Lessons for modern manufacturing and supply from the Great War

This item was submitted to Loughborough University’s Institutional Repository by an author.


Additional Information:

- This paper was presented at the 9th International Conference on Manufacturing Research (ICMR 2011). Glasgow, 6th-8th September 2011.

Metadata Record: [https://dspace.lboro.ac.uk/2134/33548](https://dspace.lboro.ac.uk/2134/33548)

Version: Accepted for publication

Publisher: ICMR (© the authors)

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: [https://creativecommons.org/licenses/by-nc-nd/4.0/](https://creativecommons.org/licenses/by-nc-nd/4.0/)

Please cite the published version.
LESSONS FOR MODERN MANUFACTURING AND SUPPLY FROM THE GREAT WAR

Wayne Osborne
Keith Case

Mechanical and Manufacturing Engineering
Loughborough University
Loughborough
Leics, LE11 3TU, UK
W.D.Osborne@lboro.ac.uk
K.Case@lboro.ac.uk

ABSTRACT

The primary source research is going to be based upon the examination of war diaries and personal papers with reference to three specimen battles, or perhaps rather campaigns, during the Great War. Loos, in September 1915, Arras in April – May 1917 and The 100 Days between August and November 1918. The engagements are to be looked at with reference to manufacturing output and supply. Quite simply how did the availability and delivery of supplies affect the outcome of these battles in their attempt to solve the crisis of the war? Was anything learned and implemented by manufacturing and supply after each battle?. The Great War has a huge amount to tell us, it contains many lessons for the future. How the British nation managed to go from an inability to manufacture all of its military requirements in 1914 to manufacturing and supplying so much later in the war that the material losses of March/April 1918 were absorbed and recouped and how the mobile war of August to November 1918, the 100 Days, was maintained and supplied is worth examining.

1 INTRODUCTION

The old cliché is true, when Britain declared a state of war with Germany on 4 August 1914, most people really did think that it was going to be over by Christmas and there was no reason for many to doubt that. All wars since the Napoleonic Wars had been short and fought on distant shores. British power rested in the Royal Navy, not the thinly spread, small army that served more as a police force than an instrument of war. Because of events and current thinking in the early years of the young century it was in the Royal Navy that research and development was carried out. In the light of what happened in the Great War it was a blind alley. Steel leviathans would not win the war; infantrymen fighting in the mud would; supported by rapidly developing aircraft and hitherto unknown weapons.

While money and resources were spent on the navy the army, by contrast, was kept short of money and resources. Even the high explosive shell was considered experimental in 1914 and from Boer War experience shrapnel was the shell of choice. Despite the work being done on naval guns design and procurement of big guns for the army was virtually non-existent. The 18-pounder field gun was in production and would be the mainstay of the Royal Artillery for the war. Little or no work had been done on heavy guns or howitzers. Machine guns were slow to manufacture and arrive at the battalions and even then they were doled out at two per battalion. Hand grenades were experimental and in short supply (HMSO 1922a). Shortly after the war began the need for hand thrown bombs became obvious but the troops were forced to make their own from whatever they could find. There was a reason for this. When it came to war with Germany the British expected that their main contribution to the war would be the navy. The B.E.F would hold the French left flank in what would be a short land war.
When the Great War broke out the world faced its biggest crisis to date and at the outset British manufacturing and supply were unable to cope with the requirements of the B.E.F. Kitchener, realising that the war would last much longer than most did, added to the problems of manufacturing and supply by calling for volunteers for the army. They came and their enthusiasm threatened to swamp the already struggling war effort and cause a crisis of their own. There were no uniforms, weapons, equipment or accommodation for these volunteers and Kitchener was informed at the time that the manufacturing industry could not fulfil their existing orders (Edmonds 19250). A huge industrial and manufacturing effort was required if the war was to be fought and won and it needed to be co-ordinated. There were to be numerous attempts to ramp up output and to create some kind of control but they were all doomed to be inadequate until the Ministry of Munitions was set up in spring, 1915.

2 THE MINISTRY OF MUNITIONS IN THE EARLY DAYS

A cursory look at the manufacture, supply and consumption of 18-pounder ammunition in the first months of the war demonstrates the poor state of ordnance manufacturing and supply to the British Army at that time and highlights the need for something to be done to redress the balance and co-ordinate efforts of manufacturing.

