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DOES OUR TECHNOLOGY BUY US? SOCIAL FACTORS THAT AFFECT THE ACQUISITION OF MILITARY TECHNOLOGY

Major Brian Maranta

JCSP 37

Master of Defence Studies

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By/Par Maj Brian Maranta

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ABSTRACT

The military has long had a close relationship with technology and military technology is sometimes seen as the solution that will solve any problem. History has many examples of where technology has contributed to success in battle; in some cases, technology allowed a numerically inferior force to defeat a larger one. However, there are also many examples of military organizations overcoming technological inadequacy to achieve victory over a superior foe.

The acquisition of military technology occupies the actions and thoughts of a significant proportion of the personnel of any military. This acquisition can be laden with frustrations, delays, and budgetary challenges, among other problems. It goes without saying that it is human beings who are performing the acquisition activities; both on the side of the military procurement organization and in companies doing technological development, trying to sell their product. This adds an additional layer of complexity to the entire process, that of social considerations. The reasons why some technologies get developed while others do not, why some succeed and others do not, and why some face greater barriers to acceptance than others lie, at least to some extent, in the way the military, as a sub set of society, allows sociological considerations to influence the process.

This paper looks at some sociological influences on the acquisition of military technology. It examines the question: is military technology deterministic? That is, does the technology itself drive the future? Or is technology socially constructed? Is the military society ultimately responsible for any successes and failures? The conclusion drawn is that military technology acquisition is socially constructed.

The author welcomes comments and suggestions, especially from anyone conducting similar or related research in this field. He may be contacted by email to: brian@magsi.com.

CHAPTER 1 – INTRODUCTION AND LITERATURE REVIEW

INTRODUCTION

The history of the technological development of human society in general, and the advances in the military's equipment and technology, are inextricably linked. The relationship between them is significant, and they are difficult, if not impossible, to separate. It is also evident the relationship between them goes both ways. There have been technologies specifically developed for the military that have become common place in the civilian world; from military jet propulsion that now serves the world-wide transportation industry, to the development of secure, survivable, national command and control networks that eventually became the Internet, an ubiquitous technology that many could simply not live without. Equally, civilian technological advances are often adopted for the military; from hunting weapons that were, in due course, turned by humans against other humans in the earliest forms of warfare, to mobile computing technology that is being adapted for modern tactical uses on the battlefields of today.

There are many theories that seek to describe the relationship between technology and its development and the society that technology serves as a whole. Given that the military is a sub-set of society, these theories can be applied, perhaps with some modifications or amplifications, to how the military relates to its technology.

The first theory is that of technological determinism. In its most basic sense, this is the theory that a society's technology is what drives it, what serves to develop its social structure and even its cultural values. The second theory is the social construction of technology, which argues it is ultimately human action that shapes technology, and that the key to understanding technology is understanding how it exists in specific social contexts.

In general, the theory of technological determinism is seen as negative; something that should be avoided, something the naysayers and 'technophobes' would warn against. On the other hand, the social construction of technology is seen as positive, something that should be sought out, a representation of humanity's triumph over the technological evils brought upon human society by itself. However, as with so many aspects of human culture, there is little in this overall relationship between technology and society that is black and white. Both theories have their merits and shortcomings. Both theories have their proponents and detractors. The relationship between society and technological development likely contains aspects of each. The truth is probably somewhere in the middle and more than likely very dependant on a myriad of other factors.

In many ways, the military has developed its tendency to pursue technology based on two primary motives. First, there is the hope that better, faster, and stronger technology will result in more efficiencies, budgetary savings and saving of lives. Second, there is the fear of being left behind and having one's adversary gain the technological upper hand. Thus the military constantly seeks to make wars easier and faster; less deadly (to us) and more deadly (to the enemy), while keeping up with, or perhaps even slightly ahead of, the latest trends and developments. But is the military in control of its own technology, or is technology driving the military? Is military society technologically deterministic, or is military society constructing its technology to suit its own needs? What social factors affect the acquisition of military technology?

It is important to note that military technological advances typically follow an evolutionary and cyclic process. This is not meant to deny the impact of 'revolutions in military affairs' (RMAs), where significant leaps forward in military technology occur. But, for the most part, for both normal military technological developments and RMAs, when one 'side' develops a technology, their adversary will work to defeat that technology, either through stronger defences against it, or through technologies that seek to make it obsolete. A classic example is the development of defensive fortifications versus the counter development of siege engines and the further development of cannons and artillery and eventually aircraft. In arms control theory, this is sometimes referred to as the 'action-reaction' cycle.[1] While the application of this cyclic theory to arms control is less than perfect (which will be seen later in the paper), the basic concept of 'action-reaction' serves to add complexity to the relationship between the military and its technology.

The military's interest in technology is easy to understand; there are many historical examples of technological superiority contributing to military success. However, there are likewise many examples of a technologically superior force being defeated by less sophisticated enemies. In a similar vein, there are examples of the novel use of technology, even inferior technology, providing victory over a technologically superior foe. So superior technology, in and of itself, cannot be seen as the 'silver bullet' that solves all problems.

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[1] Wolfgang K. H. Panofsky, "Science technology and the arms race," in *Physics and nuclear arms today,* edited by David W. Hafemeister, 352-358 (New York: Springer, 1991), 353.

In the most recent developments in military technology, militaries of the world are coming to depend more and more on Information Technologies (IT). Further, the developments and theories surrounding Network Centric Warfare (NCW) are seen as being the next RMA; even as the pace of new technological advancements in the civilian world continues to increase, the hopes of military applications of those advancements likewise gets larger.

As the military moves forward, developing and acquiring new technologies, many questions inevitably arise. Some are basic, technical questions that, in time, are relatively easy to answer. However, other questions are far less clear cut, but are equally important if the military is to be ultimately successful on the battlefields of tomorrow. Has a situation of technological determinism taken over, where technology is acquired merely for the sake of technology? Are valid military requirements being considered, and do these new technologies address them adequately? How can distinctions be made between technologies that are truly revolutionary, and those that are merely evolutionary developments of technologies already in existence? Is the military industrial complex driving the situation, eager to sell not only what they 'hype' as the latest and greatest technology, but also seeking to lock the military in to long term maintenance and upgrade plans? Is the military set upon a technological path by forces beyond its control? If so, is it the right path? Will this path lead to greater effectiveness and efficiencies? How easy will it be to change paths if it is determined the path is wrong, or if the path ends or is blocked by something that currently cannot be seen? Are the technologies being developed and acquired those that are perfect for fighting the last war, while those technologies that will help win the next war are being ignored? Can future technological changes be taken advantage of, especially in the light that it cannot be predicted what those changes will be? Failure on these points may well lead to a disaster; a situation where the military cannot adapt and goes well beyond being merely ineffective or inefficient and becomes simply… irrelevant.

This paper examines some of the many social factors that contribute to the military's acquisition of technology. This examination is guided (somewhat) by the theories of technological determinism and the social construction of technology, but will seek other influences also. The paper attempts, if not to answer fully, at least to inform the discussion surrounding the questions noted above, acknowledging in advance that perfect accuracy may well be impossible to achieve. The intent is to guide future thinking about military technology, and perhaps warn of possible roadblocks and difficulties that may result in failure or disaster. With regards to the question of whether or not military technology is deterministic, the paper concludes that it is not. Rather, it is socially constructed. That is to say, despite some appearances to the contrary, the military is not driven by its technology.

The first part of the paper will examine the interaction between military technology and society from a historical point of view. Three historical examples of society's interaction with military technology will be examined, starting with the attempt by 17th century Japanese society to limit the impact of firearms technology on their *bushido* culture. Second, the initial German campaign into France in 1940 will be examined, first from the French point of view and their reliance on the technology of the Maginot Line, then from the German point of view, and their defeat of that technology through the novel use of their own, relatively inferior armoured capabilities.

The second part of the paper will look at three military technology acquisitions from three different times. First, the acquisition of the M-16 rifle by the US Army as their implementation of the assault rifle concept will be examined briefly. Next, the current challenges in keeping up with the latest advancements in Information Technology will be studied in relatively broad detail, including the most recent developments of social networking and mobile computing. Finally, the potential future acquisition of Stratellite technology as an alternative to communication satellites for in-theatre, over-the-horizon military communications will be examined.

The third part of the paper will look at three aspects of society that have had significant impact on military technology. First, the military industrial complex will be discussed, including some examination of how it works as well as its relative importance to the overall economy. Second, the concepts of path dependence and networking, as they relate to resistance to technological change, will be described. Finally, some miscellaneous characteristics of the sociology of technology will be detailed.

Through these three broad groupings of analyses, the paper will attempt to inform the general questions asked above, and the specific question as to how, if at all, deterministic military technology is.

LITERATURE REVIEW

Many books have been written over the years that deal with technology; the subject matter is broad enough to allow for a wide gamut of books. Broadly speaking, the subjects covered include: how technology and society interact; the impact of technology on the military; how society benefits from technology; and even how technology will eventually destroy society.[2] While many books are full of doom and gloom and dire warnings about technology (giving credence to the adage that bad news sells better than good news), there are still more than a few works that provide a balanced view; that technology can be both helpful and harmful, and that it is up to society to ensure it is more the former than the latter. Given the extensive nature of the subject material, a detailed listing of books is not possible, much less a review of them all. For the purposes of this paper, a sample of four works is reviewed. The focus is mainly on the key concepts of technological determinism and the social construction of technology, as well as the relationship between technology and military society.

The Nature of Technology

In his relatively recent book, W. Brian Arthur looks at the nature of technology itself. He examines what technology is and how it evolves, even going so far as to propose a Darwinian influenced theory of technological evolution. He looks at the differences between 'technology,' 'innovation' and 'technique.' While he is, overall, sceptical about technology and its consequences, he does acknowledge that technology is a very significant contributing factor to human society. He makes some interesting conjectures. For example, he theorizes that even society's current market and economic systems can themselves be considered as technologies.[3] He goes on to integrate this concept with his theory of how technologies evolve, are innovated and then used to form components of new technologies.

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[2] As an (admittedly unscientific) example, an Amazon.ca Book Website search on the term "technology and society" generates 31,817 results. Available from http://www.amazon.ca; Internet; accessed 23 April 2011.

[3] W. Brian Arthur, *The Nature of Technology* (New York: Free Press, 2009), 54.

He discusses how early technologies form using existing primitive technologies as components. These in time become possible components, or building blocks, for further construction of technologies. This process repeats so that, slowly over time, many, complex, technologies ‘evolve’ from an initial few and simple ones.

He discusses the difference between ‘invention’ (which he states creates radical and novel evolutions of technology), and ‘standard engineering,’ (which produces incremental evolutions and improvements of existing technology).[4]

He theorizes that an era of history does not just create technology, but rather that technology creates the era. He also looks at how Science (which he deems a form of technology) uses technology itself to discover new phenomena and effects that can be used as the basis of evolution of existing technologies, as well as the revolution of new technologies.

Relating society and technology, he theorizes that new technologies may require new industries or organizational arrangements to be set up. This is, essentially, a form of Technological determinism, in that societal changes are driven by the new technologies. He looks at how, even when a novel principle evolves that is ‘better’ (by whatever form of measure), the adoption of it may be limited by the cost or social resistance to changing surrounding structures or organizations; this is an example of Social construction of technology, in that society dictated that even a notably ‘better’ technology would not change society and not be adapted into it.

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[4] Arthur, *The Nature of Technology*, 108-109.

Mr. Arthur's book is an example of the recent work that seeks to bridge the two main theories of Technological determinism and Social construction of technology. As noted above, he includes examples of both in his book, suggesting that each theory has merits to be considered.

