), <https://www.rusi.org/explore-our-research/publications/occasional-papers/assuring-tactical-sustainment-land-forces-modern-battlefield>, accessed 17 March 2026.
52. Author observations.
53. Nick Reynolds, 'Overweight Infantry: The Conflict Between Equipment Capability and Personal Mobility', *RUSI Defence Systems* (Vol. 16, 2014), <https://www.rusi.org/explore-our-research/publications/rusi-defence-systems/overweight-infantry-the-conflict-between-equipment-capability-and-personal-mobility>, accessed 17 March 2026.
54. Jon Tishman and Dan Schoen, 'We Don't Own the Night Anymore', Modern War Institute, 22 January 2021, <https://mwi.westpoint.edu/we-dont-own-the-night-anymore/>, accessed 17 March 2026.

probably countered by pervasive thermal observation and digital command and control. Instead, in modern conflicts, infantry activity is becoming overwhelmingly concentrated in periods of bad weather – fog, strong winds or heavy rain – and during the periods of thermal crossover at dusk and dawn. These weather conditions have the effect of limiting visibility and thus limiting engagement distances. As such, in the periods when weapons are most deliberately employed, it is difficult to envisage longer-range engagements. Outside of periods of bad weather, the pervasive availability of night vision may shift the advantage at night back to the defender.

A final consideration is the mode of firing. Here, there is very reliable data from contemporary conflict. Effective fire from small arms is semi-automatic. There is perhaps only one context where fully automatic fire from small arms is desirable: conducting an ambush. Killing will be most effective when the enemy is exposed, and so the maximum weight of fire should be brought to bear as quickly as possible. Moreover, those enacting the ambuscade are probably firing from prepared positions where they can best control automatic fire. Beyond the weight of fire generated by automatic shooting, it can be useful to have some parts of a section firing automatic and others semi-automatic. This means that the whole section may open fire at the same time but will subsequently reload at different times. This keeps up a continuous weight of fire, rather than delivering an initially devastating fusillade followed by ceasing fire simultaneously, thereby giving the enemy time to recover.

There are other edge uses for automatic fire. However, data from ranges on the accuracy of fire at varying distances suggests that the consequent loss of accuracy makes it counterproductive under most circumstances.[55] In some cases when automatic fire has been favoured, it is compensating for insufficient training, such as during room clearing. The limited need for fully automatic fire should discount the issues of accuracy penalties during the automatic fire of higher-power ammunition. In summary, therefore, the context of weapons employment favours a compact weapon, with a high-power, but smaller-calibre round.

## Future Target Characteristics

Determining the minimum viable characteristics of the Grayburn rifle is a function of the distance at which targets must be engaged and the characteristics of the target. Their assumed level of protection is the most important consideration. Body armour continues to improve. It is now feasible to build a wearable ballistic plate that can prevent penetration from .50 BMG ammunition at short range.[56] This does not mean that wearing such a plate enables the wearer to survive. If the wearer were shot by a

55. Data shared with the authors on the distribution of fire on ranges of soldiers, December 2025.
56. Lena Miculek - Trigger Tribe, '.50 Cal vs Body Armor??!?! You Won't Believe It!!!', YouTube, 6 July 2018, <https://www.youtube.com/watch?v=FsF8MLL-dns>, accessed 24 January 2026.

.50 BMG round, the kinetic energy imparted into the wearer would be lethal, irrespective of whether the bullet penetrated. Moreover, highly protective armour, while feasible on the torso, is less likely to be available in helmets or limb protectors. For helmets, the kinetic energy imparted to the neck becomes the limiting factor. For limbs, the thickness of the armour required imposes severe mobility constraints.

It is conceivable that the mounting of advanced composite materials on to a mechanical exoskeleton could render the weight of highly protective body armour manageable for a human to operate and hold the armour sufficiently away from the body to avoid the force of an impact being imparted to the body.[57] Such a combat suit, however, would be bulky and therefore struggle to remain useable in infrastructure designed for humans. Mobility would also probably be impeded. The connecting of a helmet to the neck and shoulders, for example, could avoid force being transferred to the neck, but would require the torso to turn to see. This would, in the first instance, present a large target. Second, in close terrain, it would probably struggle to avoid being seen first and shot first as it came around corners. Further, such equipment would be impractical for carrying out many tasks and probably would need power for thermal management. As such, it would not be wearable for a sustained period.

