VIVEKANANDA INTERNATIONAL FOUNDATION

WEAPONS AND MISSILES IN THE INDIAN ENVIRONMENT

Major General P K Chakravorty, VSM (Retd)

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Abbreviations

ABM	Anti Ballistic Missile
AEW&C	Airborne Early Warning and Control
ALH	Advanced Light Helicopter
AWACS	Airborne Warning and Control System
AMSL	Above Mean Sea Level
BMC	Battle Management Weapon Control Centre
Cal	Calibre
CBRN	Chemical, Biological. Radiological and Nuclear
C4I2SR	Command Control Communications Computer Information Intelligence Surveillance and Reconnaissance
DPP	Defence Procurement Procedure
DRDO	Defence Research and Development Organisation
DPSU	Defence Public Service Unit
FDC	Fire Direction Centre
GPS	Global Positioning System
FGFA	Fifth Generation Fighter Aircraft
ICBM	Inter Continental Ballistic Missile
INS	Inertial Navigation System
ISR	Intelligence Surveillance and Reconnaissance

LOR	Letter of Request
LOA	Letter of Acceptance
LRLAP	Long Range Land Attack Projectile
MARV	Manoeuvrable Re-entry Vehicle
MGS	Mounted Gun System
MIRV	Multiple Independently Targetable Re-entry Vehicles
NCW	Network Centric Warfare
OP	Observation Post
QF	Quick Firing.
RFP	Request for Proposal
SP	Self Propelled
START	Strategic Arms Reduction Talks
TAR	Tibet Autonomous Region
TEC	Technical Evaluation Committee
TEL	Transport Erector Loader
Tr	Tracked
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Aerial Vehicle

The Author

Major General P K Chakravorty, VSM (Retd) is a former Deputy Director General of Perspective Planning Directorate, Defence Attaché to Vietnam and Additional Director General Artillery at Army Headquarters. Post-retirement, the Officer was an Advisor to Brahmos Aerospace. Author of many books, articles and projects for the country's various top think tanks, Gen Chakravorty's main areas of interest are geo-strategy, firepower, and defence procurement, issues on which he has organised and participated in numerous seminars at national and international levels.

Foreword

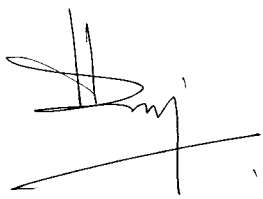
From times immemorial, fire power and manoeuvre have been the two significant pillars to the tangible aspects of military strategy. As a corollary, military's tactical as well as technical leadership down the ages have endeavoured to devise ingenious means to achieve a congruence of these two aspects to shape the battle field. Fruition of this endeavour has accelerated over the past hundred years or so when military technology developed in leaps and bounds. Indeed, the modern means of long range and high volume firepower have enabled military commanders to achieve better engagement of targets and combine that with dominant manoeuvre to test the enemy forces.

Firepower in the current era is characterised by multiple platforms– guns, howitzers, multi-rockets and missiles of various classes and capabilities. Management of such combat platforms require a range of support ancillaries to perform the tasks of surveillance, target acquisition, engagement, destruction, and finally, damage assessment. To that extent, management of firepower has assumed additional complexities of orchestrating the right combination of tactical, technical, logistic and financial factors before the firepower is actually brought to bear. Needless to state, exercise of that kind of acumen requires the professional education to be rooted at the origins of firepower, the courses of its development and finally the contemporary parameters of its application.

This Monograph titled '**Weapons and Missiles in the Indian Environment**' is a scholastic step aimed at delving into the background, development and

current status of various area weapons and missiles in the Indian context. Going further, it also offers a glimpse of key milestones to be gone past. I am sanguine that military, research and development, and finance professionals would find the descriptions contained in this Monograph of much use in informed opinion making.

Jai Hind,



General NC Vij,
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New Delhi
Jul 2017

Chapter – I

Elements of Weapons and Missiles

"The greatest victory is that which requires no battle."

–Sun Tzu

Salience of Fire Power

Weapons and Missiles comprise the combination of Small Arms, Artillery, Air Defence, Tanks, Aircraft, Unmanned Combat Air Vehicles (UCAVs), Ships, Submarines and Unmanned water vehicles. The payload from these weapons could be Conventional, Chemical, Biological, Radiological and Nuclear (CBRN). The use of nuclear bombs delivered by an aircraft at Hiroshima and Nagasaki saw the capitulation of Japan during the Second World War. Thereafter these elements have been used efficiently in numerous conflicts. In India's case, the Kargil Conflict of 1999 terminated in favour of India due to preponderance of firepower delivered by these weapons by the Indian Army and the Indian Air Force. The use of 155 mm Bofors gun in effectively engaging the Tiger Hill and Tololing, as also the Indian Air Force using Mirage 2000 aircraft to release Laser Guided Bombs on the Tiger Hill in the third week of June 1999 paved the way for assaulting troops to reach their objectives. Similarly the effective use of weapons by the Indian Army compelled Pakistan to declare ceasefire on the Line of Control (LoC) in 2003.

It is an indisputable fact that Firepower and Manoeuvre have been two components on which battles were won. Classical use of these was seen

during the two Gulf Wars in 1990's. However that was in open terrain which permitted freedom of movement. However, when we narrow it down to our mountainous borders with Pakistan and China, the issues become entirely different. Mountainous terrain on the Indian borders provides limited space for manoeuvre. Accordingly Firepower assumes greater importance. Therefore, asymmetry of firepower will decide victory in the Indian sub continent. Accordingly, making it extremely important to have a good assortment of guns, rockets and missiles.

Globally, modernisation is being undertaken by all armed forces to enable them to fight in a Network Centric Warfare (NCW) environment. Accordingly all countries are restructuring their armed forces and transforming their strategic thinking. Armed forces' networks essentially link the elements comprising of the sensor, command elements and the shooter to engage targets instantaneously. Therefore, the current focus is on precision stand-off strikes in real time. Fire power presently is undertaken from all four dimensions, which include land, sea, air and submerged surfaces of the sea. Outer space is being used currently for surveillance. However, despite the various space treaties, it is gradually becoming an area for deployment of weapons. Technologically, it would be practicable to consider deployment of anti-satellite and direct energy weapons in this region with developments taking place in this field. Extrapolating to the year 2050, fire power should be capable of breaking the enemy's will to fight. This would entail causing physical damage as also psychologically attenuate his mental capabilities so as to set in a fear psychosis.

Firepower from weapons and missiles essentially comes down to bringing effective fire on selected targets. The entire process entails getting details of the area to be engaged commonly referred to as surveillance, followed by selection of targets, and thereafter engaging the target. It is natural that the target may not have been effectively decimated. Accordingly, there is a need to undertake a Post Strike Damage Assessment (PSDA). These could lead to a correction or a reengagement to ensure destruction. Destruction of critical targets would break the enemy's will to fight, thereby paving the way to success. Asymmetry

of fire power in future wars will lead to victory. The important decision to take here is finding the right mix of weapons and missiles to achieve optimised engagement of targets.

The Elements

Results will be achieved at the target end based on the diversity of application of weapons and missiles. The principal elements are weapon and missile platforms with ammunition, which can deliver from five dimensions: land, air, surface of the sea, below the surface of the sea (hereafter referred as sub-surface), and possibly in times to come, the outer space. The elements are small arms, guns, mortars, rockets of artillery, tanks, aircrafts, missiles, Unmanned Combat Aerial Vehicles (UCAVs), armed helicopters, submarines and in future possibly stations in outer space. The ammunition, which is the payload, is the most important element of these systems. Various types of ammunition would constitute the conventional series which would comprise of high explosive, smoke, illuminating, armour piercing, high explosive squash head, fuel air explosive, cluster, precision, sensor fuzed, incendiary and propaganda. Apart from this there is a strategic variety of ammunition which comprises of nuclear, biological and chemical weapons. Further, in the field of direct energy weaponry, there laser, electro-magnetic pulse and other scientific applications. These ammunitions, with their associated platforms, are able to cause destruction which would severely impact the capability of the adversary to fight.

A new domain of warfare is the cyber space. As per the 17 intelligence agencies of the United States (US), Russia had penetrated into the Democratic National Convention using cyber techniques, thereby influencing the presidential elections of the US in 2016. Cyber warfare is the new entrant and is currently known as the fifth domain of warfare. Cyber weapons perform a series of tasks which can physically or technically destroy a target. The purpose of cyber warfare is to sabotage or damage the information system of a sensitive target. Cyber weapons are primarily used against networks to disrupt, deny,

degrade and destroy critical components. The effects would be termed as physical, syntax and semantic.[1] Cyber weapons impact all platforms and can subvert communication signals, data thereby can become an important tool for undertaking operations.

All weapons and missiles provide muscle to a nation to exercise dissuasion, deterrence and actual conduct of operations. Conflicts visualised could be land operations in a counter-insurgency situation against non-state actors, air-land operations in counter-insurgency or a conventional conflict, air operations for counter-air, air defence, sea operations for sea control or denial, sea-land operations to undertake amphibious operations, air-sea operations between two opposing naval task forces, cyber operations on a day to day basis and possibly in a decade or two would entail operations involving the outer space too. In these conflicts, victory would be attained by ensuring optimised employment of these weapons and missiles.

The elements are distributed in all the three services. Systems used in the Army are distributed to the role of the corresponding arm in battle. Small arms are primarily with the Infantry, tanks with the Armoured Corps, armoured personnel carriers with the Mechanised Infantry, guns, rockets, missiles, UCAVs, and surveillance equipment with the Artillery, air defence equipment with Army Air Defence and helicopters with Army Aviation. Engineers play a critical role in mobility of fire power platforms and ammunition, The Corps of Signals provides a substantial proportion of 'Command, Control, Communications, Computer, Information, Intelligence, Surveillance and Reconnaissance' (C^4I^2SR) requirements. Further, cyber warfare equipment will form a part of possibly Signals, Artillery and Air Defence. Firepower elements in the Navy comprises of frigates, destroyers, cruisers, corvettes, aircraft carriers, air defence ships, submarines, fighter aircrafts, maritime surveillance aircraft, helicopters, UCAVs, coastal guns and missiles. Air Force

1 Colonel Sanjeev Relia, "Understanding Cyber weapons," United Service Institution of India Journal, October-December 2013, pp 584-587.

systems would include aircrafts which are fighters and bombers as also armed helicopters, UCAVs, and missiles for engaging wide range of targets. The Air Force would also include surveillance equipment like aerostats, Unmanned Aerial Vehicles (UAVs), Radars and C^4I^2SR aircrafts like Airborne Warning and Control System (AWACs). These elements would need to be modernised to undertake NCW in a full spectrum conflict. This would entail synergy of these constituents to ensure precise standoff strikes from long ranges with increased lethality. Further, Battle Field Transparency (BFT) needs to be enhanced to ensure everything tactically important is seen and what is seen can be hit in real time.

These elements would be used in operations which could be counter-insurgency, sub-conventional, limited, conventional, and nuclear, chemical and biological. The operations would have to be 'effect based' with possibly no collateral damage. Other aspects which characterise future operations are: non-linearity, enhanced battle space and low threshold against the use of nuclear weapons. It is pertinent to note that more and more countries are developing nuclear weapons covertly to ensure security. However, conventional conflicts can still take place between countries holding nuclear weapons as has been observed during the clash on the Ussuri River between Russia and China in 1969, as also the Kargil conflict between India and Pakistan in 1999.

Creating an Asymmetry of weapons and missiles and combining it with manoeuvre would be a major challenge for attaining victory. This would be attained by seeking and identifying appropriate targets in the area of interest. Thereafter shaping the battlefield to one's own advantage would need seamless engagements with the right combination of these elements. Further, steps have to be taken to shield against enemy counter measures. Finally, the aim would be to strike to degrade, suppress and destroy, thereby breaking the enemy's will to fight.

Chapter – II

Likely Developments

"Generally in battle, use the normal force to engage and use the extraordinary to win."

-Sun Tzu

Issues Meriting Importance

The advent of technology has affected warfare exponentially. Future warfare would be confined to possibly six domains: land, sea, air, underwater, cyber and finally outer space. The state versus state conflict has reduced in the developed world. The US would possibly continue to be the sole super power with China as a competitor. Few certainties which can be assumed reasonably are elucidated below:-

- US continues to be the sole superpower, with a global multi-polar system emerging with the rise of China, India and others.
- Newer players will bring new rules to the game of power.
- Traditional Western alliances will weaken; new multi-polar alliances will emerge.
- Countries may be attracted to China's alternative development model.
- Technology diffusion and innovation leading to empowerment of state and non-state actors.

- Growing importance of missile capabilities with greater lethality, range and various types of warheads. This would automatically enhance the necessity of anti-ballistic missile and anti-cruise missile systems.
- Increased availability and capability of Intelligence, Surveillance and Reconnaissance (ISR) assets such as Satellites and Unmanned Aerial Vehicles (UAVs).
- Social media would be an important tool of influence. Control over cyber and outer space would be important in influencing media.
- Non-traditional threats will be transnational in nature, be it terrorism or cyber warfare.
- Non-state actors would attain capability in the conventional domain which will include guns, rockets, mortars, ballistic and cruise missiles, and chemical and biological capabilities.[1]

While viewing these into the future, it is important to understand that deterrence is extremely important in warfare. During an interaction with Dr Jeffery D. McCausland, (Distinguished Visiting Professor of Research of Strategic Studies Institute at US Army War College, Carlisle, Pennsylvania) at the Forum for Strategic Initiatives, New Delhi on 10 June 2014, the learned Professor gave an interesting formula with regard to Deterrence.

Deterrence = Capability x Credibility[2]

Capability and credibility form two important aspects of warfare. Any nation must have its weaponry and missiles based on requirements and must have the credibility to employ it correctly based on hot testing. Cold laboratory tests

1 Jacqueline Newmyer and Stephen Rosen, "The Character of Conflict in 2025," Workshop Report. Long Term Strategy Group at the office of Centra Technology in Burlington, Massachusetts, USA, 2008.

2 Interaction with Dr Jeffery D. McCausland, (Distinguished Visiting Professor of Research of Strategic Studies Institute at US Army War College, Carlisle, Pennsylvania) at the Forum for Strategic Initiatives, New Delhi on 10 June 2014.

have not stood the test of time and could build a false sense of capability. This is extremely important when we mesh technological advantages to firepower.

Ever since the introduction of fighting, weapons have played an important role. Warfare initially was confined to stones, bows and arrows. Historically the evolution of firepower can be traced to the invention of gunpowder by the Chinese in the ninth century. This technology was used by the Chinese military forces against the Mongols, when they invaded Northern China. The first use of gunpowder was not correctly recorded and it is difficult, therefore, to correlate the events leading to its invention and passage of the knowledge to the Middle East and onwards to Europe. Technologists agree that this was invented by Chinese alchemists searching for an elixir of immortality. It is also interesting to note that the Chinese Emperor was not keen to introduce technology as it would lead to advanced weaponry with its complexities. This was the manner in which Chinese thought in the past which is contradictory to their present intention of modernising with state-of-the-art weaponry.

Doctrines and method of fighting have thus been affected by technical advancement through the ages. Doctrines have resulted in creation of technology for weapons and missiles as also technology has modified doctrines. The current Anti Ship Ballistic Missile DF-21D has been developed by China to meet its Anti Access, Area Denial Strategy to block US Carrier Battle Groups from entering the disputed areas in South China Sea and East China Sea. Accordingly, it can be safely deduced that doctrine and technology keep complementing each other resulting in mutual advancement.