Technopoly

This book by Neil Postman, on the other hand, is decidedly negative about technology. While he may, grudgingly, admit to some of the benefits humanity has enjoyed through technology, he essentially ignores those in order to focus mainly on the negative aspects of technology. He discusses his desire to not be simply labelled a 'luddite,' and even though the original luddites were not really opposed to technology, the term has come to mean that in modern usage. However, while he himself may not be opposed to technology in general, his book seems to serve primarily as a warning against the dangers of technology. In his own words; "A dissenting voice is sometimes needed to moderate the din made by enthusiastic multitudes,"[5] and he determines the need for his book to examine technology "… for the purpose of clarifying our present situation and indicating what dangers lie ahead."[6]

He theorizes that cultures can be divided into three stages: Tool Using, Technocracy and Technopoly. These stages he describes as follows;

"Tool Using," is where tool technology is integrated into a culture. In such a culture, technology is not a thing on its own, but rather is subject to binding social or

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[5] Neil Postman, *Technopoly* (New York: Vintage Books, 1992), 5.

[6] *Ibid.,* 22.

religious systems. He then relates the story told by Farley Mowat in "The People of the Deer," which documents how the introduction of the rifle served not to modify the culture of the Ihalmiut people, but rather to eradicate it. This is an example of extreme technological determinism.

"Technocracy," develops as tools (and technology) come to play a more central role in the culture. They are not integrated, but rather they attack the culture and seek to become the culture. He discusses how the Mechanical Clock, the Printing Press and the Telescope were the key technologies that contributed to the rise of Technocracy. Looking at the telescope specifically, he conjectures about how the observations made by Copernicus, Kepler and Galileo "left the Western world to wonder if God had any interest in us at all."[7] Once again, this is an example of Technological determinism, where technology is seen as driving a wedge between a society and its faith.

"Technopoly," as postulated by Postman, is the ultimate goal of technology in a society, where the submission of all forms of cultural life to technology occurs, and where technology is deified and culture takes its direction from technology instead of the other way around. As he puts it himself, Technopoly is when a culture "tries to employ technology itself as a means of providing clear direction and humane purpose. The effort is mostly doomed to failure."[8]

In direct contrast to the theorists behind the Social construction of technology, Postman identifies social science as a supporting 'conspirator' to technology and his

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[7] *Ibid.,* 29.

[8] *Ibid.,* 72.

postulated concept of Technopoly, and thus "must be regarded with a hostile eye."[9] As will be seen later, other authors have indicated that applying the concepts of sociology and social science to the study of technology can provide much beneficial understanding of how society and technology interact; Postman does not share that view.

Overall, the book seems to engage in over generalization, including a few, mildly disquieting comparisons with Nazi Germany.[10] His section on computer technology is unfortunately dated, written as it was before the wide spread use of the Internet. He does make a rather prophetic (and sarcastic) reference to the use of computers for making presentations at corporate board meetings; one can only wonder what he would have thought of the concept of 'Death by PowerPoint.' Postman appears to be firmly on the side of Technological determinism, and his book is an example of the genre of books warning, perhaps satirically, against society's over dependence on technology.

Social Shaping of Technology

Edited by Donald MacKenzie and Judy Wajcman, this book is a collection of works by various authors. The editors have attempted to examine the intertwining of 'society' and 'technology,' while attempting to counter the concept of 'technological determinism' which they describe as being naïve and overly simplistic. Technology is not, they say, a separate sphere, independent of society, following its own logic without

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[9] *Ibid.,* 56.

[10] Clearly, Mr. Postman is not aware of "Godwin's Law" and its corollaries. The law itself states: "As an online discussion grows longer, the probability of a comparison involving Nazis or Hitler approaches 1." The first corollary to the law is generally accepted to be: "Once such a comparison is made, the thread is finished and whoever mentioned the Nazis has automatically 'lost' whatever debate was in progress." Available from http://en.wikipedia.org/wiki/Godwin%27s_law; Internet; accessed 23 April 2011.

guidance and creating effects on that society. They acknowledge that, while this opinion has been more or less replaced by a focus on the social shaping of technology, they still feel there is a need to counter any regression to the older, misleading, theory.

They acknowledge that successful engineers understand that technology is both socially shaped and society shaping, but they note that discussions of technology in the media are still influenced by ideas of technological determinism. It can be postulated, once again, that the negative (evil?) image of technological determinism is what the media is interested in selling.

The book contains a total of 30 essays, some of which are only two pages long. These works are categorized into the four chapters of the book. The first chapter serves as an introduction and discussion of general issues, while the remainder of the book focuses first on The Technology of Production, followed by Reproductive Technology and, finally, Military Technology. Interestingly, the editors refer to these by the shortened titles of 'production,' 'reproduction,' and 'destruction.' While this last is a somewhat negative view of military technology, it does serve as an interesting division of the issues they discuss.

Among these issues are the concepts of technological determinism as a theory of society as well as a theory of technology itself. They look at the interrelationship between science and technology, similar to what Mr. Arthur did in his book. Interestingly, Mr. Arthur is one of the contributing authors for this anthology.

They look at some of the prejudices of technology, for example, how many items of technology demonstrate significant gender bias, or how modern photographic and photo printing technology has a marked prejudice towards "white" skin. These are perhaps negative examples of the social construction of technology, how modern society has allowed these negative aspects of technology to become the 'norm.' These illustrations serve as cautionary anecdotes that, even in socially constructed technology, bad things can happen and that these must be anticipated and eliminated.

The final part of the book has some very interesting works. One of these examines how packet switching, the key technology that forms the basis of the modern Internet, had to be socially constructed. Basically, there was a lack of consensus of how it should work, what it was, what it should do. The people involved in developing the technology had to prove to others that it would work. "Packet switching was never adopted on the basis of purely technical criteria, but always because it fitted into a broader socio-technical understanding of how data networks could and should be used."[11] This section also includes an excellent article on how social factors had a profound negative affect on the adoption of the M-16 rifle in the US Army, a subject examined in greater detail later in this paper.

Overall, this book is a well written and balanced collection of works that serves to remind readers how technology and society are interrelated. The collection is firmly in the 'camp' of social construction of technology, and contains excellent examples of where such construction can be negative as well as positive. It specifically berates and warns against the adoption of the idea of technological determinism.

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[11] Janet Abbate, "Cold war and white heat: the origins and meanings of packet switching," in *The Social Shaping of Technology,* edited by Donald MacKenzie and Judy Wajcman, 351-371 (Buckingham: Open University Press, 1999), 352.

The Social Construction of Technological Systems

Edited by Wiebe Bijker, Thomas Hughes and Trevor Pinch, this book is, quite simply, the definitive collection of work on the concept of Social construction of technology. The primary editors were at the forefront of the development of this concept; the book is a collection of works resulting from one of the first organized workshops on the topic, held at the University of Twente in the Netherlands in July of 1984. It is from this workshop that the concepts of social construction of technology found their origin and were first developed. The basic concept is that all aspects of technology can be studied using sociological analyses. This results in a 'sociology of technology' approach that seeks to integrate technology, science, history, and society. Even the concept of technological determinism can be subsumed into their views of social construction of technology.

The first chapter looks at common themes from a historical perspective. It describes how science and technology are not separable, and that they are both products of society. Every technology is defined by the social group it is part of, and that social group includes the producers, distributors and consumers of the technology. The authors include the concept of technological determinism, rather than dismissing it: "Technological systems contain messy, complex, problem-solving components. They are both socially constructed and society shaping."[12]

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[12] Thomas P. Hughes, "The Evolution of Large Technological Systems," in *The Social Construction of Technological Systems,* ed. Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch, 51-82 (Cambridge: The MIT Press, 1987), 51.

The second chapter works to simplify the complexity of the problem, looking at how the development of technology must be considered in concert with the society at the time. It also looks at some technologies (for example, an early form of plastic known as Bakelite) that was initially poorly received by society at large, because of the radical changes in production methods that the current organizations were not at first prepared to accept.

The third chapter looks at some specific strategic research, looking at some radically changed and improved technologies that had other consequences. For example, the development of turbojet engines for aircraft demanded new methods not only for testing, but also for comparing. These modern engines are compared based primarily on thrust generated, while older, piston engine and propeller aircraft engines were compared based on shaft horsepower.[13] The concept of 'unintended circumstances' is also briefly looked at, where the strike actions of coal miners in early 20th century America had the quite unintended consequence of contributing to the demise of coal as the primary fuel for home heating furnaces.[14] Another key point brought out here is the well known concept of 'hindsight is always 20/20.' It is easy today to look back with a socio-historic analysis of any technology and be able to point out where it may have gone wrong, but to the people there at the time, it must be understood that the situation was far less clear cut and obvious.

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[13] Edward W. Constant II, "The Social Locus of Technological Practice: Community, System or Organization?" in *The Social Construction of Technological Systems,* ed. Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch, 223-242 (Cambridge: The MIT Press, 1987), 226.

[14] Ruth Schwartz Cowan, "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology," in *The Social Construction of Technological Systems,* ed. Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch, 261-280 (Cambridge: The MIT Press, 1987), 278.

The final chapter of the book looks to the future. It looks at how broad the concept of society intermingled with technology can be. "Technology is such an integral part of modern life that virtually every aspect of an industrialized society intersects at some point with technological issues."[15] The concepts of the intertwining and inseparable nature of science and technology is re-examined, and enhanced to include many other aspects of society, including invention, marketing and consumption, all of which contribute to the social effect of all technologies.

The papers contained within this book are extremely well balanced and fair in their examinations of various technological subjects. As some of the initial writings on the concept of the social construction of technology, the study of these papers serves as an excellent basis for further readings and analyses. They do not appear to have suffered overmuch from the length of time that has passed and changes in technology that have occurred since the conference, leading to the conclusion that many of the theories advanced at the workshop have a certain timelessness to them. It is additionally interesting to note how the authors of these papers sought to include the seemingly contrasting view of technological determinism, theorizing that it can itself be seen as an example of social construction of technology.

SUMMARY OF LITERATURE REVIEW

Again, while a full review of all relevant literature may not have been possible for this paper, some interesting conclusions can be drawn from what has been reviewed. Arthur and Postman are almost at opposite ends of the spectrum, with Arthur's book

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[15] Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch, *The Social Construction of Technological Systems*, (Cambridge: The MIT Press, 1987), 307.

representing a balanced and optimistic view of the role of technology in society, while Postman seeks to cast technology in an evil light. While they do not use the terms, *The Nature of Technology* appears to adopt essentially a 'social construction of technology' approach, while *Technopoly* seems to embrace the concept of technological determinism. The latter work is a mild example of the 'doom and gloom' style of technology-related writing that is available (and apparently selling well) today.

The two anthologies that were reviewed both firmly in the camp of social construction of technology; indeed, the collection edited by Bijker *et al* is perhaps the seminal work on the subject. It is interesting that the first collection, however, specifically states a desire to be a counter to the concept of technological determinism, while the second, older collection postulates that technological determinism is itself a component of the social construction of technology.

From this review, it is concluded that technological deterministic authors are, in some ways, preying on the public's innate fear of technology; fears that such technology will either bypass members of society, or enslave them. On the other hand, the social constructivists have a more balanced and optimistic view of the subject, which is inevitably more useful and much more likely to be correct.

CHAPTER 2 – SOME HISTORICAL PERSPECTIVES

"Those who cannot remember the past are condemned to repeat it." – George Santayana

In order to inform the discussion of technology and its impact, not only on the military, but on society as a whole, this paper will first look at some historical examples. For, insomuch as the introduction of new technology (both military and civilian) is something that humankind has been dealing with since the dawn of history, the struggle for how technology affects society, for both good and evil, is equally as old.

THE SHOGUN, BUSHIDO, AND FIREARMS

For the first foray into history, the paper examines Japan in the 17th century, and the attempts of the leader of that culture, the *shogun*, to mitigate the effects military technology was having on his society and its culture.

