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IMPACT OF TECHNOLOGY ON FUTURE WAR

INTRODUCTION

The dynamic nature of changes in civilizations and the nature of warfare have always been largely dependent on the changes in technology. But the nature of technological changes to come is not always easily understandable. If anyone is to declare that, in about 50 years time, the tanks, the ships and some of the aircraft, as we know of today, will disappear from the battlefields, it will probably generate a lot of incredulity. It is true that a lot of scientific predictions do not always come true; but some do in manners that sometimes create revolutionary changes. If the cavalry soldiers of the previous centuries were told at that time that the horses would not one day be used in the battlefield, they would have probably laughed it off. Even today, some people are still in love with horses - they call their tank units 'cavalry'. At the beginning of this century, when General Billy Mitchell was trying to convince the sailors that large battleships had become too vulnerable to air attacks, no one believed him. Even a successful demonstration failed to convince them. Later, he was even court-

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martialled for his over-enthusiastic drive to change the navy[1]. About 50 years later, we saw those battleships all but replaced by aircraft carriers. Those that remain are used only by the United States for power projection and shore bombardment, but not much else. All these point to the fact that it is indeed very difficult to predict the future, because technology and the nature of warfare are changing fast. Changes from the Prussian needle guns of 1864 to the guided missiles of today bear testimony to that.

As science and technology proliferate at an ever faster rate, the nature of warfare will continue to change in many ways. To prepare for the future, it is important that the whole range of emerging technologies, how they may influence the nature of warfare, and how we can take advantage from those changes be understood as best as possible. This is nothing but a truism, but yet all too often we are somewhat over-dependent on and curious about the lessons of the past wars. Thus there is a saying that the military always fights the last battle. To avoid such follies and be prepared to fight in the future, it is necessary to draw lessons from the future wars. That is easily said than done, and one is not expected to be a clairvoyant; but what it means is that the lessons of the past wars must be placed in the uncertainties of the future, wrapped in the possibilities of the emerging technologies. If required, certain tactics and strategies must be abandoned, and new ones evolved.

I shall, however, not go into too much details of tactics and strategies in this paper, but give a general understanding of how technology influenced the nature of warfare in the past and what it portends for the future. The aim of this paper will be to present a brief analysis of how technology influenced warfare, and explore the possibilities of the foreseeable future. Instead of cataloguing every technological innovation and its influence, I shall restrict myself to important innovations and general patterns of their influence on warfare.

1. Timothy Garden, *The Technology Trap*, Brassey's Defence Publishers, London, 1989, p.10.

Nature of warfare, however, does not depend on technology alone. It depends on many factors like international system, nature of statehood, economy, culture, religion, intellectual level of the armed forces, etc; and technology influences all of them. Since talking of warfare only in the light of technology will not offer a balanced view, I shall, therefore, touch upon some of those factors briefly where relevant. In general, I shall address the topic under the following headings:

* Science and Technology
* Technology, Society and War
* Influences of Technology
* Emerging Technologies and Future Wars
* Third World Dilemma

SCIENCE AND TECHNOLOGY

First I shall attempt to explain the meanings of the terms 'Science' and 'Technology'. Over the last few centuries, there has been continuous debates amongst the philosophers of sciences as to their exact meanings - no two scientists seem to hold similar views; and there are areas where science and technology seem to intermingle indistinguishably. For our general understanding, we may accept the meaning of the word 'science' as a set of theories, or generalizations that explain certain phenomenon of the universe. Where science is concerned with explaining why and how things happen, the task of technology is to make things happen. This originates from man's ceaseless endeavour to use his abilities and surroundings for useful purposes. Technology is also sometimes referred to as applied science. Technology has two distinct aspects -technical and practical. Technical aspect means the process by which a thing is created; and practical aspect predicates that every technical innovation must have a practical use. These two aspects, in combination, make technology more complex, and more time- and cost-constrained than science.

Technology aims to create devices that can be used again and again. In general, technology is expected to have the qualities of cause and effect, repetitiveness, specialization, integration, certainty and efficiency[2].

Science is a relatively recent phenomenon. The positive approach towards science by great philosophers and scientists like August Comte, Kant, Bacon, Newton, Keppler and others, since the 17th century, gave tremendous boost to the rise of science proper. The scientific discoveries that followed gave rise to industrialization and the hope for an 'Age of Enlightenment'. That further gave greater impetus to the development of further sciences and technologies. That does not necessarily mean that technology is wholly dependent on science. In reality, technology existed much before pure science. Whenever the prehistoric man used tools like flint knives, spears and dresses, they were evolving technology without the benefits of pure sciences. In today's world, science and technology are generally quite interdependent. Science requires technology in terms of instruments for observation and measurement; and technology needs science to create devices for human needs. Sometimes attempts at technological innovations lead to pure science, and vice versa. Both science and technology ultimately depend on man's natural inquisitiveness, and a desire to live a life which is physically better, intellectually richer and emotionally fulfilling.

Science and technology, however, did not advance at a uniform rate. The period before 1850 is considered a period of continuity by many, where technology changed slowly and weapons lasted for centuries. The period after 1850 is called a period of discontinuity, or change, where shelf life of equipment is measured in terms of decades. Since that period, technology continued to advance at an ever increasing rate. In turn, technology began to exert tremendous influence on every sphere of human and non-human lives, let alone

2. Martin Van Creveld, *Technology and War*, Brassey's, London, 1991, P. 315.

warfare. Today, there is not a subject, be it philosophy, social sciences, arts, literature, theology and music, which is not influenced by science and technology. As such, the whole civilization is modelled by technology. Technology even influences the way we think. In other words, technology is power.

