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Comparing Historic Military Capabilities

Apples with Apples

Richard Fisher

Using comparative historical analysis to compare and contrast historic military capabilities is possible using the Defence Lines of Development as a model. Richard Fisher demonstrates how it is not appropriate to merely compare technical aspects of equipment, but that it is necessary to also consider the training, personnel, information, doctrine and concepts, organisation, infrastructure and logistics as part of a comprehensive comparison. Equipment comparisons exist but are flawed as they may not identify the critical factors that enhance or diminish the overall capability. The method is evaluated using the infantry section's machine guns of the Second World War: the Bren and MG42.

The UK Ministry of Defence's (MoD) capability management model uses Defence Lines of Development (DLODs) to characterise a capability. The capability is split into different elements, which are identified as training, equipment, personnel, information, doctrine and concepts, organisation, infrastructure and logistics (TEPIDOIL). Richard Fisher[1] identifies how this model can be used to analyse historic capabilities over time (longitudinal studies); this article builds on it and demonstrates how the model can be used to compare similar capabilities from different countries or different periods.

The comparisons of different countries' capabilities are the basis of many military history arguments and discussions which are published in books, including a book series[2] based on this premise; however, these largely consider the technical aspects of the equipment being discussed and not the overall capability. Furthermore, they are often 'event-centric' when putting the equipment into context, focusing on the time and place where the equipment was used, which can be limiting as it does not consider the elements outside of that time and place. Notwithstanding this, they do incorporate aspects of the capability in their discussion as it is inevitable to do so. Stephen A Hart[3] directly incorporates the training and organisation of tank crews within his study, yet only indirectly considers the partial logistics required and omits many other aspects of the overall tank capability of the period of study, except for personnel, which are central to his battle discussion. Although the contemporary comparisons are affected by the bias of the time, they focus on the equipment and link the effects of that equipment with the personnel (morale) and logistics.[4] Other authors do include different aspects of the capability, with Tony Holmes[5] discussing the infrastructure requirements for the development of the aircraft and airfields[6] in his study. While many of the elements exist across these publications, there is no consistent method by which the studies can be made. Therefore, this article proposes an 'apples with apples' approach, rather than 'apples

1. Richard Fisher, 'Historical Defence Capability Analysis: Applying the Defence Lines of Development Retrospectively', *RUSI Journal* (Vol. 168, No. 1–2, 2022) pp. 98–106.
2. Osprey Publishing, 'Duel', <https://ospreypublishing.com/uk/osprey-publishing/series/duel/>, accessed 17 January 2023.
3. Stephen A Hart, *Sherman Firefly vs Tiger: Normandy 1944*, Duel, No. 2 (Oxford: Osprey Publishing, 2007), pp. 38–51.
4. National Archives (NA), 'Infantry Notes No 6 – Appendix E: "SPANDAU Versus the Bren"', WO 205/998, 17 September 1944.
5. Tony Holmes, *Spitfire vs. Bf109: Battle of Britain*, Duel, No. 5 (Oxford: Osprey Publishing, 2007), pp. 8–20.
6. *Ibid.*, pp. 35–38.

Journalists watch the Vickers and Bren MGs being fired on a range in Western Command during training in 1941. *Courtesy of Vickers MG Collection & Research Association / Crown Copyright*

with oranges', but in a way that considers the overall capability and not just the equipment, or with other factors limited.[7]

Method

This article uses DLODs to compare the same capability from different countries as a case study to develop and prove the method. As in Fisher,[8] this is a form of comparative historical analysis and is one of the three distinct features of comparative historical analysis, in that it uses 'systematic and contextualized comparison of similar and contrasting cases'.[9] Continuing the machine gunnery case study by Fisher,[10] this article evaluates machine gunnery in the context of the British and German armed forces fighting in Normandy during the summer of 1944. The light machine guns (LMGs) used were typically the Bren (British) and MG34 or MG42 (German) – commonly, yet erroneously, named the Spandau in contemporary analysis.[11] It has been regularly debated on various online forums and literature as to which of these guns is the best,[12] and the German MG, particularly the MG42 – upon which the majority of the data in

7. Merriam-Webster, 'Compare Apples and/to/with Oranges', <https://www.merriam-webster.com/dictionary/compare%20apples%20and%2Fto%2Fwith%20oranges>, accessed 7 March 2023.
8. Fisher, 'Historical Defence Capability Analysis'.
9. Frank Ohemeng, 'Comparative Historical Analysis: A Methodological Perspective', in Ali Farazmand (ed.), *Global Encyclopedia of Public Administration, Public Policy, and Governance* (New York, NY: SpringerLink, 2018), p. 2.
10. Fisher, 'Historical Defence Capability Analysis'.
11. NA, 'Infantry Notes No 6 – Appendix E'. Although the MG34 and MG42 were the designated LMGs of the German infantry section, there were various types of organisation in service with the German army and these often employed alternatives that included MGs from occupied countries or captured war stocks.
12. Ian McCollum, 'Bren Mk I: The Best Light Machine Gun of World War Two', *ForgottenWeapons.com*, 24 February 2021, <https://www.forgottenweapons.com/bren-mki-the-best-light-machine-gun-of-world-war-two/>, accessed 11 March 2024; @authordlewis, 'Research today takes me to the Bren, arguably the best light machine-gun of WWII. With around half the rate of fire of the German's MG42, the Bren was far more accurate and versatile. Allied soldiers and Resistance armies alike swore by the Bren ...', Twitter post, 4 May 2020, <https://twitter.com/authordlewis/status/1257260109035720706>, accessed 27 March 2021; John Walter, *Machine-Guns of Two World Wars*, Greenhill Military Manuals (London: Greenhill Books, 2005), p. 23.

this article is focused – is often considered to be superior due to its high rate of fire and quick barrel change as the main features,[13] as well as being the most successful general-purpose, or dual-purpose, machine gun designed.[14] By contrast, the Bren is considered superior for accuracy.[15] These technical points can only be used for limited comparisons as they do not consider the wider context of how the equipment is used, who it is used by and how they were supplied. Therefore, this article uses the DLODs to characterise and evaluate the capability comprehensively. This interpretive approach remains subjective and is based on the qualitative evidence presented and cited. However, by evaluating each of the DLODs separately and then considering the whole, a broader assessment can be made in the analysis. LMG capability can be defined as a system, given that there are a number of elements that are interacting together to carry out its purpose.[16] The different DLODs can be treated as components of the system and individually weighted and assessed in a manner akin to the system readiness levels (SRLs), shown in Table 1, something that will be familiar to defence capability management practitioners.[17] However, this is a semi-quantitative approach as it is necessary to interpret definitions to match the elements being discussed, and the findings of this approach are considered in the discussion later in this article.[18] Table 1 shows all of the SRLs, yet given that LMG capability was in use and not experimental or in development, the higher levels (6 to 9) are those most likely to be demonstrated.

