AIR POWER

Journal of Air Power and Space Studies

Vol. 5 No. 3, Monsoon 2010 (July-September)

AIR POWER Journal welcomes research articles on defence, military affairs and strategy (especially air power and space issues) of contemporary and historical interest. Articles in the Journal reflect the views and conclusions of the authors and not necessarily the opinions or policy of the Centre or any other institution.

CONTENTS
Vol. 5 No. 3, Monsoon 2010 (July-September)

Military force modernisation throws up multiple challenges, especially for a developing country like India. Based on his vast experience and knowledge, Air Marshal **P.K. Mehra** PVSM, AVSM, VM, former AOC-in-C, South-Western Air Command, focusses on the more intractable issues that need to be resolved. These issues are aggravated in the absence of adequate design and development capabilities and inadequate technological and industrial capacity.

Air-launched weapons against air as well as ground targets have been becoming increasingly sophisticated and complex. Inevitably, they demand fusion of different technologies and design expertise if a country has to make them indigenously. Group Captain **S. Bhanoji Rao**, VSM, argues persuasively for self-sufficiency in such weapons through indigenous design and production. He also argues that this can actually be carried out within the Air Force assets and capabilities, with minor assistance from other sources.

The PLA Air Force of the People's Republic of China underwent significant changes after the Sino-Vietnam War in 1979 where the PLA itself was seen to have failed to impose its military power on the Vietnam military. This triggered the four modernisations that Deng Xiaoping pursued. Wing Commander **Vishal Nigam** traces this crucial transition

period till China started getting military-technical assistance from Russia in terms of aircraft and weapons, much of it to be manufactured under licence. The result has been that this transition period has proved to be the foundation for the rapid modernisation of the Chinese Air Force.

China has undoubtedly built up its electronic and cyber capabilities as Wing Commander **Sanjay Poduval** writes. China has also declared in its official defence strategy, as spelt out in its White Papers on National Defence over the years, that it plans to fight a modern high-technology war on the basis of "informationisation" which would cover a vast ground in cyber and electronic warfare capabilities.

India has always stood for complete nuclear disarmament that must be universal and non-discriminatory. This was the basis for the "grand bargain" of the NPT resolution at the UN General Assembly, co-sponsored by India and passed unanimously in November 1965. Unfortunately, the NPT, as negotiated, created the gap between the haves and have-nots. Prime Minister Rajiv Gandhi put forward a comprehensive plan for a Nuclear Weapon-Free and Non-Violent World at the third Special Session on Disarmament in June 1988. Professor **Swaran Singh** traces the policy and initiatives of India, seeking a global Nuclear Weapon Free World, and its prospects after President Obama has lent his public support for nuclear disarmament.

Most of the literature on national security management and/or the Higher Defence Organisation (HDO) deals with these two interlocking issues separately. Wing Commander **R. Venkataraman** examines the two critical issues in national security and its subset, national defence, together in an effort to explore the potential for enhanced synergy,

especially in cases like ours where the basic foundation has to be built on the parliamentary system of governance as has been practised in the largest democracy in the world.

7. TECHNOLOGY: A HISTORICAL PERSPECTIVE   155

Almost all the changes in matters of peace and war have been affected by the technology available at that time and employed in pursuit of national interests. Wars and use of military power have given technology advancement a major boost after the Industrial Revolution impacted the world in the 18th century, and since then, technological growth has been almost exponential. Wing Commander **A.K. Singh** examines the issue of technology in the historical context to provide a sound base for future studies which can point to the direction that technology and its impact is likely to take.

EDITOR'S NOTE

Armed forces are always changing although within the framework of the military's natural conservativeness, changes in technology, the dynamics of the strategic environment and a host of other factors. Every new military weapon and equipment brings in its own demands of tactics and technical requirements; and every shift in the power equations that might impact our country would demand modification, if not a more definitive change in military strategy. But while dynamic change is intrinsic to military force, surprisingly, the institution is perceived as an almost static system. So, where does the concept of transformation of the armed forces fit in, and how does it impact on the military?

Transformation by definition would imply major changes in technology, force levels, doctrine and strategy, and force employment, individually and/or collectively. But the crucial difference between the inevitable change in each and all these areas is the rate of change. It is for this reason that the advantages sought and promised by changes in each and all these areas must be carefully assessed, including their inter-relationships and relative importance in the given circumstances. Hence, it is inevitable that military force transformation would also need to affect organisation and institutions, especially those related to command and control. The example of network-centric warfare comes immediately to mind. But perhaps the more important area is the introduction of the Airborne Warning and Control System (AWACS) in our operational environment since it promises

to alter the way air warfare would take place in the future particularly, with long-range precision strike weapons for both air-to-air, and more critically, air-to-ground warfare.

It is obvious that given the above factors, the most important aspect of transformation is the transformation of the mind. More failures are caused in the military profession (and intelligence assessments) by a rigid mindset than any other single factor. The Indian Air Force (IAF) is undoubtedly in the process of transformation, including the reality of a depleted combat force level. The most crucial challenge of the ongoing transformation, therefore, is to adapt the mind of air warriors to the process taking place so that old habits (which proverbially die hard) acquired over a period of time begin to adjust to the new paradigm of air warfare.

Another aspect of military transformation is the direction that the relative role each of the three components of military power will play in the future. This paradigm is perhaps the most contentious in all countries (including the United States which has an extensive record going back more than a century of working together) between the army and the air forces. Historically, land forces have seen the air forces as the supporting component and the army itself as the supported force. However, the transformation that is taking place and that has been tested in all the wars during the past quarter century unambiguously shows that this role has been reversed even though some countries may not fully agree with it at this stage. But because land forces are acquiring longer range weapons which traditionally and technologically would have remained the preserve of air forces, there is a critical need to lay down clear boundaries for operations of the three components of military power.

FORCE MODERNISATION: CHALLENGES

P.K. MEHRA

The most important reason for taking up 'force modernisation' is to impart a quantum jump to the capabilities of the defence forces in the entire range of military operations. Although force modernisation is a continuous process, its direction is technology dependent, and the quantum depends on the available resources and strength of the likely adversaries. The future is uncertain and there are no permanent friends or enemies, therefore, it is incumbent to take steps to match the capabilities of the neighbours and others likely to become competitive. Military strength has a bearing on the overall strength of any nation-state, hence, all countries continue to develop and, perhaps, move rapidly towards acquiring state-of-the-art equipment and technology. Ultimately, the commanders have to question whether the combat forces under his command will be able to successfully perform all the missions they are called upon to do so. A study of our own existing inventory which is based on decades-old technology and has degraded over a period of time, immediately drives home the crying need to recapitalise the equipment through either replacement or upgradation. The capabilities have to be built across the entire spectrum of conflict, with an eye on more recent trends like 4th generation warfare, which is real and which we are likely to face at some time in the future.

* Air Marshal **P.K. Mehra,** PVSM AVSM VM is former AOC-in-C South-Western Command.

No country has been able to maintain growth and achieve supremacy without intrinsic military strength.

With the rise of India, other countries look at us as an important actor in the stability of the Asia-Pacific region. The global community is looking at India and China for growth, increase in trade and financial flows, especially during these times of recession. India has to manage its relationship with the neighbours and adequately respond to the threat of terrorism to remain on the path of growth. But here is the caveat that no country has been able to maintain growth and achieve supremacy without intrinsic military strength.

In India, air power and, in fact, aerospace power holds the key to maintaining an edge over the likely adversaries and it surely cannot happen with the three to four decades-old inventory of fighter aircraft, airlift capability and other combat support equipment. Besides military hardware, there is a need to develop capabilities to hit the soft ribs of the adversaries and affect their ability to conduct war using cyber space. Additionally, space power is needed to give our war-fighters the precise advantage in surveillance, persistence, assessment of results and thereafter reengage with decisive and overwhelming force.

LIKELY NATURE OF FUTURE WARFARE AND CAPABILITY BUILD-UP OF LIKELY ADVERSARIES

The Indian defence forces have to be prepared for war across the entire spectrum of conflict. Aerospace power is expected to play a major role in winning wars and indigenous capabilities need to be developed for self-reliance. No country can become a power to be reckoned with by riding on the shoulders of other military powers. Concepts like "Comprehensive National Power" are in use to determine the total potential of a nation but it is suggested that at least a systems analysis should be carried out to determine our existing capability to fight different kinds of conflict and to determine the discrepancies in our arsenal.

A comparison with other military powers in our region indicates the steady erosion of the advantage in our combat potential in terms of

number of aircraft and hi-tech equipment. With the induction of Beyond Visual Range Capability (BVR) and the already acquired SAAB Airborne Early Warning and Control (AEW&C) aircraft by the Pakistan Air Force (PAF), both countries will be almost at par, with India retaining a marginal advantage in technology and numbers. The upgrade as well as supply of F-16s to the PAF must be kept in mind when we talk about parity. The F-16 upgrade kit will include the APG-68 (V)9 radar, embedded INGPS, APX-1 13

A comparison with other military powers in our region indicates the steady erosion of the advantage in our combat potential in terms of number of aircraft and hi-tech equipment.

advanced IFF, ALQ-211 (V)9 defensive EW suite, NVG system cockpit and external lighting, AIM-120 AMRAAM capability and AGM-74 Harpoon missile capability. This substantial improvement in PAF capability along with their joint development of J-17 aircraft with China as also the possibility of the sale of the J-10 has considerably eroded the Indian Air Force (IAF) superiority. When this potential is coupled with the Pakistani policy to foment internal trouble and flashing of the nuclear card, using a host of operational nuclear tipped missiles of the Shaheen and Ghauri class, then the need to build up IAF potential is all the more urgent. Only the development of the Submarine-Launched Ballistic Missiles (SLBMs) can provide the well needed edge in the triad for India.

China has been steadily developing the infrastructure in the Tibetan region and our own efforts do not count for much on the ground. China is working towards transforming its military force and building its capabilities to counter the US, especially in the Taiwan Strait and South China Sea. No doubt, the Chinese are far from achieving parity with the US, but their emphasis on attacking the weaknesses of the adversaries and huge investments in technology development mean that they will be a formidable adversary. China is focussed on developing capability for anti-access and area denial, keeping in mind the US commitment to defend Taiwan in case of an attack by Mainland China. Even the investment in defence Research and Development (R&D) by China is huge when compared to the amount

spent by India. It has been variously put at $30 billion vis-a-vis India's $1.65 billion.

EARLY EFFORTS AT FLEET AND EQUIPMENT MODERNISATION

There are four noteworthy events in the history of the modernisation in the Indian Air Force. The first was the development of the HF-24 aircraft, which was the best airframe design of that time. This design could compare with best in the world but for the engine. Extensive efforts were made to get an engine from the UK, France, USSR and also to manufacture it in Egypt but ultimately we had to fall back on the Orpheus 703 engine, with plans to design a reheat system for it. The HF-24 was underpowered and, hence, the aircraft did not see full life. The second was the attempt to modify the MiG-21 FL and this project study was done by Hindustan Aeronautics Limited (HAL) but this was nipped in the bud because the Soviets offered the MiG-21 M which had all the suggested improvements. This was another setback to our design and upgrade capability, which, if nurtured, could have transformed our aircraft industry. The third was the induction of Surface-to-Air-Missiles (SAMs), which gave a quantum jump to our Air Defence (AD) capability. This system was contemporary when inducted but the IAF did not realise the developments taking place the world over and continued with this highly manpower intensive system.

No other serious efforts took place to upgrade aircraft/systems till the setting up of the Inertial Navigation Integration Organisation (INIO) as a project under the Ministry of Defence (MoD) to upgrade the Jaguar Nav attack system. This project was a success story where HAL, the Defence Research and Development Organisation (DRDO) and IAF personnel worked along with foreign vendors from the UK and France and produced the Darin 1. The project faced the usual delays but downgrading and thereafter, the disbanding of the team resulted in loss of the expertise. It took us years to set up another organisation under DRDO to design and develop the Light Combat Aircraft (LCA) as a technology demonstrator by the Aeronautical Development Agency (ADA). The present status should be well known to all those keeping in touch with current military aviation.

Meanwhile, the IAF went in for the Mirage 2000 and MiG-29 aircraft to build multi-role as well as air superiority capability, especially with the availability of BVR missiles. The Su-30MKI placed the IAF in a totally different league which was really not foreseen initially. Development of the Su-30MK1 with Western and Indian avionics was the centrepiece of this plan, heralding the coming of age of our capability to integrate Western avionics and also producing some

Small and Medium Enterprises (SMEs) in the private sector have been engaged in developing a number of sophisticated components and even small systems.

avionics equipment like mission computers, radar data processors, display processors and other Electronic Warfare (EW) and communication systems. The upgrade of the MiG-21 Bison, Jaguar Darin 2, MiG-27, etc has boosted the confidence of our aviation industry. Small and Medium Enterprises (SMEs) in the private sector have been engaged in developing a number of sophisticated components and even small systems.

WHAT SHOULD BE THE FOCUS OF FORCE MODERNISATION

Domination of the Aerospace Domain

First and foremost, the concept of periodic upgrades of any and every equipment should be enshrined in our thoughts and actions. Replacements are essential but only when there are generational changes in the equipment and to bring about a transformation. Otherwise, plans must be in place soon after induction of the equipment for upgrade, depending upon the planned utility. India and the IAF do not have a culture of defining the life of equipment and sticking to a replacement or upgrade plan. The foregoing is possible in case research into developing technologies related to the inducted equipment is undertaken in parallel and even reverse engineering of some systems may be resorted to. For some, 'reverse engineering' may be a dirty word but all countries and manufacturers do it. No foreign vendor parts with the critical/latest technology even under Transfer of Technology (ToT) clauses, and modifications are difficult without basic design parameters. There are

It is better to develop or modernise your systems with already proven technologies rather than waiting for top-of-the-line equipment/ technologies and losing precious steps in building combat potential.

numerous examples like the R-73 and Litening pod on the M-2000, Sea Eagle, overwing Magic missile on the Jaguar, and Magic missile on the MiG-21 Bis. It is a painstaking process, but there is no getting away from it.

What follows is a wish list for any country which hopes to play a major role in world affairs. The pace of modernisation should be guided by systems analysis, commitment of resources, indigenous technology level and development, establishment of meaningful and transparent joint development programmes, encouraging the private sector in jointly funded technology development. It is better to develop or modernise your systems with already proven technologies rather than waiting for top-of-the-line equipment/technologies and losing precious steps in building combat potential and providing operational feedback to the technology developers. The focus of the IAF should be on the inventory comprising aircraft, aero-engines, missiles, weapon systems, combat support systems, cyberspace and space-based systems, with the intent to increase self-reliance.

The aircraft upgrades normally constitute mainly avionics and communication systems but what is essential is to also look at the possibilities of engine upgrade or engine change. The decades-old engines do not comply with the laid down environment norms and also efficiency in terms of fuel consumption. In case we are modernising an aircraft for the next decade and a half, then aero-engines should also become a part of our focus. The initial capital cost may be high but will be recovered by the time the aircraft is phased out, especially in the case of the transport fleet.

Aircraft
What is the suggested trend? There is a considerable slowdown in developing new fighter aircraft because of the prohibitive cost of development and also a shift of focus to unmanned aircraft. The USA, Russia and China are the

only ones developing aircraft but in collaboration with other countries. The manufacturers of the legacy aircraft are proposing to upgrade or replace the legacy 4th generation aircraft with 4+ generation (F-15, SAAB Gripen NG, Euro fighter tranche 3, Su-30 variants and MiG-35 aircraft), etc so as to retain the combat potential through numbers. The Unmanned Combat Aerial Vehicles/Unmanned Aerial Vehicles (UCAVs/UAVs) have proved their capability in Iraq and Afghanistan and, hence, a number of

Development of a range of 10 and 20 ton class of transport aircraft with a possible civil version and civil application is the need of the hour.

development programmes are going on. The Design and Development (D&D) for the Unmanned Aircraft System (UAS) covers the small micro/ mini to High Altitude Long Endurance/Medium Altitude Long Endurance (HALE/MALE) and even the hypersonic programmes. In our case, the Indo-Russian programme is a sound proposal as long as both India and Russia know what they are bringing to the table to jointly develop this new aircraft. If Russia has developed 90 per cent of the technologies and India the rest, then we will have to seek the technologies from Russia and, hence, will become dependent. It is not possible to have transparency since individual systems are developed in different laboratories and will be guided by patent and disclosure restrictions. Joint development of 5th generation technologies with equal partnership and total transparency should be the aim.

Development of a range of 10 and 20 ton class of transport aircraft with a possible civil version and civil application is the need of the hour. The short-term requirement for special purpose aircraft is being met through direct imports but it is in the Indian aviation industry's interest to develop indigenous capability to meet the long-term requirements. Based on the confidence gained through the development of Dhruv helicopters, a family of helicopters for utility (LUH) and combat (LCH) should be developed. Resources will have to be found in order to achieve the targeted self-reliance as enunciated by the Raksha Mantri (RM) and earlier by Dr A.P.J. Abdul Kalam. It is a bitter pill but with a healthy Gross Domestic Product (GDP) growth, it is possible. So far, nobody has identified the characteristics

and capabilities of the 6th generation and it is felt that UCAVs will play a greater role in future wars. In fact, I would suggest greater emphasis on UCAVs systems development for HALE or at least MALE. The need for persistence has been recognised and that is why development of airship-based surveillance systems is on the cards.

Aero-Engines

This has been a weak area and unless we are able to develop engines to fulfil our needs, we will remain dependent on others. In case the core engine, Kabini, of the Kaveri engine can be perfected, smaller engines can be produced for application in UAVs and small transport aircraft. Success in operationalising smaller engines albeit with reduced level of sophistication is better than aiming high and delivering nothing. Lack of success in the existing programme should propel the MoD/stakeholders to take a hard look, objectively ensuring that success is paramount and all the institutions and personnel involved are subordinate to the final aim.

Missiles

Medium and long-range surface-to-surface missiles provide the greatest deterrence value, especially since India is already a declared nuclear power. Examples of smaller countries like Iran and North Korea with capabilities to develop and launch missiles are there for all of us to see. Development of SAMs, Anti-Radiation Missiles (ARMs), Air-to-Air Missiles (AAMs) and long-range cruise missiles indicates technological prowess and, hence, the need to be focussed on them. Ballistic Missile Defence (BMD) systems, especially against multiple missile attacks, will play a major role considering the efforts being put in by our neighbouring countries to flex their muscles. The Prithvi Air Defence (PAD) missile has demonstrated success and its further development along with the associated radar holds the key towards credible deterrence, especially in view of our 'no first use' policy. Development of a nuclear submarine and SLBMs has assumed great importance in building up the triad in view of the Chinese thrust on developing a Blue Water Navy.

The existing radar network, whether ground-based or airborne, needs to be supplemented with a space-based early warning system. The DRDO has displayed its capability to develop missile defence systems but the larger question is about the responsibility for defence from the air and space. The IAF is responsible for air defence of our air space and it is but natural that BMD should be considered as an extension of the IAF's responsibility.

The IAF is responsible for air defence of our air space and it is but natural that BMD should be considered as an extension of the IAF's responsibility.

Future Weapons

We have lagged behind in weapon systems development. So far, we have only developed dumb air-to-ground weapons. I understand that we are now developing laser guided bomb kits and I hope that it leads further to Joint Direct Attack Munition (JDAM) kind of weapons using both the Global Positioning System (GPS) and lasers. Precision strike capabilities have to be looked at as a system, together with aircraft, sustained surveillance, targeting and net-centricity. The capability build-up becomes that much more complex when all components of the system are looked at to define the capabilities. Only leap-frogging will help and the task force approach to develop the key technologies should be followed. Directed Energy Weapons (DEWs), using electro-magnetic or laser beams, will have huge applications in the future. The laser weapons are extremely precise and cost-effective even to intercept ballistic missiles but their development would be very expensive. DEWs have the advantage of multiple target engagements and rapid retargeting. Space-based DEW systems will be most effective but this capability is far in the future.

SAMs have been developed by DRDO and there are ongoing programmes in collaboration with foreign vendors. SAMs and BMDs should become seamless for the comprehensive and credible defence of Indian territory and air space.

Reduced dependence on foreign weapons suppliers through indigenous development of AAMs, CCMs, ARMs and cruise missiles is the call of the

These inductions will provide immediate capability but will not serve the purpose of self-reliance unless technologies are developed simultaneously.

day. Some headway has already been made but fresh initiative is required to make these weapons operational and effect improvements through the induction of the latest technology. Even smaller and more effective bombs and other air-to-surface strike weapons are essential to improve the combat potential of our aircraft weapon systems.

Combat Support Systems

The IAF has rightly shifted its focus to acquiring combat support systems and many of them are in the pipeline. These inductions will provide immediate capability but will not serve the purpose of self-reliance unless technologies are developed simultaneously and the future upgrades/replacements of these systems are done with indigenous elements. Airborne Warning and Control System (AWACS)/Airborne Early Warning and Control (AEW&C), aerial refuelling equipment, different range/technological capabilities surveillance radars for both ground and airborne applications, a range of Electronic Warfare (EW) and Electronic Support Measure (ESM) equipment, adoption of network-centricity for future warfare are some of the support elements, which need to be developed indigenously. The amount of information required for network-centricity is maddening considering the need for physical surveillance, communication surveillance, Human Intelligence (HUMINT) and geo-awareness to be included and fused to complete the picture.

OPERATIONS IN CYBER SPACE

With an ever increasing reliance on flow of information and accepting the tenets of Net-Centric Warfare (NCW), cyber space is the new domain where wars will be conducted in the future. Control of information has, and will continue to be, a central component of military operations. China has already stated its aim to attack the soft ribs of a powerful adversary and prepare for a war in the backdrop of informationisation.

A number of reports have appeared concerning attacks through cyberspace at different locations and in both civil and military environments. The effects have been contained so far but these are probes to assess the durability of protection measures, and efforts will be on to defeat the protection devices. Nevertheless, these intrusions have shown that they create tactical, operational and strategic effects at low cost and with relative impunity.

What needs to be understood is that the capability to conduct cyber warfare cannot be limited to any one component of the defence force or civilian strategic sphere and, hence, highly qualified personnel must be employed without any reservations and irrespective of their affiliations.

SPACE-BASED SYSTEMS

Although the IAF is late in realising the potential of space-based surveillance systems, the plans to launch a dedicated satellite comprise good news. Both sustained surveillance and global communications are essential for net-centricity and the same has been amply demonstrated during the Chechen War in 1999 and the past and ongoing Gulf Wars. A networked precision strike to incapacitate terrorists and their camps will be possible by fusing information from a large number of sensors, including those based in space. Development of hypersonic vehicles flying through near space is another area of interest but can be given low priority since developing a scramjet engine is far into the future.

SOFTER ASPECTS OF FORCE MODERNISATION

All force modernisations have two aspects viz, equipment and personnel. It is easy to visualise the weapon systems requirement since this aspect is always given prominence but the aspects of organisation structure, Human Resource Development (HRD) like training and leadership do not get the required focus. Both these are interdependent and must develop simultaneously for a smooth induction and operationalisation of new equipment. Some of the systems demand a huge change in work culture and these new philosophies can be absorbed only through an overhaul of

The aspects of organisation structure, Human Resource Development (HRD) like training and leadership do not get the required focus.

our so-called time-tested systems. A higher level of leadership is required in order to change our Concept of Operations (CONOPS) and especially so when jointness is involved.

INITIATION OF THE MODERNISATION PROCESS

Modernisation may be achieved either through fresh acquisition or upgradation. The process is based on a study carried out to build capabilities to meet the operational tasks of the future and also replace the obsolete equipment to retain the combat potential. This defence procurement planning process is split into the long-term, medium-term and short-term, comprising the 15 years Long-Term Integrated Perspective Plan (LTIPP), the 5 years Services Capital Acquisition Plan (SCAP) and the Annual Acquisition Plan (AAP). The LTIPP and SCAP are prepared by Headquarters Integrated Defence Staff (HQ IDS) in consultation with Service HQ and are approved by the Defence Acquisition Committee (DAC) and the AAP is approved by the Defence Procurement Board (DPB). The AAP should cover a period of two years and invariably form a part of the approved SCAP. In formulating these plans, the Operations Branch in the Service HQ compares the existing combat potential with the targeted potential after a scan of developments in the neighbourhood, government policy direction and available technologies. The operational requirement of each and every type of equipment is clearly defined before the Plans Branch converts them into Service Qualitative Requirements (SQRs) and obtains approval from the highest level. The draft SQRs go through an iterative process and have to be cleared by a number of agencies outside the Service HQ but mostly within the MoD before finalisation. Simultaneously, the Plans Branch issues Requests for Induction (RFIs) through our Defence/ Air Attaches to the known suppliers of equipment. Most of this information is gleaned through the Internet and the rest from the vendors registered with MoD.

The acquisition process for schemes categorised as 'buy' and 'buy and make' with ToT, will involve the following functions:

- Services Qualitative Requirements (SQRs).
- Acceptance of Necessity (AoN).
- Solicitation of offers.
- Evaluation of technical offers by the Technical Evaluation Committee (TEC).
- Field Evaluation.
- Staff Evaluation.
- Oversight by Technical Oversight Committee (TOC) for acquisitions above Rs 300 crore.
- Commercial negotiations by Contract Negotiation Committee (CNC).
- Approval of Competent Financial Authority (CFA).
- Award of contract / Supply Order (SO).
- Contract administration and post-contract management.

MAKE OR BUY DECISIONS

It is relatively easy to build up a wish list and have it approved as part of the long-term reequipment plan but the process of induction of equipment is mired with roadblocks at every step. The Defence Procurement Procedure (DPP) 2008 is the Bible for defence capital acquisitions and it has been refined over the years to overcome the lacunae of the earlier system of acquisition. There have been considerable efforts to attract investments in the defence industry since 2001 through easing of controls but it did not lead to major investments due to the wait and watch attitude of the industry. Some of the other policy decisions concerning categorisation of some private industries for preferential treatment (Raksha Udyog Ratnas) at par with Public Sector Undertakings (PSUs) did not take off. Make or buy decisions have a great bearing on the level of self-reliance. The introduction of 'make or buy Indian' should help in pushing the private industry to create joint ventures with foreign vendors and offer an increasing number of products being manufactured in India. There is also a case for consideration to identify some private industry that can undertake R&D in defence equipment. There

There is a case for consideration to identify some private industry that can undertake R&D in defence equipment.

should be joint funding for R&D, with the MoD holding the patent.

CHALLENGES IN DEFENCE ACQUISITIONS

It is essential to decide whether to acquire new equipment or upgrade the existing one. A number of factors are to be considered, the important ones being the source of the equipment, its vintage, whether the equipment is in use extensively or restricted to a few countries, the cost factor, residual life after upgradation etc., to decide the number of aircraft/systems required, especially when the new system has multi-role capability, is of a much higher technology and, consequently, is much costlier than the aircraft/system it will replace. For a country of our size, numbers are as important. It is agreed that these multi-role aircraft can be based in the rear and they can provide support to different theatres of war but still the numbers are important to maintain positive asymmetry.

There is an ongoing debate on whether the UCAS will ultimately replace the manned aircraft or some key tasks will be given to the unmanned systems, controlled by an airborne/ground operator. This replacement is likely to happen some time in the future but for the next 15 years, manned aircraft will be the key element for winning wars.

It is important to evaluate the level of technology and whether it can be absorbed by our operators. Is it current and which vendor is offering better technology? There are occasions when the vendors have given equipment of older technology which they themselves have planned to phase out or the next version is already in the pipeline but they do not disclose the fact. A closer study of the level of technology on offer by different vendors will indicate the state-of-the-art and even if it is more expensive, it may be cheaper in the long run to buy the latest available.

When equipment is purchased from different vendors and from different countries, it may cause integration problems. Subsequently, this may lead to problems in jointness and networking. The level of ToT should include

adequate knowledge or an assurance from the vendor that active assistance will be provided in integrating weapons and systems from other vendors.

Lack of participation by the private sector, since the present policy envisages preferential treatment for PSUs and SMEs, is the biggest blow to our efforts for self-reliance.

Lack of participation by the private sector, since the present policy envisages preferential treatment for PSUs and SMEs, is the biggest blow to our efforts for self-reliance. A level playing field must be provided for all.

The restrictions on Foreign Direct Investment (FDI) in terms of percentage and lack of control over the decision-making due to limited investment, are also issues that need to be considered. Foreign vendors are reluctant to part with current technologies. There are restrictions on exports of items produced in the country. There should be some flexibility in FDI in percentage depending upon the level of technology on offer.

At present, offsets of a minimum of 30 per cent are mandatory in all projects worth more than Rs. 300 crore and this can be increased. For the Multi-Role Combat Aircraft (MRCA), it is 50 per cent. A case in point was the bid for helicopters. Some flexibility must be shown since the industry may not be able to absorb such large amounts of investments.

