

CENTRE FOR ADVANCED STRATEGIC STUDIES

The Centre for Advanced Strategic Studies (CASS), Pune was registered on 21st September, 1992 under the Society's Registration Act, 1860, and as a Charitable Public Trust on 28th October, 1992, under the Bombay Charitable Public Trust Act of 1950. The Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India have accorded recognition to CASS as a Scientific and Industrial Research Institution. The Centre has been granted IT exemption U/S.80G and U/S 10(23C) iv vide Government of India notification No. 80/2007 which is now in perpetuity. Section 80G gives fifty percent exemption to the donors.

The Centre aims at undertaking research and analysis of subjects relating to national and international security and development through seminars, discussions, publications at periodical intervals and close interaction with the faculty members and research students in allied disciplines in the Universities/Institutions and the Armed Forces. It expects to award research fellowships as soon as its corpus builds up and makes it possible. It aims to generate and promote interest among the academicians and public in these subjects with a view to making them alive to national security concerns. It has received very valuable support from the University of Pune in all its activities, specially from the Department of Defence and Strategic Studies. It has an Memorandum of Understanding (MOU) with Yashwantrao Chavan Academy of Development Administration (YASHADA) enabling mutual collaboration for making available their infrastructure, publications and teaching and research activities. The Centre has held a number of seminars, panel and group discussions.

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AIR MARSHAL YV MALSE MEMORIAL LECTURE

BY

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EMPLOYMENT OF AEROSPACE POWER IN
FUTURE WAR

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CENTRE FOR ADVANCED STRATEGIC STUDIES

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WELCOME BY DIRECTOR

AIR MARSHAL S. KULKARNI

Air Marshal S. Kulkarni welcomed everyone present for the Air Marshal YV Malse Memorial Lecture : 2010. He said that late Air Marshal Malse was the founder of the Centre for Advanced Strategic Studies. With his perseverance and dynamism he succeeded in getting together industrial stalwarts, late Shri Shantanurao Kirloskar and late Shri Navalmal Firodia, late Shri PVR Rao, former Secretary of Defence, Admiral (Retd) JG Nadkarni, former Chief of the Naval Staff, late Shri RD Sathe, IFS, former Foreign Secretary, Shri Sharad Marathe, IAS, former Industries Secretary, Government of India, late Professor VG Bhide, former Vice Chancellor, University of Pune and formed the National Security Forum. He saw the relevance of the Forum and the need to establish a “Think Tank” away from Delhi, deliberating and discussing National Security issues. Within a short time, through his tireless efforts the National Security Forum was transformed into the Centre for Advanced Strategic Studies in October, 1992. He persuaded late Shri PVR Rao, former Defence Secretary to take over as the President and Admiral JG Nadkarni, former Chief of the Naval Staff to take over as the Director of the Centre.

Air Marshal YV Malse passed away in 2006. Since then the Centre has organized six memorial seminars/lectures. The first one was on “Aerospace Power in a Changing National Security Environment ” on 28th July, 2007, the Second on “India's Strategic Environment and Its Implications for Military Modernisation” on 08th July, 2008, the third on “Military Force Application in the Contemporary Context” on 10th July, 2009, the fourth on “Essentials of An Aerospace Power : Indian Context” on 09th July, 2010, the fifth on “DRDO : The Challenges Ahead” on 22nd October, 2011, and the sixth on “The Future of Aerospace Power” on 29th June, 2012.

AIR MARSHAL YV MALSE MEMORIAL LECTURE

AIR MARSHAL SS SOMAN, AVSM, VM
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EMPLOYMENT OF AEROSPACE POWER
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Introduction 03 February 1942, is significant for the IAF, as on that day during the Second World War, the legendary Jumbo Majumdar, Commanding No. 1 Sqn, fitted two 250 pound bombs onto his Lysander aircraft and successfully attacked Mae-Haungsuan, a Japanese airfield in Thailand. Not only was this the first time that the Lysander was employed in the strike role but it was also the first Counter Air sortie for the IAF, or what is termed as Offensive Counter Air in today's parlance. The next day the Squadron launched six aircraft to repeat the attack. It required innovation and courage to undertake such a mission on an aircraft built for observation duties with no gun-sight and restricted to a max speed of 100 miles per hour. The pioneers of No. 1 Sqn RIAF had both; and one of the formation members was Pilot Officer Yeshwant Malse. He would continue to display these qualities, while serving in many important positions both during his service career and post-retirement; notable amongst which, were Commanding Officer 12 Squadron, Air Officer Administration, Air Officer Maintenance during the 1971 war, AOC-in-C EAC, and Deputy Chief of Air Staff. On retiring Air Marshal Malse once again displayed the very same qualities of vision and innovation when he was appointed as the first Chairman of the Airport Authority of India; and later in 1992, when he established the Centre for Advanced Strategic Studies (CASS) at Pune. Before I proceed any further, I would like to convey, my thanks to the Director of CASS for inviting me to give the Air Mshl Malse memorial talk for this year.

The Centre for Advanced Strategic Studies provides an ideal platform for my talk today and I do hope that my talk will provide an insight into the nuances of *employment of aerospace power in the*

future. In order to establish a common understanding, my definition of aerospace power is “the *total ability of a nation to assert its will through the medium of air and space.*” It includes existing as well as future assets, infrastructure, and industry of the aviation and space sectors; both civil and military. Due to constraints of time, I will limit the scope of my talk to land centric conventional conflicts.

To perceive how aerospace power might be effectively employed in future wars, it is first necessary to put into perspective, how the advent of aerospace power shaped the prosecution and outcomes of the conflicts in the past. History reveals that there has been a cyclic evolution of the methods of waging war. Each side tries to create an advantage to exploit, while the other side counters the advantage, either by using better technology or tactics. Essentially both sides aim at exploiting an asymmetry that enables a favorable time compression relative to the adversary. The introduction of air power however perceptibly altered this cyclic evolution; for it enabled vertical envelopment and thus offered a potential for offensive-action; an asymmetry that was initially not only difficult to counter but also to comprehend. Nations that could stay abreast of advances in technology, and more importantly those that could afford and adapt to its requirements, were able to employ air power offensively and create the required asymmetry. On the contrary, nations that could neither afford the high costs or those that chose to ignore the advantages of such asymmetric capability did so at their own peril. The message was clear, air power was there to stay, as it provided an asymmetric capability; that, of a perennial winning strategy founded on the cardinal principles of war namely surprise, offensive action, and concentration of force.

Broadly, the use of aerospace power during various conflicts of the past can be clubbed into three main categories. First, the use of air power before the advent of modern technology. Second, the use of aerospace power in wars, where advances in modern technology were mainly exploited by one side; and finally, the role of aerospace power in a scenario where parity more or less exists, both in terms of force-ratios and access to modern technology. Let us examine how the employment of air power achieved asymmetries in each category.