13. Sydney Jary, *18 Platoon*, 4th Edition (Bristol: Sydney Jary Limited, 1998), pp. 53–54; Ben Kite, *Stout Hearts: The British and Canadians in Normandy 1944* (Solihull: Helion & Company, 2014), p. 28; Simon Parkin, '10 Important Machine Guns of World War Two', *HistoryHit*, 7 August 2018, <https://www.historyhit.com/important-machine-guns-of-world-war-two/>, accessed 26 March 2021; Wolfenlord, 'Best Infantry Weapons of WW2', *War History Online*, 13 September 2018, <https://www.warhistoryonline.com/instant-articles/best-infantry-weapons-ww2.html>, accessed 26 March 2021.
14. W G B Allen, *Pistols Rifles and Machine Guns* (London: English Universities Press, 1953), p. 158; F W A Hobart, *Pictorial History of the Machine Gun* (London: Ian Allen, 1971), p. 102; John Hutchins, *Death Rattle: The British Soldier's Machine Gun 1870 to 2015* (Woking: Tommy Atkins Media, 2015), p. 478.
15. Neil Grant, *The Bren Gun* (Oxford: Osprey Publishing, 2013), p. 68; Hutchins, *Death Rattle*, pp. 275, 285; Jary, *18 Platoon*, pp. 53–54; A Low, *Musket to Machine-Gun* (London: Hutchinson & Co, 1942), p. 82; Walter, *Machine-Guns of Two World Wars*, p. 21.
16. SEBoK contributors, 'System (glossary)', SEBoK, 20 November 2023, <https://sebokwiki.org/w/index.php?title=System_(glossary)&oldid=69907>, accessed 11 March 2024.
17. Technical University of Denmark, 'System Readiness Level Index', Wikipedia, last updated 28 February 2021, <http://wiki.doing-projects.org/index.php/System_Readiness_Level_Index>, accessed 28 November 2023; Marc F Austin and Donald M York, 'System Readiness Assessment (SRA) an Illustrative Example', *Procedia Computer Science* (Vol. 44, 2015), pp. 486–96; Rene Oosthuizen and Jans HS Roodt, 'Credible Defence Capability: Command and Control at the Core', Land Warfare Conference, Brisbane, October 2008.
18. Other quantitative and semi-quantitative assessments were considered when preparing the study, including Likert-type scales and simpler 'better or worse' comparisons, yet the system readiness levels allowed for independent assessment against the scale rather than directly against the comparator.

Table 1: SRL Descriptions

Level	Description
9	System has achieved initial operational capability and can satisfy mission objectives.
8	System interoperability has been demonstrated in an operational environment.
7	System threshold capability has been demonstrated at operational performance level.
6	System component integrability has been validated.
5	System high-risk component technology development has been completed or there are only low-risk system components.
4	System performance specifications and constraints have been defined and the baseline has been allocated.
3	System high-risk immature technologies have been identified and prototyped.
2	System materiel solution has been identified.
1	System alternative materiel solutions have been considered.

Source: Marc F Austin and Donald M York, 'System Readiness Assessment (SRA) an Illustrative Example', *Procedia Computer Science* (Vol. 44, 2015), p. 495.

Where possible, primary sources that represent the time and theatre chosen for the study have been selected. This has not been entirely feasible and secondary sources have been used, particularly to summarise the German-language material.

Defining the Capability

While the assessment is equipment-centric, the definition of the capability is wider for several reasons. The first is that the LMG does not operate in isolation from other components in the British or German armies of the period considered: it works as part of the infantry section and it fills the capability gap of providing automatic firepower to the section. The infantry section is the basis of the infantry organisation and is the lowest capability where the LMG plays a role albeit alongside personnel armed with other weapons.[19] The same equipment was also used for similar roles outside of the capability. For example, LMGs were used in various anti-aircraft roles and were vehicle-mounted as secondary or supplementary armament. Furthermore, the German equipment – the MG34 or MG42 – was considered an *Einheitsmachinengewehr* (universal MG)[20] and was used in the light (LMG) role as well as a role partially comparable with the Vickers medium machine gun (MMG) in the British Army. While there were differences to the MMG role in the two armies, one similarity is that the *Schwehr* (heavy) role was not a function of the infantry section.[21] The Bren could also be used for some techniques (such as fixed-line firing), also used by MMGs.

Lines of Development

As with Fisher,[22] this section is structured using the TEPIDOIL acronym. Using this order creates artificial boundaries around each DLOD and forces a direct comparison between the two countries' capabilities. If the equipment were described first, as may be considered appropriate for an equipment-centric study, it is possible that other DLODs would be too strongly compared against it. Instead, it is thought more appropriate to consider the interoperability across DLODs as an aspect to be compared separately. As such, the analysis starts with the training of those using the LMGs.

Training

The training for the Bren and German MGs was part of the basic training for all soldiers and would be carried out at the initial training facilities and then

19. War Office, *Infantry Training: Training and War* (London: His Majesty's Stationery Office, 1937), p. 1.
20. Chris McNab, *MG 34 and MG 42 Machine Guns* (Oxford: Osprey Publishing, 2012), pp. 6–7.
21. Fisher, 'Historical Defence Capability Analysis'.
22. *Ibid.*

carried on into the infantry battalions before being honed as part of their battle drill. In the British Army, the syllabus included 44 periods (33 hours) of training for a recruit in primary training, followed by a further 34 periods (25.5 hours) for infantry soldiers.[23] This included the use of the Bren on the fixed-line tripod in just nine periods (6.75 hours). The principles of the training included:

> i. To prepare the gun for firing and maintain it in action.
>
> ii. To carry the gun and get it quickly into action on any type of ground.
>
> iii. To fire accurately at various rates up to 112 rounds a minute according to the requirements of various types of targets likely to be encountered in battle.
>
> iv. To observe fire and correct its application accordingly.
>
> v. To assist forward movement by fire while at the same time ensuring that such fire does not endanger his own troops.
>
> vi. To fire with effect at low-flying aircraft.
>
> vii. To perform the duties assigned to any member of the section.[24]

The men were all trained to be an 'efficient shot' with the gun and 'be interchangeable so far as duties with the LMG are concerned'.[25]