The Tokugawa Shogunate ruled Japan for more than 250 years (1603 – 1867), maintaining a hierarchical and successful society.[16] But it was not without conflict or controversy. Prior to this time, the medieval period in Japan had been dominated by a series of wars, fractured dictatorships, clan-based rivalries and crime that was only contained with the rise of three consecutive, powerful and successful lords, the third of which was the first Tokugawa *shogun*.[17] The second of these lords, Toyotomi Hideyoshi, had enacted the Sword Hunt of 1587, designed to disarm anyone who might oppose his control and prevent future challenges to the *samurai* ruling class. All swords, spears and

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[16] P.W. Preston, *Understanding Modern Japan* (London: Sage Publications, 2000), 20.

[17] *Ibid.,* 23.

firearms were taken, not only from the peasants, but also from minor lords, village leaders and temples.[18]

With the rise of the Tokugawa shogunate, a peaceful agrarian society flourished – but there was little industrialization or advances in technology.[19] The elite *samurai* ruling class who followed *bushido*, the way of the warrior, worked to keep change to a minimum and thus preserve their place in society. At the same time, *sakoku*, the 'closed country' policy, was enacted by Tokugawa Iemitsu. This policy sought to tightly control all foreign trade and links between Japan and the outside world.

The *sakoku* policy was primarily concerned with stemming the spread of Christianity in Japan; the Portuguese Jesuit missionaries who were spreading their faith were seen as portents of possible invasion.[20] In many ways, the Japanese were successful in this regard; a quick study of the CIA World Factbook reveals that, compared with other Asian countries, only 2% of Japanese people identify as Christians. In Malaysia and Singapore, that rate is 9.1% and 14.6% respectively, while in the Philippines, the percentage of the population following Christian religions is 85.4%.[21]

However, religion was not the only issue that concerned the ruling class in Japan. Firearms, and the societal threat which that technology represented, were also a problem. Not only was this technology almost inextricably linked to the Christian Portuguese, but they also posed a significant problem of social instability. "A gun in the hands of a

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[18] Stephen Turnbull, *War in Japan 1467 – 1615,* (Oxford: Osprey Publishing 2002), 73.

[19] Preston, *Understanding Modern Japan*, 25.

[20] John Keegan, *A History of Warfare,* (Toronto: Key Porter Books, 1993), 44.

[21] CIA World Factbook, available from http://www.cia.gov/library/publications/the-world-factbook/; Internet; accessed 21 April 2011.

commoner… could topple the lordliest noble…"[22] The vulnerability of the *samurai* and his vaunted *bushido* code to the actions of a mere peasant did not represent a tolerable situation. Similar bans in medieval Europe had failed, but the ability to actually carry out a ban on firearms was much easier in 17th century Japan than in Europe, because of the island geography of the country and the relative primitive nature of the technologies involved; not only the weapons themselves, but the means to transport them.

The situation lasted until the arrival of the American Naval Officer, Commodore Matthew Calbraith Perry to Japan. Perry eventually obligated the shogunate (literally at gunpoint) to accept a treaty with the US and fully open the country for trade.[23] The influx of western trade, technology and culture eventually precipitated the collapse of the shogunate and significant changes to Japanese society.[24]

In this case, the ruling class was concerned over the impact technology, including military technology, would have on their culture. While there was also a religious element, specifically the attempt to limit the spread of Christianity in Japan, the focus here is on the technological aspects. The *shogun* adopted a socially constructed approach to this technology by barring it from entering his country, or, at least, attempting to do so. In point of fact, they were justified in their concerns; in modern day Japan there is very little left of the *samurai bushido* culture, and what there is would be virtually unrecognizable by Tokugawa Iemitsu. The fact that they were eventually forced into allowing the influx of such technologies, with the concomitant affects on their culture,

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[22] Keegan, *A History of* Warfare, 44.

[23] Preston, *Understanding Modern Japan,* 32.

[24] *Ibid.,* 35.

lead to a period of time known as the Meiji restoration. During that period, Japan was obligated to 'catch up' with the modern world and its technologies, with the attendant, foreboded changes to Japanese society as a whole.[25]

As discussed previously, it is easy in hindsight to look back at the attempts by the Tokugawa Shogunate to mitigate the societal threat represented by the military technology of the time, and dismiss them as foolhardy. The difficult thing to do is learn the lessons that are there to see, and apply them to the future. In this case, the lesson learned from this historical analysis is that, ignoring technology is not the solution. As dire as the fears may be that new technologies will destabilize and undermine society, in the end, technology marches on. Rather than trying to push this technology away, suppress it, or avoid it, it is better to try to integrate it into society, in the most controlled manner possible. This situation would fit with the theories of technological determinism. But is it truly the arrival of western technologies that changed Japanese culture? Is the technology itself to blame? Or did Japanese society, through the shogun, simply commit an error by trying to limit the impact of those technologies? It should be recognized that some technologies will be difficult, if not impossible, to control; society will get the technology it demands, and may very well become irreversibly changed as a result. In those cases, straining against them becomes a quixotic exercise at best, a disaster for society at worst.

[25] *Ibid.,* 41.

THE GREAT WALL OF FRANCE

For the second historical example the paper turns to France, just after World War I, and the considerations of French society at the time to try to prevent the devastating trench warfare that had so defined that conflict.

As the sun rose in France on the 10th of May 1940, there was little to indicate that the next few days would be anything but ordinary. That they turned out to be entirely unordinary is now a matter of history.

During the period after World War I, French military thinking and planning lead to the conclusion that the most effective way of avoiding the bloody trench warfare of that conflict was to establish a firm defensive line to keep Germany out of France. Despite the exhortations of Marshal Foch to adopt a more offensive, manoeuvrist approach, they went ahead with the plan to construct what can arguably be considered the ultimate defensive line.[26]

The Maginot Line was an impressive piece of military technology. It was well designed, well planned and well engineered. It stretched along the French border, even through the Alps, all the way to the "impenetrable Ardennes Forest."[27] Its imposing structure consisted of a total of 44 large and 58 smaller forts, 360 interval casemates, 17 observation posts and 81 troop shelters, along with kilometre upon kilometre of

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[26] Anthony Kemp, *The Maginot Line Myth and Reality* (London: Frederick Warne, 1981) 15-16.

[27] I am forever indebted to my undergraduate History teacher, Dr. Keith Neilson of the Royal Military College, for first exposing me to this succinct phraseology.

connecting tunnels.[28] The fortifications were sighted specifically to the ground they sat in, so as to maximize interconnection of arcs of fire and sightlines. A total of 343 heavy artillery pieces, from 75mm mortars up to 135mm howitzers, along with innumerable machine guns, gave the line massive firepower.[29] Even today, after the passage of time and the effects of the war, the battlements are an awe-inspiring apparition for tourists in eastern France.

But the Maginot Line was not just about defensive military capability. Logistics matters were also well considered during construction, with ample power generation capabilities, and accommodations and messing facilities (albeit austere ones) for the thousands of troops who would occupy the defences in time of war. There were kitchens, latrines, washrooms, storerooms, and a hospital, as well as a 0.6 metre gauge railway to transport ammunition, heavy equipment and food and water along the line. Provisions were supplied to allow the line to function in isolation for a month or more.[30]

The construction of the Maginot Line represented a significant commitment of time, funds and effort. This resulted not only in the very effective defensive line itself, but came also to shift French military thinking. The "Maginot Mentality" began to appear, where the Maginot Line became no longer a simple, temporary measure to buy time, but the lynch-pin upon which French war plans were based.[31] In some ways, the technology represented by the Maginot Line affected French military society as a whole.

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[28] William Allcorn, *The Maginot Line 1928-45* (Oxford: Osprey Publishing, 2003), 12.

[29] *Ibid*., 22.

[30] *Ibid.,* 28.

[31] J.E. Kaufmann and H.W. Kaufmann, *The Maginot Line None Shall pass* (Westport: Praeger Publishers, 1997), 111.

Generaloberst Heinz Guderian, who would mastermind the *blitzkrieg* tactics the Germans would use with great success in France, himself wondered, "Why was the money spent on the construction of those fortifications not used for the modernisation and strengthening of France's mobile forces?"[32]

The basis of the French attitude was the assumption that the Germans, if they were to attack, would use a plan based in large part on the Schlieffen plan of World War I. It was anticipated that the Germans would need to take the entire Maginot Line, in order to secure their flanks, prior to further invasion of France, giving French forces the time to prepare strong defences. Indeed, the initial German plans were essentially that, despite the efforts of several lower ranking Generals such as Guderian and *Generalleutnant* Erich von Manstein, among others. These senior German officers attempted in vain to convince the German High Command to abandon any 'Schlieffen-like' preparations and, instead, enact a plan that correctly implemented the manoeuvrist theories emphasized by training and experience, consisting of a hard strike through the weakest part of the defences, followed by deep penetration to the more vulnerable areas of France. A plan of this nature would allow for swift victory, preventing further preparations by the defensive forces and without wasting effort on flank security. Their pleas fell on deaf ears, until an incident involving a courier forced the Germans to change their plans after all. The courier was in possession of orders that made at least some reference to *Fall Gelb* (Case Yellow), the latest German attack plan, based largely on the Schlieffen plan. He was flying at night, despite orders to the contrary, when his plane experienced engine trouble and had to make a forced landing in Belgium. As the

[32] Heinz Guderian, *Panzer Leader* (London: Michael Joseph Ltd., 1952) 94.

Germans could not be sure how much of their plans were now in possession of the French and the allies, the decision was taken to make strategic modifications to the *Fall Gelb*. This gave von Manstein the opportunity to convince Hitler, at least, that a deep, concentrated armoured attack through the Ardennes initially, bypassing most of the Maginot Line, would have the greatest chance of success.[33]

In the end, the Maginot Line was, essentially, rendered irrelevant. German forces successfully bypassed the stronger parts of the defensive line, accomplishing the deep penetration into France. Once the initial fighting died down, the remaining outposts along the line were captured at a leisurely pace, in some cases surrendering without fighting.

However, the Maginot Line must never be thought of as a 'failure,' by any stretch of the imagination. The technology involved was exceptional; while some of the forts along the line simply surrendered, those that chose to fight proved exceptionally difficult to defeat. The technology was sound; the forts were extremely well constructed and almost invulnerable.[34] However, it was technology that lacked agility and flexibility, and was based on assumptions that were eventually proven to be false. All that remains of the Maginot Line now are the fortifications themselves, their battle damage testimony to their strength, but history shows that this particular technology was not in the right place at the right time. From this historical example the importance of technology to be flexible and adaptable is reinforced. Groupthink, known in this case as 'Maginot Mind,' must be avoided, so as to circumvent the development assumptions that may well turn out

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[33] Robert M. Citino, *The German Way of War* (Lawrence: University Press of Kansas, 2005), 274.

[34] Allcorn, *The Maginot Line*, 56-57.

to be false. And, if those assumptions are proven false, doctrine dictates that plans must be changed; this can very well be applied to technology as well. This is an example of social construction of technology. In this case, while there were sound political and strategic reasons that the French put their faith in the technology of the Maginot line, in hindsight it can be seen that dependence on that particular technology was misplaced.

BLITZKRIEG: NOVEL USE OF THE TECHNOLOGY YOU HAVE

For the third, and final, historical example, the paper examines the same conflict as the previous example, but this time from the German side. There are many written works that deal with the inter war years in Germany as well as the victories and defeats of the German army during World War II. However, for the first part of this historical study, examining some of the social factors affecting German military technology during that time, a detailed analysis is not required. For simplicity, this paper focuses (with some exceptions) primarily on one book, a personal account of that time period, written by a relatively senior German officer. Specifically, "Panzer Leader" by *Generaloberst* Heinz Guderian. In effect, the socio-technological situation will be examined through his eyes.