Employment of Air Power in its Early Days

The first category in the history of employment of air power encompasses the period from the early years to Op Desert Storm. With the exception of the Bekka Valley operation in 1982, technology did not significantly contribute to the effectiveness of aerospace power in conflicts it was employed. In this era, the full potential to exploit the dimension of time was still developing, thus asymmetry was mainly achieved through individual skill and courage, tactical surprises and new philosophies. While air power's successes in the strategic role may be a topic for debate, enough evidence exists to support its asymmetric influence on the operational and the tactical outcome of various battles. In the air, the Battle of Britain stands out as a classic case of how air power was used differently by both sides. Faced by a numerically superior Luftwaffe, the Royal Air Force, chose to create an asymmetry by the innovative use of its Chain Home radars which were integrated with an effective command and control system. The integration enabled the squadrons of Fighter Command to conserve their combat potential by getting air borne only when the Luftwaffe raids materialised. Thereafter they were vectored onto the German aircraft and could attack them repeatedly both during the ingress and egress. These factors enabled the RAF to stay air borne for longer durations and follow a defence in depth strategy, thereby inflicting heavy losses on the Luftwaffe. This aspect of centralised command and de-centralised execution not only shaped the outcome of the war, but also provided a cardinal principle for employment of air power. Conversely, the Luftwaffe under the leadership of Goering did not follow this principle. The Commanders of the two German air-fleets; *Luftflotte 2 and 3*, that participated in the battle were left to plan and execute their operations independently; hence, the two air-fleets often undertook operations in isolation to one another. Thus, the asymmetric advantage due to numerical superiority that the Luftwaffe initially enjoyed was squandered. Thirty years later in Vietnam, the United States too would ignore the tenet of unity of command, when its Air Force, Army and Navy employed air power in that theatre without coordinating with each other.

Surface battles also benefitted by the asymmetry that air power provided. The tactical innovation by Hans Guderian to integrate the

Luftwaffe with German armour created an asymmetry through rapidity of manoeuvre, and ensured the success of the German Blitzkrieg. Creating a similar asymmetry later, the Russian army offensive in coordination with its Air Force would push the Germans all the way back to Berlin. In the months preceding D-Day, Eisenhower directed the Combined Bomber Offensive to target the German Army's transportation network in France. The significant disruption of the transportation system delayed the employment of the German Army reserves, to counter the D-Day invasion. This created a setback which contributed to the success of the invasion. The attack on Pearl Harbour on 07 Dec 1941, is another example of how air power could rapidly create an asymmetry to dominate a surface force. Other examples of how air power directly affected the outcome of surface battles are the sinking of the Bismark and Tirpitz. Air power would later, also demonstrate the ability to *decisively* shape the outcome of surface battles, when the surface combatants were not in direct contact with each other. Examples are the battles of Midway and the Coral Sea.

Moving forward, this era also highlighted some limitations attributable to aircraft technology, which restricted reach, firepower and weapon accuracy. As a result, to generate an asymmetry there was a tendency to employ air power assets *en-mass*. That is more aircraft per wave in order to increase both, the probability of destroying the target, as well as to enhance self protection by saturating enemy defences. To counter this asymmetry, air forces started maintaining near parity in technical capability and numerical ratios. The Indo-Pak and Arab-Israeli wars highlight this lesson. In both cases, while force parity negated the numerical asymmetry, it also resulted in the resort to pre-emptive strikes to create the necessary asymmetry. The opening hours of the six day Arab-Israeli war, would demonstrate to the world, the advantage of pre-emptive attacks, thereby exploiting surprise, to create an asymmetry against opponents equal in capability and numerical strength.

Closer home, the IAF too would create both strategic and tactical asymmetries in various operations, significant among these were the 1947 Srinagar airlift, the attack on the Governor's residence at Dhaka,

the Battle of Longewala and Op Cactus.

Employment of Aerospace Power in the Contemporary Era

The second category in the history of employment of air power was dominated by improved technology, which exponentially enhanced the effectiveness of air power. The era coincides with the break-up of the Soviet Union, and the end of the Cold War. Technological advancements in the aviation and space sectors during the Cold War created significant overlaps in the effectiveness of Early Warning, C4ISR, and Air Navigation. As these similarities significantly enhanced air power's primary functions of Air Defence, ISR and offensive strikes, exploitation of space to enhance the effectiveness of air power became necessary. Air power very soon transitioned to an aerospace power. While this era is characterised by employment of aerospace power by only one side, the asymmetry created was large. Nations that had depended on the Soviet bloc for military hardware, now had to deal with issues related to the reduction in spares support, which impacted their combat potential. Also, the United States as the new unipolar power got embroiled in numerous conflicts.

Space based applications, their spin off technologies and other advances in the aviation industry set the stage for asymmetric application of aerospace power in conflicts since Desert Storm. The asymmetry I refer to is both in terms of the overwhelming effect of technology that permitted the delivery of precise firepower, and the employment of aerospace combat power in the absence of enemy air.

Advancements in technology enhanced the efficacy of the tactical air campaign. While, in World War-II, it took waves of bombers to attack a target system, technological advancements since Desert Storm permitted a single aircraft to attack multiple systems, and in near real time. This tactical capability provided greater operational flexibility and freedom to the Air Commander, as fewer aircraft were required for each mission, when compared to the previous era. In turn it enabled the same number of aircraft to undertake additional missions or to maintain a 24/7 capability, as more aircraft were available for a given task.

However, we need to be careful when we draw our lessons regarding the employment of aerospace power in contemporary times, as these could adversely affect future operations for two reasons. First, the absence of air opposition could result in incorrect inferences that affect the conduct of the surface campaign. Since Desert Storm, US led coalition forces have enjoyed the luxury of employing their ground forces only after the coalition air forces had established air dominance. Thus, not only did the surface forces commence operations when total control of the air had been obtained; they also undertook them under the assured support of friendly air power. Control of the air also gave the air force the freedom to concentrate on CSFO tasks. The point that I am trying to highlight is that, the last few conflicts have seen technologically superior Air Forces undertake missions against adversaries who did not have a credible air opposition. This gave the Joint Forces Air Component Commander (JFACC) the freedom to plan air-operations without the need to worry about enemy air. He could thus distribute air assets to undertake both the counter air and counter surface campaigns with an assured probability of success.. Also, aerospace power had adequately shaped the battle field prior to the application of surface forces. In either case, aerospace power generated an asymmetry which assisted the Land Forces Component Commanders (LFCCs) in expeditious achievement of their objectives. To highlight the degree of asymmetry, during Operation Iraqi Freedom in 2003, coalition air forces flew more than 41,000 sorties in the first six weeks, after which air supremacy was declared over Iraq. The effective air campaign facilitated an overwhelming ground victory within 21 days. These mission statistics do not account for the near air domination that the coalition had maintained since 1991 by enforcing *No Fly Zones*. Similarly in Libya, during Operation Unified Protector, the coalition air forces flew over 26,500 sorties, which included 9000 ground attack missions. These sorties prevented the Libyan Army from conducting effective operations against the rebel forces; as every time they massed to conduct operations, they would present a better target for the coalition air forces. This asymmetric application of air power, in the absence of enemy air, shaped the battle field for the ground forces to exploit. While in Iraq the ground forces could claim success in a short surface campaign; in Libya it

enabled a rebel force to overthrow a conventional army and facilitated a regime change. Contrast this with the presence of credible air opposition; not only would this quantum of air support reduce in the initial phases, as more air-effort would be required to contest for the control of the air. It would also be prudent to expect the adversary air force to interfere with own land operations; either case necessitates the factoring of these aspects while planning a surface campaign.