TECHNOLOGY, SOCIETY AND WAR

Mode of Production and War

Technology influences warfare both directly and indirectly. It influences directly, for example, by introduction of a new weapon system and indirectly by secondary effects, either on the military, or through the society. In other words, warfare and all other aspects of our social, political and economic lives act synergistically. Such a theory is forwarded by Alvin and Heidi Tofflers. What they do is divide the traceable human history into three distinct civilizations - First Wave, Second Wave and Third Wave civilizations - each characterized by its peculiar mode of production, and mode of production determines the way we fight[3]. This is similar to Martin Van Creveld's classification - Age of Tools, Age of Machines and Age of Automation[4]- but they do not necessarily come to similar conclusions. Where Creveld is technicistic in his expression, Tofflers are somewhat sensationalistic with their use of the word 'wave'. None of those expressions capture the holistic and interactive dynamics of society in relation to technology and war. Although it is doubtful whether civilizations can be pigeonholed into distinct and separate types, I shall still use those concepts as an analytical framework and call those civilizations pre-modern, modern and postmodern. First I shall discuss how Tofflers view each of those civilizations.

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3. Alvin and Heidi Toffler, *War and Anti-war*, Little, Brown and Company, New York, 1993, pp. 19-22.
4. Martin Van Creveld, *op. cit.*, p. 2-3.

In today's world, countries are at different stages of development with different modes of production. There are still agricultural societies and industrial societies; and the post-industrial society is just beginning to emerge in some areas. Tofflers predict that these civilizations are bound to collide. What Huntington said about clash of cultures and religions[5] and what Tofflers say about clash of civilizations, may have some truths in them as evidenced by the existing tension between Islam and Christianity, and the East-West and North-South conflicts. It is, however, doubtful whether those tensions will ever break into outright military conflicts in large scale.

Pre-modern Civilization

That brings us back to the link between technology, mode of production of wealth and warfare that Tofflers talk about. According to them, the pre-modern society evolved about 10,000 years ago from pastoralism to agricultural societies, the modern society began to evolve in the 17th century with the rise of industrial revolution, and the postmodern civilization is emerging now with the information revolution. In the pre-modern era, the mode of production was agricultural and mineral extraction. Wars were then mainly fought for land by the land owners and the rulers. That agriculture was so important is exemplified by what Lord Shang, a contemporary of Sun-tzu, said, "The country depends on agriculture and war for its peace"[6]. The workers were even paid with land and agricultural produces; and the soldiers were paid by the rulers, not by the state. Wars were characterized by hand to hand fighting with weapons produced in cottage-type production methods.

Modern Civilization

Modern era started with the industrial revolution. This brought about great changes both in the society as a whole and in the nature of

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5. Samuel P. Huntington, "The Clash of Civilizations?", *Foreign Affairs*, Vol. 72, No.3, Summer, 1993, pp. 29-35.
6. Cited in Alvin and Heidi Toffler, *op. cit.*, p. 34.

warfare. As factories proliferated, wars also became industrialized. The changes eroded the pre-modern values and institutions. Wars were fought between states and peoples, not by the rulers. Professional army replaced the rag-tag feudal army. Soldiers began to be conscripted as in the American Civil War and in France with her policy of *Leve en mass*[7]. In Japan, Samurais were replaced by the draftees. Soldiers were paid with money. As the industries became the main source of wealth creation, arms production became industrialized and war became mechanized. There were two-way communication between the industries and war machines. The requirement of war also gave further boost to the industries. New weapon systems with enhanced firepower, new tactics, new methods of mobility and warfighting appeared on the battlefield. Civilian infrastructures like roads, railways, harbours, energy supply system, and communication systems came under the purview of military strategy. Following the industrial management system, division of labour had to be introduced as functions of military men increased, military became bureaucratized, general staff system came into being and written orders replaced oral orders. Efficiency became a concept - mainly, efficiency of killing. Several wars of the past, in which millions of people died, portray a picture of death on the assembly line. According to one estimate, the number of people died in war in England, Austria-Hungary and Russia between 1101 and 1599 was slightly more than one million. The comparative figure for the 17th century was 2.5 million, rising to 3.6 million in the 18th century[8].

That means that the civilian concepts of mass production, mass communication and mass consumption created a parallel in the concept of mass destruction on the battlefield. This is exemplified by the introduction of nuclear weapons, both strategic and tactical. Following Clausewitz's dictum of Absolute War, mass became a strategic

7. Cited in Alvin and Heidi Toffler, *op. cit.*, p. 38.
8. Cited in Timothy Garden, *op. cit.*, p. 19.

concept. Erich Ludendorff propounded the theory of Total War[9] and Nazi Germany carried it to its extreme. Holding similar view, Liddel Hart said, "For more than a century the prime canon of military doctrine has been that the destruction of the enemy's main force on the battlefield constituted the only true aim of war"[10]. Giulio Douhet propounded his theory of air power in the similar vein; and it is said of General Curtis LeMay, who led the raid on Tokyo in the Second World War, "To LeMay, demolishing everything was how you win a war....the whole point of strategic bombing was to be massive"[11]. Although Clausewitz did talk about destroying the Centre of Gravity as a means of winning war, but its concepts remained restricted mainly to academic discussions. In reality, killing soldiers and civilians, and destroying enemy property in a massive scale seemed to be the only way to win a war in the modern era. Industrial civilization with such concepts reached its peak in the Second World War, in which, it is estimated that 15 million soldiers and twice that number of civilians had died[12]. Somewhere around the 1970s and early 1980s, the concept of massification reached its ultimate contradiction with the nuclear strategic concept of Mutually Assured Destruction - appropriately accronymed MAD[13].

Postmodern Civilization

As we now enter the postmodern era, we see that the nature of wealth-making and warfare is changing. Since mass producing

9. Cited in Alvin and Heidi Toffler, *op. cit.*, p. 41.
10. B.H. Liddel Hart, *Europe in Arms*, Cited in Alvin and Heidi Toffler, *op. cit.*, p. 41.
11. Fred Kaplan, *Wizards of Armageddon*, Cited in Alvin and Heidi Toffler, *op. cit.*, p. 42.
12. Alvin and Heidi Toffler, *op. cit.*, p. 41.
13. If the concept of mass is a way of winning war, then it must be paradoxical, because if both parties apply nuclear weapons, then, instead of winning, both will be destroyed. Concept of mass can apply in cases where one side is weaker, or not following correct strategy and tactics. If power and tactics match in a concept of mass destruction, then the result is likely to be mutually debilitating, if not totally destructive as in the nuclear scenario.