The conclusion, therefore, is that it is likely that the protection afforded to humans by body armour will improve over the coming years and it can already enable protection against 5.56-mm and 7.62-mm ammunition on the torso from mid-range.[58] Nevertheless, protection is liable to be unevenly distributed. If a rifle cannot defeat a target at the centre of mass, it becomes necessary to double its functional accuracy, either by improving the accuracy of each shot to circumvent protected areas, or by increasing the number of rounds fired. Armour may also be adapted to improve survivability against UAV or blast, which is functionally a trade-off on optimised protection against ballistic threats. It should be noted, however, that where body armour is not penetrated, the target is still often incapacitated through energy transfer. Body armour design is likely to improve survivability but will not necessarily prevent someone who is hit from becoming a casualty.

Militaries must decide on whether to seek to penetrate improved armour by improving the kinetic performance of their rifles, to improve accuracy sufficiently to enable it to be bypassed reliably, or to fire more rounds to improve the statistical probability of bypassing armour.

Another consideration for targets is the ability to hit uncrewed systems. The question therefore arises of whether soldiers should have weapons adapted for this purpose or whether standard arms should have sights and equipment modified for engaging aerial

57. Experiments with such capabilities have been ongoing for some time. See, for example, *BBC News*, 'US Army Plans "Iron Man" Armour for Soldiers', 10 October 2013.
58. VestGuard, 'Standards and Testing', <https://www.vestguard.co.uk/standards-and-testing.html>, accessed 17 March 2026.

targets. Uncrewed ground systems are vulnerable to damage because of their dependence on sensors. There are many contexts where infantry may need to be able to hit and damage such systems. Firing at uncrewed systems is difficult because they are small and move in three dimensions. In Ukraine, it is estimated that a soldier engaging a first-person-view (FPV) drone with a shotgun has around a 25% chance of downing it in its terminal phase.[59] Many FPV drones have separately been hit with small arms. It is reasonable for soldiers to try to engage these targets. Regardless of what doctrine may say about what and who is responsible for countering UAS, soldiers will try to protect themselves by firing at them. Dedicated weapons, such as shotguns, may be carried by a section to improve the probability of kill against UAS. Adapting standard rifles for this purpose, however, will probably bring about a high increase in cost, weight and complexity, for a very modest increase in efficiency. It may also come at the expense of the weapon's primary purpose. The development of sights for this purpose should thus be pursued as a distinct area of enquiry, rather than adding to the requirements of the force's primary personal weapon. Specialist ammunition may offer another option for close-in defence but should not be the driver of weapon design.

In summary, therefore, given the anticipated performance characteristics of body armour, the Grayburn rifle must be optimised for either penetrating adversary body armour, circumventing it through accuracy, or volume of fire. Of these options, penetration, or the transfer of sufficient kinetic energy, to incapacitate at centre of mass is the most viable option.

59. Data accumulated by the Ukrainian General Staff lessons learned department, J7.

# Deductions for the British Military

This chapter matches the requirements arising from the operating environment discussed in the previous chapter. It aligns these with the trade-offs in rifle design discussed in the first chapter to set out the parameters of an appropriate rifle for the British military.

## The Rifle Within the British Fighting System

The conflict in Ukraine and the growing risk of peer conflict have spurred significant changes in the British Army's concepts of operation. It is therefore important to situate small arms within these concepts. The British Army has conceptually sought to target the enemy using a systems approach, whereby weapons are matched to specific classes of target to undermine the enemy's capacity to execute its plans.[60] The conceptual underpinnings of this work arise from the British Army Land Operating Concept and subsequent Project Velocity, which identified the 'defeat mechanisms' within the enemy force, comprising those force elements that are critical to the enemy fighting system. The subsequent Land Battle Metrics programme has endeavoured to match the identified enemy defeat mechanisms to target classes and then identify the weapons best suited to engage them.

