Dumb donkeys or cunning foxes? Learning in the British and German armies during the Great War

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There are many myths about the First World War. One in particular has been both enduring and widespread. Almost from the time of the war's conclusion, the belief arose that the officer corps of the combatant armies, and in particular the higher commanders, were unable to meet the challenges of modern warfare. The high casualties suffered by all armies, combined with almost static warfare, at least on the Western Front, convinced observers from all sides that military leaders had been unable to learn from their mistakes. While the common soldier of the war was cast as a hero/victim, his officers were castigated as unimaginative dullards or buffoons.[1] In short, the 'lions' of the war had been led by 'donkeys'.[2]

The immediate shock of the war helps to explain why the image developed in the interwar period, but it has remained remarkably resilient despite considerable research generating contrary findings. There is no doubt that portrayals of the war around the fiftieth anniversary reinforced the image of 'lions led by donkeys'.[3] However, even in this period, scholarship demonstrated the remarkable way in which the armies learned the lessons of recent fighting. Perhaps foremost among those arguing that armies, the British army in particular, were learning organizations was John Terraine. In a series of books, he demonstrated how the British army was able to adapt its tactics and develop new technologies to counter the challenges of the First World War battlefields.[4] Terraine's points were taken up by

* The analysis, opinions and conclusions expressed or implied in this article are those of the author alone and do not necessarily represent the views of the Joint Services Command and Staff College, the UK Ministry of Defence or any other government agency.

1 On the idea of the victim/hero image of the common soldier, see Helen B. McCartney, 'Hero, victim or villain? The public image of the British soldier and its implications for defence policy', *Defence and Security Analysis* 27: 1, March 2011, pp. 43–54; and, more particularly, her contribution to this issue of *International Affairs* (pp. 299–315 below).

2 The phrase 'lions led by donkeys' was supposedly used by German commanders during the war to describe the British forces. It served as the inspiration for Alan Clark's influential book, *The donkeys* (New York: William Morrow, 1961). Clark attributes the quotation to an exchange between Erich Ludendorff and Max Hoffmann, quoted in Erich von Falkenhayn's memoirs, but subsequent research has discredited this attribution. Nonetheless, it was certainly current in German thinking during the war, as evidenced by Princess Blücher's diary entry for 9 April 1918, in which she implies this is Ludendorff's view. See Evelyn, Princess Blücher, *An English wife in Berlin: a private memoir of events, politics and daily life in Germany throughout the war and the social revolution of 1918* (London: Constable, 1921), p. 211.

3 For recent examinations of this phenomenon, see Dan Todman, *The Great War: myth and memory* (London: Hambledon, 2005); Stephen Badsey, *The British army in battle and its image, 1914–1918* (London: Continuum, 2009).

4 John Terraine, *Douglas Haig: the educated soldier* (London: Hutchinson, 1963); *To win a war: 1918, the year of victory* (London: Sidgwick & Jackson, 1978); *White heat: the new warfare, 1914–1918* (London: Sidgwick & Jackson, 1982).

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a new generation of British historians in the 1990s and 2000s. They argued that the British army travelled along a 'learning curve' during the war, changing from a small, backward colonial force in 1914 to a large army with the most advanced tactics and technology by 1918.[5] Literature on the German and French armies, which faced different organizational challenges, has demonstrated how they too adapted and innovated over the course of the war.[6]

Both business management theorists and military historians have long been exploring how organizations learn. However, until recently the two literatures remained steadfastly separate.[7] While management theorists developed their ideas about 'learning organizations' and 'knowledge management', military historians have written about 'innovation' and, more recently, 'adaptation'.[8] Yet despite the different terminology, the two literatures share common ideas. In his influential work *The fifth discipline*, management theorist Peter Senge describes two types of organizational learning, 'generative' and 'adaptive':[9] a division that roughly corresponds to the concepts of 'innovation' and 'adaptation' used by military historians. 'Adaptive' learning or 'adaptation' is precisely what the terms imply: the learning is incremental and relatively minor in scope. Theo Farrell recently identified two key components of military adaptation: military organizations can first 'exploit core competencies in refining or modifying existing tactics, techniques and/or technologies' and second 'explore new capacities by developing new modes and means of operations'.[10] Although adaptation is not as radical as innovation, this is not to say that it is not important in wartime. However, it certainly has not

[5] Prominent among these works are Paddy Griffith, *Battle tactics of the Western Front: the British army's art of attack, 1916–1918* (London: Yale University Press, 1994), and *British fighting methods in the Great War* (London: Cass, 1996); Gary Sheffield, *Forgotten victory: the First World War—myths and realities* (London: Headline, 2001); Andy Simpson, *Directing operations: British corps command on the Western Front, 1914–18* (Stroud: Spellmount, 2006). The concept of a 'learning curve' has come under criticism recently (see Hew Strachan, 'Memorial differences', *Times Literary Supplement*, no. 5510, 7 Nov. 2008, p. 11). Consequently, this group of historians has modified this term to 'learning process', which more accurately reflects the ups and downs of the way in which the British army learned during the war. See Gary Sheffield, *The chief: Douglas Haig and the British army* (London: Aurum, 2011).

[6] On the French, see Michel Goya, *La Chair et l'acier: L'armée française et l'invention de la guerre moderne* (Paris: Tallandier, 2004); Jonathan Krause, *Early trench tactics in the French army: the second battle of Artois, May–June 1915* (London: Ashgate, 2013). For the Germans, see Timothy T. Lupfer, *The dynamics of doctrine: the change in German tactical doctrine during the First World War* (Leavenworth: Combat Studies Institute, 1981); Bruce I. Gudmundsson, *Stormtroop tactics: innovation in the German army, 1914–1918* (New York: Praeger, 1989); Martin Samuels, *Command or control? Command, training and tactics in the British and German armies, 1888–1918* (London: Cass, 1995); David Zabecki, *Steel wind: Colonel Georg Bruchmüller and the birth of modern artillery* (Westport, CT: Greenwood, 1994); Robert T. Foley, 'A case study in horizontal innovation: the German army, 1916–1918', *Journal of Strategic Studies* 35: 6, 2012, pp. 799–827.

[7] Recent attempts to merge the two disciplines include John Nagl, *Learning to eat soup with a knife: counterinsurgency lessons from Malaya and Vietnam* (Chicago: University of Chicago Press, 2002).

[8] There is a rich literature on 'military innovation'; for a recent overview, see Adam Grissom, 'The future of military innovation studies', *Journal of Strategic Studies* 29: 5, Oct. 2006, pp. 919–30. On adaptation, see Theo Farrell, 'Improving in war: military adaptation and the British in Helmand Province, 2006–2009', *Journal of Strategic Studies* 33: 4, 2010, pp. 567–94; Williamson Murray, *Military adaptation in war: with fear of change* (Cambridge: Cambridge University Press, 2011); and Theo Farrell, Frans Osinga and James Russell, eds, *Military adaptation in Afghanistan* (Stanford, CA: Stanford Security Studies, 2013).

[9] Peter Senge, *The fifth discipline: the art and practice of the learning organization* (New York: Doubleday, 1990). See also Christopher Argyis and D. A. Schon, *Organizational learning: a theory of action perspective* (Reading, MA: Addison-Wesley, 1978), who use the terms 'single-loop' and 'double-loop' learning instead of 'adaptive' and 'generative' learning.

[10] Farrell, 'Improving in war', p. 570.