The second lesson regarding the employment of aerospace power during this era is that the absence of air opposition could also result in incorrect inferences, that adversely affect the development and induction of combat platforms of an air force. In turn, this impacts the planning and conduct of future air campaigns. Two examples, though almost seventy years old, help amplify this aspect. Both the Japanese Naval Air Arm and the Luftwaffe were involved in air operations prior to the commencement of the Second World War. The Japanese commenced operations in North-East China from 1937 and met little or no air opposition until the United States joined the war. The Luftwaffe perforce had to participate under the garb of the Condor Legion from 1936 to 1939 in Spain (due to the restrictions of the treaty of Versailles that prohibited Germany from maintaining an Air Force). During these operations neither faced any credible air opposition. The lack of air opposition resulted in minimal losses of their bombers. As attrition due to air defence was low, they could revisit targets and drop the desired tonnage in multiple waves. As a result, they did not feel the need to develop a bomber with adequate guns for its self protection nor one that could carry more bombs. Further, the absence of enemy air attacks did not necessitate the development of an armed interceptor aircraft to shoot down enemy bombers. The net result of these experiences was that at the beginning of the Second World War, both were structured as tactical air forces; with the primary function of the Japanese Naval Air Arm to support the Imperial Navy; and that of the Luftwaffe to support the German Army. As a result, the Japanese did not induct any new aircraft during the Second World War. The lack of fire power, manoeuvrability and weight of attack would later prove disastrous for the Japanese. On the other hand, their opposing American forces continued to produce and

field new aircraft designs (virtually; one on the drawing board, one under testing & production; and one engaged in operations) throughout the war, thus creating and maintaining an asymmetric edge.

In Europe, as the distances involved in Spain were small, the Germans were led to believe that they did not need to develop a fighter or bomber aircraft with larger ranges. Thus, at the commencement of the Second World War, while the tactics and training of the Luftwaffe were superior to the other European air forces, it lacked both a long-range heavy-bomber and a armed interceptor. As a result, though the Luftwaffe performed admirably during the German Blitzkrieg campaign, the performance of its aircraft during the Battle of Britain was restricted by fuel capacity, compromising tactical routing, loiter time over target, and weight of attack. This necessitated large formations to carry out attack of RAF airfields, thus making it easier for the RAF to engage them. While Germany would attempt to rectify this operational shortfall by being the only nation to employ a jet aircraft operationally, the delay in the decision to produce the same (Messerschmit-262) did not overcome the asymmetric disadvantage and the outcome of the war. Both cases highlight the adverse results, when experiences of previous campaigns are applied without proper context. In retrospect, neither nation was able to gain control of the air. Outcomes of conflicts where air power was employed, indicates that a certain degree of control of the air is a prerequisite for all other operations to succeed. Gaining control of the air necessitates the availability of platforms that are not only capable, but also available in sufficient quantities. An absence of significant air opposition in a given scenario therefore does not justify abandoning either the quality or the quantity of platforms, which are necessary to achieve control of the Air. Quite the contrary, such calculus ought to be determined by careful assessment of future threats, the effects required to achieve national objectives, as well as the volume of airspace that needs to be controlled.

Overall, technology in general and the utility of space based assets in particular, significantly enhanced combat potential of aerospace power during this period, creating an asymmetry that was hard to

overcome. Though conceptually not new, parallel operations and effect based operations were proven. The significant absence of enemy air, however, necessitates that when we examine the employment of aerospace power in future wars, lessons must be transferred in context.

Employment of Aerospace Power in Future Wars

Aerospace power has transitioned through two distinct phases, each with pertinent lessons. In the first phase, access to technology though rudimentary, was similar to both sides. Asymmetry was therefore created by tactical surprise, while numerical parity provided a feasible counter strategy. Near parity in technology and strength led to the use of a pre-emptive strategy. The second phase, however, demonstrated that an asymmetry created by technology was more effective than those created by tactical surprises. It also highlighted the crucial role of aerospace power in shaping the battlefield to facilitate the task of surface forces.

In the future, wars are likely to be undertaken by adversaries with similar parity, both in numbers and in technological capability. In this scenario, the availability of combat assets with cutting edge technologies will have a greater role in creating asymmetries. Future wars would therefore entail an amalgamation of the lessons of both phases. To advantageously exploit the opportunities and address the challenges of future wars, it is important to avoid mistakes of the past and understand the requirements of the future.

Nature of Future Wars.

Future wars are likely to be of a short duration because of a number of reasons. Such short duration wars would therefore be of high tempo, as it would be necessary to maximise one's gains before termination of the conflict. Also, given the preponderance of battlefield sensors it would be difficult to conceal the build-up of a large scale pre-emptive attacks.

It is pertinent to note that in a war between two major adversaries, the nuclear dimension would also have a limiting influence on the scope of the conflict. In addition, the employment of SSMs would

further pose challenges for aerospace defence. We thus find that future wars are likely to be governed by limited-objectives, the key characteristics would therefore be high-tempo, short-duration, and thus sensitive to the element of time. To create an asymmetry in such conditions, it is reasonable to expect that we would need to undertake time-critical and non-linear operations that rely heavily on information dominance.

Role of Aerospace Power in Future Wars.

The nature of future wars highlight that the battlefield of the future is expanding, while the dimension of time is being compressed. As the element of time appears to be the most restrictive factor when contemplating the nature of future wars, there is a need to have a credible information-decision-action cycle. Time compression as a theory is not new, and has always been associated with asymmetry. Sun Tzu provides theoretical evidence that supports the viewpoint that temporal imbalance of the opponent strengthens ones position during warfare. His theory delves both on attack and defence, and a recurring theme is, the element of surprise which supports the control of time as a means to create an asymmetry. Arguably, it is the Observe Orient Decide and Act or OODA loop theory of John Boyd that deals comprehensively with the element of time control. He postulates that one's decision cycles need to become faster, relative to the adversary. Boyd's theory also makes the important link of exploiting temporal imbalance by meaningful action. This is significant, as in future wars such meaningful action would best be undertaken by organic elements of aerospace power. This is not to imply that aerospace power can go it alone, but merely to emphasize that aerospace power is well suited to achieve time compression, by virtue of its inherent characteristics of speed, responsiveness, flexibility, mobility, reach and offensive action.