Cannons heralded the entry of weapons in a major way into the battlefield. Xian Zhang, a Chinese poet composed a poem in 1341, "*The Iron Cannon Affair*". This poem describes the fire power of a cannonball fired from an eruptor which could pierce the heart or belly when it strikes a man or horse and could even cause numerous casualties.[3] The proto shells described in the

3 Norris John, "Early Gunpowder Artillery: 1300-1600", (Marlborough, The Crowood Press, 2003), p.11.

battle of Huolongjing were probably used for the first time.[4] The Chinese also mounted over 3000 bronze and iron cast cannon on the Great Wall of China to defend themselves against their adversaries. Cannons were later taken up by both the Mongol conquerors and the Koreans. Chinese soldiers fighting under the Mongols appear to have used hand cannons in battles of Manchuria in the year 1288. This has been found in archaeological findings at the sites where the operations were conducted.[5] Further, during the siege of Pyongyang in 1593, Chinese Ming troops used a variety of cannons to bombard an equally large Japanese Army. Despite both forces having similar numbers, the Japanese were defeated in a single day due to the relative superiority of fire of Chinese weapons.[6]

Guns came into being when the Europeans adopted gunpowder. They bored an opening in a cylinder of metal and drilled another hole of extremely small diameter at the closed end. Thereafter, behind a tight fitting lead ball, they poured gunpowder which was ignited by a flame torch, and the resulting force projected the lead ball into the target area. Often a slow burning rope was used to control the initiation. By the 15th Century, cannons were made in a greater variety of lengths and diameters. The guiding principle was that the longer the barrel, the longer the range. This is applicable even today where a 52 calibre barrel ranges more than 39 calibre barrel. By the end of the century, cannons were made more mobile. Wheeled gun carriages and trunions became common and the invention of the limber facilitated transportation of guns.

This is the period where the Indian Sub-continent enters the scene. Mogul Emperor Babur fought the first battle of Panipat in 1526 against Sultan Ibrahim Lodi of Delhi. Lodi had a greater proportion of soldiers and elephants.

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4 Needham Joseph, "Science and Civilisation in China", Volume 7. "*The Gunpowder Epic*", (Cambridge University Press, 1987), pp. 263-275.

5 Pacey Arnold, "Technology in World Civilisation: A Thousand Year History", MIT Press, 1990, p.47.

6 Archer Christon I, "World History of Warfare", University of Nebraska, 2002, p.211.

However, he had no artillery. On the contrary, Babur had cannons which he skilfully used to cause consternation among the elephants thereby winning with his firepower. This was skilful use of fire power in our country in the 16th Century.

Sweden has historically been connected with weapons. Swedes were great developers of Cannons. In the 17th Century, King Gustavus Adolphus of Sweden emphasised the use of light cannon and mobility in his armed forces. He stopped using the 12 pounder gun and used a lighter gun for the field artillery. He replaced the 12 pounder by the four pounder and the nine pounder. These could be operated by three men and pulled by 12 horses. Further, he introduced a special cartridge which had the powder and the shot, which reduced the time for loading, thereby resulting in very high rates of fire.[7]He pioneered the cargo shot, in which a canister was filled with musket balls which was very effective against troops in the open. He also organised his guns into batteries and used the artillery skilfully to decimate opposing troops. In 1631, at the Battle of Breitenfeld, Adolphus defeated Johann Tserclaes, Count of Tily in Germany, by his dexterity in the use of artillery. The Swedes were severely outnumbered, but they battered the Germans by their very high rates of fire which inflicted severe casualties. The Germans were decimated and lost the battle. During this period, efforts were made to ensure that guns could be aimed to hit a target. Accordingly, the range was controlled by measuring the angle of elevation, using a Gunner's Quadrant. However, in the absence of sights, aiming lacked accuracy.[8] The country had the courage to undertake an offensive against Russia in the 18th Century.

Napoleon was a Gunner who orchestrated the systematic use of artillery. He aptly synergised manoeuvre with firepower. The French Revolution and subsequent Napoleonic Wars revolutionised military strategy. He used firepower skilfully in his entire spectrum of operations. Prior to his rise to

7 Manucy Albert, "Artillery through the Ages", Diane publishing, 1994, pp. 7-8.

8 Tunis Edwin, "Weapons: A Pictorial History", John Hopkins University Press, 1999, p. 9.

power, Inspector General Jean-Baptiste Varvette de Gribeauval made a few technological innovations. Artillery pieces were made with components which enabled mass production. Gun carriages were built to a standard model; the mobility of the guns was improved by harnessing the horses in pair instead of moving in file, hard wood axles replaced heavy iron and accuracy was improved by the introduction of tangent sights which enabled a layer to sight the gun on the target. French artillery essentially comprised of the Gribeauval guns, which were four, six, eight, and 12 pounders, and six and eight inch howitzers.[9]These guns were extremely light. To compare, the barrel of the British 12 pounder weighed 3,150 pounds and the remaining components 6,500 pounds while the Gribeauval 12 pounder barrels weighed 2174 pounds and the remaining components 4,367 pounds. Since Napoleon insisted on speed in conducting his manoeuvres, these lighter cannons provided the flexibility he desired. In addition, his army possessed vast quantities of mortars, furnace bombs, grape and canister shot which produced devastating effects at the target end.

Indeed Napoleon was a master in handling artillery weapons. Napoleon concentrated his guns to blast a hole in the enemy's defences to enable the infantry to break-in and thereafter let the cavalry break-out. This battle procedure is relevant to this day and Napoleon's forethought has to be admired. Weapons played an important role in the sea battles also, with most ships containing anything from 50 to 100 guns. Napoleon's flagship L'Orient, with 120 guns, was the most heavily armed vessel in the world. Napoleon's final battle at Waterloo saw him use many more guns than the British or Prussians. As the battlefield was muddy, the guns fouled with the ground during recoil resulting in slow rates of fire; besides, the projectile shots at the target end got buried and did not ricochet thereby causing lesser casualties. These disadvantages, along with the Prussian playing their part, the French lost this critical battle. It was Napoleon who manoeuvred his artillery guns skilfully resulting in a combination which assured victory. This kind of correct combination of manoeuvre and firepower would be necessary for all battles in the present and future.

9 Podruchny Richard, "The Success of Napoleon", Military History on line.com, p.1.

Artillery guns must be accurate to be effective. The technological process of rifling, which entails casting spiral lines inside the barrel of a gun, was applied around 1855. This provided spin to the projectile which improved the accuracy. The Armstrong Gun which was invented by William George Armstrong had rifling and was accurate at its maximum range. The projectile fired from this Gun could reportedly pierce through a ship's side and explode inside the vessel, causing total destruction of the target. The Gun was procured by the British Army and the Duke of Cambridge was so impressed with the equipment that he declared that it "could do everything but speak."[10]Superior guns with better rifling enhanced fire power tremendously. During the Opium War against China in the 19thCentury, British battleships bombarded the coastal areas and fortifications from safe distances away from the Chinese guns. It may be pertinent to note that the shortest war in recorded history, the Anglo-Zanzibar War of 1896, was brought to a swift conclusion by effective fire of guns from British battle ships.[11]

We now step into the field of rockets and missiles. These were first used by the Chinese against the Mongols in the 13thCentury. In the 18thCentury, the Mysore ruler Tipu Sultan developed rockets which he used during the Second Anglo Mysore War in 1792 against the forces of the British East India Company. Their effective usage resulted in 3820 enemy soldiers being taken as prisoners. The 'Kushoons' were the special rocket brigades of Tipu. These rockets were later re-engineered by the British and used for some time.

Period of the Great Wars

'Small Arms' play a critical part in firepower. As a matter of fact, in close combat they are the only weapons that prove to be effective. Operation Neptune Spear, which was a US Special Forces operation undertaken in May

10 Bastable Marshall.J, "Arms and the State: Sir William Armstrong and the remaking of British Naval power", Ashgate Publishing Limited, 2004, pp.72-73 and 94.

11 Young Mark. C, "Guinness Book of World Records", Bantam books, 2002, p.112.

2011 that resulted in the killing of Osama Bin Laden, the head of Al Qaida, was undertaken by small arms. The small arms saw tremendous improvements in the 19th Century. The rifle was provided with a magazine which raised its rate of fire, the propellant was smokeless which provided concealment and the range was enhanced. The weaponry of the infantry was stepped up by the Maxim type automatic machinegun, which were very effective against artillery guns placed in the firing line, compelling these artillery pieces to either dig down for protection, or adopt steel shield against bullets, or move back further to be out of range of the bullet. Wherever ground permitted, guns were placed out of the range of the machine gun. In such cases, artillery firings and counter-fire preceded small arms fire before an assault. However, if ridges intervened between the guns and targets, there was a need to find a method by which the gun could be fired at angles of elevation to cross crests. A breakthrough came with the French 75 mm gun in 1897. The principle adopted by the gun was the Quick Firing (QF) principle. The recoil system was upgraded to comprise of a hydrostatic buffer and a recuperator. On firing the round, the buffer absorbed the recoil and the recuperator enabled the barrel to return to its original position. This was a technological milestone as prior to this, guns had only buffer systems, which absorbed the force of recoil aided by scotches, inclined planes and spades. The gun had a dial sight, which enabled successive rounds to be fired at the required range and bearing. This enabled fire to be directed by an observation post officer, using a telephone while the guns remained unseen behind cover from the target. These guns enabled firing in direct and indirect modes as also they were used for predicted fire without ranging.[12]

Moving to the Asian sector, the Japanese handled their QF weapons skilfully in Manchuria against the Russians. In September 1904 at the battle of Sha-ho, the Japanese deployed their guns on reverse slopes, which ensured they

12 Shelford Bidwell and Domnick Graham, "Fire power British Army Weapons and Theories of War, 1904-1945", George Allen and Unwin Publishers Limited, Hampstead, UK, pp. 7-10.

were not visible to the enemy or to their own infantry. In addition, they fired concentrations from reinforcing guns with whom they communicated by telephones. Communications with telephones enabled control of artillery fire which led to the usage of indirect fire power and added to its versatility.[13] The war in Manchuria led to numerous debates about the employment of artillery. While some felt that the Japanese method of indirect fire from concealed positions was the appropriate method, there were others who felt that it was better to use guns in line with the infantry, firing at targets by direct firing. The problem in keeping guns in concealed positions on reverse slopes was mainly the problem of having reliable communications. At this juncture, the only means available was the telephone which was prone to disruption due to cables being broken due to shelling. There was definitely a need to improve communications and have observation post officers at the target end and command post staff at the gun end. Gradually the communications were improved and the system adapted itself to the current system, when fire was corrected by the Observation Post Officer and the guns were deployed concealed from the direct firing weapons of the opponent.

The First World War began in 1914, with the Germans moving into France and realising the full potential of indirect fire in synergy with the infantry and cavalry. However the French and the British, using their machine guns and artillery were able to stall their advance. Both sides dug down and the entire situation turned into a stalemate, known as trench warfare. Pressing situations result in inventions and the tank was developed to break the stalemate caused by trench warfare. British Army tested the first prototype on 08 September 1915. To maintain secrecy, they were initially referred as water carriers and thereafter termed as land ships. The British took the lead in tank development and were closely followed by the French, who fielded their first tanks in 1917; but the Germans were slower in this field.

13 Captain B.Vincent, "Artillery in the Manchurian Campaign," Royal United Services Institution Journal, Volume 52, 1908.

The first use of tanks on the battlefield was the use of 49 British Mark I tanks at the Battle of Somme on 15 September 1916. The result was mixed as many broke down but one third succeed in breaking through. The numerical tally was that out of the forty nine tanks, thirty two participated in the attack and nine made it across to "no man's land" and to the German lines. The tanks had been rushed into combat, but their usage gave essential feedback for modifications to be made. The French first used their tanks on 16 April 1917, during the Nivelle offensive. However, their tanks were destroyed by effective use of long range artillery by the Germans. The first really successful use of tanks came in the Battle of Cambrai in 1917. Col Fuller of the British Army with his tanks made an excellent break-in, but the break-out was carried out by horse cavalry who marginally exploited the situation. By 1918, the British had produced the Mark V tank and the French had produced a light tank weighing eight tons. Further, the guns fitted on the tank were shortened to ensure they were stable while negotiating obstacles.

The German General Staff was more keen on Anti-tank weapons than the tanks. The only German tank to be developed was the A7B, of which 15 were manufactured. The first tank versus tank battle took place at Villers-Bretonneux on 24 April 1918. It was an unexpected engagement between three German tanks and three British tanks. The British tanks proved to be superior; however, the British plan of using mass armour could not fructify as the blockade of Germany and entry of the United States (US) brought an end to the War.[14] The tank gun had a higher muzzle velocity and could be gainfully employed in engaging Armour Fighting Vehicles (AFVs) and field fortifications while its fire power produced devastating effects on the battle field. The First World War also saw the introduction of tethered balloons and aeroplanes for gathering information and for directing artillery fire. The fixed wing aircrafts did a commendable job in directing fire power. Observation Post (OP) officers flying in these were able to correct rounds accurately, which enabled them to optimise the effects of firepower.

14 Glanfield John, excerpts from "Devil's Chariots: The birth and secret battles of the first tanks", Sutton Publisher, 2006.

There was no doubt regarding the versatility of the tank in future conflicts. The period between the two World Wars saw tremendous improvement in the tank by the British, French, US and the Germans. It was during this period that the Self Propelled Gun which was needed to move as a part of the mechanised column was developed and inducted. The period witnessed the development of aircrafts and weapon systems. Further, the Germans were developing the V-1 buzz bomb and the V-2 stratospheric rocket. Between the two wars, aircraft technology improved resulting in production of aircrafts which were capable of providing fire power in air to air, air to land and air to sea engagements. Further technological developments led to the production of the 3.7 inch Howitzer, which could be split into separate components and carried by mules. In addition, efforts were being made to tow guns with motorised vehicles. The 25 pounder was under development. The Germans, despite the World War I armistice requirements, developed tanks, aircrafts, towed artillery guns and mortars.

The Americans replaced the 75 mm gun of the First World War with 105 mm Howitzer. Further heavier models including the 155 mm "Long Tom" Gun and 8-inch Howitzer was developed. They also focussed on communications. Radio sets were introduced to control fire. The communications set up enabled a forward observer with an infantry company to maintain constant contact with his guns to his rear. Fire commands from observers were received by Fire Direction Centres (FDCs) located with gun batteries. FDCs used map grids, firing tables and instruments to compute the aiming data necessary to hit an unseen target. An officer in each FDC had the communications necessary to bring all guns within range from a division or a corps to engage a target.[15] Further effort was made to improve the variety of ammunition by the European countries and the US. Development of airpower and its capability of influencing ground battles were enhanced with the invention of the jet engine by Sir Frank Whittle of United Kingdom (UK) in 1930 and Hans von Ohain

15 Robert. H. Scales, Junior, "Fire power in Limited War", National Defence University Press,Washington D.C., April 1990 p.11.

of Germany in 1936. The German jet was flown in August 1939 and the first British jet was flown in May 1941. These were to influence battles dramatically in times ahead as the jets with their high speeds could provide fire power with their weapons to the ground forces to pulverise enemy's field defences.

The Second World War witnessed massed usage of tanks, self propelled artillery, rockets, guns and mortars. General Heinz Wilhelm Guderian, the Corps Commander who led the Blitzkrieg, stated that the most important aspect of a tank was its firepower; protection and mobility were essential characteristics but merited lesser importance. Guderian advocated the formation of the armoured division and its lethal combination of weaponry. In his book Panzer Leader, Guderian wrote,

> "In the year 1929, I became convinced that tanks working on their own or in conjunction with infantry could never achieve decisive importance. My historical studies; the exercises carried out in England and our own experiences with mock ups had persuaded me that the tanks would never be able to produce their full effect until weapons on whose support they must inevitably rely were brought up to their standard of speed and cross country performance. In such formation of all arms, the tanks must play the primary role, the other weapons being subordinated to the requirements of armour. It would be wrong to include tanks in infantry divisions: what we needed were armoured divisions which would include all the supporting arms needed to fight with full effect."