industries lack flexibility, market forces are changing the nature of industries. Smaller units are beginning to challenge bigger industries. For example, Apple computer company, starting from a garage, challenged even a giant like IBM. Large units began to lay off workers and split into smaller units. Factories are also chasing cheap labour overseas. Slowly, economy became split level and the main method of wealth making has shifted from industries to the service's sector. It also became a buyer's market, with many options and peripheral accessories to choose from. Customized marketing then created a parallel in customized destruction in the battlefield. As is evident from the 1991 Gulf War, the concept of mass that Clausewitz talked about was almost absent. In that war, the Multi-National Forces (MNF), first eliminating the detection capabilities of the Iraqi forces by destroying their radars and other sensors, and went on to gain air superiority by neutralizing the Iraqi air force and her surface-to-air weapons systems. Thereafter, the MNF disrupted Iraqi command, control and communication systems. The result was that the Iraqi ground forces were completely unprotected and out of touch with their command centres. They had no choice but to surrender. In the whole war, there was virtually no civilian casualty and hardly any collateral damage.

On the other hand, mass destruction was strongly implied in Clausewitz's view that war is an act of violence pushed to its extreme and Liddel Hart's concept of destroying the enemy's main force as a war-winning formula. Force was matched with force, and destruction was reciprocated with destruction. In contrast to those views, Sun-tzu had said thousands of years back, "For to win one hundred victories in one hundred battles is not the acme of skill. To subdue the enemy without fighting is the acme of skill"[14]. Many of his views are now gaining greater credence. In the present context, specially in the Gulf War, we saw a vanishing front line, precise targeting of military assets, AirLand Battle disrupting the rear echelons in deep interdiction,

14. Sun-tzu, *The Art of War*, Samuel B. Griffith(tr), Oxford University Press, London, 1963, p. 77.

war becoming one of information and smart weapons, and the rise of air power as the most dominant force. Demassification gave way to greater precision and selectivity. In the Conduct of War (COW) report of USA, it was revealed that targets like telephone exchange, switch rooms, microwave relay towers, bridges, etc, were chosen by the Multi-National Forces in 1991 to paralyse the brain and the nervous system of the enemy[15]. Thus it was adequately proved that an enemy can be brought to its knees principally through destruction and disruption of its Command, Control, Communication and Intelligence (C^3I) system.

This was, in brief, how Tofflers view human civilizations, and how mode of warfare is linked with how we make wealth. Robert J. Bunker is, however, quick to point out that some of the generalizations that Tofflers make are ahistorical and inconsistent with reality[16]:

* The first of his objections is that ten thousand years of human history cannot simply be lumped together as a super-civilization. Within that long period, there were, what we call, pre-classical, classical and medieval eras, each with some of its distinct characteristics. Tofflers do not give adequate answer to that criticism; however, for our understanding, we may accept that, inspite of many differences, those eras had a few things in common - unmechanized form of both production and warfare.

* Secondly, not all armies of the pre-modern era were rag-tag feudal armies. Roman, Byzantine and Mongol armies were very well organized fighting forces. Tofflers accept that the instance of the Roman army is an exception. In spite of that, it is to be considered that those armies, despite their size and organization, were pre-industrial and not professional armies

15. Toffler, *op. cit.*, pp. 70-71.

16. Robert J. Bunker, "The Tofflerian Paradox", in *Military Review*, May-June, 1995, pp. 99-102.

the way we understand today. Neither their mode of production nor their method of war was based on modern management principles.

* Thirdly, the concept of knowledge warfare and that of AirLand Battle tactics, disrupting the decision-making structure and lines of communication, that Tofflers ascribe to the postmodern era, are not really something new. The German *Wehrmacht* had already developed those concepts in their Operational Art, based on *blitzkrieg* tactics, more than fifty years back. The Tofflers, however, failed to acknowledge the German contribution to the development of the doctrine of AirLand Operations and Knowledge Warfare. In any case, the German contribution must be considered as a precursor, and with the influences of technology, such concepts are finding fuller expression now.

INFLUENCES OF TECHNOLOGY

What I discussed so far are the broader changes technology brought about in the societal patterns and how that influenced the nature of warfare. Basically, war is a social activity and the military thinking remains largely confined within the broader patterns of social structure. These may be termed as indirect, or pervasive influences of technology on warfare. Technology also influences warfare directly. The areas on which technology had most influence are the following[17]:

* Speed and Manoeuverability
* Fire Power and Lethality
* Radius of Action
* Detection and Detectability
* Vulnerability and Survivability
* Support Requirement
* Cost-effectiveness

17. Timothy Garden, *op. cit.*, p. 18.

A lot can indeed be said on each of these aspects, but to avoid being submerged in the nitty-gritty of the innumerable technological innovations and their impact on the battlefield, I shall restrict myself to the general pattern of development, giving one or two examples. In the past, to overcome man's own limitations, horses were used; but the way horses were harnessed was a matter of ingenious innovation at that time. Later, scientific and technological revolutions in the industrial era introduced many kinds of vehicles, railways and weapons platforms. Meeting strategic and tactical needs, better and better technology was sought to increase speed and manoeuverability. Today we see supersonic and agile fighters, but that by itself is not enough. One needs firepower to destroy and disrupt the enemy. From bows and arrows came guns, canons, bombs and missiles.

In the process of these developments, technology also provided increasingly greater accuracy, lethality and speed. Latest weapons include laser guided bombs with pinpoint accuracy and high supersonic guided missiles. Search for higher and higher lethality gave rise to weapons of mass destruction, like chemical, biological and nuclear weapons. Directed Energy Weapons (DEW) are now being developed. Technology also provided greater radius of actions for the weapon carriers to strike deeper and deeper into the enemy territory. Nuclear submarines can operate independently for months, almost up to any distance. Strategic transport aircraft can deploy forces anywhere in the world. This is further enhanced by en route replenishment, or air to air refuelling.

