To what extent did military and technological advances during the interwar and war period affect the outcome of the Second World War?

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Throughout history some of the greatest advancements have been achieved through war, it is this paradox that has led to this study being undertaken. The idea that from such a destructive force we gain some of mans greatest achievements is a curiosity. This study focuses on the advances made in technological warfare during the Second World War. It also examines the affects these advances had on the war and its outcome. This study will judge the effectiveness of various advances and how they might have influenced the outcome of the war. This study has only managed to briefly touch upon some of the more important aspects of advancement but aims to cover five key areas, these are; military, aviation, naval, communication and detection, and finally secret weapons. In this study the affect of jet planes, tanks, radar, sonar and nuclear power among many more will be discussed.

Keywords: Second World War; Technology; Military advancement; Weapons

The purpose of this essay is to investigate the numerous technological advances that happened in the period of the 1930’s to the 1940’s, and how far they affected the outcome of the Second World War. I hope to show the reader the importance that the advances had on individual countries, the war effort, and how these developments continued to affect people across the globe. I will be covering a large area of development, covering technological advances, including the army, aviation, naval, communication and detection, and the use of ‘secret weapons’. A large amount of development was already taking place in the interwar period, often due to the hard learned lessons of the First World War, or the aggressive stance taken by the future axis powers, already re-arming themselves in preparation for invasion. This ever increasing development of technology and science continued right up to the end of the Second World War. When world leaders were bracing themselves for the inevitable storm arising from central Europe and the Far East, they believed that the forthcoming war was going to be another stagnant war of attrition, similar to that of the trench warfare of the First World War. How wrong they were! If they knew that the Germans had been developing, first in secret and then openly, their war machine since 1933, or that Poland and France would fall in just over a month, regardless of the fact that France was thought to have the most advanced army in the world, the allied leaders might have been more inclined to prepare or invest in new ideas and technologies. For example when Sir Frank Whittle proposed his ‘jet engine’ plane, he was
‘dismissed by the Aeronautical committee of the RAF, because of a lack of funding, and on the grounds that it was not considered traditional’ (Boyne 2005, p.135).

It is often said that weapons are a means to make war, and it is understandable why people see the invention of new weapons to show military advance, and therefore, changing history. However, it is much more complex, due to the nature of military advances; the term ‘invention’ can be misused. Many inventions are simply re-inventions of previous ideas, such as the flamethrower, which initially was invented around 424 BC but later reinvented in the 1940’s. I will need to consider this when examining the invention and development of the technologies and weapons I am discussing. I will also need to consider the ‘effectiveness’ and potential for these advances, and the way they contributed to the war. I will be taking into account issues such as production, and the tactics which were employed to make these new technologies of value.

How much of an effect these technological advances had on the war, the outcome, and the future is often overlooked. The Second World War is believed to have killed an estimated 50-70 million people worldwide (Bishop and Jordan, 2005), destroyed countries, and cities alike, it placed countries in debt, which is still being paid off today. The world, 65 years later, still talks about the huge losses suffered by all.

But what did we gain? This draws me to the study of war, because it provides some of man’s greatest achievements. This is the paradox of war; from destruction we gain creation. This is an incredible topic to look at in detail, I found myself engulfed in an endless amount of possibilities for this study. Throughout history some of the most rapid times of development, in all areas whether it be science, technology, or medicine has occurred when a war has been taking place. The Second World War is the pinnacle of this paradox. Never before in history has there been such a rapid development. Arguably, this modern day advancement stems from a chain reaction set off by the war. I will be looking at some of these early advancements and seeing how they affected the war, but when reading through some of them it is worth contemplating a world without them now. For example, a world without jet or long distance aircraft, a world without radar? What would that world be like? Everything that has happened is still affecting us.

Firstly I will need to consider the technological advances made. I will integrate into these areas the effects that these advances had during the war, and furthermore how they may have changed the outcome of the war. Then I will have to consider the extent of these effects, did any significantly change the tide of war? Or were they small steps towards the ultimate goal of victory? The last part of my question I need to consider, is that of the chronology, when each advance took effect, and ensuring it is time specific to the 1930’s and 1940’s.

Given the large amount of individual literature on the technological advances that occurred during this period, it is relatively easy to find details about specific planes, tanks, or ships. But there is no complete works on the advances, or of the effect they had on the war. I have been using a range of sources such as books, journals, DVDs and the internet. These have been of great value, with aspects such as interviews on the DVDs and videos providing a good insight to the feel taken by ordinary soldiers. I have also conducted an interview with a war veteran, so will be considering his own opinions in certain aspects of my study.

Military

This section will be looking at the military advances made by the army, and land based fighting. I am limiting myself to a small portion of advances, and how they may have affected
the war; due to the huge scale of advances made during the war I have had to pick a select few of the more decisive elements.

