# FORCE MULTIPLIERS AND TRANSFORMATION OF AIR DEFENCE

**ATUL KUMAR SINGH**

*Perpetual optimism is a force multiplier.*

– Colin Powell

Since the inception of the Indian Air Force (IAF) in October 1932, like other air forces, it has constantly struggled between requirements and resources. The IAF's involvement in a series of air operations starting from the Afghanistan border in 1937[1] to Kargil in 1999 has given it a unique place in the history of air forces which have constantly evolved through air operations. The frequency of air operations led to the focus on acquiring more aircraft, a larger number of squadrons, airlift capability, and on building up the offensive capability. On the other hand, the compulsions of the IAF retarded the growth of one of its most important components, air defence (AD). There was virtually no air defence until after the 1962 War, when it received some vintage radars from the erstwhile Soviet Union, and subsequent installation of the 500 series radars (AN-FPS 89 & AN-FPS 100) by the Americans in the mid and late Sixties. Integration of air defence assets had not started as late as 1995, when George K. Tanham wrote, "The Indian Air Force is unable to or unwilling to acquire force multipliers. The nation's integrated air defence is not complete."[2] There could have been many reasons for the slow evolution of air defence.

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1. Air Chief Marshal P. C. Lal, *My Years with the IAF* (New Delhi: Lancer International, 1986), pp. 12-13

2. George K. Tanham and Marcy Agmon, *Indian Air Force: Trends and Prospects*, A Monograph Report (Santa Monica: RAND Corporation 1995), p.84. Downloaded from www.rand.org/pubs/ monograph_reports/ MR424 on February 20, 2007.

In a talk organised by the Centre for Air Power Studies on March 16, 2007, at the Defence Research and Development Organisation (DRDO) Bhawan, former Chief of the Air Staff, Air Chief Marshal S.P. Tyagi spoke about the strategic nature of air power, the growing need for an Aerospace Command, the propulsion of economic growth and the footprint of India's larger strategic interest, thrusting the IAF into becoming a continental air force and, thus, the increasing necessity for an expeditionary force. The confidence and belief of the air chief emanate from many larger issues with a bearing on national defence, the acquisition of force multipliers being one of them. The IAF is transiting through a phase of transformation that may last another 15 years, wherein it needs to review its operational philosophies, organisational structures and training patterns to adapt to the nature of a truly continental force with strategic reach. In the light of the evolving organisational transformation, the core concept of air defence also needs to be reexamined to enhance the survivability of our offensive capability when operating within and beyond our territorial bounds.

In the last decade, the air defence infrastructure in the IAF has received significant attention, starting with induction of the SU-30 MKI, upgraded MiG-21 (BISON), induction of new radars and upgrade of existing radars, automation programmes, aerial refuelling (AR), unmanned aerial vehicles (UAVs), missiles, aerostat radars and airborne warning and control system (AWACS) that have afforded the capability to start thinking strategically, and, most importantly, of the strategic role of the IAF beyond the borders. This is where the significance of force multipliers becomes more visible on our minds, thinking and attitudes and that's where Colin Powell's statement fits in appropriately, "*Perpetual optimism is a force multiplier*."

**POINT DEFENCE TO AREA DEFENCE**

A number of reasons had led to the point defence policy followed by the IAF till the late Eighties. The biggest disadvantage of point defence is that it allows the hostile aircraft to reach its target before it is engaged with a combination of weapon systems in very close proximity or right overhead the target; in almost all cases, point defence will allow hostile forces to do the damage before they are engaged.

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These problems have been identified and efforts are underway to resolve these issues at strategic, operational and tactical levels. The area defence concept intends to engage the enemy at the earliest after detection and destroy or divert the hostile aircraft before they reach their weapon release line (WRL). Hence, the requirement of early warning over a larger area; fighters with long range advanced technology airborne intercepts (AI) radars; beyond visual range air-to-air missiles (BVRAAM), etc. The force multipliers like AWACS, aerostat radars, precision weapons, and multi-role combat aircraft (MRCA), UAVs, and AR address all the major problems of air defence operations, thus, bringing in a rapid transformation in the way air defence operations are perceived. Active air defence components are playing an increasingly vital role in air dominance operations. For example, the roles of aerostat radar, AR, Su-30 MKI armed with BVRAAM have given a definitive meaning to how offensive sweep and free escort missions are to be conducted in the battle for air dominance. This will blur the line between offensive and defensive counter-air roles. Force multipliers have enhanced the reach and offensive capabilities of air defence operations, thus, bringing in the shift in the concept of AD operations. In the long term, this capability will further enhance once all the force multipliers are integrated on a net-centric platform which would be capable of integrating army and naval air defence operations in real-time and in entirety.

**FORCE MULTIPLIERS**

The US Department of Defence has defined force multipliers as, "A capability that, when added to, or employed by, a combat force, significantly increases the combat potential of that force and, thus, enhances the probability of successful mission accomplishment."[3] Force multipliers enhance the combat power of a smaller force, accordingly, the increase in combat power is made possible through various processes which include increased radius of action

3. Definition of *force multipliers* by US Department of Defence, as cited on http://usmilitary.about.com. Downloaded on November 19, 2006.

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of attack platforms, increased time on station for operations, precision attacks and information dominance. The systems that enable the achievement of the above include airborne early warning (AEW), aerial refuelling, electronic warfare, intelligence, command and control, communications and computers (C4), precision, navigation, and reconnaissance. Therefore, the force multipliers would necessarily have to address the folowing issues:[4]

(a) Time and operational tempo.
(b) Information.
(c) Concentration of force.
(d) Mass.
(e) Economy of effort.

From the Stone Age to the Space Age, technologies and innovative ideas for application of technology in warfare have contributed to enhancing the war-fighting capabilities of mankind. Be it slings, ships, cannons, aircraft, radars, rocket science or satellites, mankind has always innovated to exploit these technologies to advance his war-fighting abilities. However, technology alone, without the doctrinal concepts and organisational adaptations, does little to win wars. The pace of evolutionary technological developments in the 19th and 20th centuries and particularly after the emergence of air power, has changed the nature of war. "Technology has led to change of organisational and doctrinal concepts of war-fighting and the combined effect of technological developments, doctrinal innovations and organisational adaptations have enabled full realisation of the revolution in military affairs (RMA)."[5] The war-fighting

4. Air Commodore M. Matheswaran, "Integrating Force Multipliers and Operations" in Air Commodore Jasjit Singh, ed., *Aerospace Power and India's Defence* (New Delhi: Knowledge World, 2007), p. 223.
5. Air Vice Marshal Kapil Kak (Retd), "Revolution in Military Affairs: An Appraisal," *Strategic Analysis* vol. XXIV, no. 1, April 2000. Downloaded from www.ciaonet.org on November 12, 2006.