It is pertinent to note that during the war, operations of the land forces were effectively combined with offensive use of airpower. Technologically, this war was influenced by use of tanks, artillery guns, armed aircraft, V-1 flying bomb, V- 2 rockets and the use of nuclear weapons in Hiroshima and Nagasaki. The V-1 flying bomb was developed by the German Air Force during the Second World War. The weapon was launched at London one week after the successful landing of the Allies in Europe on 13 June 1944. The V-1 guidance system used a simple auto pilot to regulate altitude and air speed. There was a sophisticated interaction between yaw, pitch and roll. Several bombs were provided with radio transmitters to check the general direction of flight and the target's grid coordinates by radio bearing. An odometer driven by a vane anemometer on

the nose determined the arrival on the target area to undertake area bombing. They had a range of 96 km and could be air as well as ground launched. 9521 V-1 bombs were used against London and 2448 against Antwerp in Belgium. The attacks caused 22,892 casualties most of whom were civilians. It is of interest to note how these bombs were countered. The average speed of the V-1 was 560 km per hour and it flew at an altitude of 910 m (3000 ft). The British used barrage balloons and fighter aircrafts. 2000 barrage balloons were deployed and 300 V-1's were destroyed by these balloons. The aircrafts used were Tempest, Mosquito, Spitfire XIV and Mustang.

Germany produced another weapon, which was the harbinger of all future missile systems. The V-2 rocket was a ballistic missile that was used mainly for targeting London and Antwerp. This was the world's first long range ballistic missile and first known manmade object to enter space. Over 3,000 V-2 rockets were launched resulting in death of about 7,250 military personnel and civilians. The rocket ranged about 350 km and reached an altitude of 100 to 110 km. The rocket had four major technological advances, its powerful engine, aerodynamic shape, innovative guidance system and its radio transmission system. The rocket engine was fuelled by an ethanol and water combination with liquid oxygen serving as an oxidiser. The rocket was 14 m long, 1.5 m in diameter, weighed 20 tons and had a warhead that weighed 907 kg. The rocket was guided by an Inertial Navigation System which was relatively inaccurate and therefore unsuitable against military targets. After the war, most of the scientists involved with the project migrated to the US or the Union of Soviet Socialist Republics (USSR). Both these countries became superpowers using this scientific talent.

The biggest advent in the field of weapons of destruction was the nuclear weapon. This remains an issue of major concern even today and may remain so in the future. The nuclear weapons were used during the Second World War resulting in the surrender of Japan. The weapon was developed by Manhattan project under the direction of Major General Leslie Groves, of the US Army Corps of Engineers. Two types of bombs were eventually manufactured at Los

Alamos under American physicist Robert Oppenheimer. The Hiroshima bomb known as the *Little Boy* was a fission weapon used with Uranium-235, a rare isotope of Uranium extracted in factories located at Oak Ridge, Tennessee. The other at Nagasaki known as the *Fat Man* was an implosion type of nuclear weapon using Plutonium-239, a synthetic element created in nuclear reactors at Hanford, Washington. Hiroshima was bombed on 06 August 1945. 393 Bomber Squadron provided the B-29 aircraft nick named *Enola Gay*. Enola Gay was accompanied by two other B-29s. They were launched from Northfield airbase on Tinian in the West Pacific. The estimated flying time was six hours. A reconnaissance mission signalled to the bomber that the weather was perfect and Enola Gay arrived over the target in clear visibility. The bomb was released at 8.15 AM local time. It took 43 seconds to fall from the aircraft which was at a height of 31,060 ft. The pre- detonation height was about 1,900 ft above the city. Due to cross winds, it missed the aiming point, the Aioi Bridge, by almost 240 m and detonated directly over a surgical clinic. The blast equivalent was about 13 kilotons of TNT. The radius of total destruction was about 1.6 km, with resulting fires across 11 sq. km. Japanese officials determined that 69 percent of buildings were destroyed, six to seven percent were damaged, 70,000 to 80,000 people were killed immediately and another 70,000 injured. Over 90 percent of the doctors and 93 percent of the nurses were casualties.

The second bomb was dropped over Nagasaki, a port city, at 11.01 AM on 09 August 1945. The blast equivalent was 21 tons of TNT. Casualties reported were extremely high. Destructive power produced by nuclear weapons broke the will of the Japanese and compelled them to accept the terms of surrender on 14 August 1945.[16]

Period after the Great Wars

The War in Korea was the first war to be fought after the Second World War. The Korean War fought in 1950s saw the introduction of the helicopter, but it

16 President Truman Papers, "Hiroshima, US Strategic Bombing Survey. The effects of Atomic bombing of Hiroshima and Nagasaki", pp. 11 to 16.

was only used for ferrying troops and was not weaponised. It was only during the Vietnam War, which saw US involvement commence in 1964, that an armed helicopter was introduced. The Huey AH-1B Attack helicopter was used extensively to carry out Search and Destroy missions in Vietnam. The US Army created its first full scale air mobile unit, the 11th Air Assault Division, in 1964. This was commanded by Brigadier General Harry WO Kinnard. It was a conventional light division with 434 helicopters. The Huey Cobra helicopters of the two light helicopter battalions provided lift to carry infantry. Artillery firepower was provided by three conventional artillery battalions that could be lifted by Chinook helicopters and an aerial artillery battalion consisting of rocket firing Hueys. General Kinnard built and employed his division in an unconventional manner. Having undergone its trials, on 01 July 1965, the division was re-designated as the 1st Cavalry Division Airmobile. Two months after its activation, the division arrived in Vietnam. The division was pitched by General Westmoreland against North Vietnamese Military Region IV in the Central Highlands. General Kinnard by audacious use of his weaponry was able to destroy a large portion of the three North Vietnamese regiments which attacked the base at Plei Me, and for the first time had artillery deployed by helicopters on ground and Huey helicopters firing rockets from the air. Apart from this, Forward Air Controllers called-in fighters who performed creditably by day and night. Effective use of artillery resulted in tremendous success during the operations conducted from 27 October 1965 to 15 November 1965.[17] The Vietnam War also introduced the UAV, which later got upgraded to UCAV and precision ammunition. As this was a war fought under asymmetric conditions, technological developments were focussed on so as to fly and fight in all weather conditions by day and night.

The UAV, which was used in Vietnam for surveillance and directing artillery fire, soon became a force multiplier in numerous operations. During the Lebanon crisis in 1982, the Israeli UAVs completely deceived the Air Defence

17 Robert. H. Scales, Junior, "Fire power in Limited War", National Defence University Press, Washington D.C. April 1990, p.11 to 16.

system of the Syrians and were able to effectively direct Israeli fire power on the Syrian forces. The UAVs graduated to UCAVs and revolutionised firepower. Their potential as platforms for suppression of enemy air defence systems, early warning of ballistic missile attacks and even boost phase intercept of ballistic missile makes them flexible, effective and can undertake engagements at low cost. They can achieve these results without risking the lives of trained pilots and also pave the way for victory by destruction without collateral damage. UCAVs have already demonstrated their ability in Counter Insurgency operations. A number of Al Qaida leaders have been killed in precision attacks by UCAVs. The US UCAVs have mounted Lockheed Martin's *Hellfire* missile, where as Israeli UCAVs have mounted *Lahat*, a semi active laser guided missile with a range of 10 km.

Precision ammunition is guided to accurately hit a target with minimum collateral damage. The electro optical bomb was used during the Vietnam War. The entire equipment comprised of television camera and flare sights, by which the bomb would be steered until the flare superimposed the target. The camera bombs transmitted a bomb's eye view of the target to the controlling aircraft. Simultaneously, development took place in the field of laser guided weapons. All these weapons rely on the target being illuminated by a laser target designator on the ground or an aerial platform. The laser designator sends its beam in a coded series of pulses to ensure that the bomb is not confused by other signals. The best use of these bombs was by the US Air Force on 27 April and 13 May 1972 against the Thanh Hoa Bridge in Northern Vietnam. This bridge had been the target of 800 US Air Force sorties using normal bombs, but the same was successfully destroyed by Phantom jets using Laser Guided Bombs (LGBs). The use of technology in usage of artillery firepower can be effectively compared by comparing two important battles, Dien Bien Phu and Khe Sanh. At Dien Bien Phu, the Vietnamese defeated the French and at Khe Sanh troops of the 26th Marine Regiment held on due to the fusion of electronic and conventional firepower.

Asymmetry of firepower by weapons and missiles means of a higher technology enabled the Marines to hold on to Khe Sanh. The battle for Khe Sanh lasted for

77 days which was about three weeks more than Dien Bien Phu. Khe Sanh held due to two reasons; firstly the traditional tenacity of the Marines, and secondly, the availability of an effective firepower system that combined together, for the first time in warfare, both the electronic and conventional ammunition in high magnitude.[18] High technology as also fusion of conventional firepower and electronic means was the difference at Khe Sanh where the Marines held on despite numerous attacks by the Vietnamese.

Post-Vietnam development of precision weapons gained tremendous importance as collateral damage became unacceptable. In the field of artillery guns, the 155 mm Cannon Launched Guided Projectile (CLGP) was the first to be developed. This was referred as the 'Copperhead', which was a 155 mm fin-stabilised terminally guided laser projectile. The projectile would function once the target is illuminated with laser. The projectile detects the laser signal, activating the onboard guidance system and operates the steering vanes to manoeuvre the projectile on the target. The range of the projectile was a minimum of three km and a maximum of 16 km. Russians developed a similar system known as 'Krasnopol', which was used for 152 mm and 155 mm gun systems. These systems were effective against tanks and hard targets. However, they needed good visibility and a lot depended on the skill of the observer operating the laser designator. Accordingly, two types of precision ammunition were developed for the artillery - the precision guided kit and the extended range precision guided shells.

There are two known precision guided kits in use, the first is Alliant Tech system XM 1156 and the second is the Israeli Top Gun GPS/ INS 2 D course correction fuze. Both these equipment are screwed into the nose of the existing projectile like the existing fuze. The XM 1156 is guided by GPS and has an accuracy of 30 m, whereas the Top Gun is guided by INS with GPS in loop and provides an accuracy of 20 m. The M982 Excalibur is a 155 mm extended range artillery shell developed by Raytheon Missile System and BAE System. With

18 Robert. H. Scales, Junior, "Fire power in Limited War", National Defence University Press, Washington D.C. April 1990, p.11 to 16.

a combination of GPS satellite and inertial guidance, the round provides an accuracy of four to six m at a range of 37 km. The Block II of this ammunition carries either 65 Dual Purpose Improved Conventional Munition (DPICM) or two Sense and Destroy Armour Munitions (SADARM). Excalibur can be fired with 155 mm Gun and has been used operationally in Iraq and Afghanistan.

In the category of precision ammunition, there is the sensor fuzed ammunition which can be fired from the 155 mm gun. This is a carrier shell containing two cylindrical sub munitions. This has an electronic nose fuze on which time is set before firing. The fuze is set to function at an altitude of over 1,000 m above the target area. At the appropriate time, a small expelling charge ejects two container cylinders, each containing one sub-munition, from the rear of the projectile body. Here, after each container cylinder is dispersed while the rotation rate and velocity are reduced by spin brakes. After a fixed time, a secondary ejection operation separates each sub-munition from its container cylinder. As each sub-munition descends, a stabilising disc is released, after which two wings and the Electro Optical Unit (EOU) fold out with a spin rate of 15 revolutions per second. In case of Swedish Bonus ammunition, wings were selected in lieu of parachute, as they are less sensitive to strong winds and provide a smooth search pattern. The EOU is equipped with a multi band passive Infra-Red (IR) detector or a mm wave radar, which is switched on at the appropriate time and homes on to a target. The sensor fuzed ammunition's sensitivity makes it a potent weapon against mechanised vehicles.

Another area of technological development comprises of cluster munitions. A cluster munition is a form of air dropped or ground launched explosive weapon that releases or ejects smaller munition. This variety of ammunition has an enhanced lethal area that destroys personnel, vehicles, runways, electric power transmission lines and propaganda leaflets. Many of the unexploded bombs can kill or injure civilians after a conflict has ended and are difficult to locate and remove. Cluster bombs could be anti-personnel, anti-tank, anti-runway, anti-mines, anti-electrical, leaf dispensing, incendiary, and chemical weapons. Anti-personnel cluster bombs use explosive fragmentation to cause casualties to

personnel and destroy soft targets. They were widely used during the Vietnam War when huge amount of cluster bombs were dropped over Vietnam, Laos and Cambodia. The anti-tank variety in most cases contains shaped charged war heads to pierce the armour of tanks and Armoured Personnel Carriers (APCs).

Modern guided sub-munitions such as those found in the US CBU-97 can use either a shaped charge or an explosively formed penetrator. Unguided shaped charge cluster ammunition is designed to be effective against entrenchments with overhead cover. Anti-runway cluster bombs are designed to penetrate concrete before detonating thus allowing them to shatter and crater runway surfaces. The British JP 233 uses a two stage warhead that combines a shaped charge as conventional bulk explosive charge. The shaped charge creates a small crater which is expanded by the detonation of a bulk explosive charge. Anti-runway cluster bombs are normally used along with anti-personnel cluster bombs equipped with delay or booby trap fuzes that make repair work difficult. Cluster bombs are used to dispense mines and these do not detonate immediately but behave like conventional mines. Mines manufactured by the US are designed to self-destruct after four to 48 hours, to keep the battle field clear of explosives.

The anti-electric cluster bomb CBU-94/B was first used by the US in the Kosovo War in 1999. The bomb consists of a tactical ammunition dispenser filled with 202 BLU-114/ bomblets. Each bomblet contains small explosive charge that disperses 147 reels of fine conductive fibre of either carbon or aluminium coated glass. Their purpose is to disrupt and damage electric power transmissions by producing short circuits in high voltage power lines and electric sub stations. On the first attack, these knocked out 70 percent of the electric power supply in Serbia. The same ammunition was used effectively against Iraq in Gulf War II. Reports indicate it took 500 people 15 hours to get one transformer yard to get back on line after being hit with these weapons. The leaflet cluster bombs are used for propaganda purposes. In this connection, the LBU-30 bomb with leaflets has been tested by a F-16 aircraft flying at 20,000 ft in the year 2000. The LBU-30 consists of SUU-30 dispensers that have been adapted to

leaflet dispersal. The dispensers are usually recycled units from old bombs. It is important to note that enclosing the leaflets within the bomblets ensures that leaflets will fall on the intended area without being dispersed excessively by the wind.

Cluster weapons to be used for delivery of chemical payloads were developed by the United States and the Soviet Union during the period from 1950 to 1960. The Chemical Weapons Convention of 1993 banned their use. Thereafter these cluster bombs were destroyed. The last in the cluster bomb series is the incendiary bomb. These are intended to start fires and have sub-munitions of white phosphorus or napalm and they often include anti-personnel and anti-tank sub-munitions to hamper fire fighting efforts. The incendiary bomb technologically resulted in the development of the thermobaric bomb.

Technological developments in the evolution of firepower have witnessed the development of the powerful thermobaric bomb. This is an explosive that produces a blast wave of longer duration thereby increasing the number of infrastructural and human casualties. These explosives rely on atmospheric oxygen, where most explosives have a fuel oxidiser premix (gunpowder contains 25 percent fuel and 75 percent oxidiser). They have significant advantages when deployed inside confined environments such as tunnels, caves and bunkers. Thermobaric weapons have been used by Russians and the US forces. On 03 March 2002, the US used a single 2000 lb laser guided thermobaric bomb against cave complexes in which Al Qaida and Taliban fighters had taken refuge in the Gardez region of Afghanistan. The effect was devastating and it blew the entire target into smithereens. Own Defence Research and Development Organisation (DRDO) is developing the thermobaric ammunition to be fired by 105 mm Field Gun of the Indian Artillery.

Missiles

After the Second World War, both the US and the USSR started research programmes on rockets and missiles based on the German V-2 design. Variety of missiles were developed and inducted. These included the Short Range

Ballistic Missile (SRBM) onwards to the Intermediate Range Ballistic Missile (IRBM) and finally the Inter Continental Ballistic Missile (ICBM). The USSR manufactured the first ICBM in 1957 and the US in 1960. The flight phases comprise the boost phase, the mid-course phase and the re-entry phase. The boost phase lasts for about three to five minutes. The missile altitude at the end of this phase is typically 150 to 400 km depending on the trajectory chosen. The mid-course phase takes approximately 25 minutes. During this phase it is in an elliptical flight path. The apogee half way through the elliptical path is at an altitude of approximately 1200 km and the missile continues on an unpowered ballistic trajectory like an artillery projectile. The re-entry phase commences at an altitude of 100 km and lasts for two minutes with an impact speed of four km per second. ICBMs can be deployed from multiple platforms, which could be missile silos, submarines, trucks and mobile launchers on rails. Modern ICBMs carry multiple independent targetable re-entry vehicles (MIRVs) each of which carries a separate nuclear warhead allowing a single missile to hit multiple targets. The MIRVs are effective against an Anti Ballistic System (ABM) and are currently held by US, Russia, China, France, Britain and possibly Israel.