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captured the imagination of historians in the same way as its more radical cousin, innovation. Again, as the term suggests, 'innovation' describes more far-reaching and radical change. In his survey of recent work on military innovation, Adam Grissom notes three widely accepted characteristics: first, 'innovation changes the manner in which military formations function in the field'; second, 'innovation is significant in scope and impact;' and third, 'innovation is tacitly equated with greater military effectiveness'.[11]

In order to function effectively in wartime, particularly in a long, high-intensity conflict such as the First World War, armed forces need to employ both types of learning. They must adapt existing technologies, tactics, doctrine and organizations to meet the challenges of war, while at the same time developing innovations in these areas. Both adaptation and innovation must be done effectively. They need to be able to capture the experience and new ideas of individuals and share this knowledge quickly and efficiently *throughout* the organization. In short, they require some mechanism for translating tacit knowledge (knowledge held by individuals) into explicit knowledge (knowledge codified for sharing with others) and for then transferring this knowledge throughout the organization so that the organization itself can create new knowledge and learn.[12]

That armies did learn during the First World War is clear. As recent historiography has demonstrated, the war saw the development of innovative new tactics and technologies, and organizational structures to enable their effective use. This historiography, however, is less clear on *how* the armies learned. The present article will address this deficiency by examining the British and German armies as learning organizations during the war. The two armies offer an interesting comparison. Their prewar structures and cultures were very different, yet they faced the same challenges on the battlefield. How they responded to these challenges was clearly guided by their differences. As we shall see, the German army made extensive use of formal learning processes; the organization took responsibility for the transfer and creation of new knowledge throughout its structures. It put into place formal pathways for knowledge to travel from the bottom to the top of the organization and back down again. The British army, on the other hand, made more effective use of non-formal learning processes. Here, knowledge transfer and creation occurred on a more ad hoc basis, with individual elements of the organization learning in different ways and at different paces.[13] To make this distinction is not, of course, to say that the German army used only formal methods or that the British army used only non-formal approaches. However, the

[11] Grissom, 'The future of military innovation studies', p. 907.

[12] Ikujiro Nonaka, 'The knowledge-creating company', *Harvard Business Review* 69: 6, Nov.–Dec. 1991, pp. 96–104; Kiku Jones and Lori N. K. Leonard, 'From tacit knowledge to organizational knowledge for successful knowledge management', *Annals of Information Systems* 4: 1, 2009, pp. 27–39; Dick Stenmark, 'Leveraging tacit organizational knowledge', *Journal of Management Information Systems* 17: 3, Winter 2000–2001, pp. 9–24; Catherine L. Wang and Pervaiz K. Ahmed, 'Organizational learning: a critical review', *The Learning Organization* 10: 1, 2003, pp. 8–17.

[13] I have adapted the usage of formal and non-formal learning here from individual learning to organizational learning. For an overview of definitions of formal and non-formal learning methods, see Patrick Werquin, 'Terms, concepts and models for analysing the value of recognition programmes', report for the OECD, Sept. 2007, http://www.oecd.org/education/skills-beyond-school/41834711.pdf, accessed 15 Feb. 2014.

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respective structures and natures of the two armies led each to make more effective use of one style than the other. Both styles had their strengths and weaknesses; together, they enabled the two armies to adapt to the challenges of the First World War battlefields and in the process to develop a range of tactical, technological and organizational innovations. The different approaches to learning also led to differences in innovation, with the German army making extensive use of horizontal and bottom-up innovation and the British army making more effective use of top-down innovation.

The challenges of the First World War battlefields

Across the Western Front from early September 1914 a rather strange thing began occurring. As the French and German armies shifted units from their southern wings to their northern in an attempt to outflank each other, improvised field positions began appearing wherever the two armies remained. While these were by no means the extensive trench systems of later in the war, they allowed positions to be held with fewer troops, freeing up others for use elsewhere. Although often seen as an innovation of the First World War, field positions had a long history and had been used in the years immediately before 1914: both the Balkan wars of 1912–13 and the Russo-Japanese War of 1904–1905 had seen extensive use of entrenchments, and European armies were well versed in their use.[14] By November 1914, the belligerents in Belgium and France faced each other from two increasingly sophisticated defensive systems.[15] These trenches proved successful at resisting most attempts to break through for the next four years. Several interrelated factors created this deadlock.

First, the combination of cover and firepower created a tactical problem for attackers. Field fortifications provided cover for defending troops as they waited out enemy preparatory artillery bombardments and small-arms fire. Once this fire had lifted to allow attacking troops to close with the enemy, defenders would emerge and fire into the now-exposed attacking troops. Even if some defenders were killed or incapacitated by the preparatory fire, modern rifles could easily fire 20 rounds per minute, and the increasingly available machine guns could fire up to 600 rounds per minute. Added to the firepower of the infantry was that of the artillery. This increased as the war progressed, with ever-larger numbers and sizes of artillery pieces being added to the tables of organization of European armies. All of this firepower struck the attacker when he was at his most vulnerable: in order to attack he had to leave the protection of his own trenches, exposing himself to the fire of the enemy. Thus, on the Western Front, relatively few defenders could stop almost any attack in its tracks.

[14] See e.g. Prussian Kriegsministerium, *DVE Nr 275: Feld-Pionierdienst aller Waffen* (Berlin: Kriegsministerium, 1911), pp. 98–192.

[15] Sir John French's order of 16 Sept. 1914 is seen by the British as the beginning of trench warfare: James E. Edmonds, *History of the Great War: military operations France and Belgium, 1914*, vol. 1: *Mons, the retreat to the Seine, the Marne and the Aisne, August–October 1914* (London: Macmillan, 1933), p. 430. In fact, this began much earlier further south along the front.

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Added to this tactical challenge was an operational problem. The defensive effectiveness of front-line trenches meant that they could be held by relatively few troops. Given the size of the armies involved, this left large numbers of units free to act as a reserve in case the enemy did succeed in breaking into a defensive position. (Although the calculations are by no means exact, the British official history noted that the two sides could each field 15,000 men per mile, or 10 men per yard, on the Western Front in 1914.[16]) Moreover, it was clear to all that any attempt to break through the trenches would have to be carefully managed; attacking troops would have to be brought forward and artillery preparation carried out. Throughout most of the war, this buildup of men and materiel telegraphed an attacker's intentions and allowed a defender to ready his reserves. Even if surprise could be achieved, the tactical break-in took so long that invariably defenders had time to bring up fresh reserves.

As the war progressed, the two problems became more closely intertwined. From late 1915, the simple field fortifications gave way to complex defensive systems of considerable depth. Instead of a simple trench line, by late 1917 the Germans had developed sequential defensive systems, each of which comprised a number of trench lines and centres of resistance with a depth of up to 15 kilometres. The object of defence ceased to be holding the forward line and became absorbing an enemy attack and inflicting high casualties before counter-attacking to regain lost ground. Systems of such depth combined the problem of tactical movement with that of operational mobility to generate stasis on the Western Front.[17]

The two armies: organizational culture and change

The British and German armies were vastly different organizations in 1914. At the start of the war, Britain was alone among the Great Powers in having a volunteer army. Consequently, it was only able to mobilize a force of some six divisions and send about 120,000 men to France.[18] The British Expeditionary Force (BEF) that arrived in France in August and September 1914 was dwarfed by its continental rivals. Britain's main ally, France, raised an army of nearly 4 million at the outbreak of war and still had 650,000 men beyond its requirements.[19] Even the

[16] Edmonds, *Military operations 1914*, vol. 1, p. 430.

[17] For the development of defensive zones during the war, see William Balck, *Development of tactics in the World War*, trans. Harry Bell (Leavenworth, KS: General Service Schools, 1922), pp. 151–68. Also useful is the poorly titled work by G. C. Wynne, *If Germany attacks: the battle in depth in the West*. Three editions of this book exist: a first edition that was heavily censored (G. C. Wynne, *If Germany attacks: the battle in depth in the West*, London: Faber & Faber, 1940); a facsimile edition of this (New York: Greenwood, 1976); and a final, unexpurgated edition based on Wynne's original manuscript, ed. Robert T. Foley (London: Tom Donovan, 2008).