The 18-pounder ‘Quick-Fire’ was the ubiquitous field gun of the British Expeditionary Force. First produced in 1903 the weapon entered service on 3 June 1904. It had been conceived from the artillery experience of the Boer War and the appearance of other Q.F guns on the Continent. Various experimental field guns were produced for testing but none completely fulfilled the required criteria laid down by the army. They all had good points and the new field gun was the product of a collaboration between Armstrong, Whitworth, Vickers and the Ordnance Factory. By the time that the B.E.F embarked for France each division had three brigades of 18-pounders and one of 4.5-inch howitzers (Edmonds 1937). Pulled by a limber and six horses the 18-pounder gun was quick to deploy and in the hands of a good gun crew could fire three rounds a minute.

Those rounds were shrapnel shells, consisting of a hollow body packed with 374 metal balls, a detonation charge and a timer fuse cap. When the shell detonated and the cap blew off the balls exploded from the shell in a cone like a shotgun blast and was effective up to 300 feet from the detonation. Shrapnel was the field gun shell of choice of the British Army having proved effective during the Boer war against troop concentrations. Shrapnel shells were very useful as fire barrages to be laid between friendly and hostile formations. High Explosive or H.E for the field guns was only in the experimental phase in August 1914.

When the Great War stagnated during the race to the sea the opposing forces sought to consolidate their flanks. Trench warfare became the norm and the B.E.F soon realised that shrapnel was no use against earth works, trenches and strong points. The call went out to the War Office for H.E but there was little or none to be had. Even so, if stocks had been available the 18-pounder was not capable of pulverising defences and trenches. That was the job of big howitzers and big guns and there was a dearth of them.

By 31 December it was obvious to all that they were in for the long haul. The war had not ended by Christmas and it was going to go on for some time. In August 1914 the B.E.F had gone to war with ample supplies for the Continental campaign it had planned to fight on the left flank of the French Army, The war's appetite for supplies and munitions had been voracious and stocks were rapidly dwindling. Artillery had become the method of prosecuting the war as well as providing support for the infantry and shells were expended daily. Orders had been placed for shrapnel and H.E with the Ordnance Factory and the ‘Trade’, or the armament contractors approved by the War Office. The ‘Trade’ contractors were Messrs. Firth, Hadfield, Vickers, Armstrong, Watson Laidlaw, Camel Laird, Beardmore, and the Projectile Company. At the outbreak of war a number of private manufacturers did offer their services but their tooling and manpower skill base was considered to be inadequate and their offers were initially declined (HMSO 1922a). Others, used to operating in the private sector found government methods of procurement far too slow and they gave up waiting for contracts.
Figures 1-2 (HMSO 1922a) show orders and actual deliveries of 18-Pounder rounds up to 31 December 1914.

![Graph of 18-Pound Shell Orders & Delivery up to 31.12.14](image)

Of 708,000 complete and incomplete H.E shells ordered from the Ordnance Factory and Trade only 8,992 were delivered.

![Graph of 18-Pound Shell Orders & Delivery up to 31.12.14](image)

Of 6,148,082 complete and incomplete shrapnel shells ordered from the Ordnance Factory, Trade and Dominion factories only 209,105 were delivered. The figures show just how bad things were. Chief of
producers was the Ordnance Factory, which prided itself in craftsman-like work but its output was too low for wartime needs. Certain factories only produced parts for shrapnel rounds not complete rounds. Indeed not all of the approved firms made 18-pounder ammunition and tended to specialise in the production of certain types of shell. Of the ‘Trade’ firms only Vickers, Armstrong, Camel Laird and the Projectile Company produced 18-pounder shrapnel rounds and they also produced other types of ammunition. The lack of H.E is explained by its experimental nature (HMSO 1922a). No one was tooled up for it except for the Ordnance Factory and the vast majority of the munitions workforce was not trained in the processes required for production.