The training of a German machine gunner was also split into two separate phases: the first was 21 lessons covering the LMG role; and the second, 16 lessons, was the 'heavy' role with the tripod and optical sight, as well as the twin mount and pedestal mount for vehicle use.[26] The heavy role included the indirect fire role of the gun.[27] Officers and non-commissioned officers (NCOs) were required to pass the course to the same standard as the men.[28]

Assuming that lessons were of a similar length in both armies, the German machine gunner received half as much training time as the British light machine gunner, but with 43% of the time covering the heavy role, whereas the British only spent 12% of their time on this, as shown in Table 2. Therefore, in the light role – as found in the infantry section – the British machine gunner training was more significant. The quality of German training was also reported lacking in 1944, with a letter issued by the German High Command highlighting poor maintenance and low effectiveness.[29]

Table 2: Summary of Training Hours

	Light Role	Heavy or Fixed-line Role	Total Number of Lessons	Total Number of Lessons as a % of the Other Army's Lessons	% of Heavy Role Training
British	69	9	78	211%	12%
German	21	16	37	47%	43%

Source: Author generated.

Equipment

It is possible to produce an extensive paper on the merits of either weapon, of which, the principal comparisons will be on the accuracy of the Bren versus the cyclic rate of fire of the MG42. The key characteristics of these weapons are shown in Table 3.

23. War Office, *Small Arms Training: Volume I, Pamphlet No. 1: Weapons Training* (London: His Majesty's Stationery Office, 1942), pp. 8–12.
24. War Office, *Small Arms Training: Volume I, Pamphlet No. 4: The Light Machine Gun* (London: His Majesty's Stationery Office, August 1942), p. 2.
25. *Ibid.*
26. McNab, *MG 34 and MG 42 Machine Guns*, pp. 28–29.
27. Folke Myrvang, *MG34-MG42 German Universal Machineguns* (Cobourg, Ontario: Collector Grade Publications, 2002), pp. 337–55.
28. *Ibid.*, pp. 314–18.
29. *Ibid.*, pp. 333–34.

Table 3: Key Characteristics

		Bren (Mark 1 and Mark 2 approximately)		MG42
		Imperial	Metric	
Calibre		.303-inch	7.7-mm	7.92-mm
Rate Of Fire (Cyclic)		Approx 8 rounds per second		25 rounds per second
Method Of Feed		28-round box magazine[30]		50-round non-disintegrating metal belts
Weights	Gun	23 lb	10.4 kg	11.6 kg
	Spare Barrel	6 lb	2.7 kg	
	Tripod	26.5 lb	12 kg	22.5 kg
Beaten Zone Examples		500 yds (bipod): 175 x 2 yds	457 m (bipod): 160 x 1.8 m	600 m: 380 m (full); 160 m (effective)
		1,000 yds (bipod): 115 x 4 yds	914 m (bipod): 105 x 3.7 m	900 m: 250 m (full); 100 m (effective)
Maximum Sighted Range		2,000 yds (Mk 1); 1,800 yds (Mk 2)	1,829 m (Mk 1); 1,646 m (Mk 2)	2,000 m (direct, iron sights) 3,000 m (direct, optical sight) 3,500 m (indirect, optical sight)

Sources: War Office, *Small Arms Training: Volume I, Pamphlet No. 4: The Light Machine Gun* (London: His Majesty's Stationery Office, August 1942), p. 1; Oberkommando des Heeres, *Ausbildungsvorschrift für das* M.G. *42* [*Training Regulations for the MG42*] (Berlin: Oberkommando des Heeres, 1944), pp. 11–12; Folke Myrvang, *MG34-MG42: German Universal Machineguns* (Cobourg, Ontario: Collector Grade Publications, 2002), p. 349.

While the cyclic rate of fire is a technical characteristic, Tables 4 and 5 show that the practical rate of fire is much more closely aligned. This could be considered as an aspect of the doctrine of the guns as it forms part of their employment; however, the doctrine DLOD analysis (see below in this section under 'Doctrine') considers the wider role of the LMG in the section, and wider formations, rather than this technical element. The British requirement for up to 112 rounds per minute (23% of the cyclic rate) to be fired was the rapid rate (four magazines of 28 rounds each) irrespective of whether mounted on the bipod or the tripod. The German requirement was 150 to 180 rounds per minute (10 to 12% of the cyclic rate) in the light role.[31] A contemporary analysis of the rates of fire resulted in a recommendation that 'a faster firing LMG would be more efficient than our present Bren, but only slightly so. The substitution of belt feed for magazine feed would also produce an improvement, especially for defence'.[32]

30. The Bren magazine technically fits 30 rounds of ammunition but was practically filled to 28.
31. Oberkommando des Heeres, *Ausbildungsvorschrift fur das M.G. 42* [*Training Regulations for the MG42*] (Berlin: Oberkommando des Heeres, 1944), p. 12; In the heavy (MMG) role, the practical rate of fire was 400 to 450 rounds per minute.
32. NA, 'A.O.R.G. Memorandum No. 126: The Rate of Fire of the LMG', WO 291/474, 1943, p. 7.

Table 4: Rate of Fire Comparisons

	Per Second		Per Minute	
	Bren	MG42	Bren	MG42
Cyclic	8	25	480	1,500
Practical	1.9	2.5 to 3.0	112	150 to 180

Source: War Office, *Small Arms Training: Volume I, Pamphlet No. 4: The Light Machine Gun* (London: His Majesty's Stationery Office, August 1942), p. 1; Oberkommando des Heeres, *Ausbildungsvorschrift für das M.G. 42* [*Training Regulations for the MG42*] (Berlin: Oberkommando des Heeres, 1944), pp. 11–12.

Table 5: Rate of Fire Ratios

Weapons	Percent
Bren to MG42 (Cyclic)	32%
Bren to MG42 (Practical)	62 to 75%
Bren (Practical to Cyclic)	23%
MG42 (Practical to Cyclic)	10 to 12%

Source: Author generated.

The consequence of the higher rates of fire (and the lower practical-to-cyclic ratio) is an increase in the barrel change frequency. The Bren requires a barrel change after 10 magazines fired at the rapid rate (280 rounds),[33] whereas the MG42 barrel requires a change after 150 rounds ('in quick succession' – likely to be equivalent to the rapid rate).[34] There is insufficient data available on either gun to determine the availability, reliability, maintainability and serviceability of other components, which would be a key aspect of any acquisition assessment today.