The fear of the involvement of middlemen/agents who may influence decision, is a hangover from Bofors. Involvement of middlemen and payment of bribes was recently unearthed and the last DG Ordnance has been indicted. Can we wish away the middlemen? The Central Vigilance Commission (CVC) had strongly recommended that agents may be officially permitted and registered to ensure transparency and probity but no agent has come forward to get registered. To state that agents can corrupt officials shows a total lack of confidence in the integrity of government functionaries. It implies that all officials dealing with defence procurement are predisposed to corruption and, hence, must be kept away from temptations. It is a sensitive subject and has to be a matter of trust in the team of government negotiators.

The determination of reasonable and fair cost of equipment is a highly complex and arduous task. This has to be done well before the commencement of commercial negotiations and a team of experts should be constituted for the task.

Public-private partnerships in the field of defence production need to be encouraged. The government has to take positive steps to push joint ventures between Public Sector Undertakings (PSUs) with the private sector industry.

We can consider the applicability of examples from countries like the USA, UK, Russia and Australia as well as public-private-DRDO partnerships in R&D, followed by production like the Israeli model.

CONCLUSION

Force modernisation is an ongoing process and needs to be enshrined in our thoughts and actions. It is both technology and resources dependent but the bottom line is to retain or improve the combat potential of our equipment so that it is capable of fighting the next war. India has to display its military prowess if it wants to continue on the growth path. The Indian Air Force does not have a decisive edge over its likely adversaries since both of them have learnt valuable lessons from the recent wars and are truly focussed on building up their air power. The Indian Air Force had embarked upon modernisation in the past but did not follow it up, otherwise we would have been well on the path to self-reliance. India has to focus on modernisation of aircraft, aero-engines, missiles, weapon systems, combat support systems, cyber space and space-based systems with the intent to increase self-reliance. It may appear to be a very tall order but it is feasible in a slow and sustained manner. There are huge challenges in defence acquisitions because of the lack of a level playing field for the private sector and the procedures for investment in R&D. There is also a need to follow the time-frames mentioned in the DPP and in case the acquisition is very complex, a separate time-table may be issued.

INDIGENISATION OF
AIR-LAUNCHED WEAPONS?

S. BHANOJI RAO

The air armaments can be classified into two categories i.e. the externally mounted stores like aircraft gun ammunition, unguided rockets, bombs, Precision Guided Munitions (PGM), air-launched missiles, etc, and the armament stores fitted inside the aircraft like the store release carts, escape aid explosives and various power cartridges. The design and development of air armament stores is a complex and time consuming activity. It needs close coordination with the user, production agency, airworthiness approval agency and flight testing agency. Indigenisation of low technology weapons like bombs and cartridges either through reverse engineering or through new development could be achieved by our Research and Development (R&D) agencies to some extent. However, till date, the Defence Research and Development Organisation (DRDO) could not develop high-tech weapons like air-launched missiles and PGMs. Even in the case of low-tech weapons like unguided rockets and fuzes for aerial bombs, the Indian R&D failed to develop credible air armaments. Most of the air armaments are imported even if these are low-tech weapon systems.

India is emerging as a major economic power in the world. In most of the technology intensive industrial sectors, we are surging forward at a brisk pace. We have the largest pool of technical personnel. India was able

* Group Captain **S. Bhanoji Rao**, VSM is serving at Air HQ, IAF.

Even now, the IAF is using the 1,000 lb bombs whose specifications were issued in 1952. At that time, the designer, quality assurance agencies and user were together as DTD&P (Air).

to launch lunar missions and launch various satellites. Despite all these credentials, why does India still depend on the import of air armaments? What ails our air armament industry? It is necessary to delve into the reasons for the inability to design, develop and produce air armaments in India. We need to introspect and alleviate the problem areas in order to achieve self-reliance.

AIM

The aim of this paper is to analyse why India is unable to design, develop and produce air armaments for all three Services. The idea is not to find faults with the system but to identify the deficiencies in the user, R&D, producer and Ministry of Defence (MoD), with an aim to improve the respective establishments in the area of indigenisation. An attempt has also been made, especially for the Indian Air Force (IAF), to suggest remedial measures for overcoming this problem.

HISTORY

The requirement of air armaments depends on the type of military aircraft in use. Initially, a majority of the air armament stores was imported. During the British rule, the technology to manufacture the bombs which were released by the earlier bomber aircraft was provided to Indian agencies. This technology was provided by the Ministry of Supply, Royal Aircraft Establishment, London. Some of the documents were designed in the 1930s. In the early 1950s, certain stores viz. aircraft gun ammunition and bombs were produced by the Ordnance Factories Board (OFB) using these original technology documents. At that time, there were no separate agencies responsible for design, airworthiness certification and quality assurance. Subsequently, upon formation of the Directorate of Technical Development and Production (Air) [DTD&P (Air)], a large number of low-tech weapon systems viz. bombs, escape aid cartridges and gun ammunition

were developed through reverse engineering, and drawings and specifications were formulated. Even now, the **IAF is using the 1,000 lb bombs whose specifications were issued in 1952**. At that time, the designer, quality assurance agencies and user were together as DTD&P (Air). Therefore, the coordination was good and a large number of projects were successfully accomplished through reverse engineering. Subsequently, the task of indigenisation was assigned to individual DRDO labs. Initially the development activities of the Armament Research and Development Establishment (ARDE) and High Energy Material Research Laboratory (HEMRL) (then Engineer Research and Development Laboratory—ERDL) were well coordinated and the products were successfully developed in the prescribed time-frames. However, the progress of development activities became rather slow in the subsequent years.

Except for one bomb i.e. the 100-120 kg natural fragmentation bomb, none of the air armament stores could be produced by OFB till date.

The Air Staff Requirements (ASR) for new generation bombs like the 250/450 kg HSLD and the fuzes for these bombs, were issued in the late 1970s. However, the bulk production could commence only from early 2000 onwards. The delay in bulk production was primarily due to the delay in formulation of documentation and initial production problems. **Since the designer was not responsible for bulk production, this time lag from design to bulk production was very high compared to international standards**.

Till the late 1990s, indigenisation of air armaments was tasked to the DRDO only. Due to inordinate delays in development and DRDO's reluctance to take up reverse engineering projects, the IAF had tasked OFB to indigenise certain low-tech weapons like the Russian origin bombs and rockets. However, except for one bomb i.e. the 100-120 kg natural fragmentation bomb, none of the air armament stores could be produced by OFB till date. The success story for designing the 100-120 kg bomb is mainly due to the involvement of the Directorate General Aeronautical Quality Assurance (DGAQA) and employment of retired IAF officer, Air Cmde K.V. Rao, as a consultant for OFB for one year.

The development of air-launched missiles and laser-guided bomb kits has been in progress for the last two decades. The progress is very slow and the IAF continues to depend on imports.

PRESENT SCENARIO

The design and development of air-launched weapons are different from those of ground-launched weapons. The design safety and airworthiness are of paramount importance. The designer, airworthiness certification agency, quality assurance agency and flight testing agency are to work in a cohesive manner for expeditious completion of development projects. Each agency has an important role to play in the indigenisation of air armaments. Once the product is developed, the transfer of technology would take place to the bulk production agency. At present, there are two sources for supply of air armament stores i.e. OFB and ARDE. The bulk production of a majority of the stores is through OFB whereas certain stores viz. power cartridges, release cartridges, etc. are supplied in limited numbers by ARDE. Therefore, depending on the type of weapon system, the indents are placed by the Services. Bharat Dynamic Ltd (BDL) is trying to refurbish/provide life extension of Russian origin air-launched missiles. However, a proper system has not yet been formulated.

INDIGENISATION OF AIR ARMAMENTS

The indigenisation projects may be classified broadly into two categories. i.e. the Services-sponsored projects and technology demonstration projects. In the case of Services-sponsored projects, the Staff Requirements are defined and the design agency is to submit the feasibility report and after acceptance of the feasibility report, the R&D work commences. In the case of technology development projects, the R&D work commences as a technology demonstration and once a certain degree of success is achieved, the Services are briefed for its acceptance as a Services-sponsored project.

In the IAF, the externally mounted stores are required by the Operational Branch and the power cartridges are indigenised by the Maintenance Branch. In both cases, indigenisation is not the primary duty—it is an additional duty.

Therefore, adequate time is not devoted by the IAF for indigenisation activities. A scrutiny of the technical specifications of indigenous air armaments has revealed that IAF officers (Technical Armament Branch) had worked on these products during the development stage and all specifications were formulated by them. A sizeable number of armaments were designed by the IAF officers during the DTD&P (Air) times.

Amongst the air armaments, indigenous production is very limited. Only low technology weapons are being produced in bulk. The list is given below:

- 1000 lb bomb of different makes – production based on British documents.
- 250 kg HSLD bomb – designed in 2000 by ARDE.
- 450 kg HSLD bomb – designed in 2000 by ARDE.
- 100-120 kg bomb – designed 2002 by OFB.
- 68 mm rocket – designed in the late 1980s by ARDE.
- 30 mm ADEN ammunition – through Transfer of Technology (ToT) by OFB.
- 30 mm GSH – through Transfer of Technology (ToT) by OFB.
- 23 mm GSH – through ToT by OFB.
- Various power cartridges and escape aid explosive cartridges.

The fuzes for the aviation bombs were developed by ARDE. However, their usage has been discontinued as incidents of air burst occurred due to certain design deficiencies. The ARDE was initially reluctant to accept that there were deficiencies in design. However, by the time ARDE accepted the need to design the fuzes in the fail safe mode, the IAF had stopped using these fuzes and adapted a Russian origin fuze as the common fuze for all bombs. Regarding the live ammunition for aircraft guns, OFB is unable to make this due to difficulties in quality assurance problems for fuzes. Therefore, the live ammunition is being imported and the practice ammunition is being made in India.

In the case of the 68 mm rocket, a large number of amendments are pending for ratification by the ARDE. Since the rocket group of ARDE

had been wound up a long time back, there is no response from ARDE despite being the designer. OFB is continuing to produce the rockets with deviations, as the product with the changed specifications is performing without any problems.

At present, the following air armaments are under indigenisation:

OFB (tasked in November 1999)
- 57 mm rocket – first flight trials done in September 2007. Still pending.
- 80 mm rocket – development stage.
- 240mm rocket S-24B – development stage.

DRDO
- 100-120 kg pre-fragmented bomb – under pilot lot production.
- 250 kg pre-fragmented bomb – under development.
- 500 kg pre-fragmented bomb – under feasibility study.
- 500 kg M-62 Russian origin bomb – under feasibility study.
- Laser guided kit – under development for 20 years.
- Anti-tank missile – under development.
- Air-to-air active radar-guided missile – under development.
- IN/GPS guidance kit with range enhancement – under development.

DEFICIENCIES OF AGENCIES INVOLVED IN INDIGENISATION

The primary agencies involved in indigenisation are the user, R&D organisation, flight testing agency, airworthiness certification and production units. Since all these establishments are under the MoD, the MoD policies play a major role in their approach for indigenisation. It is, therefore, necessary to identify the areas which affect the process of indigenisation. The details are given in the subsequent paragraphs.

System Deficiencies at User Level

(a) Domain knowledge on air armaments is very limited in the IAF and Indian Army. Some of the Requests For Induction (RFIs) from the Army are classic examples of lack of core competence. Earlier, the IAF had the Technical Armament Branch which had expertise on air armaments. Now, very few

experts on armaments are available. Every AE(M) officer would like to work on aircraft instead of armaments as the recognition of an officer's effort on aircraft is clearly visible and better appreciated by the commanders. Armament activities are least visible. Very few commanders give importance to the armaments in the field units. The flying task is given paramount importance compared any other activity in the field units. Since the working environment is not conducive to develop core competence in armaments, the number of officers who have the capability to lead the armament indigenisation projects is limited.

Very few commanders give importance to the armaments in the field units. Since the working environment is not conducive to develop core competence in armaments, the number of officers who have the capability to lead the armament indigenisation projects is limited.

(b) Air Headquarters (HQ), especially the Operation (Op) Branch, has not given importance to air armaments. A majority of the armament functions like procurement, War Wastage Reserve/Armoured Assault Tank (WWR/AAT) scaling, allotments, utilisation policies, trials and indigenisation of main stores are looked after by the Op Branch. The highest ranking officer to look after this is a Group Captain. In fact, in the chain of command, till the year 2008, there were two officers between the Director Weapons and the Vice Chief of the Air Force. Now, it has been increased to three officers. The greater the number of officers in the chain of command, the more will be the hurdles. Whereas, maintenance of these stores at the Maintenance Branch is looked after by an officer of Air Vice Marshal rank. Moreover, the total number of officers in the Directorate of Weapons (Op Branch) is so low, that they are barely sufficient for day-to-day fire-fighting, and there is no time for policy matters. Compared to the Naval Armament Inspectorate, the total number of officers working in the area of air armaments in the entire Air HQ is very limited despite the fact that the IAF has more variants and numbers of armament stores.

When the primary version of a new generation system cannot be indigenised, the advanced systems cannot be designed and developed by our R&D.

(c) Longer tenures could have helped the officers to build up expertise. But due to typical tenure-based posting across the board, the officers working in the armament field are unable to gain core competence.

(d) Indigenisation is not the primary responsibility of the officers in the present system of work. The officers' primary responsibility is the operational utilisation and its maintenance. A separate officer is to be posted to both the branches for dedicated work on indigenisation.

(e) When the Services Qualitative Requirements (SQRs) are formulated, the Services seek the best features available on similar systems in the global market. When the primary version of a new generation system cannot be indigenised, the advanced systems cannot be designed and developed by our R&D. Therefore, the SQRs must be given as Mark-1, Mark-2, and so on, for any weapon system. Initially, the basic version to be developed is the Mark-1 and the advancements could be in the other versions.

(f) The Services often provide the SQRs of the main weapon system. The associated equipment required to utilise the main system is not defined. It is often presumed that the designer would know the requirement. Due to this, development of associated accessories gets delayed which, in turn, delays induction of the equipment into the Services.

(g) Due to the very nature of tenure-based postings, the person defining the SQRs may not have the requisite knowledge of the entire weapon system. Therefore, errors at project definition could occur.

(h) Project management at the user end needs expertise and continuity. The project manager needs to interact with the R&D teams and testing agency. In case the officers are posted to the R&D team, they could manage the project efficiently.

(j) Since the technology is changing rapidly, the Services keep changing the specifications to keep pace with the technology. This leads to delay

in project completion. It is important to fix the project definition. Any amendment to specifications could be considered as an upgrade of the first project. Generally, this is not in practice.

(k) The user feedback is not given to the design agency routinely unless defects occur. Feedback helps in improving the design of the weapon system.

At times, after successful flight trials, it takes 10 years for an item to be produced in bulk due to lack of documentation and non-availability of associated equipment. The designer is not responsible for bulk production.

System Deficiencies at DRDO

(a) Due to lack of knowledge of the overall requirements of any weapon system, parallel R&D of the main system and its associated equipment does not take place. All R&D activities are concentrated on the main item only. Only when the main item is successful, does the R&D team consider indigenisation of the associated items.

(b) The gestation period is very long at the design and development stage as well as ToT for bulk production. There is no accountability for lapses in time-frames. In a majority of cases, the project team gives unrealistic time-frames and never meets the deadlines.

(c) Without adequate ground trials, the project team seeks flight trials. The cost of the flight trials is not included in the project cost. One flight trial of air armament stores costs approximately Rs. 1.5 crore. In the case of the proximity fuze development, the project was shelved after the conduct of 11 flight trials, wherein the fuze functioned inadvertently in the last two flight trials.

(d) Once the prototype is developed successfully, the project team declares successful completion of R&D and does not complete the associated documentation on time. At times, after successful flight trials, it takes 10 years for an item to be produced in bulk due to lack of documentation and non-availability of associated equipment.

(e) The designer is not responsible for bulk production. Therefore, the designer does not spend adequate time in preparing the production

There is a need for constant upgradation of the product by the designer in terms of quality and performance. Generally, this is lacking from the designer.

technology documents. Preparation of documents for the process schedule and the Quality Assurance (QA) requirements must be the responsibility of the designer. When any product is produced under ToT from abroad, all production documents are properly made by the designer and one representation of the designer ensures production as per the standards. No such methods are followed in India. The DRDO needs to study the ToT documentation of any air armament product ex-abroad and prepare the documentation accordingly. In fact, two groups from the same lab prepare different standards of documents for ToT. There is no standard template. When one such checklist was prepared by DGAQA, the DRDO justified why they should not make efforts to make such a comprehensive template.

(f) During the development phase, the hardware is manufactured under the direct supervision of the scientists of DRDO. Since they are the designers, the production process control cannot be accomplished under their supervision. When the same product is to be manufactured in bulk by the OFB or trade sources, the educational qualification and understanding of the quality and specification requirements of the product is limited as the technicians are uneducated. Therefore, it is necessary to stipulate step-by-step procedures in the production process documentation by the designer. This is not done by the DRDO.

(g) Once the product is in regular production, the designer closes the project, whereas the production agency faces difficulties in bulk production and certain amendments would be required to the drawings and specifications. Also, there would be a need to introduce additional QA measures based on the feedback from the producer and user. Hence, there is a need for constant upgradation of the product by the designer in terms of quality and performance. Generally, this is lacking from the designer.

(h) After finalisation of the design, the drawings and specifications are issued as 'provisional' documents. Based on the production problems and feedback from the user, the product specifications and drawings are to be changed. However, the latter part does not take place. It is pertinent to note that the **specifications issued in 1952 for the 1,000 lb bomb are still 'provisional'. Till date, almost all the specifications issued for air armament stores are still 'provisional'**. The designer has never made efforts to issue final specifications and drawings.

(j) The DRDO is reluctant to accept positive criticism about the performance and quality of the design. The deficiencies in design are never accepted. The user always compares the product with a similar item from abroad. If the performance is not up to the expectations, it would be better to classify the item as Mark-1 and try to design a better product as the Mark-2 version. This system is not followed.

(k) Aircraft availability for flight trial becomes critical if the aircraft serviceability is low and the commitments of the Services are high. In case the R&D team conducts extensive ground trials and has a high degree of confidence in their ground tests, the air armament weapon systems could be cleared with a minimum number of flight trials.

System Deficiencies at OFB

(a) OFB is a production organisation. R&D is not their core competency. The primary effort of any ordnance factory is to chase targets and increase production turnover. The man-hours spent by the workforce on R&D, which affect production, are not acceptable to the management. Therefore, R&D takes a back seat. Even if they are able to produce any item through reverse engineering, they are not able to complete the process of tests and documentation required for the qualification and airworthiness certification of air armament stores.

(b) Most of the products produced by OFB are meant for the ground forces. The entire staff of OFB i.e. officers and technicians are, therefore, used to the quality norms of the ground forces which are a little relaxed, when compared to those of the air armaments. Since the Quality Assurance/

In the case of the 450 kg HSLD bomb, the rejection at the casing stage is almost 75 per cent. This aspect is not reflected anywhere in the system audit.

Quality Control (QA/QC) requirements and proof testing of air armaments is much more stringent, OFB finds it difficult to produce items of the correct specification. Since the volume of orders for air armament stores is low compared to that of the ground forces, OFB is reluctant to take up the air armament task.

(c) The old industrial employees of OFB are not educated. Most of the old technicians are 8th class qualified. Therefore, adherence to process schedules and process control is very difficult, and without this, quality products cannot be made. There is no practice of following a checklist by the technicians/ supervisors. It is based on memory and practice. Therefore, the possibility of non-adherence to the correct process cannot be ruled out.

(d) The industrial employees of OFB (below the Gp B officers) are entitled for financial incentives based on the number of items produced and overtime work. Since R&D is considered non-productive activity, the workforce does not come forward actively for such work. They need to be forced to work on R&D project. OFB also uses its best employees in production rather than R&D work. Therefore, R&D activities are non-starters.

(e) The technical involvement of middle level management is very low. They act as managers rather than as technical officers. Dependence on junior level managers, who do not possess the requisite knowledge of the armament systems, is of no use. Except for a few individuals, as a system, OFB cannot implement a fool-proof process of manufacture so as to provide a quality product. Generally, the factories are supposed to formulate a process schedule and follow it meticulously. Instead, they tend to follow whatever system in vogue which may not meet the process schedule and the gauge schedule. It is only when the QA agency objects about the production for non-adherence, that the system is followed. This attitude needs to be changed for improvement in quality.

(f) Because of strict quality norms, the number of gauges used in air armament systems is more compared to the items used for the ground forces. In case any component of the armament store is to be outsourced, the outsourced firm is to manufacture all the gauges to produce the item. Since there is no guarantee that the firm would again be in the L-1 category the next year, the firm either delays the production or seeks enhancement of cost. If the ordnance factories are given permission to indent the next five years' requirement in a phased manner from the trade sources, this problem could be alleviated.

ADEN gun ammunition is manufactured under ToT. The fuze 933 of this gun ammunition's testing is carried out as per the proof specification of 1946.

(g) The machines, jigs and fixtures are to be periodically calibrated. In practice, it is done mostly only on paper. Only the gauges are calibrated periodically but the jigs and fixtures are checked only when the quality is affected.

(h) There is no accountability for rejected items in a semi-finished condition. All higher officials seek the cost of the items produced. No one sees the cost of items rejected at each stage of manufacture. Since rejections at this stage are not monitored by the MoD, OFB adds the cost of the rejected material to the final finished product. In the case of the 450 kg HSLD bomb, the rejection at the casing stage is almost 75 per cent. This aspect is not reflected anywhere in the system audit. If an audit is conducted on the total raw material procured and the end product weight, the loss to the state could be assessed. Since the rejections are not monitored, it has become a practice to manufacture armament stores with minor deviations. Since such deviations are not acceptable to the air armament stores, indigenous stores cannot be made as per the expectations.

(j) Whenever ToT takes place, OFB does not sign any contract with the ToT firm for regular updates in product specifications as well as the proof specification. It may be noted that the ADEN gun ammunition is manufactured under ToT. The fuze 933 of this gun ammunition's

The existing process does not permit funding of any defence project to the private industry. Without the participation of the major players of the private industry, the new generation weapon systems cannot be indigenised.

testing is carried out as per the **proof specification of 1946**. All the designers and manufacturers need to update the technology and obtain the latest acceptance rejection criteria and the testing methodology. This is never looked into by OFB.

(k) The process schedules and process control documents are not available at the shop floor when any product is made. These are kept separately. Therefore, the process audit cannot be accomplished properly.

(l) The promotion policies of OFB do not encourage professional competence. The management is concerned about the target quantity rather than the quality and adherence to process schedules. Unlike the armed forces where filtration is ensured at every rank, above Lieutenant Colonel/Wing Commander, this is not practised in the Ordnance Factories (OFs.)

(m) The OFB is not able to produce quality propellants for gun ammunition and rockets. Most of the propellants produced are with certain deviations. Clearance for using these propellants is given only after proof testing with the hardware. Since the propellants are in the boarder case at the time of manufacture, their performance might deteriorate during storage.

(n) A majority of the OFs are working on vintage technology in explosive filling and handling. Loss of human lives is not taken seriously. They are considered expendable as risks are involved in the handling of explosives. The entire process of handling of explosives needs to be brought at par with the European countries.

System Deficiencies at MoD

• The MoD depends heavily on the DRDO. The industry is considered a 'trader' rather than a 'partner'. The existing process does not permit funding of any defence project to the private industry. Without the participation

of the major players of the private industry, the new generation weapon systems cannot be indigenised. Design and development of air armament stores is a complicated process, considering the requirements of flight safety. Only an integrated approach would be a viable option. Dependence on DRDO alone would delay the process. The industry, which has the requisite technology for manufacturing the hardware, needs to be taken as a 'partner' rather than a 'vendor'. The industry would come forward only when there is an assurance that its investment would get proper returns in developing the product. Therefore, the MoD needs to debate this issue and give suitable instructions to the Integrated Defence Staff (IDS) and DRDO. On many occasions, the industry involved in the development of the equipment does not get the contract when it is produced in bulk. Therefore, after a couple of experiences, they do not come forward for development activity.

Since there is no competition, the prices of indigenous air armament stores are very high compared to the imported stores, especially for bombs and rockets.

- The IDS had issued certain convening orders to the IAF for development of products of air armament stores. These would remain a paper exercise unless a separate expert team is formed for dedicated work on the project. When the IDS projects are received by the IAF, the concerned officials consider these as additional tasks. They tend to concentrate on the primary task. Therefore, a separate team needs to look into the IDS projects for indigenisation of air armament stores. Some of the project definitions are unrealistic to achieve. We cannot start running directly without learning how to walk. However, the projects defined are very ambitious. A realistic assessment is to be made to redefine/prioritise the projects.

- At present, the user does not sign any contract with OFB. Targets are decided and OFB issues the price list. Since there is no competition, the prices of indigenous air armament stores are very high compared to the imported stores, especially for bombs and rockets. The cost of a majority

It emerges from the above that the failure of indigenisation of air armaments is primarily due to lack of coordination and focus. of the indigenous bombs is double compared to the imported bombs. Moreover, OFB does not supply all the items of the bomb in one go. The warheads are supplied separately and the tail units are supplied separately. Also the items are not supplied on time. To improve, the efficiency of OFB, contracts may be signed with OFB by the user (as was done for Hindustan Aeronautics Limited – HAL) for time-bound supply and cost negotiations, comparing with the cost of items abroad.

- At present, the industry is not permitted to do the explosive filling. Therefore, the user has to place the indents on either OFB or ARDE or BDL for any armament products. To make it more competitive, the government needs to permit the industry to compete with OFB and BDL. The explosive filling may be retained with any government agency, if necessary.

- Every department tries to protect and defend its own system. The MoD may not get the correct picture of the problems of indigenous development. It would be better to have **an independent body working directly under the MoD, to link all the other departments (DRDO, user, OFB, DGAQA and CEMILLAC) for expeditious completion of the indigenisation task.** The team needs to assess the feasibility of realisation of the project within the given time-frame. Experts from each department/Service may be pooled to carry out this activity. The tenure of the task force team should be a minimum of five years, considering the gestation period of development projects.

ANALYSIS

It emerges from the above that the failure of indigenisation of air armaments is primarily due to lack of coordination and focus. Each department/Service has its own agenda in which indigenisation does not figure as a primary task. Since OFB is a production agency, the indigenisation projects should not be assigned to them. They may be involved by the respective R&D agency from

the beginning of development for expeditious bulk production. India has the largest pool of technical manpower. But we are import dependent mainly due to the non-involvement of industry as a partner and lack of thrust in every department. Giving the authority and accountability to a dedicated team, it will be possible to indigenise the low-tech weapons. Also, the existing weapons could be improved. For the development of high-tech weapons, we need to take industry and foreign companies as partners and make a beginning. Since we are considered one of

Certain posts should be created exclusively for indigenisation of air armament stores. The posts could be at Air HQ as well as at DRDO, MoD, IDS, etc.

the largest armed forces, we need to establish a credible weapon industry. So far, the focus has been only on the weapon delivery platform, not on the weapon itself. We feel satisfied that we are able to indigenise the fighter aircraft, but we need to remember that it would be carrying mostly imported weapons. Therefore, the deficiencies mentioned above need to be examined by an independent body and necessary policy changes are to be initiated in each organisation for achieving self-reliance.

RECOMMENDATIONS
The following are recommended:

IAF
(a) The IAF is a fighting force. All flying efforts are meant for ensuring the delivery of weapons. But the weapons and people handling the weapons are given least importance. The IAF needs to create an environment to enhance core competence in air armament activities. The P-Branch needs to deliberate on the system to be incorporated for enhancing the core competence in the field of air armaments. It should indicate the training, career profile and promotional avenues.

(b) Certain posts should be created exclusively for indigenisation of air armament stores. The posts could be at Air HQ as well as at DRDO, MoD, IDS, etc. The primary responsibility of the officers is indigenisation

The Op Branch may deliberate on the requirement to create a post of ACAS Weapons (Ops), who would come directly under the DG Ops (Air).

of air armament stores and improvement of the existing products. In fact, the IAF has not been sparing officers for the projects of air armaments.

(c)   The tenures of the project managers must be five years instead of two / three years.

(d)   The Op Branch may deliberate on the requirement to create a post of ACAS Weapons (Ops), who would come directly under the DG Ops (Air). The ACAS (Ops) could also take the responsibility of the operational utilisation role of equipment common to multiple fleets of Air Defence (AD) and Ground Aircraft (GA) role aircraft. Also, this directorate would be responsible for procurement of associated equipment of the main stores viz training weapons, belting machines, proof equipment, tools, manuals, mandatory spares, etc. At present, the weapon is procured by the Op Branch and role equipment and Tool Testers Ground Equipment (TTGE) are procured by the Maintenance Branch based on the inputs of the respective fleet's Op Directorate. In case the AVM rank post cannot be created, there could be at least an Air Cmde (PD Wpns), who could directly come under DG Ops (Air). This would ensure expeditious decisions on all aspects related to air armaments for the AD as well as GA roles.

(e)   Increase the number of officers posted to DASE and D Weapons in the Maintenance and Op Branches respectively.