During the inter war years, Germany was limited by the Treaty of Versailles to an army of no more than 100,000, and tanks and armoured cars were specifically prohibited.[35] This did not stop Guderian from taking the "armoured troop carriers" that

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[35] Williamson Murry, "Armoured Warfare: The British, French, and German experiences," in *Military Innovation in the interwar period,* ed. Williamson Murray and Allan R. Millett, 6-49 (Cambridge: University Press, 1996), 16.

were allowed and using them to develop the concepts, tactics and doctrine that would eventually come to be known as *blitzkrieg*.[36]

After World War I, the German Army was dissatisfied with the outcome of that conflict, and the strict controls imposed by the Treaty of Versailles. They welcomed the opportunity to prove that the war had been conceded by politicians, not lost by the Army, and that German fighting ability still reined supreme. In effect, the inter war years gave the German Army time to develop a strong *esprit de corps* and the drive to succeed in the inevitable, follow-on conflict..[37]

One of the first armoured vehicles developed with Guderian's input during the inter war years was the *Panzerkampfwagen I*. This vehicle, although intended as a trainer, became a mainstay of German armoured operations throughout the war. But one would hardly know that when looking at the vehicle in person; it is a remarkably unimpressive piece of equipment. By today's standards, it is little more than a lightly armoured car, albeit with tracks. Weighing in at slightly over 5 tonnes, barely over 4 metres in length and 2 metres in width, and armed with only a pair of medium machine guns.

Even compared to the contemporary allied tanks, the *Panzerkampfwagen I* was at a disadvantage. In his study of the enemy, Guderian acknowledged that "French tanks were superior to the German ones both in armour and in gun-calibre," and that France had "the strongest land army in Western Europe." Not only did they have better quality

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[36] Guderian, *Panzer Leader*, 21.

[37] Ibid., 432-433.

tanks, he also admitted French armoured vehicles significantly outnumbered those possessed by Germany.[38] It is unmistakable the Germans were facing a technologically superior foe, with their own technologies having been limited by the Treaty of Versailles. And yet, the *blitzkrieg* manoeuvre masterminded by Guderian in 1940 is a textbook example of highly mobile, deep strike armoured warfare; a significant success that stands as a 'how to do it right' example for any aficionado of mechanized combat. In this case, novel use of inferior technology, combined with a fierce fighting spirit and élan, lead to a German victory, despite the advantages enjoyed by the French.

However, the initial German operational victories were eventually followed by overall strategic loss. A detailed analysis of what went wrong for the German army during World War II is beyond the scope of this paper, and while there are many books written on the subject only a few points will be touched on here, in order to further the historical study of military society and technology at that time.

One recognized source of error on the part of the Germans was the strategic direction from the highest levels of German military and political leadership. While most find it fit at this point to simply lay all fault squarely on Adolf Hitler, Citino contends that the German General Staff from that time must also share some of this culpability. Simply laying everything at the feet of 'The Little Corporal' is a bit too easy, as he puts it; "Blaming… Hitler was a convenient way for [them] to shift the blame… He was dead, first of all… and second, he was Hitler."[39]

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[38] *Ibid*., 94.

[39] Citino, *The German Way of War*, 269.

Citino goes on to postulate that, while there were many things the German army did well (*blitzkrieg* being the best example), there were many things they did poorly during the war. As examples he lists intelligence and counter-intelligence, logistics in all its senses (from the tactical battlefield to the contribution of civil industry to the war effort), and, finally, the ability to work in concert with allies, not just Italy, but also with the Soviet Union, who started the war allied with Germany.[40]

In addition to these errors, the entry of both the Soviet Union and the United States into the war as enemies of Germany can be seen as one of many final blows to German hopes for success. With the allies' overwhelming political, social and (perhaps most importantly) economic resources, all hopes for German victory were forever dashed.

In the first part of this third historical analysis, it was shown that superior tactics, doctrine and a fierce sense of élan helped the Germans compensate for inferior technology. However, even these concepts are not enough by themselves in the long run. Superior logistics, supply and strategic thinking became key factors that eventually trumped all other considerations and contributed to allied victory and German defeat.

If this analysis is taken one step further, considering the economic and industrial systems of the Allies and the Germans to also be technologies, as W. Brian Arthur does,[41] it may be concluded that superiority in the most applicable technologies is what must be the goal of any military, but these technologies may not be immediately recognized as

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[40] *Ibid*., 270.

[41] Arthur, *The Nature of Technology,* 193.

classic, military technologies. That is, it is not always about gun calibre and missile accuracy, sometimes it is strategic superiority and logistic accomplishment that wins the war.

SUMMARY OF HISTORICAL PERSPECTIVES

In this chapter, the technological interactions of three different societies were examined. In the case of the Japanese, society tried to ignore technology so as to limit its impact. In the case of the French, a faith in existing technology developed that was, in some ways, misplaced. And in the case of the Germans, a real inferiority in technology was surmounted through novel uses of what was available, resulting in significant (initial) military victories followed, eventually, by military defeats.

Each of these examples provides lessons to be learned, albeit negative lessons from societies that had difficulties dealing with their technologies. It behoves future military technologists to attempt to learn the lessons provided by these examples.

CHAPTER 3 – SOME TECHNOLOGICAL PERSPECTIVES

"Any sufficiently advanced technology is indistinguishable from magic." – Arthur C. Clarke

Turning from the historical examples and the lessons that may be applied from them to the acquisition and use of technology by the military, the paper will now look at some specific technologies and how they were adapted, are being adapted, or could be adapted into military society. In order to maintain a broad overview, examples of military technology acquisition from a broad spectrum of time frames will be examined. First, the past acquisition of the M-16 rifle by the US Military will be looked at, in order to show how preconceived notions can have adverse effects on equipment acquisition. Next, the current information age revolution, with the associated revolution in military affairs, will be looked at in detail, including the contributions this technology is making to the current revolutions in the Middle East. Finally, the possible future technology acquisition of Stratellites for long range communication links will be investigated.

THE US ARMY AND THE M-16 RIFLE

More often than is perhaps prudent, personal choices, personalities and even preconceptions can have a significant impact on military equipment acquisition. In some cases, society (or part of it) resists change, despite the fact that the change may bring improvements, merely because it is change, and change can be scary. The US Army's initial attempts to implement the assault rifle concept, through the acquisition of the M-16 assault rifle as a replacement for the M-14 battle rifle, serves as a quick example.

When the US Army was considering the possibility of an assault rifle, the task to examine the situation, evaluate contenders and choose a successful bidder fell to the US Army Ordnance Corps. This organization was ultimately responsible for all small arms acquisition, not only for the US Army, but ultimately for the all US forces.

Within this organization, a form of 'groupthink' came to dominate. Essentially, individuals were placed in this unit because of their expertise with weapons. Even if that expertise was not fully developed, upon arrival newly joined members quickly 'learned the ropes,' and the preconceptions that went along with them. Of significant note is the 'marksmanship' attitude that was pervasive in the unit, where the ability to hit a target at long range, albeit on the confines of a controlled rifle range in peacetime as opposed to in combat situations, was seen as the ultimate skill to which an infantry soldier should aspire.[42] This was just one example of the Ordnance Corps tendency to think in "… small time, insular, old fashioned" terms. As an institution, it was reluctant to stray too far from what they knew. Indeed, in many cases, "… when presented with a new technical possibility [its first instinct] was to reject it and stick to its own, traditional solutions."[43]

With an assault rifle, as compared to a battle rifle, there is less concern with long range accuracy. The concept emphasises short range firepower, preferably a weapon with a fully automatic firing mode. Ideally, both the weapon and its ammunition should be light and easy to take care of. Something practical for the soldiers slogging in the mud

[42] Thomas L. McNaugher, *Marksmanship, McNamara and the M16 Rifle: Organizations, Analysis and Weapons Acquisition*, (Santa Monica: Rand Corporation, 1979), 7.

[43] James Fallows, "The American Army and the M-16 Rifle," in *The Social Shaping of Technology*, ed. Donald MacKenzie and Judy Wajcman, 382-394 (Buckingham: Open University Press, 1999), 385.

of foreign countries, not something that performed admirably on the well-groomed shooting ranges on bases in the continental US.[44]

The M-16, a militarized version of the AR-15, fit the needs of the field soldiers spectacularly. But the Ordnance Corps was not impressed. As an example, one of the key performance requirements for any replacement rifle, as dictated by the Ordnance Corps, was a specific muzzle velocity, which the M-16 did not have. Despite the fact that this muzzle velocity had no impact on its suitability as a short-range, high firepower weapon, the manufacturer ended up using different ammunition to meet this requirement. This ammunition only served to make the weapon more difficult to keep clean, and contributed to numerous failures in the field. In the closing terms of the contract, the Ordnance Corps also insisted on significant, mainly cosmetic, modifications of the M-16 (manual bolt closure handle and increased rifling twist are two examples) all to meet their insular standards and preconceived notions. These changes resulted in the issuing of a notoriously inferior rifle, prone to jamming and failure, which did not meet the real needs of the soldiers in the field.[45]

This brief narrative shows an example of social construction of technology with unintended negative consequences. Essentially, preconceived notions resulted in the acquisition of inferior technology. In this case, the possibility exists that lives were lost directly as a result of this technology choice. But, once again, it is easy to look back at past events and criticize. The lesson that must be learned is that preconceived notions,

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[44] *Ibid*., 387.

[45] *Ibid*., 391.

both good and bad, exist, and must be dealt with as part of the technology acquisition process.

INFORMATION TECHNOLOGY

Moving forward to the present, information technology (IT), and some of the factors affecting how the military views IT, are now examined. Given the pervasive (near ubiquitous) nature of IT, impacting almost every aspect of today's society, it can be appreciated that this is, to put it mildly, a large subject. This paper looks at some aspects in a fair amount of detail, and glosses over others, with a view to focus on the socio-technological concerns that exist and that may be or become militarily important.

Similar to its affect on civilian organizations and business practices, IT has become essential in all aspects of the military's ability to perform administrative work. Standard office computers and productivity applications have all but eliminated certain administrative and clerical support functions. Gone are the typing pools and clerk cells of the past; everyone does their own 'paper' work these days. While some may decry the loss of clerical support staff and complain about the difficulties of mastering these new procedures, the fact is that military society has adapted to the new IT realities, in this case, as a way to maximize efficient use of personnel.

Outside of the office environment, more and more military functions are becoming 'computerized.' While there are definitely efficiencies to be made, the process of digitization is not without some difficulties. For example, in 1997, the USS *Yorktown* (CG-48), a test bed for the US Navy 'Smart Ship' program suffered a total system failure. This caused the ship to become 'dead in the water' for some time, reportedly even needing to be towed back to port. Apparently, the problem resulted when a crew member incorrectly entered a 'zero' in a data field, causing a 'divide by zero' error which brought down all machines on the network.[46] Despite initial problems such as this one, the US Navy is proceeding with the Smart Ship program. The ultimate goal of the program is to reduce crew requirements and thus save money. The determination to proceed despite initial problems is admirable. Naysayers may question this determination, but in the end, technical problems can eventually be solved, if there is resolve to do so. However, caution must be maintained; it would be too simple for an attitude of 'IT will solve all our problems' or 'IT will bring the boys home' to evolve.[47] Current success is no guarantee of future successes, and problems must be dealt with as they arise.