[18] In fact, the British army had a nominal strength of some 733,514 in 1914, but of this number only 247,432 were regular army, of whom about 140,000 were stationed in the British Isles. The remainder were scattered throughout the empire. Territorial troops, who were indifferently trained and who had signed up only for home defence, accounted for 268,777. These troops were organized into six regular infantry and one regular cavalry divisions, and 14 Territorial Force divisions and 14 Territorial Force mounted brigades in Britain, as well as nine divisions and eight mounted brigades in India. See War Office, *Statistics of the military effort of the British empire during the Great War, 1914–1920* (London: HMSO, 1922), p. 30; James E. Edmonds, *History of the Great War: military operations France and Belgium, 1918*, vol. 5: *26 September–11 November: the advance to victory* (London: Macmillan, 1947), p. 589.

[19] État-Major de l'Armée—Service historique, *Les Armées françaises dans la grande guerre*, vol. 1: *La Guerre de*

Belgian army counted more rifles than the BEF. Consequently, on the outbreak of the war British strategists immediately set about taking steps to expand the small professional army by creating a new force manned by hitherto untrained volunteers from British society as a whole.[20] The BEF went from an initial five infantry and one cavalry divisions in France in 1914 to 61 infantry and three cavalry divisions in 1918. Indeed, by January 1918 the entire British army comprised 80 infantry and eight cavalry divisions. All told, excluding dominion troops, there were almost 74,500 officers and nearly 1.5 million British troops in France alone.[21]

This expansion of the British army created considerable challenges for organizational learning. While the original regular army, and in particular the original six divisions of the BEF, were generally well trained, many of these long-service soldiers and officers were killed, captured or wounded during the first months of the war. Between the beginning of August and the end of November 1914, the British army lost more than 86,000 men in France; perhaps more importantly, it lost 3,627 officers. As 1914 drew to a close, the average British infantry battalion had only one officer and 30 men who had landed in France in August and September. As the British official history of the war noted: 'The old British army was gone past recall, leaving but a remnant to carry on the training of the New Armies.'[22]

The German army in 1914 was a very different institution from the British army. German soldiers were short-service conscripts. The active army in 1914 counted some 761,000 men of three annual classes. Once a recruit's period of active service ended, he joined various categories of reserve, which were used to fill out the active units and to form independent reserve units upon outbreak of war. Having refined its system of conscription during the course of the nineteenth century, the German army could draw upon a deep pool of trained manpower in August 1914.[23] While not all able-bodied men had been through the army, 3.7 million were called to the colours on mobilization.[24] These formed 92 divisions. Of these, 1.3 million were deployed in the west against the French and the British armies in 78 divisions organized into seven separate armies.[25]

The German army also underwent considerable expansion and change during the war. In overall numbers, it went from 92 divisions upon mobilization to 241 by January 1918. Moreover, like the BEF, the German army also suffered considerably

mouvement (opérations antérieures au 14 novembre 1914) (Paris: Imprimerie nationale, 1936), pp. 54–5.

[20] Although 14 Territorial Force divisions were available, Horatio Kitchener, the British Secretary of State for War, favoured the creation of new units under regular army control rather than reliance on the Territorials. See Peter Simkins, *Kitchener's army: the raising of the new armies, 1914–1916* (Manchester: Manchester University Press, 1988); K. W. Mitchinson, *England's last hope: the Territorial Force, 1908–1914* (Basingstoke: Palgrave Macmillan, 2008).

[21] Edmonds, *Military operations 1918*, vol. 5, pp. 589–90.

[22] James E. Edmonds, *History of the Great War: military operations France and Belgium, 1914*, vol. 2: *Antwerp, La Bassée, Armentières, Messines, and Ypres October–November 1914* (London: Macmillan, 1925), pp. 465–7; Brian Bond, *The Victorian army and the Staff College, 1854–1914* (London: Eyre Methuen, 1972), p. 324. It is worth noting that the infantry strength of the BEF in August 1914 amounted to only 84,000.

[23] Stig Förster, 'Militär und staatsbürgerliche Partizipation. Die allgemeine Wehrpflicht im Deutschen Kaiserrerich, 1871–1914', in Roland G. Foerster, ed., *Die Wehrpflicht: Entstehung, Erscheinungsformen und politisch–militärische Wirkung* (Munich: Oldenbourg, 1994), pp. 55–70.

[24] Reichsarchiv, *Kriegsrüstung und Kriegswirtschaft*, vol. 1: *Die militärische, wirtschaftliche und finanzielle Rüstung Deutschlands von der Reichsgründung bis zum Ausbruch des Weltkrieges* (Berlin: Mittler, 1930), p. 217.

[25] Hermann Cron, *Das deutsche Heer im Weltkriege* (Berlin: Siegismund, 1937), p. 102.

in the open warfare of 1914, losing more than 18,000 officers and almost 820,000 men killed, wounded or missing by the end of 1914.[26] The impact on the organization, however, was very different. While the British army had little to draw on beyond its core of long-service soldiers and officers, generations of conscription had built up a pool of trained manpower from which the German army could draw replacements. Moreover, the German army had the basic infrastructure in place to prepare previously untrained men for front-line service quickly.

Simple numbers do not tell the entire story. The central group within any army is its officer corps. This group leads the forces in the field, develops and refines doctrine, tactics, techniques and procedures, and formulates operations and strategy. In terms of officers, too, the British army was poorly provided for compared to its continental cousins, with only around 11,000 officers on active duty in August 1914. There were a further 13,000 on various reserve lists, but most of these were poorly trained and lacked experience.[27] In contrast, the German army had a well-developed officer corps to lead its troops. In August 1914 there were nearly 120,000 mobilized, including large numbers of reserve officers.[28] As being an officer conferred considerable social status within imperial Germany, the army was able to take its pick of educated young men, many of whom opted for a reserve commission rather than a career in the army.[29]

Perhaps more importantly, German army officer education prior to the war was both quantitatively and qualitatively superior to that in the British army. While both armies stressed the importance of 'character' in the selection and promotion of officers, the British army held fast to an amateur tradition, at least until the years immediately prior to the First World War.[30] Then, the shock of the initial defeats in the Second Anglo-Boer War provided the impetus for considerable reform in the British army's officer corps—not least, highlighting the need for the creation of a corps of professional staff officers and for wider officer education.[31] In 1906 a general staff was formally created and the Staff College, the institution of higher

[26] Heeres-Sanitätsinspektion des Reichswehrministeriums, *Sanitätsbericht über das deutsche Heer (Deutsches Feld- und Besatzungsheer) im Weltkriege 1914/1918*, Band III: *Die Krankenbewegung bei dem Deutschen Feld- und Besatzungsheer* (Berlin: Mittler, 1934), p. 12.

[27] War Office, *Statistics of the military effort*, p. 30.

[28] Reichsarchiv, *Kriegsrüstung und Kriegswirtschaft*, vol. 1, p. 217.

[29] John Hartmut, *Das Reserveoffizierkorps im Deutschen Kaiserreich, 1890–1914: Ein sozialgeschichtlicher Beitrag zur Untersuchung der gesellschaftlichen Militärisierung im Wilhelminischen Deutschland* (Frankfurt: Campus Verlag, 1981); Steven E. Clemente, *For King and Kaiser! The making of the Prussian army officer, 1860–1914* (New York: Greenwood, 1992); Ute Frevert, *A nation in barracks: modern Germany, military conscription and civil society* (Oxford: Berg, 2004), pp. 157–70. For a fictional but nonetheless revealing account of the role of reserve officers by one of imperial Germany's foremost authors, see Walter Bloem, *Sommerleutnants* (Leipzig: Grethlein, 1910).