(f)   Create better testing facilities at 28 ED for life extensions and defect investigations of imported and indigenous stores.

(g)   Indigenisation projects must not be given to OFB. All projects are to be given either to DRDO or the industry (if the government permits it to participate).

(h)   While formulating the SQRs, the Services need to indicate the associated equipment required for testing, storage and transportation. Since SQRs for associated equipment cannot be defined clearly, these must be mentioned in the project directive.

(j) When new products are to be developed, formulations of SQRs must be realistic and provide scope for improved versions as Mark-I, Mark-II, so on.

The remedial actions to be taken at DRDO, OFB and MoD have not been specified. Based on the deficiencies mentioned for each organisation, the respective organisation needs to introspect frankly. If need be, the MoD may form a committee of experts and find an amicable solution. Firstly, there must be will and resolve to give greater impetus to indigenisation. Then only, some tangible solutions would emerge.

India needs effective air-launched weapons of its own. Except for limited unguided weapons, India is not able to design modern guided weapons.

CONCLUSION

Considering the internal and external security scenario, India needs effective air-launched weapons of its own. Except for limited unguided weapons, India is not able to design modern guided weapons. The private industry has the technology to produce modern non-armament related equipment. If this is tapped and translated from generic technology into air armaments, we will be able to produce world class products. However, indigenisation of air armaments is a long drawn process. Unless the government introspects and takes certain radical measures, the blame game of DRDO vs. the user will continue and we will be depending on imports for another two/three decades. The deficiencies mentioned in each system need to be analysed and corrective measures undertaken. When we can send a satellite to space, we can also make a missile to hit a target. Only the resolve and implementation system is lacking.

PLAAF IN TRANSITION: 1979-93

VISHAL NIGAM

To learn knowledge and truth from the West in order to save China.

— Deng Xiaoping (1919)

The singular challenge not only for Asia, but the entire international community in the third quarter of the 20th century has been "the rise of China". Ashley J. Tellis and Michael D. Swaine have eloquently stated that "*this process is significant not only because it promises the internal transformation of one of the world's oldest civilizations, but also because, if concluded successfully, it could result in a dramatic power transition within the international system*"[1]. Beyond doubt, the future growth of China's national power as well as its military capabilities will greatly impact not only Asia but the world at large. China is well aware that its military inventory suffers from a major technological lag when compared to its neighbours and its adversaries, and it is whole-heartedly committed to the modernisation of its conventional forces in order to match up with its adversaries' military might, though not in a hurry but in a gradual and with a well thought out strategy.

The transition of the 'Middle Kingdom' to an economic power centre has also been acknowledged by contemporary political commentators like Robert Fogel, who predicted that the Chinese megacity dweller will be

---

* Wing Commander **Vishal Nigam** is a Research Fellow at the Centre for Air Power Studies, New Delhi.
1. Michael D. Swaine and Ashley Tellis, *Interpreting China's Grand Strategy: Past, Present and Future* (RAND: Santa Monica, CA, 2000), p. 1.

The most fundamental strategic interest of China since the late 1970s has been modernisation.

living twice as well the average Frenchman when China transits from being a poor country in 2000 to a superich country in 2040.[2] He also predicted that the Chinese economy will reach $123 trillion in the same year, all great fodder for it to grow not only as an economic superpower, but also modernise its obsolete military arsenal.

The most fundamental strategic interest of China since the late 1970s has been modernisation. The Chinese leadership had adopted a pragmatic approach to many political and socio-economic problems and sharply reduced the role of ideology in its economic policy. In fact, when we look at Deng's assessment that China's military modernisation could take place after its economy begins to grow, it was, indeed, spot on. He believed that modernisation of national defence could only be founded on development of agriculture and industry, which, in fact, was the Chinese perspective of security, dependent on its comprehensive development. The transition of the political leadership, economy, doctrine and strategy in the 1980s, leading to the process of modernisation of its defence, are all romantically intertwined and, therefore, a good case study to be analysed in that perspective.

TRANSITION

Deng Xiaoping's tryst with capitalism as well as China's process of a makeover dates back to Deng's early days in France, where he travelled as part of a work study programme.[3] The early exposure to the new kind of economic system in France had an overbearing influence, which transformed him into a more confident individual, who, in the future, would go on to lead China and transform its economy with a vision vastly different from his predecessors. In France, Deng studied Marxism and became a member of the Chinese Communist Youth League in Europe as well as the Chinese

2. Robert Fogel, Director of the Centre for Population Economics at the University of Chicago Booth School of Business and winner of 1993 Nobel Memorial Prize in Economics. The article was printed in the January/February 2010 issue of *Foreign Policy Journal*.
3. http://www.cbw.com/asm/xpdeng/life.html

Communist Party (CCP)[4]; on his return to China, he actively participated in the "Long March" and "Great Leap Forward". During the course, he was elevated to the post of General Secretary of the Secretariat and ran the country's daily affairs, along with President Liu Shaoqi, until both went barking up the wrong tree, by moving away from an ultra-leftist approach to a more pragmatic, right opportunist approach.

Deng, more pragmatic and a less defensive realist, fell out of Mao's favour during the Cultural Revolution and was purged from all his offices in the late 1960s. When Zhou fell ill with cancer, he was able to convince Mao to reinstate Deng in mainstream politics by appointing him as the first Vice Premier to run the daily affairs in 1974.[5] Zhou Enlai and Deng Xiaoping were both moderates favouring modernisation of all sectors of the economy. In January 1975, Zhou Enlai, speaking before the Fourth National People's Congress, outlined a programme of what came to be known as the *"Four Modernisations"*[6] for the four sectors of *agriculture, industry, science and technology and national defence.* In January 1975, Deng Xiaoping's position was solidified by his election as a Vice Chairman of the CCP, member of the Political Bureau and its Standing Committee as well as China's first civilian chief of the People's Liberation Army (PLA) General Staff Department. The year 1976 saw the death of three seniormost officials in the CCP and the state apparatus: Zhou Enlai in January, Zhu De in July, and Mao Zedong in September. After Zhou's death, demonstrations at the Tiananmen Square memorialising Zhou, however, did not go down well with Mao's supporters, putting China in a state of serious political uncertainty. Deng Xiaoping, who should have been the logical successor as Premier, received a temporary setback after Zhou's death for the second time, when radicals launched a major counter-assault against him. In April 1976, Deng was once again removed from all his public posts in favour of a relatively unknown, Hua Guofeng, who was named as acting Premier and the Party's first Vice Chairman. After Mao's death, the Central Committee exonerated Deng Xiaoping from responsibility for the Tiananmen Square incident and he

---

4. http://www-chaos.umd.edu/history/prc3.html#end_of_mao
5. http://www.cbw.com/asm/xpdeng/contents.html
6. http://www-chaos.umd.edu/history/prc3.html#end_of_mao

was reinstated to all the posts from which he had been removed in 1976. The Congress proclaimed the formal end of the Cultural Revolution, blamed it entirely on the Gang of Four, and reiterated that "*the fundamental task of the Party in the new historical period will be to build China into a modern, powerful, socialist country by the end of the twentieth century.*"

THIRD PLENUM: POLITICAL TRANSITION

The culmination of Deng's reascent to power and the start in earnest of political, economic, social, and cultural reforms were achieved at the Third Plenum of the Eleventh National Party Congress Central Committee in December, 1978. The *Third Plenum* is considered a major turning point in modern Chinese political history. "Left" mistakes committed before and during the Cultural Revolution were corrected and the *"two whatevers"* policy (support whatever policy decisions Mao made and follow whatever instructions Mao gave) was repudiated. The classic Party line calling for a protracted class struggle was officially exchanged for one promoting the "Four Modernisations". It was also highlighted that in the future, attainment of economic goals would be a measure of success or failure of policies and individual leadership.

Subsequently, a major brainstorming session was carried out at the Fourth Plenum of the Eleventh National Party Congress Central Committee, giving a "preliminary assessment" of the entire thirty-year period of Communist rule. The plenum also marked the official acceptance of a new ideological line that called for "seeking truth from facts" rather than the "two whatevers". The new Party hierarchy sought to assess, and close the books on the Maoist era and move on to the era of the *"Four Modernisations"*. The culmination of Deng's drive to consolidate his power and ensure the continuity of his reformist policies among his successors was the calling of the Twelfth National Party Congress in September 1982 and the Fifth Plenum of the Fifth National People's Congress in December 1982.[7]

---

7. http://www-chaos.umd.edu/history/toc.html

DOCTRINE AND STRATEGY

'Doctrine 'is the fundamental principle guiding those who use military force and 'strategy', on the other hand, is the way in which the military forces are to be utilised to achieve a desired outcome of an actual or potential conflict. Doctrine became a guide to new technology and weapons acquisition and China witnessed a paradigm shift from the concept that the "fight depends on the kind of arms" to a new axiom which is "build weapons to fight whatever kind of war"[8].

Active defence is a concept of deterrence through decisive engagement, which prescribes strategic defence and tactical offensive.

Although China did not have a formal public document stating its military strategy, military analysts have described it as "Active Defence". Active defence or offensive defence is a concept of deterrence through decisive engagement, which prescribes strategic defence and tactical offensive. What it implies is that though China does not fight or initiate wars of aggression, it engages in war only to defend its national sovereignty and territorial integrity to attack only after being attacked. The old concept of luring the enemy deep inside was changed to forward defence.[9] However, China's definition of initial attack as well as its perception of a perceived security threat has always been ambiguous.

The Chinese adopted a "weak-strong" strategy that used force and diplomacy selectively. It was a "calculative strategy" to protect China from external threats as it pursued its geo-political ascent, hence, allowed China to continue to reform its economy and evolve Comprehensive National Power (CNP) without having to deal with impediments and distractions of security competition.[10] Post Mao, the Chinese tried to develop a strategy to build CNP, and evaluate China's standing in relation to other nations. Hence, the Chinese have described their national

---

8. David Shambaugh, *Modernising China's Military, Progress, Problems and Prospects* (New Delhi: Bookmart Publishers, 2004), ch. 3, p. 60.
9. Lt. Gen. C.K. Kapur, *China's Military Modernisation* (New Delhi: Manas Publication, 2005), ch. 4, p. 57.
10. Swaine and Tellis, n. 1.

development *strategy* as a quest to increase China's *Comprehensive National Power*.[11]

DOCTRINAL TRANSITION

David Shambaugh in his writings has fluently explained the Chinese concept of "doctrine" which is "*military thought*" that translates to "*military guiding principles*".[12] As China's polity was transforming in the Seventies, it was also witnessing a silent doctrinal shift from "people's war" (1935-79) to "people's war under modern conditions" (1979-85). The doctrine further evolved to "limited war" (1985-91) and finally to "limited war under high-tech conditions". Richard D. Fisher has systematically evaluated the evolution of the PLA's operational doctrine in terms of its posture, dynamics, manpower and arms. The transition from engaging in a protracted war to a local war as well as from a defensive posture to an offensive one has been highlighted in Table 1. During this period, doctrine had been fundamental to military modernisation; at the same time, it had also been a catalyst for a vast range of PLA reforms: reconfiguring the force structure, professionalism, personnel recruitment, training, research and development, weapons procurements and operational strategy.[13]

Table 1: Evolution of PLA Operational Doctrine

Period	Nomenclature	Length	Posture	Dynamics	Manpower/Arms
Pre-1979	People's War	Protracted	Defence Dominant	Mobile Lure Enemy In Deep	Manpower Intensive/ Combination Of Regular And Local Militia
Post 1979	Local War Under Modern Conditions	Less Protracted	Defence Dominant	Positional Defence Of Borders And Cities	Less Manpower Intensive/ Combined Arms Mainly Ground Forces

11. Office of Secretary of Defence, *Annual Report to Congress, Military Power of PRC, 2009*, ch. 2, p. 11.
12. Shambaugh, n. 8, ch. 3, p. 58.
13. Ibid., p.56.

Post 1985	Local War Under Modern Conditions	Quick Battle Quick Resolution	Offensive: Gain Initiative By Striking First	Mobile Forward Deployment	Elite Forces And Sharp Arms/ Combined Arms Mainly Ground
Post 1996	Local Wars Under High-Tech Conditions	Quick Battle Quick Resolution	Offensive Dominant	Mobile Forward Deployment	Mechanised "Elite Forces And Sharp Arms" Local And Temporary Superiority/ Joint Service Operations

Source: Richard D Fisher Jr., *China's Military Modernisation: Building for Regional and Global* (UK: Praeger Security International, 2008).

VIETNAM WAR, 1979

Richard D. Fisher Jr articulately explains the Chinese psyche to engage in offensive wars to achieve victory in geo-strategic as well as operational results. Zbigniew Brzezinski, Carter's National Security Adviser (NSA), also described this particular trait of the Chinese with specific reference to the 1979 Sino-Vietnam conflict as the "*single most impressive demonstration of raw power politics*". To substantiate his argument, Fisher cites examples from the second Sino-Japanese War, where Mao waged a lacklustre war against the Japanese, hoping to exhaust his greater foe, the Kuomintang. Similarly, in the Korean War, he committed troops to impress Stalin, defeat the Americans, and assert authority over Korea, in the bargain, sacrificing 2,50,000 troops[14]. Also, when Vietnam signed the Treaty of Friendship and Cooperation with the Soviet Union in 1978, the Chinese not only described it as a military alliance, but went a step further to dub Vietnam as the "Cuba of the East" and ended up fighting a limited offensive war. Brzezinski's description of

---

14. Richard D. Fisher, *China's Military Modernisation Building for Regional and Global Reach* (UK: Praeger Security International, 2008), ch. 1, p. 8.

Historically, the Chinese have always lived under a constant veil of insecurity. raw power politics comprised China's geo-political[15] insecurity and "teach a lesson model"[16], which by now was entrenched in its psyche.

Historically, the Chinese have always lived under a constant veil of insecurity. As long as Vietnam was divided, it posed no threat to China, and Beijing continued to support Vietnamese Communists with millions of dollars of aid along with rifles and guns free of charge. The unification of Vietnam, the souring of Sino-Soviet relations and the greater role of Russia in a unified Vietnam made China itchy—it wanted Vietnam to cut all relations with Russia, which was refused outright. Deng, profoundly hurt by what he considered Vietnamese ingratitude, stopped aid and started withdrawing all support extended to Vietnam. Simultaneously, he also initiated a fierce diplomatic campaign denigrating Vietnam and projecting it as an instrument of Soviet hegemony. Deng visited America and Japan to lobby against Vietnam, where he openly expressed the intention of teaching Vietnam a lesson. Deng, however, assured that the war would be a limited offensive, and the Americans in their own way were delighted by China's doggedness to take a tough stand against the Vietnamese[17]. The Chinese started financing the Khmer Rouge in Cambodia to open up a second front for Vietnam and, as a result, the Khmer Rouge launched ferocious attacks on Vietnam from 1975-78. Vietnam responded by invading Cambodia and toppling the regime, which finally ended up in the 1979 Sino-Vietnam conflict.

As against the common perception, the PLA Air Force (PLAAF) was substantially mobilised during the 1979 Vietnam War. The campaign,

---

15. 'Geo-politics' is the art of using political power over a given territory. The term was coined by Rudolf Kjellen, a Swedish political scientist, at the beginning of the 20th century. Henry Kissinger, defining 'geo-politics', stated that "one characteristics of geo-politics is inter-changeability of actors, that is, it really makes no intrinsic difference, whether the United States is in alliance with China against Japan or with Japan against China. What matters is all are playing the game of power politics."

16. British military analyst, Maj Gen Shelford Bidwell has credited China with enunciating a new form of war, which he called "Teach a Lesson Model".

17. G. D. Bakshi, "The Sino-Soviet War: Case Studies in Limited Wars", www.bharatrakshak monitorvolume 3(3).htm

however, was not planned with the broader aim of the PLAAF complementing the ground forces in terms of interceptors, providing close air support, battlefield air interdiction or, for that matter, offensive counter-air operations. The ground forces were happy to depend on the Surface-to-Air Missile (SAM)-2s to provide cover and defend against any air attack; thus, restricting the PLA's advance into the enemy territory to 30 miles, which was the range limitation of the SAM-2s. The role of the PLAAF, once again like in the Korean War,

Political considerations as well as lack of confidence in the PLAAF's ability to operate in a high threat environment restricted the use of air power in the conflict.

was mainly cosmetic, as it did not provide any air support to the ground forces. There is also one school of thought that sees the Vietnam campaign as a deliberate strategy on the part of Deng to make the PLA leadership rethink their tactics and evaluate the importance of air power in the overall strategy, when it comes to future high-tech wars, both total and limited[18].

The PLAAF had a substantial number of aircraft and manpower to take on the leaner Vietnamese Air Force. Rear Admiral James B. Linger and Dr A. James Gregor have mentioned in their writings that around 450 aircraft were deployed when Beijing decided to undertake the attack, which later increased to 950 at the peak of the conflict. The deployment consisted mainly of MiG-19s, along with few MiG-17s, MiG-21s, Q-5 and H-5, capable of carrying a 6,000 lb bomb load. These aircraft were deployed along the Vietnamese border, skirting a perimeter of a 250-mile radius from Hanoi. The political considerations as well as lack of confidence in the PLAAF's ability to operate in a high threat environment restricted the use of air power in the conflict. Notwithstanding, a few Chinese aircraft like the MiG-17/19, the Q-5 did manage to penetrate Vietnam's air space, making brief appearances near Lang Son and Lao Cai (Fig 1), though without firing a single shot. All in all, 5,500 were sorties flown by the PLAAF which included 600 penetrations in northern Vietnam.[19]

18. Discussion with Jayadeva Ranade, Distinguished Fellow, Centre for Air Power Studies, New Delhi.
19. RAdm James B. Linder (Retd) and Dr A. James Gregor , "The Chinese Communist Air Force in 'Punitive' War Against Vietnam," *Air University Review*, September-October 1981.

Fig 1

Source: Wikipedia

The ignominious defeat of the Chinese in at hands of the Vietnamese Army was indeed a "wake up call" for the Chinese. Gerald Segal, in his book *Defending China*, has mentioned that China's 1979 War against Vietnam was a complete failure: "China failed to force a Vietnamese withdrawal from Cambodia, end border clashes, failed to cast doubt on the strength of the Soviet power, failed to dispel the image of China as a paper tiger, and failed to draw the United States into an anti-Soviet coalition", hence, unable to meet any of its objective, it was nothing more than China's demonstration of "raw power politics". The Chinese military until now believed in an air defence strategy and invested in a large force of relatively cheap and technologically unsophisticated aircraft. While the defensive capability of the PLAAF had been recognised, the absence of the air combat role was conspicuous. Deng, aware of this limitation, strongly believed that in the future, air power would play a decisive role in any conflict and that there was an urgent need for it to be modernised.[20] It was, in fact, the Vietnam

20. Air Cmde R. V. Phadke , *People's Liberation Army Air Force: Shifting Air Power Balance and Challenges to India's Security* (2002), ch. 1, p. 3.

War which fundamentally changed the thinking of the Chinese political and military leadership guided by Deng, thus, defining the process of modernisation for China's defence in the years to come.

SOFT AND HARD TRANSITION

The PLAAF was in transition from an obsolete to a more advanced force structure in the coming decades. This transition involved upgrade of not only its hardware consisting of aircraft, missiles

Deng strongly believed that in the future, air power would play a decisive role in any conflict and that there was an urgent need for it to be modernised.

and weapon systems but also refurbishing of its systems like organisation, personnel, training, doctrine, logistics and maintenance which are referred to as 'software'. Both the hardware and software aspects are interdependant and play a vital role; however, at times, there is a tendency to overstate the importance of hardware and ignore the software aspect while looking at modernisation of the armed forces. During the course of this transition, various aspects of software like organisation, leadership, training and doctrine as well as the hardware aspects can be analysed to understand the process of transition.

ORGANISATIONAL TRANSITION

The PLAAF is traditionally divided into five branches which are aviation, Anti-Aircraft Artillery (AAA), Surface-to-Air-Missiles (SAMs), radar and airborne troops, listed in the order of protocol. There is a clear distinction between 'aviation', which includes aircraft and 'air defence' which includes AAA, SAMs and radars.

The PLAAF's chain of command flows from Headquarters Air Force down to Military Region Air Force (MRAF), air corps, command posts, bases and operational units. The MRAFs were organised to control large geographic areas, aligned with the ground forces' Military Region (MR) to provide air defence to strategic areas and support to ground and naval forces. They were also responsible to provide logistics and maintenance support to lower formations. Realignment of MRAFs had taken place on

PLAAF training suffered during the Cultural Revolution, adversely affecting its institutions.

a number of occasions since the formation of the PLAAF, but the reduction from eleven to seven took place in 1985 and since then, has been more or less static.

The air corps was established to control more than one division within the MRAF and command posts were established to control aircraft and air defence assets deployed to, or operating in, a special area. As the PLAAF reorganised itself, eight of the thirteen air corps[21] were either abolished or downgraded to command posts. This was done with the intention of making the organisation more operational by eliminating the unnecessary administrative functions. Finally, by 1993, all command posts[22] with the exception of Lhasa were further reorganised as bases, in response to the PLA's plan of overall reduction in forces in the 1980s.[23]

The Air Defence Forces (ADF) command post was merged with the PLAAF in 1957. Out of the seven deputy commanders in the hierarchy of the PLAAF, two were nominated from the erstwhile ADF. The PLAAF's organisation structure changed from three core first level departments consisting of headquarters, political and logistics in the 1970s to four first level departments, by adding aeronautical engineering in 1976 to its structure. This was later changed to equipment–technical department in 1992 and once again in 1998 to the General Armament Department (GAD). Since then, the structure has, by and large, remained the same.

TRAINING

PLAAF training suffered during the Cultural Revolution, adversely affecting its institutions. Pilot training was reduced from 30 months to 12 months, theory classes stopped, literally crippling the growth of the PLAAF. The

---

21. The five active air corps were 1st/Changchun, 7th/Nanning, 8th/Fuzhou, 9th/Wulumuqi and 10th/Datong

22. The seven existing command posts were Dalian, Tangshan, Xian, Shanghai, Wuhan, Kunming and Lhasa.

23. This section on organisational transition is adapted from the writings of Kenneth Allen, senior analyst at the CNA corporation, who has descriptively analysed the organisation structure of the PLAAF during this period.

entire training system had to be revamped to get the PLAAF once again back on track. The operational pilot training was the biggest challenge due to the ageing fleet, limited flying and rudimentary simulator systems.

The PLAAF was, thus, training hard to adapt to combat situations in future high-tech conflicts.

The philosophy for selection and training too required a change as the PLAAF had started recruiting high school and graduate students to undergo pilot training. The training was spread over three phases, consisting of 20 months at the basic flight school, followed by 28 months at the flying academy and finally four to five years of operational flying in a unit. However, by the middle of the 1980s, the PLAAF began to experiment with an additional fourth phase, wherein the third phase for fighter and ground attack pilots was restricted to one year conversion at a transition training base followed by the fourth phase of a slightly truncated version of old operational flying training at units. The programme was finalised in July 1988, when the Central Military Commission (CMC) authorised each MRAF to establish a transition training base.[24]

The PLAAF during this period of transition placed great emphasis on training at several levels for officers as well as for soldiers. In the case of officers, basic training at the academy was followed by a stint at the Command College for mid-level/senior level commanders, followed by training at the National Defence University. Operationally, however, they were being continuously trained towards understanding the importance of intra-Service and joint-Service exercises.

Much has been said about the PLAAF training, quality of pilots and awareness of air combat strategy. Since the late 1980s, the PLAAF started making concerted efforts to focus on realistic training. In 1987, the PLAAF established a Flight Test and Training Centre at Cangzhou airfield near Tianjin (Hebei province), to test new aircraft under development, train pilots on new types of aircraft and devise new air combat tactics. Since then, it

---

24. Kenneth W. Allen,Glenn Krumel, Jonathan D. Pollack, *China's Air Force Enters the 21st Century* (RAND), ch. 7, p. 130.

has been carrying out interesting studies on combat, such as manoeuvrable combat, air attack, fighting for air supremacy as well as night attack and defence. The PLAAF was, thus, training hard to adapt to combat situations in future high-tech conflicts. These tactics were tested and thereafter disseminated to units, where they were incorporated in live exercises. However, the PLAAF's inhibition to employ multi-mission tasking because of its orientation towards single missions, irrespective of the capability of the aircraft, has been a challenge which it needs to overcome through continued training. The PLAAF's tactical training and simulator flying has helped make up for the limitations and it effectively conducts more than 90 percent of its tactical training on simulators.

In 1958, the PLAAF also constructed a large centre for testing its Air-to-Air Missiles (AAMs) and SAMs in the Gobi Desert near Dingxin in Gansu province. In the late Eighties and early Nineties, the PLAAF upgraded the facilities at Dingxin, created a separate range and set up a tactical training centre in association with the one set up at Cangzhou. The Jiuquan Space Centre was established with a sophisticated command and control centre, air and ground tactical training ranges, simulated runways built to scale, radar, simulated enemy command posts, ammunition and oil depots, along with a large number of simulated tanks deployed in combat position as well as a mock Taiwanese air base, Chingchuankang. The PLAAF units could converge at the Gobi Desert and practise tactics developed at Cangzhou in a close to a real combat environment.[25]

As a result of these changes in training, PLAAF pilots have been noted flying in more sophisticated simulated air-to-air combat with the aggressor units, training in an Electronic Counter-Measures (ECM) environment, flying over the Taiwan Strait and East China Sea, conducting live missile firings beyond the coast, dropping live bombs at ranges, and flying at low altitudes, by day and night, under different weather conditions. They have also practised emergency mobility deployments to permanent and auxiliary airfields within and outside their assigned MRs. All these changes in the

---

25. "PLA Air Force Organisation and Modernisation," http/www.china-defense.com/aviation/ plaaf-ops/plaaf-ops_10.html

training pattern will show up positively when the PLAAF pilots have to engage in future combat.

WANG HAI EFFECT

Although the PLAAF has been described as "an independent Service", it continues to work in the shadow of the army. The fundamental question that remains is whether the PLAAF will free itself from the clutches of the PLA and also exercise the necessary clout, responsibilities and autonomy in the future. One reason for the PLAAF to be kept subservient to the PLA could have been the Lin Biao and Wu Faxian nexus towards an abortive coup against Mao in 1971. Deng too, sceptical, after he gained control of the Chinese Communist Party (CCP) in 1978, wanted to go slow and assert some kind of authority over the so-called 'metaphorically' dangerous Service and, hence, planted a number of political heavyweights into the PLAAF.

All PLAAF commanders until 1985 were army officers, transferred into air force command positions. Wang Hai, became the first aviator to take over as commander of the PLAAF. His experience in the Korean War, having shot down nine US aircraft and being awarded a 'war hero' title, helped him to understand air power better than his earlier non-aviator commanders. He had risen from the ranks, and had worked at various levels as a flight commander, deputy division commander, division commander and deputy commander before being appointed the commander of Guangzhou MRAF in 1975. He saw the 1979 Sino-Vietnam conflict from close quarters, which helped him draw a roadmap for the future PLAAF. In 1985, Wang Hai was appointed as the PLAAF Commander and Deputy Party Secretary in the Chinese People's Political Consultative Conference (CPPCC)[26]. This was also the first time that a PLAAF Commander was appointed as a member of the CPPCC. Earlier, Liu Yalou, Wu Faxian, Zhang Tingfa and Gao Houliang were PLAAF Commanders or Political Commissars, who were appointed as members of the Politburo or the Central Military Commission (CMC), but none prior to Wang Hai became members of the CPCC.

26. http://www.sd.xinhuanet.com/sdsq/2006-03/02/content_6366248.htm

Wang Hai identified three parameters in air power: manoeuvrability, firepower and use of electronic warfare.

Wang Hai defined the roadmap for the PLAAF's transition and demonstrated how modern technology could change the role of air power and revolutionise the concept of future wars. He identified three parameters in air power: manoeuvrability, firepower and use of electronic warfare. He also emphasised the tremendous impact that airlift capability could have on quick mobility of troops which, in turn, would have an adverse impact on the enemy. Use of aerial platforms for information, intelligence gathering and electronic warfare too would be important tools to expose the enemy's strategic intention along with its deployment and movement of troops. Hence, the PLA, without effective use of air power and its applications, would become deaf and mute.[27]. The importance of contact with foreign air forces was also overtly emphasised and a number of delegations were sent and received during this period. Zhu Guang became the first political commissar to ever travel abroad when he visited America in 1988, thus, setting a trend for the later political commissars, who visited Cuba, Portugal and Turkey. The exposure to the world air forces influenced the thinking of not only the present leaders but also exposed the future leadership in their thought process which would show effects in the years to come.

It was Wang Hai who formally laid out a plan in 1987 that the PLAAF could simultaneously have both offensive and defensive capability. He emphasised that the combined arms combat environment required a force that could move quickly over long distance, fight in an electronic environment, possess the capability to attack an enemy and, at the same time, secure the PLAAF from sustaining damage from an enemy air attack. However, it was in 1996 that the CMC, along with PLAAF leadership, started reemphasising publicly about the PLAAF's capability to fight an offensive air battle.