These concepts largely pertain to the divisional and corps level. Practical experimentation in implementing these ideas, however, has been focused between the company and brigade. The British Army's Experimental Battlegroup has been evaluating new weapons mixes through its participation in the US Project Convergence.[61]

60. British Army, 'Army Announces New Way of Winning Future Wars', 16 September 2023, <https://www.army.mod.uk/news/army-announces-new-way-of-winning-future-wars/>, accessed 24 January 2026.
61. British Army, 'British Army and Allies Push Boundaries of Modern Warfare in NATO Exercise', 3 April 2025, <https://www.army.mod.uk/news/british-army-and-allies-push-boundaries-of-modern-warfare-in-nato-exercise/>, accessed 17 March 2026.

Separately, the pursuit of a Digital Targeting Web is intended to provide the command and control structure with ways to effectively find and strike targets with the appropriate systems. The British Army has also sought to replicate this approach at lower levels, using Project Asgard to try to build battlegroup and brigade 'recce-strike' structures that can increase the efficiency and lethality of attacks.[62] Lessons have, to some extent, been independently validated by the Royal Marines through their participation in, and experimentation at, US Marine Corps warfighting exercises at Twentynine Palms.

Traditionally the ultimate task during ground manoeuvre has been delivered by combat troops arriving on the objective. Fires have been assigned to support this outcome. In the current approach, because fires assets are each assigned specific tasks – and may need support to execute them, such as force protection, while they move into position to fire – there will probably be less flexibility in retasking fires assets to support infantry actions. Organic firepower within the company, therefore, is paramount.

Deductions can be drawn from this on the selection of a new rifle for the force. The mobile fires platform is likely to generate general support artillery that, because of its role within the broader fires system, is less likely to be prioritised for close support fires. For this reason, the British Army is exploring the procurement of 120-mm mortars for this role. Furthermore, while brigades and battlegroups are investing in reconnaissance and strike UAV capabilities, it is likely that these will increasingly be used to support platoon and company actions. Thus, the use of small UAVs may be envisaged as taking over suppression after longer-range UAVs and general support artillery have handed over to 120-mm mortars. These will then hand over to machine guns, automatic grenade launchers and small arms to enable infantry to close and engage. There are thus several overlapping range brackets covered by emerging weapons.

The deduction is that British close combat forces need a rifle that can deliver suppression at ranges out to 400 m and be reliably lethal within 150 m. Furthermore, the weapon should be well suited to fighting from and into closed positions and restricted terrain.