[30] Tim Travers, *The killing ground: the British army, the Western Front and the emergence of modern warfare, 1900–1918* (London: Routledge, 1993), pp. 3–36; Keith Simpson, 'The officers', in Ian F. W. Beckett and Keith Simpson, eds, *A nation in arms: a social study of the British army in the First World War* (London: Tom Donovan, 1990), pp. 63–96; Simon Robbins, *British generalship on the Western Front, 1914–18: defeat into victory* (London: Cass, 2005), pp. 1–17; Timothy Bowman and Mark Connelly, *The Edwardian army: recruiting, training and deploying the British army, 1902–1914* (Oxford: Oxford University Press, 2012), pp. 7–40. On German officer selection, see Clemente, *King and Kaiser*, pp. 55–79; Martin Kitchen, *The German officer corps, 1890–1914* (Oxford: Clarendon, 1968), pp. 22–48.

[31] John K. Dunlop, *The development of the British army, 1899–1914* (London: Methuen, 1938); Spencer Jones, *From Boer War to World War: tactical reform of the British army, 1902–1914* (Norman: University of Oklahoma Press, 2012).

education within the British army, was reformed and refocused.[32] However, these developments came late, and their implications had only begun to be felt in the army by the outbreak of war in August 1914. On mobilization, there were only about 450 trained staff officers in the British and Indian armies, and of these, only a small percentage had attended the Staff College after the Haldane reforms of 1906–12.[33]

In contrast, between 1871 and 1914, the German army had developed to a very high degree an effective system of staff officers. With many higher commanders selected on the basis of their birth and relation to the crown, the general staff system provided a shadow command system with the German army.[34] With a highly competitive selection process, the prewar general staff system ensured that competent and highly trained officers would be in place in all command teams within the German army.[35] Moreover, officers trained in the general staff rotated between command and staff appointments. Thus, while the German army might have had only 625 general staff officers on its books before mobilization in 1914, these were the officers actually performing staff roles.[36] With around 100 fully trained general staff officers having graduated from the *Kriegsakademie* every year since 1876, the German army had a deep reservoir of highly educated and well-trained officers upon which to draw throughout the war.[37]

The approaches to formal training and education of officers were mirrored in, indeed were a reflection of, the cultures of the two armies in the years before the war. Although his was perhaps an extreme view, General Sir John Hackett wrote of the original BEF:

> Its officer corps was still the preserve of young men of good social standing who had the outlook of amateurs, which is what they mostly were. They were ill-paid, with 'half a day's pay for half a day's work', and so had to be of independent means. This means they were hard to teach and many were unteachable. They were not well trained and were expected to be neither industrious nor particularly intelligent … As a foreign observer put it, among the officers of the British army bravery had often to compensate for lack of ability.[38]

The German army, on the other hand, was home to one of the world's 'perfect' institutions in the form of the Great General Staff.[39] As an organization, the

[32] Bond, *The Victorian army and the Staff College*, pp. 181–298.

[33] Of the 447 in the army list, 219 were killed during the war, including 54 in 1914 and a further 34 in 1915: Bond, *The Victorian army and the Staff College*, p. 324.

[34] Perhaps most famously, Kaiser Wilhelm II told his son Crown Prince Wilhelm when he took command of the Fifth Army in 1914 that he must do whatever his chief of staff told him to do: Kronprinz Wilhelm, *Meine Erinnerungen aus Deutschlands Heldenkampf* (Berlin: Mittler, 1923), p. 4.

[35] On the development of the Great General Staff, see Arden Bucholz, *Moltke, Schlieffen and Prussian war planning* (Oxford: Berg, 1991).

[36] Wiegand Schmidt-Richberg, *Die Generalstäbe in Deutschland, 1871–1945* (Stuttgart: Deutsche Verlags-Anstalt, 1962), p. 18.

[37] Louis von Scharfenort, *Die Königlich Preußische Kriegsakademie, 1810–1910* (Berlin: Mittler, 1910), p. 196.

[38] John Hackett, *The profession of arms* (London: Sidgwick & Jackson, 1983), p. 158. Cf. Bowman and Connelly, *The Edwardian army*, pp. 32–40.

[39] The four other 'perfect' institutions were the Roman Curia, the British parliament, the French opera and the Russian ballet: Annika Mombauer, *Helmuth von Moltke and the origins of the First World War* (Cambridge: Cambridge University Press, 2001), p. 34.

German army stressed the importance of education and debate and provided accelerated promotion to those officers who showed the most intellectual promise.[40]

In short, the British army in 1914 and throughout most of the war exemplified an amateur organization. Social status, personal connections and patronage contributed greatly to officer selection and promotion. Education and specialist knowledge were not as highly valued. On the other hand, the German army represented, for the most part, a professional organization.[41] Although status and connections were important for officer selection and at times for promotion, there existed a stronger link between the development of a core of specialist knowledge and career development. This existed, not least, in the general staff, which provided accelerated promotion and considerable responsibility based on proven competence and knowledge of warfare. These differences patterned the approaches to learning in the war favoured by the two organizations.

Formal learning during the war

Given the size and nature of the two armies, it should be little surprise that the German army both favoured and led in the realm of formal learning during the war. Two examples of learning and innovation typify the strength of this formal learning approach. The first concerns the development of defensive doctrine during and after the summer of 1916, when the German army found itself fighting a difficult defensive battle on the Somme. Its previous defensive doctrine, as developed through the battles of 1914 and 1915, proved to be deficient in the battle of materiel waged by the British and French attacking armies.[42] Over the course of the battle, a new defensive doctrine slowly emerged. It did so based on the *Erfahrungsberichte* (lessons-learned reports) that each division and army corps was required to complete after a period in combat.[43] Despite orders to the contrary, units leaving the battle shared these reports with other units across the Western Front, and units in quiet sectors actively sought out the reports as a means of staying current with battle experience.[44] On the basis of that experience, units began challenging and diverging from the defensive doctrine prescribed by the

[40] Robert T. Foley, 'Institutionalized innovation: the German army and the changing nature of war, 1871–1914', *RUSI Journal* 147: 2, 2002, pp. 84–90.

[41] Although dated, Morris Janowitz, *The professional soldier: a social and political portrait* (Glencoe, IL: Free Press, 1960), and Samuel P. Huntington, *The soldier and the state: the theory and politics of civil–military relations* (Cambridge, MA: Harvard University Press, 1957), still offer useful introductions to the professionalization of the armed forces in the late nineteenth and early twentieth centuries. See also Bengt Abrahamsson, *Military professionalization and political power* (London: Sage, 1972), pp. 12–39; Andrew Abbott, *The system of professions* (Chicago: University of Chicago Press, 1988), pp. 3–31.

[42] Chef des Generalstabes des Feldheeres, Nr 7563r, 'Gesichtspunkte für den Stellungskrieg', Oct. 1915, Bundesarchiv/Militärarchiv (BA/MA), PHD7/1. This document had been issued by the German high command after taking into account the lessons of defensive fighting in 1915: see Samuels, *Command or control*, pp. 158–70.

[43] Unlike most contemporary British reports, which provided a narrative of events, these German reports focused on practical lessons and tactics. See Foley, 'A case study in horizontal innovation', pp. 814–16.