By March 1915 the guns on the Western Front were rationed to a small number of shells per day. The 18-pounders were down to 8 per day and Sir John French called for more but output was low and by April of that year they were down to a miserable 3 shells per day, the big guns were similarly rationed (Edmonds 1927). Operations on the Western Front had to be closed down for want of shells. There was also a shortage of motor lorries to deliver the shells once they arrived in France (Henniker 1937). The crisis of the war was not going to be resolved this way.

It was quite clear after the first months of the war that the system of manufacturing and supply of munitions and war materials that existed was incapable of doing the job. Changes were attempted but it was not until the Ministry of Munitions under the former Chancellor of the Exchequer, David Lloyd George, was formed in the spring of 1915 did major changes begin. The creation of this Ministry gave Britain its very first Minister and backed by very powerful legislation it was probably the most powerful organisation that Britain had ever seen.

The reasoning behind the Ministry of Munitions was that ultimate victory or ultimate defeat depended upon the supply of munitions and war material. It was soon established that it was impossible to place any limit on the financial cost of that production and supply. Very soon after the outbreak of war the War Department and Admiralty were, in the main, freed from Treasury control. As long as expenditure was vitally necessary and in the public interest Treasury sanction was not required. The same freedom was extended to the Ministry of Munitions. The sizes of manufacturing and production programmes were then dictated by the military requirements and not by cost. However, some contractors soon discovered that while high prices charged for small production runs in peacetime were acceptable to the Government high prices for enormous production runs were not acceptable. Under Lloyd George the Ministry of Munitions placed large, long term orders and deliberately over ordered. In the case of the manufacture of big guns and howitzers ordered in 1915, the order was spread over two years with delivery initially expected in 1917. Long-term orders enabled the Ministry of Munitions to induce contractors to undertake extensions to orders which would provide earlier deliveries. Therefore, the Ministry of Munitions had no financial constraints and orders and manufacturing were stimulated by what was required not by cost. In peacetime cost often tempered and modified what was required and indeed delivered. The Ministry of Munitions had an ability to roughly estimate what was required and shape demand.

A distinctive feature of the organisation was the employment of businessmen in key chief executive positions. What became known as the “Business man system” (HMSO 1922b). Previously the Government had only employed these men as advisors. Now the Ministry of Munitions utilised their talents as deputies. The team included; Sir George Gibb, general manager and director of two great railway operations, the North-Eastern Railway and the Underground Railway in London. Mr. George Booth, shipowner and director of the Bank of England. Major-General Percy Girouard, formerly director of military railway traffic in Egypt and South Africa, a former administrator of Nigeria and East Africa and since 1913 a director of Armstrong, Whitworth & Co. Mr. G. H. West of Armstrong Whitworth & Co, director of the firm and shell shop manager, a man with unrivalled knowledge of shell production. Mr. Alfred Herbert head of the heavy machine tool company, Alfred Herbert & Co Ltd, of Coventry. All of these men were used to big schemes and could ‘get things done’. They had already been advising the government but Lloyd George, in the opinion of many civil servants and politicians, breached governmental protocol and tradition when he appointed them to senior Civil Service posts. Lloyd George believed that Civil Service tradition could not stand in the way of the management of the crisis. Girouard became Director-General of Munitions Supply with Booth and West below him as departmental heads. Herbert had
control of machine tools. There were, of course, many more men in this team, one of whom was Sir Eric Campbell-Geddes, who had worked on the Baltimore and Ohio Railroad, U.S.A and the North-Eastern Railway, U.K. He later became a Major-General. The others, some ninety men were, among other jobs, ordnance works men, ship builders, weapons manufacturers, distillers, a designer of public works, and an investments man. A team of experienced civilians were required for what was a civilian task, manufacture and distribution of goods. Government ‘traditions’ were upheld when the Secretariat, Finance and Contracts Departments were concerned. There was, of course, a good number of skilled and competent civil service staff to fill these posts. The Inspection and Design Departments were staffed almost entirely by the military. Another arm of the Ministry was staffed by scientists. Mathematician, Lord John Fletcher Moulton, was made Head of Explosives Supply Department. Physicist, Sir Richard Glazebrook was made Head of the National Physical Laboratory (HMSO 1922b).