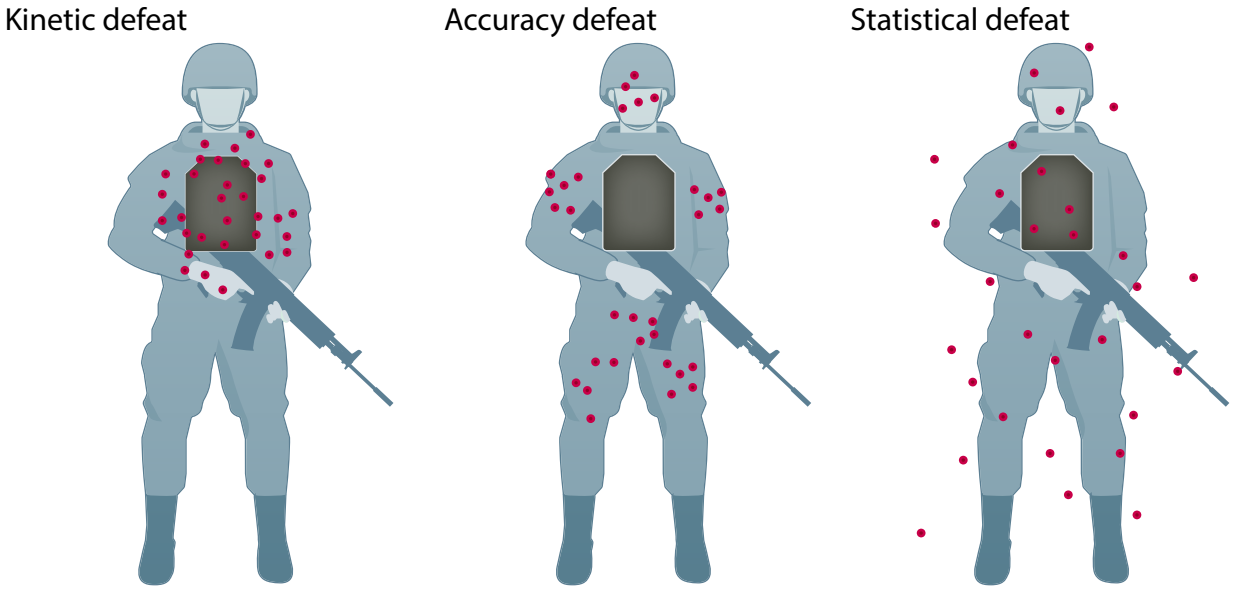
## Matching Trade-Offs to Requirements

Selecting a rifle with the characteristics to deliver on the requirements outlined above can be achieved in several ways, but these involve trade-offs. The first question for the British Army is the logic by which it wishes to assure terminal effect on target. This can

62. British Army, 'New Technology Unveiled that will Increase British Army Lethality', 21 July 2025, <https://www.army.mod.uk/news/new-technology-unveiled-that-will-increase-british-army-lethality/>, accessed 24 January 2026.

either be achieved by increasing the kinetic energy of the rifle sufficiently to penetrate modern and future body armour at 400 m, increasing the accuracy of the rifle to enable shooters to circumvent body armour, or delivering sufficient weight of fire so that it is sufficiently probable that the armour is circumvented.

**Figure 3:** Different Approaches to Lethality

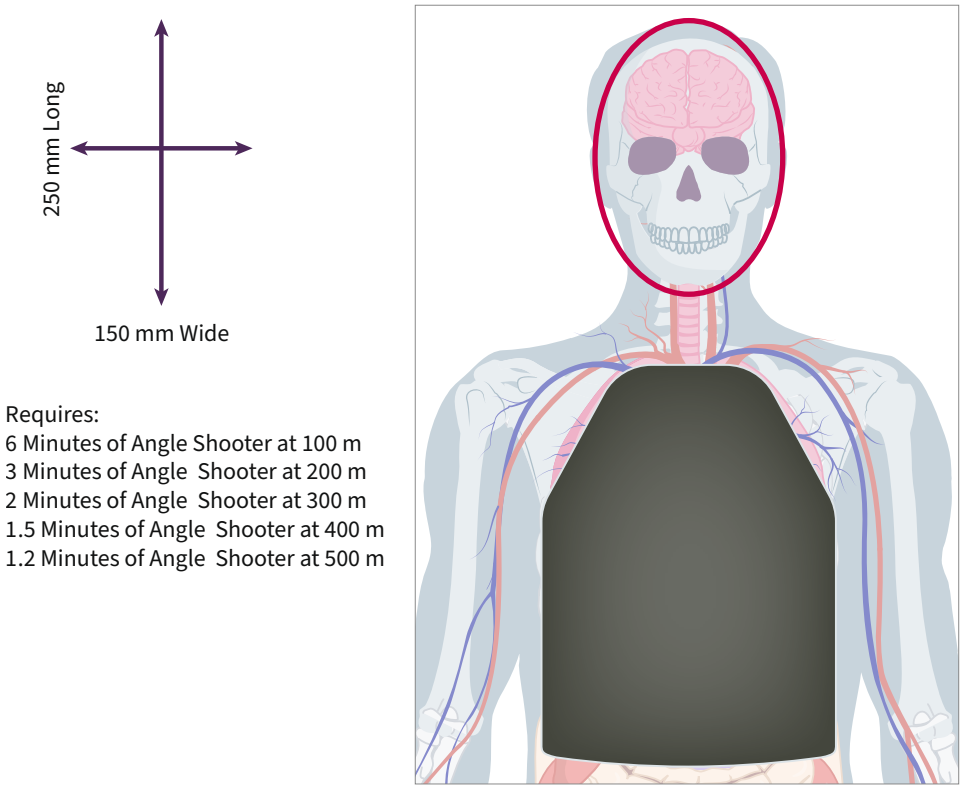



Source: The authors.