[44] Later this sharing was made a formal requirement, and armies and army groups used lessons-learned reports in their training establishments. See Heeresgruppe Kronprinz Rupprecht, Ic. Nr 2881, 25 April 1917, Hauptstaatsarchiv (HStA), Stuttgart, M33/2 Bü25.

high command. Without waiting for official sanction, divisions fighting on the Somme began deepening their defensive positions, holding the front line more weakly, and changing the way in which command of the forward battle was carried out. It is important to note that this knowledge spread widely and quickly throughout the German army in late 1916 by means of the lessons-learned system. This major innovation in doctrine, captured by the lessons-learned reports, was used by the German high command in late 1916 in rewriting its official defensive doctrine.[45] A new manual was published by the German high command on 1 December 1916, entitled *Principles for the conduct of the defensive battle in position warfare*; a revision appeared on 1 March 1917 once the lessons of the battle of the Somme had been fully analysed.[46]

The formal organizational learning process did not end with the publication of this new doctrine. The German high command recognized that the doctrine would need to be tested and continuously refined in the face of enemy developments and new ideas from the combat troops. Indeed, after the battle of the Somme, there was still considerable debate about some of the key elements of new defensive tactics, including the importance of holding the forward-most trenches. The chief of staff of the First Army, which had borne the brunt of fighting on the Somme, Fritz von Loßberg, disagreed fundamentally with the principle of flexible defence that formed part of the new doctrine. Erich Ludendorff, the First Quartermaster-General and de facto head of the German army, ordered Loßberg to be critical of the new doctrine in the final lessons-learned report published by the First Army at the end of January 1917, thus continuing the debate over tactical developments.[47]

In addition, the high command established two new schools on the Western Front that were given a number of important goals. First, these schools were to teach the new doctrine to the divisional commanders and their staffs. Second, with a full division assigned as practice troops, each school was to test the new doctrine and to look for ways in which it could be improved. This was aided by the schools' third function, namely the sharing of knowledge by the many divisional commanders and staff officers attending who had considerable experience of their own of fighting at the front. Ample time was built into the courses for this knowledge-sharing and for commenting on the ever-developing ideas generated by the schools. Finally, the schools also hosted officers from the Eastern Front and from Germany's allies, Austria-Hungary, Bulgaria and Turkey. Thus they provided a forum for sharing knowledge across fronts, as well as developing doctrine on the Western Front.[48]

[45] Robert T. Foley, 'Learning war's lessons: the German army and the battle of the Somme 1916', *Journal of Military History* 75: 2, April 2011, pp. 471–504.

[46] Chef des Generalstabes des Feldheeres, *Grundsätze für die Führung in der Abwehrschlacht im Stellungskrieg*, 1 Dec. 1916 (new edn 1 March 1917), BA/MA, PHD7/16.

[47] Armee-Oberkommando 1, Ia Nr 2122, 'Erfahrungen der 1. Armee in der Sommeschlacht 1916. Teil I: Taktischer Teil', 30 Jan. 1917, Landesarchiv Baden-Württemberg—Generallandesarchiv, Karlsruhe, 456 F1/525.

[48] The memoirs of the commander of one of these schools are useful here. See Otto von Moser, *Feldzugsaufzeichnungen als Brigade-, Divisionskommandeur und als kommandierender General 1914–1918*, 2nd edn (Stuttgart: Belser, 1923), pp. 244–55.

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The second example of the formal learning process as employed by the German army again involved sharing knowledge created at the lowest levels across the army as a whole. While the German army was primarily on the defensive on the Western Front between late 1914 and early 1918, it did conduct a number of small-scale 'attacks with limited objectives', as well as the major offensive at Verdun from February to August 1916. In the course of these actions, important knowledge was gained about how to deal with the deadlock of the trenches. This led to the development of what have become known as 'stormtroop tactics'.[49] Already in early 1915 a number of special units had been created across the Western Front designed to experiment with ways of tackling particularly difficult areas of the front in attacks.[50] Comprising combined-arms teams of infantry, sappers and some artillerists, these units proved their worth in attacks across the Western Front in 1915 and 1916. They pioneered the decentralization of command to the lowest levels, with leaders of platoons and squads being given independent responsibility on the battlefield. They also helped create a platoon capable of independent fire and manoeuvre, by breaking this unit down into squads with different functions (for example, support squads armed with machine guns and attacking squads armed with small arms and hand grenades).[51]

The development of these units represented important tactical innovation. While initially they were specialist units, the successes of these *Sturmabteilungen* convinced the high command that their methods and organization should be shared throughout the army. The process of sharing these innovations began in May 1916. The Chief of the General Staff at that time, Erich von Falkenhayn, ordered Sturmabteilung Rohr to function as a training organization and disseminate its knowledge throughout the German forces.[52] He required each army to send 'two experienced officers (captains or senior lieutenants) and four non-commissioned officers' for a 14-day course run by Sturmabteilung Rohr.[53] These six men were to use the knowledge gained on the course to establish further courses in their own armies to train more in these new methods. Falkenhayn ordered that the process continue until each division had formed its own *Sturmabteilung*, which would then take over the dual role of providing a specialist formation for difficult attacks as well as functioning as a unit to train the ordinary infantry in new tactical methods.[54] This process was extended in early 1917, when *Sturmabteilungen* were

[49] These tactics are sometimes referred to as 'infiltration tactics' or, erroneously, 'Hutier tactics'. See Lazlos Alfoldi, 'The Hutier legend', *Parameters: Journal of the US Army War College* 5: 2, 1976, pp. 69–74.

[50] Helmuth Gruss, *Aufbau und Verwendung der deutschen Sturmbataillonen im Weltkrieg* (Berlin: Junker & Dünnhaupt, 1938), pp. 13–35.

[51] Of course, this is not to say that similar tactical development did not occur in the British army. However, this development was more fitful than in the German army. See Griffith, *Battle tactics*, pp. 65–100.

[52] Chef des Generalstabes des Feldheeres, Nr 279590p., 'Sonderausbildung von Sturmabteilungen', 15 May 1916, Bayerisches Hauptstaatsarchiv—Kriegsarchiv, Munich (HStA-KA), III.b.AK/54. This process can be followed in the XIII. Armeekorps, which on 23 June 1916 ordered its three divisions (26th, 27th and 117th Infantry Divisions) each to send one officer and three non-commissioned officers to be instructed by the team who had been sent to Sturmabteilung Rohr. See Generalkommando XIII. Armeekorps, Ia Nr 6702, 23 June 1916, HStA, Stuttgart, M33/2 Bü300.

[53] For an account of this course, see 'Bericht von Hauptmann Kretzer (K.B.19 Inf. Regt.) über die Erfahrungen beim Sturm-Bataillon der 5. Armee', 15 June 1916, in HStA-KA, III.b.AK/54.

[54] Gudmundsson, *Stormtroop tactics*, pp. 50–51; Gruss, *Sturmbataillonen*, pp. 35–40.

officially formed in each army to serve as continuous training and experimentation units.[55]

In effect, the German high command established an efficient knowledge-sharing system by 'teaching the teachers'. The training units played an important role in sharing the most recent knowledge of front-line tactical experience down to the lowest levels across the army. With fewer than 100 small-unit leaders attending each two-week course, large numbers could go through the training quickly.[56] In addition, the work of these units fed into the construction of a new small-unit tactical doctrine that formalized the developments of the *Sturmabteilungen*. In late 1916 a group of experienced but relatively junior officers met to rework the army's basic infantry doctrine, the *Exerzier-Reglement für die Infanterie*, which had last been fully updated in 1906.[57] Captain Willy Rohr, commander of Sturmabteilung Rohr, was one of the 24 men gathered to perform this task and was responsible for a number of key sections of the new document.[58] By January 1917 the team had compiled a new doctrine that served as the basis for all subsequent recruit training.[59]

Development did not end with the publication of the new doctrinal manuals. The German high command continued to make use of the feedback mechanisms in place—lessons-learned reports, trials conducted at the new schools, continued tactical experimentation—to adapt its doctrine and to transfer the most up-to-date knowledge across the army. Indeed, this feedback loop is evident in the updating of the army's formal doctrine. The *Grundsätze für die Führung in der Abwehrschlacht im Stellungskrieg* was revised and reissued in March and September 1917 and again in September 1918. *Ausbildungsvorschrift für die Fußtruppen im Kriege* was also revised and reissued in January 1918.[60] Throughout the war, the German army encouraged open debate and discussion of its tactical methods. Enshrining these debates in its formal learning processes, the German army was able to make effective use of the new knowledge and innovations created at the front.