platforms, weapon systems, doctrines and command and control structures are the by-products of technology. Constantly inventive technology has given many platforms which, when employed by a force or its components, have contributed in enhancing the combat potential of the force, thus, increasing the probability of mission accomplishment. "The stunning victory of the Western armed forces and their allies in the Gulf War in 1991 could doubtless be ascribed to the .employment of significant force multipliers like airborne warning and control system (AWACS), joint surveillance target attack radar system (JSTARS), joint tactical information distribution system (JTIDS), in-flight refuelling, satellite aided navigation, precision-force technologies, etc."[6]

**RADARS**

*Next to the atomic bomb, radar was the most decisive weapon of the war.*

– Grand Admiral Karl Doenitz, German Navy

Air power would top the list of force multipliers in the history of warfare and the radar will stand only second to it. Radar was probably the biggest force multiplier of World War II and the *raison d'être* for British success in the Battle of Britain. This was followed by other force multipliers like AEW, UAVs, and command, control, communications, intelligence (C31) systems. In their short history of 70 years, radars have traversed the path of development from chain home (CH) radars to space-based radars. The multiplicity of functions extends from surveillance, target tracking, airborne intercept (AI), meteorological radars, synthetic aperture radars (SAR) and through the wall surveillance radars (TWS) – the list is endless. In addition to upgrading its existing high powered and medium powered radars (HPR and MPR), the IAF is in the process of improving its surveillance and weapon guidance capability by acquiring indigenous systems like the Indian doppler radar (INDRA),

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6. Kak, Ibid.

central acquisition radar (CAR) and induction of foreign systems like aerostats and Green Pine radars. The technological developments in radar like mono pulse technique, digital signal processing, phased array trans-receiver modules and recent development of active electronically scanned array (AESA) radars have enabled a quantum jump in the performance and utilisation of radars in surface, air, naval and space-based operations. Information technology has enabled integration and networking of surveillance systems to provide a composite air picture for more efficient command and control and battlefield management. The enhanced capacity and capability of the data handling system (DHS) to integrate different types of radars, simultaneously process and display digital track data on thousands of tracks with improved quality of resolution on LCD or plasma operator work stations (OWS) has had a remarkable impact on situational awareness and quality of controlling.

**AWACS AND AEROSTAT RADARS**

Radar had the effect of forcing air operations down to lower levels to stay below the radar horizon and, thus, evade detection. The next logical step was to mount the radar on an airborne platform, thereby, nullifying the benefits of a low level approach. This technological leap has been, perhaps, the single greatest force multiplier in air operations.[7] The role, employment and capabilities of AWACS have transformed the nature of warfare because of its strategic nature and operational capabilities. In the 1980s, AWACS assumed a broader role as a tactical adviser for a greater number of fighter aircraft operating within its radar coverage. By assisting the interceptor aircraft in controlling the defensive intercepts, AWACS assumed the role of augmentation platform for ground-based radar units. In the 1990s, during the Gulf War, AWACS provided control and battle management support to offensive counter-air forces in a theatre-wide offensive.[8] The subsequent technological upgrades like advanced computer technology, secure communication, maritime surveillance capability,

7. Squadron Leader Ajai Singh, "The Air War with AWACS Symmetry," *The Indian Defence Review*, 1995. Downloaded from http://www.bharat-rakshak.com/LANCER/index.html on November 25, 2006.
8. Major Thomas W. Nine, "The Future of USAF Airborne Warning & Control; A Conceptual Approach." Downloaded from www.fas.org/man/dod-101/sys on January 3, 2007.

improvement in radar, radio and display systems have further enhanced the role of AWACS as a command and control platform. As a tool of power projection, the US has used AWACS for coercive politics. Air Commodore Jasjit Singh wrote in 1987, "…the US has made increasing use of AWACS for political purposes, leading, in fact, to some people coining the term **'AWACS diplomacy'** to describe the phenomenon."[9]

The strategic importance of AWACS emanates from its ability to extend multiple functions like early warning, surveillance, ESM (electronic suppression measures), SIGINT (signals intelligence) capability, command and control and battle management from one airborne platform. As a strategic asset, AWACS will be employed to achieve overall military objectives and the operational roles in the theatres of war would have to be prioritised. Air dominance operations will remain a primary mission along with integrated operations with the army and navy to attain time critical military objectives. Initiative, surprise, concentration of firepower, shock effect and attaining operational advantage over adversaries would remain the guiding principles for employment of AWACS. It could play a crucial role in enhancing the survivability and credibility of our nuclear delivery capability in a retaliatory strike. The strategic role of AWACS rests in its ability for power projection and the pivotal role that it plays in air dominance, thus, providing the increased survivability of offensive elements. In addition, AWACS, in conjunction with other force multipliers, could be used as an instrument of coercive diplomacy or the good old "gunboat diplomacy" exercised by powerful navies of the world.

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At the operational level, increased reaction time and enhanced early warning

9. Air Commodore Jasjit Singh, *AWACS: The New Destabiliser* (New Delhi: Lancer Press, 1987), p. 33.

by gap-free radar coverage at low and medium altitudes extending up to the range of 400-450 km, is the singular characteristic of AWACS which would address major problems of the air defence system. Taking into consideration the safety aspects, if an AWACS is flown 150 km inside own territory, it will provide gap-free low and medium level radar cover at least 250 km inside the adversary's territory, enhancing the functional capability of AD. This would be of significant importance, considering the lack of depth in the case of India's western adversary as this would facilitate constant monitoring of operational activity and flying tactics from most of the main and satellite airfields. As an ESM platform, SIGINT from AWACS would augment the existing intelligence resources, and the electronic ORBAT (order of battle) of the adversary would become transparent to a large extent. The enhanced radar pick-up ranges would give an impetus to the area defence concept and offensive capability to carry air defence into the enemy's territory.

Aerostat radars would augment the ground-based radars. These radars have greater capabilities in terms of detection ranges, V/UHF RT range, SIGINT, etc. Mounted on tethered balloons, the radars, could be hoisted to a height of 10,000 to 15,000 feet, depending upon the payload. The radar overcomes the limitation of line of sight and provides gap-free low and medium altitude coverage at ranges greater than 300 km. However, as compared to AWACS, aerostat radars have limitations in terms of range, operator work stations (OWS) and communication facilities which preclude their role as a command and control platform. But these will play a very vital role in providing low level radar cover, tactical control of aircraft and SIGINT. Therefore, the importance of aerostat radars should be seen as complementary to AWACS. As mentioned earlier, AWACS could be used to achieve overall military objectives and may not be available exclusively for air defence operations, therefore, the aerostats would fill this gap in the absence of AWACS. In the overall analysis, both AWACS and aerostat radars will significantly boost the air defence capability of air forces. The effect of AWACS and aerostat radars would be seen in the conduct of the following operations:

- Air dominance operations.

