How Can Technologies Born from War Provide Lasting Benefits to Society?

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

"War. Huh, yeah, what is it good for? Absolutely nothing!" – A famous and commonly sang lyric from Edwin Starr's 1970 hit 'War' (Whitfield, 1970). But is his view objectively correct? This paper tackles the controversial topic of war's benefits using the STS Framework of Technological Determinism. By providing examples of beneficial technologies produced by war that changed society worldwide, the paper shows that there have been not only positive impacts of wars throughout history, but that without some of these technologies our world today would be vastly different. The examples in this paper come from both world wars, discussing technologies that were primarily intended for militaristic benefit yet have morphed into inventions that provide benefit to the world such as farming, power or travel.

Background and Preface

War is often seen as an abhorrent act, resulting only in the deaths and suffering of innocent people, the destruction of cities and the dismantling of economies and societies. Some argue for war's utility – arguing for liberation of oppressed people, acquisition of resource or simply national pride over land. Furthermore, the technologies themselves can be the subject of controversy – for example, about the creation of the ammonia fixing process by Fritz Haber during WW1, *Sabaton* sings "Haber-Bosch…Sinner or a Saint?" (Broden, 2022). It is important to note that I am an Aerospace Engineer writing this paper – a field long known as 'war profiteers' – and as a result I will have inherent personal bias. However, I aim to be as objective as possible throughout this paper; laying out facts, examples, and case studies, in place of opinion, and evaluating societal impacts and how this collective information backs up the STS framework of Technological Determinism. Additionally, this paper does not aim to justify war or provide any defensive arguments, merely to show that society impacting technologies can be, and have been, born from conflict.

Technological Determinism

This paper focuses on the framework of Technological Determinism: the argument that "institutions, societies, culture and economics evolve because of developments in technology" (Généreux, 2019). As this paper is discussing the effects that war has on society, specifically beneficial technological advances, this framework will be ideal to show the evolution of international trade, culture, and infrastructure due to advances made during wartime or for militaristic uses. In order to provide evidence in favour of this framework's analysis of the topic, this paper provides scholarly articles as well as blogs, journals and media. Technological Determinism does have drawbacks to its theory. Hard Determinism posits that technology is the only driving factor behind social change, ignoring all other factors – such as political agendas, social movements or natural phenomena, to name a few. Furthermore, HD wholly ignores any discussion on what prompts technological change; the theory directly contrasts with the Social Construction of Technology (SCOT). Within the paper, these drawbacks are addressed. The other track of TD is Soft Determinism, a theory that does allow for social factors as a driving force behind technological and societal change. This horn of determinism is favourable, as many of the limits created by HD are nullified, this is why Soft Determinism is what the paper applies.

Methods

As afore mentioned, this paper will be using not only articles, but also examples – such as the inventions of vaccines, radar (and microwaves) and jet engines (Little, 2021) – to show precisely how much of a positive effect previous wars have had on society. There will be a distinct focus on both World Wars and the Cold War, as these are the most recent major examples and happen to have occurred during a time of distinct technological advance – likely due to the scale and stakes of the worldwide conflicts. The paper will be laid out in chronological order, examining and analysing technologies born during these times and their impact on today's society and day-to-day life.

Research & Discussion

In this section multiple technologies developed from war will be discussed, with their impacts on modern society analysed in order to determine show positive impacts they may have had.

World War One

The first world war created a distinct arms race between the European powers, fuelling a plethora of technological advancements. A key problem for the British during this race was that despite being able to mass produce weapons for soldiers on the front, they had minimal effectiveness when compared to their enemy. This issue was due to the barrels overheating – prompting Harry Brearly to add chromium to iron, alloying the two metals in order to better resist the heat. This alloy was the first true stainless steel and was the platform for resounding development – within six years patents had been filed, with the modern precipitation hardening processes being discovered and implemented a mere ten years after (Vij, 2018). In modern society, stainless steels have countless uses, from storage containers to cooking pans to even repairing broken bones and joints. This evolution provides us an extremely clear example of a technology developed for purely militaristic uses that has transposed into a common-use material; a technology that significantly impacted society – as technological determinism theorises – for the better.