[55] For example, see Armee-Oberkommando 6, Ia Nr. 76899, 'Besondere Anordungen zur Errichtung der Sturmlehrabteilung der 6.Armee', 14 November 1916, HStA-KA, AOK6/21; Gudmundsson, *Stormtroop tactics*, pp. 77–89.

[56] An example of the courses can be found in Armee-Oberkommando 6, IIc Nr 85875, 'Lehrkurse beim bayer. Sturmbatl. 6', 11 Jan. 1917, HStA-KA, AOK6/21.

[57] Prussian Kriegsministerium, *DVE Nr 130: Exerzier-Reglement für die Infanterie* (Berlin: Mittler, 1906).

[58] See 'Liste der Bearbeiter der Ausbildungs-Vorschrift für die Infanterie', in BA/MA, PH3/28. The group was directed by the Chief of Staff of the Third Army, Colonel von Oldershausen, and consisted of two colonels, three lieutenant-colonels, six majors and 13 captains. This contrasted greatly with the commission assembled to write the 1906 regulations, which was composed of very senior generals. See Eric Dorn Brose, *The Kaiser's army: the politics of military technology in Germany during the machine age, 1870–1918* (Oxford: Oxford University Press, 2001), pp. 153–5. Cf. also the British approach to doctrine writing: Jim Beach, 'Issued by the general staff: doctrine writing at British GHQ, 1917–1918', *War in History* 19: 4, 2012, pp. 464–91.

[59] *Ausbildungsvorschrift für die Fußtruppen im Kriege (AVF)* (Berlin: Reichsdruckerei, 1917). This important document has been largely overlooked by historians. For a brief analysis, see Anthony King, *The combat soldier: infantry tactics and cohesion in the twentieth and twenty-first centuries* (Oxford: Oxford University Press, 2013), pp. 133–5. The actual manual appears to have been written by General der Infanterie Hermann von François, famous from the battle of Tannenberg (Aug. 1914). See Hermann von François, *Der deutsche Kronprinz: Der Soldat und Heerführer* (Leipzig: Max Koch, 1926), p. 172.

[60] For how this was done in practice, see Robert T. Foley, 'The other side of the wire: the German army in 1917', in Peter Dennis and Jeffrey Grey, eds, *1917: tactics, training and technology* (Canberra: Australian Military History Publications, 2007), pp. 155–78.

Non-formal learning during the war

If the highly professional German army excelled at making use of formal methods of organizational learning during the war, the opposite was true for the more amateur British army. Lacking a strong central organization, the British army initially had no structure in place for collecting and disseminating new knowledge throughout its organization. While it did strengthen its formal learning processes as the war progressed, it made extensive and very effective use of other, non-formal methods of learning throughout the war. It is unsurprising that an organization in which personal connections were so central to its functioning should rely on similar methods for learning. Again, two examples show how this style of learning operated in the British army. The first example is what was probably the most important technological innovation to emerge from the First World War—the development of the tank. If anything proves the veracity of the expression 'success had many fathers', it is the tank. The interwar period saw a bitter battle over its paternity, with many claiming its invention.[61] The difficulty of reaching a conclusion is indicative of the non-formal learning process by which the tank was developed.

Of course, the idea of an armoured fighting vehicle was not new in the First World War. Indeed, none other than Leonardo da Vinci had toyed with the idea of creating an armoured chariot in the 1480s.[62] More recently, the British science-fiction writer H. G. Wells had published a short story entitled 'The land ironclads' about a future war in which armoured fighting vehicles dominated combat.[63] More practically, the Royal Navy had made considerable use of armoured cars since the beginning of the war.[64]

However, the combination of enough armour to protect the vehicle and its occupants from small-arms fire with adequate firepower and the mobility to cross the challenging terrain of the First World War battlefield was in all likelihood first conceived by Ernest D. Swinton in October–November 1914. At the time, Swinton was serving as an official war correspondent on the Western Front. From 1910 to 1914, however, he had served on the Committee of Imperial Defence. Observing the growing deadlock on the Western Front, Swinton remembered a communication he had had about the possibility of using the caterpillar track system developed by the Holt Company for military purposes. This system offered the prospect of allowing a heavily armoured vehicle to traverse broken ground. On a visit to London on 20 October 1914, Swinton mentioned this to his former superior at the Committee of Imperial Defence, Colonel Maurice Hankey, who was then functioning as secretary to the War Cabinet. The next day, Swinton

[61] Indeed, in 1919 a royal commission was established to answer this question: J. P. Harris, *Men, ideas and tanks: British military thought and armoured forces, 1903–1939* (Manchester: Manchester University Press, 1995), pp. 39–40. Harris provides the most coherent account of the early development of tanks, which serves as the basis for much of the following.

[62] Clough Williams-Ellis and A. Williams-Ellis, *The Tank Corps* (London: Country Life, 1919), p. 6; B. H. Liddell Hart, *The tanks: the history of the Royal Tank Regiment*, vol. 1: *1914–1919* (London: Cassell, 1959), pp. 4–14.

[63] H. G. Wells, 'The land ironclads', *Strand Magazine*, no. 26, Dec. 1903, pp. 751–64.

[64] Liddell Hart, *The tanks*, pp. 18–21.

and Hankey were joined by Captain T. G. Tulloch, who as an employee of an automotive company before the war had also come up with plans for an armoured fighting vehicle. Hankey was impressed with the ideas generated in these discussions and included them in a lengthy memorandum on the war submitted to the War Cabinet at the end of 1914.[65]

The ideas generated by Swinton, Hankey and Tulloch mirrored those coming out of a section of the Admiralty set up by its First Lord, Winston Churchill. In the open warfare of 1914, the Royal Naval Air Service (RNAS) began using automobiles armed with machine guns to provide protection for forward airfields. The units quickly began experimenting with armour for these automobiles. The experience encouraged Churchill to establish an RNAS Armoured Car Division in late 1914, and by early 1915 it had some 70 armoured cars based at Dunkirk. Churchill also asked the RNAS to develop a means by which the barbed wire and trenches of the Western Front could be overcome, and the Admiralty Air Department began its own experimentation with caterpillar-tracked vehicles in early 1915. The initial ideas convinced Churchill that the project should be extended and funded; and so, in late February, he established a 'Landship Committee'.[66] None of the committee members had experience of combat. Indeed, the committee had little connection with the War Office, let alone with the BEF in France. When three of its members visited France in March 1915 in an attempt to see conditions at the front, they were unceremoniously turned away, as they lacked any authority to be there. Nor did any of the original committee members have any knowledge of automobile or tractor design; however, to their credit, they soon brought in additional members who did, and, after developing some basic ideas, contracted two automotive firms to produce prototypes.[67]

The Landship Committee stumbled along until mid-1915. At this point, Swinton again came into the picture. In June, he had written a lengthy memorandum on armoured vehicles, which he submitted to the commander-in-chief of the BEF, Sir John French. French was impressed enough to forward Swinton's memorandum to the War Office with his recommendation that the ideas be followed up.[68] This finally got the War Office's attention, and shortly thereafter the Landship Committee was reconstituted as a joint Admiralty–War Office endeavour. From here, progress was quite rapid. Experiments conducted by the Lincoln Works developed a working track system by September 1915. This system was combined with a rhomboid shape in January 1916, and the new design proved capable of meeting the performance requirements demanded by the army. The War Office recognized the possibilities of this new, albeit still primitive, weapons system and

[65] Ernest Swinton, *Eyewitness* (London: Hodder & Stoughton, 1932), pp. 81–4; Lord Hankey, *The Supreme Command 1914–1918*, 2 vols (London: Allen & Unwin, 1961), vol. 1, pp. 244–55.