The Bren was able to fire using both single-shot and automatic fire,[35] whereas the MG42 could only fire fully automatic.[36] The originally identified tactical benefit of single-shot fire was to disguise the presence of a machine gun in the position until rapid fire was necessary.[37]

Both guns could be mounted on tripods to provide a more stable platform from which to fire. This made them suitable for fixed-line firing and, in the case of the MG42, indirect and overhead fire – similar to the role of the Vickers MG in the British Army, albeit incapable of the same levels of sustained fire.[38]

Personnel

British and German machine gunners were drawn from the infantry section so they already met the criteria for that role. In the British Army, initially, every man was considered interchangeable in all roles and there were no particular characteristics that made someone more suitable to be a Bren gunner,[39] unlike the Vickers machine gunner.[40] By 1945, the Bren gunner, and No. 2, were considered a higher standard than other riflemen, with 'qualities comparable to a junior [non-commissioned officer]'.[41]

For German machine gunners, it was 'recommended that one does not choose soldiers

33. War Office, *Small Arms Training: Volume I, Pamphlet No. 4* (1942), p. 31.
34. Oberkommando des Heeres, *Ausbildungsvorschrift fur das M.G. 42*, p. 109.
35. War Office, *Small Arms Training: Volume I, Pamphlet No. 4* (1942), p. 1.
36. Oberkommando des Heeres, *Ausbildungsvorschrift fur das M.G. 42*, p. 11.
37. War Office, *Small Arms Training: Volume I, Pamphlet No. 4* (1942), p. 11.
38. Fisher, 'Historical Defence Capability Analysis'.
39. War Office, *Small Arms Training: Volume I, Pamphlet No. 4* (1942), pp. 2–3.
40. Fisher, 'Historical Defence Capability Analysis'.
41. War Office, *Job Analysis (Field): The Infantry* (London: His Majesty's Stationery Office, 1945), p. 15.

with glasses, or soldiers that are left-handed, but rather strong and well-built muscular boys, with good perception and a reasonable amount of initiative'.[42]

The morale effect of LMGs, whether sending or receiving their fire, varied based on the technical characteristics that had been explained to the soldiers. The rate of fire of the German MGs was such a concern[43] that it received special mention in British literature to counter it by allaying the soldiers' concerns by focusing on the 'inaccuracy' of the higher-rate-of-fire weapon.[44] This article is limited to the infantry section yet it was a significant morale factor that the Bren was being used in the context of the combined arms support that could be provided by the Allies and this had to be used to overcome the German MGs in defensive positions.[45]

Information

Fisher identified the information requirements in machine gunnery as being both proactive and reactive, with the former providing information to the machine gunners through fire control orders for the section LMGs.[46] Such orders would be verbal and part of the infantry battalion or brigade operation briefings, with little, if any, mention in the formal operation or admin orders.[47] The lowest level of wireless (radio) communications for the infantry was in the platoon headquarters, which oversaw three sections. Each section relied on runners from the platoon headquarters, with the LMGs getting their information from the section commander via the section second-in-command. It appears that German communications also relied on runners but from the company downwards, as platoons did not have wireless operators.[48]

The systems for improving the information on LMG use are based on the standard training memoranda[49] and Army Council Instructions in the British Army. Examples include the introduction of longer slings[50] and barrel wear.[51] The overall responsibility for LMGs in a German infantry unit was with a dedicated warrant officer – the *waffenmeister* – who would receive a newsletter from his chain of command to provide the latest information.[52]

Reactive information on the state of guns was communicated by the British Light Aid Detachments of the Royal Electrical and Mechanical Engineers and they completed inspection reports which covered the Bren in their attached units;[53] it is likely the *waffenmeister* did the same for German MGs.

Doctrine and Concepts

The value of the Bren gunner, and the importance of it being a role for everyone, is evidenced by the 1945 statement that 'casualties may reduce an infantry section to half its normal size, but the section will still continue to play its part in battle whilst there is a Bren gunner left'.[54] Furthermore, its role affected that of others in the section, with an attack resulting in many men 'becoming ammunition carriers for the

42. Myrvang, *MG34-MG42 German Universal Machineguns*, p. 319.
43. NA, 'Infantry Notes No 6 – Appendix E'; Colin John Bruce, *War on the Ground 1939-1945* (London: Book Club Associations, 1995), pp. 149–51; Jary, *18 Platoon*, p. 8; Alan Allport, *Browned Off and Bloody-Minded: The British Soldier Goes to War 1939-1945* (New Haven, CT: Yale University Press, 2017), pp. 229–30.
44. War Office, 'Army Training Memorandum No. 46', WO 231/263, October 1943, p. 33; NA, 'A.O.R.G. Memorandum No. 126', pp. 6–7; NA, 'Infantry Notes No 6 – Appendix E'.
45. John Buckley, *Monty's Men: The British Army and the Liberation of Europe* (New Haven, CT: Yale University Press, 2014), p. 135.
46. Fisher, 'Historical Defence Capability Analysis'.
47. These are often included in the appendices of the war diaries, and the author has checked a selection of them which were taken from series WO 171 at NA.
48. Battle Order, 'German Rifle Company (May 1944)', <https://www.battleorder.org/1944-schutzenkompanie>, accessed 12 June 2023.
49. Army Council, *Army Training Memorandum: War, January 1940 to May 1945, Parts 28 to 52* (Uckfield: Naval & Military Press, 2008).
50. NA, 'Army Council Instructions 1944 (Part 1), Paragraph 377, Small Arms – Slings, Bren .303-inch, M.G., Mark I', WO 293/31, 1944.
51. NA, 'Army Council Instructions 1945 (Part 1), Paragraph 663, Small Arms – Machine Guns, Bren – Barrel Wear', WO 293/33, 1945.
52. Myrvang, *MG34-MG42 German Universal Machineguns*, pp. 377–78.
53. Celia Cassingham, 'REME Trades: Armourer', REME Museum, 2 January 2022, <https://www.rememuseum.org.uk/blog/reme-trades-armourer>, accessed 12 June 2023.
54. War Office, *Job Analysis (Field): The Infantry*, p. 8.

Bren gunner; much less importance had been laid on fire and manoeuvre tactics'.[55] Remarkably, this is a position more normally associated with the German Army[56] and demonstrates how little difference there is between the two armies' section tactics.