---

27. You Ji, *The Armed Forces of China* (UK: IB Taurus Publishers), ch. 5, p. 126.

PLAAF TRANSITION

The Air-Land Battle doctrine that reviewed US Army tactical doctrine in the post-Vietnam War era, was carried out by the US Army Training and Doctrine Command (TRADOC) in the 1970s and published in 1981. The concept was to involve close interaction between all air and ground capabilities in future conflicts. The PLAAF's literature concentrated on strategy and campaigns, but did not explicitly discuss any specific doctrine. In the 1980s, after the Sino-Vietnam conflict, the PLAAF may have been influenced by the American Air-Land Battle doctrine, since there appeared to be an apparent shift in Chinese air power strategy and concepts, where the PLAAF's role was expanded to include the dual responsibility of defending the Chinese air space and supporting the ground forces. However, during this period, there existed a stark gap between its aspirations and capabilities and it was this gap that the PLAAF was seeking to narrow during the period of transition.

The PLAAF's role was expanded to include the dual responsibility of defending the Chinese air space and supporting the ground forces.

Historically, the defensive nature of the people's war doctrine which had been prevalent for many years could have also dampened the PLAAF's resolve to redefine the role of air power. It may be observed that through the 1950s to the later part of the 1970s, the PLAAF lacked the vision with regard to different kinds of air combat missions like offensive counter-air operations, close air support, battlefield interdiction and state-of-the-art command and control systems, never a part of the PLAAF's calculus. This was not only evident in the Korean War but also during the 1979 Sino-Vietnam conflict. However, post the Sino-Vietnam conflict, there was an apparent shift from the traditional defensive posture to an offensive one, where the PLAAF appeared to have started thinking on the lines of incorporating such mission statements in its combat strategy.

The other objective of the PLAAF in this period of transition was to improve its deterrent capability by strengthening its airborne forces, increasing its strategic reach and enhancing its quick mobility capabilities. It saw itself more likely to be engaged in local wars, hence, possessing the

The PLAAF's main focus was on modernising six core combat capabilities: air superiority, ground attack, transporting troops, reconnaissance, AEW, and logistics and maintenance. capability to end the war quickly and also at the same time, attaining the political objectives. To meet this objective, the PLAAF established a rapid reaction force within each theatre of operation, to include at least one fighter division in every battle area. Each division would then have a force package of three fighter regiments, one ground attack, one Airborne Early Warning (AEW), one ECM regiment, one reconnaissance aircraft along with a reliable intelligence network comprising one Electronic Warfare (EW) aircraft.

In terms of air power, the PLAAF's main focus was on modernising six core combat capabilities: air superiority, ground attack, transporting troops, reconnaissance, AEW, and logistics and maintenance. It started to believe that air superiority, development of technology, firepower, manoeuvrability and control of electronic means were all critical, without which strategic objectives could not be achieved. Hence, the PLAAF, in its combat strategy, initiated considerable reforms in force structure, training, and weapon systems. It defined its role with greater clarity, listing out areas of responsibility in terms of its offensive capability, control of the air, air strike as well as air defence. Use of specific weapon systems to accomplish special missions was also adequately discussed. Concepts like air deterrence and Beyond Visual Range (BVR) weapons are examples of some concepts which influenced the strategic thinkers of the PLAAF.[28] Also, the realisation that any future war would have to be multi-dimensional, involving land, sea, air and space had an overbearing influence on the Chinese psyche. The period of transition witnessed the PLAAF breaking away from the shackles of being subservient and evolving as an independent force with laid down objectives.

TRANSITION FROM DEFENSIVE TO OFFENSIVE AIR CAMPAIGN
An 'offensive campaign' has been articulately explained by R. McCabe of the US Air Force (USAF), as one which seeks to maximise the enemy's

28. Ibid., ch. 5, p.125.

weaknesses by "moving the battlefield as far as possible toward the enemy's side" and forcing the enemy to fight on the defensive at China's initiative. It intends to exploit air and space power's advantages of initiative, versatility, and suddenness. The campaign can either stand alone as an independent air force effort or, far more likely, become part of an integrated joint campaign of surface-to-surface missiles, special operations forces, electronic and information strikes, and attacks by aircraft.[29]

It took the PLA thirty years to realise, *"that the largest obstacle for any ground force or a united campaign came from the air".*

Historically, the PLAAF had never been an offensive air force, probably because of its own limitation in terms of capability. The PLAAF's inventory of its frontline aircraft in the 1980s was obsolete, with limited capability to operate at night, in bad weather or in an ECM environment. The strategic bombers like the H-5/H-6 were far inferior to the bomber force possessed by its adversaries and neighbours, as they were incapable of launching an air-to-air campaign, airfield attacks and Suppression of Enemy Air Defence (SEAD). The PLAAF's participation in close air support, battlefield air interdiction, and interdiction had also been limited. Its force of attack aircraft was ill-equipped and the crews not adequately trained to provide direct support to ground units. Hence, the PLAAF, over the years, had been a defensive force, merely supporting the role in any offensive campaign, with the major burden carried by the missiles.

It took the PLA thirty years to realise, "*that the largest obstacle for any ground force or a united campaign came from the air*". The impact of air power was evident from multiple payloads, pinpoint targeting, strategic bombing and troop mobilisation, which could frustrate any adversary. Given the condition of the antiquated PLAAF, the ground forces had started acknowledging that air attack by a potential enemy would be the greatest challenge in future high-tech wars. This major shift could have been a basis for a transition, where the PLAAF was literally pushed into developing

---

29. Lt. Col. R. McCabe, USAF , "Chinese Air Force and Air and Space Power", *Air and Space Power Journal*, Fall, September 2003.

offensive capabilities in terms of control of air, air strike and air defence, to be able to participate in joint operations.

The transition from a 'defensive air force' to an 'offensive air force' also coincided with the process of modernisation, which included restructuring, enhanced training and hardware upgrades. The Chinese had noticed and absorbed these changes taking place in other air forces around the world. They carefully studied the American Air-Land doctrine, analysed the force structure of the US Air Force (USAF) and the Russian Air Force in the late 1980s and early 1990s and observed that the USSR had reduced its fighter jets by 55 percent and the Americans by 24 percent[30], because in high-tech conditions, simple function fighters could not establish air superiority or a level of deterrence and, hence, had to be replaced by multi-role aircraft. In the late 1980s, the PLAAF tabled a proposal to reduce the fighter jets from 70 to 55 percent and strengthen itself with specialised function aircraft like Airborne Warning and Control System (AWACS), aerial refuelling, large transport aircraft, electronic warfare and reconnaissance aircraft.[31]

The PLAAF was transforming to conduct major air battles far away from home, thereby, enhancing the size of its air war zone so that the distinction between the air defence front line and in depth strike zone becomes fuzzy. As an offensive force, the PLAAF required to prepare itself not only for strategic targets in the enemy's rear but also for defence against the opponent's aircraft and long distance missile strikes. Future wars would be a product of information and high technology, weaponry and air power. Acceptance of air power being a part of the decision-making apparatus, and an independent instrument for application of state interest and integration in the context of a joint campaign[32] can be seen in the context of transition from a historically defensive force air force to an offensive one.

---

30. You ji, n. 27, ch. 5, p. 133.
31. Ibid., p. 137.
32. Ashley J. Tellis, Senior Associate, Carnegie Endowment for International Peace, Washington, Talk at CAPS on the PLAAF on April 28, 2010.

HARD TRANSITION

It has been a long journey for the PLAAF since 1949, born out of a cocktail of a few hundred obsolescent aircraft. The Chinese had consolidated brilliantly and by 1954, set up 28 divisions consisting of more than 3,000 aircraft. It was further expanded to 50 divisions, which remained pretty static until the mid-1980s; thereafter, they were reduced to 32 divisions. The PLAAF inventory, for a considerable time, consisted of aircraft of the 1950s and 1960s technology, like the J-5, J-6, Yakovlev, Lavochkin and the IL-10. Though these aircraft were world class in their times, they were now no more than a 'junkyard'.

The workhorses of the PLAAF during this period were the J-6, second generation fighter and Q-5 ground attack aircraft, both variants of the MiG-19. The J-6 made up the bulk in the PLAAF inventory through the 1960s till the turn of the century, with more than 3,000 aircraft. The Q-5 was a close air support aircraft with ground attack and air-to-air combat capabilities. Although, the Q-5 was capable of carrying a nuclear payload, it was limited by its relatively short range (about 800 km radius of action) and primitive avionics. The H-5 was the Chinese version of the Soviet IL-28, medium bomber which served as the PLAAF's primary dedicated bomber. The H-5's effectiveness in a traditional bombing role was once again limited by its range and slow speed, which made it highly vulnerable to modern air defence systems.[33] These aircraft were far inferior in technology, avionics and radar systems to many aircraft possessed by countries in the neighbourhood[34] as is evident from the capability tabulated in Table 2.

33. The Chinese use standard designators for their military aircraft. "J" (Jian) is a designator for fighters, "Q" (Qiang) for ground attack, "H"(Hongzha) for bombers,"Y"(Yun) for transport and "Z" (Zhi)for helicopters.
34. Roy Kamphausen and Andrew Scobell "Right-Sizing the People's Liberation Army: Exploring the Contours of China's Military", in Philip C. Saunders and Erik Quam, *Future Force Structure of Chinese Air Force*, ch. 8, p. 387.

Table 2: Role and Capability of PLAAF Aircraft in the 1980s

Type	Derivative	Role	Combat Radius	Payload
J-6	MiG-19	Fighter	600 km	Pl2/Pl5 AAM, 250 kg bomb
Q-5	MiG-19	Ground Attack	600 km	Pl2, Pl5,Pl7 AAM, Bl 755 Cluster Bombs, Durandal Anti-Runway Bombs
J-7	MiG-21	3rd Gen Fighter	800 km	Pl2,Pl5,Pl7, Pl8,Pl9 AAM, R 550 Magic,[35] 500 kg Bomb
J-8	-	3rd Gen Fighter	800 km	Pl2, Pl5, Pl8, Pl12 AAM, 1,500 kg Bombs
H-5	Il-28	Med Bomber	1,000 km	3,000 kg Internal Bombs
H-6	Tu-16	Bomber	2,000 km	9,000 kg

Source: Compiled from Wikipedia, FAS and Jane's.

The J-5 and J-6, which had reached the end of their service life, were being gradually phased out. Dr You Ji mentions that the PLAAF scrapped over 6,000 old aircraft in the 1980s, of which J-5 and J-6 constituted a large chunk, profoundly affecting the PLAAF's overall size in the later part of 1980.[36] The force structure of the PLAAF increased linearly until the mid-1980s except for a brief period during the Cultural Revolution. It peaked in the mid-1980s and thereafter showed signs of decline as the bulk of the aircraft had reached the end of their service life. Fig 2 illustrates that the J-6, which had been the workhorse for the PLAAF, was being gradually replaced with variants of the J-7, J-8 and future fourth generation aircraft. Since the replacement of the combat aircraft was not on a one-to-one basis, as was evident from the production line in the 1980s (Table 3), the force structure of the fighters in the PLAAF declined in the 1990s, though a majority of its fighter aircraft still consisted of the J-6. Analysis of Fig 2 and Table 3 gives a fairly good picture of the dynamics of the force structure from 1954-93 and also draws out an excellent sketch of the combat capability of the PLAAF. Induction of the

35. Paul Jackson, ed., "J-7B Version with R550 Capability was Supplied to Egypt and Iraq in 1982-83," *Jane's All the World's Aircraft 2006-07*.
36. n. 27, ch. 5, p. 134.

J-7 and J-8 was a logical step to augment the depleting force structure of the PLAAF in the 1980s and 1990s.

Fig 2: China's Combat Aircraft
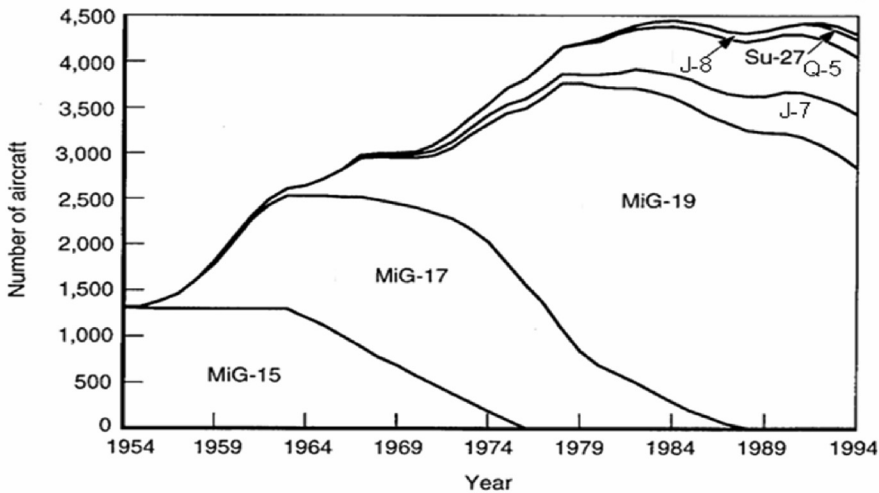
Chinese Jet Fighter Inventory, 1954–1994

Source: Kenneth W. Allen, Glenn Krumel, Jonathan D. Pollack,

China's Air Force Enters the 21st Century (RAND).

Table 3: China's Annual Combat Aircraft Production
For Domestic Use (1980-1992)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
J 6	150	-	-	-	-	-	-	-	-	-	-	-	-
J7 I	-	40	50	50	50	50	50	50	50	50	50		
J7 III												24	24
J8		10	18	18	18	18	18	18					
J8II												12	12
H5	20	20	20										
H6	6	6	6	6	6	66	6	6	6	6	6		
Q 5 Production Stopped in 1975													

Source: Srikanth Kondapalli, *China's Military* (New Delhi: Knowledge World, 1999).

To fill the void created by the existing technological gap and the force structure, the Chinese produced variants of the J-7 and J-8 in the 1980s as replacement for the obsolete second generation J-6. Ironically, both the J-7 and J-8 were aircraft of 1960s vintage and nothing more than marginally 'advanced' obsolete aircraft in the 1980s,[37] far behind the capabilities of the fourth generation aircraft deployed by Russia, America and China's neighbours.

TRANSITION TO J-7

In the 1960s, the Chinese started the development programme of the J-7 at the Shenyang Aircraft Factory based on incomplete technical data of the MiG-21F received from the Soviets. The static test on the J-7 was carried out in November 1965 and the first flight test was conducted in January 1966 with the WP-7 (WoPen)[38], the Chinese copy of the Soviet Tumansky R 11F -300 turbojet engine. The fighter was certified for production in 1967.

The J-7 production was reassigned to a newly built Chengdu Aircraft Industry Corporation (CAC) in Sichuan province. The production of the WP-7 was also handed over to the Liyang Aero Engine Company at Guizhou province in 1968. From 1969-75, Chengdu modified the J-7 design to roll out the J-7-I version in 1976. The programme was severely hampered by the Cultural Revolution, and when the first aircraft rolled out in 1976, it had already become obsolete. The J-7-I modernisation continued with upgrades in the avionics suite, airframe, weapon system and engine. The result was an upgraded version with the WP-7B engine, certified for production in 1979 and called the J-7-II.

The J-7 II upgrade was assisted by British GEC-Marconi. It included the 956 HUDWAC (Head-Up Display and Weapon Aiming Computer), Skyranger air-to-air ranging radar with anti-jamming capability, Air Data Computer (ADC), radar altimeter, IFF (Identification of Friend or Foe), and a secured radio communication. After the 1989 Tiananmen incident, the GEC-Marconi Skyranger radar was replaced by the Italian Grifo 7 fire

---

37. Lt. Col. Patricia M. Fornes, "Modernising China's Air Force: It's Strategy, Budget and Capabilities", Research report submitted at the Air War College.
38. Chinese nomenclature for engines: HS(HuoSai: Piston engine), WJ (WoJiang: Turboprop), WP (Wopen: Turbojet), WS (WoShan: Turbofan), WZ (WoZhou: Turboshaft)

control radar with a range of more than 55 km[39]. Indigenous modifications of the weapon system, and airframe structure through computer aided design continued on the J-7-II. A rear view mirror, more fuel tanks under the dorsal fairing and an enlarged vertical fin were incorporated to improve the performance of the platform. The aircraft was fitted with pylons capable of carrying the PL7 AAM, Magic R 550, PL-2, PL-5 short-range AAM. The J-7 EB version was used for the aerobatic team fitted with smoke canisters.

However, the J-7-II lacked the capability for combat in all weather day/night conditions. The Chinese were eyeing the multi-role capability of the MiG-21 MF, which they were able to acquire from the Egyptians in 1979[40]. The CAC reverse engineered the MiG-21 MF with the help of computer aid design to roll out the first version of the J-7-III in 1984. The aircraft was fitted with the JL-7 (J band) multi-purpose pulse-Doppler fire control radar, target tracking using optical gun sight, IFF, HUD (Head Up Display), autopilot, ADC, radio altimeter, HF/VHF communication system, RWR along with chaff and flare dispensers. It was powered by the WP 13 turbojet engine, developed by Guizhou Liyang Aero Engine Company. The J-7-III lacked the 'punch' as its JL-7 fire control radar was unreliable, without BVR and 'look-down/shoot-down' capabilities, which by now were available on all major Western aircraft. The J-7D incorporated minor improvements over the J-7-III: an upgraded avionics suite, fire control radar and the engine replaced with a slightly more powerful WP-13 F1. The weapon capabilities were marginally enhanced to carry the PL-7 and PL-8, however, it was still lacking in BVR capabilities. Chengdu's attempt to reverse engineer the MiG-21 MF was not entirely successful and, hence, it reverted to the J-7-II design to develop an improved version, the J-7 E, for the PLA. This aircraft was first flown in 1992 and inducted in the PLAAF in 1995.

Improvements on the J-7E mainly focussed on aerodynamic performance and avionics. The original delta wing plan-form was replaced by the new "double-delta" design similar to that of the Russian Su-15 and Swedish Saab J-35 Draken and the engine changed with the WP-7F[41]. Avionics included the JT-1

---

39. http://www.sinodefence.com/airforce/fighter/j7.asp
40. http://www.sinodefence.com/airforce/fighter/j7.asp
41. Jackson, n. 35.

HUD, KW8602 RWR, 8430 ADC, JD-3 Tactical Aircraft Navigation (TACAN), KG-8605 internal radar noise jammer, and 941-4AC chaff/flare dispenser.

The J-7MG was an export variant developed by CAC based on the J-7E, with the WP 13F engine. The fighter was fitted with X-band British Marconi Electronic Systems and Super Sky Ranger pulse-Doppler fire-control radar. It had the 'look-down/shoot-down' capability and five working modes that could track up to eight targets simultaneously. The Marconi HUD, along with fire-control computer and a HOTAS (Hands On Throttle-and-Stick) improved the cockpit design and ergonomics to allow the pilot to fly the aircraft without taking his eyes off the horizon and HUD, thus, improving his situational awareness. The system could also be integrated with the Helmet-Mounted Display (HMS). It also featured a coloured Electronic Flight Control System (EFCS), Automatic Direction Finder (ADF), VHF Omni-directional Range (VOR), TACAN and Instrument Landing System (ILS).

The J-7 PG had been in service with the Pakistan Air Force (PAF) and was almost similar in configuration to the J-7MG. The J-7MG/PG series export fighter had been the most successful amongst the J-7 and, hence, Chengdu developed its domestic equivalent, the J-7G. The J-7G was equipped with an I/J-band KLJ-6E pulse-Doppler fire-control radar based on the Israeli EL/M2001, helmet mounted sighted AAM, new one-piece front windscreen for better cockpit visibility, Type III IFF, indigenous zero-height, zero-speed ejection seat and an improved ECM suite. The J-7G aircraft first flew in June 2002, and finally entered the PLAAF in 2004.

The CAC was also developing an updated version of the J-7 M under the Super-7 programme. The programme was a trilateral agreement among the US, China and Pakistan to replace the WP-7B/WP-13 engines with GE F-404. The project had to be shelved because of the sanctions imposed on China in 1989. The CAC, however, continued with the wind tunnel experiments of a completely configured Super 7 and rebranded the design as FC-1, a future fourth generation aircraft.[42]

---

42. http://www.sinodefence.com/airforce/fighter/fc1.asp

PEACE PEARL

The J-8 was the first indigenously designed aircraft in the PLAAF. The aircraft was built at Shenyang Aircraft Corporation (SAC) and designed at the 601 Aircraft Design Institute. It was an enlarged version of the J-7, with two WP-7 engines. The work on theoretical evaluation commenced in May 1964 at the Research Academy of the Chinese Military of Defence to produce a Mach 2 aircraft capable of intercepting the US B-58 and F-105. Within a year, the J-8 entered the engineering development phase with the first mock-up ready for inspection in December 1965, and the prototype production commenced in 1966. The first two prototypes rolled out in July 1968, and were flown on July 5, 1969. This programme was also interrupted because of the Cultural Revolution, and the test flights could not be completed until 1979. The J-8, mounted with delta shaped wings and two Liyang WP-7 aero-engines, finally entered service in 1981.[43]

Though the aircraft achieved more or less all the design targets, lack of modern avionics and armament capabilities did not give the J-8 any distinctive advantage over the J-7. Slow progress in developing the fire control radar and the unsuccessful trial of the PL-4, left the aircraft capable of carrying only a PL-2 IR homing short range AAM for air combat. Around 50 such aircraft were produced, and remained in service until 1990. The J-8-I was an improvement over the J-8, which included JL-7 monopulse fire control radar, SM-8A aeronautical gun sight, onboard computer, improvised cockpit panel along with a new ejection seat and an oxygen system. This aircraft went through its mid-life modernisation upgrade in 1990s, with an ECM suite and RWR, and was called the J-8 E.

The J-8-II was a redesigned J-8 developed once again by SAC. Thereafter, various versions of the upgraded J-8-II were alphabetically classified. The original nose air inlet of the J-8 was moved to the sides to provide space for a larger size radar. The two underpowered WP-7Bs were replaced by the more powerful WP-13 A II engines. The J-8B was the first variant of the upgraded J-8-I which flew its first flight in 1989.

43. "Sino-Defence," http://www.sinodefence.com/airforce/fighter/j8.asp

The upgrade included a Type 208A mono-pulse fire control radar with extended range coupled with an interception fire control computer, HK 13 E HUD, JD-3II TACAN. The later version of the J-8B was upgraded with the KLJ-1 pulse-Doppler fire control radar and KJ-8602A RWR. Capability to carry the semi-active radar homing MRAAM and air-to-ground rockets, along with an auto pilot, were added to the J-8,[44] but the J-8B still lacked the BVR combat capability, mainly because of its ineffective fire control radar.

To address various limitations in the J-8-II, China decided to get into a military alliance with the US. This was the largest $550 million Foreign Military Sales (FMS) agreement between the US and China to upgrade the J-8-II interceptor aircraft by Grumman under the "Peace Pearl" project. This involved 42 Chinese military officers working on the joint arms project with the United States at Grumman Corp in Bethage, NY and Wright–Patterson AFB near Dayton, Ohio.[45] The upgrade package for the 50 aircraft included the Westinghouse APG-66V radar (also fitted on the F-16), 1553B MIL-STD data bus, fire control computer, HUD, cockpit Multi-Functional Display (MFD), navigation system and ejection seat. The urgency to grab the deal, coupled with the PLAAF's obsession with secrecy, prevented Grumman from understanding the cockpit of each of the 50 Chinese aircraft, which were unique and, hence, required individual adjustment, leading to cost overruns.[46] However, the project was short-lived and cancelled post-1989 Tiananmen Square incident, as part of the sanctions imposed by America and the West on China.

Following the cancellation of the "Peace Pearl" project, the SAC continued to upgrade the J-8II, possibly with the assistance of Israel or Russia. In the early 1990s, Shenyang proposed a radically upgraded variant, the J-8C (also known as the J-8III) featuring new avionics and power plant, which would eventually bring the fighter into the same league as modern

44. Ibid.
45. "US Allows Chinese Military Back Into Joint Arms Project," *The Washington Post*, October 29, 1989.
46. Thomas L. Wilborn, "Security Cooperation With China: Analysis and a Proposal", November 25, 1994, Strategic Studies Institute.

Russian and Western combat aircraft like the MiG-29 and Mirage 2000-V. The J-8C programme entered full scale development around 1991 and the aircraft first flew successfully in 1993.

The J-8C was an upgraded J-8-II, which included a new multi-mode pulse-Doppler radar based on the Israeli Elta EL/M 2035 radar technology. It was also equipped with a digital fire-control system and a new glass cockpit with Multi-Functional Displays (MFD). The aircraft's original WP-13 A II turbojet engine was replaced by the more powerful WP-14 turbojet then being developed by Shenyang Liming Aero-Engine Company[47]. The J-8C project in the late 1990s had to be shelved in favour of the SU 27/J11, but the same technology was later used in developing the J-8F.

The J-8D was a modified J-8, with a fixed refuelling probe on the starboard side of the cockpit. The first hook-on with the H-6 tanker took place in the early 1990s; however, the PLAAF demonstrated its capability of air-to-air refuelling to the world on October 01, 1999. The air-to-air refuelling was a big boost, as it increased the combat radius of the J-8 from 800 km to 1,200 km.

The J-8F was an improved variant of the J-8C with a stiffened nose and two wing fences on each wing. It was also regarded as the first true 'multi-role' fighter, hence, the most capable variant in the J-8II family. New features in the J-8F included a glass cockpit, a more powerful WP-13 B II engine, new fire-control radar (JL-10) with the capability of a radio command transmitter to provide mid-course correction to its PL 12 MRAAM during a BVR attack. It was also capable of guiding the R-27 and R-77 along with an enhanced air-to-air and air-to-sea modes of firing precision guided armaments, including laser or satellite guided bombs. The J-8F could also be fitted with a fixed in-flight refuelling probe.

The SAC was now able to upgrade the J-8II with Russian technology because of the turnaround in the Sino-Russian relations in the early 1990s. The J-8IIM, intended primarily for the export market, featured with the Russian Phazotron Zhuk-8II pulse-Doppler fire-control radar specially tailored for the J-8II fighter, coupled with the Vympel R-27R1 (NATO

---

47. n. 43.

codenamed AA10), semi-active radar-homing MRAAM. The package provided the J-8IIM with 'real' BVR combat capability and the aircraft was flown successfully on March 31, 1996.

The J-8II ACT (Active Control Technology) was a technology demonstrator, designed for studying and testing the 'Fly-By-Wire' (FBW) technology. The aircraft, was based on the J-8II airframe, with a shorter fuselage and a pair of front canards just behind the air inlets. The J-8II ACT was introduced in the 1990s to replace the older FBW demonstrators based on the J-6(J-6 ACT) and J-8 (J-8 ACT). The J-8II ACT played an important role in the future development of the PRC's third generation fighter programme.

TRANSPORT AND HELICOPTERS

Other than combat operations and aggressively modernising its fighter fleet, the PLAAF's other mission was also to provide airlift in support of its ground forces. Its capacity to augment the PLA's airlift requirement was restricted because of its antiquated aircraft. The PLAAF's transport fleet mainly consisted of the Y-5 (An-2), Y-7 (An-24), Y-8 (An-12), IL 18, indigenously manufactured Y-11 and Y-12 along with a few old Lisunov (Li-2) and IL-14 (Table 5). The 15th Airborne Corp was also a part of the PLAAF and utilised the An-2, IL-14, IL-18 and Y-7s for its missions. The transport element of the PLAAF had participated in a few combat operations in past campaigns, which included airborne assault landing and attack on the enemy's lines of communication. Hence, the 15th Airborne Corp was envisaged to play an important role and was, thus, elevated to a strategic force, directly controlled by the CMC. During a crisis, the PLAAF was empowered to utilise civil aircraft to transport troops, as was demonstrated in the 1989 Tiananmen incident. Until the mid-1990s, due to limited airlift capabilities, only one of the 15th Airborne Corps' three divisions consisting of around 11,000 troops, along with light tanks and self-propelled artillery could be rapidly deployed within 48 hours. The airlift capability was, however, enhanced with the induction of 10 IL-76 heavy lift aircraft in 1993.

The transport aircraft were also utilised in maintaining the Signals Intelligence (SIGINT) in the Asia-Pacific region. The principle Chinese airborne Electronic Intelligence (ELINT) platform was the EY-8, indigenously developed as a derivative of the An-12. The system was designed to detect, identify, analyse and locate land-based or shipborne radar emitters with a high probability of intercept. It was more than established that Israel was actively involved in assisting the development of China's airborne ELINT/ EW capability.