[66] Initially, the committee comprised Mr Tennyson d'Eycourt (director of naval construction), Colonel W. C. Dumble (a former manager of the London Omnibus Company), Squadron Leader T. G. Hetherington (who had been transport officer for the RNAS Armoured Car Division) and Mr Dale Busell (representing the Admiralty director of contracts). See Winston Churchill, *World crisis 1915* (London: Thornton Butterworth, 1923), pp. 74–81.

[67] Harris, *Men, ideas and tanks*, pp. 21–5.

[68] Swinton, *Eyewitness*, pp. 146–51.

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quickly placed an order for 100 machines, in the hope that these would contribute to the 'war-winning' offensive being planned for summer 1916.[69]

That this innovative new weapons system did not live up to expectations when first employed in September 1916 should not detract from its long-term importance.[70] The introduction and subsequent development of tanks led to significant changes in how wars on land would be conducted.[71] The initial development process, though, tells us quite a lot about learning in the British army during the First World War. Here we see the real strengths of the British army's organizational culture. Ernest Swinton did not hold a position within the hierarchy of the BEF in France, but his experience as an official war correspondent showed him the tactical challenges facing British troops on the Western Front. Swinton combined this information with knowledge of vehicles capable of crossing the broken and blocked terrain of the front to come up with an idea for an armoured vehicle capable of dealing with the enemy defences. He then made use of his personal connections with the secretary of the War Cabinet to feed his ideas into the system. Swinton's concepts coincided with similar ideas being formed by Winston Churchill. Again, as First Lord of the Admiralty Churchill stood outside the army, but he made use of his personal authority to begin developing an armoured vehicle completely independently of the War Office. Indeed, the army was initially uninterested in the concept of the tank and refused to take part. Once it became clear that the war would not come to an end in 1915 and that the tactical problems of the Western Front were proving beyond the capabilities of conventional tactics, the War Office and the BEF became involved—but only once the development process was well advanced. Thus, without personal connections and patronage at the highest levels of government, the tank probably would never have seen the light of day.

The second example of learning in the British army again demonstrates the importance of personal connections and the readiness to make use of expertise and knowledge from outside the organization. In July 1916 the BEF launched its largest offensive of the war to date. Sir Henry Rawlinson's Fourth Army attacked astride the Somme River alongside the French Sixth Army. Although there is some dispute about the goals of the offensive, there is no doubt that it was intended to be a battle of materiel from the start.[72] Indeed, the BEF had increased considerably in size and equipment to make this type of battle possible, growing from five divisions at the beginning of August 1914 to 55 divisions in France by early July 1916. Moreover, it had added enormously to its artillery, with 1,437 guns at the beginning of the battle of the Somme compared to the 324 it had

[69] David J. Childs, *A peripheral weapon? The production and employment of British tanks in the First World War* (Westport, CT: Greenwood, 1999), p. 4; Harris, *Men, ideas and tanks*, pp. 31–3.

[70] On the use of tanks in the battle of the Somme, see Williams-Ellis and Williams-Ellis, *The Tank Corps*, pp. 24–34; Trevor Pidgeon, *Tanks on the Somme: from Morval to Beaumont Hamel* (Barnsley: Pen & Sword, 2010).

[71] For a critical view of the significance of the tank in the war, see Tim Travers, *How the war was won: command and technology in the British army on the Western Front, 1917–1918* (London: Routledge, 1992).

[72] Robin Prior and Trevor Wilson, *The Somme* (London: Yale University Press, 2005), pp. 35–69; William Philpott, *Bloody victory: the sacrifice on the Somme and the making of the twentieth century* (London: Little, Brown, 2009), pp. 88–130.

had in 1914.[73] On the first day of the offensive, 100,000 British infantrymen from 26 divisions attacked their German opponents. The offensive soon settled down into a long-drawn-out attritional battle. At its height, the British army needed to provide some 300,000 troops at the front line with water, food, clothing and ammunition, as well as keeping 1,500 artillery pieces and 150,000 animals supplied. On top of this, wounded troops needed to be evacuated, and units moved in and out of the battle zone.[74]

Unfortunately for the BEF, its logistical system was nowhere near sufficient to deal with the strains of such a prolonged battle of materiel. Built up slowly and in an ad hoc manner over 1914 and 1915, the railways and roads, along with the vehicles that travelled them and the men that maintained them, sufficed for only a much smaller army, with a much lower expenditure of munitions and supplies.[75] Supply bottlenecks and outright failures severely limited what the attacking British troops could do as the battle wore on and, indeed, threatened to undermine the entire offensive. As Ian Brown has noted, by the battle of the Somme 'the BEF had neither a coherent light railway organization, doctrine, nor more importantly, a centralized transportation authority or coordinating body. Transportation remained an essentially ad hoc construct based on the old *Field Service Regulations, Part II* (1912) and had ceased to be equal to the task.'[76] Moreover, the BEF lacked the necessary knowledge to create a supply organization capable of meeting the requirements existing in 1916. The organization's few trained staff officers were desperately needed within combat units to keep these functioning properly, and even if more staff officers had been available, their prewar training would not have prepared them adequately to build the massive logistical system required by modern battles of materiel.[77]

Once again, the British army turned to an outsider with the requisite knowledge and experience to meet its needs and to transform its logistical organization. Aware of the supply difficulties facing the BEF, David Lloyd George, at the time Secretary of State for War, sent Sir Eric Geddes to France to formulate a view on what could be done to solve the growing problem. Geddes was one of the group of businessmen Lloyd George had brought into government to help with industrial policy, and the War Secretary believed that the knowledge Geddes had gained as a railway manager with considerable experience in Britain and India would be useful in addressing the supply issues now facing the army.[78] In summer 1916 Geddes travelled to France to see the situation for himself. Sir Douglas Haig, who had succeeded French as commander-in-chief of the BEF, was so impressed with the visitor and so afraid of the implications of the logistical problems besetting

[73] James E. Edmonds, *History of the Great War: military operations France and Belgium, 1916*, vol. 1: *Sir Douglas Haig's command to the 1st July: battle of the Somme* (London: Macmillan, 1932), pp. 300–304.
[74] A. M. Henniker, *History of the Great War: transportation on the Western Front, 1914–1918* (London: HMSO, 1937), pp. 119–46.
[75] Ian M. Brown, *British logistics on the Western Front, 1914–1919* (Westport, CT: Praeger, 1998), pp. 75–108.
[76] Brown, *British logistics*, p. 140; also Sheffield, *The chief*, pp. 149–50.
[77] On the deficiencies of the staff officers, see Robbins, *British generalship*, pp. 34–50.
[78] On Geddes's life and career, see Keith Grieves, *Sir Eric Geddes: business and government in war and peace* (Manchester: Manchester University Press, 1989).

his forces that he requested Geddes be seconded to General Headquarters as director-general of transportation in France. Lloyd George and Geddes agreed, and Geddes was given the temporary rank of major-general and a remit to sort out the BEF's supply system.[79] Over the next few months, Geddes and his small staff of personnel, brought to France from his company, the North Eastern Railway, transformed the BEF's logistics and laid the foundations of a system that could support the offensives of the coming years.