- Tactical control of offensive sweep (OS) and free escorts.
- Navigational assistance, threat updates and recovery of strike aircraft where necessary.
- Suppression of enemy air defence (SEAD) and battlefield air interdiction (BAI), air transport support operations, special heliborne operations (SHBO), assistance in combat SAR and UAV missions.
- Radar assistance to air combat support operations like aerial refuelling (AR) and ELINT (electronic intelligence) missions.

**AERIAL REFUELLING (AR)**

The endurance of combat aircraft is limited by the amount of fuel it carries, its weapon configuration, operating altitude and speed at which it flies. In air defence operations, fighters maintain a very high state of operational readiness for prolonged durations, and depending upon the threat perception or early warning, combat air patrol (CAP) missions are launched to deter and / or intercept the enemy strike aircraft before it reaches its weapon release line (WRL). Assuming that an aircraft on an air defence mission has an endurance of 45 minutes, then, based, on this figure, a simple calculation would indicate that to maintain a 24-hour CAP in a given area, a minimum of eight aircraft are required without any unserviceability; 36 missions (54 sorties) would have to be flown in a period of 24 hours, and each aircraft would fly six or seven sorties, and eleven pilots would be required at the rate of five sorties per pilot, considering that no engagement takes place and only one mission remains in the air at any given time. This is the most simplistic scenario but an enormous task to achieve because it is virtually impossible to maintain 100 per cent serviceability and this requirement will increase manifold if engagements take place and two or more missions are in the air simultaneously. Such resources are not available even with the best of air forces to be tied down to one task of CAP. While the task may be important, it is still a wasteful method of using scarce resources. If one could assume that aerial refuelling will increase the endurance of such an aircraft to two hours, the figures would alter to show incredible savings of 50-60 per cent in all areas. "By extending the on station time of combat air patrol (CAP) formation or by extending the radius

of action for the strike formation, or by increasing the on station time of the command and control platform such as AWACS, the aerial refuelling contributes immensely to the economy of force as well as maximisation of force application."[10]

Enhanced early warning from AEW systems may obviate the requirement of launching CAP missions, but in the absence of such warning or to protect high value assets (HVA) like AWACS, aerostats or tankers, a CAP may still be required in a given area. Therefore, if there is an operational imperative of launching CAP aircraft, the task would be achieved with fewer aircraft and with more efficiency. Aerial refuelling will also enhance the endurance of the command and control platform like AWACS. An AEW system on the IL-76, reportedly has an endurance of four hours or more; depending upon the distance to the area of operations from launching base, transit time, etc, this endurance could be doubled with aerial refuelling. A command and control platform in a given area for 7-8 hours could be a deciding factor between the success and failure of an operation. Similarly, multi-role fighters like the SU-30 or Mirage 2000, capable of carrying a large number of air-to-air missiles (AAMs) could be used in the role of offensive sweep or free escorts in the enemy territory, and on their return leg, the same aircraft could refuel in the air and carry out a CAP mission. Notwithstanding the capability, this kind of flexibility could be exercised subject to limitation of crew fatigue and other technically limiting factors like temperatures, oil, lubricants, greasing of the aircraft.

**UNMANNED AERIAL VEHICLES (UAVS)**

Designed to obtain enemy intelligence and enhanced situational awareness, UAVs have grown into indispensable instruments of intelligence, surveillance, reconnaissance (ISR), weapon delivery, target lasing and SEAD and many other roles unthought of earlier. In the times of rising costs and restrictive defence budgets, the UAV serves as an effective force multiplier for air power. The unprecedented success of the UAV emerges from its higher survivability owing to its small radar, acoustic and infrared signatures and ability to perform a number of missions. However, the basic premises are rapidly changing; UAVs like the

10. Matheswaran, n.4, p. 223.

Predator, Global Hawk, Harpy, etc. have transformed the entire concept of a UAV into that of an unmanned combat aerial vehicle (UCAV). The operational concepts of the UAV and UCAV are catching up fast simply because of the multiplicity of roles that could be performed by the UAV without risking human life, and even with increasing costs, it is still considered expendable as compared to manned aircraft. Israel learned the true value of UAVs in the 1973 Yom Kippur War, and the Israeli strike against Syrian missile batteries in the Bekaa Valley operation in 1982 provides several examples of effective UAV use in combat.[11]

***Interceptor UCAVs***

In air-to-air combat, where awareness, responsiveness, reach, speed and agility are likely to be the determining factors, the removal of the pilot will remove the consideration for human physiological limits while designing and developing the UCAV; it would also reduce the risk of casualties. A UAV will reduce the radar cross-section, greatly increase acceleration limits, and a low observable UCAV could perform the air-to-air combat role by executing 12-30g turns to present minimum RCS to the threat and evade missiles. UAVs with stealth characteristics could loiter undetected for prolonged durations which could be further enhanced with aerial refuelling. The UCAV replacing an AD fighter is a promising prospect, but a distant reality in the Indian context. The removal of the pilot from the cockpit may sound a lucrative proposal but the practical difficulties of a UAV controller doing the job of a pilot and that of a fighter controller are yet to be assessed; secondly, artificial intelligence is still nowhere compared to human brains when it come to faster thinking and instinctive reactions when faced with adversity and uncertainty.

***UAVs in ISR Role***

In the foreseeable future, ISR is likely to remain the primary role for UAVs in all three Services. The Bekaa Valley is the most comprehensive example of exploitation of the UAV in the ISR role. Months before the attack, Israeli UAVs "fingerprinted"

11. Capt Brian P. Tice, USAF, "Unmanned Aerial Vehicles: The Force Multipliers of 1990s," *Air Power Journal*, Spring 1991. Downloaded from www.airpower.maxwell.af.milairchroniclesapj.htm on January 8, 2007.

Syrian surface-to-air radars by gathering the electronic frequencies of those radars and programming them into Israeli anti-radiation missiles for use during an attack; using the electronic frequency signatures gathered earlier, Israeli fighters, carrying anti-radiation missiles, closed in, and along with artillery fire, destroyed the surface-to-air missiles (SAMs).[12] The real-time SIGINT and data transfers or live video images make the enemy's electronic ORBAT transparent even before the hostilities have commenced, and assist in planning offensive operations and SEAD. The Israeli Air Force also used UAVs in the surveillance role by positioning them over three major airfields deep within Syria to gather data on when and how many aircraft were taking off from Syrian airfields. This information was given immediately to the E-2C AWACS aircraft, which vectored Israeli fighters against the Syrian MiGs. UAVs made matters worse by jamming Syrian ground control intercept (GCI) communications with MiG fighters, which were highly dependent on GCI. In yet another role, UAVs acted as laser designators for laser-guided weapons launched by fighters against the SAMs.[13]

***Data and Communication Relay Station***

A low cost UAV loitering at 15,000-20,000 feet can be used as a platform to relay surveillance data, U/VHF RT, ELINT information, etc. between two stations operating beyond line of sight. The constraints of aerial surveillance platforms would often demand platforms which could be used as relay stations between the aircraft and the radar station or between the AWACS and the command and control centre. Broadband communications, advanced computing, micromechanical devices, and human-machine interface are key technologies that would be used on such a platform.