While ballistic missiles in most cases carry nuclear pay load, cruise missiles which fly at lower altitudes and can be steered to the target with precision, have been developed and used extensively in the Gulf Wars, Afghanistan, Kosovo, Libya and recently in Syria. The most extensively used Cruise missile has been the US subsonic Tomahawk missile with ranges of about 1700 km and guided by GPS, INS, TERCOM (Terrain Contour Matching), DSMAC (Digital Scene Matching Area Co-relation). The Tomahawks were mainly launched from naval ships, but a few were launched from F-117. The missile is accurate and its effects are devastating. The Indo-Russian Joint Venture Cruise Missile 'BrahMos', developed a decade ago, is a Fire and Forget Cruise Missile, which has a range of 290 km and is a precision weapon capable of undertaking surgical strikes. This is a unique system with platforms on land, sea, and submarine, while development is in process for the air version. Currently, after India has signed the Missile Technology Control Regime (MTCR), the range of the missile is being extended to about 400 km.

Precision technology in the field of missiles has resulted in the development of loitering missiles, in which the missile has the sensor and the shooter located within. Accordingly, the missile can select a target and engage it with pin-point accuracy. Further, its endurance enables the missile to loiter over the target area, thereby providing it the opportunity to select and engage a target. The endurance of a loitering missile varies from 30 minutes to 8 hours. The missile is in its final stages of development and would be inducted into service thereafter. Once inducted, the missile would be ideal against targets such as bridges, railway siding, logistic areas, critical points in a military station, head-works, missile sites, ammunition dumps and command and control centres. It may be pertinent to note that another precise missile is the short range fire and forget Hellfire missile. The weapon is an air-to-surface and surface-to-surface missile. It is a high explosive anti-tank metal augmented charge. It has a solid fuel rocket engine and has an operational range of 500 m to 8 km. The guidance system is millimetre wave radar seeker. It has been launched from rotary and fixed wing platforms as also UCAVs, tripods, ships and ground vehicles. The missile has killed the Hamas leader Ahmed Yassin in 2004 and the Al Qaida leader Anwar Al Awlaki in 2011.

Technology has also seen the development of rocket systems by Russia and the US. Though these systems are not very accurate, they produce shock action by delivering large quantities of explosive simultaneously on the target. The GRAD BM-21 and Smerch of Russia, the Multiple Launch Rocket system (MLRS) and the High Mobility Artillery Rocket System (HIMARS) of the US and PINAKA weapon system produced by India are the systems which cause shock by their awesome firepower. The Smerch has a maximum range of 90 km and fires a variety of ammunition which can pulverise a target, thereby breaking the enemy's will to fight. The Pinaka and MLRS attain a maximum range of 40 Km.

Anti Ballistic Missile

An Anti Ballistic Missile (ABM) counters ballistic missiles, thereby enhancing the effectiveness of firepower of own missile system. The term includes any anti-missile system designed to counter ballistic missiles. Many short range tactical

ABM systems are currently operationalised. The best known systems are the US Army 'Patriot', the US Navy Aegis' and the Israeli 'Arrow'. The Patriot missile performed correctly during the Gulf War, though the inability to tackle Iraqi Cruise Missiles remained a weakness. Russia has the S-300, S-400 and S-500 ABMs. China has acquired the S-400 system and is developing other ABMs. India has also developed ABMs which have been successfully test fired. India is also acquiring the S 400 system. Against ICBMs, there are only two systems, the Russian A-135 (Gorgon and Gazelle) and the US Ground Based Mid-Course Defence. The interceptors are based in Alaska and provide protection against missiles launched from North Korea, China and Russia. Similar interceptors have been placed on the East Coast for defence against missiles from Iran. ABMs are not successful against MIRVs and it is economically ineffective in countering multiple warheads. With the withdrawal of the US from the ABM Treaty in 2002, the Russians are no more complying with the Strategic Arms Reduction Treaty II (START II), thereby maintaining the MIRVs against which no ABM system is practicable.

Recently, the Israeli Defence Forces have developed and inducted the Iron Dome Mobile Air Defence system. This has been developed by Rafael Advanced Defence System and is designed to intercept artillery rounds and rockets. The system has three main components - a detection cum tracking radar, Battle Management Weapon Control Centre (BMC) and a missile firing unit that launches the Tamir interceptor missile equipped with electro-optic sensors as well as several steering fins for high manoeuvrability. The radar detects a round or a rocket's launch and tracks its trajectory. Thereafter, the BMC calculates the expected point of impact and fires the interceptor missile to destroy the rocket over a safe area. The launch platform has three launchers each carrying 20 interceptors. The system has been deployed by Israel in early 2011 and has been effective in the Gaza Strip against rocket attack in August 2014.

Direct Energy Weapons

This is a new class of weapon system which are currently under development. These weapons emit energy in an aimed direction without the means of a projectile. It transfers energy to a target for desired effect. The energy can come

in the form of Electromagnetic radiation in lasers or masers, particle beam weapons, flame throwers and sound in sonic weapons. Laser weapons usually generate brief high energy pulses. Most of the existing weaponised lasers are gas dynamic lasers. These use a low powered oscillator to generate a coherent wave which can destroy a target. The pulsed energy projectile emits an IR laser pulse, which creates rapidly expanding plasma at the target. The resulting sound, shock and electromagnetic waves stun the target and cause temporary pain and paralysis. Further there are particle beam weapons which can use charged or neutral particles to decimate targets. The last weapon in this category is a sonic weapon. These weapons utilise sound to injure, incapacitate or kill an opponent.

Currently, these weapons are in the development phase in the form of sonic bullets, sonic grenades, sonic mines or sonic cannons. These either emit a focussed beam of sound or dispense sound over an extensive area. Sound waves of high power emitted by these weapons can disrupt ear drums and cause severe pain or disorientation. On the contrary, less powerful sound waves can cause nausea and discomfort. These weapons would need to be optimised once the development phase is completed.[19]

Command, Control, Communications, Computers, Information Intelligence Surveillance and Reconnaissance (C^4I^2SR)

Evolution of technology has changed dimensions of war from human centric to platform centric and currently the move is towards NCW. This warfare integrates Sensors, Decision makers and firepower. The entire process in the current battle space has integrated these elements resulting in synergy during operations. This has been possible due to development of multifarious sensors, communication links between sensors and command elements as also with weapons to engage selected targets and PSDA to know the efficacy of engagement.

Broadly, there is a wide array of surveillance equipment. Sensors are located on land, sea, under water, air and outer space. Ground based surveillance

19 Ray Guns, "Laser Warfare," www.spacewar.com, 29 March 2017.

equipment comprises of the Thermal Imaging Integrated Observation Equipment (TIIOE), Long Range Observation and Reconnaissance Equipment (LORROS), Short Range Battlefield Surveillance Radars, Medium Range Battle Field Surveillance Radars, Weapon Locating Radars and Sound Ranging systems. Naval surveillance equipment comprise of Radars, Sea bed arrays and Sonar Surveillance. The Air component comprises of Aerostats, Airborne Warning and Control System (AWACs), Tactical Reconnaissance, UAVs and UCAVs. Space based systems comprise of Geo synchronous satellites, Remote Sensing satellites, Low Earth Orbiting satellites and space stations. Information provided by these sensors is interpreted by the command and control elements leading to decisions regarding target engagements. A tactical C^4 I^2 system would be primarily based on Command Information Decision Support System (CIDSS) with affiliated systems comprising of Artillery Combat Command & Control System (ACCCS), Electronic Warfare System (EWS), Battlefield Surveillance System (BSS), Air Defence Control & Reporting System (AD C&RS), Operational Air Support (OAS), Air Space Control System (ASCS) and Communications & Data Network System (CDNS). These systems enable the data to be processed leading to selection and engagement of targets resulting in effective firepower at the objectives to accomplish the operational aim.

Futuristic Developments

Evolution of Technology has enhanced our potential to use guns and missiles by great magnitude. The present battlefield environment provides for good surveillance, creditable reconnaissance, leading to systematic target acquisition followed by engagements with an aim to degrade or destroy, thereby breaking the enemy's will to fight and paving the way to victory. The developments described above are likely to fructify by 2030. The point to note is where we reach in the next two decades. Technology keeps on improving and the areas which would be impacted are as stated below:-

- In the next two decades, warfare will possibly include five domains, Land, Sea, Air, Cyber and Outer Space. Firepower of guns and missiles will be a part of all five domains including the cyber domain which would possibly entail 'Hard Kill' of cyber assets.

- Technology will enable surveillance of land and sea assets and also movements under water and in Outer Space. Recent operations between Israel and Hamas in the Gaza Strip have indicated the use of tunnels by Hamas to link various locations in Israel and Egypt. Surveillance of underground would be a major area for scientific research. Further, technology will ensure real time imaging in terms of targets to enable accurate observation while undertaking engagement.
- The entire operations will be net centric. Communications will be with every soldier and he would be in a position to call, observe and correct fire. He would also have a hand held computer which would provide necessary information.
- Warfare will essentially be non-contact and would entail the issues of engagement, adjustment and post strike damage assessment to be done with minimum human interference.
- The human being would be gradually replaced by robots that would constitute about 30 percent of the forces. It is visualised that aircraft, ships, submarines and ground vehicles would be unmanned. Robots would also be used in offensive operations duly guided by commanders from remote locations.
- Conventional ammunition will become more lethal and accurate. Use of thermobaric and other developed explosives will cause higher casualties. A large percentage approximately 60 percent of all ammunition will be Precision Guided Munitions (PGMs).
- Ranges of Guns firing shells at ranges of 190 to 200 km would be developed to engage targets. Currently two developments are on in the US. The Long Range Land Attack Projectile (LRLAP) is a developmental programme to produce a precision guidance 155 mm naval artillery shell for the US Navy. The system is under development by Lockheed Martin Missiles and Fire Control, the prime contractor being BAE Systems. In cooperation with BAE, a version of LRLAP has been designed to be used with 5 inch/54 naval cannon. The 155 mm/62 AGS shell weighs 102 kg and has a bursting charge of 11 kg.

The guidance of the projectile is GPS and INS. The Circular Error of probability is less than 50 metres. The warhead is Unitary High Explosive and the range is 190 km.[20] By June 2013 four full cycle live tests had been conducted. In September 2013 Lockheed received USD 18 million contract to transition the Long Range Land Attack Projectile (LRLAP) to production. The fielding is planned in a few years based on Service requirement. By 2025, the equipment would not only have been operationalised but stabilised.

- In addition to that, the US has dropped a 21000 lb bomb at Achin district of the eastern province of Nangarhar in Aghanistan. This is close to the Pakistan Border and the Islamic State of Iraq and Syria (ISIS) militants were based in a tunnel complex in that area. The bomb blasted at 7.32 p.m. local time on 13 April 2017. The bomb a GBU-43B which is a 'Massive Ordnance Air Blast Bomb'. It weighs more than 10,000 Kg and contains 8100 Kg of explosive. Its explosion is equivalent to 11 tons of TNT and the radius of the blast is 1.6 km. The bomb is burst in the air and penetrates through tunnels, kills by shrapnel, produces an immense blast wave and causes shock and awe which psychologically paralyses the individual. As per reports received about 94 ISIS militants have been killed in the attack.[21]
- Unmanned platforms in the form of aerial vehicles, land systems, ships, patrol vessels and submarines would gradually replace the human being. Currently all gas stations in the US are gradually becoming unmanned. There are numerous unmanned trains being run in the US airports. Even Delhi Metro is slated to run unmanned metro trains in the newly constructed lines. Taxis are soon going to be run by robots and possibly there would be no man made taxis in the US by 2030. A conscious decision has been taken by the US Air Force that 30 percent of their

20 Long Range Land Attack Projectile, United States of America, www.naval-technology.com,down loaded on 14 April 2017.

21 "Massive bomb dropped by US in Afghanistan", cbc news /world, www. cbc.ca/news/world/Afghanistan-mother, updated on 15 April 2017.

aircraft of all categories would be unmanned. As stated in the next 20 to 30 years, these are going to explode and create innovations in use of air power and firepower.[22] Further, the entire logistics system would possibly be unmanned. The weapon of the Artillery is ammunition and the entire logistic chain could be unmanned. PGMs would reduce the logistics load that would be required to be maintained. The use of loitering system would gain prominence.

- Cyber warfare will be the most important component directly affecting operations at Land, Sea, Air and Outer Space. Firepower of guns, rockets and missiles are entirely dependent on electronics and interference in these would cause serious impact on surveillance, engagement and adjustment of fire. Cyber could also be used in peace to disrupt power distribution and tamper with firepower logistics networks to thereby cause confusion.
- Nano technology is likely to be used extensively. Military equipment including weapon platforms are going to be lighter enabling them to be easily operationalised in mountainous terrain.
- Biotechnology weapons causing awkward sounds by shells resulting in loss of hearing or use of chemicals to induce sleep could be covertly used by 2050.
- The field of Avionics is likely to witness fighter aircrafts flying at Hypersonic Speed which entails flying at a speed greater than Mach V.
- ABM Systems would be more effective and possibly Outer Space would be used for detection and engagement. Cruise Missiles would be ideally tackled from Outer Space.
- Directed Energy Weapons would be inducted and optimised by 2050. Laser and particle beam weapons would be capable of decimating targets. As explained earlier, these weapons emit highly focussed energy,

22 Colonel Bradley T Hoagland, "Manning the Next Unmanned Air Force, " Centre for 21st Century Security and Intelligence, Policy Paper August 2013.

transferring that energy to a target would damage it. These weapons would be line of sight and could be deployed sensibly.

- Developments in the nuclear field, particularly of Electro Magnetic Pulse, need to be researched and carefully applied to firepower.
- Navigational systems would be numerous and it would be incumbent for any country using firepower to have its own navigational satellites. Currently the US has the Global Positioning System (GPS), Russia has GLONASS, European Union has the Eurosat and Chinese have the Beidou System. India is also planning to have her own navigation system.
- By 2050 there would be a counter for every weapon in terms of Soft and Hard Kill. This must be borne in mind as in applying firepower, deception will become extremely important.
- Critical technologies for future requirements would be Nano technology, Robotics, Artificial Intelligence, Bio technology, Micro-Optronics/Electronics, Cyber, Radar, Microwave, Directed Energy systems, Avionics, Nuclear, Missile, Rockets and Material Science.

Chapter – III

Impact on India

"Ultima Ratio Regum" (The final argument of kings)

Inscription on French cannons, on order of Louis XIV

Introduction

India, unlike any other nation in the world, is severely confronted by hostile borders. The country has two adversaries China and Pakistan, which have disputed borders. India till date has fought three wars with Pakistan and one war with China. Apart from these wars, the Kargil conflict in 1999 was a major operation involving the Indian Air Force and the Indian Army. Further, hybrid warfare conditions persist in the state of Kashmir vis-a-vis Pakistan.

Despite India's best efforts to make peace overtures to these nations, they continue to remain aggressive in their stance towards India. The Chinese see India as its principal challenger in Asia, whereas Pakistan, despite cultural similarities, would like to continue the animosity to India as it suits the interests of the Pakistani Army who calls the shots in their country. As both countries are involved in intense modernisation of their Armed Forces, it is incumbent upon India also to modernise and meet the challenge.

As all these countries are nuclear weapon states, strategists often state that only a limited war could be feasible as no country would like to cross the nuclear Rubicon. There is another school of thought that argues that India

has to be prepared for a war either with China or Pakistan. There could be a worst case scenario, where India may have to fight a two front war with China and Pakistan. India has no other option but to build up its forces militarily to undertake this challenge. This would entail enhanced force levels and also additional units of firepower comprising guns, rockets and missiles. The other aspect is the measures to tackle Pakistan. India would have to be conventionally stronger than Pakistan even as years roll by.