After the First World War countries that were eager to ensure their safety and sovereignty, especially newly formed countries, started to stockpile huge amounts of already outdated weapons. Towards the end of the First World War, the world was beginning to see the potential of a new form of warfare. With the relatively new innovation of the combustion engine, it was thought that there would be a way of providing transport, firepower, and protection on the battlefield. This became known as the tank. There were large amounts of research taking place during the interwar period, mainly by Britain and France. At the outbreak of the Second World War, when Germany began its invasion of the low countries and France, the Allies formed up to fight the Germans. “Even though the Germans were outanked, having a mere 2600 tanks, compared to the Allies 3300” G, Marshall (1994). The ensuing battles were easily won by the Germans; part of their success can be attributed to their use of tanks. The British sent in their Matilda tanks, with the French Char B1, against the German Panzer II light tank. The Char B1 was introduced in 1937; it was at the time a powerful tank, notably more powerful than its adversary the Panzer II, but yet the Char B1 failed even to slow the enemy. It suffered from two main problems; firstly it was cumbersome on the battlefield, with a high chance of breakdown, due to its complex build. Its next fault was that they were in the hands of the French, who under Charles De Gaulle used them as an infantry support weapon. This gave the Germans the advantage, for a new age had arrived. They used their superior tactics, and ability of high speed tanks to make a decisive blow to the Allies. The Panzer II may not have been seen as the most advanced in terms of armament, but with superior speed and agility it could easily take down the clumsy Char B1’s. The same fate befell the British Matilda, put into service in 1934, it was slow and lightly armoured, and was soon shown to be obsolete by the Germany Panzer II. Indeed the Matilda was obsolete on the Western front, but it proved itself to be an effective tank in the North Africa campaigns. During my interview with 96 year old David Lee (see appendix A), a tank driver who saw service in North Africa, he told me how the Matilda was very reliable, and seen as a valuable asset to the British. This was the beginning for the modern tank in the Second World War. The Germans had made an incredible advance in Tank warfare already, especially when considering the restrictions the treaty of Versailles placed on them, not allowing production of any tanks. In respect to the Panzer II, it was designed as a tractor to avoid the terms of the treaty, but it still played its part. If it were not for the Panzer II, and other German mechanised units, the Germans would not have been able to use Blitzkrieg to its full potential. This tactic of Blitzkrieg allowed the Germans to take France in 6 weeks and Poland in 5 weeks. Trehwitt (1999, p.22) stated about the Panzer II that ‘the tank formed the backbone of the invasions of Poland and France’ he later went on to say that ‘by the time of the invasion of Russia in 1941, the tank was obsolete apart from that of the role of reconnaissance tank’. This clearly shows the level of advancement in tank warfare; for a tank to become obsolete after 2 years shows how tanks were becoming the new weapon of war, and was set to take its place as a crucial part.

During operation Barbarossa, which commenced on the 22 June 1941, the Russians had been developing their new tank, the T34. The T34 was the result of the Russians developing and embracing foreign ideas. It combined a powerful gun, thick armour, and the mobility to make it an all round good tank. Put into mass production in 1940, it was said by Albert Speer ‘that it gave us a nasty surprise when it appeared on the battle field in 1941’. (1995, p.331). In response to the T34 being introduced, the Germans designed the Panzer V (Panther) to help combat the threat of the T34. It first saw action in 1942, gaining a reputation for being a powerful tank, but it did have a tendency to breakdown due to its complex design. The
Germans also had put their Panzer VI (Tiger) into production, designed as a heavy tank; it outstripped the Russian T34 with ease. The German and Russian tanks’ first major clash was in July 1943, at Kursk. This battle went down in history as the largest tank battle in history, with huge resources used on both sides (see appendix B). The Panther and Tiger tanks were far superior in armament and firepower, but the Russians had one key advantage, numerical superiority. The Russians threw their tanks into the fray, unconcerned by the strength of the German tanks. If the T34s could get in close to the Tigers and Panthers then they were able to penetrate their 4 inch thick amour. Overy (1995, p.210) believes the Germans to be superior, stating that ‘the Panzer armies cut swathe after swathe through the Soviet defences, virtually destroying the Soviet tank and air arm, and brought the soviet union almost to the point of collapse’. Despite this Hitler himself called off the offensive on the 15th July, because of the losses the fourth Panzer army was enduring. To look at this in context, we will need to look at the 12th July, where 800 T34s advanced on the Germans, seeking to close with the heavier Panthers and Tigers who were trying to pick them off from long range. By the end of this one day, the Russians had lost over 300 T34s, compared to less than a hundred German Tanks (Grant 2005, p.307). To sum up, the German tanks were more advanced technically, and therefore could take out large numbers of Russian tanks, with little loss to their own. But in the end the Russians prevailed, due to their numerical strength and use of mass production. The Germans could not utilise mass production of their tanks due to the complexity of their design. During the Russian campaign in August 1941 General Franz Halder, Army Chief of Staff was quoted saying "The Russian colossus...has been underestimated by us...whenever a dozen divisions are destroyed the Russians replace them with another dozen.” In this case I believe that technology provided a huge advantage to the Germans, but this alone could not defeat the Russians. Black (2007, p.190) argues that ‘the technology of the Germans was clearly more advanced, technically better in firepower and armour’ but contrary to this Trewhitt (1999, p.38) believes that ‘the T34 was an advanced tank for its era... with an excellent design’ leading on to state that ‘it is no exaggeration to say that the T34 was the most decisive tank of World War II’. Other authors such as Cambell (1985) and Grant (2005) are also in agreement with Black, and I feel that although the T34 was of huge importance, it was not in any way as advanced as the Tiger and Panther tanks, and that Trewhitt is exaggerating his claim on the T34s ability.