***Employment of UAVs for AWACS/AEW Augmentation***

In the mountainous terrain of Jammu and Kashmir (J&K) and the northeast, the performance of ground-based radars is extremely restricted; even AWACS and other airborne platforms will perform sub-optimally due to radar shadows. The

12. Tice, Ibid.
13. Tice, Ibid.

problem could be resolved if UAVs could be equipped with smaller airborne radars with limited ranges of 100 km or thereabout, and could perform the role of gap filler in the valleys and radar shadow areas. Data link with AD fighters and AWACS for real time-target information will augment the radar picture of AWACS/AEW systems. Conventional radars have not been mounted on UAVs as yet, although the technological feasibility is not in doubt. Northrop Grumman and Raytheon are developing the Multi-Platform Radar Technology Insertion Programme (MP-RTIP) for the JSTAR upgrade of the USAF (US Air Force). The MP-RTIP is an active electronically scanned array (AESA) radar that can be scaled in size for different platforms.[14] The MP-RTIP uses an active AESA radar for high resolution images and is also capable of detecting moving vehicles through the ground moving target indicator (MTI). Similar technology could be modified to install active AESA radars for detection of aircraft.

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***UAVs in Naval Air Defence***

UAVs play a major role as an ELINT platform in the naval air defence. Surveillance and early warning on radar emissions, frequencies of communication and tracking systems provide early warning and add to the reaction time of AD forces. The Indian Navy is already operating the Heron and Searcher Mk II UAVs and plans to induct rotary wing UAVs. Although a VTOL UAV operating from the deck will provide more operational efficiency, a shore-based HALE UAV would be more suitable for carrying radar payload to extend the early warning on flying objects.

**THE FIFTH GENERATION: MULTI-ROLE COMBAT AIRCRAFT (MRCA)**

The fifth generation aircraft technology is focussed on the system of integrated

14. Tom Kington, "Next Stop for Synthetic Aperture Radar," *Defence News*, February 19, 2007.

systems. There is greater emphasis on situational awareness (SA) of the pilot in the cockpit, through AESA radar, electro-optical/infrared (EO/IR); focal plan array[15], data and information fusion, human and weapon interface and net-enabled targeting. For example, there will be a vast gap between the SA of pilots in the MiG -21, MiG-29 and the SU-30 MKI. The fourth and fifth generation fighters have been classified as force multipliers because of the current cutting edge technologies such as composite materials, thrust vectoring, extreme manoeuvrability, advanced radar and sensors, and integrated avionics designed to reduce the pilot's workload, vastly improving situational awareness. Super cruise and stealth technology are the key features of fifth generation aircraft. "The key to the future air warfare lies in excellent pilot SA and effective pilot vehicle interface (net-centricity); balanced multi-role capability with operational flexibility and precise targeting and rapid kill chain for increased lethality and survivability."[16] In January 2007, India and Russia reached an agreement to jointly develop a fifth generation aircraft. Designated as the PAK-FA, the programme envisages a fighter with all fifth generation capabilities. These include advanced stealth features, a full composite airframe, a crucial AESA radar, advanced integrated onboard sensors, vectored thrust nozzles for superior manoeuvrability, the ability to launch beyond visual range and ground attack missiles, and, importantly, the ability to fly at supersonic velocities without the use of engine afterburners known as super cruise.[17]

The SU-30 MKI is a fourth generation aircraft with additional features; it has been produced to order and meets the requirements of all users, and particularly that of air defence. The integral aerodynamic configuration, combined with thrust vectoring, results in practically unlimited manoeuvrability and unique

15. A matrix of detector cells attached to a semiconductor chip. The detector cells are responsive in IR wavelengths, in which they absorb IR radiation, convert it into electrons, and send a voltage signal in response to form an image. Technically, FPAs operate much like a charged coupled device (CCD), which is used in the visible light portion of the spectrum and is found in video cameras. IR imaging FPA detector cells are composed of materials sensitive to IR radiation. Downloaded from www.xenics.com/Products/Glossary.php on February 22, 2007.

16 Christopher M. Chadwick, vice president, Global Strike Systems Boeing, "The Future of Air Warfare," a presentation on the capabilities of fifth generation aircraft at the Centre for Air Power Studies on July 13, 2006.

17. Shiv Aroor, "Advanced Stealth Fighter Aircraft India-Russia's new Joint Venture," *The Indian Express* (New Delhi) January 24, 2007.

take-off and landing characteristics. Aircraft can carry 12 air-to-air missiles of different categories. Indian Su-30 MKI fighters are also to be armed with the Brahmos cruise missile, under joint development by India and Russia. The Brahmos has a range of 290 km and a warhead of up to 350kg.[18] An excellent long range radar (with flexible azimuth and elevation coverage) married with other target acquisition systems, the ability to network within the formation and with platforms like AWACS, ability to carry a mix of weapon systems, high endurance (nine tons of internal fuel) and ability to refuel in the air, make it a formidable force multiplier for AD operations.

**PRECISION WEAPONS**

Precision weapons have ushered in a new paradigm of air power application: effect-based operations (EBO). Operational planning now targets key nodes of the system to achieve the desired objective rather than target the entire system for destruction. While targeting the Iraqi Air Defence System (IADS), planners designated the desired mean point of impact (DMPI) that when struck, would disable the command and control functions of the sector operations centres (SOC). As a result, the operational objective of disabling the sector integrated air defence system (IADS) was achieved without having to destroy the entire SOC. The effect-based planning reduced the required number of weapons from eight to two 2,000-pound precision guided munitions (PGMs) directed at SOC on the first night of the war.[19]

Precision weapons directly impinge upon the survivability of ground-based air defence systems. A study of all recent air wars would indicate increasing emphasis and importance of SEAD operations to achieve the desired level of command in the air. In the modern air wars, high value assets (HVA) like aerostats, ground-based radars, command and