The demand of non-linear operations in future wars, necessitates that it is important to understand the coercive role that each service brings to the fight. As per Robert Pape, an eminent aerospace theorist; the coercive capability of an air force is best suited for non-linear operations. Thus the employment of aerospace power gives the national leadership a wider range of options to choose from,

permitting a *calibrated, restrained and responsible use of force at the time and place of our choosing*. As aerospace power is well suited to facilitate both, time compression as well as non-linear operations, the employment of aerospace power in future wars would therefore prove decisive.

Contribution of Aerospace Power to the Effectiveness of the Surface Campaign.

Future wars shall not permit us the liberty of executing a long drawn surface campaign and there will be a need to exploit quick gains. Therefore, once a degree of control of the air has been established it needs to be simultaneously exploited by the surface forces. This calls for *synergy* between the three services. It is imperative that the three services remain integrated and formulate common objectives.

What this entails is that the air strategy must be formulated in consonance with the other services, and such integration must commence from the planning stages. Neither service can afford to make independent plans and then expect the other services to support that plan. Not only would this be suboptimal but also lead to an ineffective application of military power. Such *synergy* would also permit a switch between the supporting and supported functions of each service and hence the air and the surface campaign plans would complement each other. Within these plans, aerospace power would undertake its roles and missions to gain control of the air and create asymmetries that the surface forces could exploit. Missions flown towards control of the air would not only be undertaken in parallel with CSFO missions, but would also permit enhanced exploitation of asymmetries by the surface forces, due to non-interference by the adversary air forces.

Having seen pertinent lessons from the past and the likely requirements of the future, one can move forward to addressing the requirements of building a capability that would create and exploit the symmetry in the future. As technological, more than tactical surprise shall hold the key to achieving asymmetry, it should be no surprise that building such capability would mainly be based on technology. Building a force dependent on technology is however not without its

associated problems. As per Moore's law, the processing speed and the memory capacity of computer chips shall double approximately every two years. In contrast, the minimum time to induct a system is 5 years, indicating that new systems are likely to be redundant before they are operationalised. These factors necessitate the requirement to constantly upgrade and retain our technological edge. Our capability, however also accrues from systems and platforms, whose functionality is dependent on infrastructure. Thus, there is a need to view this transformation holistically. Needless to say, the IAF is already well underway on this path and key facets of this transformation are as follows.

Modernisation of the IAF.

Force Multipliers. We are inducting Force Multipliers, which, as the name suggests, are assets that shall be the key to producing the asymmetric advantage in our future wars. We have already completed the process of integrating these assets into our operations. The acquisition of AWACS, Mid-air refuellers, Special Ops capable C-130J, Aerostats, and spaced based assets all fall under this category.

War Enablers. These force multipliers would be complemented by War enablers such as Precision Guided Munitions, Electronic Warfare assets, and Remotely Piloted Aircraft.

Robust AD in the Future. Preservation of our war waging assets is important, and the IAF has been vested with the responsibility of air defence of the nation. Our Air Defence systems are being made more robust with the planned induction of modern AD sensors and a range of Surface to Air Ground Weapon systems. Army Air Defence is an important component of Air Defence of the TBA. The Air Defence systems of the Army in the TBA are being integrated with the Air Force networks to facilitate effective air defence of this battle space. I am confident that once this integration is complete, the enhanced Air Defence environment in the TBA would give our surface forces the freedom to conduct the surface campaign, without any major interference from enemy air forces.

Network Enabled Operations. High-tempo operations of

future wars would depend on network enabled operations. Network enabled warfare is dependent on the Information grid, within which reside the sensor and shooter grid. Information dominance therefore assumes importance. As space is being increasingly utilised as a medium to enable information dominance, the IAF is integrating its terrestrial, airborne and space based communication nodes on a fast track. This would form the backbone of our information grid, with adequate built-in redundancies.

As regards the sensor grid, more effective surveillance systems are being fielded and amalgamated into our integrated command and control system. Secure communication and data connectivity would transform the already significant capability we possess, into an effective combat capability. This would compress timelines and permit us to carry out time sensitive targeting and thereby create asymmetries when fleeting opportunities present themselves.

As regards the shooter grid, we are in the process of replacing existing legacy systems, upgrading (existing systems and platforms) and inducting state of the art equipment. Multi-role aircraft with extended range and endurance would enable exploitation of the swing role. Long range Precision Weapons would enhance asymmetric capability due to large stand-off ranges and better accuracy. Hence, our focus is on capability building of the IAF to meet likely security challenges of the future. The operational capability of our contemporary fleets (Su-30 MKI, MiG-29, Mirage-2000, and Jaguar) is being enhanced through appropriate upgrades. This capability will be further enhanced by the acquisition of future inductions viz., MMRCA, FGFA, C-17, Chinook and Apache. With technologically upgraded platforms it is also necessary to have adequate numbers. The lessons of the first phase clearly highlight the need to achieve numerical parity when faced with adversaries equal in capability. The IAF is therefore rebuilding the strength of its fighter squadrons to the thirty nine and a half squadrons that have already been approved. The IAF is well on track in this phase of its transformation.

Far from the problems of the Second World War, where Commanders had to deal with the fog and friction of war, today's Commanders have to deal with vast volumes of information and their problem is prioritising between what is actionable and what is irrelevant. The plethora of sensors that are available to provide information, make it important to protect our own information while denying the adversary the ability to control his information domain. This creates an opportunity that could be exploited; thus, misinformation needs to form a part of our capability to gain asymmetric advantage. Psyops, information control, its denial and deception shall therefore also form part of our Network Centric Warfare requirements of the future.

Air Campaign Control and Battle Management Systems.

To ensure optimum and effective utilization of all these assets, the IAF has inducted Air Campaign Control and Battle Management Systems, which additionally provide awareness to Commanders both, in the field and at critical nodes. The availability of these systems permit a faster information-decision-action cycle, which in turn enables significant time compression; the key to achieving asymmetry.

Infrastructure Development. Successful combat operations of an air force also depend on the operational environment, and we are in the process of upgrading our infrastructure. Concerted efforts are being made to enhance the availability of operating surfaces, hardened shelters, weapon storage areas, additional fuel tankages and modernisation of airfield infrastructure. These infrastructure programmes would complement our operational capabilities.