Stainless steel was not the only invention to have impacted the modern medical fields. During the war, field medics were deployed to attempt to save the lives of wounded soldiers. Unfortunately, due to the remote nature of trench warfare, many lives were lost because of the inability to reach a ‘proper’ hospital. Blood loss and infection were two of the highest killers during the time, prompting new inventions to save lives on the battlefield. A world-changing invention was implemented in 1917 by the American Captain Robertson: the blood-bank. (Klein, 2019) This new technology allowed for the storage of large quantities of blood

to be stored in close proximity to battlefields, reducing the time between injury and transfusion (incidentally, a rarely used procedure prior to WW1). Without this technology, countless lives would have been lost even in the modern day, with blood banks being a centrepiece of emergency medicine. Additionally, the American war effort introduced rudimentary sanitary pads – initially created to combat the cotton shortage, but shortly after promoted by *Ladies Home Journal* to help become a staple in department stores worldwide, labelled as Kotex (Klein, 2019). This war-born technology is different to the others previously mentioned as this invention has become a life-saving commodity available on shelves. It has stuck to its original purpose yet has been able to transfer from a militaristic use to a household item.

The next invention was made purely for destruction. As mentioned in the introduction, Fritz Haber invented a process which allowed for the conversion between nitrogen and hydrogen to ammonia – and vice versa. Once refined by Carl Bosch, the process was used in WW1 Germany on an industrial scale to produce nitrates for munitions. Haber also used this process, among other chemistry, to create the ever-infamous chlorine gas – an invention so notorious and feared it even caused Haber's wife to commit suicide after witnessing the effects (History, n.d.). The gas would later claim the lives of 1.3 million more troops. German artist Schlumberger drew a caricature of a winged dragon on Haber's back breathing his poison gas onto the battlefield (Schlumberger) – showing that the public view of this invention was only negative. However, the process itself showed no malice. In fact, it is now the most common and efficient process for nitrogen fixing – a critical component within agriculture, specifically for fertilisation. Without the process, it is estimated that half the world would be without food (Blois, 2023).

World War Two

Much like the Great War, the Allied resistance of Nazi power led to more key inventions and developments for the battlefield and beyond. A world changing technology was developed by Hans von Ohain for the Nazi powers: the jet engine (Roberts, 2003). This invention altered the course of the war in the sky, providing German pilots with superior speed and manoeuvrability over Allied aircraft – another example of a technology born for militaristic dominance and therefore, destruction. Yet, this invention propelled society forward in the post-war years. Commerce thrives on the basis of this technology – transport of goods both intra and internationally relies heavily on aircraft propelled by these engines. Additionally, people started to use air travel for both business and leisure, not only providing jobs within the industry, but also enabling quick and affordable worldwide travel, further boosting the economy. Without jet engines, flight times would be almost four times as long: a flight from Dublin, Ireland to St John's, Canada is about 4h 36 min (TravelMath), whereas pre-WWII times were close to 16 hours (V, 2019). This time difference shows the significant impact the jet engine had on the world, without even discussing any further technologies born from the jet engine. As far as an example for technological determinism goes, this is one of the best.

A lesser known development of the time was radar, developed by Arnold Wilkins and Robert Watson-Watt in 1935 (The Birth of Radar and World War two, n.d.). The premise of waves bouncing of a metallic object was further developed through the war effort, enabling forces to identify enemy targets beyond the visible range, giving the radar users a distinct edge in a fight. One of the big developers of this technology was Raytheon Technologies. Soon after the end of the war, Raytheon microwave scientist Perry Spencer allegedly noticed a chocolate bar melting in the lab, prompting him to bring in popcorn kernels as a test (MacDonald, 2012). In 1947, Spencer – and Raytheon – introduced the *Radarange* with the intention of revolutionising cooking. By the 1960s, Raytheon had acquired many electronics

and appliance companies, and even let then 26-year-old Jo Anne Anderson lead a team of 42 women to demonstrate the use of the *Radarange* to the public. At this time, the technology became known in households as the Microwave oven – an appliance people worldwide use daily for cooking, reheating and home-science experiments.