The last point on land warfare I wish to make is that of anti-weapons, such as anti-tank guns. In this modern war, where tanks had become the most important and decisive element of a battle, developers had to create a weapon that troops could use easily to defend themselves from the tank threat. This was identified as a key issue affecting British troops by French (2000, p.87) who later went on to say ‘that infantry needed their own indirect fire weapons so that they could neutralize or destroy enemies without waiting for artillery support’. Black (2007, p.162) states that ‘Anti-weaporny moves in concert with weaponry and the tank was no exception’. In the interwar period, there was a development of high velocity guns that used solid shot in order to penetrate tank armour by kinetic energy. This is where the Allies differed from their German counter-parts because they preferred to use armour and infantry together. Field Marshal Montgomery insisted on co-operation between the two, stating that ‘I cannot emphasize too strongly that victory in battle depends not on armoured action alone, but on the intimate co-operation of all arms; the tank by itself can achieve little’ (cited in Black, 2007, p.163). This was the view held by most Allied leaders, this was backed up by Richard O’Connor, who instructed his commanders to ‘go cautiously with your armour, making sure that any areas from which you could be shot up by panthers and 88s are engaged. Remember what you are doing is not a rush to Paris’ (Cited in Black, 2007, p.163). This quote mentions the use of ‘88s’ which was one of the many variants of anti-tank weapons.
designed by the Germans. It was originally designed as an anti-aircraft weapon, but was 'used with devastating effects as an anti-tank gun, its large high velocity projectiles being able to defeat the heaviest armour' (Campbell, 1985, p.247).

In conclusion tanks and anti-tank weaponry played a crucial part in the Second World War, affecting many key battles, changing the face of war and introducing—a mechanical form of mobility. If it were not for the tank, then it is perfectly plausible that the Second World War would have been similar to the first, a stagnant war of attrition, where no real gain or loss was made with the cost of millions of lives.

Aviation

Blitzkrieg brings me onto the next stage of my study, looking at aviation, its developments, and crucial success. The Germans believed that they alone controlled the skies and quickly set about ensuring this was true; their first targets during their Blitzkrieg were the airfields. The German Blitzkrieg showed a crucial change in how wars were fought; tactical changes had to be made at the beginning of the war which was only able to take effect because of the technological advances. So for example, Blitzkrieg would not have been possible if not for the tanks’ mobility, or the use of aircraft. Tanks and planes were the order of the day; military strategists believed that the combination of both would lead to victory. N. Voznesensky, Chairman of the soviet state planning commission, said in 1940 that ‘... modern imperialist was is a war of engines- engines in the air and engines on the land.’ (Cited in Overy, 1995, p.208). This made direct reference to tanks and the use of planes in war.

Between the two world wars, flying caught the imagination of the world; pilots attempted ever increasing feats, such as longer flying, and faster flying. As for the military aircraft, it was believed that bombers could win wars on their own. But fighters were still seen as important, especially for the interception of bombers and to support ground troops. When the metal frame mono plane fighter was introduced, it became significantly more advanced in speed, agility, and range to that of its 1914-1930 wooden bi-planes. After the First World War, the most advanced planes of the day could fly at a speed of 125mph, by the outbreak of the Second World War, the Germans basic fighter plane, the Messerschmitt BF 109 (also known as ME 109), could achieve a speed of 350mph (Spick, 2004, p.264). During the inter-war period, it was recognised that there was various new threats, due to the advancements in all aeronautical areas. These came in the shape of new bombers, carrying larger bombs, increased speed, and altitude. The Luftwaffe (German air force) developed an effective combat style in keeping with their modern air force; they tried to destroy all enemy planes before they could take off. Even when this was not possible, they easily out manoeuvred, and out gunned their often obsolete opponents. They also developed the Messerschmitt ME110 twin engine, fighter escort, to safe guard their bombers. The drawback of this was that it only had a one hour fuel tank, not allowing time to engage in fighting. Air supremacy was achieved quickly and decisively, except for in one circumstance, the battle of Britain, against the Royal Air Force (RAF). Hermann Goring in June 1940 stated that "My Luftwaffe is invincible...And so now we turn to England. How long will this one last - two, three weeks?" (Cited on WWI.net, 2006) in fact he never took Britain, and his so called 'invincible Luftwaffe' could not defeat the RAF.