In the present context, detection and detectability are attracting ever greater attention for technological innovation, because firepower be-comes useless without accurate detection first. Research efforts sought to increase the means of detection and to reduce detectability of one's own assets. Stealth technology is the latest example in the battle for detections, detectability and survivability. Earlier, intelligence gathering by humans, with crude estimates, was the only means. To-day a wide ranging sensors and methods, like photographic cameras,

radars, thermal imagers, magnetic anomaly detectors, ESM, etc, are available. In the Gulf War, we have seen greater use of satellites, RPVs and J-STARS, which can monitor deployment of enemy troops remaining more than 100 miles away from the battlefield.

Technology also allowed more efficient use of support requirement. That included faster communication, faster logistics, quicker transportation, efficient management, etc. The last on the list is cost-effectiveness. Technology, in most cases, improved cost effectiveness, but in some areas it remains controversial. By use of advanced technology, and by integrating more capabilities, most systems are made more cost-effective. For example, a Tornado aircraft can fly faster and neutralize many targets today with little attrition. The number of bombers of the Second World War that can be bought with the cost of a Tornado, will neither be as effective, nor will survive in the present scenario. In other cases, it is difficult to measure effectiveness in concrete terms. A B-1 bomber is cost-effective, but if one is shot down, the balance will be negative[18].

That was a brief description of the areas on which technology had most impact. However, technology did not contribute in isolation to each of these areas, but had many patterns. I shall explain some of those. Firstly, technology was, in a way, a battle between offence and defence. Increased firepower will call for better countermeasure on the part of the enemy. Soon, he will develop a weapon with greater firepower. Then you will also need to reciprocate, and reduce your own detectability and enhance survivability. Increased speed of a platform will be counteracted by faster and more manoeuverable weapons. If both sides can afford and have the know-how, attainment of surprise will always be difficult. Thus, both proceed towards a technological stalemate.

In most cases, technology advanced in an incremental manner, but within this linearity, technology also brought about dimensional

18. Martin Van Creveld, *op. cit.*, pp. 317-319.

changes in the nature of warfare. In the pre-industrial era, warfare was two-dimensional - Land and Sea warfare. After the tactical surprise of Bushnell's Turtle in 1776[19], submarines came into being and warfare went beneath the waves. This gave rise to a completely new form of warfare - sub-surface warfare. Submarines being intricately linked with naval warfare, sub-surface warfare is, however, considered an integral part of maritime warfare. Another dimensional change occurred at the beginning of this century with the rise of air power. The basic concept of electronic warfare was very old, but greater use of electronic and electro-magnetic spectrum in the 20th century gave rise to yet another form of warfare - electronic warfare (EW). Space is another dimension that is just beginning to be exploited. Thus air warfare and electronic warfare came to be known as warfare in the 3rd and 4th dimensions respectively, and space can be called the 5th dimension. By these dimensional changes, technology also changed warfare in range, depth and complexity. Battle of Waterloo, between Napoleon and Wellington, decided the victory for England - it was a battle of two generals in one small battlefield. Today, to earn victory, the whole nation or the national alliances have to be subdued in its entirety.

Another impact of technology on war is called Tooth and Tail effect. In the early modern and pre-modern eras, most of the troops in an army were combatants. Today, in the armed forces of the advanced countries, the number of actual combatants is about 15%-20%. The rest is support personnel. Each new equipment introduced needed its own backup support in terms of logistics, maintenance, training, coordination, and integration. Thus, the comparative size of the fighting forces reduced and the size of the support services increased.

Technology, can provide great advantages. Most often, new technologies are inducted with enthusiasm, only to realize later that every equipment has its own vulnerabilities, limitations, and traps.

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19. Kenneth Macksey, *Technology in War*, Arms and Armour Press, London, 1986, p-9.

Very often, by procuring advanced technology from a particular country, the dependent country falls into the trap of the technological pattern, and cannot come out of that structure easily. This is because that country has to depend on the country of origin for spares, related equipments, other compatible technologies, and for political considerations. Often an equipment is procured, realizing later that its spares production is discontinued. Sometimes an advanced technology is procured enthusiastically just because it is made available, without properly assessing as to how best it could be integrated in the doctrine, what it can do to the enemy, and what is its cost in the long run. For example, in the post-WW II period, focus was on developing faster, more manoeuverable, and more survivable aircraft with the capability to carry a lot of weapons. But even then, about 10 years of bombing by the USA in Vietnam by a total of 800 sorties could not destroy the Than Hoa bridge[20]. That gave rise to the need of more accurate weapons. Later, only 4 F-4 Phantoms destroyed the bridge with an early model of smart bombs in a single attack. Emphasis, thus, went onto the development of effective overall systems.

On the other hand, technology is not limitless. There cannot possibly be any weapon more lethal than nuclear bombs. Speed of vehicles and platforms has almost reached a plateau. Speed can be increased, but only at the cost of payload, endurance and cost. Therefore, a compromise will always have to be made depending on the requirement. Technology solves many problems, but also introduces new vulnerabilities. For example, use of radio and radar can provide great advantages, but they can be jammed. A sophisticated aircraft will be very effective operationally; but its cost will be high, and its survivability, both on the ground and in the air, will be a major concern. These limitations and vulnerabilities of technology must be considered at all stages of military thinking.

Most important impact of technology is on strategy and tactics. Concepts of mass, strategic bombing, manoeuvre, and static defence,

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20. Alvin and Heidi Toffler, *op. cit.*, p. 73.

as exemplified by trench warfare, were all driven by technology. In the post-World War II period, we saw strategies like Massive Retaliation, Mutually Assured Destruction, Forward Defence, Deterrence, etc. We also see air superiority as a strategic concept, which influences the whole spectrum of warfare. Technological impact on strategy is often slow, but has wider implications. Most immediate impact of technology is on tactics. For example, great success was achieved initially by the Egyptian forces by their surprise introduction of SA-6 missile in 1973 war. Many Israeli aircraft were shot down in the initial few days. Quick brainstorming by the Israelis revealed that SA-6 radars did not have vertical coverage. Israelis, thereafter, changed tactics by attacking vertically, and by applying ECM measures were successful in defeating the SA-6s in the later part of the war. This change of tactics and use of better technology led to their victory[21]. That was, in effect, exploitation of both the strengths and weaknesses of technology. Every new technology, therefore, has to be enmeshed intimately with doctrine, strategy, and tactics.