It would be a miracle if Pakistan would wish to be at peace with India. The country would like to use asymmetric methods to continue a low level proxy war with India, which in current terminology is known as Hybrid Warfare. India has so far been tolerating it possibly to avoid a war with a nuclear overhang. This situation may not be acceptable to the current Government as also future leadership of India. They may like to use India's conventional superiority to strategically expose Pakistan's nuclear bluff. Nuclear weapons have been used so far only once and Pakistan's military would rather not use these against India, as a riposte from India would possibly lead to Pakistan's annihilation. Accordingly, Pakistan has to calibrate its asymmetric tendencies keeping in view India's flexibility to respond due to the emergence of stronger leadership. [1]

Let us also consider Pakistan's usage of Tactical Nuclear Weapons. It is essential to understand that 'Nasr', the Tactical Nuclear Weapon (TNW) that Pakistan possesses, is stated to have a range of 60 km and has undergone its first flight test on 19 April 2011. The launch system is similar to artillery rocket system. It is believed to be derived from the Ws-2 Weishi Rockets system developed by China's Sichuan Aerospace Corporation. Four rockets can be carried on the Chinese origin Transport Erector Launcher. The warhead section has been estimated to have a cylindrical section which is 361 mm in diameter, 940 mm long with a conical portion which is 660 mm long. The first question is whether the warhead has been miniaturised successfully for the Nasr? There is

1 Brigadier Narender Kumar, "Hybrid Warfare: Pakistan's tool of War in J&K, Salute to the Indian Soldier", 15 October 2016.

no scientific proof that the same has been completed. Accordingly, the weapon remains but cold tested. The next issue pertains to its deployment. As the range is extremely limited, the weapon will perforce have to be deployed possibly about 20 km from the LoC or the International Boundary (IB). This has its own problems as the usage becomes decentralised.

Presuming that the yield is sub-kiloton, it is pertinent to evaluate where the TNW will be used. In the mountainous region it will have no impact; in the plains the Army dominated by Punjabi Generals would not like to use it as it would leave scars in their heartland. The only area which is suitable is the desert region opposite Rajasthan. Let us assume that Indian mechanised formations are launched in this region. There would be a minimum inescapable requirement of 436 TNWs to stop an Armoured Division. Currently Pakistan is possibly holding 120 nuclear warheads. Out of these, let us assume about 30 are TNWs. If about four TNWs are used against a mechanised formation, then it would at best produce 20 fatal casualties. Many former dignitaries from both India and Pakistan have stated that this would lead to a holocaust, which can destroy Pakistan and possibly a few targets in India. Pakistani Generals are good planners but lack the audacity to execute and would never play this event which would go out of their control. They would like to continue with asymmetric steps in preventing escalation. A conundrum is thus created, which Pakistan believes would deter India from launching conventional strikes into Pakistani territory.[2]

Chinese Assertiveness and the Pakistan Factor

To understand what the implications for India would be in future, we have to analyse the past, consider the present and extrapolate possibly two decades from now as to what would be the shape of events. The preceding paragraphs clearly bring out what are the nuances of China-India-Pakistan relationship currently and what would be the status in future. The point is that India, as per existing trends and net assessment, has to contend with contentious

2 P K Chakravorty, "The Tactical Nuclear Weapons Conundrum," Centre for Land Warfare Studies, claws.in, Serial 1839, October 2016.

relationship with both Pakistan and China. Further, between China and Pakistan, the technology driver is China. The moot point is the methods used by China to update its technology. Once we understand critical technologies being absorbed by China, it would be clear where they would possibly reach in the next two decades. A table below shows critical technologies obtained by China:-

Area	Period	Source	Effect
Nuclear Weapon designs	1970 to 1990	Open sources and contact with laboratory engineers	The Cox Commission reported in 1999 that the PRC had gained information on theW-88, W-87, W-78, W-76, W-70, W-62 and W-56 nuclear warheads, plus some warhead casing designs, which likely helped the PLA design new smaller warhead casing designs. These would have possibly helped PLA design new smaller warheads for its DF-31 and JL-2 missile.
FBI Counter-intelligence	1980 to 2000	FBI informant	Compromised FBI counterintelligence officials, who passed essential inputs
Stealth, F-117	1999	F-117 downed by Serbia in 1999	Reported to have obtained parts of stealth coating outer skin, engine radiation suppression area and guidance system. Could have assisted in developing stealth systems.
Stealth B-2	1999-2002	Engineer from Northop Grumman	The Engineer pioneered new technology Infra Red suppression on B-2 bomber. Possibly parted with stealth technology. Led to creation of stealth cruise missiles.

Combat Aircraft, Shuttle and Missile Technology	Late 1970 to 2006	Dongfan Greg Chung	Aeronautical engineer who worked for Rockwell and Boeing cooperated with AVIC-1 officials.
Cruise Missile Technology	1998-2000	Taliban	China reportedly paid USD 10 million to Taliban regime for US Tomahawk Cruise missile pieces.
Terfenol-D	Prior to 2002	PRC students in US	This improves the quality of submarine sonar.
Anti Submarine Technology	1985-1997	Peter Lee	Former Los Alamos nuclear lab engineer Peter Lee shared advanced radar technology, useful for tracking submarines and he shared nuclear testing data that could help PLA develop modern nuclear warheads.[1]

All these technologies have enabled China to develop state of the art weaponry, which has made it currently the second most powerful nation in the World.

Chinese assertiveness vis-a-vis India can be summarised as under:-

- Refusal to clarify Line of Actual Control.
- Warning to India on prospecting of oil off Vietnamese coast.
- The creation of Xinjiang economic corridor through Pakistan Occupied Kashmir and the presence of PLA in Gilgit-Baltistan, commonly known as the China Pakistan Economic Corridor (CPEC).
- Reclaiming islands in South China Sea and building airstrips.

1 Summary Report of the Select Committee on US National Security and Military/ Commercial Concerns with the People's Republic of China, Volume 1, submitted by Mr Cox of California, Jeff Gerth and James Risen. Extracted from the book by Richard D. Fisher Junior, "China's Military Modernisation," Pentagon Press, 206 Peacock Lane, Shahpur Jat, New Delhi-110049, p.37

- Forays by Chinese submarines in the Indian Ocean.
- Building of dams in Tibet on the River Brahmaputra and possibly working for a diversion of the river Northwards at the Great Bend.
- Supporting Pakistan on terrorist activities in Kashmir.

There are other areas of concern which relate to China not recognising India as a nuclear armed state. Hence China does not discuss Confidence Building Measures and Risk Reduction Measures. China is opposed to India becoming a member of Nuclear Suppliers Group (NSG), the WASSENAR Arrangement and the Australia Group; most importantly it is moving heaven and earth to oppose India's entry into the Security Council. In a recent case, China and Russia did their utmost to stop the United Nations (UN) General Assembly effort to enhance the membership of the Security Council. It is a dynamics of change that Russia is currently moving with the Chinese in stalling efforts of India to become a member of the Security Council.

China has developed close friendship with Pakistan which has fought three Wars with India. India and Pakistan have also fought a major conflict at Kargil in 1999 in which massive use of artillery was undertaken. Fire assaults involving more than 50000 rounds were fired by the Indian artillery to decimate the enemy defences and resulting in capture of occupied heights along the LoC. Air power was also used in a limited manner. Missiles were not used and nuclear weapons were not mentioned.

Analysis

China and Pakistan pose serious military threat to India. The threat could be hybrid or a full spectrum conventional warfare. The way developments are taking place, it is clear that Pakistan is the closest military ally of China and there could be numerous reasons leading to a war with China and Pakistan. Strategically, India must avoid a two front war to ensure balance in dealing with these countries. Currently, our artillery and missile assets as also the air power do not permit us to undertake operations against both these countries together.

Chapter – IV

Optimisation of Weapons and Missiles in the Environment of Hybrid and Conventional Warfare

"The harder the fighting and the longer the War, the more the infantry and in fact all arms, lean on the Gunners,"

–Field Marshal Bernard Montgomery

Introduction

The termination of the Second World War was achieved with the nuclear bombing of Hiroshima and Nagasaki. Thereafter we witnessed many conflicts, some of which were Conventional Wars, the others were in the category of Hybrid Warfare. Hybrid Warfare is a combination of multiple conventional and unconventional tools of warfare. This includes regular forces, special forces, irregular forces, support of local unrest, diplomacy, information warfare propaganda, economic warfare, cyber warfare, psychological warfare and many more tools, which enable us to create a combination that helps us in waging a protracted war.[1] It is a military strategy that blends conventional warfare, irregular warfare and cyber warfare. There is no universally accepted definition of the subject and often described as non-linear war, non- traditional war or

1 Lt Gen P C Katoch, "The Zonkey of Hybrid Warfare", The Citizen, www.thecitizen.in, May 03, 2017.

special war. The Hezbollah-Israel conflicts in 2006, the ISIS advance into Iraq in 2014, the Russian intervention in Ukraine in 2014, are all examples of Hybrid Warfare.

Visualising our threat, the Indian Armed Forces have to be prepared for a war with China and Pakistan. Depending upon the circumstances, it could be a Two Front or a single front war. In addition to these aspects, the Hybrid War going on in Jammu and Kashmir has its nuances. All these pose an immense challenge to our guns, rockets and missiles. These would be required to destroy and decimate targets based on their priorities to enable missions to be accomplished.

Hybrid Warfare in Jammu and Kashmir

The Hybrid War in Jammu and Kashmir commenced in 1989 and is currently in its 28th year. Pakistan wishes to avenge its defeat in the 1971 War by undertaking this asymmetric mode of conflict. Viewing India's superior conventional might, it decided to engage India in a long drawn hybrid conflict, by which it would make India bleed with a thousand cuts. While doing so, it aimed to attack the state of Jammu and Kashmir, thereby causing alienation amongst its population. The process employed low levels of violence, brought about by a regular infiltration of terrorists and promotion of Islamic radicalism. Currently, there is sporadic violence in the Kashmir Valley and at the LoC. It is reported that two more brigades have been inducted in Pulwama in Southern Kashmir.[2] Despite all this the situation remains tense and to add to the violence; an Indian Army Officer, Lieutenant Ummer Fayaz while on leave, was abducted at Bhatpara in Southern Kashmir and assassinated on 08 June 2017. This is the first time that a serviceman has been assassinated in the Valley. The important issue here is the manner in which we respond to the situation. This has to be analysed viewing our superiority in weapons to include guns, rockets and missiles.

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2 Lt Gen Syed Ata Hasnain, "Changing Nature of Asymmetric/ Hybrid War in J&K, Challenges and Prospects", United Service Institution Of India, Strategic Year Book, 2017, ISBN: 973-93-86457-14-1, Vij Books India Private Limited, Delhi, 2017.

Pakistan has been fighting a Hybrid War with India since 1990. After the Kargil Conflict of 1999, it has realised that this was the best manner in tackling India which enjoys a conventional superiority. There have been a series of events with the crescendo being reached in Mumbai on 26 November 2008, and its openly supported agitations in the Kashmir valley since 08 July 2016 consequent to the killing of Burhan Wani, a terrorist commander of the Hizbul Mujahideen. Currently it appears that his relatives are leading the movement in Southern Kashmir. In all these events it is interesting to note that events are launched by non-state actors from Pakistan. They undertake these operations as Fourth Generation Warriors to cause chaos, consternation and casualties in India's hinterland. Pakistan perpetually denies any hand in these activities. Diplomatically, India has left no stone unturned in giving details to Pakistan about its covert support to the militants. The Pakistanis are good listeners and understand that issues get diluted with the passage of time. They continue protracted negotiations taking one step forward followed by a step backwards. The media and the Indian establishment speak optimistically that issues would improve and just then a militant attack takes place, catching us unaware as to how it happened. In the debates and statements Pakistan denies involvement, and at the same time, cautions India that they are a country possessing nuclear weapons and that India should not cross the rubic

In such a situation where diplomacy does not work, we are left with the option to curtail water flowing into Pakistan or use hard power. These options are often discussed at all forums but when push comes to shove, we as a country buckle down. It is time we change our stance and stop our sweet behaviour when fourth or possibly fifth generation warriors are attacking our police stations, army and air force bases. It is assessed that these attacks are the handiwork of the Inter-Services Intelligence (ISI), which functions directly under the Chief of the Army Staff of Pakistan Army. Since the Army and the Pakistan Civil administration are not on the same page, these attacks will continue to keep the Indian Armed Forces bleeding. It is pertinent to note that for the first time in its history, the Pakistan Army is fighting militancy in all its four provinces. This situation would continue as Pakistan continues to irrationally

differentiate between a good and bad terrorist, little realising that both are one and the same. To this end, the surgical strikes on 29 September 2016 had its impact but for a limited time as Pakistan is aiding local terrorists to keep the pot boiling in the valley.

It is gradually becoming clear to our citizens that present methods to deal with Pakistan's covert use of hard power are only skirting the problem and that our response has been but defensive with limited results. It is time we changed our approach and start giving effective response to these attacks. On the civilian side, we can calibrate the flow of water in a manner that Pakistan feels the pinch of receiving lesser quantity. The next step is to activate the LoC. This should be done carefully after removing the civilians to safer places and use artillery to hit his field works, command and control centres as also his gun areas. Pakistan's capability in terms of guns and ammunition is limited in comparison with India. Pakistan always prevents us from using our artillery as he knows that the Indian artillery is stronger and has the capability to undertake sustained fire, which would play havoc with his command and control systems, line of communications and his day to day routine in his defences on the LoC. With our detailed knowledge of his gun positions, we have the capability to silence his guns and decimate other targets. To take our minds back to November 2003, Pakistan had unilaterally declared ceasefire which we later accepted gracefully. At that time, our domination of artillery fire was complete and Pakistan was running out of its capability to undertake sustained artillery duels. As on date, our capabilities have been enhanced and we can also attack terrorist bases accurately by using our BrahMos missiles and other weapons. Assuming there are about 40 training areas for militants in Pakistan, these missiles could be used for destruction with greater accuracy than even the Tomahawks.

The next aspect pertains to our superior conventional forces. If the Pakistan Army does not change its attitude by our domination of the LoC, we may have to undertake conventional operations which would entail use of intermediate battle groups in the mountains and riverine terrain in conjunction with deep strikes in deserts. while the battle groups would be used in shallow thrusts,

strike formations would undertake deep strikes. Pakistan has lowered its nuclear threshold and threatens to use TNWs against these offensives. But the TNW is a Cold Tested weapon and its range being limited would have to be deployed in the field at about 40 km from the border, making it vulnerable to own air and missile attacks. Nuclear weapons of Pakistan are for deterrence and for providing parity with India in a politico-strategic realm. The actual possibility of use of tactical and strategic nuclear weapons is zero. Senior Pakistani officers have categorically stated that the Indian response to Pakistan's first use would be total holocaust. In late 2010, with 90 TNWs, it was considered difficult to stop an Indian armoured division moving dispersed on a 30 km frontage. There would be a minimum inescapable requirement of 436 TNWs to stop an armoured division. The reported accelerated production of plutonium from three military dedicated reactors in Khushab and a fourth under construction would result in an inventory of 200 warheads by 2020. To further compound to the existing problem, the issue of miniaturising the warhead to fit into the Nasr missile with a 30 cm diameter is a complex engineering problem. Data shows that a TNW use against a Combat Group moving dispersed over an eight km front would at best produce 25 casualties and damage to about four tanks. Accordingly, not much should be read against the TNW and the Indian Army must retain the option of deep strikes particularly in the Southern Theatre. The artillery must work towards locating the Nasr and develop possibly with external assistance a Make in India project to destroy the Nasr in flight.

The entire response must therefore be synergised; it is high time we took the fight back to Pakistani soil. The entire strategy calls for a changed mind-set, which must work out the details and synergise the leaders, bureaucracy and the armed forces to meet the Pakistani challenge.