While it is mechanically possible to significantly increase the accuracy of a rifle, the authors believe – for the reasons outlined in the first hapter – that it is unrealistic to increase the functional accuracy of soldiers under field conditions to make the reliable circumvention of body armour a realistic approach. The result would probably be a very expensive, but functionally ineffective weapon.

When comparing the kinetic or statistical approach, certain trade-offs become apparent. A rifle prioritising kinetic effect will require a higher-calibre round and thus will reduce the capacity of the weapon, soldier and unit, increasing the need for resupply. For the UK, which is often operating in an expeditionary capacity, this is a non-trivial concern. The kinetic approach can be delivered with a relatively compact and ergonomic weapon. It can still achieve sufficient functional accuracy within the relevant ranges identified above. However, the weapon is likely to have significant felt-recoil and come with a correspondingly higher training burden.

**Figure 4:** Accuracy Necessary at Different Ranges to Achieve Shot Placement Versus the Head




Source: The authors.

The statistical approach can maximise the kinetic effect possible within the limitations of a smaller round at the expense of ergonomics, or it can prioritise ergonomics at the expense of penetrating body armour, even at short range, and reduce the likelihood of incapacitation at medium range. An ergonomic compromise between barrel length, and thus kinetic performance versus size, uses a bullpup configuration, but this reduces the ergonomic handling of the weapon. A rifle designed for the statistical defeat of the target is likely just as effective at delivering suppression at 400 m as one designed to penetrate body armour at that range. However, the risk is that it may be less lethal at short range. In a context where each party can shoot the other in a short space of time at close range, this might put British close combat troops at a significant disadvantage. To mitigate this risk, the rifle would need to prioritise accuracy in close quarters battle and, thus, incur a significant training burden. Another partial mitigation could be to use materials in the bullet that maximise the probability of incapacitation at close range. However, this may require a legal assessment of what is militarily necessary in the future operating environment.

While precision is not seen by the authors as a realistic means of circumventing armour, achieving sufficient battlefield accuracy out to 400 m does require the use of adequate sights. The resulting risk is that the pursuit of accuracy drives an investment

in advanced optics that are often more expensive than the rifle. For example, the Vortex 1-10x AMG currently mounted on the KS1 is a high-performance scope. However, it comes with significant drawbacks. First, it is expensive and delicate. Second, the high level of magnification – while useful at longer distances – also makes it hard to acquire targets at short distances. In combat, this partially reduces the accuracy benefits from a high-velocity round firing on a flat trajectory – which would normally obviate the need for the shooter to correct for distance – because it obliges the shooter to adjust the magnification to suite the range. A simpler fixed 4x optic with an integrated holographic, red dot or even aperture sight for close shooting would be easier to use and perfectly adequate for the rifle's intended range.

To a certain extent, these challenges can be mitigated by adopting a rifle with a common lower receiver and controls but with options for different barrel lengths, so that different user communities can optimise the rifle for their role. For the Royal Navy, for example, the use of a weapon for ship boarding generally requires a short and ergonomic design comparable to the requirements for fighting in an urban area, although targets are less likely to be wearing body armour. Indeed, overpenetration is likely a greater concern. The other part of the Royal Navy that would use the weapon is the Royal Marines, who may have similar requirements to the British Army, with the exception that Norway's mountainous terrain may favour longer engagement ranges. The difference could probably be addressed using a longer barrel. The RAF's main use-case for the weapon would be for the RAF Regiment to conduct perimeter defence of airfields. Sight lines may be longer around these facilities, especially from prepared guard infrastructure.

There is justification in tailoring accessories and barrel length to user group. However, it should also be noted that if the UK finds itself in a protracted conflict, it will need to significantly expand the size of the force, and conditions may not allow significant time for training. Standardising around a robust, reliable and scalable solution is therefore important. This also drives a decision that values having ammunition and rifles manufactured in the UK with the corresponding expertise and capacity to expand production.