Technology also has many indirect and pervasive influences on military culture, leadership, management techniques and education. Increased induction of higher technologies demands higher level of education in the military. Higher education will, in turn, make the soldiers more individualistic and analytic. Thus, the style of management and leadership will also have to change to bring to bear the fruits of technology. Personal valour and military machismo are already diluted to a great extent. We are already hearing the expression 'Battle Management' instead of Warfighting. In 1991, Shwartzkopf was more concerned with formulation of plans and resource management than leading the troops into battle. Pulse of his leadership was transmitted mainly through military communication means and the media. All these wide-ranging implications of technology is compared

21. R. Sivron, "Air Power and Yom Kipper", in E. J. Feuchtwanger, and R.A. Mason(ed), *Air Power in the Next Generation*, The Macmillan Press Ltd, London, 1979, pp. 86-92.

by Van Creveld to the ripple on the surface of water when a stone is dropped[22]. Ripples spread far and wide. Complexities arise when ripples of several technologies merge. In many ways, technology has became a way of life, we take technology for granted. Problems arise if those ripples are not accounted for.

EMERGING TECHNOLOGIES AND FUTURE WARS

Having described the direct and indirect impacts of technology on warfare, I shall now deal with some of the emerging technologies and their possible influences in future wars. Since many technological innovations have been arbitrary and accidental, it is difficult to make accurate predictions[23]. Since technology and war have a two-way correspondence, nature of future technology will be guided by the nature of threat perceived. Both Van Creveld and Tofflers agree that there may not be any world wars because the method of wealth-making has changed, with its consequent changes in civilization. The nature of warfare is changing from one of mass destruction to one of customized destruction by smarter weapons. As advanced countries achieve a technological stalemate, war between them becomes less likely. As territorial expansionist threats of the colonial eras are no more there, and as free market capitalist mode of production is gaining greater currency with increased level of interdependence, the nature of security threat is also being redefined with a search for non-military means of guaranteeing security. This sounds like inter-war period's idealism, in which, the First World War was considered 'a war to end all wars'. However, even if there is no large scale war, no one denies that there will be no Saddam Husseins and Radovan Karadjic' in the future.

As mentioned earlier, technology has also split the world societies into three levels. Technology is there, but it has not benefited all the countries. There still exists agricultural societies. Thus future wars

22. Martin Van Creveld, *op. cit.* p.2.
23. *ibid,* p. 313.

may also be three level wars, or any combination thereof, where a postmodern society fights a modern society as in the 1991 Gulf War, or a modern society engages a pre-modern one[24]. In many cases, in place of reduced centralized threat as explained above, there will be more of distributed threats, made possible by dissemination of higher technologies to many non-state actors. The occurrence of distributed threat is not a new phenomenon, but the fear of their destructive capabilities by their acquisition of newer technologies is ominously new. With the spread of higher technology, some terrorist organizations may even be able to target the high-tech centres of the developed countries. For example, collapse of the highly computerized central bank of an advanced country may lead to economic collapse. If such conflicts increase, the state itself may partly lose its sole right to make war. Wars may be fought by non-state entities as is evident in Afghanistan, Sri Lanka, Bosnia and Rwanda. As the nature of nation state concept begins to get fuzzy, many smaller wars in various parts of the world will appear. Since the nature of these wars will be different, technology to cope with such distributed threats will also be different.

Technological development will take place across the whole spectrum of warfare in all the aspects as was mentioned earlier. However, research and development in speed, manoeuverability, fire power and radius of action are not expected to produce any spectacular changes as they have almost reached their functional and technological limits. Great potentials exist in the aspects of accuracy, detection and detectability, vulnerability and survivability, support requirement and cost-effectiveness. In the future, weapons will also be more intelligent and autonomous. They will decide for themselves when to launch[25]. Much of future research will concentrate on those. I shall explain some of those developments.

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24. Alvin and Heidi Toffler, *op. cit.*, pp. 81-83.
25. Gary B. Griffin, "Future Forces, Future Fights", *Military Review*, November, 1994, pp. 56-57.

In the area of detection, electro-magnetic spectrum will continue to play greater roles. Along with further sensor developments, development of platforms will also continue in terms of range, endurance and survivability. Thus J-STARS, AWACs, RPVs and Satellites will be increasingly used. Presently, only a few countries possess those assets. In the future, countries may even be divided between space and non-space powers. Seeing the potentials of satellites, many countries are rushing to acquire those capabilities. Recently, even the United Arab Emirates(UAE) has sought to acquire its own satellites[26]. By new capabilities, it is hoped, the satellites will be able to measure depth of water, and select helicopter landing zone and provide 3-D positional information to airborne forces. Improvement in the present sensors will allow it to acquire accurately enemy weather, enemy position and topographical information, and pass them down in real time to the operators in the fields. The importance of satellites is highlighted by the formation of Space Command in the USA, and expression 'air power' is being replaced by 'aerospace power'. This is highlighted by General Donald J. Kutyna, when he said, "In a future of decreased, retrenched forces, we will rely on space even more. Space system will always be the first on the scene"[27].

Serious development is taking place in another field - robotics. Robotics is not a new concept. Present day RPVs are, in fact, robots. The advantages in using robots in the battlefield is that they are NBC proof, there is no loss of life and no training is required. All you need is software. The US army is considering many non-combat roles for robots. In the reconnaissance role, the scout robot will be able to climb hills, traverse most other terrains and gather information by many of its sophisticated sensors. It should also be able to detect NBC threat. Another robot vehicle, called Tactical Unmanned Ground Vehicle

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26. Alvin and Heidi Toffler, *op. cit.*, p. 101.
27. *ibid*, p. 99.

(TUGV), is being developed to clear mines[28]. Similar vehicles are also being designed to excavate, and repair runways. Robot sentries are already under trial[29]. Such sentry vehicles will have sophisticated sensors, and be remotely controlled. Today, technology exists, and serious thoughts are being given to robotize some of the ships, tanks and helicopters to reduce risks to human lives. In the future, battlefields will see more of RPVs, drones and many other kinds of robots with even greater capabilities. In the USA today, 57 military uses of robotics have already been identified, one of which is to create robot soldiers[30]. However, the use of robot soldiers will not be for replacing the humans, but to save their lives. Since robots are expensive and they lack ethical and finer judgement, humans will continue to function in many roles.