Base and Cyber Security. All our assets and critical information also need to be protected, both in peace and during war. The internal environment in our country is not benign and hence base and cyber security assumes importance. While bases form the hard part of supporting infrastructure; information related to various systems, and operational data comprise the soft part. Both parts are equally vulnerable to attacks, and the operational consequences are drastic if these vulnerabilities are compromised. The IAF is taking strong measures to enhance base and cyber security so that the full potential of our combat power would be applied when required.

Means to Create and Exploit Asymmetry in the Future.

Integrated Operations. One of the most important ways of achieving asymmetry is through *synergy* and integration of operations between the three services. We are increasingly taking part in more number of joint exercises to validate and further refine joint concepts. In the recently concluded Air Force exercise Live Wire, significant components of the Army and Navy were involved. In addition the meetings between the Army and Air Commands have now been institutionalised. The procurement process of platforms, weapons and assets between the three services is being streamlined to ensure commonality of equipment and operating procedures. While commonality of future equipment is good, it is also necessary to ensure interoperability of existing systems as this will ensure operational integration at the tactical level. The Defence Communication Network which is in the final stages of development is going to provide seamless communication and data connectivity between the three services. Such interoperability would enable an integrated and effective military response to future security threats.

Indigenisation. Indigenisation of our defence industry has an important role in building asymmetric capability. Historical evidence and contemporary international relations reveal that dependence on imported arms and equipment are impediments to strategic autonomy. If India is to be counted as a reckonable power, self reliance on a robust indigenous defence industry is essential. The IAF has benefited from HAL's indigenisation programmes; and we look forward to the early induction of the LCA. I would however, like to include a caveat that there are times when capabilities need to be procured to address immediate threats. The defence of our nation can not be compromised to suit the timeframes of delayed indigenous options; or undertaken in isolation, wherein they don't meet the service requirements. In such a scenario, there would be occasions when the criticality of timely import of advanced technological platforms would assume significance. Moreover, if such measures are not resorted to, then the indigenous options may only replace the platforms that are being phased out, without any capability accretion; and might present a serious operational setback.

Tactics and Training. It is also important to train realistically, as this helps simulate future scenarios and guides our capability building process. In this regard, Exercise Iron Fist conducted in Feb 2013 was a test of targeting. In three hours, a number of aircraft carried out a live operational fire-power display by day and night. Iron Fist tested not only the campaign planning and execution tools, but also combat units in their assigned roles. This was soon followed by Exercise Live Wire, a pan Air Force exercise that tested the IAF in its entirety, to include battle control and management systems, the information-decision-action cycle and all our combat support services. While Iron Fist was a test of capability to undertake accurate weapon delivery in a high-tempo scenario, Live Wire was a test of (*capacity* and *endurance*) to sustain high tempo operations.

Human Resource Development. However, it must be remembered that all this capability needs to be matched by the capability of our greatest asset the human resource. The IAF has given it due importance in its mission statement, "*People first, Mission always.*" The history of conflict shows that while technology and platform capability have their place, it is the human in the loop who shall best adapt to a changing situation and produce the desired asymmetry. In future wars, besides knowledge and professional skills, the ability to innovate and adapt will prove decisive in producing the asymmetric effect that we desire and it is this quality that we are trying to inculcate in our Air Warriors.

Developing Strategic Thought. Such development is not restricted to tactical employment for it also encompasses strategic thought. Changing times entail a change in strategy. To ensure that aerospace power produces decisive results in future wars, necessary timely investments would need to be made to maintain the technological edge. The development of air power assets and their employment must therefore be assessed in light of the significant strategic benefits that accrue and not just the higher cost that it entails.

A well resourced and state of the art aerospace power can

practically do anything that the National Leadership asks of it, provided the right questions are asked. How does political guidance affect the effectiveness of air power? Benjamin Lambeth, an air power theorist, states that “air power can never be more effective than the strategy it is intended to support.” Clausewitz goes further “Only if statesmen look to certain military moves and actions to produce effects that are foreign to their nature do political decisions influence operations for the worse.” The challenge therefore for Air Warriors would be to anticipate and cater to future wars, without forgetting the lessons of the past.

Conclusion

Recently, the IAF undertook Op Rahat, a disaster relief operation, in Uttarakhand which demonstrated to undertake a large scale air mobilisation in adverse terrain and weather conditions. Over 3,500 sorties were flown to evacuate 24,000 people and lift approximately 800 tonnes of relief material. Contrast this with the requirement of a mere 20 sorties to heli-lift an infantry company of approximately 150 troops. Capability building is a continuous process. Just last week a Super Hercules landed at Daulat Beg Oldie at an elevation of over 17,500 feet demonstrating a potent operational capability. Next week we *induct* the C-17 Globemaster, which would further enhance our strategic capability. These examples demonstrate that the IAF is well set on its path of transformation. The credit for this would certainly go to the vision and wisdom of our predecessors many of whom are present here. They have taken our Air Force to the level of preparedness that it has achieved today; both for operational and peace-time commitments. We acknowledge your contribution.

In addition, credit for driving this stage of our transformation must also go to the CAS who has been closely associated with this process. His guidance and steadfastness has kept the IAF focused on its path of modernisation. 71 years ago, our pioneers too, demonstrated similar qualities and these slowly evolved as traditions of Mission, Integrity and Excellence that have been passed down to successive generations within the IAF. It was precisely these strategic qualities that Air Mshl Malse exhibited when he founded and

directed the Centre for Advanced Strategic Studies. We have a lot to learn from him.

Ladies and Gentlemen, while my talk today has focused on the employment of aerospace power in future wars, I firmly believe that to respond effectively to future challenges, the most potent asymmetry that can be created is through the *synergised* and integrated operations of the three services. I am confident, that we shall respond to any challenge that the future holds for us, just like we have always done in the past. One Team, One Fight!

Jai Hind!

CHAIRMAN REMARKS

LT GEN (RETD) AMITAVA MUKHERJEE

INTRODUCTION

The scope and nature of warfare in the Indian context is circumscribed by several geopolitical and strategic factors such as global and geostrategic constraints, our political and economic limitations and the nuclearised sub-continental environment. Modern warfare in our context will be characterized by its short intense duration, high operational tempo, with blurred dividing lines between the tactical, operational and strategic levels of war. Integrated application of combat power with information superiority, precision strike and manoeuvre warfare will form key ingredients of future wars covering a wide spectrum, ranging from low intensity counter insurgency/counter terrorism operations, border conflicts and limited/full scale conventional war with a nuclear backdrop. Modern aerospace power, a prime component of integrated combat power, with its technological brilliance and unique operational capabilities, will play a vital role in this wide spectrum of future warfare.