China also produced the French Super Frelons (SA 321) Anti-Submarine Warfare (ASW) and Search and Rescue (SAR) variants for the navy. The Super Frelons were called the Z-8—the first helicopter in the PLA capable of operating from the deck of surface vessels.[48] It also developed the JH-7, primarily for the navy at the Xian Aircraft Company (XAC); the test programme commenced in 1988 and the prototype flew in 1993. The aircraft was powered by the Rolls Royce Spey Mk 202. As we look at the development programmes in the aviation industry through the 1980s and 1990s, it is evident that the 'geo-politics' of the region had influenced the process of modernisation in the PLAAF. China in the 1980s was in alliance with America, and after Tiananmen and the end of the Cold War, aligned with the Russians. The inter-changeability of actors and them guiding the process of military modernisation was quite evident during this period.

GEO-POLITICAL TRANSITION

From the US' standpoint, rapprochement with China was a geo-political convenience needed to contain Soviet expansion in the Cold War era. However, following the Soviet disintegration and with the Japanese power contained within the US-Japan framework, China became a key concern for the Americans and the only alternative centre of power and influence in the strategically important Asia-Pacific region. In US foreign policy, the only common ground between the 'doves' and the 'hawks' with reference to China, was that both saw China as a potential threat to

---

48. http://www.sinodefence.com/airforce/helicopters /sa321.asp

US interests in Asia and both were in agreement to destablise China as a potential power.[49]

The heyday of China-US rapprochement, was ironically during the hawkish 'Reagan Administration'. The US planners believed that China needed the US more than the US needed China and, therefore, concessions to China were unnecessary. China during this period was virtually hooked on to the US capitalist ideology and culture and was more than eager for assistance in the fields of dual use technology, high speed computers, weapon systems, military hardware, and access to US doctrine and training. China's effort also to produce frontline fighters and match up with the capability of the West was assisted by the Americans as was seen in the "Peace Pearl' project. By the mid-1980s, the Reagan Administration had relaxed control of high-tech exports to China, resulting in over $5 billion arms sales to China. The private sector made handsome profits through military sales to China as a result of trade relaxation, ironically, a golden era for US-China relations under the hawkish anti-Communist US President. It was not only China which was buying arms from the US, but surprisingly the US through the Central Intelligence Agency (CIA) was also purchasing arms from China for the Mujahideen in their war against the Soviet Union in Afghanistan. This continued until the sale of the Silkworm anti-ship missile to Iran,[50] which led to the first of a series of restrictions on high-tech exports to China by the Reagan Administration in 1987, prior to Tiananmen.

TRANSITIONAL VACUUM

You Ji explains 'transitional vacuum' as the partial solution of Russian support to modernise the PLAAF's zero stock of sophisticated aircraft against the background of its potential opponents in the region[51]. The 1992 agreement with the Russian Federation to buy 48 SU-27, all-weather night fighters, to be delivered by 2000, was a great example of the 'transitional

49. Henry C. K. Liu, Chairman of New York based Liu Investment Group, "US, China : The Politics of Ambiguity," article in *Asia Times* on April 24, 2002.
50. Ibid.
51. You ji, 27, ch. 5, p. 156.

vacuum'. Also, in the same year, China and Israel normalised diplomatic relations and legalised the transfer of "electronic technology".[52]

Tiananmen, the end of the Cold War and the collapse of Russia resulted in China's geo-political realignment with Russia. For China, the implications were profound, because of its need to modernise the PLAAF. The development of the J- 8-IIM with Russian support, a high level team led by the Vice Chairman of the CMC, Liu Huaqing visiting Russia, and the SU-27 deal were indicators of this 'geo-political shift'. A former enemy had now became a source of supply of modern military technology, reaffirming Henry Kissinger's definition of 'geo-politics': "One characteristics of geo-politics is inter-changeability of actors". Ashley Tellis had aptly described that "during the period of transition, the PLAAF was evolving with a vision far more sophisticated and impressive than its past".[53]

BUDGET TRANSITION

Chinese philosophy as well as Mao's paradoxical dictum states that the "option of force enhances the prospect of peaceful reunification". Hence, military modernisation forms an important part of the overall calculus of the Chinese "Grand Strategy". However, defence was made subordinate to the country's economic development by Deng in the late 1970s and defence expenditure was, therefore, kept in check.

Certain glaring contradictions surface while analysing defence expenditure in China from the mid-1960s to the early 1990s. It is a well known fact that the official estimates of Chinese defence expenditure are not computed as per the international norms and there is a strong belief amongst analyst that the official defence expenditure represents a small portion of the estimated defence expenditure which mainly includes the net manpower cost of the armed forces in China.[54] The defence expenditure had remained constant at around Yuan 13-15 billion from 1971-78, though

---

52. n. 37.
53. Tellis, n. 32.
54. Air Cmde Jasjit Singh, *Asian Defence Review 2008-2009* (New Delhi: KW Publisher), ch. 1, p. 26.

the force level increased from 2.8 million to 4.5 million. Sixty percent increase in manpower without any change in budget allocation was 'mumbo jumbo'; however, one could partly attribute it to the Cultural Revolution, low quality military and poor quality manpower. A reverse trend of reduction in manpower and an increase in the budget allocation were seen after 1981, when the process of "Four Modernisations" was institutionalised. The spikes in the military expenditure in 1969-70 as well as 1979-80 can be ascribed to the Sino-Soviet conflict and the 1979 Sino-Vietnam War.

In the period from 1978-87, China concentrated on economic development and defence was kept low on priority. The annual increase in defence expenditure was 3.5 percent while the Gross Domestic Product (GDP) increased by 14 percent. Also, the share of annual defence expenditure in the GDP dropped from 4.6 percent in 1978 to 1.78 percent in 1987[55]. The focus was more on economic development than on military modernisation. Though the nominal military expenditure increased from 1981-92, the real expenditure fell to a maximum of 25 percent during the same period (Table 4).

The production of combat aircraft dropped from 450 aircraft per year in mid-1970 to around 70 aircraft in the 1980s (Fig 3). The factories stopped production of the J-6, Q-5, H-6 and started producing variants of the J-7, J-8 with assistance from the West. Though production of these aircraft was in relatively small numbers, it helped them develop indigenous capacity to produce more advanced aircraft in the future. Hence, the PLAAF was transiting from a huge force pivoted on the J-6 until 1980 to a force structure with relatively modern J-7/J-8 aircraft, but in small numbers. The strength of aircraft in the inventory of the PLAAF during the period of transition gives a fairly good picture of the type and capability of its force structure (Table 5).

---

55. Ministry of National Defence, "The Peoples Republic of China," http://eng.mod.gov.cn/ Database/Expenditure/index.htm

Table 4: Chinese Military Budget (Billion Yuan) 1978-93

Year	Price Index 1978=1.00	Nominal Expenditure	Real Expenditure	Military Budget Expenditure 1978=1.00
1978	1.00	16.784	16.784	1.00
1979	1.02	22.266	21.829	1.30
1980	1.08	19.384	17. 932	1.07
1981	1.11	16.797	15.173	0.90
1982	1.13	17.635	15.634	0.93
1983	1.15	17.713	15.470	0.92
1984	1.18	18.076	15.358	0.92
1985	1.28	19.153	14.952	0.89
1986	1.36	20.075	14.783	0.88
1987	1.46	20.962	14.387	0.86
1988	1.73	21.800	12.630	0.75
1989	2.03	25.147	12.363	0.74
1990	2.08	29.031	13.977	0.83
1991	2.14	33.031	15.457	0.92
1992	2.25	37.790	16.781	1.00
1993	2.55	42.580	16.698	0.99

Source: State Statistics Bureau, Chinese Statistics Yearbook, 1997, p. 267.

Fig 3: Chinese Jet Fighter Production, 1960-1995
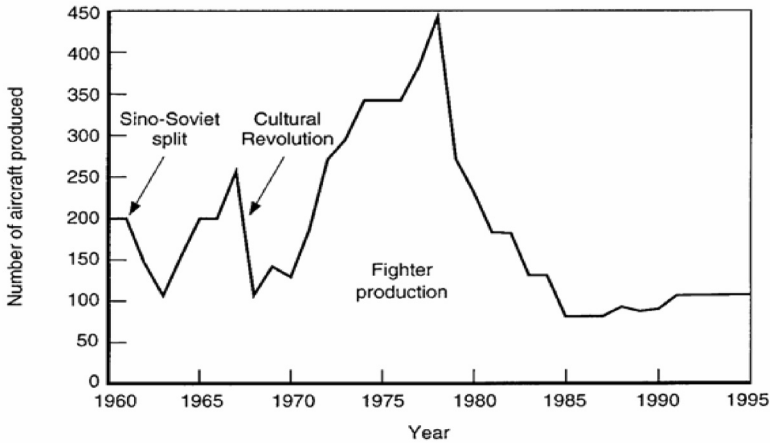
Source: Kenneth W. Allen, Glenn Krumel, Jonathan D. Pollack,

China's Air Force Enters the 21st Century (RAND)

Table 5: PLAAF Aircraft from 1981-92

	1981	1983	1985	1987	1989	1991	1992
J-5 (MiG-17)	300	300	400	400	400	400	400
J-6 (MiG-19)	3,000	3,000	3,000	3,000	3,000	3,000	3,000
J-7 (MiG-21)	250	300	200	200	300	500	500
J-8	50	30	30	30	100	100	100
Q-5 (MiG-19)	500	500	500	500	500	500	500
H-5 (TU-16)	450	450	500	500	250-300	350	350
H-6 (IL-28)	100	120	120	120	120	120	120
TU-2	100	-	-	-	-	-	-
SU-27	-	-	-	-	-	-	24
Y-5 (An-2)	300	300	300	300	300	300	300
Y-7 (An-24)		FEW	10	20	20	25	25
Y-8 (An-12)	FEW	FEW	10	12	25	25	25
IL-18	-	-	-	-	10	10	10
LI-2	100	75	75	75	50	50	50

IL-14	50	FEW	FEW	FEW	-	-	-
BAE Trident1E/2E	-	-	-	-	18	18	18
Y-11	-	-	-	-	FEW	15	15
Y-12	-	-	-	-	FEW	2	2

Source: *Military Balance*, published by IISS for the years shown in the table.

The developing countries were the major arms market for the Soviet, Americans and Western suppliers. However, of late, some of these developing countries too have built a substantial market in the domestic arms industry, especially China. At one point in time, 10 percent of total industrial output in China was contributed by the armament sector and export of arms was seen as a solution to revive the huge number of loss-making defence industries. China offered its combat aircraft and weapon systems to many Third World countries (Table 6). Though it had been a late entrant in the arms trade, from 1985-89, Beijing exported nearly $7 billion worth of arms, becoming among the top ten arms suppliers to Third World countries.

Table 6: China's Export of Combat Aircraft

Country	Variants	Qty	Delivery
Egypt	J-7A	90	Delivered in the Early 1980s
Pakistan	J-7P	95	Delivered in 1988-90
	J-7PG	66	Delivered in 2001-02
Tanzania	J-7A	16	Delivered in the Early 1980s
Iraq	J-7B	90	Delivered in the Mid-1980s
North Korea	J-7B	40	Delivered in the Early 1980s
Sri Lanka	J-7BS	4	Delivered in the 1990s
	JT-7	2	
Sudan	J-7B	22	Delivered in the 1990s
Bangladesh	J-7M	14	
	JJ-7	2	JJ-7 Delivered in 1989
	J-7BG	12	J-7BG and JJ-7BG Delivered in 2006
	JJ-7BG	4	

Iran	J-7M	18	Delivered in the Mid-1980s
Albania Burma	J-7A J-7M	12 24	

Source: www.sindefence.com/airforce/fighter/j7.asp (updated as on December 25, 2008)

Other than exports of its combat aircraft to the Third World countries, 'defence conversion', which is the use of the military industrial complex for civilian production, became another source to finance the process of modernisation and bridge the budgetary shortfalls in the early 1980s.

START OF MODERNISATION

The PLAAF's leadership had taken a holistic approach that looked at every aspect of activity in the air force during this period of transition. The PLAAF started understanding that modernisation was not just about modern aircraft, weapons and technology but also about institutions, people, leadership, doctrine and a host of other issues. The rationalisation of the organisational structure and elevation of the PLAAF Commander to the rank of General and his inclusion in the CPC indicated that the PLAAF was no longer an accessory of the ground forces; which by itself was an important indicator of the elevation of air power in the role it plays as well as an integral element of the joint force.

The transition from the obsolete J-6 class of aircraft to the J-7 and J-8 was in fact, the foundation being laid for future modernisation of the PLAAF. The 2006 Defence White Paper describes the modernisation goals as follows:

The first step is to lay a solid foundation by 2010; the second is to make major progress around 2020; and the third is to basically reach the strategic goal of building informationised armed forces and being capable of winning informationised war by mid-21st century.

China has been doggedly working toward these goals from the 1990s, to achieve sustained military modernisation of the PLAAF as well as its armed forces. Jiang Zemin, Secretary General, CCP, and Chairman, CMC, while delivering a speech on January 13, 1993, at a meeting of the CMC, had promulgated a new military strategy for the PLA to guide its future modernisation efforts, which focussed on sustained modernisation. This was the roadmap for the military modernisation of China for the next millennium.

CHINA'S ELECTRONIC AND CYBER WARFARE CAPABILITIES

SANJAY PODUVAL

Informationised arms . . . together with information systems, sound, light, electronics, magnetism, heat, and so on, turn into a carrier of strategies.

— Maj Gen Dai Qingmin

In the early 1990s, the People's Liberation Army (PLA) responded to the altered form of warfare by quickening the Research and Development (R&D) of advanced conventional platforms, as set by the then emerging high-tech combat environment. But, after analysing the series of anti-terror wars led by the US, the PLA has now realised that systems integration is more important than individual hi-tech hardware. Therefore, in 2002, China substantially revised its 1993 national defence strategy of fighting a regional war under hi-tech conditions to a new strategy of fighting a "regional war under the condition of informatisation." This sweeping change initiated a new phase in Chinese military modernisation programmes with the focus being hinged on integrating new military theories and concrete reforms. Central to this theme is Information Technology (IT) which is the principle driver in the present-day global military and economic change.

These extensive military modernisation programmes have fundamentally transformed the People's Republic of China's (PRC's) ability to fight high-tech

*   Wing Commander **Sanjay Poduval** is a Research Fellow at the Centre for Air Power Studies, New Delhi.

The Chinese military, using increasingly networked forces capable of communicating across Service arms and among all echelons of command, is pushing beyond its traditional missions focussed on Taiwan towards a more regional posture. wars. The Chinese military, using increasingly networked forces capable of communicating across Service arms and among all echelons of command, is pushing beyond its traditional missions focussed on Taiwan towards a more regional posture. This modernisation effort, known as informationisation/informatisation, is guided by the doctrine of fighting a "local war under informationised conditions," which refers to the PLA's ongoing effort to develop a fully networked architecture capable of coordinating military operations on land, in the air, at sea, in space and across the entire Electro-Magnetic (EM) spectrum. Adhering to this line of thinking, the PLA is working towards a unified C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance) system and IT-based networking for better cooperation and coordination within the Services and between the Services in the battlefield. The final goal of this programme is to realise an unobstructed and digitalised transfer of information between all systems: at the strategic, operational and tactical levels, among the Services and between platforms.

In Chinese writings, Electronic Warfare (EW), along with networking, has been the focus of discussions which in many ways is analogous to the American concept of Network-Centric Warfare (NCW). The emphasis on jointness and integration applies equally to integrating various military networks. Chinese theorists have coined the term "Integrated Network Electronic Warfare" (INEW) which indicates that they aim to amalgamate NCW operations with EW. This implies that the Chinese view EW from a systems approach and not as a separate or distinct element of war-fighting. Informatisation is, thus, singled out as the driving force for PLA transformation. This reflects a new understanding about the type of war the PLA expects to face in the future: even if the combat is between conventional platforms, the key to victory are the IT systems. As a consequence of their

emphasis on IT and networking, the Chinese have realised the importance of cyber warfare. The underlying theme of cyber warfare ties in perfectly with their concept of the assassin's mace, *Sha Shou Jian* (literally "killing hand club"). Given the above context, the aim of this paper is to provide an insight into the Chinese capabilities and concepts of INEW and cyber warfare.

The PRC has completed one million km of fibre optics line and communication infrastructure called "Eight Horizontal Grids and Eight Vertical Grids."

PLA'S INEW CAPABILITIES

China's 2004 White Paper shows that the Chinese military has understood that there is a large and expanding technology gap between itself and modern militaries, especially that of the US. China's leaders, including President Hu Jintao, have ordered the PLA to pursue "leap ahead" technologies and "informationised" capabilities to increase weapons' mobility, firepower and precision.

In response to this, the Central Military Commission's (CMC's), Technical Department of General Service Headquarters responsible for strategic Signals Intelligence (SIGINT) has established a number of monitoring stations to intercept signals from countries like India, Taiwan, Japan, South Korea and others. The PRC's Fourth Armed Forces Department which looks after offensive and defensive Information Warfare (IW) activities has set up "an information warfare simulation centre" for training its corps of network warriors. The centre uses high technology simulation skills and equipment to simulate information warfare and its environment. The Fourth Department has special detachments and units that manage and direct SIGINT and EW operations for the PLA at all levels and includes operations of the air force and navy.[1]

The PRC has completed one million km of fibre optics line and communication infrastructure called "Eight Horizontal Grids and Eight Vertical Grids" supported by satellite, ground mobile receiving stations

---

1. Manuel Cerejo, "China, Cuba and Information Warfare, Signal Intelligence, Electronic Warfare and Cyber Warfare," at http://www.futurodecuba.org/ChinaandInformationWarfare4.htm

and ground-to-air data links.[2] At the national level, the C3I system is based on fibre optic cables, satellite communications, micro-wave links, tropo-scatter communications and automated command and control systems. The PLA has both secured and non-secured telecommunications and has an army-wide data communication network and integrated field operations communication system. Its WAN is capable of supporting peace-time operations within Chinese borders and limited pre-planned operations along China's periphery, with limited capability for large-scale joint operations.

With technologies obtained from the Western countries and by exploiting its booming commercial IT and telecommunications sector, it has improved the quality of its military programmes. The PLA has acquired and deployed a wide variety of air, sea and land-based Intelligence, Surveillance and Reconnaissance (ISR) systems to enhance its ability to detect monitor and target military activities in Asia and the West Pacific Ocean. Some of the latest programmes include electro-optics, synthetic aperture radar, over the horizon radars, and surveillance systems that can detect stealth aircraft.

EW is a key element in the PLA's "Three Attacks and Three Defences" strategy (attack stealth aircraft, cruise missiles and helicopters; defend against precision strikes, electronic warfare, and enemy reconnaissance) to meet the requirements of "local war under informationised conditions." Both military and civil sectors are actively exploring IW concepts which could lead to developing a corps of network warriors to defend China's telecommunication, command and information networks while uncovering the vulnerabilities of adversaries' networks.

RESEARCH AND DEVELOPMENT

The Chinese R&D clearly recognises the important role that electronic warfare plays in the informationisation of their PLA. Experiments and trials are carried out with an emphasis on appreciating the effect on operating systems and frequencies. In the Chengdu Military Region (MR) experiments are continuously carried out to test and evaluate the jamming effectiveness

---

2. Abe C. Lin, "Comparison of Information Warfare Capabilities of the ROC and PRC," at http://cryptome.org/cn2-infowar.htm

from the opposing side. They articulate that the traditional jamming parameters of measuring signal-to-noise interference ratio at the receiver, maximum transmission range at the transmitter site, detection zone (specifically for radar systems), the suppression coefficient, the discover probability, and the deceit probability are only effective in a field test situation and are essentially worthless in a war as the jamming side cannot possibly obtain these evaluation data on the enemy directly. This indicates that their insight

In modern aerial warfare, possessing hundreds of fighters and bombers counts for little if they cannot be effectively and efficiently deployed against an adversary.

and analysis most closely resembles what one should expect to encounter when facing an informationised PLA. It is also suggests the steps they will take to ensure training in a real war scenario.

On the "Multi-Signal Jamming Technology in [a] Complex Environment", Li Dongxin, a researcher from the National Keu Lab of Information Integrated Control in the Chengdu MR says that the two main radar jamming technologies used for PLA Electronic Counter-Measures (ECM)—multi-pulse velocity-range decoys and multi-pulsed false target jamming—are intended to target a pulsed-Doppler radar system but are not very effective against phased array radars. Specifically, Dongxin's conclusion is that in an increasingly complex multi-signal environment, ECM equipment has no choice but to make fundamental improvements.[3]

Chinese AEW, ELINT and JSTAR Developments

The Chinese military appreciate very well that in modern aerial warfare, possessing hundreds of fighters and bombers counts for little if they cannot be effectively and efficiently deployed against an adversary. They are, therefore, in the quest for the development and deployment of the Airborne Warning Control System (AWACS), Electronic Intelligence (ELINT) and Joint Strategic Target Attack Radar System (JSTARS).

3. Jorge Muniz, "Declawing the Dragon: Why the US Must Counter Chinese Cyber-Warriors," http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA502899&Location=U2&doc=GetTRDoc.pdf

The Chinese unveiled the KJ-2000 AWACS during their 60th anniversary celebrations. This AWACS which is now in service is equipped with a domestic AESA (Active Electronically Scanned Array)[4] similar to Sweden's Ericsson Erieye radar. The radar was designed by the Research Institute of Electronic Technology (also more commonly known as the 14th Institute) at Nanjing. The Chinese officials claim that the domestic radar is capable of tracking more targets at greater ranges than the Israeli Phalcon radar which was offered to them in the late 1990s.

The Chinese have also developed the Shaanxi Y-8 into an ELINT platform. This aircraft was first sighted in the summer of 2004 near Shanghai and features a long canoe-shaped fairing under the port side of the forward fuselage, together with various blade aerials and antennas mounted on the sealed rear loading ramp. A slightly different maritime ELINT version of the Shaanxi Y-8, possibly the Shaanxi Y-8 (DZ), is undergoing flight trials for the PLA Naval Air Force[5].

The Shaanxi Y-8 platform has also been used as the basis for what is believed to be an experimental JSTARS type configuration. This aircraft features large bulged cheek fairings on either side of the forward fuselage which are believed to house a sideways looking radar. The fuselage also has various other fairings and one on the tip of the fin, which possibly houses ELINT receivers. It is not certain how many of these aircraft are flying and their capability is also not known.

The rapid advances made recently by China in the area of airborne early warning will sooner or later lead to the production and operational deployment of at least one and possibly two airborne early warning aircraft. However, the operational effectiveness of these aircraft remains to be seen. Nevertheless there is little doubt that, with billions now flowing into the Chinese economy every year, the Chinese will continue to seek to acquire advanced technology and the current evidence suggests that sooner or later, one way or another, they will start building and developing these aircraft themselves.

---

4. Sinodefence.com, "KongJing-2000 Airborne Warning & Control System," http://www. sinodefence.com/airforce/specialaircraft/kj2000.asp
5. http://www.spyflight.co.uk/china%20awacs.htm

China's Anti-Radiation Missile: FT-2000

The Chinese, in their quest to develop counter-measures against AWACS, and stand-off jammers have developed various versions of a surface-to-air Anti-Radiation Missile (ARM), the FT-2000 series. Developed and manufactured by the China National Precision Machinery Import and Export Corporation (CPMIEC) during the late 1990s, the FT-2000 is also believed to be capable of destroying tactical ballistic missiles, similar to the US Patriot and the Russian S-300P systems on which it is based. At present, two versions exist, the mobile FT-2000 and the fixed-based FT-2000A.

The FT-2000 is also believed to be capable of destroying tactical ballistic missiles, similar to the US Patriot and the Russian S-300P systems on which it is based.

The FT-2000 was designed to neutralise and counter airborne jamming devices. It contains a passive radar target seeker programmed to detect the specific EM signals emanating from its target and home on to them. The system is equipped with modified HQ-9 interceptor missiles, each of which is 6.8 metres long, 0.47 metres in diameter, and has a launch weight of 1,300 kg. The HQ-9 missiles give the FT-2000 a range of 12 to 100 km and an operating altitude of 3 to 20 km. The mobile system is transported and launched on an 8 X 8 cross-country launcher with four canisters that resemble those used by the S-300P.

In addition to the mobile FT-2000, China has developed a fixed-based variant, the FT-2000A. According to a recent Chinese sales brochure, the FT-2000A uses a highly-modified HQ-2 missile that has been equipped with passive radio frequency homing seekers. Each HQ-2 is armed with a 60 kg fragmentation warhead and has a range of 60 km and a maximum altitude of 18 km. Reports indicate that each FT-2000A battery consists of 12 missile launchers, each containing one missile, and a central control station. The central control station has one master passive sensor and three auxiliary passive sensors. The four sensors are capable of triangulating on EM signals in the 2- and 6-GHz frequency range, which covers most AWACS aircraft and other EM wave seeking targets, thus, earning it the nickname "AWACS

killer"[6]. In addition to its role as an anti-radiation missile system, the FT-2000 also has advanced capability against tactical ballistic missiles, although this point is seldom mentioned.[7]

According to Harris Khan a defence analyst from the Pakdef Military Consortium, the Pakistan Air Force (PAF) is actively looking to purchase a high-altitude missile air defence system, with the Chinese-built FT-2000 as the front-runner[8]. In October 2003, it was reported that China had closed a deal with its neighbour, Pakistan, to supply the latter with an unspecified number of FT-2000 missiles to counter India's early warning capabilities. The China-Pakistan deal followed India's arrangement with Israel and Russia to install three Israeli Phalcon AWACS on the Ilyushin Il-76.[9]

According to an article published in Malaysia in January 2003, the People's Liberation Army is eager to export the FT-2000 around the globe. It is, therefore, entirely possible that "AWACS killer" air and missile defence systems like the FT-2000 will soon proliferate throughout Asia, Europe, and the Middle East, a development that would introduce a multitude of strategic problems the world over.

Directed Energy Weapons

Since the invention of gunpowder, a weapon's effectiveness has no longer depended on the wielder's strength, but on the chemical energy of the propellant or explosive. While centuries of technological advances have improved the power of these materials, the basic operating principle ultimately remains the same. Modern battlefield weapons are descendents of muskets and cannons but with greater range, accuracy and

6. "FT-2000, Missile Defence Systems," http://www.missilethreat.com/missiledefensesystems/id.20/system_detail.asp

7. Richard D. Fisher, Jr., "The Impact of Foreign Weapons and Technology on the Modernisation of China's People's Liberation Army", A Report for the U.S.-China Economic and Security Review Commission January 2004, http://www.globalsecurity.org/military/library/report/2004/04fisher/part3.htm#impactonplamissile

8. Wendell Minnick, "Pakistan Targets Air Combat", http://www.defensenews.com/story.php?i=3637167, Published: July 14, 2008.

9. Bulbul Singh, "Pakistan Seeks FT 2000 Missiles to Counter Indian Warning System," *Aerospace Daily*, October 28, 2003.

power packed in them. Another revolution in weaponry is currently underway, with Directed Energy Weapons (DEWs) on the cusp of entering the domain of chemical-powered weapons on the battlefield. DEWs use the electromagnetic spectrum (light and radio energy) to attack and destroy targets at the speed of light. After decades of research and development, DEWs are becoming an operational reality. Such weapons generate streams of electro-magnetic energy that can be precisely aimed over long distances to disable or destroy targets.

Some estimates suggest that approximately 10,000 personnel, including 3,000 engineers from 300 organisations are involved in China's laser programmes alone, with perhaps 40 per cent of related R&D being conducted for defence applications.

DEWs include High Power Microwaves (HPM), high energy laser and particle beam technologies. Research is currently on in the field of high energy lasers and high power microwaves and a lot of progress has been made towards the weaponisation of the EM waves. This is one of the reasons for the change in nomenclature of ECM (Electronic Counter-Measure) to EA (Electronic Attack). A number of programmes are being actively pursued by China, Israel, Russia and the US, to name a few. Though the US is in the forefront of these technologies, countries like China and Russia have not lost sight of these weapons and are investing a lot in this field. China is currently devoting a considerable amount of resources on the tactical and strategic use of directed energy weapons for applications in areas such as air defence, anti-personnel, communications, weapons guidance and fire control, sensors, space tracking, Anti-Satellite (ASAT) and Ballistic Missile Defence (BMD). While still probably trailing behind the expertise of the US, China's DEW related R&D and applications programmes are massive and sophisticated by any international standards. China is believed to be a world leader in various specific areas. Some estimates suggest that approximately 10,000 personnel, including 3,000 engineers from 300 organisations are involved in China's laser programmes alone,

Militaries all over the world increasingly depend on space systems for various force enhancements and application functions.

with perhaps 40 per cent of related R&D being conducted for defence applications.[10]

The National Engineering Research Centre for Solid State Lasers (SSL) in Beijing is conducting R&D on solid state lasers. The SSL Shenguang-2[11] reportedly has a power output of a terrawatt. The establishment has also developed a tuneable titanium-sapphire ruby laser with a power output of 650 megawatts. They are also in the process of developing high-energy lasers to be used as ground-based ASAT weapons (China currently has the capability to damage, under specific conditions, optical sensors of satellites).