One of the reasons for this was it had two aircraft in service that could match the ME109 and ME110. These were the Hawker Hurricane and the Super Marine Spitfire. The Hurricane benefited from better manoeuvrability where as the Spitfire was best at high altitude, and had better speed. The Spitfire became the symbol of British defiance, and spirit, with Churchill
even saying that ‘never in the field of human conflict was so much owed by so many to so few’ (Cited in Cohen and Major, 2004, p.846) this was a tribute to fighter command. This quote is very significant, not just because of Churchill’s recognition to fighter command, but it signals a new age of war. It the battle of Britain was the first conflict that depended on a modern engine of war to fight in relatively small numbers. No longer would the old thoughts of ‘whoever has the most wins’ type of attitude play a part. It was a war of technology now.

Aeronautical theorists of the inter-war period believed that bombing would be the decisive factor in the next war. More important would be the use of strategic bombing, for war plants, factories, industries, docks, and civilian targets. Murray (1999, p.116) believes this to be true, stating that ‘in so far as strategic bombing’s contribution to the eventual victory of Allied forces in the war is concerned, they were right.’ Murray believes that Allied victory was not just in its bombers, but in its versatility, and ability to adapt. The bombing by the Allies could also be considered such a success, on the grounds that it obliterated the Third Reich, by sheer weight. This was achieved through mass production of aircraft, bigger bombers, such as the Lancaster and B29’s, which allowed from bigger and better bombs. This was made possible due to new innovations into the four engine bombers, which outdated the two engine bombers used by Germany. The RAF remained the constant bane to the Luftwaffe throughout the war. The US and Russian air force also had some success and caused great problems for the Luftwaffe, but in different theatres of war. In the case of the Americans, their bombings had a damaging effect on German industry. Hitler was so infuriated that he ordered ‘The British Air Force must be eliminated’ (Cited in Farrington, 2004, p.175) in preparation for his invasion.

In response to this, Richards (1966, p.318) believes that:

‘The 1000 or so pilots of fighter command who bore the brunt of that fighting- including the 400 or more who lost their lives- saved more than Britain by their exertions. By earning Britain a great breathing space in which further progress of events was to bring her the mighty alliance of Russian and the United States, they made possible the final victory, and the liberation of Europe from Nazi terror.’

The next technological advance to enter the Second World War was the jet engine plane. The idea of a jet engine plane had been around since the early 1930’s, when Sir Frank Whittle proposed it to the RAF. His idea was dismissed and the production set back by years. The Germans on the other hand were ever the opportunists; they took full advantage of the jet plane. It produced two main jet planes, the first being the Messerschmitt 163 Komet (Comet), and the second being Arado Ar 234 Blitz. The Comet was designed to become a glider after its 7 minutes of fuel ran out, featured swept-back wings (a major wartime development in itself) and a single rudder plane at rear. It could reach a top speed of 623mph. Although it showed a great achievement in aeronautical advancement it suffered from several major setbacks. Due to its 7 minute fuel limit, and gliding ability thereafter, it had a short range, because it had to glide back to its base. It was also too fast, because of its speed, it could not intercept the bombers which it designed to do. According to Military Factory (2009) the Comet was only credited with the kill of 9 B29 bombers. On a more positive outlook, the Blitz had more of an effect; it was the first purpose built jet bomber. It could play the part of bomber and fighter due to its speed and high velocity cannons. It is worth noting that the British had some success with jet planes, creating the Meteor, while the Russians and Americans created them too late to have any effect on the war.

Although the advances in aviation were vast, only some of them had a direct impact on the war. The 1930’s had an explosion of technological developments, the resulting revolution of technology created new planes, but also a host of technological supports, such as radar, blind
bombing devices, navigation systems, and radio advances. However not all advances had an effect on the war. The jet plane for example, provided no real change to the war effort, despite Hitler believing them to be the saviour of Germany. Weinberg (1994) argues that ‘the whole programme [jet] was largely useless’, Boyne (2005) agrees in part with Weinberg, not thinking it was ‘useless’ but more that it did not have any ‘real’ effect on the war and its outcome. The real success was in the development of ordinary planes, making fighters faster and more manoeuvrable. Ensuring bombers had adequate protection from fighters, giving them the means to carry more and lager bombs over greater distances.