UNIQUE ATTRIBUTES OF MODERN AEROSPACE POWER

The speaker has already comprehensively covered the evolution and maturation of aerospace power into a potent and versatile instrument of national as well as military power. Aerospace power with its inherent characteristics of speed, agility, swift responsiveness, rapid flexibility and adaptability, has transformed the application of integrated air/land combat power on the modern battle field. In the last two or three decades, the Information Age Revolution in Military Affairs [RMA] has made its maximum impact on aerospace power with the following unique operational capabilities:-

- All weather real time intelligence, surveillance, and reconnaissance [ISR] employing radar and electro-optic [EO] sensors, enabling unmatched transparency of the battle field.
- Accurate target acquisition/designation for precision strikes by

precision guided munitions [PGMs] from a variety of airborne platforms , both manned and unmanned.

- Information superiority, coupled with digital command , control and communication systems, integrating sensors, weapon systems and decision making centres , enabling Force Commanders to concentrate maneuver forces at the right time and place for decisive results.
- Rapid tactical and strategic mobility of forces, both intra theatre and inter theatre in response to fast changing battle field scenarios.
- Effective Special Forces operations by stealthy insertion, precision strike and rapid extraction.

CHALLENGES OF AEROSPACE POWER IN MODERN AIR LAND BATTLE

Integration of Aerospace Power at the Strategic Level. Despite the lessons of the Kargil Border War, the Kargil Review Committee, and the Naresh Chandra Committee, integrated strategic planning for future conflicts at the national and Service HQs level and theatre level, leaves much to be desired . The absence of Joint Operational Directives at the Service HQs as well as Army/Air/ Naval Command levels, is a serious lacuna which may result in sub-optimal employment of the technological brilliance of aerospace power. Similarly, the absence of Joint Force HQs at the Command and Corps level could hamper the effective prosecution of operational plans in the vital conduct phase of the war. This would get further aggravated by the displaced locations of Army/Air Force Command HQs and the daunting task of integrating aerospace power between an Air Command and multiple Army Commands/Corps. Illustratively, HQ Western Air Command is required to coordinate aerospace power with three Army Commands and eight Corps in various stages of defensive and offensive operations which would not be conducive to execute effective joint operations in any future war.

Integration of ISR Sensors and Command/Control Systems of the three Services into a Joint C4ISR Network. The present arrangement of linking the HQs of the Army/Air Force/Navy Commands is not sufficient to achieve information superiority and battle field transparency. Near real time situational awareness

which is vital for both air and land warriors, can be achieved only by networking air and surface based sensors of the Army, Air Force and the Navy into each other's Command and Control systems with high speed broad band digital communications. For example, the detection of a hostile low flying heli-borne force by the Air Force AWAC system, must be transmitted in real time to both Air Force and Army air defence weapon systems through the IACC/JADC network as well as to the Army's manoeuvre forces to effectively engage and defeat the enemy heli-borne forces.

Advent of the New Force Multiplier – Airborne Ground Surveillance System [AGS]. In the last two or three decades, the AWACS and the AGS, such as the US JSTAR, have emerged as potent force multipliers which has transformed the application of aerospace power in air defence and offensive air support operations and attaining information superiority, enabling the detection, tracking and engagement of hostile manoeuvre forces at long ranges with PGMs. This also enables the rapid redeployment of own manoeuvre forces to destroy the enemy force. The combination of these two platforms networked into the Air Force/Army's command and control systems, would enable the creation of a unique airborne air – land battle management system for decisive results in a short war scenario. The AGS with its combination of air borne Synthetic Aperture Radar[SAR] and Ground MTI Radar, is capable of all weather detection and tracking of moving targets at long ranges [depending on the height of the platform] and carrying out radar imagery, to identify the nature and size of the hostile force, for executing rapid reaction precision strikes. There is therefore an urgent requirement to induct AGS systems in the Air Force on a variety of platforms such as long endurance fixed wing aircraft and UAVs, in a coordinated manner, and integrate them into a comprehensive networked Joint C4ISR system, so that the application of own air-land integrated combat power can be well ahead of the enemy in the OODA cycle, for decisive results.

Modernisation and Transformation of Tactical Air Power. Our entire system of battle field offensive air support, including close air support, has remained more or less unchanged since the Second World War. To meet the operational imperative of delivering fast reaction precision air power in response to the rapidly changing battle field environment, there is an urgent requirement to

modernize and transform the existing structure of the Tactical Air Centre and the entire system of delivery of offensive air power. The entire FAC/GL team needs to be revamped by reviewing the scale of allotment, mobility, and re-equipping them with laser designators and electro-optical target acquisition devices along with digitized communications, for precision strikes employing PGMs. There is therefore an urgent requirement to bring the precision revolution in air power to the battle field. A radical transformation is required in our existing organizational structures for battlefield air operations, introducing all weather ISR devices for accurate target acquisition/designation and joint doctrines/SOPs for effective employment of PGMs on the battlefield.

Priority of Employment of Aerospace Power. In the recent past there has been animated debate in certain quarters on the priority of employment of aerospace power, between counter air operations and battlefield air operations which is unnecessary and counter productive. In an ideal situation, maximum concentration of air power would be employed to win the “Air War” and achieving a favourable air situation for “shaping” the battlefield, so as to launch unhindered land operations with freedom of maneuver. In the ultimate analysis, it is the imperatives of national security, the unfolding operational scenario and the prevailing geo-strategic situation, which will influence the priority of use of air power. In the 1999 Kargil War, due to the unique geopolitical environment of that conflict, aerospace power using fighter aircraft was restricted to close air support and battlefield interdiction on own side of the AGPL, and employed innovatively in unprecedented high altitude missions, without conducting counter air operations. Future conflicts would therefore demand scenario based flexible application of aerospace power, in which the optimum balance between the strategic and tactical application of air power would be decided by the Air Force planners in consultation with the Army, tailored to the specific geo-strategic and operational scenario, in furtherance of the overall strategic military objectives.

The other debate regarding the priority of application of airpower between battlefield interdiction and close air support also deserves greater clarity. Currently, there is a tendency to accord higher priority to interdiction missions. It may be mentioned that in Operation Enduring Freedom and Operation Iraqi Freedom, after

the initial strategic strikes, bulk of the offensive air support missions were directed towards close air support missions. In Iraq, 75% of the individual combat actions between US/British forces and Iraqi forces were brought to a decisive conclusion by close air support. Therefore it is solely the imperatives of the operational situation which should dictate the priority and balance between the two primary forms of offensive air support.