**Precision weapons have ushered a new paradigm of air power application: effect-based operations (EBO).**

18. Su-30MKI: "Multi-Role Two-Seater Fighter Aircraft, Russia." Downloaded from www.airforce-technology.com on January 11, 2006.
19. Col. Edward Mann, Lt. Col. Gary Endersby and Tom Searle, "Dominant Effects: Effect-Based Joint Operations," *Aerospace Power Journal*, Fall, 2001.

control centres, communication hubs, missile sites, etc. would receive the first wave of cruise missiles, laser guided bombs (LGBs), joint direct attack munitions (JDAMS) and anti-radiation missiles (ARMs). A high value asset like an aerostat radar will need a very dense terminal defence protection against concerted air attacks. For example, it has been reported that H2 and H4 bombs in India's neighbourhood have been converted into precision weapons with the add-on kit of the global positioning system (GPS) and inertial navigation system. These bombs are reported to have stand-off ranges of 60 and 120 km respectively and could prove to be very effective against high value assets like aerostat radars, CRCs and UAV control stations. India's potential adversaries have acquired precision weapons of Russian origin such as the Kh-29 air-to-surface missile, Kh-31 anti-shipping and ARM, Kh-59 long range land attack missiles, KAB 1500 and KAB 500Kr laser and TV guided bombs.

**NET-CENTRIC WARFARE (NCW)**

"As compared to all other force multipliers, the NCW capability, when put in place, will create the most astounding force multiplying effect for any force. The NCW concept revolves on exploitation of force structure by networking each and every sensor and platform so as to achieve exceptional levels of situational levels awareness and, thereby, optimize command and control and decision-making systems and, thus, achieve optimal, economic and efficient application of force."[20] The command, control, communications, computers, intelligence, surveillance, reconnaissance (C4ISR) capabilities of a nation integrated on a net-centric platform would be the biggest force multiplier in the AD network because a net-centric platform is truly an integrated system of systems.

The criticality of the air defence system rests in short reaction times between detection, identification and tactical action. Therefore, sharing of information, improved situational awareness and expeditious decisions are fundamental to air defence operations. In the AD organisation, NCW would mean networking of ground-based radars, AEW platforms, communication hubs, AD fighters, SAM and artillery systems, electronic warfare and integration of army and naval AD

20. Matheswaran, n.4, p.228

assets. The resultant battlefield SA arrives at decisions and a suitable response mechanism based on the networked weapon system. It is an extremely complex process and more so in our case because of the variety of sensors that range from an observer on the border post to AWACS. These sensors are from different countries and of different vintage. Problems of interoperability would also surface while integrating weapon platforms, communication systems and the concept of operations of the sister Services. "Translating this concept into a real operational capability requires far more than just injecting information technology in the form of an information infrastructure or info structure. It requires concepts of operation, C2 approaches, organizational forms, doctrine, force structure, support services and the like all working together to leverage the available information."[21]

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Difficulties notwithstanding, the net-centric platform is imperative for air defence, because it enables the capability of geographically dispersed forces to operate as one integrated force. The entire cycle of air defence functions from detection of threat to its identification as friend or foe, confirm the availability and state of readiness of weapon systems; and the decision to commit the weapon system and control the fighters to intercept the strike aircraft requires extensive communication. Control and coordination among sensors, weapon systems and command and control centres is so time critical that even a small delay or wrong decision could result in achieving or not achieving a kill on enemy forces. Therefore, the timeliness and correctness of decisions becomes critical. A networked force would function more efficiently because of high situational awareness and resultant coordination. In short, NCW will enable the rapidity of operations due to a faster observe, orient, decide, and act (OODA) cycle.[22] The other advantages of net-centric warfare are:

21. Davis S. Albert, John J. Garstka, Frederick P. Stein, *Net-Centric Warfare: Developing and Leveraging Information Superiority* (CCRP Publication Series, second edition, February 2000) on http://www.dod.mil/ nii/NCW.
22. Matheswaran, n.4, p.229.

- Information superiority enabled concept of operations.
- Higher speed of decision-making and effective command and control.
- Greater coordination in conduct of interception.
- Timely and precise information for engagement by terminal weapons.
- Reduced sensor to shooter cycle.
- Possibilities of inflicting higher attrition on enemy forces.
- Increased survivability of key assets like airfields, critical bridges, dams, civil and military installations.

**SURVIVABILITY VS VULNERABILITY**

The operational potential and enhanced combat efficiency extended by force multipliers enhance the survivability of key assets and offensive elements but make them vulnerable to hostile attacks. The exorbitant cost, overarching role in air operations and the psychological impact of losing one force multiplier could have public and political implications which multiply owing to extensive media coverage of all wars. The cost of such force multipliers is an overriding factor; for example, three AWACS could cost upward of $ 1.1 billion and reports indicate that one aerostat system is likely to cost nearly $ 40 million. Such platforms will require additional protection and air defence measures such as CAP, and surface-to-air missile systems. The vulnerability of force multipliers, therefore, becomes a critical factor in operational planning, deciding the home base, area of operations and, most importantly, air defence resources consumed by force multipliers.

The vulnerability of force multipliers also imposes certain restrictions on the operational exploitation. The vulnerability of AWACS to a hostile intercept, anti-radiation weapon system or simply a long range surface-to-air missile compels the operational planners to operate such a crucial force multiplier 150 km inside own territory, thus, losing out on the major part of the operational advantage. Also, there has been an ensuing debate on AWACS busting and it has been extensively discussed in the air force and the civilian circle of think-tanks. Though history would tell us that not even one AWACS has been shot down till date, the air wars involving AWACS were fought in conditions of asymmetry of forces, which may not be the case with India. The third issue pertains to economy of air effort – the

extensive early warning may obviate the requirement of CAP; some might argue that the air effort which was saved from CAP missions will now be utilised for AWACS protection. This argument may be right but it is to be seen in the light of the following factors:

- The stage of operations: the extent of air dominance the forces enjoy will decide the extent of protection required by AWACS.
- Except for high mountainous terrain, AWACS provides a minimum 250 km of warning of hostile aircraft, therefore, terrain and geographical location of air operations become very important in the case of AWACS.
- The air effort required to defend an AWACS for eight to ten hours would be much less compared to 24 hours CAP.

**The vulnerability of force multipliers, therefore, becomes a critical factor in operational planning, deciding the home base, area of operations and, most importantly, air defence resources consumed by force multipliers.**

Similar arguments are extended as regards utilisation of air-to-air refuelling. During operations, demands for tankers will outnumber the availability; therefore, aerial refuelling between various ongoing operations will have to be prioritised. The SU-30 and M-2000 class of aircraft will primarily carry out the air dominance missions and they will require aerial refuelling in the course of their operations, and outbound strike missions would prefer the tankers being positioned en route, to refuel shortly before leaving own territory. Similarly, missions recovering from hostile territory may require emergency refuelling to divert or recover at another base in greater depth. Hence, the air-to-air refueller will have to operate as close to the border as its safety will allow. The safety of the tanker will also be a consideration for operational planning, selection of a safe tow line beyond the adversary's radar coverage and at adequate depth from the border at which the tanker would be safe from a surprise attack. Location of launch bases and routing of offensive missions and air defence aircraft cover, the control and safety of receivers and a separate V/UHF RT channel for effective

control of the tanker are the major planning factors for aerial refuelling.