The principal tactical manuals of the period,[57] and their interpretation,[58] described the elements of doctrine as, for both armies: attack or offensive combat and defence. However, only the British discussed withdrawal and only the Germans discussed combat outpost, advance guard and outguard duty as separate topics. As mentioned, it is apparent that there is little difference between the two armies' tactics. However, the most identifiable is the position of the LMG in the section, which is almost an organisational element. In the British section, the LMG was held in a separate gun group under the control of the section second-in-command, whereas, in the German section, it was under the direct control of the section commander. This likely resulted in more reactive LMGs for the Germans, with the rifles following, yet possibly more independent, and sometimes detached, in the British section.[59] The Bren was also a little more protected in advance and positioned for flanking fire based on diagrams in the tactical manuals of the period.[60] There was a vulnerability of the German LMGs when advancing but this was of little concern in the defence and as soon as the section reached its appropriate position for an attack, the section commander would identify a location for the LMGs and then lead the assaulting riflemen.[61] Although the machine gunners would be trained on how to follow-up and consolidate, their lack of an NCO familiar with a potentially changing plan could have been a risk, but it is not one evidenced in the material studied.

The doctrinal beliefs regarding accuracy and rate of fire also informed the decision-making for equipment and training: the rate of fire of the MG42 allows for bursts of three to eight rounds to land on the target in very quick succession as a cone of fire. A new target would be identified for another burst, allowing for multiple targets to be suppressed.[62] In minor contrast, the Bren would fire four to five-round bursts at a slower rate, but with higher accuracy.[63] The assumption for both armies is that they achieve suppression: the Germans by having a cone of fire on target before the enemy has a chance to react; and the British by ensuring that the first few rounds hit their target directly.

Organisation

By 1944, the British infantry section was commanded by a corporal, with six riflemen and a separate Bren group commanded by the section second-in-command (usually a lance corporal) and had two men: the No. 1 and the No. 2, with gun and ammunition respectively.[64] The German section – the *gruppe* – had the *gruppenführer* in command, an LMG troop with the No. 1 as the machine gunner and two assistants for ammunition, and six riflemen forming the rest of the section.[65] Both armies reduced the number of riflemen as manpower shortages became problematic during the war, with the Germans possibly losing the second LMG assistant in some organisations.[66] Both armies had three sections within a platoon (or German *zug*). At the company level (three platoons), there were two MGs in the heavy role.[67]

The British section explicitly required the riflemen to carry additional ammunition for the

55. Buckley, *Monty's Men*, pp. 134–35.
56. Harry Töpfer, *German Tactical Manual*, p. 6, <http://www.gr916.co.uk/pages/research.htm>, accessed 12 June 2023.
57. War Office, *Infantry Training, Part VIII. – Fieldcraft, Battle Drill, Section and Platoon Tactics* (London: His Majesty's Stationery Office, 1944); Military Intelligence Service, *The German Squad in Combat*, Special Series No. 9 (Washington, DC: War Department, 1943).
58. Töpfer, *German Tactical Manual*.
59. War Office, *Small Arms Training: Volume I, Pamphlet No. 4* (1942), p. 34.
60. War Office, *Infantry Training, Part VIII. – Fieldcraft, Battle Drill, Section and Platoon Tactics*, p. 52.
61. Military Intelligence Service, *The German Squad in Combat*, pp. 6–8.
62. Myrvang, *MG34-MG42 German Universal Machineguns*, pp. 319–21; Military Intelligence Division, *Intelligence Bulletin* (Vol. II, No. 9, May 1944), pp. 86–87.
63. War Office, *Small Arms Training: Volume I, Pamphlet No. 4* (1942), p. 1.
64. War Office, *Infantry Training, Part VIII. – Fieldcraft, Battle Drill, Section and Platoon Tactics*, p. 39.
65. Töpfer, *German Tactical Manual*, pp. 4–5; Military Intelligence Service, *The German Squad in Combat*, pp. 2–3.
66. Gary Kennedy, 'Organization of the German Infantry Battalion 1938 to 1945', updated October 2021, p. 22, <http://www.bayonetstrength.uk/GermanArmy/GerInfBn/OrgGerInfBn-headerpg.htm>, accessed 14 June 2022.
67. *Ibid.*, p. 24.

Bren;[68] however, the German literature available for this study does not identify this,[69] yet it is implied in other sources.[70]

For the period of the study, these structures remained largely consistent. However, variations occurred outside of the regular infantry division, with airborne forces potentially having higher numbers of LMGs and other automatic weapons.

Infrastructure

The requirements for supporting an LMG start from the production facilities, which also provide the spare parts and ancillary equipment to ensure the LMG is a true capability rather than a gun on its own. The facilities for training the soldiers to use it are also key. For the LMG role, they are shared with the basic training facilities for the infantry soldier and do not require separate infrastructure; furthermore, the infrastructure existed before the introduction of these weapons.

Despite its Czech origins, the Bren was procured so that it could be built in the UK. The Mark 1 gun was first built at the Royal Small Arms Factory (RSAF) in Enfield. Production was simplified to increase output and the Mark 1m was introduced, with many variations depending on the particular modifications. Further simplifications resulted in the Mark 2, and changing requirements for a lighter gun with a shorter barrel resulted in the Mark 3; however, this did not see service until 1945 and even then, only in limited numbers and specific units outside the infantry. In addition to RSAF production, the Monotype Corporation (a typewriter and print equipment supplier) manufactured parts across its network.[71] 'Design for production' was a key principle as the war progressed.[72] The changes incorporated into the Mark 2 resulted in a 25% reduction in the number of production-hours required to produce a Bren,[73] to an estimated 45–50 hours.[74] Approximately 337,000 Brens were made in the UK and Canada during the war, with a further number made in Australia, which is outside of the scope of this study as they were not used in northwest Europe.[75] Of these, the Monotype Corporation recorded that it produced 73,020 guns requiring 2,628,720 components; it also produced 2,863,355 components as spares or to support other manufacturers.[76] At least 72 other manufacturers provided components and accessories to support the use of the gun and these were distributed across the UK.[77] There was compatibility in several key components across different marks of gun as well as between the UK, Canadian and Australian manufacturers.