Employment of Attack Helicopters. Some military planners have propagated a somewhat romanticized perception of the invincible attack helicopter acting as a vertical arm of manoeuvre by mechanized forces and even called it a “flying tank”. This has been largely based on the performance of American attack helicopters such as the AH-64 [which is also being procured by us] in recent conflicts in Afghanistan, Iraq, and Libya and earlier NATO exercises during the Cold War.. The single characteristic which is common to these conflicts is the fact that they were totally one sided against weak adversaries with non-existent Air Forces and absolute air supremacy being achieved in the early stages of the campaigns, thereby providing full freedom of the use of air space by all types of combat aircraft and helicopters with total impunity. The fact is that the attack helicopter, though marginally armoured in selected places, is an extremely vulnerable platform which can be shot down easily by heavy calibre small arms fire, radar controlled AD guns, shoulder fired surface- to- air missiles[SAMs] and other low level SAMs . They can function effectively only when a favourable air situation has been achieved over the battlefield, in a low intensity ground based air defence environment coupled with air defence suppression.. In Operation Iraqi Freedom and Enduring Freedom in Afghanistan, over 60 armed/attack helicopters were lost due to ground air defence fire, an attrition rate which we can ill afford.

An excellent illustration of this grim reality was demonstrated in the 1999 Kosovo Air War when 48 American AH-64 attack helicopters, supported by more than a regiment of heavy multi barrel rocket launchers [for air defence suppression!] and a Brigade Combat Team, a total of 5100 troops for local ground protection, were deployed with great difficulty, as Task Force Hawk in Albania, for operations against the Serbian ground forces. Tragically, these attack helicopters remained unutilised on the ground for more than two and

a half months and were never launched inside Serbia for fear of being shot down by Serbian ground based AD weapons such as Kvadrats, OSA-AK, Schilkas, Strellas and Iglas. There is no denial that the attack helicopter is a formidable tank killer in close air support missions, preferably in defensive operations. In offensive operations the attack helicopter is best employed for optimum results in a low intensity air defence environment, when a favourable air situation has been created over the battlefield.

Employment of UAVs and UCAVs. In the post Cold War era, the Unmanned Aerial Vehicle[UAV] has emerged as a versatile force multiplier, capable of conducting a variety of ISR missions , EW [ELINT and ECM], combat search and rescue, aerial decoys, IED surveillance/ location, contributing enormously in achieving information superiority, battlefield situational awareness and facilitating precision strikes. In its armed incarnation, UCAVs such as the American MQ-1 Predator and the MQ-9 Reaper in the hands of the CIA and US Special Forces Command, have earned fame and a degree of notoriety, in precision targeted killing of Al Qaida and Taliban terrorist leadership and their clones in Afghanistan, North/South Waziristan in FATA, Pakistan, Yemen and Somalia, sometimes with unintended collateral damage. Once again, all these UAV/UCAV missions, have been carried out against lightly armed jihadi fighters, in situations of total air supremacy and a totally benign air defence environment.

Barring the mini and micro-UAV variety which are less vulnerable due to their small radar cross section and low visibility/noise level, all UAVs/UCAVs due to their slow speed[maximum 100-150 kmph] and limited maneuverability, are extremely vulnerable to air defence interceptors , ground based air defence guns, missiles and small arms fire. UAV losses have also taken place due to pilot errors, technical failures at rates much higher than fixed wing manned fighters. During the 1991 Gulf War, despite total air superiority, the US lost 18-20 RQ-2 Pioneer UAVs due to ground fire. Similarly, in Operation Allied Force [Kosovo Air War], US/NATO lost around 40-45 UAVs and in the more recent Iraq and Afghanistan conflicts, approximately 38-40 Predators and Reapers were lost to ground fire from insurgents and technical failures. Considering the high cost of UAVs of the Heron/Predator/Reaper type, it would be

pragmatic to employ the more sophisticated UAVs with a degree of caution on own side of the FEBA, using sideways looking long range cameras/electro-optic sensors or SAR/GMTI radars, preferably in a favourable air situation. As far as the much debated question ofUCAVs replacing manned fighter aircraft is concerned, for the immediate future the manned fighter will remain pre-eminent, as the remotely controlledUCAV cannot match the versatility, flexibility, agility and decision making ability of the human brain, in critical combat situations. Besides, theUCAV suffers from similar vulnerabilities as the UAV and would therefore have a much greater rate of attrition as compared to the manned fighter. At best,UCAVs can supplement manned fighters in specific operational situations in close air support missions.

CONCLUSION

The technological brilliance of aerospace warfare, has transformed the very nature of modern air-land warfare, as manifest in all major conflicts since the 1991 Gulf War. Since most of these wars in Iraq, Kosovo, Afghanistan and Libya have been totally one sided and fought in conditions of air supremacy, one must guard against learning the wrong lessons. In our present geo-strategic environment of meeting the dual challenge of a hostile Pakistan and an increasingly assertive China with its accelerating military modernization programme, the balance of overall combat power between the adversaries will be entirely different. It is the effectiveness with which aerospace power is employed in achieving information superiority and destruction of the major enemy strategic and tactical assets by precision air strikes, which will decide the outcome of any future conflict. To enable this, urgent action needs to be taken to plug the gaps in our ISR system and modernize and transform our entire joint system of application of precision aerospace power on the battlefield. Towards this objective, the structural and doctrinal impediments need to be rectified so that aerospace power is employed optimally as a battle winning instrument in future conflicts.

CENTRE FOR ADVANCED STRATEGIC STUDIES

CASS PUBLICATIONS

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1.	“Defence and Industry”	17 May 93
2.	“Use of Force in Internal Peace Keeping”	04 Dec.93
3.	“The Emergence of China : Political, Economic and Military Implications for India”	22-23 Nov.94
4.	“First SLK Memorial Lecture” by Shri P.Chidambaram, Union Minister for Commerce.	05 Jun. 95
5.	“Human Rights : Law and Order in India”	30 Sep. 95
6.	“The Emerging Security Environment in South East Asia with Special Reference to Myanmar : Political, Economic and Military Implication for India”	02-03 Dec.95
7.	“India 2020 : An Agenda for the Nation” by Maj Gen (Retd) KS Pendse.	Feb. 96
8.	“India : The Nuclear Challenge” by Lt Gen (Retd) EA Vas, Maj Gen (Retd) KS Pendse, Dr. Col (Retd) AA Athale.	Mar. 96
9.	“Challenges to India's National Security And India's Defence Preparedness”	20-21 Apr. 96
10.	“Citizens Rights and Indian Democracy” “Second SLK Memorial Lecture” by Dr. P.C. Alexander, Governor of Maharashtra	20 Jul. 96
11.	“Challenges of Comprehensive Test Ban Treaty Implications for India”	28 Aug. 96
12.	“Regional Security Environment To The North-West of India With Special Reference To Afghanistan.”	21-22 Mar. 97
13.	“Changing Scenario of The Constitutional Values” “Third SLK Memorial Lecture” by Justice AM Ahmadi, Former Chief Justice of India	02 Aug. 97
14.	“Information Warfare”	24 Sep. 97
15.	“Laws of War”	09 Jan. 98
16.	“Indian Ocean - The Challenges Ahead”	06-07 Mar. 98