The success or failure of air defence operations hinges on the ability to operate in an integrated and coherent fashion, capable of applying firepower on hostile airborne objects, from detection to destruction. The advantages of a net-centric platform have already been covered earlier but the vulnerability of net-centric warfare lies in cyber warfare. Like any other information technology-based platform, net-centric warfare is also vulnerable to leakage of information, hacking, viruses, sabotage and subversions. While it gives significant advantage in maintaining the speed of information sharing, decision-making and force application, the collapse of the NCW platform could have the opposite effects. The security and survival of the NCW platform is, therefore, of prime importance, and planners may have to build in redundancy by planning multiple communication routes, alternate servers, building storage capacities, adherence to information security procedures, etc.

**The success or failure of air defence operations hinges on the ability to operate in an integrated and coherent fashion, capable of applying firepower on hostile airborne objects, from detection to destruction.**

The study of the air wars in the last three decades would suggest that the vulnerability of a force multiplier is a significant factor only in the case of force symmetry and absence of air superiority. Air forces that won their battle of air superiority / dominance could afford to exploit the force multipliers with greater freedom without miscalculating the vulnerability aspects.

## FORCE MULTIPLIERS AND AUTOMATION

A force multiplier in isolation will address specific problems like early warning, reaction time, endurance or firepower but without a proper command and control system which can orchestrate and synergise the entire operation, the force multiplier would be utilised sub-optimally. The IAF continues to build on its past experience and indigenous research and development in collaboration with public and private sector companies, to develop a fully automated and integrated system. The complete potential of force multipliers could be best exploited when integrated

on a net-centric platform to generate a combined effect of surprise, speed, flexibility, concentration of firepower, and mass with economy of effort.

Airborne early warning and command and control platforms like AWACS and aerostat radars would resolve the problem of detection and reaction time. The radar integration will facilitate a composite air picture and rapid flow of information on data channels will significantly improve situational awareness. This alone will have a far-reaching impact on all the other functions of air defence. The reaction time would be adequate to obviate any error in identification and ensure that friendly forces are warned of an impending threat, and our own force, if in enemy territory, could be identified and recovered safely at alternate locations. This would also give adequate time to warn the air bases and upgrade the readiness state of terminal weapons. Army formations in TBA and air defence elements of the strike and holding corps will have access to the composite air picture which will improve control and coordination of army air defence weapons. The situational awareness and improved coordination will give more precise information to terminal weapons of vulnerable areas/ vulnerable points (VAs/VPs) on strike direction, number of aircraft, etc; thus, the task of allocation and engagement of hostile tracks to AD artillery and short range air defence systems (SHORADS) would become more streamlined and achieve higher attrition on hostile forces.

Integration of force multipliers on an automated platform would play a significant role in SEAD operations. ELINT and COMINT gathered by AEW platforms and UAVs will provide vital information on the deployment pattern and electronic ORBAT of the adversary. This information will be used for planning, guidance and delivery of precision weapons against two to three tier chains of low level radars or one could simply avoid these radars and low-level air defence weapon systems by flying medium levels under own radar cover.

## THE DOCTRINAL IMPACT

It needs to be reiterated that force multipliers demonstrate their impact on the entire force and not on a particular operation. Therefore, force multipliers will have an all encompassing impact on the way the IAF will apply aerospace power in the future. The overwhelming impact of force multipliers in Bekaa Valley,

Desert Storm and Operation Iraqi Freedom (OIF) needs no emphasis and the lack of AEW capabilities and its fallout in the Falklands War are also well known. To understand the impact of force multipliers, we need to study the strategic, operational and tactical implications for air defence operations.

***Strategic Aspects***

The air force strategic doctrine would be to achieve "control of the air" because ultimately that will decide the effectiveness of the rest of the air operations. At the strategic level, the impact of force multipliers will be felt in the planning, execution and success of air force strategy. The air dominance operations would be the most critical part of "control of the air," and force multipliers would play a vital role. A force multiplier by itself is not capable of winning a battle; it is the integration and synergy with conventional forces that would bring in the desired results. An aggressive approach and synchronised proactive actions will best exploit the capabilities of force multipliers. Active air defence components will play a significant role in overall execution of air dominance operations, integrated employment of terrestrial, airborne and space-based systems will enhance security and survivability of own offensive elements which generates the force multiplication effect. However, for this entire strategic vision to work successfully, broad doctrinal guidelines and policy instructions would have to be issued top down, which would lead to revision of the existing Air Staff Orders (ASO), standard operating procedures (SOPs), and a more flexible approach for innovative tactical options.

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***Operational Aspects***

At the operational level, the biggest impact of force multipliers on AD would be to alter the way we have been conducting our AD operations. Higher situational awareness, self-synergistic actions and ability to share data would

shift the emphasis from concepts of point defence to area defence. Command and control platforms, enhanced communication facilities and integration of systems will make it obligatory to review the existing organisational structure. Force multipliers will engender more flexibility to shift the command and control responsibilities from ADDCs to AWACS and vice versa on an as required basis.

We also need to consider shifting our launch bases in greater depth to increase their survivability, and be beyond the range of the adversary's AEW/ESM systems. It is a long-term and capital intensive process, therefore, a plan to gradually shift launch bases in a phased manner may work over a period of the next 10-15 years. Launch bases in depth give more time to react and intercept / destroy the impending threat. Higher survivability of our launch platforms would ensure retaliatory capability in both conventional and unconventional conflicts. Similarly, after the fructification of all modernisation plans, there will be a case for review of the air defence organisation.

Force multipliers provide round the clock surveillance capability in depth of the adversary's territory, to monitor and instantly counter-attack its offensive elements. Israel and the Coalition forces used UAVs, AWACS and JSTARS with enormous success for constant surveillance and offensive operations in Bekaa Valley and the Gulf War respectively. Hence, there will be more stress on offensive sweep and free escorts as compared to combat air patrol. The offensive potential of air defence elements will have a significant impact on the planning of counter-air operations and the cumulative impact of force multipliers would actually blur the line between offensive and defensive counter-air operations. Long and medium range engagement by surface-to-air missiles would become the main features of area defence.

AD assets will also be taken into consideration in the planning and execution of air transport support and airborne assault operations. This is not to say that they were not taken into consideration till now, but not much assistance could be extended hitherto. Force multipliers, however, will provide positive radar cover, threat warning, protection by AD fighters and assistance in recovery from the area of operations.