The reduction in production cost, as seen with the marks of the Bren gun, was also witnessed in the transition from MG34 to MG42, with the MG42 being 20–23% cheaper to produce[78] and the production time being halved from 150 to 75 production-hours.[79] The MG42 was built by five manufacturers, with the majority across two of those. It is estimated that approximately 370,000 to 400,000 were produced during the war – some literature suggests as many as 700,000 but this appears unfounded[80] and is likely a total of both MG34s and MG42s. From 1942, production was done alongside the MG34 and, for several months, the MG34/41.[81] Although detailed information is

68. War Office, *Infantry Training, Part VIII. – Fieldcraft, Battle Drill, Section and Platoon Tactics*, p. 39.
69. Military Intelligence Service, *The German Squad in Combat*, pp. 2–3; Myrvang, *MG34-MG42 German Universal Machineguns*, pp. 328–29.
70. Töpfer, *German Tactical Manual*, p. 6.
71. Grant, *The Bren Gun*, pp. 13–17.
72. M M Postan, D Hay and J D Scott, *Design and Development of Weapons* (London: His Majesty's Stationery Office, 1964), p. 265.
73. *Ibid.*, p. 360.
74. James Holland, *Normandy '44: D-Day and the Battle for France* (London: Bantam Press, 2019), p. 413. This amount is unreferenced but appears supported by other generalised sources.
75. Ian Skennerton, *British Small Arms of World War Two: The Complete Reference Guide to Weapons, Makers' Codes and 1936-1946 Contracts* (Margate, QLD: Ian D Skennerton, 1988), pp. 50–51.
76. Monotype Corporation, *Instruments of War & Peace: An Account of the Wartime Activities of Monotype Corporation* (London: Monotype Corporation), p. 9.
77. Skennerton, *British Small Arms of World War Two,* pp. 53–55.
78. Ioannis-Dionysios Salavrakos, 'A Re-assessment of the German Armaments Production During World War II', *Scientia Militaria, South African Journal of Military Studies* (Vol. 44, No. 2, 2016), pp. 113–45.
79. McNab, *MG 34 and MG 42 Machine Guns*, p. 18.
80. Myrvang, *MG34-MG42 German Universal Machineguns,* pp. 133–37.
81. *Ibid.*, pp. 443–45.

not available, German MG production also used sub-contracting.[82]

At a strategic level, there is a view that Germany's industrial mobilisation for war was a failure as it did not adopt principles of mass production whereas the Allies did. The British were supported by the US and Soviet manufacturing bases, whereas the Germans merely had their own, disregarding the compatibility of any Italian equipment. Their curve to increase productivity was stifled by their lack of resources and the Allied efforts to disrupt their supply and manufacturing processes.[83] A further point of failure was that, despite the use of forced and slave labour from occupied countries on production projects, this did not integrate the existing industries of those countries into the German strategy.[84] Furthermore, Rheinmetall noted that its production facilities could not be constructed easily or relocated without an argument about 'red tape' despite the demands of the war.[85]

Logistics

The main elements of logistics support for an LMG include ammunition, barrels (as both guns had quick-change barrels to manage overheating) and other spare parts.

The Bren No. 1 carried a spare parts wallet and four magazines (112 rounds in total), as did the section second-in-command – in addition to 50 rounds for his own rifle. The Bren No. 2 had 50 rounds for his own rifle and five magazines (140 rounds) and a spare barrel for the Bren. As mentioned previously under 'Organisation', the riflemen of the section carried additional ammunition for the LMGs. Each rifleman carried 56 rounds in magazines for the Bren (two magazines of 28 rounds each), as well as a bandolier of 50 rounds in chargers, which could be used in either the Bren's magazines or rifles. Combined with the integral ammunition of the Bren group, this allowed for 1,000 rounds per section.[86] This was the first-line allocation of ammunition within the unit.[87]

In the German section, the machine gunner (No. 1) carried 50 rounds in a drum on the side of the gun, ready for use in the same way that a Bren was carried with a magazine fitted. The No. 1 also had a pouch with tools and spares. The assistant (No. 2) carried four further drums of 50 rounds, as well as an ammunition box of 300 rounds and a spare barrel. If present, the ammunition carrier (No. 3) had two boxes of 300 rounds each, bringing the ammunition total to 1,150 rounds.[88] It is likely that the removal of the No. 3 in the 1944 re-organisation resulted in the 600 rounds previously carried by him being distributed across the riflemen of the section in 50-round belt sections. These are more visibly carried in the German section than the additional Bren magazines of the British section because the magazines for the Bren fitted into the basic pouches of the 1937 pattern webbing – a task for which they had been designed[89] – whereas the German pouches for rifle ammunition merely contained rifle chargers with no universal carrying capability.[90] Given the emphasis in the German training manual on the cleanliness and preparation of the ammunition belts,[91] it is surprising that this practice continued throughout the war, especially with the concerns issued in February and August 1944 on training and usage issues.[92]

The German platoon carried an additional LMG as a weapons reserve from March 1944, and this would supplement, or replace when damaged, the section weapons but no additional ammunition was supplied for them.[93] The only additional Brens in

82. *Ibid.*, p. 133.
83. Mark Harrison, 'Industrial Mobilisation for World War II: A German Comparison', in John Barber and Mark Harrison (eds), *The Soviet Defence Industry Complex from Stalin to Khrushchev* (Basingstoke: Macmillan Press, 2000), pp. 99–117.
84. Salavrakos, 'A Re-assessment of the German Armaments Production during World War II', pp. 113–45.
85. Rheinmetall, '125th Anniversary of Rheinmetall – the Years 1936 to 1945', <https://www.rheinmetall.com/en/company/history/125-years-rheinmetall/years-1936-1945>, accessed 29 November 2023.
86. War Office, *Infantry Training, Part VIII. – Fieldcraft, Battle Drill, Section and Platoon Tactics*, p. 39.
87. Jeremy C D Smith, 'Defence Logistics Definitions and Frameworks', *Defence Logistics: Enabling and Sustaining Successful Military Operations* (London: Kogan Page, 2018), pp. 21–23.
88. Military Intelligence Service, *The German Squad in Combat*, pp. 2–3.
89. War Office, *The Pattern 1937 Web Equipment* (London: His Majesty's Stationery Office, 1939), p. 5.
90. MP44.nl, 'German Uniforms and Equipment: Ammunition Pouches (Patronentaschen)', <https://www.mp44.nl/equipment/ammo_pouches.htm>, accessed 17 June 2023.
91. Oberkommando des Heeres, *Ausbildungsvorschrift fur das M.G. 42*, pp. 61–64.
92. Myrvang, *MG34-MG42 German Universal Machineguns*, pp. 333–34.
93. Kennedy, 'Organization of the German Infantry Battalion 1938 to 1945', p. 23.

the British infantry battalion were at the company level and were part of the local defence for the headquarters sections.