A final consideration is interoperability with NATO Allies. NATO has put considerable effort into standardising military equipment among Allies to maximise the efficiency of defence industrial production. While this is a good aspiration, it is not reflected in the decisions made by Allies. The US is already transitioning to 6.8-mm ammunition. Some European Allies are returning to 7.62-mm rifles while others have recently bought modern 5.56-mm rifles. Even within these categories, differing legal interpretations mean that some countries cannot use other countries' ammunition. Moreover, with countries often optimising their rifles for nationally produced ammunition, mixing and matching often affects rifle reliability and performance. In short, the UK should not seek to chase others in pursuit of standardisation because

NATO is becoming increasingly fragmented. The UK has historically had its small arms adversely affected by trying to align with Allies. This occurred when the EM-2 was withdrawn from service shortly after its adoption, even though it was superior to the eventual combination of SLR and Sterling. Instead, the UK should set the requirements for its needs and establish production accordingly.

# Conclusion

The selection of a new service rifle for the British military is simultaneously non-transformative – ensuring the continuity of a capability – and, yet, it will have a felt impact across the force. Tactical equipment often goes in and out of fashion within militaries. At present, very short-barrelled 5.56-mm AR format carbines are in favour. Without reaching a definitive conclusion on the rifle that should be procured, this paper has determined that such a weapon is not optimal for the requirements of future close combat forces.

The emerging operating environment is imposing difficult decisions for the military on the selection of trade-offs. The analysis in this paper does not show that the US requirement of terminal defeat of body armour at 600 m is necessary. However, even a requirement to penetrate at 400 m would require a change in calibre, incurring costs in ammunition capacity across the force and a higher training burden with greater felt-recoil. Alternatively, if the British Army accepts a need to circumvent body armour through weight of fire, it will take risk in close engagements, especially if it selects a compact rifle.

The deduction is that whatever rifle is selected, the British military must clearly explain to its personnel the logic of the decisions that it has taken on these trade-offs. General assurances of increased 'lethality' are not sufficient. Selling the decision to the force requires an explanation of how it addresses the tactical requirements of the future. The rifle must be reliable, robust and obviously suitable for the task that soldiers are given in employing it. With a firm foundation, the limitations or drawbacks that arise are more likely to be accepted.

This paper has broadly assessed that the British Army will have overlapping ranges for indirect and direct precision and area-effect capabilities suitable to enable infantry to close with and kill the enemy within future tactical formations. Personal weapons will probably play a role because of their responsiveness at ranges out to 400 m, while most lethal fire is liable to occur within 150 m. The future operating environment will probably see the force work extensively from vehicles and fight from, through or into structures and closed positions. Moreover, infantry engagements are liable to shift from night to day, especially during bad weather or periods of thermal cross-over at dusk and dawn.

Interoperability is often seen as a reason to keep things the same. This is a bad instinct in this case because countries are taking diverging decisions. Differences of interpretation over the legality of bullet design further erode interoperability. In many ways, the UK is better off choosing what it believes is the most effective approach and then advocating for it. This sees it leading, rather than chasing, what will probably be a moving target of judgements made by other people.

As the introduction of a new rifle is the retention of a capability rather than an upgrade, there is a risk that Grayburn is delayed in the equipment plan, easing in-year budgetary pressures. This approach is liable to bring about conditions where a replacement rifle cannot be further delayed but where there is no financial flexibility. The result would be a decision driven by cost at the expense of requirements. It is important that the MoD does not make this mistake, and equips its troops with a weapon in which they can have confidence, and which contributes to the combined-arms fighting system.

# About the Authors

**Laurence Thomson** was the Chief of the General Staff's Visiting Fellow at RUSI. As part of the Military Sciences research group, his research was focused on Land Power lethality, contemporary conflict and British Army modernisation. A regular British Army officer in The Parachute Regiment, he has served at command and staff in the 16 Air Assault Brigade Combat Team (16 ABCT), Headquarters of the Allied Rapid Reaction Corps (HQ ARRC), 3rd United Kingdom Division and within Field Army Headquarters. He has completed operational tours to Iraq, Afghanistan and wider Europe.

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