*Tactical Doctrines*

The entire premise of tree top low-level tactics will become redundant in the face of gap-free low level cover and more so in the case of AWACS symmetry. In Operation Desert Storm as well as Operation Iraqi Freedom, the USAF flew all their missions at medium levels under the extensive radar cover provided by AWACS and also reduced their attrition from low level air defence systems (LLADS). On the other hand, British Tornados were constrained to fly at low level and suffered heavy attrition because their weapons could be delivered only at low level. The IAF needs to reexamine its operational philosophy in the future, because the shift from low level to medium level would require a change in training patterns, weapon systems and weapon delivery profiles. Besides higher survivability, the medium level approach also affords a larger radius, longer range and freedom of manoeuvrability.

**The IAF needs to reexamine its operational philosophy in the future, because the shift from low level to medium level would require a change in training patterns, weapon systems and weapon delivery profiles.**

There will be a substantial change in the employment of weapon systems and support operations in the battlefield. Aerial combat will completely shift from visual to beyond visual range interceptions. The dependence on ground control intercept (GCI) will reduce and after initial input on target, interception will become increasingly autonomous. Threat location, target parameters and control instructions will be passed on data link, reducing voice communication and susceptibility to electronic interference.

Extended low level radar cover would facilitate positive radar cover, threat update, routing through safe routes and quick identification and safe recovery of counter-air and battlefield air interdiction (BAI) missions, combat search and rescue (CSAR), special heliborne operations (SHBO), ELINT missions, etc.

Coordination between the army and air force will improve with better situational awareness. Air space management in TBA will lay greater emphasis on real-time, positive control which hitherto was not possible owing to poor SA

and communications. Procedural controls are more restrictive in nature and considered suitable only in the case of unreliable / poor communication. The communication network of the army and air force has been modernised and continues to improve. Therefore, the safety of friendly forces will increase, and the perpetual fear of being shot down by friendly fire will diminish considerably, if not vanish. In most cases, the inability to identify a friend from foe, grossly inadequate reaction time and the fear of being attacked are factors that lead to fratricide. The surveillance and intelligence elements of force multipliers normally give adequate reaction time to identify and follow the procedures. Steady radar pick up, ability to handle a large number of tracks and maintain an identified air picture will improve the quality of air space management over TBA.

**Coordination between the army and air force will improve with better situational awareness.**

**FORCE MULTIPLIERS AND FORCE STRUCTURE**

It is widely believed that induction of force multipliers and automation of air defence operations would help reduce manpower. With an increasing number of computers and networking, databases and automation, manpower reduction may sound very logical, but the experience in the recent past has indicated otherwise. Specifically with regard to the air defence system, one could cite two examples, the first being the automated display of the air picture – a typical manual air defence organisation would require observers and plotters to display the air picture an plotting boards, and in a semi-automated environment, an observer and a feeder are still required to feed the information into computers to display and update the air picture. Similarly, on a mobile observation post, we would still require two personnel to observe and feed the observation data on the communication

**Induction of force multipliers and modernisation of the air defence infrastructure will demand considerable emphasis on the quality of manpower required.**

network although the display at the far end may be automated. With computerisation and automation more and more specialised, trained personnel will be required to maintain the expected standards of efficiency. Therefore, the existing standards of automation and networking have not resulted in the expected reduction in manpower.

On similar lines, any expectations of instant reduction of manpower with the induction of force multipliers may not stand the test of time. However, once we achieve the levels of total integration on a net-centric platform and all three Services achieve the same levels of automation in their operations, it may be possible to reduce manpower by 15-20 per cent, but that may take another decade and a half. Hence, the major alterations in force structure may still seem distant but there are other more important issues pertaining to recruitment of quality manpower, specialised training and, most importantly, bringing in the attitudinal changes and awareness by educating the leadership at all levels on the impact of force multipliers, their performance capabilities and limitations, and how they will impinge upon the requirement of manpower.

**Any expectations of instant reduction of manpower with the induction of force multipliers may not stand the test of time.**

## MANPOWER AND ORGANISATIONAL ASPECTS

Air Vice Marshal Kapil Kak has very aptly brought out, "Meeting the challenge of RMA may demand substantial changes in doctrines, organisations, maintenance philosophies and, most of all, attitudes."[23] To develop a coherent and integrated operational philosophy for optimal exploitation of force multipliers in AD operations, there is a need for organisational restructuring, better command and control and utilisation of resources. Force multipliers are technology intensive; therefore, training on operations, exploitation and maintenance of the systems is an imperative. There are several examples where radars, data handling systems or even

23. Kak, n.5.

aircraft have not been fully exploited or have been underutilised due to lack of training or understanding. Operational exploitation of the systems would also mean attitudinal flexibility apart from inventive and ingenious ideas for exploitation of technology to generate asymmetry of forces. Along with intensive on the job training, the concept of operations and doctrinal changes will have to be made to adapt to the revolutionary changes.

Induction of force multipliers and transformation of the air defence infrastructure will demand considerable emphasis on the quality of manpower that is required to man, operate and exploit these systems. Advance technology platforms like AWACS, fifth generation fighters, etc will require technology-savvy manpower, with appropriate educational qualifications. This specialised manpower then would have to train on specific systems and, more importantly, be educated on the utilisation and operational exploitation of force multipliers in modern air warfare. Lessons from the Arab-Israel War in 1973, a study of the air wars in Bekaa Valley, Falkland Islands, Gulf War, Kosovo Campaign, Iraq War and the war in Lebanon in 2006 give a very good idea of how force multipliers have impacted the outcome of wars, where they can be used successfully to swiftly attain military objectives, as well as in other areas where technological superiority has not helped achieve the desired results. For example, post-war stability and peaceful transfer of power in Iraq and the failure of the Israeli Air Force to achieve operational objectives in the Lebanon War of 2006. The leadership at all levels will need to understand the implications of force multipliers and their effect on war-fighting capabilities and the required changes in doctrine.