R&D is also on in China for the development of an HPM warhead, which is likely to be operational by 2015.[12] Extensive studies are also being carried out to study the effect on electronics due to HPM with the aim of developing impregnable shields not only to protect the systems delivering these weapons but also their ground-based systems if subjected to such attacks.

The DEW programmes of China have been aided by the erstwhile Soviet Union's scientific community that has been absorbed by China. Recent reports attributed to the US Defence Intelligence Agency also indicate that Israeli Aircraft Industries may have transferred key high-energy laser technologies to China. With its ASAT test in 2007 and the blinding of a US satellite in 2006, China has conveyed a message to the world that in any future conflict with it, no country will be able to use its satellites (at least, the low earth satellites) for military purposes.

INEW in Space

Militaries all over the world increasingly depend on space systems for

---

10. Source Jane's Defence, at http://www.aeronautics.ru/archive/research_literature/aviation_articles/Janes/topics/plasma_stealth/Directed%20Energy%20Weapons%20and%20Sensors.pdf

11. "Directed Energy Weapons and Sensors," http://www.asiafinest.com/forum/index.php?showtopic=188488, Jan 17 2009.

12 Source Jane's Defence, at http://www.aeronautics.ru/archive/research_literature/aviation_articles/Janes/topics/plasma_stealth/Directed%20Energy%20Weapons%20and%20Sensors.pdf

various force enhancements and application functions. Space force plays an increasingly critical role in enhancing information superiority, situational awareness and targeting to military forces. Space power is, therefore, a vital element which provides the ability to be persuasive in peace, decisive in conflict and preeminent in any form of combat. Having realised this, Chinese military strategists and aerospace scientists have been quietly designing a blueprint for achieving space dominance for more than a decade. Chinese military scientists have contended that support from space for warfare will become the core of future non-contact combat. The integrated space-based electronic network of combat platforms, weaponry, and C4ISR components will guide the various combat elements of the three armed Services to launch long-distance precision attacks on ground, sea, air and space targets.

Just as land dominance, sea control and air superiority have become critical elements, space superiority is emerging as an essential element of battlefield success and future warfare.

Just as land dominance, sea control and air superiority have become critical elements, space superiority is emerging as an essential element of battlefield success and future warfare. As space systems become lucrative targets, there will be a critical need to develop robust capability to ensure space superiority – as it has been for the land, sea and air dimensions. Accordingly, the PLA revamped its R&D testing and evaluation programme of the late 1990s and decided to cancel weapons projects that had been active for 10 years or longer and to direct these funds to developing so-called ''new-concept weapons'': laser, beam, electro-magnetic, microwave weapons. China also aims to develop a new generation of solid-fuel rockets to carry micro-satellites in an endeavour to establish a space network for precise positioning, communications, electro-magnetic jamming, and reconnaissance. This is perfectly in sync with their concept of INEW.

Since the space theatre of war is in outer space and more than 120 km above the earth's surface, there are no restrictions concerning national boundaries and sovereign air space. The side possessing space dominance,

can, therefore, exercise complete freedom of action. The unique, high-altitude advantages of space have strategic and decisive significance for the side exercising space dominance. It will be possible:

- To execute such offensive operations as satellite attack, missile intercept, and ground firepower support.
- To guarantee the operational independence of friendly military space forces, and to translate these advantages into information, air and sea dominance.

Without space dominance, the Chinese believe that one is actually putting oneself in the disadvantageous position of "being defeated first and then going to war."

Owing to its strategic significance, space EW—aimed at jamming, sabotaging, and destroying satellites—has become the most important way to gain information dominance in future wars.[13] As the pivotal role of space-based reconnaissance becomes increasingly manifest, various countries are rushing to develop counter-measures. Active jamming is said to be the most effective technique among asymmetrical counter-measures. It is divided into active suppressive and active deception jamming. Active suppressive jamming includes barrage, spot, and random pulse jamming. Active deception jamming includes repeater, responsive, and scattered wave jamming.

EW satellites travelling in geo-stationary orbits or 300-1,000 km orbits can conduct electronic reconnaissance and jamming in wide areas. Based on the capabilities of reconnaissance satellites, Chinese aerospace scientists have compiled the following list of "space-information counter-measures":

- Aim for the satellite's effective payload by applying suppression interference to cause overload in the satellite's receiving system, data processing system, and memory.
- Target the satellite's remote control system by:
  - Establishing a space target monitoring system to acquire the satellite's technical parameters and character information.

---

13. Mary C. FitzGerald, "China's Military Modernization and its Impact on the United States and the Asia-Pacific," http://www.uscc.gov/pressreleases/2007/07_03_22pr.pdf

○ Effectively detecting and analysing the satellite's operational system and down-link remote signal.

- Attack the satellite's space-to-ground communication and command nodes to weaken the connection, link, mutual operation, and networking flexibility in order to degrade its operational effectiveness.

- Use high-energy and kinetic weapons to blind or destroy the reconnaissance satellites.

Another system which is a potential target for disruption is the US Global Positioning System (GPS) network. While Chinese military experts applaud the "brilliant" performance of the US GPS in recent high-tech military operations, they continue to clarify its inevitable "Achilles' Heel." They have delineated three major weaknesses. These are especially relevant as India is well on her way to develop and deploy the GAGAN[14] and IRNSS[15] position, navigation and timing system.

- First, defeat GPS at its source by exploiting the weakness of the low orbits of navigation satellites. This could be accomplished by attacking them with ASATs or high energy laser weapons.

- Second, defeat GPS in the middle by exploiting the scattered and exposed ground stations.

- Finally, defeat GPS at the end by exploiting the fact that navigation signals are highly attenuated. After attenuation by natural causes, the ground signal is very weak and easy to jam.

Besides these, China is also developing ELINT and SIGINT reconnaissance satellites. These digital data systems will be able to transmit directly to ground sites via a system of data relay satellites to support global coverage. Furthermore, Beijing has acquired mobile data reception equipment that can support rapid data transmission to deployed military forces and units.

---

14. GAGAN – GPS and geo-augmented system; the Indian Space Research Organisation and Airports Authority of India are implementing a Space-Based Augmentation System (SBAS) over the Indian air space for civil aviation, called GPS and Geo-Augmented Navigation (GAGAN) to provide a seamless navigation service for all the phases of flight over Indian air space.
15. IRNSS – Indian Regional Navigation Satellite System.

Unlike India's wherein there is a clear non-military slant, the Chinese space programme has a strong military bias which permeates even the scientific, domestic, and commercial elements of the space effort.

China is developing micro-satellites for remote sensing as well as for putting into place networks of electro-optical and radar satellites. The Chinese are expanding their Computer Network Operation (CNO) initiatives to include activities that threaten the space control and supporting computer networks of their adversaries, thus, posing a significant risk to their critical war-fighting systems.

The sphere of action in space is not limited to these operations but also has tremendous potential applications in:

- Detection, tracking and destruction of ballistic missiles.
- Disrupting communication links between satellites and ground stations by 'drowning out' the signal with a more powerful 'fake' signal or by targeting ground stations via physical attacks or computer hacking.
- Misdirecting or hijacking Unmanned Aerial Vehicles (UAVs) especially those linked via satellites.
- Taking over enemy computers.

Unlike India's wherein there is a clear non-military slant, the Chinese space programme has a strong military bias which permeates even the scientific, domestic, and commercial elements of the space effort. China has a comprehensive, integrated and focussed space programme. Owing to its strategic significance, Chinese aerospace experts state that disrupting, sabotaging and destroying satellites has become the most important way to gain information dominance in future wars.

The increasing exploitation of space by China under all weather conditions will improve intelligence gathering and targeting capability across the vast expanse of the Indian landscape. There is a risk that space-based communications of our nuclear arsenal could be neutralised by Chinese ASAT capabilities. This would have an adverse effect on our nuclear deterrent if redundancy is not adequately maintained. By virtue of

having good battlefield awareness and transparency, China will be able to prioritise target selection and enhance the destructive potential of its arsenal while prosecuting air, land and sea campaigns. China's counter-space capabilities are a threat to India's limited yet valuable ISR, communication and navigation satellites, through both hard kill and soft kill options, which could deny India the much needed overall battlespace awareness. While China continues to improvise on its capabilities, indirectly it also makes Pakistan a 'proxy space power' given its penchant for proliferation of technology and capabilities. Exploitation of China's capabilities for use by Pakistan against India cannot be ruled out in any future conflict.

CYBER WARFARE CAPABILITIES

Chinese View on Cyber Warfare

Historically, the PLA based its strategic philosophy on "active defence," meaning that China would never attack someone first but would be ready to respond if attacked. The doctrine drew inspiration from Mao Zedong's theory of "protracted war," in which he argued that "we must, as far as possible, seal up the enemies' eyes and ears, and make them become blind and deaf, and we must, as far as possible, confuse the minds of their commanders and turn them into madmen, using this to achieve our own victory." The goal of this paralysing attack is to inflict a "mortal blow" [*zhiming daji*], though this does not necessarily refer to defeat.[16] However, this philosophy of active defence has changed over the past few years with the advent of the cyber age. There has been a continuous stream of open-source descriptions of both cyber units in, and offensive cyber operations by, the Chinese military. Gen Dai Qingmin in a *Military Science* article in 1999 signalled a change to the offensive posture when he opined that offence is at least as important as active defence, and "the key to gaining the initiative in operations lies in positively and actively contending with an enemy for information superiority. China should establish such a view for Information

16. James C. Mulvenon, "Chinese Information Operations Strategies in a Taiwan Contingency," http://www.uscc.gov/hearings/2005hearings/written_testimonies/05_09_15wrts/mulvenon.pdf

Chinese analysts often speak of using these attacks to deter the enemy, or to raise the costs of conflict to an unacceptable level.

Operation (IO) as 'active offence'." His view was that active offence is essential for maintaining information control, obtaining the initiative, and offsetting an opponent's superiority. Offensive information methods can help sabotage an enemy's information systems. The PLA has openly stated that US' reliance on computer systems is a huge vulnerability, ripe for exploitation. The PLA's open recognition of the need for offensive operations reflects a significant break with traditional military thought.[17]

The Chinese are developing their capabilities keeping the US in focus, for they believe that by keeping the US as the benchmark, others will easily be catered for. At the strategic level, contemporary writers view IO and CNO as useful supplements to conventional war-fighting capability, and powerful asymmetric options for "overcoming the superior with the inferior." According to one PRC author, "Computer network attack is one of the most effective means for a weak military to fight a strong one." Yet another important theme in Chinese writings on CNO is the use of computer network attacks as the spear-point of deterrence. Computer network attacks are particularly attractive to the PLA, since they have a longer range than their conventional power projection assets and a well planned computer network attack could force the enemy to surrender without fighting.

Chinese analysts often speak of using these attacks to deter the enemy, or to raise the costs of conflict to an unacceptable level. Specifically, computer network attacks on non-military targets are designed to "...shake war resoluteness, destroy war potential and win the upper hand in war," thus, undermining the political will of the population for participation in military conflict. In the modem age, cyber warfare targets computers—the core of weapons and C4I systems—in order to paralyse the enemy.

To this end, China is developing new Information Warfare (IW) measures where cyber attacks on the enemy's C4ISR will be an integral part of future

17. Lt. Col. Timothy L. Thomas, US Army (Retd.) "China's Electronic Strategies," http://www.au.af.mil/au/awc/awcgate/milreview/thomas.htm

warfare. This idea is significant because about 80 percent of US military communications facilities rely on civilian networks, creating a window of opportunity for cyber strikes.

At an operational level, the emerging Chinese IO/CW (Cyber Warfare) strategy has the following key features:

- Chinese authors emphasise Computer Network Defence (CND) as the top priority. In interviews, analysts assert their belief that the US is already carrying out extensive computer network attacks against Chinese servers. As a result, they contend that CND must be the highest priority in peace-time, and only after that problem is solved can they consider "tactical counter-offensives."

- Second, CNO is viewed as an unconventional warfare weapon to be used in the opening phase of a conflict to inflict a paralysing blow on the enemy. PLA analysts believe that a virtual incapacitating strike at the beginning is necessary, because the enemy may simply unplug the network, denying them access, thus, obviating all prior intelligence preparation of the battlefield.

- Third, IW is seen as a tool to permit China to fight and win an information campaign, precluding the need for conventional military action.

- Fourth, China's challengers, in particular the United States, are seen as "information dependent," while China is not. This latter point is an interesting misperception, given that the current Chinese C4I modernisation is paradoxically making them more vulnerable to US methods.

- Perhaps most significant, the computer network attack is characterised as a preemption weapon to be used under the rubric of the rising Chinese strategy of *xianfa zhiren*, or "gaining mastery before the enemy has struck."

Preparing for people's war is a recurring theme in Chinese writing, as IW will be carried out by the PLA and society as a whole. This concept has found practical expression in turning some of the 1.5 million reserve forces into mini-IW regiments. The People's Armed Forces Department (PAFD)

has reportedly organised militia/ reserve IW regiments at district levels in many provinces. For instance, in Echeng district of Hubei province, the PAFD has a network warfare battalion as well as electronic, intelligence and psychological warfare battalions, and also a training base for IW activities. A version of this concept was also put into practice following the bombing of the Chinese Embassy in Belgrade on May 8, 1999, during "Operation Allied Force." The Chinese hacked a number of US political, military and diplomatic websites, and also carried out a network battle by mobilising thousands of net users for sending e-mails and viruses. This caused servers to crash, paralysing a large number of websites.[18]

Concerns about China's net force were taken seriously after the above mentioned attacks on US computer systems and after the Chinese militia carried out IW exercises, which included India, the US, Taiwan and Japan as target countries. The aim of such training was to disrupt critical infrastructure like banking, power supply and telecommunication networks in the target country as part of China's strategy of the asymmetric approach to warfare.

In the cyber domain, the Chinese have adopted three methods for targeting such networks: the first is the use of e-mails for planting viruses, then phishing[19] and, lastly, the introduction of 'intelligent Trojans' and 'vacuum Trojans'. Diverse routes of planting Trojans and viruses have been used to attack critical PCs, which in turn send out files or cause malfunction. Hackers' tools are becoming more robotic and simple; for instance, a vacuum Trojan will extract information from a pen drive automatically when connected to a USB port. The Chinese military daily, *Jiefangjun Bao* carried an article in August 2002 about the forms of network attacks. These were listed as "premeditated" (i.e. a persistent computer virus embedded in software), "contamination" (aimed at the quality of information), "strong" (referring to the forced modulation of computer viruses into electro-magnetic waves),

---

18. Ellen Messmer, "Kosovo Cyber-War Intensifies: Chinese Hackers Targeting US Sites, Government Says," http://edition.cnn.com/TECH/computing/9905/12/cyberwar.idg/
19. In the field of computer security, phishing is the criminally fraudulent process of attempting to acquire sensitive information such as usernames, passwords and credit card details by masquerading as a trustworthy entity in an electronic communication.

and "fission" (the strong regeneration capability of a virus). All are capable of being inserted in peace-time, except perhaps the "strong" variety.

The prospect of Internet-based warfare has come to the fore after a series of high-profile international attacks.

CW is inexpensive and attractive as the targeted party can be delivered a paralysing blow through the net and it will be difficult for the latter to discern the origin of the attack. A large amount of useless information can be created to block or stop the functioning of an adversary's information system. Thus, a people's war in the context of IW can be carried out by hundreds of millions of people, using open-type modern information systems.

China's International Cyber Warriors
China's cyber attacks have shown a significant increase in the last decade. Some of the incursions can appropriately be construed as computer reconnaissance missions on military systems to spot vulnerabilities or plant trap doors or viruses or sleeping agents into the systems which could be activated during a crisis. This fits in well with the old Chinese saying, "A victorious army first wins and then seeks battle. A defeated army first battles and then seeks victory".

Besides the long distance reconnaissance which the electronic systems enable, the computer network attack also enjoys a high degree of "plausible deniability," rendering it a possible tool of strategic denial and deception. Cyber operations are inexpensive and easy to repudiate; the enemy country can receive a paralysing blow through the Internet, and the party at the receiving end will not be able to tell whether it is a prank or an attack from an enemy.

The cost of hi-tech strikes on government communications is falling, while the amount of damage they can inflict is growing. Among the chief threats are the cyber attacks during peace-time which aim to shut down the government machinery, financial institutions, rail, road, air traffic control systems and online communication networks or use the Internet to attack other official institutions. The prospect of Internet-based warfare has come to the fore after a series of

high-profile international attacks. In 2008, it emerged that a gang of hackers, believed to be from China, had infiltrated computer systems at the Pentagon and launched attacks on government networks in Britain, Germany, India and Australia. US officials, who have labelled the group Titan Rain, have accused them of operating under the auspices of officials in Beijing.[20]

The New York Times also reported that in a series of "sophisticated attempts" against the US nuclear weapons lab at Oak Ridge, Tennessee, Chinese hackers were able to "remove data".[21] This illustrates the alarming fact that the Chinese cyber spies are now capable of entering fortified computer networks. US Strategic Command Chief Gen James E. Cartwright told Congress in March 2007 that "America is under widespread attack in cyberspace." During Fiscal Year (FY) 2007, the Department of Homeland Security received 37,000 reports of attempted breaches on government and private systems, which included 12,986 direct assaults on federal agencies and more than 80,000 attempted attacks on Department of Defence computer network systems. As for China's part in this trend, one American cyber security analyst said that intrusions from China are showing an increasing trend and in the last three months of the last quarter of 2007, the attacks from China had almost tripled. [22]

Jonathan Evans, then chief of Great Britain's MI-5, in a confidential letter to 300 accountants, legal firms, and chief executives and security chiefs at banks, warned them that they were under "electronic espionage attack" from "Chinese state organisations." Mr. Evans noted that a number of British companies—Rolls Royce, for example—had discovered that viruses of Chinese government origin were uploading vast quantities of industrial secrets to Internet servers in China.[23]

20. Bobbie Johnson, technology correspondent, "NATO says Cyber Warfare Poses as Great a Threat as a Missile Attack," http://www.guardian.co.uk/technology/2008/mar/06/hitechcrime.uksecurity
21. John Markoff, "China Link Suspected in Lab Hacking," *The New York Times*, December 9, 2007, p. A-03, at www.nytimes.com/2007/12/09/us/nationalspecial3/09hack.html
22. Stephen Fidler, "Steep Rise in Hacking Attacks from China," *The Financial Times*, December 5, 2007, at www.ft.com/cms/s/0/c93e3ba2-a361-11dc-b229-0000779fd2ac.html. Source cites Yuval Ben-Itzhak, chief technology officer for Finjan, a Web security group based in San Jose, California.
23. Rhys Blakely, Jonathan Richards, James Rossiter, and Richard Beeston, "MI5 Alert on China's Cyberspace Spy Threat," TimesOnline, December 1, 2007, at http://business.timesonline.co.uk/tol/business/industry_sectors/technology/article2980250.ece (December 11, 2007)

In August 2007, German Chancellor Angela Merkel learned that three computer networks in her own office had been penetrated by Chinese intelligence services. A few days later, she confronted the visiting Chinese Premier directly about the attacks and demanded that China play by the rules. Premier Wen Jiabao, straight-faced, expressed utter shock and promised that his government would get to the bottom of it. He then asked for detailed information from Germany's counter-intelligence agencies to help China's security police find the culprit!!![24]

According to Richard Lawless, Deputy Under Secretary of Defence for Asia-Pacific Affairs, the Chinese are "leveraging information technology expertise available in China's booming economy to make significant strides in cyber-warfare." The Chinese military's determination to familiarise themselves and dominate to some degree the Internet capabilities is providing them with a growing and very impressive capability.

While the various governments may be reticent to reveal the vulnerabilities of their databases to Chinese penetration, the information available shows how widespread Chinese cyber attacks have become. Cyber warfare units in the Chinese PLA have already penetrated the Pentagon's unclassified but sensitive Non-classified Internet Protocol Router Network (NIPRNet) and have designed software to disable it in times of conflict or confrontation. Maj Gen William Lord, Director of Information, Services, and Integration in the Air Force's Office of War-fighting Integration admits that "China has downloaded 10 to 20 terrabytes of data from the NIPRNet already," and added, "There is a nation-state threat by the Chinese."[25]

Patriotic Hacking

At 8 am on May 4, 2001, anyone trying to access the White House website got an error message. By noon, whitehouse.gov was down entirely, the victim of a so-called distributed denial-of-service (DDoS) attack. Somewhere in the world,

24. John Blau, "German Govt PCs Hacked, China Offers to Investigate: China Offers to Help Track Down the Chinese Hackers Who Broke into German Computers," *PC World*, August 27, 2007, at www.washingtonpost.com/wp-dyn/content/article/2007/08/27/AR2007082700595.html.
25. "Pentagon Warns of Internet Incursion by Chinese Cyber-Terrorists," GCN, August 24, 2006.

hackers were pinging White House servers with thousands of page requests per second, clogging the site. Also attacked were sites for the US Navy and various other federal departments. A series of defacements left little doubt about where the attacks originated as each had a Chinese signature. The military escalated its Infocon threat level from normal to alpha, indicating risk of crippling cyber-attack. Over the next few weeks, the White House site went down twice more. By the time the offensive was over, Chinese hackers had felled 1,000 American sites.

This cyber-conflict grew out of real-world tensions. A month earlier, a US EP-3 reconnaissance aircraft flying off the southern coast of China had collided with a Chinese F-8 fighter jet. The American pilot landed safely, but the Chinese pilot was killed. China's hackers lashed out. It wasn't the first foreign attack on American sites, but it was the biggest – it was dubbed as the *First World Hacker War*. On the anniversary of this cyber war, as businesses were bracing for another round of hacking, the Chinese government is said to have successfully called for a stand-down at the last minute, suggesting that the Chinese government has a sufficient amount of control on these hackers.[26]

Patriotic hacking is increasingly carried out by sophisticated, nationalistic hacker groups and appears to have become a permanent feature of Chinese foreign and security policy crises in recent years. On the one hand, the emergence of this trend presents the PRC military and political leadership with serious command and control problems. Specifically, uncontrolled hacking by irregulars could potentially undermine the PRC's political-military coercive diplomacy strategy during a crisis. Unlike traditional military instruments such as missiles, many of the levers of computer network operations by "unofficial means" are beyond the control of the Chinese government. This could negate the intended impact of strategic pausing and other political signals during a crisis. Yet, at the same time, patriotic hacking offers several new opportunities for the PRC.

• First, it increases plausible deniability for official Chinese CNA/CNE.

---

26. Pamela Hess, "China Prevented Repeat Cyber Attack on US," UPI, October 29, 2002, http://www.upi.com/view.cfm?StoryID=200210291219245101r.

- Second, it has the potential to create a large, if unsophisticated set of operators who could engage in disruption activities against the adversary networks. Commentators from the intelligence community of Taiwan emphasise the use of the "unofficial power of IW" and highlight the role of non-state actors in achieving state coercion goals.

For these reasons, one could be tempted to state that the patriotic hackers are "controlled" by Beijing. Among the arguments marshalled to support this thesis is the fact that consistently harsh punishments are meted out to individuals in China for committing relatively minor computer crimes, while patriotic hackers appear to suffer no sanction for their brazen contravention of Chinese law. Other analysts begin from the premise that since the Chinese government "owns" the Internet in China, patriotic hackers must, therefore, work for the state. Still others point to the fact that a number of these groups, such as Xfocus and NSFocus, appear to be morphing into "white-hat" hackers (i.e., becoming professional information security professionals), often developing relationships with companies associated with the Ministry of Public Security or with the ministry itself. Whatever their standing in reality, because of their usefulness, these independent groups are at the least "state-tolerated" or "state-encouraged." They are tolerated not only because they are useful tools for the regime, but are, at the same time, careful not to pursue domestic hacking activities that might threaten internal stability or security and thereby activate the repression apparatus. Indeed, most of the groups have been issued constitutions or other organising documents that specifically prohibit members from attacking Chinese websites or networks. What is left to be seen is whether these state pampered groups morph into the cyber version of an E-Frankenstein monster.

Ghosts in the Net
The largest spying operation to come to light was uncovered by Shishir Nagaraja and Ross Anderson while investigating intelligence leaks at the Office of His Holiness the Dalai Lama (OHHDL) in Dharamsala. In a matter of two years, at least 1,295 computers in 103 countries, including many

belonging to embassies, foreign ministries and other government offices, as well as the Dalai Lama's Tibetan exile centres in India, Brussels, London and New York had been infiltrated. Though the fingers directly point to China, it is not clear whether there is a direct involvement of the Chinese government. The malware installed in these compromised computers besides phishing (extracting user identity and passwords) also scanned the systems for important information. The malware also has the ability to turn on the camera and audio-recording functions of an infected computer, enabling monitors to see and hear what goes on in a room. It is, however, not clear whether this facility was used. [27] GhostNet is the name given to this large-scale electronic spying operation, based mainly in the People's Republic of China. Investigators focussed initially on allegations of Chinese cyber-espionage against the Tibetan exile community, such as instances where e-mail correspondence and other data were stolen. This led to the discovery of a much wider network of compromised machines.

Compromised systems were discovered in the embassies of India, South Korea, Indonesia, Romania, Cyprus, Malta, Thailand, Taiwan, Portugal, Germany Pakistan and the office of the Prime Minister of Laos.

Despite the lack of evidence to pin-point the Chinese government in the operation of GhostNet, researchers have found actions taken by government officials from the People's Republic of China that were linked to the information obtained via the GhostNet. One such incident involved a foreign diplomat who was sent an e-mail invitation from His Holiness the Dalai Lama, but before they could follow it up with a courtesy telephone call, the diplomat's office was contacted by the Chinese government and warned not to go ahead with the meeting. Another incident was about a Tibetan woman who was interrogated by Chinese intelligence officers and was shown transcripts of her online conversations.[28]

Technical Functionality: E-mails are sent to target organisations that contain contextually relevant information. These e-mails contain malicious

27. Shishir Nagaraja and Ross Anderson, "The Snooping Dragon: Social-Malware Surveillance of the Tibetan Movement," http://www.cl.cam.ac.uk/techreports/UCAM-CL-TR-746.pdf March 2009.
28. "Tracking GhostNet: Investigating a Cyber Espionage Network," http://www.infowar-monitor.net/ghostnet; http://www.tracking-ghost.nett

attachments, that, when opened, drop a Trojan horse onto the system. This Trojan connects back to a control server, usually located in China, to receive commands. The infected computer will then execute the command specified by the control server. Occasionally, the command specified by the control server will cause the infected computer to download and install a Trojan known as Ghost Rat that allows attackers to gain complete, real-time control of computers running Microsoft Windows. Such a computer can be controlled or inspected by attackers, and even has the ability to turn on camera and audio-recording functions, if present, of infected computers, enabling monitors to perform surveillance.[29]

Shadow Network

On April 06, 2010, researchers and collaborating institutions based at the Munk School of Global Affairs at the University of Toronto published a report, *Shadows in the Clouds Investigating Cyber Espionage 2.0,*[30] which states that a Chinese network based in Sichuan province had been carrying out a spying operation for several months, targeting Indian government establishments, including security installations. According to the *New York Times,* it is possible that the operation had the blessings of the Chinese government.[31] This cyber infiltration has been named the "Shadow Network". The report documents a complex ecosystem of cyber espionage that systematically compromised government, business, academic, and other computer network systems in India, the offices of the Dalai Lama, the United Nations, and several other countries. The profile of documents recovered suggests that the attackers targeted "specific systems and profiles of users".

During the period in which the attacks were monitored, the attackers pilfered 99 documents, from India, including what appears to be one encrypted diplomatic correspondence as well as five documents marked

---

29. n. 27.
30. "SHADOWS IN THE CLOUD: Investigating Cyber Espionage," *2.0.* INFOWAR · MONITOR. JR03-2010. www.f-secure.com/weblog/archives/Shadows_In_The_Cloud.pdf
31. "Did China Govt 'okay' Cyber Attacks on India?," http://www.dnaindia.com/india/report_did-china-govt-okay-cyber-attacks-on-india_1368298

The above operations clearly indicate that China's cyber warfare capability is deep, pervasive and a threat not only to governments and militaries but also to foreign corporations and individuals.

"RESTRICTED" and four documents marked "CONFIDENTIAL". These documents contained reports concerning secret assessments of India's security situation in the states of Assam, Manipur, Nagaland and Tripura, as well as those concerning the Naxalites and Maoists. The documents also contained confidential information from Indian Embassies regarding international relations with, and assessments of activities in, West Africa, Russia/Commonwealth of Independent States and the Middle East, as well as visa applications, passport office circulars and diplomatic correspondence. Some of the breaches also involved Indian Embassy computers in Kabul, Moscow, Dubai, United Arab Emirates, and the High Commission of India in Abuja, Nigeria. Data was also accessed from Indian Military Engineer Services in Bengdubi, Calcutta, Bangalore, Jalandhar, the 21 Mountain Artillery Brigade in Assam, three Air Force bases and from computers at two Indian military colleges.[32]

This is a much bigger, more sophisticated, different and a more deeply focussed India specific Internet spying operation than the surveillance ring GhostNet that attacked Indian data last year. The attack made extensive use of Internet services like Twitter, Google Groups, Blogspot, blog.com, Baidu Blogs and Yahoo! Mail to automate the control of computers once they had been infected.