While undertaking operations against Pakistan, the ideal terrain would be the desert region. Our mountains lack space and the plains are full of water obstacles, which would result in time consuming break in operations. The deserts would have a set of minefields, which could be negotiated with greater speed when enemy strong points and nodes could be bypassed, isolated, invested or finally captured. Normally a mechanised formation with an armoured division, about

two Reorganised Army Plains Infantry Divisions (RAPID), an independent armoured brigade, an engineer brigade, air defence elements and an artillery division with adequate air support from the air force would be deployed for the purpose. The aim of the operation would be to capture important communications centres and destroy enemy's mechanised reserves. Prior to the operations, surveillance would be undertaken in the areas of interest using all surveillance equipment, with heavy reliance on remote sensing satellites and Unmanned Aerial Vehicles (UAVs). Possibly, the operations would involve the following phases:-

- Degradation of key objectives by air, artillery including rockets and missiles. The artillery division to suitably decimate forces and ensure effective engagements with post strike damage assessment by UAVs.
- Capture of selected enemy border outposts. They must be pulverised by artillery fire to facilitate quick capture.
- Advance across three thrust lines using the mechanised spear heads.
- Speedily crossing enemy's forward defensive minefield, intermediate defensive minefield and depth defensive minefields. Undertaking encounter and opportunity crossings wherever possible and reaching the 'projection area' to undertake a tank versus tank battle against strategic reserves of the enemy.
- Based on the operational plan, mechanised forces would bypass, contain and isolate strong points on the axis of advance. To open an axis of maintenance, a selected node or a strong point to be captured using the formation and thereafter suitable track be developed for move of ammunition and supplies.
- Launch a sizeable heliborne force to capture a lightly held objective in depth. One of the mechanised spearheads to link up as early as possible with this force. medium artillery and close air support must be provided to the force.
- Entire operations should be completed as early as possible. Likely time would be about 96 hours.

Needless to state, all of the above mentioned operations would have to be carried out under a preponderance of gun, rockets and missile systems. It is envisaged that the enemy would try and impede the momentum of advance by employing his reserves at the divisional, operational and strategic levels. The manoeuvres in the plains and desert terrain would be in consonance with other thrusts in the mountains against terrorist training centres. The entire operation would be short, swift and lethal. It is essential that the Indian Army acquires two major weapon systems for these manoeuvres. These are the Unmanned Combat Aerial Vehicles (UCAVs) and the Loitering Missile. Both these weapon systems would enable us to undertake precise destruction of targets.

During the manoeuvre cyber operations must be undertaken to ensure degradation of enemy Communications and data links, synergy of these will pay rich dividends. Our Western adversary needs to be dealt in an offensive manner to ensure that he stops interfering with our internal affairs. Further we must exploit our conventional superiority to exploit issues to our advantage without buckling to his ineffective nuclear threat. Our mechanised spearheads are trained and they must be used if push comes to shove. The nuclear bluff has been exposed during the surgical strikes undertaken in September 2016. There is a need for us to resort to escalating issues, in case Pakistan does not stop the terrorist actions being undertaken in the valley of Jammu and Kashmir. Hybrid Warfare must be calibrated to our advantage rather than leave it for Pakistan to exploit. In such a conflict, guns and rockets would play greater roles than the missiles.[3] In such scenarios, the air force may be used only for surveillance and logistics missions.

Dynamics in the Chinese Theatre

The world is witnessing the rise of China, which is becoming more assertive day the day. China, with its active participation in the Chinese Pakistan Economic

3 P K Chakravorty, "Undertaking Manoeuvre Operations in the Current Environment", Salute, Volume 8 Issue 11, www.salute.co.in. Volume 8 issue 11, pp 14-17.

Corridor (CPEC,) which passes through disputed areas of Kashmir, has become the third player in the state of Jammu and Kashmir. As a matter of fact, Pakistan has become a military and economic ally of China. The new Government in the United States is not clear on the strategy it wishes to adopt with regard to Asian continent. Unpredictability of the US has further made it difficult for foreign policy analysts to gauge their approach on South Asia. Further it appears that future US interventions will entail no committal of ground troops. The US will mostly use firepower in terms of cruise missiles, stealth bomber and fighter jet attacks in conjunction with UCAVs firing PGMs.

China is gradually extending its sphere of influence. Further, the global centre of gravity has shifted decisively from Europe to Asia. Today, Asia has seven out of the world's 10 major economies and a major part of the nuclear weapon powers. The rise of Asia has also witnessed the rise of tensions. The modernisation of Chinese Armed Forces and its politico-military friendship with Pakistan could lead to the following situations:-

- **India Pakistan War (with or without Chinese Involvement)** – With rise of tensions over Pakistan sponsored terrorism there are increasing possibilities of a major terrorist strike which escalates into an Indian military response and results in a limited conventional war against a nuclear overhang between India and Pakistan. This conflict could remain confined to Jammu and Kashmir or spill over across the International Border in Punjab and Rajasthan. The war could possibly escalate and there is likelihood of India attempting a blockade of ports in Pakistan. The two ports of Gwadar and Karachi are possibly going to be blocked. Further, air and missile strikes will be undertaken against refineries and other economic targets. It would indeed be a challenge to ensure this limited war to be below the nuclear threshold and this would place major emphasis on escalation control dynamics. It would obviously affect the Indian economy as also possibly cripple the Pakistani economy. It is pertinent to note that the threat of Chinese intervention in such a conflict would be possible and India may need overwhelming support of the United States to deter Chinese intervention.

- **Sino-Indian Conflict –** China may not enter a conflict triggered by Pakistan. However, Pakistan is most likely to take advantage of any India-China conflict. The conflict could be based on the border issue, coupled with the domestic situation in China, which could lead to diversion of the issue by going into a conflict with India.[4]

  Managing the rise of China, with its extensive military modernisation, is going to be a difficult issue. The drivers of conflict between India and China could be the following:-

  - **Tibetan Issue –** Tibet remains a core issue between India and China. India would like China to begin a process of reconciliation and healing in Tibet, in its own interest and for stable Sino-Indian relations. Beijing has linked Arunachal as a part of Tibet and has been claiming the entire state and naming places in the state with Chinese names. Further, China has been building dams on the River Brahmaputra and tampering with the flow at the Great Bend. Choice of the new Dalai Lama is also causing consternation in the region. All these issues could exacerbate and result in issues going out of control. Being a sensitive issue this could result in hostilities.[5]

  - **India–US Strategic Partnership –** Signalling renewed intensity in the ties, India and the US, on 25 January 2015, decided to further elevate the long standing strategic partnership by enhancing cooperation in crucial areas to include defence, trade and commerce, technology transfer, counter terrorism and climate change.[6] The Joint Declaration mentions about freedom of navigation and

4 Major General G D Bakshi, "India's National Security Crisis, Chapter 6, Non Alignment 2.0. An analysis of proposed national security", Bloomsbury Publishing India Limited, New Delhi 2014, pp 117-122.

5 Brahma Chellany, "Why Tibet remains y\the core issue in India China relations", Forbes magazine, forbes.com, 27 November 2014.

6 "India – US release declaration of friendship to elevate strategic partnership," The Times of India, 25 January 2015.

freedom of flight which refers to the oceans and the skies. An article that appeared in the Global Times and People's Daily on 25 January 2015 cautioned India not to fall into the trap, which was being laid to pit New Delhi against Beijing. It added that many Western media reports have pointed out that the US, regardless of historical complications, is putting more efforts into soliciting India to act as a partner, even an ally, to support Washington's 'Pivot to Asia' strategy, which is mainly devised to counter China's rise. In a further elaboration, a daily pointed to the West's ulterior motive to frame the Chinese dragon and the Indian elephant as natural rivals.[7] These issues can cause provocation which could throw things out of control.

- **High Profile Posturing in the Indian Ocean Region** – Reports emanating from Beijing indicate that China is contemplating setting up military bases overseas to counter American influence and exert pressure on India. These have been interpreted by some sections as a veiled reference to China's interest in securing permanent military presence in Pakistan. Although it might not be politically feasible for the Pakistan Government to openly allow China to set up military base, New Delhi fears that Islamabad might allow Beijing use of its military facilities without any public announcement. It is possible to explain the construction of ports and facilities by China on purely economic and commercial grounds, but regional and global powers like the US, Japan and India inevitably view the sum total of China's diplomatic and military efforts in the Indian Ocean as projecting power. Moreover, most of Chinese naval facilities in the Indian Ocean are dual use in nature and no serious strategy can discount their future military use. The notion that China aspires to dominate the Indian Ocean is a bit farfetched. However, China wishes to play a greater role in the region to protect and advance its

7 "In Republic Day message, China tells India not to fall into trap laid by US," The Times of India, 26 January 2015.

interests, especially the commercial interests, as well as to counter Indian options. Countering India will be a difficult task given the immense geographical advantages that India enjoys in the Indian Ocean. Even the task of protecting the SLOC remains challenging for the People's Liberation Army Navy (PLAN) as of now. Meanwhile, the steps that China is taking have caused concerns. In 2009, a sonar stand-off is reported to have taken place between the Indian Navy and the Chinese Navy while their ships were proceeding to the Gulf of Aden.[8] In the year 2014, two incidents of Chinese submarines visiting Sri Lanka were viewed with concern by India. As both the Navies get stronger, such posturing might lead to accidental conflagration which could result in confrontation.

- **Water Issue –** Taming of the Brahmaputra River by China could have major implications for India. China certainly wants to utilise Tibetan water resources for its own development. It is presumed that one day China may divert waters from the Great Bend of the Yarlung Tsangpo (River Brahmaputra), north of the McMahon line to build another mammoth dam, much bigger than the Three Gorges Dam, which currently is the biggest dam in the world. China has viewed Engineer Guo Kai's 'Shuotian Canal Project' as a perfect model, which would save China with Tibet's waters. In addition, this will be another gigantic power plant with an astonishing generating capacity of 20 to 40,000 Mega watts. This, if constructed, will be three times bigger than the hydro electric plant at the Three Gorges Dam. This one plant can fulfil five times the energy requirement of Bangladesh. Taming of this river will require explosives of great quantities. The impact would be profound on the people of North East India and Bangladesh. Further, the area being seismically unstable; the construction of the dam could cause

8 Harsh V. Pant, "China's naval expansion in the Indian Ocean and India-China rivalry." The Asia Pacific Journal: Japan Focus, www.japanforces.org/=Harsh V Pant/3353.

severe earthquakes. Further, there is a proposal to build 28 dams on the Brahmaputra, which would sequester silt that normally gets washed to the flood plains of India and Bangladesh to revive fertility of their agricultural lands. Disruption of this kind therefore is bound to exacerbate tensions and could lead to hostilities.[9]

- **Collapse of Pakistan –** Pakistan is an unstable state with factionalism running against the dominant Punjabis by groups from Baluchistan and the North West Frontier Province. There are issues between the Sindhis and Punjabis, which could cause friction as also problems with the Shia population of Gilgit-Baltistan. Further, ethnic divides have been exacerbated by the Inter-Services Intelligence (ISI) of Pakistan, which has links with numerous terrorist groups operating in Pakistan. Some of the terror groups operate against Afghanistan, some against India and some against the Government of Pakistan. The economy is in doldrums and the politicians are destabilising the country. The Pakistan armed forces contain many Islamic elements, who are in league with these terror groups. All these could result in a collapse of the State and the Chinese would see an India hand in it, which could lead to China teaching a lesson to India.
- **Border Dispute** – The border dispute between India and China remains unresolved and there are sporadic standoffs between troops deployed on both sides. There have been altercations and it does not take long for small incident to get blown up to accidents. The current stalemate is dangerous and could lead to hostilities between the two sides. The Indian Prime Minister visited China in May 2015 but despite friendly talks, he has stated that the border issue is like a tooth ache which could easily conflagrate into hostilities.[10]

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9 The Himalayan Voice, ´China and India race for damson River Brahmaputra; Impacts could be massive and unknown, "strategic human alliance. Blogspot.com, 04 December 2014.

10 Press Trust of India, "Eagerly Looking forward to China's visit," economictimes.

Likely Strategic Scenarios

Based on the drivers of conflict escalatory dominance, four alternate scenarios could emerge for the South Asian region. These are as elucidated below:-

- **Strategic Brinkmanship –** This is the current scenario, when the leaders of the region have failed to dispel regional mistrust and suspicion. Compelled by the increasing socio political, economic and security challenges, smaller South Asian nations seek support of bigger nations. Both India and China are willing to provide support. China, along with Pakistan, is keeping India tied down with sporadic border aggression in the North and routine infiltration attempts besides violations on the LoC on the West. Owing to the compulsion of domestic politics and lack of timely reforms, the Indian economic growth suffers.

- Adverse signposts of this scenario are as under:-
    - Contentious political and diplomatic posturing like issue of visa and exchange of visits.
    - Restricted economic cooperation in terms of export/import and market access.
    - Creeping assertiveness including border intrusions and transgressions.
    - Strengthening of Sino-Pakistan nexus.
    - Repeated attempts to estrange the states of Nepal, Bangladesh, Bhutan, Sri Lanka, Bangladesh and Maldives from India.
    - Covert support to Indian insurgent groups and Maoists.
    - Increased cyber espionage and sabotage.
    - Enhanced activities along the border and strategic highways in the cover of exercises.
    - Regular demonstration of disruptive technologies.

indiatimes.com, 13 February 2015.

The impact of all these will be the rise of Chinese influence in the Indian neighbourhood. India would be threatened with growing asymmetric threats and posturing by the PLA.

India-Centric South Asia – The scenario envisages India stepping up its efforts towards political stability, diplomatic initiatives and undertaking reforms to accelerate economic growth resulting in higher Gross Domestic Product (GDP) and Comprehensive National Power, which effectively reduces the gap with China. India can take a lead in forging strategic multilateral partnerships with its neighbours, thereby effectively reducing the mistrust and gradually dispersing anti-India feelings. The indications would be as under:-

- Greater political cohesiveness and revival of economic growth.
- Rapid military modernisation.
- Building of credible asymmetric deterrence capabilities.
- Creation of bilateral or multilateral strategic partnerships.
- Effective control by security forces on the internal situation.
- Developing special strategic relations with US and Other countries of Asia Pacific and East Asia.

The impact would be a pro-India outlook amongst South Asian states and lead to greater regional cooperation. It would also restrict the manoeuvring space of the regional hegemon in South Asia.

China-Centric South Asia – This scenario will occur if India continues to falter on economic growth, resulting in slow military modernisation and social development, and if India lacks initiative and fails to resolve outstanding issues with its neighbours. The Sino-Pakistan nexus will get stronger and China would step-in as a balancer for the smaller South Asian nations. The signposts of this scenario would be as under:-

- China's continued growth in Comprehensive National Power.
- If India stumbles in economic growth.

- Slowdown in India's military modernisation.
- Lack of reforms in India for other modernisation.
- Absence of Indian political and diplomatic initiatives resulting in build up of trust in the region.
- Rising Sino-Pakistan nexus.
- Stagnant in Indo-US relations.
- Convergence of Sino-US and US-Pakistan interests.
- Enhanced Chinese economic and military support to smaller South Asian nations.

The impact would be a Chinese supremacy in South Asia. China's supremacy would encourage Pakistan to be more belligerent towards India.

Sino-Indian Condominium - A scenario like this is possible when India continues with its economic growth whereas Chinese growth rate stagnates or reduces owing to internal or sub-regional compulsions. In such a scenario, China may take initiative to forge cooperation with India. In such an eventuality, India can retain its strategic status in the region without interfering with China's status in East Asia and Asia Pacific. Indicators here would be as follows:-

- Good growth of Indian economy.
- India's fast paced military modernisation.
- China falters in economic growth resulting in slowing down of military modernisation.
- Growing internal unrest in China.
- Stable Indo-US relations.
- Relative stability in Indo-Pakistan relations and weakening Sino-Pak nexus.

The impact will be a safe situation for India and restrain in Chinese assertiveness, resulting in strategic stability for both the countries.