To reduce the tail in comparison to the bite, tremendous research is taking place in reducing support services and increasing survivability. The idea is to make men more independent, and equipment more maintainable and supportable from distant locations. The future airborne soldiers may use para-sail, glide great distances and, armed with accurate navigation devices, land within $\pm$ 10 meters of the target area. Future radio may have on-line GPS, Fax, coding and decoding system and automatic voice translators. Camouflage system will be able to change colour according to environment. Filmless camera is already in the market. Virtual reality and 3-D holographic projection will enhance realism and reduce training cost. Some soldiers of the future will wear, what they call, an exo-skeletal

28. Judith Gunther, Suzanne Kantra and Robert Langreth, "The Digital Warrior", *Popular Science*, Reproduced Through USIA's *Special Features Service 132*, No. 1, 4 July 1995.
29. Robot Defense Systems of Colorado has created a wheeled robot called Prowler, which can be controlled from 19 miles away, and be fitted with sophisticated weapons and sensors. Japan has also developed a robot helicopter for crop dusting and data collection cited in Alvin and Heidi Toffler, *op. cit.*, pp. 112-113.
30. *ibid*, p. 110.

suit, or Soldier Integrated Protection Ensemble (SIPE)[31], which will provide NBC protection and be fitted with Head Up Display (HUD), computerized aiming system, Night Vision Goggles (NVG), radio, and Global Positioning System (GPS). These are some of the developments that are taking place now.

A more spectacular area of development is in non-lethal weapons, in other words, war without blood, or environmentally friendly war. Such weapons can be used in counter-insurgency, hostage rescue and controlling mob violence. Instead of killing, these weapons aim to incapacitate people in many ways - by inducing sleep, or by causing disorientation, nausea, vomiting and loss of bowel movement[32]. Russians used laser blinding flash in Afghanistan. If such weapons were available at that time, so many children need not have died in Wako, Texas, with the David Koresh incident. Means to incapacitate vehicles and equipment is also being developed. Some of these are anti-fraction to make surface slippery, and polymer adhesive, delivered from the air, to make equipment and vehicles immobile and inoperative. Chemical agents for fuel contamination, and rubber and metal embrittlement, and filament gun for entanglement, like the spiderman's gun, are being developed.

Other emerging devices are, what they call, micro and nano technologies[33]. Professor Johannes G. Smits of Boston University already holds a patent of on electric motor that is only one millimetre long. With such devices, one could create a robot of the size of an ant walking around anywhere undetected and gathering intelligence. Nano technology aims to develop machines that is even smaller - small enough to work on a molecule in the bloodstream. How these machines could be used in warfare is difficult to predict at the moment, because they would need large enough additional equipment for data transmission and for control. Perhaps it could replace germ warfare,

31. Judith Gunther, Suzanne Kantra and Robert Langreth, *op. cit.*, pp. 1-6.
32. Alvin and Heidi Toffler, *op. cit.*, p. 127-134.
33. *Ibid*, pp. 120-121.

not for mass killing, but for neutralizing people. These technologies could, however, be effectively used for medical purposes and for miniaturizing other equipment. These devices will also have their own vulnerabilities, and further technology will develop to counter them. The fear is, if some of these technologies fall into the hands of terrorists, they could create havoc.

One point, however, must be made is that the development of most technologies today is greatly influenced by development in computer technologies. High processing power of computers and highly compressed digital data transmission will allow real time data transmission in all the dimensions of warfare. Fax, E-mail and multimedia systems will interconnect command centres and the units down to the lowest level. What a satellite sees now can be instantaneously transmitted to the soldier on the ground, or the aircraft already in the air, and vice versa. In this regard, the quotation of Alan D. Campen, "The Gulf War was a war where an ounce of silicon in a computer may have had more effect than a ton of uranium" is relevant[34]. The first aim of war will be to gain as much information as possible and preventing the same to the enemy. Information war will thus need information strategy and information tactics. C^3I warfare will be able to provide a knockout punch to the enemy before the outbreak of traditional war. Command of information will require command of technology. This is also referred to as knowledge war.

Since land and sea warfare, and information gathering will depend on air power and satellites, these dimensions will dominate the future wars. In other words, much activities of war will be conducted above the earth's surface by aerospace power. That does not mean the roles of armies and navies will diminish. On the contrary, these forces will have to be adapted and made flexible to meet the diverse threats of the future. Retrenchment in terms of size may result, but more capabilities

34. Alan D. Campen(ed), *The First Information War*, International Press, AFCEA, Fairfax, Virginia, 1992, pp. ix-xi and 32-33.

and survivability will mean a greater punch by a given unit. A brigade will be able to do the job of a division[35].

Again, since the benefits of aerospace resources will be shared by all the services, the concept of centralized control and de-centralized execution for some assets will continue. However, there will have to be much greater integration. On the other hand, when certain bases are given all the combat and support assets, the bases will be allowed to exercise decentralized control to a large extent. In any case, greater influence of the media will bring about greater accountability, and central control will be diluted to some extent. Since army and navy will have to meet wide varieties of threats, they will enjoy more decentralization. At the same time, real time information flow would also mean greater monitoring and coordination.

We may not see any micro or nano technology in any battlefield in the near future, but we will definitely see greater use of robotics, satellites, aircraft and computers. Information and knowledge will dominate warfare. That will need higher level of education in the military as a whole. That, in turn, will result in changes in leadership style, military management and military culture. The future war will need customized resources, and must aim for neutralizing the enemy by neutralizing its brain and the nervous system. However, technology by itself cannot win a war, technology will have to be integrated intimately with new strategy and new tactics.