3 THE LESSONS

The work so far has begun to generate some raw data and ideas for lessons. Powerful legislation was required. D.O.R.A or the Defence of the Realm Act was a remarkable piece of legislation that had numerous sections and amendments. It literally allowed the Ministry of Munitions and the rest of the Government to do what they wanted. It caused great unease in Parliament as it certainly infringed personal liberty. Military or Government requisitioning of land under D.O.R.A worried many MPs who were landowners (HMSO 1922b). This was one piece of legislation among many.

State Control of industry and materials. Industry and therefore manufacturing had to be centrally controlled if the central goal of victory was to be achieved. Even so central control posed many problems. All manufacturing had to be centrally regulated; even those companies not engaged in major war work. They still had to be able to turn their hand to some kind of minor war work if and when required (HMSO 1922c).

Politicians learned to listen to the ‘experts’ and act upon their advice. Kitchener in his role as a politician did not heed the advice of French or Haig in the lead up to Loos. They told him it would fail for want of trained troops and supplies and they were correct (Edmonds 1928). Do not enter into a program/operation until ready. The British Army was not ready to fight the biggest battle it had ever faced in September 1915 (Edmonds 1928). All agencies had to be ready to try something new and be open to ideas. A distinctive feature of the organisation was the employment of businessmen in key chief executive positions. This became known as the “Business man system” (HMSO 1922b) Previously the Government had only employed these men as advisors. The Ministry of Munitions utilised their talents as well as seeking the experience of engineers, scientists and railwaymen among others.

Mobilisation of the work force. The civilian population and importantly the skilled workers had to be placed where they were needed. Lloyd George believed that the war would only be won if the nation submitted to the sacrifice of personal liberty. The state had to control labour (HMSO 1922b). Support of the population for national projects is vital and government had to learn not to treat the population as idiots. The notion of wholesale industrial compulsion advocated by Lloyd George was an anathema to the British then and it would be today. Therefore, Government ambition and plans had to be modified to take this national attitude into account. Concessions had to be made to the workforce, pay and conditions being central to this (HMSO 1922b). Welfare of the workforce and population to maintain support. The provision of canteens in factories went a good way towards improving the welfare of the workforce. The canteens ensured that the workers on all shifts ate well. Some canteens also provide gyms, baths, and classrooms as well as food. Legislation, the Munitions of War Act 1916 and Miscellaneous Provisions Act 1916, was used to force the employers to provide decent canteen facilities for the health and well being of their workforces (HMSO 1922d).

4 CONCLUSION

Under Lloyd George these businessmen and ‘experts’ were allowed a free rein and could do business by personal interview. While a useful situation this also caused trouble between departments as the men
often, and quite naturally, put their own departments first, ahead of the greater good of the Ministry of Munitions. To begin with all that mattered was the swift production and supply of munitions but as the manpower pool and the source of materials dwindled a check had to be placed upon the deputies activities. In essence, in the early days, 1915, it was actually impossible for a department to over produce. As time went on it became necessary to be aware of the needs of other departments, all ordering equally important products. During the latter days, the word “Co-ordinate” became almost an obsession within the Ministry of Munitions. Even so, in the spring of 1915, the Ministry of Munitions was not going to turn things around instantaneously and in September of 1915, the British Army had to fight the biggest battle that it had ever been involved in at Loos.

Fought for political reasons and at the behest of Britain’s senior ally, the French, fought against the advice of the top military men, Sir John French and Sir Douglas Haig, both of whom argued with the Secretary of State for War, Lord Kitchener, that it would be costly in manpower and the big guns and ammunition required for an operation of this size were sadly lacking. The Battle of Loos was almost a great victory and the fact that it impressed the French and made the Germans sit up and take note of the British could not disguise the face that it was a poor defeat. Loos was a defeat for more reasons than Sir John’s poor handling of reserves, the men who had to implement the operation had been correct, a lack of guns, ammunition and even hand grenades had contributed to the failure of a big attempt to solve the crisis of the Great War. The Ministry of Munitions had a crack management team but they needed time to ramp up manufacturing and give the military what it required to win the war.

ACKNOWLEDGMENTS

This work is a progression from the Masters work undertaken in the Centre of First World War Studies at the University of Birmingham under Dr. John M. Bourne, Professor Peter Simkins and Professor Gary Sheffield.

REFERENCES