Likely Nature of Conflict with China

It is extremely difficult to correctly assess Chinese military intentions. China's stated operational strategy guideline is called 'Active Defence' which stipulates not to initiate conflicts or undertake aggression.[11] In 2007, Lt General Zhang Qinsheng, the PLA Intelligence Chief, stated that strategically China adheres to self-defence and would win by striking only after the enemy has struck. He was emphatic that China would not fire the first shot. It is interesting to note that the PLA officers are taught the reverse of what the Intelligence Chief remarked. The PLA National Defence University text book '*The Science of Campaigns*' says, "The essence of active defence is to take the initiative and to annihilate the enemy."[12] Details obtained from another text book, *'The Science of Military Strategy*' elucidates, "Under high tech conditions for the defensive side, the strategy of gaining mastery by striking only after the enemy has struck does not mean waiting for the enemy's strike passively". Thereafter, it modifies the definition of 'first shot' by stating that if hostile forces such as religious extremists, national separatists and international terrorists challenge country's sovereignty, it could be considered as firing the first shot on the plane of politics and strategy.[13] Accordingly, a war could commence against Xinjiang, Tibet and Taiwan by this logic. Thus a pre-emptive strike against Taiwan, Xinjiang and Southern Tibet (Arunachal) is permitted. In light of such definitions, India must be prepared to face a full spectrum conflict from China against a nuclear backdrop.

Currently, the PLA has incorporated 'Integrated Joint Operations' amongst the three services based on the lessons learnt during the Gulf Wars, Afghanistan, Bosnia and the current conflict in Libya. The degree of PLA success in these

11 Office of the Secretary of Defence, "Annual Report to Congress, Military Power of the Peoples Republic of China 2007," p.12

12 US Department of Defence, "PLA Report 2007," pp 12-13.

13 Peng Guangqian and Yao Youzhi, "The Science of Military Strategy (English First Edition)," Beijing Military Science Publishing House 2005, p. 426.

operations is difficult to judge from sources in the open domain. However, the importance given to the matter can be observed by the fact that after 2004 commanders of the Navy, Air Force and he Second Artillery have become permanent members of the Central Military Commission high command.

The recent reforms to the PLA inducted by Xi Jinping makes theatre commands responsible for joint warfare. With these changes, the PLA's current task in war is to attack and destroy enemy's most powerful critical assets. Active defence has graduated with the present doctrinal progression to fighting 'local wars under informationised conditions'. The current procedure entails offensive actions unlimited by time and space once hostilities have begun. The focus is on mobility and state-of-the-art electronics and weapon systems. With the advent of the new strategy of operations, PLA ground forces are training in combined arms and integrated joint operations. Special emphasis is being laid on airborne assault, close air support, reconnaissance, electronic warfare and cyber operations. The ground forces appear to place heavy emphasis on using conventional missile strikes and Special Forces to deliver possibly pre emptive strikes against enemy's command and control centres as also logistics areas. These would be followed by deployment of combined arms forces, which would rely on 'Area Denial' by the PLA Air Force (PLAAF) . It is extremely interesting to note that the PLA has begun moving away from scripted exercises towards greater free play, with an emphasis on lessons learnt than on smooth 'victory' of the PLA.

China has evinced great interest in the Indian Ocean, and by 2030 the PLAN would be actively involved in this area. PLAN is currently focussed on acquiring dominance in the Yellow Sea, the Taiwan Straits, the East China Sea and the South China Sea. The Indian Ocean falls second in the present order of priority. Though China would like to move to the Indian Ocean, there are numerous issues engaging China at the first tier. The US decision to retain strong forces in the Asia Pacific, a strong Japanese naval power projection and development of naval capabilities of Vietnam, Indonesia and Australia would possibly delay Chinese deployment in the Indian Ocean Region. However, by 2030 PLAN

would be active in the waters of the Indian Ocean. The Indian Navy will be challenged in its own backyard in another 15 years.

The PLAAF, like the other two services, has become more offensive and is developing capability to use its with modern aircraft firepower assets around China's periphery. Chinese Air Force is focussing on C^4I^2SR, Airborne Early Warning (AEW) and mid air refuelling. With regard to nuclear weapons, China has concentrated on improving the credibility of Chinese nuclear deterrence. This has resulted in the Second Artillery moving from liquid fuelled rockets to solid fuel and from silo based missile towards mobile launchers and reloadable launchers. Since the last decade, the Second Artillery has been developing conventional missiles to enhance PLA's fighting capability in a conventional war under a nuclear shadow. China is keen on using space for military operations. Though no official space doctrine is available in the open domain, both the Chinese Air Force and the Second Artillery are involved with military applications of the Outer Space.

Pakistan's strong friendship with China helps it against adverse fallout from its anti-India policies. Further, the United States still looks at Pakistan as a Major Non- NATO Ally and is keen to scrounge on whatever assistance can be obtained from Pakistan, rather than to seriously try to resolve cross-border terrorism issues between Pakistan and India. All organs of Pakistan, be it the political leaders, the Army, the ISI and the bureaucracy, believe that only cross border terrorism can compel India to engage with Pakistan. It is important to note that Pakistan's possession of nuclear weapons imposes constraints on India's countervailing strategy. Pakistan strongly feels that its nuclear capability prevents India from initiating a war, which possibly would idea lingers.

Viewing all these issues, as also the existing problems of India with China and Pakistan, a conflict is possible if situation goes out of control. Pakistan is fully involved in trans-border terrorism, which meets its strategic requirements. While China's main focus is on Taiwan and South China Sea, it is deeply concerned about Tibet too. China could involve itself against India in a low intensity or a full spectrum conventional conflict. In a low intensity conflict, it

may only involve cyber war, in which China knocks out important command and control nets of our Armed Forces. As our firepower in land, sea and air are dependent on communication networks, the entire weaponry employment could be degraded by cyber warfare.

It is reported that China is covertly aiding militant groups in the North Eastern portion of India who are able to undertake sporadic missions against Indian security forces. Of late, good relations of India with Bangladesh and Myanmar have reduced the impact of these insurgent elements considerably. China would undertake a full spectrum conventional conflict under a nuclear overhang to either capture Tawang and other important areas of Arunachal Pradesh and Ladakh or to teach a lesson to India as it did with Vietnam during the 1979 War. Guns, rockets and missiles will play a vital role in this conflict.

Weapons, Rockets and Missiles in a Full Spectrum Conflict

War with China will be fought under a nuclear overhang. India and China have a nuclear doctrine of 'No First Use', which could make decision makers on both sides cautious. China could launch a major offensive in Arunachal and Ladakh with the purpose of capturing Tawang and grabbing areas in Arunachal and Eastern Ladakh. There are other options; however this is possibly the most likely option. All operations will be under China's Western Command. The force level estimated based on its objectives would be about 30 divisions plus with elements of the Second Artillery. In the most likely option China would launch main offensive on the Kameng Division with about eight to ten divisions, on 'Rest of Arunachal Pradesh' with about six to eight divisions and Ladakh with six to eight divisions. Besides, holding attacks would be launched against Sikkim with four to five divisions, against UP-Tibet Border with two to three divisions and against 36 Sector with one division. There would also be a reserve of three divisions. Operations would be integrated joint operations with possible use of air borne elements. The forces would mainly comprise of about 15 divisions from the Western Theatre Command, 12 divisions from other Theatre Commands and elements of 15 Air Borne Corps who now form a part of the PLA Air Force.

The conflict would be preceded by disruption of communication networks by cyber warfare. There is a possibility of China destroying our remote sensing satellites to avoid correct detection and identification. China would use DF-21 ballistic missile of 2150 km and cruise missiles of 300 to 600 km range, and would attack command and control centres, logistics installations, bridges, mountain passes, airfields, UAV sites, missile storage locations and gun positions. China would also have ABM systems to counter our missiles. Airpower available to China for this operation will operate from the five airfields in Tibet, Chengdu and Kunming. Air availability would be about 40 fighter squadrons which would include, by 2030, at least eight squadrons of J-20 stealth fighter aircrafts. Aircrafts would also be used for close air support of ground troops as also for air-borne operations. PLA has recently practised air-borne operations in training exercises in Tibet and would definitely use this as a *coup de main* operation. Exercises by the PLA in the Tibet Autonomous Region (TAR) in July-August 2012 included missile tests, use of fighter jets and the Air Borne Corps, and ground troops for the capture of passes at 5000 m above Mean Sea Level (MSL). It is pertinent to note that in the Greater Himalayas passes on the Indo- China border are at these altitudes.

The PLA would have tremendous firepower for the offensive. There would be about 30 (plus) divisional artillery brigades, each having four field regiments and one medium regiment. That works out to a total of 120 field regiments and 30 medium regiments. There would also be about six Group Army independent artillery brigades, each having four medium regiments and one rocket regiment, and that works out to a 24 medium and six rocket regiments. In addition, there would be two artillery divisions, each with nine medium regiments and three rocket regiments. Overall, there would be a total of 120 field, 72 medium and twelve rocket regiments for the offensive. Currently, our own firepower resources have numerous voids and it would require a proactive action by the Ministry of Defence, Army and Air Force authorities to make up the operational voids and so to optimally utilise our existing capability in the mountains. We would also need to have a relook at our entire force levels on the Sino-Indian border which is currently inadequate to meet an onslaught of

30 divisions plus. Viewing our present force structure, our three strike corps are poised for offensives against Pakistan. For a dissuasive capability vis-a-vis China, we would need two strike corps for the mountains with two artillery divisions. We would need latest generation fighter aircrafts to be deployed at our forward airfields to be able to engage Chinese aircrafts and the assaulting forces effectively while these are in the process of mounting the offensive.

There are hardly 13 years to 2030. Artillery of the Indian Army needs to innovate as procurements take a long time to fructify. Accordingly, the artillery of the Strike Corps, particularly those with the artillery divisions and a few more medium regiments have to be dual tasked for the mountainous regions bordering China. China itself has only 50 percent of the forces coming from the Western theatre Commands whereas the rest, not directly positioned against the Sino-Indian Border, have to be drawn from other theatre Commands. Periodic exercises must be conducted for the Indian forces in the designated area of operations on the Sino-Indian border. Apart from the yearly operational alerts, two sided exercises must be conducted in conjunction with the Indian Air Force once every three years in which all other Commands must participate. Being inter-service exercises, the Ministry of Defence must involve itself, and have its focus on China-Pakistan collusive effort.

With regard to weaponry, our reach in the mountains is about 40 km, which is the range of the Bofors Gun in high altitude terrain. This serves the purpose of just the contact battle, while requirement is of taking the adversary right from his mobilisation and concentration areas. For the intermediate battle, we must use rockets whose shock action will break the adversaries will to fight. But despite their effective employment during the Kargil conflict in 1999, probably none of our rocket regiments are deployed in the mountains. Upgraded Grad BM-21 with extended range, Pinaka Multi Launcher Rocket System and Smerch Rocket System with lesser number of tubes mounted on the Kamaz vehicle, with maximum ranges varying from 40 km, 37 km and 90 km respectively, would be effective against the Chinese in high altitude terrain. Efforts therefore must be made to procure Smerch with lesser number of tubes

mounted on a Kamaz vehicle for the mountains. It is reported that the Russians have developed rockets for the Smerch system with ranges of 120 km. We must not only procure the rocket, but obtain Transfer of Technology for the entire variety of Smerch ammunition. Viewing the asymmetry of firepower, there is a necessity for acquiring five additional Smerch Regiments for deployment of one regiment each in Eastern Ladakh, UP-Tibet Border, Sikkim, Kameng Division and Rest of Arunachal Pradesh. Meanwhile, the Pinaka Rockets with an extended range must be tried out and if successful be deployed in the mountains. It is obvious that the 'Heron' UAV and the future DRDO UAV 'Rustam', with capabilities of operating at 30000 ft, would be able to undertake detection, identification, recognition and PSDA. The UCAV must also find its way into the Indian Army to augment its precision firepower.

A full spectrum conflict with China would be in the conventional domain, as both countries have pledged 'No First Use' of nuclear weapons. Missiles capable of firing conventional warheads would therefore have their might displayed with full fury. The Chinese have the DF-21 of 2150 km range mounted on TEL and numerous cruise missiles with ranges from 300 to 600 km tp cover the most of the Indian sub-continent. These missiles could be deployed south of Lhasa in Tibet or in Delingha (Qinghai) and around Kunming in the Sichuan province. Currently, the only missile with conventional capabilities held by the Indian Army is the BrahMos supersonic cruise missile with a range of 290 km which has been tested in March 2017 to the range of 450 km.[14] Flying at higher altitudes, the missile would possibly range around 600 km. Our targets in Tibet are more than 500 km whereas to engage missile storage locations in Qinghai or Sichuan province, communication and command and control centres and airfields in Kunming and Chengdu, we would need missiles with a range of 1000 km. DRDO is developing sub-sonic cruise missile 'Nirbhay', which has not performed creditably during development trials.[15] If all goes well,

14 India test-fires BrahMos missile with 450km range- The Tribune, *www.tribuneindia.com/news/nation/india-test...BrahMos-missile...450km.../376038,* 11 March 2017.

15 Indigenous Nirbhay missile to be test-fired again: DRDO- The New Indian Express, *www.newindianexpress.com/.../indigenous-Nirbhay-missile-to-be-test-fired-again-drdo*,

it would possibly take another six to eight years before the missile is inducted into our armed forces, say by 2023-2025. Contrarily, there are missiles which are yet to be inducted after 32 years of development. Contingency planning is therefore needed; possibly we could plan on one of the Agni missiles carrying conventional warheads or extending the range of our present supersonic cruise missile up to 1000 km by miniaturising the size.

We also need ABM systems which would be able to tackle the Chinese missiles. Chinese are developing ABM systems similar to Russian S-300 and S-500. Currently, we are going in for 'Akash' with a range of 25 km and the Russian S 400 'Triumf', while the DRDO has undertaken development trials for the Prithvi Air Defence (PAD) and Advanced Area Defence (AAD) systems. Initial tests have been carried out with a modified Prithvi missile simulating an enemy missile and an interceptor AAD missile to destroy it. Similar tests were undertaken by PAD missile using the Swordfish Long Range Tracking Radar (LRTR). In February and March 2017, India successfully launched two home grown interceptor missiles capable of destroying targets at exo and endo- atmospheric regions. On 11 February 2017, DRDO successfully flight tested Prithvi Defence Vehicle (PDV) interceptor missile which destroyed a target missile, fired from a ship, at an altitude of 97 km. On 01 March 2017, a supersonic endo-atmospheric AAD interceptor missile named 'Ashwin' was fired from Abdul Kalam Island (erstwhile Wheeler Island) against a target missile launched from Chandipur based launching complex. The missile was destroyed at an altitude of 15 Km. Dr Sateesh Reddy, the Scientific Adviser to the Defence Minister, said that the mission was successful in meeting all parameters set for the trial. These tests were extremely significant for India's ongoing ABM Programme for the following reasons:-

- Long range radar and multi-function fire control radar located far away successfully detected the incoming missile from take off, and tracked it through the entire path.

15 February 2017.

- The trajectory of the incoming missile was continuously estimated by the guidance computer that gave command for the launch of the interceptor.
- Guided by the command, the AAD missile was launched automatically to counter and kill the target missile.
- The Fibre Optic Gyro (FOG) based INS interceptor, on board computers, guidance systems and the critical Radio Frequency (RF) Seekers performed correctly.
- Complete radar systems, communication net works, launch computers, target update systems and avionics proved to be successful.
- With AAD and PDV systems, which are capable of killing targets at both low and high altitudes, India is the fourth country to have developed a multi-layered BMD programme, after the US, Russia and Israel.
- These two-tier interceptor missiles are likely to be inducted after a couple of more tests, possibly by 2018.[16]

Prior to launching of an offensive, China would like to possibly deactivate our surveillance systems by knocking down a few of our remote sensing and communication satellites using its ASAT missiles which have been successfully tested. Our own developments would take some time and there is a requirement to push our resources to develop this capability expeditiously.