THIRD WORLD DILEMMA

Finally, the explosive nature of science and technology, and their revolutionary impact on the nature of conflicts bring us to the question of what the Third World countries can do. Considering the constraints of economy and low level of development of most Third World countries, to what extent can they keep up with the changing world

35. Craig B. Wheldon, "Light Cavalry: Strategic Force for the Future", *Military Technology*, April, 1993, pp. 13-19 and Alvin and Heidi Toffler, *op. cit.*, pp. 76-77.

and ensure their security ? There are, however, no easy answers to those questions. Firstly, there are great diversities amongst the Third World countries. China, India and Bhutan are all considered Third World countries, but there are immense differences between them in all respects. A smaller country with less developed economy will be more constrained to adopt new technologies. On the other hand, mere technological superiority may not always be enough to deter a much larger aggressor. But if a conflict is between two comparable powers, then the one which has technological superiority is likely to prevail. In any case, there is no choice for any country but to take advantage of the emerging technologies as best as one can do, not only for the military purposes, but for emancipating the lives of the peoples, the very purpose for which states exist.

Then again, the states must redefine their security perspective and not fall in the trap of arms race. In many cases, the projected level of threat is not always so real as is made out to be. Arms race, therefore, does nothing but to deplete the national coffer, slowing down socio-economic development. There can not be a viable military without a viable economy, and the reverse is not necessarily true in the present-day context. Therefore, economy and economic threat should be high on the list of threat perspective. In many cases, territorial threat was a pre-industrial and colonial era phenomenon. With territorial imperialism all but gone, territorial expansionist threat has also diminished to a great extent. The main source of wealth-making has gone transnational, and some people are also talking about free movement of labour. The world is becoming one of great interdependence. On the other hand, in our attempt to redefine security, we must also look at other short-term and long-term threats at the national level. In most cases, it can be seen that hunger, poverty, illiteracy, national disintegration, lawlessness, etc., become greater impediments to nation building than military threats.

The fact remains that territorial threats, albeit less, will continue to remain, and one will not often know when and where that threat will

come from. The best option is, therefore, depending on the peculiar imperatives of every country and region, to make a long term balanced evaluation of threats, and evolve a policy where socio-economic emancipation remains the first principle. Even when real military threat exists, technological superiority is not always necessary to ensure one's security. What a country needs is to integrate local non-tech resources to its military strategy. For example, the Vietcong used jungle, China used human waves and Switzerland used its rugged terrain in their respective instances. A country like Bangladesh has resources like water and people that can be harnessed for all the purposes. That does not go to suggest that the people be used as human waves like Mao Dze Dong did, but that they can contribute to our security in more ways than one. The question is how they are integrated in our strategic structure.

These factors are indeed under some consideration of our military planners. As mentioned earlier, better use of local non-tech resources, nationalism, unity, social bond, media and peoples' opinion play very important roles in the security equation of a country. All this goes on to form the inner strength of a country, or, in other words, internal deterrence. If sufficient internal deterrence exists, a foreign power can at the most nibble at the borders, or occupy it temporarily, but cannot hold it for long, however small it may be. This is evident from the result of the liberation war of Bangladesh in 1971.

The Third World countries can neither afford to, nor do they need to, copy the Western model, or the process by which they became technologically advanced. Most technologies today are available off-the-shelf. Even if certain technologies can be afforded, difficulties arise with the question of adapting them due to poor overall technological base. The Third World countries, therefore, need to enhance their overall infrastructure and establish research facilities to exploit the full potentials of the local and borrowed technologies, and of indigenous resources. Instead of addressing all aspects of military activities, original research can be undertaken on specific areas of a

country that need not be purely military-orientated. Advancement in certain civilian technologies will provide some comparative advantages. It also needs greater collaboration between the military and the academic institutions.

As portrayed earlier, strategy and tactics in the future will be increasingly dominated by technology, the war will be complex, information flow will be fast and the level of uncertainty will increase. To exploit the full potentials of the emerging technologies and make correct decisions, the level of education in the armed forces will need to be enhanced. This is already the case in the Western countries, but the Third World countries are lagging behind. However, there is a wind of change in this regard recently, but only up to a point. The level of education in the armed forces should be enhanced across the board, and that may call for large scale restructuring of the military, its ethos, culture and values. As the information culture is likely to de-emphasize the strict hierarchical structure, it will give rise to more horizontal management. Discipline of the body and reflex will have to give way to the discipline of the mind. The Third World military will, therefore, have to be more amenable to those changes and be less conservative. Since Bangladesh may have to fight many kinds of wars, either at home or abroad, and participate in many types of peace missions, the military will have to be very flexible at every level.

Finally, great emphasis must be given on the low-tech answers to high-tech threats. Along with the acquisition and adoption of new technologies, a Third World country must also constantly search for low-tech solutions to high-tech threats. Many examples can be given. For instance, a laser guided bomb can be defeated by thick enough concrete, a laser weapon can be defeated by a simple mirror, raising a radar by balloon can increase the detection range of radars. Even the USA uses balloons to detect very low-flying aircraft, used for smuggling drugs across the border. Each technology will also present its own weaknesses. Since technological superiority cannot be maintained in most cases, simple methods of exploiting the weaknesses of

enemy technologies must be found. In other words, turn weaknesses into strength, and one must look for innovative application of available resources. These methods will not bring victory, but will definitely reduce the impact of hostile action of the enemy, and increase survivability.

CONCLUSION

Considering the different modes of production, traceable human history can be divided into three civilizations - Pre-modern, modern, and postmodern, each with its own peculiar mode of making war. In the pre-modern era, when the mode of production was agriculture, and utilities and tools were made by hand, the warfare was characterized by largely hand to hand fighting with weapons made in cottage-type production method. Modern era was created by industrialization with the concept of mass production, mass education, mass marketing, etc; and correspondingly, warfare was dominated by the concepts of mass destruction. The concept of efficiency of production was paralleled by efficiency of killing by highly lethal weapons.

Slowly, as the nature of the technology and market demands changed, those mass-producing industries became inflexible and out of tune. This is now giving rise to distributed production and customized marketing. In the field of warfare, the concept of mass destruction is giving way to customized destruction. These changes in the society do not, however, indicate that it was the mode of production that determines the nature of warfare. In reality, it is technology that determines both the mode of production and how we make war. Technology, in a way, is the midwife of social transformation. However, it must be recognized that there is a two-way correspondence between the mode of production and the nature of warfare. This is brought about by social mores, language, culture, management techniques and technology. Technology, thus, has both direct and indirect impact on the society and the nature of warfare.