‘If we lose the war in the air, we lose the war, and we lose it quickly.’

Field Marshal Montgomery (Cited in Black, 2007, p.177)

Naval

‘In a naval battle the side having the greater range can open fire at the greater distance... If along with this he has stronger armour... he must necessarily be superior... the faster has only one advantage: to utilize its greater speed for retreating.’

Adolf Hitler (Cited in Speer, 1995, p.324)

This statement almost became redundant during the war; once again the face of war had changed. In 1939 Britain had the grandest navy in the world, and the pride to go with it. Britain and other countries soon realised they faced a problem because naval warfare changed so much that it made all previous weapons and tactics almost useless. Not often was it the biggest ships that won the battles anymore, in fact these capital ships became easy prey soon after the outbreak of the war. A new era had arrived; it came in the form of aircraft carriers. These new ships were able to sit a hundred miles away from where the battle was taking place, safe, while their planes attacked the enemy. This was a hard lesson to learn for many, with the development of sea planes and more advanced ship to air planes, battleships soon suffered. The British found this out quickly, with their Prince of Wales battleship and battle cruiser Repulse being sunk in December 1941 at the hands of the Japanese aircraft carriers.

The Battleship had seen its day, but this does not mean there were no advances made. For example, the Germans produced one of the most powerful ships of the war, the Bismarck which was a constant source of trouble for the British. On several occasions the British organised task forces to hunt down the Bismarck but it could always outrun and outgun its British hunters. It was never clearer than when HMS Hood entered into battle with her. The Bismarck with her newly equipped armour piercing shells, easily tackled the Hood, which took a direct hit from the Bismarck’s broadside; it pieced her hull and exploded her ammunition store. One hit to take down Britain’s biggest and most prized ship, dealt a devastating blow. Britain was set to take revenge, with her new creation, HMS Ark Royal. The Ark Royal set off in pursuit of the Bismarck, and launched her Swordfish planes against her, striking a vital blow with a torpedo to her rudder. This effectively made the Bismarck a sitting target, and was soon destroyed. The commander in chief of the German Navy, Grand Admiral Carl Donitz commented on the 24th May 1943, on the naval air supremacy Britain had over her, stating that ‘Our losses...have reached an intolerable level. The enemy air force played a decisive role in inflicting these high losses.’ (Cited in Lavery, 2006, p.186). The new advances in both ships and planes were beginning to show. The Germans, Italians, and Russians had no carriers which proved fatal in terms of their naval war.
There were two very decisive sea battles that evidently changed the war, both with the use of aircraft carriers as the main ship. The first and essentially most important was that of Pearl harbour, ‘the day of infamy’. This was a surprise attack launched by the Japanese aircraft carrier fleet on an American harbour. The Japanese Zero planes launched from their fleet, wreaked havoc among the battleships, destroyers, and submarines. There is one saving grace to this story, and one reason why the use of aircraft carriers unquestionably changed the outcome of the war. The saving grace for the Americans was that their three aircraft carriers were not in harbour at the time of the attack, for if they would have been, then the Americans would have found themselves near on defenceless. Rose (cited in Cook, 1999, p340) talks about how it was planes from the USS Enterprise (one of the aircraft carriers that was out of harbour on that fateful day) that later destroyed four Japanese carriers at the battle of midway. She then goes on to say that Midway was a ‘decisive battle that changed the course of the whole pacific war’ (Rose, 1999, p.340). The reason why Pearl harbour was such a pivotal point in the war was because the attack led to the direct involvement, and the joining to the war by the USA. It would have been impossible without America, to win the war. They provided money, weapons, technology, and men to aid in the fight against the Axis powers. So it is perfectly logical to say that without the use of the Japanese carriers, America could have stayed out of the war or joined too late, so therefore they had a direct link to the outcome of the war.

The next decisive role played by the aircraft carriers, was at the battle of Midway. This was a decisive battle, where the aircraft carriers were the only real combatants. The two fleets of America and Japan never actually saw each other, due to the range of the aircraft each possessed. This battle ended with a total victory to the Americans, the Japanese suffered the loss of four carriers, two heavy cruisers, three destroyers, 229 aircraft, and 3,500 men. The Americans on the other hand only suffered the loss of one carrier, one destroyer, 150 aircraft, and 307 men (Jorgensen 2007, p.227). This was a resounding victory and affected the entire war. It shifted the balance in favour of the Americans, and the Japanese were never able to recover from their losses, so much so that they never rebuilt their four carriers. Historians such as Jorgensen (2007) and Polmar (2006) argue that his was a severe blow to the Japanese, and that due to the battle of Midway, they had already lost the war in the pacific. Polmar (2006, p.305) states that the ‘events had a profound effect upon the Japanese… defeating them in both new and traditional forms of naval warfare’. It is worth noting that the Japanese still believed that their highly trained navy would win over their American and British counterparts, despite their inferior technology in terms of aircraft carriers. This clearly was not the case.