Looking at the concept of Network Centric Warfare (NCW), it is often seen as an attempt to translate a perceived information advantage into a tactical advantage. In other words, it is looking to figure out what to do with the glut of information that is available on the battlefield and make sense of it. Ideally, Data becomes Information, Information becomes Knowledge and Knowledge becomes Wisdom. But when the amount of data grows too large to handle, this process becomes problematic. In some circles, NCW is being touted as the next revolution in military affairs (RMA); as much as the civilian world is in the midst of an information revolution, so too is the military. Information technologies flow easily back and forth between those two parts of society, with military and civilian technology each being adapted for the other segment, to the point where it is

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[46] Gregory Slabodkin, "Software glitches leave Navy Smart Ship dead in the water," in *Government Computer News*, 13 Jul 1998. Available from http://gcn.com/articles/1998/07/13/software-glitches-leave-navy-smart-ship-dead-in-the-water.aspx; Internet; accessed 17 March 2011.

[47] Michael O'Hanlon, "Can High Technology Bring US Troops Home?" Foreign Policy no. 113 (Winter, 1998-1999): 72-86.

difficult to ascertain who started it first. "The central claim… is that, just as computer-based information and communications technology is changing the political, economic and social aspects of life it is also changing military affairs."[48] It is interesting to note that the proponents of this view are describing a heterogeneous system of technology and society, similar to the ideas presented by Bijke *et al* in their treatises on the social construction of technology. That is to say, separating these technologies from the societies that use them is a difficult, and possibly nugatory, exercise. Some of the advances that fall under the umbrella of this RMA include the potential evolution of 'smart' weapons (which accurately strike pre-programmed targets) into 'brilliant' weapons (which locate, identify and destroy targets autonomously).[49] There exist other parallels between civilian technology development and NCW; just as personal computers gained significantly in utility once they were networked together via the Internet, NCW seeks to network platforms, (aircraft, vehicles, soldiers, etc.) for unified target sensing, command and control and engagement.[50]

But Benbow goes on to ask some pertinent questions. Including, 'will it work?' 'are there counters to the RMA?' and, perhaps most telling, 'is it really revolutionary?' It is easy to dismiss such questions as being merely contrarian nay-saying, but that misses the point. Arguably, the answer to the question 'will it work' can probably be assumed to be 'yes… maybe eventually, but yes." As with the Smart Ship program, initial failures are not indicative of overall non-viability; technical difficulties will eventually be

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[48] Tim Benbow, *The Magic Bullet? Understanding the 'Revolution in Military Affairs'* (London: Brassey's, 2004), 79.

[49] *Ibid*., 79.

[50] *Ibid*., 83.

surmounted. As for counters, it is safe to assume that any technology will eventually have counters developed for it, and there will be counter-counters that will be developed for those counters, and so on and so forth. Such has been the case for military technology in most of human history, IT and NCW can hardly expect different treatment. But the key question, 'is it really revolutionary,' is likely best answerable by the counter question; 'does it really matter if it is or not?' Benbow goes on to suggest the true RMA will only occur with the development of truly 'futuristic' technologies such as nanotechnology, advanced artificial intelligence and so forth.[51] In the end, all this postulation accomplishes is to push the RMA forward to the next generation of advanced technology. What matters is, in the present, adaptation of civilian computer technology carries with it the promise of greater military efficiency. Whether or not the current technological development represents a true RMA, or even if the overall concept of RMAs is, in and of itself, a valid one, is immaterial to the successful adaptation of these technologies so as to contribute positively to military operations.[52]

In the meantime, the asymmetric enemy of today's conflicts, unfettered by any potential social baggage, has enthusiastically embraced the latest technologies, and is using them in novel ways. The Taliban is "a uniquely 21st century threat… both deeply embedded in Afghanistan's complex society and impressively agile."[53] The enemy is making huge inroads in leveraging social networking technologies, "organized not by

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[51] *Ibid*., 100.

[52] Colin S. Gray, *Strategy for Chaos* (London: Frank Cass, 2002) 12.

[53] Stanley A. McChrystal, "It Takes A Network," *Foreign Policy* (March/April 2011) available from http://www.foreignpolicy.com/articles/2011/02/22/it_takes_a_network?print=yes&hidecomments=yes&page=full; Internet; accessed on 17 March 2011.

rank but on the basis of relationships and acquaintances, reputation and fame… The enemy does not convene promotion boards; the network is self-forming."[54] If the information advantage is to be turned into a true tactical advantage, this novel use of new technology by the adversary must be countered. "We realized we had to have the rapid ability to detect nuanced changes… and process that new information in real time."[55] The enemy has become adept at forming ad-hoc networks, leading to the conclusion "It takes a network to defeat a network."[56]

These conclusions strengthen the need for military society to focus IT advances and advantages, in order to counter the adversary's novel use of these technologies. Unlike the French in World War II, agility must be maintained. However, as discussed later in the paper, there are other social pressures that interfere with the goal of remaining agile.

The use of decentralized decision making and rapid, lateral communications in and between the ranks of asymmetric adversaries, such as the Taliban, represent the rapid integration of new technologies and capabilities to meet their immediate needs. The concept of the 'Flash Mob' may have originated initially as a social science experiment, but today the same techniques allow terrorists to gather quickly, attack rapidly, and disperse swiftly, thus severely hampering the military's ability to track, pursue and persecute targets.

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[54] *Ibid.*

[55] *Ibid.*

[56] *Ibid.*

The most recent IT related developments in world society would be the rise of mobile computing and social networking. The recent activities in Egypt and Libya have also shown that social networking, in the hands of dedicated individuals, can accomplish the toppling of governments and initiation of regime change, without necessarily requiring bombs or firearms. In a recent TED talk (Technology, Entertainment, Design), Wael Ghonim, an Egyptian Google executive, discussed the recent Egyptian revolution.[57] He was one of the initiators of that monumental event, but all he simply did was create a Facebook page memorializing one of the victims of government sponsored violence. He refers to the event as 'Revolution 2.0,' where it was shown, beyond doubt he says, that "the power of the people is much stronger than the people in power."

Turning to the social networking site, Facebook, the rapid advance of this social media site can be mind boggling. A recent article in Business Insider reported that Facebook has passed 600 million users.[58] That number represents 8.9% of the entire population of the world. Put another way, one out of every 11 people in the world has a Facebook account. As it was put on a YouTube video,[59] if Facebook were a country, it would be the world's third most populous, behind China and India, with almost twice the population of the United States.

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[57] Wael Ghonim "Inside the Egyptian Revolution," *TED Talks*, available from http://www.ted.com/talks/wael_ghonim_inside_the_egyptian_revolution.html; Internet; accessed 21 April 2011.

[58] Nicholas Carson "Facebook has More than 600 Million Users, Goldman Tells Clients," *Business Insider* 5 January 2011, available from http://www.businessinsider.com/facebook-has-more-than-600-million-users-goldman-tells-clients-2011-1; Internet; Accessed 21 April 2011.

[59] sjsocialmedia, "Social Media Revolution – Fad or Here to stay?" *YouTube Video*, uploaded 19 October 2010, available from http://www.youtube.com/watch?v=iO2oDooDc0k; Internet; accessed 23 April 2011. This population comparison is only one of many fascinating indications of how social media has become pervasive in society.

Facebook, Twitter, Flickr, YouTube and Wikipedia represent significant changes in how society functions and interacts. News is no longer something you watch on TV at a specific time of day, or even all day. News now comes directly to you, and it can be targeted for you and your interests. It will show up either on your Facebook page, in your RSS (Really Simple Syndication) feed, or to your Twitter account, beamed to your mobile computing device. When the power of mobile computing and social media are combined, the result is almost instantaneous, worldwide distribution of events as they occur. When anything interesting happens in the world; from the banal to the controversial, from natural disasters such as the recent earthquake and tsunami in Japan to the current civil unrest in the Middle East; within minutes the information is spreading around the world. Within minutes, there are Twitter updates, photos posted to Flickr, full HD video posted to YouTube, and Wikipedia articles discussing the event in detail; these last are sometimes updated hourly as further developments occur. This is the truly revolutionary power of information technology in the 21st century; every single person on the globe has the ability, through easily acquired and widely available technology, to be the 'reporter on the scene.'

Looking specifically at Wikipedia; it is an online, collaborative encyclopaedia which consists of more than 3.6 million articles (in the English version). It is estimated that it represents on the order of magnitude of 100 million hours of human thought.[60] The range of articles and details within articles are expanding and updating every day, and its accuracy is purported to rival the print encyclopaedias of days gone by. While

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[60] Clay Shirky, "Gin Television and Social Surplus," available from http://www.herecomeseverybody.org/2008/04/looking-for-the-mouse.html; Internet; accessed 22 April 2011.

some Wikipedia articles do contain errors, it must be pointed out that even print encyclopaedias contain errors, and the advantage of this software based alternative is that errors can be corrected quickly.

General McChrystal's epiphany that "it takes a network to fight a network" represents the first, initial steps to integrate these monumental social changes, not only for the acquisition, design and use of military technology, but also for their effects on military society itself. This latter concern is also the subject of the "US Army Social Media Handbook."[61] As with any new technology, the possibilities for contribution to military operations are significant, in both positive and negative ways. This technology must be socially constructed, so as to maximize the former and minimize the latter.

The social media applications listed above represent revolutionary software. But hardware has been undergoing some amazing revolutions also. It has taken a bit longer in time, but if a large enough measuring stick is used, the change is astounding. Specifically, going back 30 years to 1982, the greatest advance in portable computing to date was just announced: the Osborne Executive portable computer. Today, portable computing is all about smart phones, such as Apple's iPhone. Comparing the two; the Osborne is 100 times heavier, takes up almost 500 times as much volume, and cost 10 times as much, but the iPhone has 100 times as much computing power (as measured by processor clock speed).[62] Again, the time between the two is long; 30 years is essentially

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[61] US Army Social Media Handbook, January 2011, Office of the chief of public affairs. Available from http://www.carlisle.army.mil/dime/documents/Army%20Social%20MediaHandbook_Jan2011.pdf; Internet; accessed 22 April 2011.

[62] Wikipedia article on Moore's Law, available from http://en.wikipedia.org/wiki/Moore%27s_law; Internet; accessed 17 March 2011.

an entire human generation. But because of these advances in mobile computing, people today all over the world have easy access to a hand held device that is a combination of a sophisticated communication appliance as well as a powerful, general purpose computer. The military must adapt to the challenge of the availability of that hardware. Interestingly enough, military applications have already begun to be developed to take advantage of the capabilities provided by mobile computing. One example is called 'Bullet Flight.'

Bullet Flight is a ballistic calculation application, designed to rapidly determine long range sniper firing solutions in tactical scenarios. It may be one of the first military applications for mobile computers, but the potential for this form of computing to contribute to military operations has been recognized as significant.[63] Bullet Flight is available through the Apple iTunes store, and comes in three versions. The "heavy" (military level) version costs $29.99 and runs on Apple's iPhone or iPod touch. The company also produces an adaptor mechanism to strap the device to the weapon to enhance ease of use.[64]

> *"Are you a Sniper who needs to make detailed calculations to ensure that first shot finds its intended target? There's an App for that."*

But one of the most interesting things about the mobile computer revolution is the implications for the current standard for general computing platforms. Of the three, current, market leaders for mobile computing (Apple's iPhone, Google's Android phones

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[63] Barry Rosenberg, "Why Smart Phones Might Become the Army's Secret Weapon," *Defence Systems*, 21 May 2010, available from http://defensesystems.com/articles/2010/06/07/c4isr-1-cerdec-handheld-devices.aspx?s=ds_160610&admgarea=TC_DEFENSE; Internet; accessed 24 April 2011.