Most important direct impacts of technology on the nature of warfare were on speed, manoeuverability, fire power, lethality, radius of action, detection, detectability, vulnerability, survivability, support requirement and cost-effectiveness. Of these, the first five have almost reached their technological limits. Any improvement in any aspect is most likely to be at the expense of the other aspects. Further research will concentrate on balancing these requirements rather than outright increase in any one aspect. Great prospect, however, exists for the improvement of detection, detectability, survivability, support requirement and cost effectiveness. Improvements in detection capability, and accuracy of weapons are giving way to greater selectivity, leading to customized destruction, in other words, demassification. Thus, economy of efforts, as a principle of war, is gaining greater emphasis than the principle of mass. Another direct impact of technology is on strategy and tactics. It is true that sometimes an equipment may be designed deliberately to suit one's strategy and tactics; but many other times, innovations can arise out of surprise. In those cases, it becomes necessary to change one's own strategy and tactics to derive maximum benefit from new technologies.

The first of the indirect impacts of technology is that it is a battle of offence and defence. One innovation by one country will call for a countermeasure, and that countermeasure will then have to be bettered. Thus the technological innovations follow a chain reaction leading to technological stalemate between certain countries, and greater technological gap with others. The political impact of that is that war between technologically stalemated countries became less likely. Secondly, technology created many dimensions of warfare. From only land and sea warfare the scope of warfare has expanded to air warfare, electronic warfare and space warfare. Space war includes not only the possibility of war in the space between platforms, but also the use and denial of space resources for earthly wars. These dimensional changes have made warfare complex, specialized and dispersed, leading to the problems of command and control, integration and the Tooth and Tail

effect, i.e., increased proportion of support services compared with combatants.

With the other aspects having almost reached their technological limits, future technology will be applied to improve accuracy, detectability, survivability, support requirement and cost-effectiveness. In improving accuracy, weapons will be more intelligent and autonomous. For better detection and detectability, we shall see greater use of electromagnetic spectrum through improved sensors operated by platforms like J-STAR, AWACS, RPVs and satellites. Most of these assets are not the ones that many countries of the world can afford; but in military alliances, like that in NATO, such resources may be shared. At the same time, many countries are also vying for independent slots in the space. The reason is clear. The space resources give a capability that no other platform can provide. With emerging sensors of satellites, almost nothing can be hidden on the surface of the earth.

Along with those developments, we see increasing use of robotics and RPVs. Increasing use of robots will not, however, be to replace the humans, but to reduce cost and save their lives in situations of high risk and difficult assignments. Researches in miniature technology gave rise to micro and nano technology. Micro technology speaks of machines smaller than a head of a matchstick, and nano machines will be no bigger than a large molecule. Such technologies will have wide use in robotics, miniaturization of sensors and medicines. Since these technologies are still in an evolving stage, their uses and methods of integration are subjects of further research. The developments which will have most spectacular impact in the coming decades are in non-lethal weapons. Instead of killing, these weapons will seek to immobilize platforms and incapacitate soldiers. This will eliminate the concept of mass killing at least in a limited area, specially in counter-insurgency war and in controlling mob violence.

These developments will mean that a given unit of force will have higher capability. Reduction of support services will make these units more independent to meet the distributed threats. Thus, while the

units will enjoy more decentralized command, there will still be greater control made possible by higher computer capability. Computer technology has also made development in other technologies, specially in sensors, platforms, weapons control and robotics feasible. In the future, even the smallest fighting units will be connected in computer network with other forces. Since higher technology and their use will be the deciding factors, the future wars will be dominated by knowledge and information management. As technologies proliferate, many of them will be accessible to non-state actors, making the distributed threats more ominous than before. So far, improvements in accuracy, detection and survivability made customized destruction in the battlefield possible, but technologies will have to be evolved further to meet the elusive nature of the dispersed threats.

While technological development and its consequent stalemate between the advanced countries reduce the possibility of conflict between them, the same is not true between the developed and underdeveloped countries. Thus it is seen that many Western countries are discovering threats from some Third World countries. This technological lag makes the Third World countries relatively more vulnerable. While they have no choice but to try to catch up with others technologically as far as possible, they are also engulfed in their own underdevelopment, and technological dependence and traps. But as technology changed, the world civilizational pattern also changed. Colonial mode of production has given way to world capitalist mode. Therefore, colonial concept of territorial expansion is no more in practice, but other threats still exist. The perceived threats, in most countries, are not so real as are often projected. One must remember that a hyped up threat scenario in the Third World can only benefit the arms producers of the West. Therefore, the Third World countries must define their threats more realistically, concentrate on economic development, and find greater perils in non-military threats.

For ensuring security, while the Third World countries search constantly for newer technologies, they must also exploit five other dimensions of security:

* Firstly, most countries are bestowed with some peculiar features of their own. For example, water, people and terrain can be turned into resources in one's search for security. Many similar features can be developed to organize the internal strength of a country, which may provide internal deterrence to external threats.

* Secondly, countries must re-discover and develop their indigenous technologies, some of which may have disappeared earlier under the influence of modernization. Development of these technologies will give many comparative advantages either directly to the military, or indirectly through the development of the economy.

* Thirdly, the Third World countries should look for low-tech answers to many high-tech threats. Technologies solve many problems; but in most cases, they develop many of their own vulnerabilities and weaknesses. Low-tech answer can exploit many of these weaknesses.

* Fourthly, the Third World countries must learn to adapt to the changing social environment brought about by technology. Higher technology demands higher education of the military personnel, and higher information flow brings about greater transparency and lowering of decision making level. All this will transform the traditional soldiers into hi-tech warriors resulting in greater individualism, lesser hierarchical control, lesser military machismo and more exercise of initiative. Thus, the concept of discipline of reflex will give way to the concept of discipline of the mind. The Third World countries will have to be amenable to those changes. Achievements in all those will, however, not be easy.

* Finally, success in obtaining maximum benefits of technology, both local and imported, will also depend on how the local academic community can be integrated with the military to solve security problems.

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