Arguably the most notorious invention of the entire 20th century was led by Robert J. Oppenheimer – The nuclear bomb. The Manhattan Project, active between 1942 and 1946, was a Top-Secret government program within the United States with the sole purpose of creating a nuclear weapon before Nazi Germany. This "greatest scientific gamble in History" (Truman, 1945) was used, at the time, for one objective - the obliteration of two cities in order to end The War, claiming the lives of between 130,000 and 206,000 civilian lives. Few sources have since argued that the development of nuclear weapons has had a positive impact on history, with Oppenheimer himself famously stating "I have become death, destroyer of worlds" after witnessing the effects of his work. Soon after the development of this weaponry, scientists and politicians alike pushed for the development of nuclear power – an effort endorsed by President Dwight Eisenhower at the United Nations in 1953. Nuclear power, while dangerous and highly volatile provide a clean and cheap way to provide large quantities of energy – sources claim that nuclear power can be up to 8,000 times as efficient as fossil fuels for energy production (Pros and Cons of Nuclear Energy, 2018). There has been significant debate over nuclear power in recent years due to safety concerns due to accidents such as Chernobyl and Fukushima – both disasters which have rendered nearby land highly radioactive and not safe for human habitation. However, the development of this technology has born significant fruit when compared with its father – the nuclear bomb. From a means of pure destruction to a way to provide energy thousands of time more dense and cleaner than our major methods, it is clear to see the way that technological change shapes our lives.

The Cold War

Much like both world wars, significant political pressure drove involved countries to increase their military spending, prompting technological development. A prominent example during this time was the Space Race between the United States and the Soviet Union. A show of power, much of the technology was created by further developing what had been created during the World Wars. However, significant steps had to be made from aircraft and weaponry to creating a capsule capable of both sustaining life in a vacuum and with the ability to endure the extreme heat produced during atmospheric re-entry. Much of this technology, along with the mathematical basis for trajectories, launch times, and orbital paths, would not have been possible without the de-segregation of NASA in 1958. Prominent figures credited with the success of both Alan Shepard and John Glenn's launches were black women such as Katherine Johnson, Dorothy Vaughan and Mary Jackson (as seen in the film Hidden Figures) – an example of how social change distinctly impacts technology. As mentioned in the Frameworks section, this is an example of one of the shortcomings of TD as a theory and an example where SCOT is able to fill the gaps. Had the civil rights movement in America not progressed until later in the century; had figures Martin Luther King Jr. not spoken up for the abolishment of segregation, the outcome of the technological propaganda battle between the United States and the Soviets may have turned out far differently – as it stood, the Soviet Union had already sent Laika – a stray dog – into orbit, successfully putting earthborn life in orbit for the first time in history. This may in turn have altered the course of the whole cold war. Whatever the outcome may have been, it is clear that Technological Determinism alone is not able to provide sufficient argument as a theory.

Closing Remarks

In conclusion, it is clear to see that technologies develop significantly over time, often sometimes in unexpected ways. Technological determinism has proven to show how the development of society is based on these technological advancements over three different, albeit chronologically similar, periods. However, it has been shown that TD alone may not be a sufficient theory, leading engineers to pair multiple frameworks together – such as SCOT – to achieve a full picture. Examples of war born technologies evolving into machines, processes or items that have altered society in ways that have undoubtedly aided our advancement are able prompt engineers to think deeply about how what we develop may become and what the adverse effects may be – both good and bad. When developing new ideas, it is not enough to simply state and consider the obvious; engineers must do more than scratch the surface of what a technology can become in the future.

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