[64] Knight's Armament corporate website, available from http://www.knightarmco.com/bulletflight/index.htm; Internet; accessed 17 March 2011.

and HP's Palm phones), none of them use processors made by the Intel corporation and none of them run on Windows-based operating systems from Microsoft. The shared hegemony position so long enjoyed under the 'Wintel' alliance is, in many ways, 'missing the boat' in terms of the mobile computing revolution. At this point, current military computer solutions are, essentially, exclusively Wintel based hardware, operating systems and applications. In the past, there has been consternation when older versions of these components were no longer supported by the original manufacturer, essentially forcing the military to upgrade. What will be the impact on military computer systems if these two companies find it difficult to remain in business, and their technology is simply no longer available? Again, this provides an excellent example of society driving technology, potentially causing an issue for the military to deal with in terms of technology acquisition. Technology is always changing, and information technology changes at a pace that sometimes boggles the mind. The challenge for the military is the ability to adapt to the fast pace of change. But the complexity is not just about barely keeping up with technology, but trying to predict where technology will go, and trying to anticipate how your adversaries will use that same technology, potentially in novel ways, in order to defeat you.

STRATELLITES

In the final section looking at technology issues, the paper examines a potential future technology that may face challenges to adoption. This situation exists despite the fact that, at least in some ways, it offers improvements over current technical capabilities. Essentially, the existing 'tried and true' solutions prevent consideration of new technology. For the purposes of this analysis, it will be necessary to go into some technical detail about how the army copes with the problem of long range operational communications.

For normal, tactical level communications, the military normally relies on Very High Frequency (VHF) radio transmissions. These have generally good bandwidth capacity for both voice and data communications, and overall good range, albeit limited by line of sight. Long range, beyond the horizon, strategic level communications, used to link theatres of operation back in to national communication systems, have become reliant almost exclusively on satellite communications over the past 20 years. These systems, although expensive, offer much greater bandwidth and reliability than the long range, High Frequency (HF) systems used before that time.

There are situations, either due to distance or intervening terrain, where standard VHF equipment is not able to provide the medium range links needed for operational level communication interfaces. In a 'mechanized combat in central Europe' concept, this problem was solved through the use of radio re-broadcast (RRB) systems, which used multiple links to extend range and go around or over mountains. Essentially, by placing a pair of VHF radios between two command posts beyond the range of normal systems, with each station using a different frequency and the RRB automatically rebroadcasting all traffic from one frequency onto the other and *vice versa*, the range of standard VHF equipment could essentially be doubled. Multiple RRB links were also possible, though rarely used. This sort of situation was more an exception than a rule, as in these scenarios (again, 'mechanized combat in central Europe'), operations occurred over relatively small amounts of terrain, and this form of communication link extension was needed only occasionally.

In modern operations in theatres such as Afghanistan, however, such extended ranges are much more common, as the force will patrol out over large areas of territory. However, the use of RRBs is generally problematic, as the tactical situation does not allow for a small detachment of two or three people to be located by itself in the area of operations, due to security issues. Because combat troops cannot be spared simply to guard a minor communication post, an alternate solution had to be found in order to provide in-theatre, long range (beyond line of sight) communications. For the most part, the military has turned to satellite systems. Thus, the same technologies used to provide strategic level communication links halfway around the world are being used for relatively short, over the horizon, operational links.

In many ways, this has a 'using a sledge hammer to smash a fly' kind of feel to it. The requirements for communication links are met, and, as the old saying goes, 'if it's stupid, and it works, then it ain't stupid.' But the idea of using such powerful and capable equipment for a relatively short link just seems to be, in some ways, a waste of resources.

Other concerns exist also. As was seen during the Op HESTIA deployment to Haiti, multiple organizations, including the environmental components and other government departments, as well as allies and even media teams, were all requesting satellite communication links to operate during the disaster relief mission. These links are generally controlled by a small number of civilian corporations, and there are never enough to meet everyone's demand. And in that sort of situation, the group that gets there first (with the most money) wins.

However, an alternate solution for long range operational communication links exists, albeit theoretically, in the form of Stratellites.[65] These are, essentially, medium altitude, long endurance UAVs, which look very much like blimps or airships. 'Medium altitude' might be a bit misleading; Stratellites are designed to operate in what is termed 'near space' at altitudes of approximately 65,000 feet. These systems can provide wireless, beyond line of sight communication links, with one system providing an area of coverage of around 480,000 square kilometres. This coverage could therefore easily support communication links used by troops deployed on, for example, a domestic operation that spread across all of south eastern Ontario and western Quebec, from Toronto to North Bay to Quebec City and even into upper New York State. In an international scenario, one Stratellite system as detailed above could provide communication coverage for almost the entire country of Afghanistan. Theoretically, such systems offer significant advantages over standard communication satellites, and their use would free up satellites for the long-haul communications that Stratellites could not easily do. While such systems are being proposed by their manufacturer primarily as an alternative to installing cell phone tower infrastructure, and thus provide wireless communications in areas of rough terrain or low population density, the military applications, not only for in-theatre beyond line of sight communications, but also for high altitude, persistent surveillance, are obvious. Yet, given that satellite technology exists, and is deemed 'good enough,' the likelihood of such technology receiving the funding necessary for further development is very low. It becomes a 'chicken and egg'

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[65] World Surveillance Group corporate website, available from http://www.wsgi.com/stratellite.php; Internet; accessed 21 April 2011.

problem; nobody wants to invest in the technology until it is proven, but it cannot be proven without sufficient investment funds.

This institutional resistance to change is a negative example of the social construction of technology. Where new technology is deemed to ‘not fit in’ to the society, its likelihood of adoption is dramatically lowered.

SUMMARY OF TECHNOLOGICAL PERSPECTIVES

Improvements in technology have always carried the possibility of improvements to military affairs. This is one of the key generators of the military’s fascination with technology; the hopes for greater efficiencies and effectiveness, combined with concurrent fears of technological obsolescence. From these examples it is clear society’s views on technology can have a significant impact on how that technology is adapted, developed and used. This impact ranges from the resistance to change and fear of the unknown, to the uncontrollable adaptations of whatever seems to be new and useful, without further considerations. Clearly, as new military technologies are developed and adopted, these social factors must form a significant part of the considerations involved in those processes.

CHAPTER 4 – SOCIETAL CONSIDERATIONS

"What is not good for the beehive, cannot be good for the bees." – Marcus Aurelius

Having looked at some historical examples of the relation between society and technology, as well as some specific technology examples, the paper will examine some specific aspects of society as a whole that affect the military acquisition and use of technology. As a full examination of all ways in which society affects military technology would be prohibitively large, this paper will simply focus on a few items, and try to draw lessons from them. Specifically, an examination will be made into the role that the military industrial complex plays in the acquisition of military technology, and how the military itself contributes to that role. Also, an attempt will be made to evaluate the relative importance of the companies that form this sub-component of society, based on their overall contribution to the economy. Some socio-technological factors will also be looked at, specifically how they can contribute to where technology is being updated and where it is languishing. Finally, some miscellaneous considerations for technology and society will be looked at.

THE MILITARY INDUSTRIAL COMPLEX

As Bijker and his compatriots discuss in their works on social construction of technology, any study of technology, especially from a sociological point of view, inevitable finds difficulty because of the heterogeneity of the problem. Technologies inevitably involve a large variety of different groups of people, and it is difficult, if not impossible to determine which group is the one that is crucial to the technology's eventual success. They attempt to list at least some of the concerned parties:

> "… individual inventors, research scientists, designers and design engineers, production engineers, sales and marketing teams, bankers and financial advisors, lawyers, politicians and state officials, and, of course, consumers – whether individuals, firms or state agencies."[66]

Thus, the military industrial complex (MIC) is, obviously, a key player in the social dynamics surrounding military technology. However, the name itself is a bit of a misnomer. What exactly is the military industrial complex? What does it consist of? That it is probably complex is certain, but the term seems to imply it functions as a single entity. Even ignoring the obvious competition between and amongst military contracting companies competing for the same contracts, it is likely equally certain the actions of the MIC are far from the actions of a single, organized entity. A simple investigation of the MIC can lead to some basic conclusions.

The MIC itself drives many of the equipment acquisition procedures the military deals with on a daily basis. For military equipment, especially complete weapon systems, the system is only tangentially linked to the standard economic model of supply and demand. In one specific example: the state is both the purchaser and the consumer. In military contracts, price is usually based on cost plus mark-up, with the only limit being the military budget. Shortages or overproduction are usually due to mistakes rather than an indicator of consumer inclination. Thus, normal market analyses do not always apply to the MIC.[67]

The system is further complicated by the fact that militaries, and those who acquire technology for them, "have an inherent tendency to define and anticipate current

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[66] Bijker *et al*, *The Social Construction of Technological Systems*, 308.

[67] Mary Kaldor, "The weapons Succession process," in *The Social Shaping of Technology*, ed. Donald MacKenzie and Judy Wajcman, 406-418 (Buckingham: Open University Press, 1999), 407.

contingencies based on past experience."[68] In other words, this is the 'buying the perfect technology for fighting the last war' phenomena, similar to what the French did with their Maginot Line.

Kaldor further postulates that, in some cases, the resistance shown toward that which is new stems from the fact that the ultimate test of military technology, and the capability it provides, is war. In the absence of war, the military tends to be conservative. Indeed, she says "Institutional resistance to major innovations… has been extensively documented." She lists the longbow, the breech-loading gun, the machine gun and even the tank, the submarine and the airplane, as examples. The issue is that only through hindsight is the ultimate judgement on the significance of developments in military technology allowed, so technologies that have been 'proven in battle' enjoy greater confidence than those not so proven.[69]

She goes on to argue that, despite some obvious examples to the contrary, "one of the lessons of World War II was the importance of technical superiority." However, the Soviet Union, she argues, placed greater emphasis on simplicity and quantity rather than technical superiority. The old saying of 'quantity has a quality all its own' appeared to be a mainstay of Moscow strategic thought during the cold war period. The difference in their supply institutions led to the conclusion that "The mass production capabilities of

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[68] *Ibid*., 409.

[69] *Ibid*., 409.

the United States and the Soviet Union were probably, in the last analysis, the decisive factor in World War II."[70]

Looking at supply institutions; in effect, those companies that supply military technology, Kaldor divides them into two main groups, depending on if they are associated with invention or innovation. The former are more likely to develop 'revolutionary' technology that challenges the status quo of organization or doctrine. The adoption of these technologies is more likely to be subject to institutional resistance, as described earlier.[71]

Those companies associated with innovation face the ongoing dilemma; as they depend on inherent technological capabilities to obtain more contracts, they find that they "… cannot afford to disband design teams."[72] They become more involved with continuous development rather than production, and less likely to develop 'revolutionary' technology.

These companies are driven to obtain new orders as soon as development of existing systems is complete, in what is known as the "follow-on imperative." The competition thus created between contractors focuses on technological issues rather than price; the award of a contract usually implies the requirement to pursue development regardless of cost, resulting in cost overruns. Thus, companies compete by offering technological improvements.

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[70] *Ibid*., 410.

[71] *Ibid*., 411.

[72] *Ibid*., 412.

However, the challenge that emerges is that “new technologies can only get through the innovation and integration stages if they conform to the requirements of the dominant scenario,” which is usually old, outdated, based on unchanged performance parameters, and fails to consider the latest technological advances.[73]

While Kaldor’s analysis of this part of the military technology acquisition system was written more than 10 years ago, the overall conclusions are still relatively accurate. Thus the frustrations found in dealing with the military industrial complex are, essentially, products of the procurement procedures that are as much a part of military society as drill and weapons practice. In other words, they are socially constructed from military technological desires and limitations. President Eisenhower’s farewell address to the US people in 1961 contained a warning of the dangers of the military industrial complex gaining too much power and endangering the democratic process. After 50 years, those warnings appear quite prophetic. But, as discussed above, those dangers are the result of the societal inputs to the entire military technology acquisition system. This is not to say they are inevitable, but rather, since it is essentially military actions that gave rise to them, it is up to the military to correct the situation.