Both the British and German LMGs were in the same calibre as the infantry rifles: .303-inch and 7.92-mm respectively. This allowed the personal weapons of the riflemen to supplement the LMG ammunition if required. The planned load for a British rifleman's ammunition was only 50 rounds for his own rifle and 106 rounds for the Bren.[94] In the German section, the riflemen carried 60 rounds of ammunition for their rifles and, as identified above, any ammunition for the LMG was on an ad hoc basis.[95]

The supply of weapons and small arms ammunition to the infantry section was the responsibility of the ordnance branch in both armies. The centralisation of the Army Equipment Depots in the German Army made them susceptible to Allied air bombing and frustrated their supply chain; however, they quickly distributed their supplies to Army Equipment Branch Depots which overcame some of the risk.[96] Although the Allies had the problem of bringing all supplies from overseas to Normandy, they were relatively safe in doing so at the pace required, with only the weather causing problems – such as the storm in late June 1944 that caused delays.[97]

Interoperability of the DLODs

The heavy and fixed-line roles are outside of the scope of this study as they were not employed in the infantry section during the late 1944 period; however, the use of the tripod equipment appears to have influenced the training and doctrine of the section, with valuable training hours for all soldiers being used for tripod training even though the majority of guns were not used in that role.

The Germans were acutely aware that the high rate of fire of the MG42 could result in ammunition wastage; this was considered throughout their training and doctrine to reduce the rate of fire to a practical amount that was not dissimilar to the Bren, albeit with the rounds on target very quickly. This should have reduced the perceived logistics burden to a manageable amount; however, at least one account disputed that and suggested that the savings in production-hours for production of the simplified MG42 (from the MG34) was offset by the increased infrastructure and logistics requirements for the ammunition.[98]

Both armies integrated their MGs and considered the relationships between training, doctrine and equipment. It is apparent that much of this was influenced by the logistics both tactically and strategically, particularly the ammunition supply and how it was carried. The number of rounds carried by both sections were remarkably well matched and the role of the riflemen in the section was subservient to the LMG irrespective of the army they fought for. Furthermore, the oft-debated statistic of rates of fire is explicitly dependent upon ammunition supply (logistics) and training with the use of practical rates of fire, which were again remarkably similar, being the outcome of this interoperability.

Analysis

The narrative in the results section provides the information for an interpretative analysis using the SRLs for each DLOD. The SRL chosen is a subjective assessment based upon the definitions in Table 1. They demonstrate to what extent the capability was suitable for the intended role, with an SRL score of 9 indicating that there were no identified problems or possible improvements with its service.

Training

Training on the Bren appeared greater in quantity and quality for the infantry section's LMG capability, while the German training of the equipment in the heavy (MMG) role diminished the time spent on the LMG role. Furthermore, the training failures noted in the German system are evidence that the system was not fully integrated. Therefore, the Bren receives a 9 on the SRL scale, and the MG42 receives a 7.

Equipment

Although the MG42 was a more recent development, it was developed from the principles of the MG34 and therefore has a similar length of service as the Bren, which was developed from the Czech ZB

94. War Office, *Infantry Training, Part VIII. – Fieldcraft, Battle Drill, Section and Platoon Tactics*, p. 39.
95. Military Intelligence Service, *The German Squad in Combat*, pp. 2–3.
96. Myrvang, *MG34-MG42 German Universal Machineguns*, pp. 41–42.
97. Zoe Jackson et al., 'The Waves at the Mulberry Harbours', *Journal of Ocean Engineering and Marine Energy* (Vol. 3, 2017), pp. 285–92.
98. Myrvang, *MG34-MG42 German Universal Machineguns*, p. 451.

in the early 1930s. Given the time in service and a proven system, it is difficult to separate them for scoring purposes as both had achieved and demonstrated their operational capability. However, the contemporary recommendation for an increased rate of fire and belt feed in an LMG demonstrates the Bren lacked some elements, and thus scores 8 against the Germans' 9 on the SRL scale.

Personnel

The German Army placed more emphasis on its selection criteria for machine gunners; however, the British recognised that Bren gunners were to be comparable to junior NCOs, thus equalising this point.

The morale effect of the German MG42 with its higher rate of fire was clearly a major threat to the British and it was described in many personal accounts of the period, as well as formal training material; therefore, this demonstrates that their 'shock and awe' system (as seen with the likes of the Stuka dive bomber) was effective and consequently scores the Germans a 9 on the SRL scale against the British Bren's 8 as, although reliable and accurate, it did not counter that effect.

Information

Both armies had effective systems in place for passing relevant information to and from their machine gunners and armourers; however, they operated slightly differently with the armourer integral to the battalion in the German Army. Both systems seem to be effective with little to separate them; therefore, both score 9 on the SRL scale.

Doctrine and Concepts

The differences in doctrine are limited and subtle, with the relationship between the section commander and the LMG team being the principal one. In the British section, the role of the section second-in-command as Bren group commander gave it potentially better independence, whereas the German direct command gave it a clearer orders route. However, in a flowing battle such as that experienced in the Allied advances of the summer of 1944, the latter may have impacted the sustainability and resilience of the section and therefore, the German doctrine receives a score of 7 on the SRL scale, and the British a score of 8.

Organisation

Both armies structured their section around their LMG. As with doctrine, the principal difference was the relationship between the section commander and the LMG. The British had a partially independent LMG group with its own NCO, yet this has, as discussed in the text, advantages and disadvantages. The challenges that the sections faced with manpower as the war developed were more acute for the Germans and happened earlier than the British, due to the German Eastern Front having a drain on the personnel. It also had a direct impact on the LMG group whereas the British protected this irrespective of the number of riflemen available. Therefore, the British score an 8 on the SRL scale; whereas the Germans score a 6 as they did not have a resilient system.

Infrastructure

Multiple manufacturers were employed by both countries. The burden on infrastructure, and the logistics of supply, was reduced through the simplification of designs through the various marks of Bren and from the MG34 to MG42. It is apparent that the incremental design of Bren marks was production-led and continued to reduce the resources needed to around two-thirds of that of the MG42.

The use of distributed manufacturers by both countries resolved many of the anticipated problems from enemy action; however, by late 1944 and into 1945, the Allied bombing efforts affected the German strategic infrastructure, whereas the British had the advantage of its empire production of the Bren as well as wider Allied (mainly US) production of other materials, freeing up Bren production capability in the UK.

Manufacturing infrastructure and the difficulties it faced from enemy action were equal when looking across the whole war; however, the scope of the study is the late-war post-Operation *Overlord* period and, therefore, the German infrastructure was being impacted to a greater extent. Furthermore,

the production time and resource requirements for the Bren were only two-thirds of that of the MG42, which did not have international support. As such, the Bren scores 9 with a 6 for the Germans.