China would employ its air force for firepower dominance in the area of operations. Exercises held in Tibet by the PLA Western Command has witnessed the use of fighter aircrafts from Tibetan airfields as also the elements of its air-borne corps. To effectively counter this threat, our Air Force has commenced deployment of fighters in airfields close to Arunachal Pradesh and in some other areas. Our aircrafts should be able to attack Chinese air fields, missile storage locations and detraining stations in Tibet and Qinghai provinces, as

16 Hemant Kumar Rout, "India Achieves Major Milestone in its Anti Ballistic Programme", The New Indian Express, 01 March 2017, newindianexpress.com.

also the airfields at Kunming and Chengdu. Our Air Force must be able to provide for strategic lifts of own troops and employ its firepower assets to enable own deployment and redeployment. To this end, the Air Force is correctly focussing on strategic lift capability, both in terms of aircrafts and helicopters, procurement of which may be expected by 2030. These airborne firepower platforms need to be fine tuned for operations in high altitude regions of Tibet. The DRDO must make forays in this field of technology through collaborative research. With modernisation of air lift and air transportation of weapons, better artillery support would be available for operations in Tibet.

Operations in the ensuing decades would depend upon large scale employment of UAVs, UCAVs and other Unmanned Aerial Systems (UAS). While UAS covers the entire gamut of unmanned systems, UAVs would play a predominant role with regard to surveillance. UCAVs would be a combination of surveillance, target acquisition, engagement, destruction and PSDA. In providing firepower for our battles in Tibet, it would be essential to gain mastery of operating these systems in high altitudes. The Chinese are developing large number of UAS and would be utilising the same in operations in Tibet. Our Aeronautical Development Establishment is in the process of developing a UCAV known as 'Aura' in collaboration with the Gas Turbine Research Establishment, IIT Bombay and IIT Kanpur. Being a classified project, which is in the preliminary stage, very little is known about the progress.[17] As the process would take considerable time, it is essential that the Indian armed forces procure a UCAV which could be gainfully employed in the air-land battle over Tibet. In the meantime, the Indian Army must procure a UCAV of the Predator or the Hero TP variety, which can fire missiles to provide for adequate precision weaponry in the tactical battle area.

India is engaged a hybrid war in Jammu and Kashmir. It has also to be prepared for a two-front war with China and Pakistan. Firepower from artillery and missiles will play a critical role in these eventualities. India needs to leave no stone unturned to modernise its forces in all the above mentioned aspects.

17 Shiv Aroor, "India's Ghatak Stealth UCAV," livefistdefence.com, 17 February 2017.

Chapter – V

Way Ahead

"I do not have to tell you who won the war. You Know the Artillery did".
–General George S Patton

Introduction

Weapons and missiles are extremely important in the Indian sub-continental warfare. They play a decisive role in hybrid as also conventional warfare. In the current battle space, they perform a predominant role by providing firepower in a combined arms battle. Operational 'fires' undertaken during the Kargil conflict in 1999 paved the way for the capture of critical enemy localities. The current environment focuses on precise stand-off strikes in a network centric arena against a nuclear backdrop. The art of operations is characterised by non- linearity, which require battle field transparency to ensure simultaneous operations at the strategic, operational and tactical levels. Future wars have to be short and the battle space could be along our borders or in our island territories. Classically, usage of these force multipliers is to be undertaken through surveillance, target acquisition, engagement of selected targets and post strike damage assessment. These aspects shape the battlefield by providing battlefield transparency and degradation. Further, these undertake punitive fire assaults to pulverise the objectives thus resulting in destruction of the enemy, which exponentially eases the task of assaulting troops. Viewing the current threat from our adversaries, there is a need to modernise our guns, rockets, and missiles to enable the preparedness for a two front war. Any modernisation of

equipment involves equipment ratios of 30 percent state-of-the-art, 30 percent current and possibly undergoing upgrade or overhaul and the remaining 40 percent in the final stages of service life and reaching obsolescence in about five to seven years. It is pertinent to note that both China and Pakistan are modernising their guns, rockets and missiles.

As would be evident, we need both the guns and missiles; these required for different types of complex and non-linear operations. It would thus be incorrect to focus only on one equipment and neglect the other. India has taken a very balanced approach to this respect and has given appropriate emphasis to both, the guns and the missiles.

Thrust of Modernisation in the Indian Army

As discussed in the previous Chapter, India faces security threats from its adversaries in all five dimensions, be it Land, Sea, Air, Cyber and Outer Space. Firepower has a place in all these dimensions and artillery forms the most significant component of firepower. Army modernisation plan aims to develop prioritised capabilities through induction of high technology weapons and acquisition of force multipliers, with a focus on creation of a lethal, agile and networked force to meet the futuristic security challenges.

This entails induction of Critical technologies. Capabilities are thus being enhanced to meet challenges across the spectrum to include the following:-

- Battlefield transparency.
- Battlefield management systems.
- Night fighting capability.
- Enhanced firepower of guns, rockets and missiles.
- Precision guided weapons.
- Integrated manoeuvre capability.
- Combat aviation Support.
- Network centricity.

Emphasis is also being given to make up deficiencies, upgrade existing platforms, improve infrastructure in border areas, especially along the Sino-Indian Border, and focus on human development to harness technology at the cutting edge level. A new Defence Procurement Policy has been issued in 2016 to ensure better terms for undertaking procurement of defence equipment. The Defence Ministry is trying to systematically tackle the problematic issues. A new policy regarding strategic partnership with private industry for production of major equipment has been approved. Currently, four systems have been identified comprising fighter jets, submarines, helicopters and tanks.

Profile

The role of weapons and missiles is to destroy/neutralise/suppress the enemy by synergised and orchestrated application of all fire assets at selected points of decision to physically and psychologically degrade enemy's cohesion with the ultimate aim of breaking his will to fight. Weapons and missiles can attack operational centres of gravity to impacts upon the fighting capability of any military organisation. To undertake this task, the profile is based on guns, rockets, missiles and surveillance and target acquisition equipment. The profile would also be based on the operational requirements of the Indian Army and cater for threats in relation to the terrain. With regard to guns, the requirement would be to replace the existing 105 mm and 122 mm Field Guns and enhance the basic calibre of the Indian artillery to 155 mm (52 calibre). This would provide enhanced range and greater throw-off at the target end. There would be other variations which would comprise 155 mm Self Propelled Track regiments for the armoured divisions in desert terrain, 155 mm Self Propelled Wheeled for mechanised forces in riverine terrain, 155m mm Mounted Gun System to operate in semi-desert terrain and the 155 mm Ultra Light Howitzer to operate in mountains and to meet 'Out of Area' contingencies.

In addition, there would be the Light Regiments of 120 mm, with greater range and capability to move easily or be mule-packed based on the type of terrain. Further, the Rocket Regiments would be a mix of GRAD, Pinaka and Smerch Regiments. There would be regiments equipped with super-sonic

Cruise Missile BrahMos configured for all types of terrain, sub-sonic Cruise Missile Nirbhaya, and Long Range Surface-to-Air Missiles. In addition, there must be conventional variants of our ballistic missiles and loitering missiles with pin point accuracy.

Surveillance forms a major component for direction of fire. The armed forces need to maintain surveillance cover to formations operating all over the country. The Surveillance and Target Acquisition (SATA) Regiments would be scaled at the corps level and SATA Batteries at the division level. The surveillance philosophy will guide the future sensor profile of these regiments and will focus on battle field transparency with emphasis on depth battle, to be disseminated in near Real time. The essential surveillance equipment would comprise as given below:-

- Thermal Imaging Integrated Observation Equipment.
- Long Range Reconnaissance and Observation Equipment.
- Battle Field Surveillance Radar, Medium Range, Long Range and Short Range.
- Weapon Locating Radars.
- Sound Ranging System.
- Unmanned Aerial Vehicles.

The profile of these equipment has been planned up to 2027 which would be the culminating year of the 14th five year plan. Adherence to the plan would enable the Indian Army to build its capabilities systematically over a deliberate period.

Modernisation of Weaponry and Missiles

The Indian Army is operating in a NCW environment. It has to provide for surveillance and reconnaissance resulting in target acquisition. That would lead to engagement which have to be monitored through PSDA to ensure that the target is destroyed. In NCW, fire of weapons and missiles shapes the battle

field, degrades enemy's war waging capability, and destroys his field defences, communication sites and logistics echelons, thereby paralysing him and thus enabling us to accomplish the mission.

The Regiment of Artillery of the Indian Army is currently equipped with a variety of surveillance devices, guns, mortars, rockets and missiles. The surveillance devices are a part of the Surveillance and Target Acquisition (SATA) Regiments. The devices currently held comprise the UAVs which are of four types. These are the Medium Altitude Long Endurance (MALE), Heron UAV and Short Range UAVs Searcher MK I, Searcher Mk II and indigenously built Nishant. These UAVs have been operationally optimised and are extremely useful tool for surveillance. Our current holdings are minimal and their numbers need to be enhanced. The DRDO is currently developing a MALE UAV Rustam and UCAV Aura which will possibly be inducted in the short term.

The SATA units are currently equipped with Medium Range Battlefield Surveillance Radars (MBFSR) and Weapon Locating Radars (WLR). The MBFSR currently held is the ELM 2140, which is able to detect tanks, vehicles and troops. They are held in minimal quantities but well exploited by mobile masts. The WLR currently held is the ANTPQ-37, which has been optimised with a reasonable degree of success. Further, SATA units are equipped with Long Range Reconnaissance and Observation System (LORROS). This equipment has excellent day and night surveillance capability and has proved its effectiveness in operational areas. SATA units also have the passive weapon locating system of Sound Ranging. The system currently held is old and needs to be replaced by state-of-the art equipment. Bharat Electronics, in conjunction with DRDO, has developed a WLR which is undergoing evaluation of trials.

As regards Guns, the Regiment of Artillery is equipped with Field, Medium, Self Propelled, Light and Medium Regiments. Field Regiments possess either 105 mm Indian Field Gun / Light Field Gun or 122mm Field Howitzer. Medium Regiments possess 130 mm Medium Gun, 155 mm Bofors Medium Gun (39 calibre) and a few regiments of Soltam Guns. Self Propelled Regiments are equipped with 130 mm Catapult and the Light Regiments are equipped with

120 mm Mortars. There is also a Heavy Mortar Regiment equipped with 160 mm Mortars.

The Regiment of Artillery also holds rockets and missiles. Rocket Regiments are equipped with 122 mm GRAD BM-21 Rockets, 214 mm Pinaka Rockets and 300 mm Smerch Rockets. The Missile Regiments are equipped with the Super Sonic Cruise Missile BrahMos which has a range of 290 km.

Apart from this, the Regiment hold a variety of ammunition to include High Explosive, Smoke, Illuminating, Cargo, 'Kransopol' PGM, Terminally Guided Sub Munition and Fuel Air Explosives. While our surveillance equipment, rockets and missiles are modern, our guns and ammunition are reaching obsolescence and need to be replaced at the earliest. The Regiment has started the process of inducting artillery combat command and control system for state-of-the art communications between the observation post and guns. The variants of our ballistic missiles and ABM systems need to be optimised to permit use of conventional weapons.

Future – Rely on Indigenous Design and Manufacture

Recently, the Regiment of Artillery has inducted six 155 mm (45 calibres) 'Dhanush' Gun systems, manufactured by the Ordnance Factory Board. It is also reported that indent for 114 of these Guns has been placed. This is to be followed by a further order of about 300 Guns. The Gun is designed, developed and 'Made in India', which enhances our indigenous capability of manufacturing state-of-the art equipment. The equipment has undergone extensive evaluation trials and would attain a maximum range of about 38 Km.

The other guns pertain to the 155 mm Ultra Light Howitzer (39 calibre) and the Self Propelled Gun K 9 'Vajra' (52 Calibre). The Ultra Light Howitzer (ULH) is manufactured by BAE Systems and is being procured by the Foreign Military Sales Route from the US. The Letter of Acceptance (LOA) has been received and the process of induction would soon commence. While a few pieces would be obtained from the Original Equipment Manufacturer (OEM),

the remaining would be made in India by the Mahindra Defence. The Gun is extremely light and can be heli-lifted by helicopter Chinook CH 47 C which is being procured by the Indian Air Force. It is expected that 145 pieces of this Gun would be added to the inventory. Two guns are currently in Pokharan Field Firing Ranges for preparation of Range Tables.

The K 9 Vajra is a Self Propelled (SP) Gun. This is an indigenised version of a South Korean SP Gun, which would be made in India by the Larsen and Toubro Limited. The Gun would be utilised in the desert regions bordering our Western flank and would be the first SP Gun to be inducted into the Army after the old 105 mm Abbot and the 130 mm Catapult. About 100 pieces would be the initial order. The contract has been signed and the Gun would be manufactured at the Larsen and Toubro plant at Talegaon, near Pune. Assistance for the project will be provided by Samsung Techwin. This is a thundering moment for the Indian Artillery, which has broken the glass ceiling and taken a great leap forward in the field of modernisation. These systems would make a quantum difference to the Regiment of Artillery.

There are numerous projects currently underway. Trials for the 155 mm (52 calibre) Towed Gun has been completed. The Gun from Nexter France and Elbit in Israel are in the fray. A Committee of Experts has been set up to look into the issues observed as a result of the General Staff evaluation. Based on their recommendations, the future towed gun's fate would be decided. The DRDO, with the assistance of Bharat Forge and Tata Strategic Equipment Division, have developed two prototypes for the Advanced Towed Artillery Gun. Development firings carried out for this 155 mm (52 calibres) Gun at Balasore has been well received. The BrahMos has been successfully tested by the user in the steep dive mode at the Andaman and Nicobar Islands and its fourth regiment, which would be in the mountainous region, would be inducted. Further, it is creditable that the Bi-modular Charge System would soon be manufactured by the Ordnance Factory Board.

There are few areas that the Regiment of Artillery must attend. First is the 155 mm (52 calibre) Mounted Gun System. The Acceptance of Necessity for 814 of

these Guns has lapsed. This Gun, mounted on the prime mover, has excellent mobility and the authorities must do their utmost to revive the Acceptance of Necessity and issue a Request for Proposal. The next issue is to find a suitable long range Rocket system of 80 to 90 km range for the mountains. The Common Gun Tower has been accepted after completion of all procedures. Currently, there are some aspects which need financial clearance for the project. Once these are settled, induction of 100 Common Gun Towers would commence. This would solve the problems for all Gun Towing Vehicles.

The Artillery must have PGM in its inventory. Currently, a few rounds of Krasnopol are available. These are not of a high quality and an efficient PGM must be selected and inducted. There is an urgent need to have joint venture projects come up in this field to ensure that we are able to acquire capability to make these weapons indigenously. The Artillery can only sustain itself through indigenous development. Effective steps must be taken by all agencies in this regard.

As regards missiles, our entire development of ballistic and cruise missiles are indigenous. We would be moving towards greater range for ICBMs and stabilising the development of 1000 km Sub Sonic Cruise Missile Nirbhay. As regards Air Defence, our Akash has been inducted by the Air Force and the Army. We will soon sign the contract for five regiments of S 400 Triumf with Russia. We have co-developed with Israel the Medium Range Surface to Air Missile (MRSAM) and the Long Range Surface to Air Missile (LRSAM). The ABM systems will be inducted once user evaluation is completed and this would make our air defence strong and flexible. With regard to Short Range Missiles, we have to work on the indigenous Nag or look for alternative variants like the Javelin from the US or the Spike from Israel. Further, we must acquire UCAVs and Loitering Missiles. Both of them can be developed indigenously with foreign collaborations.

Strength lies in our capability to indigenously design, develop and manufacture weapons and missiles. While great strides have been taken in this field, we can only improve by providing a level field to the private sector to join-in.

The current policy to develop strategic partnerships with private companies and foreign OEM would be a step in the right direction. This will ensure building of capabilities, which would enhance our military Strength vis-a-vis our adversaries.

To conclude, India has to be prepared for hybrid and conventional wars. These wars would be won by asymmetries of firepower which are achieved through weapons and missiles. We need to focus on indigenous design, development and manufacture of these systems. Further, there must be synergy between the Ministry of Defence, the Services and the Industry. This will ensure that we are ready to face all military eventualities.

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