Any discussion of the military industrial complex invariably paints it as a large, potentially evil, singular organization, but perhaps some basic statistical analyses can provide some sober second thoughts in this area.

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[73] *Ibid*., 412.

Each year, Fortune magazine releases the 'Fortune 500 List;' the list of the largest 500 companies in the US. [74] The list ranks these companies by the most basic parameter: gross revenue. Although it also notes profits, market capitalization and other metrics, the people who control this list have determined that, when it gets right down to it, the most important statistic for any company is its gross revenue, or how much money that company caused to change hands in a year.

The list also groups these 500 companies into various industries, based on their primary revenue source, and then compiles additional industry statistics for those groupings. The focus of the following basic statistical analysis will be placed on the 'Aerospace and Defence' industry, which equates, for the most part, to the MIC. From the 500 companies that made it to the 2010 version of the Fortune 500 list, there are 14 that are in the Aerospace and Defence industry. This group includes giants such as Boeing, Lockheed Martin and Northrop Gruman, as well as 'smaller' companies such as Precision Castparts, Textron and Rockwell Collins. This is not to say that these 14 companies are the only companies in the MIC, but rather they are the largest 14 companies that generate revenue primarily within the Aerospace and Defence industry. Other companies exist in the MIC, but as they are not Fortune 500 companies, they do not appear in this grouping of the 14 largest MIC companies. Based on the information from the 2010 Fortune 500 list (using data from fiscal year (FY) 2009), those 14 companies generated a total combined revenue of just over $349 Billion, and employed a total of 1,135,300 people.

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[74] The statistics and information that follows in the paper come from the most recent Fortune 500 list; for simplicity, only this one footnote is made. The list is available from http://money.cnn.com/magazines/fortune/fortune500/2010/; Internet; Accessed 17 March 2011.

At first glance, these numbers appear significant and large, almost daunting. And they are, without a doubt, impressive numbers. $349 Billion is a large amount of money. However, to bring this number into perspective, the statistics from the Aerospace and Defence industry can be compared with those from the Petroleum refining industry. From the same Fortune 500 list, the Petroleum refining industry consists of 12 companies. During the same time period, that industry generated just under $818 Billion in revenue, more than double the Aerospace and Defence industry, but employed only 288,197 people, only one quarter as many. While the Aerospace and Defence industry is a significant contributor to the overall economy, it can be concluded from these simple statistics that the Petroleum refining industry is, essentially, bigger, and perhaps more important to the economy.

For a second comparison, the 14 companies of the Aerospace and Defence industry can also be compared with a single company, all on its own. Specifically; Wal Mart. Wal Mart, in the same fiscal year, generated $408 Billion in revenue, and employed 2,100,000 people. That represents 17% more revenue, and almost twice as many employees, as the Aerospace and Defence industry, all within a single company. So, what do these two comparisons mean? Admittedly, these comparisons are based on statistics, and are thus open to many interpretations. But, for the purposes of this paper, the comparisons serve to put the military industrial complex into perspective. Given one person's, usually meagre, individual finances, when numbers such as $349 Billion are quoted, it is easy to become overwhelmed by all those zeros. While it is true the military industrial complex is large, it is also true that it is not abnormally so, when compared to other industries, or even, in one case, a single company. A sense of perspective must be kept, in terms of the MIC's overall impact on the whole economy, compared with the impact of other industries.

PATH DEPENDENCE AND NETWORKING

The next concept to be examined is Path Dependence. Essentially, the concept is that decisions made in the present or near future are strongly affected by decisions made in the past, even though past circumstances may no longer be relevant in the current situation. From a technology point of view, this means that potential improvements in technology are resisted, sometimes for no other reason than 'because that's the way we've always done things.'

The classic example is the QWERTY keyboard layout. This is the keyboard in widest use today; essentially, every computer sold more than likely has the familiar QWERTY keyboard layout, so named because of the first six characters on the first row of keys. The original QWERTY design was developed in the late 19th century when it was first used on typewriters. In those days, pressing down on a key caused a hammer to rotate upwards, via a series of levers, and strike the paper through a pre-inked ribbon in order to mark the paper with a character. This is one of those technologies that, when described to 'the kids of today,' it appears almost unbelievable. At the time of its development, one of the primary design requirements of the layout was to ensure the hammers did not get fouled as typists worked. As typists became familiar with the layout, they began typing at increasing speeds. The mechanical linkages were such that, when typing speeds became too high, the hammers would jam together. Also, in one of the final changes to the layout, a minor reordering of keys was made, placing the 'R' key on the top row. This was to make it easier for salesmen of the device to peck out the brand name “TYPEWRITER” using only the top row of keys as a demonstration technique. With very few changes, that keyboard layout is still in use today.

The QWERTY layout is not optimized for fast or efficient typing. It is generally accepted that most people in the world are right handed, and yet, the QWERTY layout allows thousands of English words to be typed using only the left hand, while only a few hundred words can be typed using only the right hand. Even the ‘slanting’ layout of the keys, where one row is offset by half a key from the rows above and below it, was required to allow the installation of the levers between keys and the hammers, not to make it easier to type.[75]

Despite all this baggage from times gone by, modern computer systems still use this keyboard layout. The most recent, advanced mobile and tablet computer systems, such as the iPhone and iPad, lack any physical keyboard at all. But on these devices, the standard arrangement of keys is the same developed more than 100 years ago.

Other layouts exist; one example is the Dvorak layout, developed in the 1930s. Proponents of this layout claim it reduces finger travel and uses more alternation motions between the two typing hands, allowing not only for faster typing, but even purportedly contributing to lessened incidence of repetitive strain injuries such as carpal tunnel syndrome.[76]

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[75] Wikipedia article on the QWERTY keyboard, available from http://en.wikipedia.org/wiki/Qwerty; Internet; accessed 21 April 2011.

[76] Wikipedia article on Dvorak keyboard, available from http://en.wikipedia.org/wiki/Dvorak_Simplified_Keyboard; Internet; accessed 21 April 2011.

Yet, even with better alternatives in existence, the odds of a different keyboard arrangement becoming standard are exceedingly low, because of the path dependence that provides significant resistance to change. It is simply too difficult to teach everyone how to type all over again, so it is easier to carry on with the existing technology rather than adopting a 'better' one.

Another factor that affects the adoption of technology is known as the networking effect. Essentially, the value or usefulness of certain products or technologies increases as more people become users of that technology. In some cases, new technologies are slow to be adopted, if at all, because they cannot get past the 'tipping point' of sufficient, initial acceptance to be useful. Once again, this generates a 'chicken and egg' scenario, where the technology needs people to adopt it to become useful, but it's not useful until enough people adopt it.

A simple example is the telephone. Theoretically, the first person who bought a telephone had to wait for the second person to buy a phone before he could make a call. But as the number of phones in use increases, the more useful those phones become to all the people who own them, to the point where it is considered a technology that is vital and compulsory in society. This can also result in the bandwagon effect, as more and more people are encouraged to adopt a new technology and it becomes the *de facto* standard. This is, perhaps, an overly simplified example, but it serves to illustrate the concept.

From a military standpoint, this may be why so many militaries use 5.56mm ammunition for small arms, 155mm ammunition for artillery guns and diesel for vehicle fuel. There are savings and economies to be realized when allied militaries can agree upon and implement these standards, contributing to efficiency and effectiveness. This is especially true in multi-national operations. When considering new technology, competitive bids that maximize such efficiency, effectiveness and interoperability are considered more favourably than those that do not.

In the world of information technology, networking and path dependency contributed to the 'Wintel' hegemony, where the vast majority of personal computers used processors designed by the Intel Corporation and the Windows operating system developed by Microsoft. However, as noted earlier, this hegemony is beginning to fail, with the rapid proliferation of handheld computers that use neither Microsoft operating systems nor Intel processors. Similarly, online social networks such as Twitter and Facebook become more useful as the numbers of users increase. However, the development of such standards can have a negative effect on future technology, as has been seen when newer, better technology is resisted because it is not 'the standard' that everyone is using. Such standards, and their longevity, can be difficult to predict. In the IT world, it used to be said that 'nobody ever lost their job by recommending IBM,' this later changed to '… recommending Microsoft.' But standards have been known to change, due to social pressures on them, and technology that is purchased because it 'was' the standard may well become obsolete in the future.

In other cases, the path dependence and networking can result in standards that, if they were to be replaced, would result in efficiencies, but these effects can sometimes work at odds to each other. An example is Railway gauges. Standard Gauge (the distance between the two rails of a railway system) is fixed at 4 feet, 8½ inches. While this is possibly a strange measurement (why not 4 feet 8 inches, or even 5 feet, for simplicity?), the point is, 60% of the worlds railways use this gauge measurement (including all of those in North America and Europe). Despite this fact, there are still at least seven, additional, different, widely used gauges, and literally dozens of other, lesser used gauges throughout the world. In places where railways of two different gauges meet (for example; at some international borders), significant effort must be expended to allow traffic (passengers and freight) to continue their journey from one country to the next. This is known as a 'break of gauge' and adds significant cost and inconvenience to such trips. At these break of gauge locations, in some cases, the seemingly complicated but accepted solution is to switch out the wheel assemblies (bogies) on the rail cars between gauges.[77]

These are all examples of how society influences technological development, sometimes not for the best. Sometimes, technology develops in ways that seem, upon deeper examination, to make no sense. Good technologies are not developed because of the resistance to change that is common in society. Also, technology must sometimes first reach a 'tipping point' for societal acceptance; when that is reached, adoption is often rapid and wide ranging. Once again, these analyses lead to factors that must be considered whenever technology is being looked at, developed and adopted.

SOCIOLOGY OF TECHNOLOGY

In the final analysis of social factors and the interactions thereof with technology, some miscellaneous sociology points will be examined.

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[77] Wikipedia article on Rail Gauge, available from http://en.wikipedia.org/wiki/Rail_gauge; Internet; accessed 21 April 2011.

In the introduction, a brief mention was made of the 'action-reaction' cycle of arms control theory. Essentially, this theory states the advances in military technology, made through scientific development, is fed by a series of actions and counter actions that occur between countries. This leads to a succession of defensive and offensive technology improvements, each designed to counter the other. These cycles can be observed and thus defined, but it appears the relationship between technology improvements and weapon design is not as clear cut as might be supposed. "Examination of this history of the arms race suggests that non-scientific factors have preempted [sic] what might be logically predicted on technical or even military grounds."[78] It may be concluded that the 'non-scientific factors' referred to by Panofsky are social inputs to technology; it is interesting to note that these facts appear to have significant impact even at the level of strategic arms technologies.

Looking at one aspect of technology, specifically, that of design, studies have shown that it carries a greater impact on technology than what is generally accepted by most organizations. However, there are exceptions. Apple Inc. is famous for making sure that its products are not only functional, but are well designed and easy for non-technical people to use. For Apple, this is not an optional part of their product development process. Indeed, in a 2003 interview published in the New York Times, Apple CEO Steve Jobs expressed his company's dedication to design;

> "Most people make the mistake of thinking design is what it looks like. People think it's this veneer – that the designers are handed this box and

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[78] Panofsky, *Science, technology and the arms race*, 353.

> told 'make it look good!' That's not what we think design is. It's not just what it looks like and feels like. Design is how it works."[79]

This sentiment is not just the opinion of one company CEO. Scientists have proven that technology that is attractive to users actually tend to work better, with fewer user difficulties and frustrations. In an experiment with ATM machines, two Japanese researchers studied various layouts for ATM controls.[80] All these layouts were basically identical in terms of the operations they controlled and the numbers of buttons. But some were arranged in a more attractive manner; in other words, they were designed to be more aesthetically pleasing. And the experimenters found that the attractive layouts, despite having the same functionality, were perceived to be easier to use. A pair of Israeli scientists, thinking that there must be some Japanese cultural dependencies that affected the experiment's outcome, sought to replicate the experiment in order to show these cultural dependencies.[81] They were shocked to discover that not only were the original findings replicated, the results were even stronger in Israel than in Japan.[82] This is an extremely powerful example of how social factors can affect technology. If people have a preference for good design, if good design can actually make something work better, than the success or failure of a particular technology could rely as much on its design, or how users interface with it, as its ability to meet specific performance requirements.