‘The only thing that frightened me during the war was the U-Boat peril.’

Winston Churchill

This leads me onto my last point in naval warfare, the submarine. Although the submarine played its part in the First World War, it was dramatically improved in the lead up to the Second World War. The submarines development and potential almost changed the outcome of the war in Europe, and certainly changed it in the pacific. Not only did the U-boats of Germany have success in taking out British shipping, they also instilled fear in the British public. As you can see from Churchill’s quotation, even he admitted that he feared them. After my interview with David Lee (see appendix), I realised this was no exaggeration, he told me through how he was loaded onto an overcrowded supply ship in preparation to be transported to Africa. He discussed how the ship had to take them on a ‘zigzag’ path to avoid any possible U-Boat patrols. He retold a story of how one night the crew thought they were
being ‘hunted’ by a U-Boat, he described it as “the most nerve racking experience of the war, and without a doubt the most scarce moment in my life”. The effect that U-boats were having on sailors’ morals, this was due to the new successes the Germans were having, often attributed to new technological advances. Some of the major improvements to their submarines were to fit Schnorchel devices, which allowed the submarine to charge its batteries while under water, and the ability to start and keep the running of a diesel engine, thus leading to less time on the surface, where it was most vulnerable. Most historians can agree that the U-Boat attacks on British supply routes were a crucial factor in nearly defeating Britain. Boyne (2005, p.247) even goes as far to claim that ‘a comparative handful of German submarines came within just months of forcing Britain to her knees’. In contrast to this, historians such as Black (2007) and Walters (1966), have more American based theories of the insignificance of anything outside of the American domain. With Black (2007, p.170) arguing that ‘the most successful submarine campaign during the war was that by the Americans in the pacific, and this became the most victorious one in history’ and then furthering his argument by saying ‘the German campaign was far less successful’. Although the Americans were very successful, it is of total ignorance to suggest it was the only country to have any significant success in their use. Also Germany and Japan, producing the most technologically advanced submarines of the war, showed some success. For example the Japanese I-400 class sub had the ability to launch up to three aircraft from its deck, from a giant catapult, also fitted with a crane to recover them after their mission.

In conclusion, naval supremacy helped define the war, it allowed Britain to survive on her island, and led to the crippling of the Axis powers. Submarines played a very important role in the war, nearly crippling the British, and helping to stop vital supplies to the Japanese. The new era of naval warfare had arrived, utilising key components of speed, mobility, range, and technology to achieve mastery over the oceans. It is clear for all to see that naval superiority was crucial for the victor, and the Allies showed they were willing to diversify and embrace the new age of naval war. With leading technologies, the Allies won the oceans, and inevitably won the war on land, due to the result in the seas.

Communications and detection

I feel it is important to discuss some of the technological advances that were not necessarily designed as weapons of war. Some exciting new technology was born in the war, predominantly out of necessity to defend themselves and others. I will be briefly discussing radar, sonar, coding/decoding, and other means of communication.

Radar gave the Allies a crucial advantage over the Germans, and can be seen as an important contribution to the war effort. The development of radar increased hugely by the Allies during the war, it was vital to detect aircraft and ships alike. Due to the increases in speed and range that we have previously looked at, of bombers in particular, it became necessary for the range and reliability of the radar to advance. Radar was not only used on a land based scale, but in 1938 it became installed on British ships. This would give them a better advantage over enemy aircraft and fleets. The radar was systematically improved according to Black (2007, p.174) such improvements consisted of the sophisticated cavity-magnetron in 1940, which was an essential to the microwave radars development. The most important part played by radar was in the battle of Britain, where it undoubtedly ensured the survival of Britain. This was achievable because it provided the British with an early warning system against German bombings. This intern allowed the RAF to maintain their dominance over Britain, which led to the cancelling of operation Sea Lion (the proposed invasion of Britain). So this leads me to the conclusion that the radar played a key role in determining the war in Europe.
Although Sonar was invented during the First World War, it began to play its part in the Second World War. Although not used widely, it began to be used in the hunt for German submarines. The Allies soon realised the potential of being able to hear and detect their hidden enemies. However the Germans soon found ways to counter the Sonar, developing a rubber coating for their submarines, effectively dampening the sound waves sent back to Allied shipping. This made the use of Sonar less effective. Sonar did not have a major role in the Second World War but served its purpose and paved the way for future developments.