The problem of recruiting the right quality manpower is mired in complications. Economic growth and rapid changes in social values have altered many parameters affecting the quality of manpower for the defence forces.[24] In last three-four years, the IAF has experienced the problem of retaining the skilled and trained manpower, losing them to more lucrative offers by private and public sector enterprises. Money, stability of residence,

24. Air Commodore Jasjit Singh, *India's Defence Spending*, Second Edition (New Delhi: Knowledge World in association with IDSA, 2001), p. 103.

children's education and family commitments have been the main reasons. Former Chief of the Air Staff, Air Chief Marshal S. P. Tyagi (in a talk at DRDO Bhavan on March 16, 2007), spoke of retaining the trained manpower as the biggest challenge for the aerospace leadership. While it is true that the increasing cost of manpower, pay and allowances and the burden of pensions will remain a nagging issue, at the same time, the requirement of technology-savvy, information technology-oriented manpower is imperative for a modernised air defence force. If anything, the changing socio-economic scenario will only increase the burden of pay and allowances for the armed forces to remain competitive in the order of priority of jobs. Some of the possibilities that may be considered to ease the pressures of retaining and recruiting the potential manpower are as follows:

(a) **Civil-Military Interface.** Consequent to economic development and growth of the defence industry in the civil sector, it may be a viable idea to use civilian employees of the private and public sectors in the high-tech environment, especially in maintenance activities. However, the pros and cons are to be weighed in the context of quality of services provided, financial implications and security issues, etc.

(b) **Review the Term of Service.** The major aspect of the manpower problem in the armed forces is the opportunities of growth in terms of promotions, pay packages, early retirement and rehabilitation post-retirement. The term of service needs to be reviewed to meet this challenge. A shorter term of seven to eight years, followed by five years of reserve liability, may serve the purpose of the armed forces and the aspirations of the youth. At the end of this 12-year commitment, instead of a life-time pension, personnel may be extended nominal facilities like membership of messes, canteens and medical facilities up to a certain period or age.

(c) **Educational Qualifications**. In a high-tech environment, general education is not good enough; we need specialists in specific areas. If engineers are required for maintenance, servicing and overhauling, even operators need to have a technical bent of mind to understand, study and exploit the systems to

maximise their potential. As in the civil enterprise, there are MBAs in every stream of corporate functioning. We also need to induct specially trained personnel with appropriate backgrounds in air traffic control (ATC), fighter controlling, logistics and accounts. For example, a maths and physics background may help a fighter controller or a radar operator to understand the technological aspects of radar, communication and aircraft.

(d) **Information Technology Orientation.** The entire process of modernisation of the armed forces revolves around automation, transparency of information, reducing paper work, more efficient data handling and time management. Thus, all spheres of activities are being computerised, and networking and integration of systems has become inevitable. In the last decade, the IAF has made significant progress in spreading awareness and education on information technology (IT) equipment, networking and communication processes. However, very few air warriors carry the enormous burden of making the IAF IT-savvy. Although progress is being made, inclusion of IT courses and diplomas in educational qualifications for all personnel will accelerate the process and meet the future requirements.

(e) **Role of Simulators**. Irrespective of how they are used and whom they actually fight, the armed forces of a nation are established to fight full-fledged conventional war against a known and identified enemy. Such full scale conventional wars are becoming rare in the changing politico-economic scenario. In the absence of conventional wars, and with rising costs, simulators will play a very important role in the training of personnel. Simulation of real-time war scenarios and generating specific conditions to meet the expected threat scenarios will help prepare the forces for actual operations while keeping the costs under control. While one may argue that simulators never give the realistic feeling of operations and more often than not, simulated scenarios are generated to suit own perceptions of threat and weapon systems, war-gaming simulators can, however, help appreciate many aspects of air warfare that will not be realised otherwise.

In an important announcement, Chief of the Air Staff, Air Chief Marshal F. H.

Major has said that the IAF will concentrate on human resource issues.[25] All aspects of manpower management recruitment, training, follow-up training, retention and retrenchment need to be comprehensively reviewed to maintain competent, professional force levels in all streams of the IAF. Gone are the days of recruiting personnel with basic graduation/post-graduation degrees, retaining them for 20 years and retiring them just when they are transiting through mid-life crises. The focus should be on getting the right quality of manpower, with relevant educational qualifications, and educating the lower and middle level leadership on the significance of transformation brought in by force multipliers and the way they will impact the future of air wars.

## CONCLUSION

The force multipliers are not replacing the conventional ground-based air defence systems; rather, these assets will provide a more synergistic, efficient and responsive air defence network. While operating inland, these assets will provide a redundancy to existing ground-based systems and while operating beyond our territorial boundaries, force multipliers will provide added capability to the IAF, which hitherto was not available – to carry their AD assets along with them for out-of-country contingencies.

**Developments in the fields of information, communication and networking have transformed aerospace power into an inherently expansive force multiplier to the military power of the nation.**

The impact of force multipliers on air defence operations cannot be quantified in terms of the number of VAs/VPs defended or the percentage of attrition imposed on hostile forces. The impact of force multipliers is more apparent on AD operations because of enhanced survivability and offensive potential. "The developments in the fields of information, communication and networking have transformed aerospace power into an

25. By Special Correspondent, "LTTE Air Strike an Irritant, not Threat," *The Asian Age*, April 10, 2007, at http://203.197.197.71/presentation/leftnavigation/news/india.

inherently expansive force multiplier to the military power of the nation."[26] On similar lines, acquisition of AWACS, aerostats, and UAVs will tremendously boost the ISR capability, AR will multiply the reach and flexibility, precision weapons are more destructive with economy of effort, and net-centric operations will harness the potential of all force multipliers into one platform. Effective air defence involves integration of sensors, weapon systems, communications, electronic warfare and real-time transfer of data and technology. The combined potential of all the force multipliers could be enumerated as:

- Greater line of sight; extensive early warning.
- Enduring observation window; 24x7 SIGINT operations.
- High situational awareness and self-synchronisation.
- Smaller OODA loop.
- Reduced sensor-to-shooter cycle.
- Enhanced reach and flexibility.
- Higher survivability.
- Redundancy for conventional control and reporting organisation.
- Concentration of firepower, with precision and economy of effort.
- Capability to inflict greater attrition on the adversary's air power.

Now, the following questions may arise: are these capabilities exclusive to AD operations alone? Will defensive operations with force multipliers lead to air dominance? The answer is "NO". However, the point being driven home is that the offensive elements of AD can now create a situation which will help achieve air dominance. There is a much larger role for air defence in supporting offensive operations. The AD aircraft can be positioned beyond our borders and territorial waters, and need not be reactive; SAMs can engage hostile aircraft before they cross over. The other air operations, including offensive air operations, which were earlier conducted without or with negligible support of AD systems, now have a larger stake in the success of the expanding role of air defence elements. The impact of all these capabilities will be seen in the prosecution of an air war and the role of air defence in achieving the objectives of the air war. Nonetheless, the most important aspect is that the role of force multipliers in AD operations is definitely

26. Matheswaran, n.4, p. 233.

changing the defensive and reactive image of air defence. At least in the Indian context, increasing use of force multipliers, space-based capabilities, and multi-role fighters in all type air operations, in the long-term, will remove the defining lines of offensive, defensive, tactical and strategic operations, and integrated on a net-centric platform, all missions will just have one task – "air operations".