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[79] Rob Walker, "The Guts of a New Machine" *New York Times*, 30 November 2003, available online from http://www.nytimes.com/2003/11/30/magazine/the-guts-of-a-new-machine.html; Internet; accessed 21 April 2011.

[80] M Kurosu and K Kshimura, "Apparent usability vs inherent usability: experimental analysis on the determinants of the apparent usability," in *Conference companion on Human Factors in computing systems* 292-293 (Denver, Colorado, United States, 1995)

[81] T. Lavie and N. Tractinsky "Assessing dimensions of perceived visual aesthetics of web sites," in *International Journal of Human-Computer Studies 60*, 3 (March 2004), 269-298.

[82] Donald Norman, *Emotional design: why we love (or hate) everyday things* (New York: Basic Books, 2004), 17-18.

Of course, improvements and developments in technology (both civilian and military) are also subject to spreading or diffusion from one culture to another. Historically, as military organizations encountered new, potentially superior, technologies on the battlefield, not only in terms of hardware, but also in terms of doctrine, tactics and other methodologies, they would seek to emulate or acquire those technologies. Logically, this should lead to the rapid and systematic spread of all military technologies around the world. However, studies have shown that such diffusion is subject to significantly more variation than originally expected. Once again, the sociological impact on this factor of military technology is seen. Specifically, it was found that "innovations requiring significant changes in sociocultural values and behaviour patterns spread more slowly, less uniformly, and with more unpredictable outcomes."[83] These findings are being applied to discussions surrounding the current RMA involving information technology. To wit, one key factor in the RMA will be the consideration of which nations (or even non-state actors) are most proficient at adapting these new technologies for military uses.[84] From theses studies, it can be concluded that it is these social factors that will have perhaps the greatest impact on these adaptations.

Although it was stated that the military is clearly and inextricably linked to technology and the pursuit of technological improvements, it is also generally accepted that technology is but a single link in the chain that leads to military success. As Jon Connell put it, somewhat strongly:

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[83] Emily O. Goldman and Leslie C. Eliason, ed; *The Diffusion of mililtary technology and ideas*, (Stanford: Stanford University Press, 2003), 9.

[84] *Ibid*., 9

> "The greatest fallacy in modern military thinking is the notion that somehow hi tech can do it all, that endless refinements in military hardware can be a substitute for the more traditional military arts. We may fondly imagine… that scientists can take all the effort out of defence and that microchips and pieces of metal, if only they can be configured the right way, are all we need. But history suggests it is a delusion. Defence is not a video game. You do not win wars simply by pushing buttons."[85]

Most military people would say the above is merely a truism, something that is known, accepted, understood and followed. But history has indicated that it is a lesson that gets forgotten, and thus needs to be re-learned regularly.

When examining the historical example of the initial German success in World War II, superiority of technology is seen as playing only a minor role. The fighting spirit and élan of the German soldiers, compiled with the radical use of armoured vehicles known as *blitzkrieg*, compensated for the German technological inferiority. This is perhaps the most significant example of how military technology is socially constructed. In the end, military technology does not exist in a vacuum. The use of technology is guided by doctrine and best practices; as new technologies are developed, new doctrine must be created to take these new capabilities into account. It is also possible that new technologies will allow for radical improvements or changes to doctrine. Technologies also inevitably demand maintenance and support, and those demands may themselves require new technologies to support them. The best technology in the world is useless if it cannot be maintained in an efficient and effective manner. Technologies will also drive the research into new technologies, either as replacements or improvements and upgrades. Finally, technology is used by people; soldiers, sailors and airmen and women, to perform military tasks. Those people need to be trained in how to use that technology,

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[85] Jon Connell, *The new maginot line* (London: Secker & Warburg, 1986), 3.

and that training can itself take advantage of technological changes and improvements. Any technological program must always remember to take all these social factors in to account.

SUMMARY OF SOCIETAL CONSIDERATIONS

Society is irrevocably intertwined with its technology. As new technologies develop, the decisions on how they are adopted into society are made by society itself. But the reasoning behind those decisions is not always clear, not always immediately apparent to the developers of technology. From the machinations of the military industrial complex, to path dependencies that lead to surprising limits on technological adaption, to the importance of design and aesthetics, the interaction between society and its technology is significantly complex. However, from a military point of view, it must be remembered that technology is not, by and of itself, the only factor in victories. Good planning, fighting spirit and the ability to make maximum use of tactical, operational and strategic opportunities that present themselves are equally as important.

CHAPTER 5 –CONCLUSION

In this short examination of the social factors that affect the acquisition and adoption of technology for military uses, data has been considered from a broad range of time; from 17th century Japan to the current revolutions in the Middle East; a span of more than 400 years. Various technologies have been looked at also; from future technologies that may become adopted, to the latest developments in social media, to past developments of basic military technologies such as small arms.

The military will always, for very good reasons, be interested in technology and technological developments. In the end, good technology can be a game changer; a major contributor to either defeat or success in any military endeavour, not just combat.

The two primary theories in this area, introduced in the opening chapter of this paper, are technological determinism and social construction of technology. This paper has shown that taking a broad view of what technology is and how it relates to society at large is necessary. Further, just as Bijker *et al* concluded, these theories are not, strictly speaking, alternatives. It is not a case of one being correct and the other being wrong. In actuality, it would appear that the social construction of technology theory includes the concepts found in the theory of technological determinism. In general, the manner in which all the various sub-component organizations and technologies within society interact with each other is socially constructed, not deterministic. This applies to military society also.

That is not to say that technological determinism is without merit. Indeed, there will be times when it appears that technology is what is driving society, rather than the other way around. But by taking a broader view, it can be found that the apparent deterministic nature of the technology in question is, in reality, itself socially constructed. Thus the deterministic factors can be offset and pushed back so as to drive the technology where society wants it to go.

It was not the intent of this paper to examine in any detail whatsoever the current military equipment procurement process. Such a study would demand detailed research and analysis so as to be far beyond a simple master's level study. Instead, in the introduction a series of questions was set out that arise when the issue of where the military is going with respect to technology is considered. These concerns and quandaries are on the minds of anyone involved in the acquisition process the military employs to procure equipment and capability. At least, if those questions are not on the minds of those people, they probably should be. It was accepted at the start that these questions may not be fully answered by this paper; indeed, the questions may not be fully answerable at all. But from the examples given and analyses made, guidelines may be developed in order to steer some of the thinking of those interested in the future of military technology.

Most importantly, technology cannot simply be ignored, nor can its effects on society be dismissed. That is not to say that those effects are beyond some form of control, but the effects must be analysed, determined in detail what they are and then decisions must be made about what to do about those effects. If new technologies, or improvements to existing technologies, are ignored, then it is possible (to the point of inevitability) that one's adversaries will adopt those technologies faster and more efficiently, and there will be consequences to suffer.

In any military planning process, assumptions must inevitably be made. Information is never complete, but planning must go on. As taught during senior military training courses, any assumptions made must be made carefully, and must be verified for truth as quickly as possible. This paper concludes that this is just as important for assumptions related to military technologies as it is for any military matters. If assumptions are found to be incorrect, then changes to the technological path must be made. These decisions are important even if they mean, from a technology point of view, abandoning certain existing (and comfortable) technological paths in favour of those implied by the new information, and accepting the difficulties such abandonment may cause.

Any perceived technological superiority enjoyed at any time cannot be allowed to develop into complacence. Not only is such superiority fleeting, but recall that technological superiority does not always guarantee military success. This paper examined just one of many cases where an adversary was able to use their available technology, even inferior technology, in novel ways in order to achieve victory. In other words, technology alone will not solve the military's problems.

There will be times when the technological advantage will belong to the adversary, even if only fleetingly. Rather than despair, novel ways must be found to use existing technology, even if it is inferior. Opportunities that present themselves to overcome any technological superiority the adversary may have must be taken advantage of.

Technological development is a complex issue. There will be situations where the correct application of the correct technology will resolve an issue, but it is also inevitable that the introduction of new technologies, designed to solve certain problems, will themselves introduce new problems to solve. This is not to say that new technology should not be pursued, but simply that new technology must be carefully integrated into the current systems and current society, and vigilance must be maintained in order to determine any possible negative second and third order effects of that technology.

Technology is ever changing, and the changes occur rapidly, often unpredictably. Things taken for granted today were unimaginable only few short years ago. Likewise, what will be taken for granted a generation from now is impossible to imagine today. Technological developments must be monitored; those changes must be adapted to. There will be times where revolutionary or otherwise significant changes will completely invalidate past technology related decisions. At that point, the technologies that were embraced in the past must be abandoned, in order to gain full effect of the new technologies. In other words, if a negative 'path dependant' situation develops, the potential costs or difficulties of abandoning the path must not prevent such abandonment, so as to attain maximum efficiency.

The military must remain open to change, even if (or perhaps especially if) that change challenges the *status quo*. The phrase 'but that's the way things have always been done' is not a reason to do anything, it is an excuse to not move forward and improve. Societal prejudices and path dependencies must be considered when acquiring technology. Resistance to change is a natural human tendency, and the military is equally subject to this behaviour, as is any part of society. Prejudging and rejecting a new technology simply because it will result in change will quite likely result in a lost opportunity to improve efficiency or effectiveness. That is not to say that all new technologies should be embraced without thought, but if the only reason a technology is rejected is because it duplicates existing technology, perhaps the situation needs to be looked at in greater detail.

Technological agility must be maintained. The watchword for future technology production and acquisition is ‘configurability.’ A widget that does only one thing is not as useful as widget that can do many things; ideally it should be able to be configured to do things in the future that cannot even be thought of today. Also, many technologies rely on corporations. The potential for the failure of those corporations should be considered and anticipated. The days of ‘there will always be a [insert large corporation name here]’ are no longer. Arguably, those days were never here in the first place.

As fast as technology is changing, society itself is also changing, often in ways that are unexpected and unpredicted. No one could have anticipated the social and political changes of the last 50 years; the fall of the Soviet Union, the dismantling of the Berlin wall, the rise of non-state actors and terrorists, the current revolutions in Middle Eastern countries. Societal changes must also be anticipated, as best as is possible, and integrated into future technology considerations.

Technology is but one link in the chain. In the end, militaries are made up of people, people who do jobs. Technology can help them, but that technology must still be useable and simple; it must be well designed and well supported, otherwise it either will not get used, or it will be used in such a way as to negatively impact efficiency and effectiveness. In addition, the acquisition of new technology always carries with it second and third order effects. These include warehousing issues, supply considerations, training, maintenance, spare parts, in-service support contracts, and end of life disposal considerations, to name but a few. All of these must be taken in to account when moving forward and acquiring new technologies.

When making any military plan, the saying goes, 'the enemy gets a vote.' Current and potential future adversaries also have access to the latest technologies, and they generally do not have to work under the same restrictions imposed by the military's equipment acquisition processes. Their particular societal construction may allow them to adopt technologies faster, or to use those technologies in more novel ways. Adversaries may not be as limited in their thinking, more able to maintain agility, better able to see the potentials of technology and, in short order, apply those potentials in ways that may not be immediately obvious. This must be anticipated, and current technologies must be adapted to compensate.

Military society itself affects how it adopts technology. The analyses in this paper have led to the conclusion that military society drives technology, not the other way around. Military technology is socially constructed, it is not deterministic.

If our technology is buying us, it is because we are letting it.

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