Encoding messages became a necessity during the war due to long range communications. Admiral Yamamoto famously stated after Midway that ‘It has disastrous effects on your forces, if the enemy knows when and where you will strike’ (Cited in Polmar, 2006, p.251). The Germans and Japanese both suffered the same fate because they both believed their codes to be unbreakable. The German Enigma machine was captured and deciphered, this led to the ‘valuable strategic guidance to the Allies, supply and transport information’ (Bennett 1999, p.291). The term Ultra was used to call the intelligence derived from the Enigma machine. Bennett (1996, p.88) states that ‘Ultra outstripped the enemy intelligence’ but believes that its ability was never utilised effectively and therefore having no means of properly applying itself to the outcome of battles. Ultra and other code breaking devices played a very important role in understanding and the checking of the enemy, but cannot be perceived as a saviour.

The radio, although already in existence, it played an ever increasing role in the Second World War. Although it was still plagued with problems, it was used to great effect in the use of tank and air warfare. It was used to support and guide tanks, and air units that went much further ahead than the command groups. This ability to command armies from miles away, led to better informed decisions and better intelligence. It was especially used effectively by the Germans, who used radio as a vital part in their Blitzkrieg. The reason why radio gave such an advantage during Blitzkrieg was because land and air units could co-ordinate much more effectively. Radio also paved the way for radio navigation systems for aircraft which allowed so called blind flying. Planes could now be directed over exact locations to drop their bombs, this worked with devastating effect against Britain. In true style of all military developments, an anti-weapon was soon found by the British, this was the birth of the radio jammer. Radio maintained its status as a crucial part of the armed forces, making air raids more devastating than ever, but it also allowed the development of tactical strategies too.

It is important to remember the gains and sacrifices that were made in the attempt of non-military organisations to help inform, and better prepare the military for the tasks ahead. Without Radar, Sonar, codes, and good communications, many more people would have died. These inventions were not made to damage, but converted to do so by the need to become the victors. It is clear that a technological edge in these areas gave an advantage in battle.

**Secret Weapons**

‘If the radiance of a thousand suns were to burst into the sky that would be like the splendour of the mighty one... I am become Death, the shatterer of worlds’

Quoted from The Bhagavad Gita, CH. 11, Sects 12 and 32; by J. Robert Oppenheimer, director of the atomic bomb project, after the first successful test

I will be looking at two sets of ‘secret weapons’ in this section, one being the V1 and V2 weapons used by the Germans to harass the British population. The second being the most powerful weapon of all time, one that ended the war, and ultimately changed the world
forever. The Atomic Bomb. Overy (1996) comments on the technological advances made on both sides, he believes that ‘two projects illustrated change: the development of the rocket missiles… and the Anglo-American atomic weapons ’. The debate over the atomic bomb has had much attention over the last 65 years, with much dispute as to its moral use and its effect of the post war world. Also there has been much debate over the ability of the Germans to produce an atom bomb, and how this would have changed the world we live in.

The V1 and V2 rockets were effectively the world’s first ballistic missiles, being an unmanned rocket capable of long range attacks. They were nicknamed the ‘weapons of vengeance’; this was because of Hitler’s aspirations of retaliating against the Allied bombings. Hitler was impressed by them so much that he ordered that mass production must begin immediately, assuring his generals that they ‘would be decisive against Britain… and make the British willing to make peace’ (cited in Shirer, 1964, p.1235). He was so confident in these ‘wonder weapons’ that he dismissed the idea of the atom bomb. Historian such as Overy (1995, p.239) believe that Hitler’s inability to grasp nuclear fusion was a decisive factor for not giving adequate funding to the German atomic programme. He also argues that Hitler was not alienated by rocket technology and could grasp the complexities, therefore giving more time to the idea that they were the solution he so desperately craved, with Hitler hailing them as ‘revolutionary for the conduct of warfare’ (cited in Overy, 1995, p.329). At the time Britain was very fearful of this new age of weapons, with good reason. The V weapons were fired indiscriminately at the capital from France, with devastating effects on morale. Although they wreaked havoc among the population of London, striking fear into them, it has become clear that they were not as effective as Hitler believed. Blanning (1996, p.224) believed that they were to incarcerate to be decisive in any way, also commenting on their ‘insignificant payload’. It is fair to say that the vengeance weapons did not have the intended effect, and that they did not have a big impact on the outcome of the war either. This can be seen because out of the 5,800 missiles launched, only 2,420 made it to their target of London. An estimated nine thousand Londoners were killed by the V weapons. The fact that they were attacking civilian targets meant that they were achieving no real victory in terms of military success. In the larger scale of things, all the V weapons used still only represented 0.23 % of the tonnage of bombs dropped on Germany by the Allies. In conclusion the V weapons could have actually affected the Germans war effort in a negative way. It was estimated by the American Bombing Survey, that the Germans could have produced an additional 24,000 aircraft if they had allocated their resources to aircraft production instead of the V weapons (cited in Overy, 1995, p.240).