The above operations clearly indicate that China's cyber warfare capability is deep, pervasive and a threat not only to governments and militaries but also to foreign corporations and individuals. The Chinese government can decipher most types of encrypted e-mails and documents. China's Internet spy network is thought to be the most extensive—if not the most creative—in the world. The government's strongest tactic is a vast network of botnets—parasitic software programmes that allow their users

---

32. "Chinese Hackers Steal Secret Indian Documents," http://timesofindia.indiatimes.com/world/us/Chinese-hackers-steal-secret-Indian-documents/articleshow/5767793.cms

to hijack networked computers.[33] Individual bots can be building blocks for powerful conglomerations known as "botnets" or "bot armies," similar to traditional Chinese espionage. It may not be the most efficient form of cyber warfare but China wields this instrument very effectively.[34]

While much of China's Internet spying is aimed at Taiwan, it is also driven by Beijing's desire for global power status. With the United States and Russia investing in offensive and defensive cyber warfare capability, China, not wanting to be left behind, is applying its strengths and devoting its resources to stay ahead of them instead of being caught in the middle.

With its information infrastructure under tight governmental control, China can leverage its massive manpower resources in a manner that allows it to conduct far more direct and holistic cyber warfare operations than any other country. Because of the tight control over the Internet activity inside the country, virtually all information coming into and out of China can be filtered out by the flip of a switch, which is an unprecedented amount of control. Today, with current technology, the Chinese government can hack into almost anything, even without information on specific encryption programmes. It can do this not only by breaking codes but also through

---

33. A botnet or robot network is a group of computers running a computer application controlled and manipulated only by the owner or the software source. The botnet may refer to a legitimate network of several computers that share programme processing amongst them. Usually though, when people talk about botnets, they are talking about a group of computers infected with the malicious kind of robot software, the bots, which present a security threat to the computer owner. Once the robot software (also known as malicious software or malware) has been successfully installed in a computer, this computer becomes a zombie or a drone, unable to resist the commands of the bot commander. A botnet may be small or large depending on the complexity and sophistication of the bots used. A large botnet may be composed of ten thousand individual zombies. A small botnet, on the other hand may be composed of only a thousand drones. Usually, the owners of the zombie computers do not know that their computers and their computers' resources are being remotely controlled and exploited by an individual or a group of malware runners through Internet Relay Chat (IRC) There are various types of malicious bots that have already infected and are continuing to infect the internet. Some bots have their own spreaders - the script that lets them infect other computers (this is the why botnets are also referred to as computer viruses).
   A zombie computer (often shortened as zombie) is a computer connected to the Internet that has been compromised by a hacker, a computer virus, or a Trojan horse. Generally, a compromised machine is only one of many in a botnet, and will be used to perform malicious tasks of one sort or another under remote direction. Most owners of zombie computers are unaware that their system is being used in this way.
34. "China: Pushing Ahead of the Cyberwarfare Pack," March 2, 2009, http://www.stratfor.com/memberships/132785/analysis/20090225_china_pushing_ahead_cyberwarfare_pack

less elaborate means, such as capturing information upstream on Internet servers, which, in China, are all controlled by the government and its security apparatus. If a foreign company is operating in China, it is almost a given that its entire computer system is or will be compromised. If companies or individuals are using the Internet in China, there is an extremely strong possibility that several extensive bots have already infiltrated their systems. STRATFOR sources in the Chinese hotel industry tell of extensive Internet networks in hotels that are tied directly to the Public Security Bureau (PSB, the Chinese version of the CBI). During the 2008 Olympics, Western hotel chains were asked to install special Internet monitoring devices that would give the PSB even more access to Internet activities.

The Chinese Internet spy network relies heavily on bots. Many Chinese websites have these embedded bots, and simply logging onto a website could trigger the download of a bot onto the host computer. Given that the Internet in China is centrally controlled by the government, these bots likely are on many common websites, including English-language news sites and expatriate blogs. It is important to note that the Chinese cyber warfare capability is not limited by geography. The government can break into websites anywhere in the world to install bots.

China has invested considerable time and resources to developing its bot armies, focussing on quantity rather than quality and shying away from more creative forms of hacking such as SQL injections (injecting a code to exploit a security vulnerability)[35] and next-generation remote exploits (in such features as chat software and online games). The best thing about bots is that they are easy to spread. An extensive bot army, for example, can be employed both externally and internally, which puts China at a distinct advantage. If Beijing wanted to cut its Internet access to the rest of the world in a crisis scenario, it could still spy on computers beyond its national

---

35. SQL injection is an attack in which a malicious code is inserted into strings that are later passed to an SQL server for parsing and execution. It is a technique that exploits a security vulnerability occurring in the database layer of an application. In computing, a parser is one of the components in an interpreter or compiler, which checks for correct syntax and builds a data structure (often some kind of parse tree, abstract syntax tree or other hierarchical structure) implicit in the input tokens.

boundaries, with bots installed on computers around the world. The upkeep of the spy network could easily be accomplished by a few people operating outside of China. In comparison, India, because of the myriad operators, does not have the ability to shut down its Internet network in a time of crisis, nor could it get into China's network if it were shut down.

A bot army might be a large, blunt instrument, but finding a bot on a computer can be a Herculean task, beyond the capabilities of some of the most Internet-savvy people. Moreover, the Chinese have started to make their bots "user-friendly." When bots were first introduced, they could slow down computer operating systems, eventually leading the computer user to reinstall the hard drive (and, thus, killing the bot). Sources say that Chinese bots now can be so efficient they actually make many computers run better by cleaning up the hard drive, trying to resolve conflicts, and so on. They are like invisible computer housecleaners, tidying up things and keeping users satisfied. Since there is no such thing as a free lunch, the payment for this housekeeping, of course, is intelligence.

A great deal of the computer chips and other hardware used in manufacturing computers for companies and governments are made in China; and these components often come from the factory loaded with malware.

In addition to bots and other malware, the Chinese have many other ways to expand their Internet spy network. A great deal of the computer chips and other hardware used in manufacturing computers for companies and governments are made in China; and these components often come from the factory loaded with malware. It is also common for USB flash drives and computers to come from the factory preloaded with malware. These components make their way into computers operating in major companies and governments. The Pentagon in November 2008 was forced to ban the use of USB thumb drives because of a computer security incident.[36]

---

36. Associated Press, "Pentagon Bans Thumb Drives," November 21, 2008, http://www.military. com/news/article/pentagon-bans-thumb-drives.html

NETWORK ATTACKS AGAINST LOGISTICS

Preemption [*xianfa zhiren*] is a core concept of emerging Chinese military doctrine. It is a strategy by which they aim to overcome even a powerful adversary by taking advantage of serious gaps during the deployment stage. By pursuing the strategy of preemption, they endeavour to overcome the enemy by launching preemptive strikes during the early phase of the war or in the preparations leading to the offensive. The Chinese are developing preemption as their core strategy after analysing the operational vulnerabilities of the US during the deployment phase. Using this strategy, they seek to zero in on the hubs and other crucial links in the system that move enemy troops as well as the war-making machine, such as harbours, airports, means of transportation, battlefield installations, and the communications, command and control and information systems. They view India as a slow starter and extremely vulnerable in the initial stages of the conflict. The analysts believe that a preemption of information operations mainly relying on distant battle and stealth to destroy or disrupt C3 systems is the best way to deliver a bolt from the blue in the initial stages of the conflict and seize the initiative. The idea of a preemptive CW/IW strike has been elevated to the central place in the PLA's design of the attack: crippling the enemy's major military assets rather than its urban centres. This has also broadened their vision in waging an anti-Revolution in Military Affairs (RMA) war against a superior opponent.

There are two macro-level targets for Chinese computer network operations: military network information and military information stored on networks. Computer network attack seeks to use the former to degrade the latter. Like the US doctrine, Chinese CNA targeting therefore, focusses specifically on "enemy C2 centres," especially "enemy information systems." Of these information systems, PLA writings and interviews suggest that logistics computer systems are a top priority military target. According to PLA sources, it is essential to zero in on the crucial links in the opponents' apparatus that move enemy troops such as their information systems, and neutralise their information accuracy, timeliness of information, and reliability of information.

In addition to logistics computer systems, another key military target for Chinese CNA is military reliance on civilian communications systems. This view stems from the PLA's analysis that the main US weakness is during the deployment phase, where the US is heavily dependent on computer networks. Chinese authors highlight that the US uses the civilian backbone and unclassified computer networks (i.e., NIPRNET) which are attractive targets and an intelligence goldmine. This is a potential vulnerability which can be attacked through computer network attacks. Classified networks, on the other hand, are an attractive target but could be less accessible.

Computer network attack could also delay resupply to the theatre by misdirecting stores, fuel, and munitions, corrupting or deleting inventory files, and thereby hindering mission capability. The advantages to this strategy are numerous: (1) it is available to the PLA in the near-term; (2) it does not require the PLA to attack/invade any state with air/sea assets; (3) it has a reasonable level of deniability, provided that the attack is sophisticated enough to prevent tracing; (4) it exploits perceived casualty aversion and overattention to force protection; and (5) it overcomes the tyranny of distance and could achieve the desired operational and psychological effects.

THE GENERATION LEAP STRATEGY
Throughout its history, the PLA has suffered from inadequate and outdated information technology, characterised by limited capacity and lack of security. In the past, these weaknesses had severely limited the military's ability to transmit and process large amounts of information or coordinate activities among the various military regions, thereby reducing military effectiveness. The PLA is very much aware of the critical role played by information-based C4ISR technologies in the Gulf and Afghanistan Wars. To overcome these deficits, the PLA has embarked on a well financed generation leap strategy to modernise its infrastructure. The idea of a generation leap is at the core of the PLA's IT-RMA transformation. It means that the PLA pushes two transformations simultaneously: mechanisation and informatisation. In the West, the former precedes the latter, as the platforms are the carriers of the systems. China's mechanisation is far from complete, but it is in a

The transfer of technologies required for leapfrogging in the C4ISR domain was facilitated by the enormous competition amongst the Western telecom firms to get a share of the billions in the potential Chinese market.

hurry – the PLA is trying to invent its own way of informatising.

According to Chinese military analyst You Ji, the PLA is currently engaged – as part of an ambitious "generation-leap" strategy – in a "double construction" transformational effort of simultaneously pursuing both the mechanisation and informatisation of its armed forces. Initially, the PLA intends to digitise and upgrade its current arsenal of conventional "industrial age" weapons – through improved communications systems, new sensors and seekers, greater precision, etc. Concurrently and with equal emphasis, the Chinese are trying to leapfrog development in building informationised capabilities, by putting greater effort and resources into C4ISR infrastructures, networking, and information warfare. By this process, the PLA hopes to transform itself from a mechanised military into a informatised military, with a combat capability for both "soft kill and hard kill." The PLA informatisation can be divided into three stages of evolution: digitalisation, systems integration and intelligentisation (*zhinenghua*). Digitalisation is the initial phase. The PLA has not fully entered this stage, but it is already working on comprehensive networking.

The PLA believes that its late start can save it from the blind exploration of a wrong path. The US experience shows the rules of, and steps in, transformation from mechanisation to informatisation. Through learning from the US, the PLA hopes to skip a few stages of development and enter the fast track early. American military reforms are, therefore, providing a good roadmap for the PLA to quicken the pace of its reforms.

The transfer of technologies required for leapfrogging in the C4ISR domain was facilitated by the enormous competition amongst the Western telecom firms to get a share of the billions in the potential Chinese market. The state backed Chinese IT sector quickly moved beyond merely

importing Western technology to co-developing technology with them. Significant players in the Chinese telecoms market, such as Huawei and Datang, maintain deep co-development relationships with the world's top information-technology powerhouses, but they also have clear ties with the Chinese military, which has now become both a research partner and a valued customer for their IT products.

In microelectronics, China is quickly becoming an important design and production base in the global semiconductor industry, providing the PLA with potential access to a secure supply of advanced integrated circuits for use in sensors and weapon systems. The result is significant levels of military access to cutting-edge information technology, fuelling a C4ISR revolution in the armed forces.

The introduction of an advanced, secure telecommunications infrastructure, has enabled the PLA to achieve significant improvement in its communications and operational security[37], as well as in its capacity to transmit information. The use of advanced optical fibre communications facilities, satellites, long-distance automated switches and computer controlled telephone systems have significantly accelerated the Chinese armed forces' digitisation process and the rapid transmission and processing of military information. The speedy development of strategic communications networks has shortened the distance between command headquarters and grassroots units, and between inland areas and border and coastal areas. Currently the armed forces' networks for data exchange have already linked up units garrisoned in all medium-sized and large cities in the country as well as in the border and coastal areas.

As a result of the automated exchange and transmission of data, graphics and pictures within the armed forces, military information can now be shared by all military units.[38] On the sensor front, China has also made significant advances, as evidenced by the deployment of new constellations of navigation satellites (*Beidou*), communications satellites

---

37. James C. Mulvenon, "Chinese C4I Modernisation: An Experiment in Open Source Analysis," http://www.rand.org/pubs/conf_proceedings/2005/CF189.pdf
38. Evan S. Medeiros, Roger Cliff, Keith Crane, James C. Mulvenon, "A New Direction for China's Defence Industry," http://www.rand.org/pubs/monographs/2005/RAND_MG334.pdf

The PLA's projection is that in a worst case scenario, China's future war will be fought against lightning air and missile surgical strikes, or sustained air, missile and electronic bombardment.

(*Dongfanghong-4, Fenghuo*)[39], and phased-array radars.[40]

CONCLUSION

The PLA's projection is that in a worst case scenario, China's future war will be fought against lightning air and missile surgical strikes, or sustained air, missile and electronic bombardment. If it is the PLA that takes action, it would be an information dominated attack. Non-personnel engagement will be a new but prominent feature of combat, although exchange of fire within short distances (e.g., aerial dog-fights) could possibly occur.

The idea of a preemptive IW strike has been elevated to the central place in the PLA's design of the attack: crippling the enemy's major military assets rather than its urban centres. This has broadened its vision in waging an anti-RMA war against a superior opponent. To PLA strategists, the informatisation of the US military has not only generated strength, but also exposed weaknesses. The 9/11 tragedy reflects the vulnerability of a mighty nation to new kinds of war. The PLA is contemplating various types of asymmetrical warfare for self-protection. To this end, China is developing new IW measures. Cyber attacks on the enemy's C4ISR will be an integral part of future warfare. Such attacks are much cheaper than attacks on carrier battle groups. The PLA believes that the more a military depends on IT, the more vulnerable it becomes to strikes at its information hubs. For the first time, militarily weaker powers have found the means to deliver punches to the soft-underbelly of the more powerful enemy.

The much talked about missile threat is another form of non-contact warfare the PLA in contemplating. Saturated conventional missile attacks at military targets and communication hubs are one of the first choices.

---

39. Mark A. Stokes, "China's Strategic Modernisation: Implications for the United States," http://www.fas.org/nuke/guide/china/doctrine/chinamod.pdf

40. *People's Daily* (China), "China's New Missile Destroyer: the 'Magic Shield of China'" http://www.freerepublic.com/focus/f-news/919629/posts

The goal of missile warfare is to bring the war to the enemy's territory. It reduces human losses for the PLA, and has a greater psychological effect on the opponent's population. Missile launches are also more manageable and can be halted promptly to avoid escalation and direct confrontation.

The PLA has been particularly influenced by the information technologies-led RMA and is determined to transform the PLA into a force capable of fighting and winning "limited local wars under conditions of 'informatisation'." This doctrine revolves around short duration, high intensity conflicts characterised by mobility, speed, and long-range attack, employing joint operations fought simultaneously throughout the entire air/space, land, sea and electro-magnetic battlespace, and relying heavily upon extremely lethal high technology weapons.

Consequently, the PLA has in recent years put considerable effort into acquiring new capabilities for mobility, power projection, and precision strike. The PLA has made undeniable progress since the late 1990s in expanding its capabilities in several areas, particularly missile attack, power projection over sea and in the air, space, INEW, directed energy weapons and precision-strike. "Informatisation" is a potentially critical new development in the PLA's war-fighting capabilities, implying a fundamental shift from being platform-centric toward INEW. China's military transformation has, more than any armed force in the Asia-Pacific region, imitated US transformation in terms of ambition and scope. Long-term trends in Chinese military modernisation have the potential to pose a credible threat to militaries in our region if they are not doing so already.

TOWARDS A NUCLEAR WEAPON FREE WORLD: INDIAN PERSPECTIVES

SWARAN SINGH

Starting from the four former US senior officials writing articles proposing a nuclear weapon free world in the *Wall Street Journal* in January 2007, a series of global initiatives have sustained the groundswell on this theme around the world. A number of initiatives in this direction include the Oslo Conference of February 2008, the London Dialogue in March 2008, an Experts' Roundtable in Berlin in June 2008, the setting up in September 2008 jointly by Australia and Japan of an International Commission on Nuclear Non-Proliferation and Disarmament, then in December 2008, over 100 political, military, business and civic leaders from across the globe launching the Global Zero initiative in Paris followed closely by President Obama's speech in Prague in April 2009, his chairing of the UN Security Council on September 24, 2009, that passed Resolution 1887 and then his Nuclear Security Summit in April 2010. All these marked the backdrop of the 8th Review Conference of the nuclear Non-Proliferation Treaty (NPT) that was held in New York during May 3-28 and which managed to adopt a consensus final document calling for initiating the process to a convention on nuclear weapons ban.

* Prof **Swaran Singh** is Professor for Diplomacy and Disarmament at the School of International Studies , Jawaharlal Nehru University , New Delhi . This paper was presented at an International Conference hosted jointly by Australian National University and China Institute of Contemporary International Relations on "Exploring the Contours of Sino-Australian Security Cooperation in as Transnational Regional Context," held at Canberra (Australia) during April 21-23, 2010.

This is also the first time in the history of the nuclear age that none of the major powers seems to oppose these initiatives towards the NWFW.

As regards India, it sees this groundswell as a vindication of its dream though it also remains very conscious of the need for an early commitment by all the nuclear weapons powers.[1] Secondly, the year 2010 holds very special significance with regards to India's search for a Nuclear Weapon Free World (NWFW). According to the Rajiv Gandhi Action Plan—that was presented by India's Prime Minister to the Third UN Special Session on Disarmament on June 9, 1988—we would have achieved an NWFW before the end of this year.[2] Sure, this Action Plan was neither the first nor last of its kind but it does represent an important milestone in India's sustained interest in nuclear disarmament and, at least from the Indian perspective, is recognised as an important watershed in the evolution of both global as also national cumulative wisdom toward towards building an NWFW. China had similarly proposed for a world nuclear weapons convention on the occasion of its first nuclear tests in October 1964 and the Chinese policy-makers and scholars have also continued to show interest in nuclear disarmament.[3]

Of course, we are today debating an NWFW in the backdrop of another major transformation wherein this campaign for an NWFW is led this time by none other than the United States. This is also the first time in the history of the nuclear age that none of the major powers seems to oppose these initiatives towards the NWFW, which has allowed them to gather some momentum in

1. Laxminarayan Ramdas, "Abolition of Nuclear Weapons: Political Apathy and a Possible Way Ahead", in David Krieger, ed., *The Challenge of Abolishing Nuclear Weapons* (New Jersey: Transaction Publishers, 2009), p. 21; also Robert Green, "Nuclear Deterrence Scam Blocking Progress to a Safer World", *The Huffington Post*, June 8, 2010, at http://www.huffingtonpost.com/robert-green/nuclear-deterrence-scam-b_b_603157.html

2. This Action Plan is formally known as "Action Plan for Ushering in a Nuclear Weapons Free and Non-Violent World Order" and is listed as Annexure 2 in Manpreet Sethi, ed., *Towards a Nuclear Weapons Free World* (New Delhi: KW Publishers, 2009), pp. 151-156. To locate it in the history of several such proposals, see Lawrence S. Wittner, *Confronting the Bomb: A Sort History of the World Nuclear Disarmament Movement* (Stanford, Ca: Stanford University Press, 2009), p. 185.

3. Shen Dingli, "Toward a Nuclear Weapons Free World: A Chinese Perspective," (Sydney: Lowy Institute *Perspectives*, November 2009), p.6. He says, "While such an objective of global zero is commendable, it will not be effective unless coupled with reductions in conventional threats and an improvement in global security that obviates the need for deterrence."

various parts of the world. It is for generating this unprecedented and expanding commitment for an NWFW that President Barack Obama has already been conferred the Nobel Peace Prize for 2009, and as result of his continued efforts in building consensus amongst world leaders, the groundswell has been heartening though the NWFW as yet remains a seriously contested proposition.

THE NEW GROUNDSWELL FOR SURE

At the very outset, it is President Obama's immediate backdrop that makes his successive proclamations – among these are his Prague speech of April 5, 2009, the UN Security Council Resolution 1887 of September 24, 2009 and his Nuclear Security Summit of April 12-13, 2010, in Washington – such a refreshing, convincing, even inspiring aspiration. Obama's departure on matters nuclear becomes especially significant given his predecessor's track-record of abandoning and defying arms control treaties; especially his vision about "revitalising" nuclear forces and taking "anticipatory action" (read preemptive strike) that was outlined respectively in the George Bush Jr Administration's *Nuclear Posture Review* and *National Security Strategy* of 2001. In comparison, the Obama *Nuclear Posture Review (NPR)* of April 2010 seeks to provide negative security guarantees to all Non-Nuclear Weapon States (NNWS), promising that in no circumstances will the US use or threaten to use nuclear weapons against any of the NPT-signatory NNWs. At the least, such professions by the US should discourage the NNWS from aspiring to have nuclear weapons and, in turn, create the necessary atmospherics for the Nuclear Weapon States (NWS) to begin reducing their dependence on nuclear weapons.

This tectonic shift towards nuclear disarmament had begun with the collapse of the former Soviet Union in the late 1980s and had witnessed pronouncements about the expected "peace dividend" for the rest of the

It is for generating this unprecedented and expanding commitment for an NWFW that President Barack Obama has already been conferred the Nobel Peace Prize for 2009, and as result of his continued efforts in building consensus amongst world leaders, the grounds well has been heartening.

world. As early as in 1985, at their Geneva Summit, Gorbachev and Reagan had announced, "A nuclear cannot be won and should never be fought".[4] Finally, the threats of a nuclear Armageddon had come to an end. Even the US-Soviet detente of the early 1970s that had produced a series of arms control treaties did not generate such pious aspirations. This brief period of confusion and idealism of the early 1990s, with the US as the sole surviving superpower in the lead, was followed by the unconditional and indefinite extension of the NPT in May 1995. As a result, while most states pledged to abstain from nuclear weapons, the NPT-endorsed five NWS could now ensure world peace based on their time-tested nuclear deterrence.[5] The Comprehensive Test Ban Treaty (CTBT) and possibly the Fissile Material Cut-off Treaty (FMCT) were expected to seal this arrangement forever.

Of course, all this was easier said than done. The enormous military establishments built during the Cold War years – including the North Atlantic Treaty Organisation (NATO) – now faced a spectre of their swords turning into ploughshares. The search for finding a new enemy had already begun. For the mere reason that most of the smaller conflicts had been ignored or pushed under the carpet during the Cold War confrontation, the post-Cold War period heralded the rise of ethno-nationalism and asymmetric intra-state violence, resulting in cascading episodes of ethnic cleansing, from Bosnia, Cambodia to Rwanda, compelling the US to lead the Coalition of the Willing into a Desert Storm Operation. The Persian Gulf War was to see US forces in Iraq till almost the end of the 1990s and they were back again from the year 2003. This trend was in tune with the shifting focus from East-West to North-South hyphenation, making threshold rogue states and their so-called illegitimate aspirations for Weapons of Mass Destruction (WMD) the new buzzword in nuclear parlance. Finally, 9/11 produced a much needed enemy – transnational terrorism – that was worth the attention of the great powers and one that ensured, even if briefly, the continued relevance of the nuclear paradigms of the Cold War years.

4. Mario Esteban Carranza, *South Asian Security and International Nuclear Order: Creating a Robust Indo-Pakistani Nuclear Arms Control Regime* (Burlington: Ashgate, 2009), p. 158.
5. Michael Quinlan, *Thinking About Nuclear Weapons: Principles, Problems, Prospects* (Oxford: Oxford University Press, 2009), p. 80.

But soon, this spectre of terrorism and rogue states was eroding the efficacy of conventional theologies on nuclear deterrence and non-proliferation. The inevitably expanding numbers of new States with Nuclear Weapons (SNW) and, after the implosion of the A. Q. Khan network in October 2004, the increasingly credible threats of WMD falling into the hands of terrorist outfits, were to push the dominant discourse to rethink and revisit its formulations.[6] Unlike daring yet rational rogue states, terrorists would have no compunction, no incentives and no option to use their nuclear assets in the old fashioned escalation control deterrence matrix. Terrorists are not likely to develop their own nuclear arsenals and, given their extreme mobility, they would prefer to use, rather than lose, their nuclear access. It was this new reality that was to make the United States' hard-core conservative, realist, former high-ranking and experienced four officials begin publishing a series of joint annual articles in *The Wall Street Journal* from January 2007 propagating unilateral initiatives, arguing that the time for developing an NWFW had come.[7]

This seemingly pious yet realist sentiment had immediate echoes across European friends and allies. In June 2008, a widely publicised editorial was written by four former British Secretaries of Defence and Foreign Affairs – Douglas Hurd, Malcolm Rifkind, David Owen and George Robertson – advocating drastic reductions (though not unilateral) and lowering of the salience of nuclear weapons in national security strategies. In January 2009, four prominent retired German politicians – Helmut Schmidt, Richard von Weizsacker, Egon Bahr and Hans-Dietrick Genscher – supported similar calls for action by Moscow and Washington to promote nuclear disarmament.[8] In June 2008, again, the Prime Ministers of Australia and Japan announced the setting up of a bilateral International Commission on Nuclear Non-

---

6. David Albright, *Peddling Peril: How the Secret Nuclear Trade Arms America's Enemies* (New York: Simon & Schuster, 2010), p. 32
7. George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "A World Free of Nuclear Weapons", *The Wall Street Journal*, January 4, 2007; George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "Toward a Nuclear-Free World" *The Wall Street Journal*, January 15, 2008; George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "How to Protect Our Nuclear Deterrent: Maintaining Confidence in Our Nuclear Arsenal is Necessary as the Number of Weapons Goes Down", *The Wall Street Journal*, January 19, 2010.
8. *SIPRI Year Book 2009* (Oxford: Oxford University Press, 2009), p. 409.

Proliferation and Disarmament that submitted its extensive report titled *Elimination of Nuclear Threats* in November 2009. Many more similar pieces were written, speeches made and conferences held elsewhere.

THE IDEA WHOSE TIME HAS COME

This groundswell, initiated by the four senior US officials, had certainly stirred up the debate amongst academics, policy-makers and strategists around the world yet it would have stayed just that had it not been reciprocated by the 2008 US Presidential candidate Barack Hussein Obama who was to later to make history as he took over as the 44th yet first black President in US history, which further strengthened the sense of this being an epoch-making time for our world. With "change" as his byword, he has so far not succumbed to the doomsday soothsayers though his Administration has continued with several of his predecessor's global military engagements, military and nuclear projects, as also exposed his being circumscribed and failing to deliver on promises like ratification of the CTBT by the US Senate and starting FMCT negotiations. But his search for evolving an NWFW has continued to muddle through various hiccups.

Seen in the backdrop of the US having been reluctant to talk of on NWFW and even abandoning the Anti-Ballistic Missile (ABM) Treaty and several other international regimes, including the anti-personnel landmine ban, Kyoto Protocol etc., President Obama does represent a convincingly new vision. It is this backdrop that makes Obama's Prague speech of April 5, 2009 being viewed as a "radical vision" with "emphasis on the moral responsibility of the US for a world without nuclear weapons, in the framework of which the legal following up on the START-1 and SORT agreements, as well as the hastened American ratification of the Comprehensive Test Ban Treaty (CTBT), is only the first albeit important step."[9] But most important was President Obama chairing the UN Security Council session in September 2009 and getting all the five NWS to agree to a breakthrough resolution committing

---

9. Nik Hynek, "Continuity and Change in the US Foreign and Secuity Policy with the Accession of President Obama" (Prague: Institute of International Relations, *Policy Paper*, August 2009), p. 6; Rajiv Nayan, "The Nuclear Agenda of the Obama Administration", *Strategic Analysis* (New Delhi), vol. 33, issue 5, September 2009, pp. 623-628.

themselves to "…create the conditions for a world without nuclear weapons, in accordance with the goals of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), in a way that promotes international stability, and based on the principle of undiminished security for all."[10]

The *Nuclear Posture Review* (NPR) – a process that began in the Clinton years – has also seen an interesting evolution with Obama's becoming known for underlining the reduced role of nuclear weapons. [11] Similarly, the US and Russia managed to sign their post-START-1 nuclear agreement on April 8, 2010, effecting substantial reductions in their nuclear stockpiles. This was followed by Obama's Nuclear Security Summit that was (a) attended by high-profile delegates from 47 countries, including heads of state and government from 37 nations; and (b) which reached a consensus joint communiqué and a work plan underlining that nuclear terrorism was the most serious threat to the 21st century world. As part of this new enthusiasm, Ukraine pledged to surrender all its remaining nuclear fissile materials by the year 2012 and Canada promised to return at least a substantial part of spent fuel to the US before 2018. Now where does India stand in this new momentum for nuclear disarmament and an NWFW?