To begin, Geddes expanded drastically the physical infrastructure of the BEF's supply network and added to its supply capability. Shortly after taking over, he placed orders in Britain for 1,200 miles of railway track, 7,000 wagons and 61 shunting locomotives. He also set in place the massive expansion of the Railway Operating Division of the BEF. This organization expanded from 675 personnel and 59 locomotives in 1916 to 18,500 personnel and 1,486 locomotives by the end of the war.[80] In addition to improving the BEF's physical supply infrastructure—road, railways, ports—in the relatively short time he was director-general of transportation, Geddes introduced doctrinal innovations to the BEF's supply process. Prior to his arrival, the fighting BEF had largely been living from hand to mouth. The amount of supplies they could use, particularly artillery munitions, was heavily regulated by the Quartermaster-General. Geddes turned this situation on its head. Making use of the type of statistical forecasting that was a commonplace in civilian transportation, he worked closely with the BEF's operational planners to look forward to determine what the combat troops' needs were likely to be and adjusted supply to meet these predicted needs. Moreover, again using his knowledge from business, Geddes helped unify the disparate collection of bodies that had grown up with responsibility for aspects of the supply network and simplified the organization. On becoming director-general of transportation, he brought the directorates of railways and inland water transport, transportation, light railways and roads, and docks together under the direction of one man and his staff. Additionally, he developed a close working relationship with the Quartermaster-General at General Headquarters and the holder of the newly created post of General Officer, Lines of Communication Area. By the time Geddes left his post in May 1917, the entire logistical structure of the BEF had been revolutionized, permitting it to fight the great battles of materiel in 1917 and even make the return to mobility in 1918 without fear of running out of critical supplies.[81]

Once again, Geddes's appointment and his accomplishments were attributable to the organizational culture of the British army. With the existing system on the verge of collapse in the summer of 1916, both Lloyd George and Haig recognized that the British army lacked the knowledge required to solve the problems confronting it. The two men had the foresight to look outside the organization to find people who did have the requisite expertise. With years of experience organizing a major British rail firm, Geddes was the right man for the job. In the

[79] David Lloyd George, *War memoirs*, 6 vols (London: Ivor Nicolson & Watson, 1933–6), vol. 2, pp. 789–801.
[80] Henniker, *History of the Great War: transportation*, pp. 167–73.
[81] Henniker, *History of the Great War: transportation*, pp. 190–226; Brown, *British logistics*, pp. 139–78; Grieves, *Sir Eric Geddes*, pp. 27–39.

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face of sometimes considerable resistance from within the BEF, he was able to make changes in the way in which the army's logistical system operated on the basis of his business knowledge. Knowing that he had powerful patrons—Lloyd George and Haig—sped up the process of transformation Geddes introduced and ensured that his ideas would be taken seriously by the old guard within the BEF.

Conclusion

While both the British and the German armies undoubtedly made use of formal and non-formal learning processes to deal with the challenges of the First World War battlefield, it is clear that their very different cultures shaped how they learned during the war. That organizational learning should be driven by organizational culture should come as no surprise. With a well-organized general staff, the German army during the war was able to capitalize on its strong prewar culture of questioning and learning, in the way demonstrated by the examples outlined above. The general staff was able to make effective use of incremental low-level adaptation to innovate on a larger scale. Mandatory lessons-learned reports transferred the most up-to-date knowledge quickly to other units and ultimately to the high command. From hundreds of such reports, trends in adaptation could be easily discerned and combined to develop more effective tactics.

German examples demonstrate both horizontal innovation and bottom-up innovation. The higher-level defensive doctrine that took shape during the battle of the Somme reflected the ability of the organization to transfer knowledge quickly and effectively across the army with little intervention from the German high command. A similar process of knowledge management can be seen in the dissemination of offensive tactics. Here the successes of a small, experimental unit were recognized clearly by the German high command, which used this same unit to 'teach the teachers' and thereby developed a highly effective means of sharing this knowledge rapidly across the army. Adaptation and innovation did not end here; these same mechanisms were used to share new knowledge throughout the army over the course of the war. The German high command deliberately constructed feedback loops to ensure that the most useful knowledge was shared and learned, while out-of-date tactics were discarded.

Despite these successes, the culture of the German army made it very unlikely that it would develop something like the tank.[82] It had a strong core of professional knowledge into which the tank did not readily fit.[83] Indeed, it is a tribute to the flexibility of the culture of the British army that it was able to develop this crucial innovation, however long it took. The development of the tank shows what could be accomplished by making use of personal networks both outside and within the organization to create and share new knowledge. A classic case

[82] Although the German army did make use of an outside innovation in the form of gas, this required much less investment of resources and could be relatively easily fitted into tactical doctrine. See Max Schwarte, *Die Technik im Weltkriege* (Berlin: Mittler, 1920), pp. 272–304; L. F. Haber, *The poisonous cloud: chemical warfare in the First World War* (Oxford: Clarendon, 1986), pp. 22–40.

[83] Ralf Raths, 'German tank production and armoured warfare, 1916–18', *War and Society* 30: 1, 2011, pp. 24–47.

of top-down innovation, the tank would never have been developed without the involvement of highly placed patrons, most notably Winston Churchill. Indeed, while the tank is perhaps the most prominent instance of the technological innovation that occurred in the British army during the war, there are other important examples, including the highly successful Stokes mortar, radios fitted to aircraft, and microphones for sound ranging of enemy artillery.[84]

Similar attributes mark the other example of innovation within the BEF examined above. Again, personal connections and patronage were essential prerequisites for doctrinal and organizational change in the logistical processes of the BEF. Haig recognized that the organization lacked the knowledge required to solve its supply problems in 1916 and grasped at the offer of help from an outsider.[85] The patronage of Lloyd George ensured Geddes's appointment to the post of director-general of transportation, and Haig's patronage enabled Geddes to introduce into the BEF civilian practices that transformed it organizationally and doctrinally. These innovations ensured that supply ceased to be a limiting factor in BEF operations from early 1917.

The case-studies presented here demonstrate the respective strengths and weaknesses of formal and non-formal approaches to learning in wartime. The formal methods employed by the German army helped ensure the rapid transfer of knowledge throughout the organization. However, the strong centralization of learning this entailed reduced the likelihood of the German army's making use of knowledge from outside the organization. The British army, on the other hand, was well placed to take advantage of ideas and expertise from outside its ranks. Indeed, lacking a deep pool of highly trained staff officers, the British army often had to look externally for civilian expertise to make good its deficiencies. Moreover, a system built on personal connections and patronage enabled innovation, ensuring that radical ideas and far-reaching changes would be considered, if not always welcomed. It is therefore unsurprising that technology played a prominent role in British innovation during the war, while German innovation tended to focus on tactical developments.

We can see here how non-formal approaches to learning favour radical solutions, while formal approaches make more effective use of existing systems. The case-studies presented here also show an element that is often lacking from existing studies on military innovation—the link between organizational culture and the way in which an organization adapts and innovates. The centralized learning processes employed by the German army during the war encouraged horizontal and bottom-up innovation, while the non-formal approaches employed by the

[84] Shelford Bidwell and Dominick Graham, *Firepower: British army weapons and theories of war, 1904–1945* (London: Allen & Unwin, 1982); Guy Hartcup, *The war of invention: scientific developments, 1914–1918* (London: Brassey's, 1988); Griffith, *Battle tactics*, pp. 48–79; Robin Prior and Trevor Wilson, 'Conflict, technology and the impact of industrialization: the Great War, 1914–1918', *Journal of Strategic Studies* 24: 3, 2001, pp. 128–57.

[85] With a strong railway section in the German general staff before the war, the German high command contained enough expertise within its organization to deal with the logistical challenges of the war. Also, the war brought large numbers of civilian transportation experts into the army hierarchy. See Wilhelm Groener, 'Über Feldeisenbahnwesen', *Preußische Jahrbücher* 210: 3, 1927, pp. 273–88; Adolph Sarter, *Die deutschen Eisenbahnen im Kriege* (Stuttgart: Deutsche Verlags-Anstalt, 1930).

British favoured top-down innovation. Both approaches ensured that the British and German armies of 1918 bore very little organizational or doctrinal resemblance to those of 1914. Whatever the approach or approaches taken, the 'lions' of First World War battles were hardly led by 'donkeys'.

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