The atomic bomb is a vast topic to outline, but I will explain its necessity, morality, and more importantly its effect on the Second World War. The Americans had been developing the bomb for some time, spending over $2 billion on the project. The Germans are often thought to have spent months from developing the atom bomb as well. Campbell (1985, p.280) strongly believes that the ‘atomic race’ was never a contest and that ‘the Germans never got near the ultimate deterrent’. She also believes that one of the major factors in this was that ‘the absence of those physicists driven into exile by Nazi racial and ideological policies, such men as Einstein, Pontecorvo, and Gullicini’ stunted the growth in atomic dominance. This in fact was one of several reasons. The first being Hitler’s desire to create other weapons such as the V1 and V2, while not being interested by nuclear power. Hitler and many other high ranking officers also believed that the theories behind nuclear power were the work of so called ‘Jewish physics’. The last major short coming of the Germans was their over confidence. They believed that the development of the bomb would take many years and therefore that they would win the war before it could be made.
At the Allied Potsdam conference on the 26th July 1945, the Allies demanded that the Japanese surrender unconditionally, and bow to all of their demands, or they would face utter destruction. On the 27th July, the Japanese refused. The Allies followed through with their threat and on the 6th August dropped the first atomic bomb on Hiroshima. Then another was dropped on 9th August on Nagasaki. This directly led to the unconditional surrender of the Japanese on the 14th August. One might assume that this would be the ultimate in weapons and the most significant weapon of the war. It is widely accepted that this was what brought about the surrender of Japan. On the other side of the argument Keegan (1989, p.486), believes that Japan would have surrendered regardless and that the dropping of the bomb was more of an American statement of power. Heuser (2000, p.8) also agrees with this statement, replying with the idea that it went ahead because President Truman ‘wanted to impress Stalin with the military power America could command’. His evidence for this is that he sees no other ‘logical explanation’ to drop two atomic bombs on an already doomed Japan. Other historians such as Black (2007) and Parker (1995) also believe that Japan was ready to surrender but agree with the bombings, using the justification that they were saving lives (mainly American troops) by doing so. Heuser (2000, p.8) agrees to some extent on this issue, stating that ‘because of the determination of the Japanese military not to be taken prisoner and their willingness to incur death rather than surrender’. In short the nuclear bomb did have its intended effect, without question it put Japan out of the war for good. The atom bomb is the ultimate in military technology and finalised the destruction of the Axis of evil. After Japan was hit, there was no question as to who the victors were.

Conclusion

‘The danger inherent in any report confined to one aspect of the war is that it may mislead the reader into forgetting that the conflict was won by a combination of ground, naval, and air forces, each of which carried its share of the common burden’.

Vice Admiral Forrest Sherman, US Navy.

There were hundreds, if not thousands of military and technological advances during the early twentieth century. The arms race led to a mass of weapons developments in all aspects of the military. This time period saw the greatest boom in weapons and technology in the history of the world, and causing destruction on an unprecedented scale. As we have seen through this study, there were several decisive technological advances that directly or indirectly led to the end of the war. It can be argued that many held the key to victory, but only one advance had such a decisive role, the atom bomb. The atom bomb showed the new way of thinking, the concept that masses were no longer the mainstay of war, but the future lay in fewer units being able to wield more power. Other technological developments of the war had significant implications too, some directing the Corse of the future, such as the jet plane. The advances I have covered are a mere scratch on the surface of what was discovered, invented and reinvented during the early twentieth century. Other creations such as the bouncing bomb, parachutes, synthetic rubber, synthetic oil, and helicopters were among other famous advances. This study did not even attempt to cover other areas of development such as medical advance, where things such as penicillin were discovered, or how we still use many things learned in the war to benefit us today, with aspects like fertility and conception research playing vital roles in our hospitals.

The effects of invention and innovation in the field led to ultimate superiority in battle, leading to an advantage too great that the Axis powers could not recover from. Although it is true Germany and Japan produced some of the most effective and ingenious technologies of
the war, but they lacked several crucial ingredients for success. Firstly they did not have the ability to master mass production. They very rarely sought simple solutions, to simple problems. Hitler’s insatiable thirst for new and often absurd weapons often led to a waste in resources, such as the gigantic *Mouse* tank, or the development of a cannon designed to bombard London from mainland France.

Technology played an essential role in the outcome of the war; it shifted the world powers and enabled a new dawn. They changed the entire war, affecting everything, having a massive influence on the outcome of the war. If one side got the advantage in this technological age then the other was doomed. This ultimately happened in favour of the Allies, which led to the destruction of the Axis powers.

**References**


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*Appendices for this report can be viewed in the Supplementary Files link, located in the Reading Tools list in the window adjacent to this article*