Logistics

Both LMGs have approximately the same first-line ammunition supply and use the rifle calibre ammunition of their respective armies. Without a comprehensive study of ammunition production and supply, it is not possible to identify significant differences in the logistics as they specifically relate to the LMG. The inability for the LMG team to carry all its own ammunition is a limiting factor and both British and German systems score 8 as a result.

Discussion

The mean score of SRLs, shown in Table 6, for the capabilities described is 8.4 for the British Bren and 7.6 for the German MG42. The differences for the individual DLODs and the mean are shown in Figure 1; however, as identified in the method, only scores 6 to 9 were likely to be used and this was the case. Therefore, the differences are notable when the scale is reduced, as shown in Figure 2. The largest differences are training, organisation and infrastructure. The first two changed frequently during the Second World War and studies outside of the specific scope of this article (Normandy 1944) would likely result in different scores, as would the presentation of different evidence and, of course, the subjectivity of the researcher. If the scores for training and organisation were the same, then the overall system score would have depended on infrastructure improvements to differentiate the capabilities (in this case, the mean difference would be reduced to 0.3 points – Bren at 8.4, MG42 at 8.1). Nonetheless, the first two elements are where researchers could be more objective in their assessment as there were quantitative information and primary source information available. The training system in place for the British Bren machine gunner was not only longer overall but also more suited to the LMG role, with less time dedicated to the tripod-mounted fixed-line role of the weapon. For the most part, how the guns were used on their tripods was the same. The MG42 was also used in a more extensive indirect fire role; whereas the British used the Vickers MG for this capability, which was enhanced by a greater range and water-cooling to enable truly sustained fire.[99]

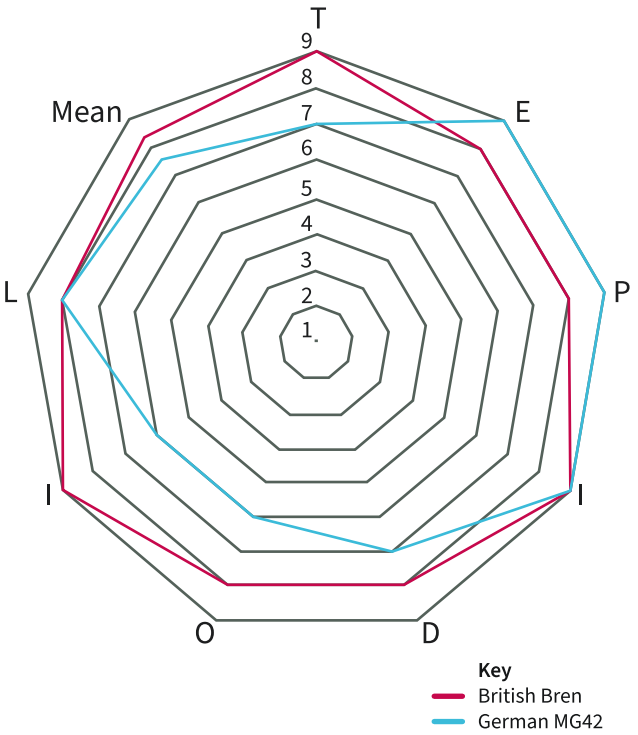
Table 6: Summary of SRL Scores

	T	E	P	I	D	O	I	L	Mean
British Bren	9	8	8	9	8	8	9	8	8.4
German MG42	7	9	9	9	7	6	6	8	7.6

Source: Author generated.

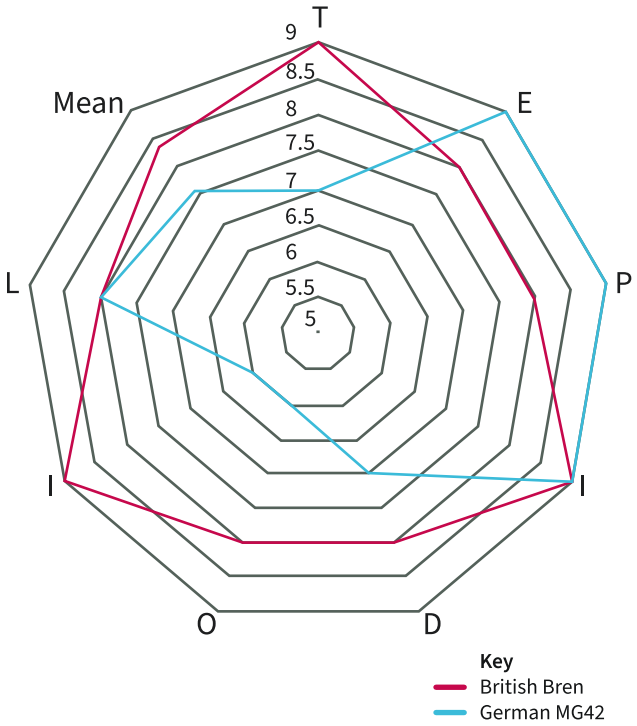
99. Fisher, 'Historical Defence Capability Analysis'.

Figure 1: DLODs Comparison (on a Scale of 1 to 9)



Source: Author generated.

Figure 2: DLODs Comparison (on a Scale of 5 to 9)



Source: Author generated.

The interoperability of the DLODs is linked to the rates of fire: the MG42 relied on good quality training to manage the expenditure of ammunition and placed the burden on the logistics train. When this failed, through inexperienced personnel, it caused the wider system to fail. Therefore, while the DLODs can be scored individually, it is their operation as a system that determines their eventual success.

As to the method, it was necessary to interpret the SRLs more broadly than previous authors have done, as SRLs were not designed to consider DLODs as components nor historical analysis as their purpose. While this analysis used the SRL structure, it requires refinement for each application, and at times it may be appropriate to test an alternative scoring method. The subjective nature of the assessment for many of the DLODs, with little quantitative information available to study, renders it open to conjecture and further interpretation of different authors and the bias of using mainly English-language literature. Secondary sources for elements of the study are also limited. In comparison with the Vickers MG studied previously,[100] information on the Bren and MG42 was much more limited through open sources.

Despite these constraints, this article demonstrates that the DLOD model can be used for the evaluation and comparison of a capability. It evaluates the equipment in its wider context and provides wider learning and better comparisons. The differences in rates of fire and time to change a barrel do not consider the similarities in areas such as first-line ammunition supply, or the differences such as training hours. It is this latter point that appears to be the biggest gap between the two armies and demonstrates the value of training and organisation even where other elements are reasonably matched. ■

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100. *Ibid.*