Sl. SEMINAR PROCEEDINGS No.	Date of Seminar
17. "The Changing Pattern of India's Relations with America" "Fourth SLK Memorial Lecture" by Dr. Abid Hussain, Vice Chairman, Rajiv Gandhi Institute of Contemporary Studies.	03 Jul. 98
18. "Pokhran II and its Implications"	01 Sep. 98
19. "Nuclear India And The World"	08 Sep. 98
20. "The Challenge of Terrorism"	29 Oct. 98
21. "Foreign Policy Imperatives For Nuclear India"	26-27 Feb. 99
22. "On Building a Globally Competitive Indian Industry : The Role of Research & Technology" "Fifth SLK Memorial Lecture" by Dr. R.A. Mashelkar Director General, CSIR	22 Jul. 99
23. "Challenges of J&K"	04 Feb. 00
24. "Indo-Pak Relations : Challenges Ahead"	30-31 Mar. 00
25. "Insurgency In India - Causes & Perspectives"	28 Dec. 00
26. "Self Reliant Defence and Indian Industry" "SLK Memorial Lecture - 2000" by Shri K. Subrahmanyam, Converner, NSAB	18 Jul. 00
27. "Governance In India : Challenges Ahead"	25 Jan. 01
28. "India and China by 2020 : Political, Economic Sociological and Military Perspectives"	14-15 Mar. 01
29. "Global Terrorism And India's Response"	19-20 Mar. 02
30. "Globalization And Its Impact" "SLK Memorial Lecture - 2002" by Dr. C. Rangarajan, Governor, Andhra Pradesh	24 Apr. 02
31. "Governance In India" "Shri N.K. Firodia Memorial Seminar : 2002"	03 Oct. 02
32. "Globalisation And India"	19 Mar. 03
33. "Elections And Democracy in India" "Shri N.K. Firodia Memorial Seminar : 2004" by Mr. J.M. Lyngdoh, former Chief Election Commissioner, Justice B.P. Jeevan Reddy, former Justice of Supreme Court	17 Feb. 04

Sl. SEMINAR PROCEEDINGS No.	Date of Seminar
34. "Comprehensive Security : Need of the Hour"	25-26 Feb.04
35. "Ombudsman, Lokayuktas, Lokpals ; Concept and Working, with Special Reference to State of Maharashtra"	25 Mar.04
36. "Comprehensive Security II : Economic And Internal Security"	03 Mar.05
37. "India And Its Neighbours : A Regional Security Perspective"	04 Jan.06
38. "Probity And Propriety In Public Life" "Yashwantrao Chavan Memorial Seminar:2006" by Shri Milind Gadgil, Journalist.	03 Feb.06
39. "Social Unrest in India : Challenges Ahead" "Yashwantrao Chavan Memorial Seminar:2007" by Dr.DN Dhanagare, former Vice Chancellor, Shivaji University, Kolhapur; Ambassador PV Joshi, IFS Addl. Secy., MEA	13 Mar.07
40. "Emerging World Order And Sino Indian Relations"	21 Mar.07
41. "Aerospace Power in a Changing National Security Environment" "Air Marshal YV Malse Memorial Lecture:2007" by Air Chief Marshal FH Major, PVSM, AVSM, SC, VSM, ADC, Chief of the Air Staff	28 Jul.07
42. "Future Environment, Perceived Threat Preceptions And Imperatives in Response" "Brigadier NB Grant Memorial Lecture:2007" by Lt Gen N. Thamburaj, SM, G.O.C.in.C., HQ, SC	02 Dec.07
43. "Indian Democracy : Its Strengths & Weaknesses" "Professor S.V. Kogekar Memorial Lecture" by Dr. Dileep Padgaonkar,	25 May.08
44. "India's Strategic Environment And Its Implications for Military Modernisation" Air Marshal YV Malse Memorial Lecture by Dr. Bharat Karnad	08 Jul.08
45. "Indo-US Relations : The Changing Perspective"	22 Oct.08

Sl. SEMINAR PROCEEDINGS No.	Date of Seminar
46. "Challenges Before the Fifteenth Lok Sabha" "Professor S.V. Kogekar Memorial Lecture" by Dr. Madhav Godbole, former Home Secretary, Govt. of India	26 May,09
47. "Secularism in India : Meaning andPractice" "Yashwantrao Chavan Memorial Lecture" by Justice Narendra Chapalgaonkar	14 May,10
48. "Right to Information : Reality and Rhetoric" "Professor S.V. Kogekar Memorial Lecture" by Mr. Wajahat Habibullaj, Chief Information Commissioner, Govt. of India	26 May,10
49. "West Asia : A Factor in India's Security and Foreign Relations"	21 Apr.10
50. "Essentials of an Aerospace Power : Indian Context" "Air Marshal YV Malse Memorial Lecture" by Air Marshal PK Barbora, PVSM, VM, ADC, Vice Chief of the Air Staff, IAF	09 Jul.10
51. "Naxalism and Maoism and Indian Army"	26 Aug.10
52. "Indo-Pak Relations and The USA"	17 Sep.10
53 "The Kashmir Imbroglio"	29 Oct.10
54. "Value System in the Armed Forces" "Brigadier NB Grant Memorial Lecture" By Lt Gen (Retd) Ashok Joshi, PVSM, AVSM	18 Dec.10
55. "Poverty Alleviation in India : Challenges Ahead" "Yashwantrao Chavan Memorial Lecture" By Dr. YSP Thorat, Former Chairman, NABARD & Chief Executive Officer, Rajiv Gandhi Charitable Trust, New Delhi	13 Jan.11
56. India and East Asia : Opportunities Ahead	23 Mar. 11
57. MAE Seminar on "India & East Asia : Opportunities Ahead"	23 May,11
58. Prof. S. V. Kogekar Memorial Lecture on "Free and Fare Elections : Challenges Ahead" by Shri N. Gopalaswami, Former Chief Election Commissioner	26 May, 11

Sl. SEMINAR PROCEEDINGS No.	Date of Seminar
59. MAE Seminar on : "The Arab Spring : Meaning Causes and Implications"	24 Feb, 12
60. Air Marshal Y V Malse Memorial Lecture on "The Future of Aerospace Power" by Air Chief Marshal (Retd) P. V. Naik PVSM, VSM.	29 Jun, 12
61. "A Gandhian Perspective on International Security" "Yashwantrao Chavan Memorial Lecture" by Ambassador P.A. Nazareth, IFS (Retd)	03 Jan.13
62.	