Prima facie, in spite of initial misgivings from both sides, Obama has developed an unusual chemistry with India's Prime Minister. Both have had successive meetings in various global and bilateral forums and in their last meeting at the Nuclear Security Summit, India's Foreign Secretary was reported quoting Obama, saying that "there was no country in the world where the opportunities for a strong, strategic partnership are greater and

India's Foreign Secretary was reported quoting Obama saying that "there was no country in the world where the opportunities for a strong, strategic partnership are greater and more important to him personally or to the United States, than that with India."

---

10. *UN Security Council Resolution 1887*, S/RS/1887, September 24, 2009, at http://www.america.gov/st/texttrans-english/2009/September/20090924173226ihecuor0.5509411.html
11. For details, see Martin Butcher, Obama's Nuclear Posture Review, *BASIC Getting to Zero Special Briefing* (London: Basic, June 25, 2009), pp. 1-14.

more important to him personally or to the United States, than that with India."[12] The years of George Bush Jr had witnessed India being transformed from a target to a partner in nuclear non-proliferation. And after a year of diplomatic engagement, India finds itself on the same page even with the Obama Administration and this is especially true when it comes to matters nuclear. With the signing of their reprocessing agreement in March 2010, their partnership, including their working together for an NWFW, has been both streamlined and reinforced.[13] To cite from their Joint Statement issued during Indian Prime Minister Manmohan Singh's November 2009 visit to Washington DC, both sides had underlined their "shared vision of a world free of nuclear weapons and pledged to work together, as leaders of responsible states with advanced nuclear technology."[14] Never before have global circumstances been so favourable to India's disarmament policy.

INDIA'S ETHOS, TRADITIONS, LEGACIES

The Indian elite sees India as having made a "pioneering contribution… in the quest for nuclear disarmament… stood by the belief that the best guarantee for India's security as indeed for the security of the world at large was a world free of all nuclear weapons."[15] The recent revival of interest in the subject, they say, only highlights the continuing relevance of India's vision and proposals. According to a senior leader in the government, this requires (a) binding commitment by all nations; (b) demonstration of good faith through a tangible progress; and (c) reorganisation of doctrines and institutions to sustain a nuclear weapon free world.[16] Indeed, as early as in 1948, India had tabled a resolution at the UN General Assembly that noted the then UN Atomic Energy Commission's proposal for the control

12. Raj Chengappa, "Obama-Manmohan Chemistry: The Peacenik and the Flying Sikh", *The Tribune* (Chandigarh), April 14, 2010.
13. Swaran Singh, "On the Same Page", *Hindustan Times* (New Delhi), April 14, 2010, p. 12.
14. Joint Statement by President Obama, Indian Prime Minister Singh, November 24, 2009; accessed on April 16, 2010 at http://www.america.gov/st/texttrans-english/2009/November/20091125115540eaifas0.3806574.html
15. Inder Kumar Gujral, *Viewpoint: Civilization, Democracy and Foreign Policy* (New Delhi: Allied Publishers, 2004), p. 24.
16. Pranab Mukherjee, "Asian Security in the Twenty-first Century: Key Challenges", in N.S. Sisodia, V. Krishnappa and Priyanka Singh, eds., *Proliferation and Emerging Nuclear Order in the Twenty-first Century*, (New Delhi: Academic Foundation, 2009), p. 16.

of atomic energy "…for peaceful purposes and for the elimination from national armaments of atomic weapons."[17] Scholars repeatedly cite examples of Nehru's call for a "Standstill Agreement" in April 1954 and for a Partial Test Ban Treaty (PTBT), India's role at the Eighteen-Member Disarmament Committee (ENDC), its co-sponsorship for a non-discriminatory treaty on non-proliferation in 1965, for a global treaty on no-first use in 1978, for a nuclear weapon free world in 1982 and then for a nuclear weapon free and non-violent world in 1988.

Indian scholars also cite India's civilisational ethos and culture privileging peace and traditions from Buddhism to India's peaceful national liberation movement. There is also increasing belief that the excessive peace preaching by India's founding fathers was not driven exclusively by the desire to seek a high moral standing but also as the most pragmatic position possible, given India's leverages and limitations of that time. But the fact that these pragmatic policies were inspired by faith in non-violence and commitment to peace remains writ large in numerous narratives on the genesis and evolution of India's nuclear disarmament policy. The most inspiring influence on Nehru who guided India's foreign policy almost from the early 1930s till his death in 1964, was Gandhiji. Gandhiji held a strong conviction that "the moral to be legitimately drawn from the supreme tragedy of the [nuclear] bomb is that it will not be destroyed by counter-bombs, as violence cannot be destroyed by counter-violence. Mankind has to get out of violence only through non-violence."[18]

The India National Congress' foreign policy spokesperson from the late 1930s and India's Prime Minister and Foreign Minister from 1947 till 1964, Nehru had the most profound influence in defining the broad vision of India's nuclear disarmament policies and postures. As early as in 1940 (when Italian Enrico Fermi was still working on achieving in 1942 a self-sustaining fission in Chicago University), in a confidential note penned for the inner councils of the Indian National Congress, young Jawaharlal Nehru

---

17. Arundhati Ghose, "Negotiation of the CTBT: India's Security Concerns and Nuclear Disarmemnt", *Journal of International Affairs*, vol. 51, 1997.
18. Daniel A. Dombrowski, "Gandhi, Sainthood, and Nuclear Weapons", *Philosophy East and West*, vol. 33, no. 4, October 1983.

wrote: "Both because of our adherence to the principle of non-violence and from practical considerations arising from our understanding of world events, we believe that complete disarmament of all nation-states should be aimed at and is, in fact, an urgent necessity if the world is not to be reduced to barbarism."[19] His numerous speeches professing commitment to never using nuclear science for evil purposes and his multiple high-profile disarmament initiatives remain only too well-recorded.

Mrs. Indira Gandhi was the Prime Minister whose tenure witnessed India's first nuclear test during May 1974 but, given the general tenor of national orientation of the Indian power elite, she chose to disappoint her dedicated scientific fraternity by calling it a Peaceful Nuclear Explosion (PNE). She told the Indian Parliament, "This experiment was part of the research and development work which the Atomic Energy Commission has been carrying on in pursuance of our national objective of harnessing atomic energy for peaceful purposes." She further said: "No technology is evil in itself: it is the use that nations make of technology which determines its character. India does not accept the principle of apartheid in any matter and technology is no exception."[20] On her return to power in the early 1980s, she joined the high-visibility "Six-Nation-Five-Continent" initiative[21] where, starting from their first meeting on May 22, 1984, these heads of state and government from mid-ranking countries began to meet frequently, urging the international community to halt all testing, production and deployment of nuclear weapons and their delivery systems, followed by reduction and elimination of nuclear forces.

Between Indira Gandhi and Rajiv Gandhi as two Prime Ministers from the Indian National Congress, there had been a brief interregnum of a Janata Party led government which had also tried to reorganise India's disarmament vision which was part of their debate on "genuine" non-alignment that sought to ensure equidistance from the two superpowers

19. Mani Shankar Aiyar, "Towards a Nuclear Weapons Free and Non-Violent World Order", in Sethi, ed., n.2, pp. 19-20.
20. Katherine Frank, *Indira: The Life of Indira Nehru Gandhi* (New York: HarperCollins, 2002), p. 360.
21. These countries included Argentina, Greece, India, Mexico, Sweden and Tanzania.

and was seen as an attempt to shift from Moscow to Washington. This period had witnessed a visit to India by President Jimmy Carter and a brief rethink on India's disarmament posture. On June 9, 1978, at the First UN Special Session on Disarmament (UNSSD), Prime Minister Morarji Desai had proposed a ban on nuclear weapon tests, this time as part of a proposed outline for nuclear disarmament. This tradition was to be sustained by Prime Minister Indira Gandhi

No other Prime Minster of India had as short and as intense a contribution to nuclear disarmament as did Rajiv Gandhi.

reiterating this proposal through a call dated June 11, 1982, to the Second UNSSD. This time, India's proposal included a call for a Convention on No-Use or Threat of Use of Nuclear Weapons, a freeze on the manufacture of nuclear weapons combined with a cut-off in the production of fissionable material for weapons purposes, and a test-ban treaty.[22] This was to be developed into a far more serious effort during the tenure of Rajiv Gandhi who followed Indira Gandhi as India's Prime Minister from 1984.

Indeed, no other Prime Minster of India had as short and as intense a contribution to nuclear disarmament as did Rajiv Gandhi. Young at the age of 40 to be Prime Minister of India, Rajiv Gandhi's tenure became known for a whole range of forward looking initiatives. Especially, his contributions to India's nuclear disarmament remain unusually out of proportion to his years in power. To begin with, he inherited the "Six-Nation" initiative of his mother and former Prime Minister Indira Gandhi, that had begun in the year 1984. This picked up momentum during Soviet General Secretary Gorbachev's visit to India during November 1986 which is remembered for the signing of a 10-point declaration of principles for building a nuclear weapon free and non-violent world. The same formulation was repeated in Rajiv Gandhi's 1988 Action Plan to the UN which presented India's most detailed proposal on nuclear disarmament, ever made. Given his inspired idealism and futuristic vision, historians of nuclear disarmament have compared Rajiv with Jawaharlal Nehru, and his legacies continued

---

22. N. D. Jayaprakash, "Non-Proliferation and the Challenge of Nuclear Disarmament", *Dissident Voice*, at http://dissidentvoice.org/2010/05/non-proliferation-and-the-challenge-of-nuclear-disarmament/

Our leaders also realised that a nuclear weapon-free world would enhance not only India's security but also the security of all nations. That is why disarmament was, and continues to be, a major plank in our foreign policy.

to be important as India celebrated 20 years of his Action Plan in 2008. However, negation of his vision by the great powers must have contributed to Rajiv Gandhi agreeing to the counter-view and allowing India's nuclear weapons programme to culminate in India trying for nuclear tests during August 1995 and to finally achieve that feat in May 1998.

Indeed, once it had conducted five nuclear tests on May 11 and 13, 1998, which India claimed to be nuclear weapons, several serious doubts were cast on India's nuclear disarmament credentials, especially its call for an NWFW. But once the heat and dust on India's nuclear explosions had settled, the world began to see the nuanced articulation of India that insisted on how New Delhi's decision to exercise its nuclear option had not been an easy choice and that it did not even dent India's cardinal faith in nuclear disarmament. Again, several important pronouncements can be cited to prove the point. For instance, addressing the Indian Parliament on May 27, 1998, Prime Minister Vajpayee sought to put these questions at rest as he announced: "Our leaders also realised that a nuclear weapon-free world would enhance not only India's security but also the security of all nations. That is why disarmament was, and continues to be, a major plank in our foreign policy."[23] This commitment was clearly enacted as part of India's draft nuclear doctrine that was released on August 17, 1999. The draft doctrine made it amply clear that it is in the "absence of global nuclear disarmament [that] India's strategic interests require effective, credible nuclear deterrence" and that otherwise, "global, verifiable and non-discriminatory nuclear disarmament is a national security objective." And it specifically underlines how "India shall continue its efforts to achieve the

23. Suo Motu Statement by Prime Minister Shri Atal Bihari Vajpayee in Parliament on May 27, 1998, accessed on April 16, 2010, at http://www.indianembassy.org/pic/pm-parliament.htm

goal of a nuclear weapon-free world at an early date."[24] Successive speeches and policy documents can be cited to reinforce the point about the peace orientation of India's nuclear policy formulations.

Global, verifiable and non-discriminatory nuclear disarmament is a national security objective.

INDIAN PERSPECTIVES

No doubt, mainstream India continues to show a leaning towards nuclear disarmament yet, in spite of celebrating and privileging peace, India does have its own share of maximalists and hawks who remain sceptical about this so-called vision for an NWFW. But often, even the hawks have found it difficult to negate the desirability of an NWFW. K. Subrahmanyam – the well-known strategic thinker from contemporary India – has been arguing in favour of a nuclear weapons convention from the early 1990s. For him, to argue that nuclear weapons cannot be disinvented is as puerile as arguing that biological, chemical and radiological weapons cannot be disinvented and, therefore, should not have been banned. Instead, he finds the answer in what he calls the "nuclear weapons cult" of the major powers that has ensured a "cartelised possession by few nations, and King Atom as the keeper of the peace in the industrialised world for the last 40 years."[25] So the solution for him lies in delegitimising nuclear weapons and undermining their attraction as the currency of power in international relations.

Another well-known strategist, Jasjit Singh, whose team had organised in New Delhi a major international conference to celebrate 20 years of the Rajiv Gandhi Action Plan says: "As long as nuclear weapons exist, the risk of their use by accident, miscalculation and/or intent can never be ruled out. As long as nuclear weapons exist with some countries, other countries would find a powerful incentive to acquire them. It is in this context

---

24. *Draft Report of National Security Advisory Board on India's Nuclear Doctrine* (Embassy of India, Washington DC), accessed on April 16, 2010 at http://www.indianembassy.org/policy/CTBT/nuclear_doctrine_aug_17_1999.html, para 2.1 and 8.1.
25. K. Subrahmanyam, "Eradicate the Nuclear Cult", *Bulletin of the Atomic Scientists*, March 1987, pp. 38-39.

Manpreet Sethi favours the approach of "progressively devaluing nuclear weapons and eventually delegitimising them."

that we find that a nuclear weapon free world… is actually extremely complex."[26] To seek it through a conventional non-proliferation mindset, therefore, remains a non-starter at best. Among some of the challenges that it involves include (a) challenges of organising security without nuclear weapons; (b) reorganising discourses on both proliferation and deterrence that have undergone a transformation; and (c) managing a peaceful paradigm shift where security is no longer possible in the Westphalian system of competitive nation-states but makes cooperation amongst states an essential prerequisite. There is no military solution today, for instance, to environmental, energy and food security or even to transnational terrorism. So, the old deterrence or proliferation paradigms have little relevance to the new reality.

Amongst the younger group of scholars in nuclear matters, Dr Manpreet Sethi describes how the debate for an NWFW "always flounders on two basic issues – the desirability of achieving such a state; and the feasibility of doing so."[27] Manpreet Sethi favours the approach of "progressively devaluing nuclear weapons and eventually delegitimising them."[28] This is where the norm of 'non-use' is sought to be privileged and India has been talking of adopting a global No-First Use Convention. Other than its desirability – which remains relevant to the domain of advocacy – serious academic questions on the feasibility of an NWFW continue to be raised about whether it is possible to come about, given that (a) nuclear knowledge cannot be disinvented; (b) delinquent nations can cheat; (c) a non-nuclear world will be more prone to wars; and (e) the sheer technical and financial challenge of dismantling nuclear assets, disposing of fissile materials and creating transparency and safeguards, and how this tedious process will be

---

26. Jasjit Singh, "The Third Nuclear Wave: Introductory Remarks to the New Delhi Conference", in Sethi, ed., n.2, p. xiii.
27. Manpreet Sethi, "Approach to Nuclear Disarmament: Devalue to Discard", in Sethi, ed., n.2, p. 85.
28. Ibid., p. 88.

too complex to achieve consensus. Above all, as past experience shows, countries that matter have been convinced and are even sceptical of the motivations of NWFW proponents. But it is in this backdrop of little interest shown by the major powers in the past that President Obama's continued efforts to take the lead in the NWFW campaign make such a convincing case and inspire cooperation by the major powers. And if anything, this only vindicates the validity of India's disarmament policy.

An NWFW today seems to be a relatively convincing case of an idea whose time has come. But the challenge to its proponents remains, and is still robust.

CONCLUSION

To conclude, therefore, India's 1988 Action Plan that marked its continued commitment to an NWFW also remains an important determinant of India's current policies and postures. And here, what explains the "failure of Prime Minister Rajiv Gandhi's 1988 Action Plan aimed at convincing the nuclear weapon states to achieve nuclear disarmament in a time-bound fashion" is that it was perhaps too early for the major powers to appreciate the NWFW vision in 1988 when the Cold War systems were collapsing like a house of cards yet their mindset remained entrenched in the comfort zone of their past.[29] The resemblance between the youth, idealism and ambitions of Prime Minister Rajiv Gandhi and those of President Barack Obama is too stark to miss, except that an NWFW today seems to be a relatively convincing case of an idea whose time has come. But the challenge to its proponents remains, and is still robust. But it is in the wake of this rising groundswell that India sees for itself a responsibility (and opportunity) to be the catalyst in strengthening initiatives towards building an NWFW.

It is also true that while the power of 'ideas' like an NWFW is being emphasised, the idea of 'power' refuses to cave in. So the NWFW vision turning into reality seems to face friction with the 'currency of power'

---

29. Brahma Chellaney, *Security: India's Future in the New Millennium* (New Delhi: Orient Longman, 1999), p. 233; T. V. Paul, "The Systemic Bases of India's Challenge to the Global Nuclear Order", *The Nonproliferation Review*, Fall 1998, p. 6; also T. V. Paul, *The Tradition of Non-Use of Nuclear Weapons* (Stanford: Stanford University Press, 2009) see "Introduction", pp. 1-14.

proponents and their fusion betrays the circumspection of all these efforts for an NWFW. For instance, in spite of President Obama's continued drive to evolve a global consensus on an NWFW, he has conceded space to Pentagon hardliners. His NPR released on April 6, 2010, clearly "negates the idea of US unilateral nuclear disarmament. So does the President's increased budget to refurbish the ageing infrastructure of nuclear weapons and material-handling facilities."[30] There are still several opponents of this dream. They may have been subdued by the recent tide for nuclear disarmament, but this window of opportunity may not stay open indefinitely. This is what makes an NWFW an inspiring goal but also a formidable challenge for our generation, requiring not only efforts at the levels of great leaders but also at the level of opinion and policy-makers, scholars, and, especially, the strategic community.

---

30. George Perkovich, "After Prague, What's Next for Arms Control?", *New York Times*, April 7, 2010, at http://www.nytimes.com/2010/04/08/opinion/08iht-edperkovich.html

NATIONAL SECURITY MECHANISM AND THE HDO

R. VENKATARAMAN

Those who value the traditional definition of the Higher Defence Organisation (HDO) would affirm that the National Security Council (NSC), Cabinet Committee on Political Affairs (CCPA), Cabinet Committee on Security (CCS) and Nuclear Command Authority (NCA) which oversee the National Security Mechanism (NSM) in their own ways, cannot be considered a part of the HDO. The reason for this affirmation stems from the belief that the conventional idea of 'security' meant the security of territorial integrity from external aggression. But this view has been increasingly challenged in the recent past by the contemporary outlook that internal stability and order also contribute towards the comprehensive national strength of a country and are, hence, equally important factors in protecting and maintaining the security of the nation-state.

Consequently there have been demands for a holistic approach to security rather than treating internal and external threats in water-tight compartments. The Kargil Review Committee (KRC) recommended that the members of the NSC, the senior bureaucracy servicing it and the Service Chiefs need to be continually sensitised to assessed intelligence pertaining to national, regional and international issues through periodic intelligence briefings of the CCS, with all supporting staff in attendance. A closer look

---

*   Wing Commander **R. Venkataraman** is a Research Fellow at the Centre for Air Power Studies, New Delhi.

at the statement would reveal the significance of a relationship that ought to exist among the three apex decision-making bodies on national security namely the CCS, NSC and the Chiefs of Staff Committee (COSC). A few occurrences in the recent past would add credence to the issue.

- Among the many measures that were initiated in response to the Mumbai terrorist attack on 26/11, the Indian government had set up a high level committee under the chairmanship of the Cabinet Secretary to review the measures taken for coastal security at regular intervals[1]. Headed by the Cabinet Secretary, the committee included the Chief of the Naval Staff, Secretaries of all concerned Ministries such as Defence, Home and Petroleum besides the Chief Secretaries of coastal states. Setting up of a Joint Operation Centre for the conduct of joint exercises involving the Navy, Coast Guard and Coastal Police, and improved information sharing were the objectives. The Ministry of Defence (MoD) has approved dry leasing of twin-engine helicopters and aircraft for the Coast Guard for air surveillance in addition to the 80 fast interceptor craft being procured by the Indian Navy to supplement the efforts of other coastal security agencies.

- An ambitious proposal which was put forth by the Union Home Ministry in February 2000 to set up a National Intelligence Grid (NATGRID) by pooling data from nearly a dozen law enforcement and intelligence agencies was rejected by the CCS[2]. Apparently, the CCS wasn't satisfied with the safety mechanisms meant to uphold the privacy of citizens and wanted to establish a "foolproof" intelligence network. When approved by the CCS, agencies such as the Research and Analysis Wing (R&AW), Intelligence Bureau (IB), Enforcement Directorate (ED), National Investigation Agency (NIA), Central Bureau of Investigation (CBI), Directorate of Revenue Intelligence (DRI) and Narcotics Control Bureau (NCB) would have access to the consolidated data, as and when needed.

- There has been a series of CCS meetings in the last few months to discuss the possible role of the armed forces in anti-Naxal operations.

---

1. *Frontier India*, June 18, 2009.
2. Vinay Kumar, "'Big Brother' Fears Stall Chidambaram Data Plan," *The Hindu*, February 14, 2010.

Among the key issues facing the government are the clearing out of mines in the Naxal-affected regions and the use of helicopters to evacuate casualties during Naxal attacks, use of the armed forces in supporting roles and resolving the issue of Command and Control (C2) where the state and Central forces are deployed together.

India has to deal with the challenge of internal security while ensuring that this does not undermine its capacity for effective external defence and this has been a tough balancing act.

The events quoted above reiterate the contemporary concept of national security which presupposes that many foreign and domestic political, economic and military issues are intertwined and each has implications on the other. India has always been a victim of political insurgencies (particularly in the border states) and Pakistan sponsored extremist attacks in various corners of the country, which have adversely affected the country's economic and technological progress. Even today, the principal security threat for India remains the threat to internal security. India has to deal with the challenge of internal security while ensuring that this does not undermine its capacity for effective external defence and this has been a tough balancing act. Commenting on the economic aspect, Ashley Tellis has said, "Preserving internal security became extremely expensive and has now come at the cost of being able to acquire the new technologies required to raise a modern military force"[3]. An analysis by the India Defence Consultants (IDC) concluded, "We have to get our huge Homeland security machinery i.e. the Home Ministry's million strong paramilitary forces linked to the Army as soon as possible, in what is called 'Command and Control' or we will soon have a Frankenstein monster on hand—a bigger and well equipped paramilitary force doing precious little operationally"[4]. This may be an extreme opinion which is contestable but events in the recent past, particularly the Naxal problem, have made it imperative that greater

---

3. Ashley Tellis, *India Today Conclave*, New Delhi, March 13, 2004.
4. Homeland Security in India, *An IDC Analysis*, New Delhi, September 7, 2006.

coordination between the conventional HDO and other NSM structures be forged.

It is understandable that the NSC (which plays a vital strategic role on security matters), the CCS (which is the highest political authority on security issues) and the NCA (which controls the development, deployment and use of strategic weapons), have specific objectives to be achieved but there is certainly a case for more horizontal interface amongst these bodies. In order to identify the commonalities of purpose and the possible linkages, the roles and responsibilities of these organisations are to be analysed.

THE NATIONAL SECURITY COUNCIL

Considering that India was born in the midst of communal strife and its territorial integrity was challenged within a weeks of its independence, one would have expected a National Security Council to have been established long ago. Possibly, the establishment of a responsive HDO and preoccupation of the political leadership with other social and political issues deprived the country of this development. It is also possible that Nehru's philosophy of security management contributed to the inaction. It was only in the Eighties that sporadic demands for establishment of a coordinated policy-making body on security issues surfaced. It was under Shri V.P. Singh as Prime Minister that a tentative beginning was made to revamp the NSM. However, the exercise remained a non-starter and subsequent attempts by the Narsimha Rao government to establish an NSC were also resisted by some political leaders, ill-advised by the civil bureaucracy.

The emergence of India as a nuclear power and its anticipated transformation into a major power of the region led Prime Minister A.B. Vajpayee in 1998 to set up a special Task Force headed by Shri K.C. Pant to review the NSM. Shri Jaswant Singh and Air Cmde Jasjit Singh (Retd), were the members. After examining the recommendation of the Task Force, the government set up a revamped NSM on November 19, 1998. The Cabinet Secretariat resolution which notified the creation of the NSC stated[5]:

---

5. Cabinet Secretarial Resolution No.281/29.6.98/TS dated April 16, 1999.

The Central Government recognises that national security management requires integrated thinking and coordinated application of the political, military, diplomatic, scientific and technological resources of the state to project and promote national security goals and objectives. National security, in the context of the nation, needs to the viewed not only in military terms but also in terms of internal security, economic security, technological strength and foreign policy. The role of the council is to advise the Central Government on the said matters.

The salient features of the NSC, with an extensive mandate to address the security issues holistically, remain:

- To address the political, economic, energy and strategic security concerns of India.
- The six-member NSC, headed by the Prime Minister, has the Home Minister, Defence Minister, External Affairs Minister, Finance Minister and Deputy Chairman, Planning Commission, as members, besides the National Security Adviser (NSA). Other Ministers and officials are invited to attend as required.
- The NSA is to oversee the functioning of the new mechanism and act as primary adviser to the Prime Minister, the Indian Cabinet and the NSC on internal and international security issues. The directors of R&AW and IB technically report to the NSA rather than the Prime Minister directly. He is expected to receive all intelligence reports and coordinate them before presenting before the Prime Minister.
- A National Security Advisory Board (NSAB), consisting of persons of eminence outside the government, with expertise in defence, internal security, strategic analysis, foreign affairs, economics, science and technology. The board is meant to provide a long-term prognosis and analysis to the NSC besides recommending solutions on policy issues referred to it.
- A 17-member Strategic Policy Group (SPG) headed by the Cabinet Secretary and comprising the Chiefs of Staff, Secretaries of key ministries, and the chiefs of the intelligence agencies has been set up to provide

policy options for consideration by the NSC. The SPG consists of the following members:

- ❍ Cabinet Secretary.
- ❍ Chiefs of Staff of the Army, Navy and Air Force.
- ❍ Director of the Intelligence Bureau.
- ❍ Foreign Secretary.
- ❍ Home Secretary.
- ❍ Defence Secretary.
- ❍ Finance Secretary.
- ❍ Secretary (Defence Production).
- ❍ Secretary (Revenue).
- ❍ Governor of the Reserve Bank of India (RBI).
- ❍ Secretary of the R&AW of the Cabinet Secretariat.
- ❍ Secretary of the Department of Atomic Energy.
- ❍ Scientific Adviser to the Defence Minister.
- ❍ Secretary of the Department of Space.
- ❍ Chairman of the Joint Intelligence Committee (JIC).

- To service the work of the NSAB, SPG and NSC, a National Security Council Secretariat (NSCS) was set up with an additional role of intelligence assessment through coordination of various of intelligence agencies. For this purpose, the JIC was merged with the NSCS.

The composition of the NSC is generally perceived as a mix of the American and British models of security management. The ideas of the NSC, NSA and the NSCS are being seen as borrowed from the US model. The UK did not have an NSC when India established one in 1998. However, the SPG was meant to retain the role of the Cabinet Secretary (as in the UK), in the national security policy-making and coordination roles (discussed in detail later). A study of these models in some detail would help us to assimilate this aspect better.

NSC OF THE USA

The principal task of the NSC, with the NSA acting as its manager and facilitator, is essentially to integrate the foreign and defence policies.

The US was the first to realise the importance of such an integrated, well-structured approach which was reflected in the creation of the National Security Council (NSC) with a dedicated national security staff in 1947. It is the President's principal forum for considering national security and foreign policy matters with his senior national security advisers and Cabinet officials. The NSC is chaired by the President. Its regular attendees (both statutory and non-statutory) are the Vice President, Secretary of State, Secretary of the Treasury, Secretary of Defence, and Assistant to the President for National Security Affairs. The Chairman of the Joint Chiefs of Staff is the statutory military adviser to the Council, and the Director of National Intelligence is the intelligence adviser. The Chief of Staff to the President, Counsel to the President, and the Assistant to the President for Economic Policy are invited to attend all NSC meetings while heads of other executive departments and agencies, as well as other senior officials, are invited to attend meetings when appropriate. It is designated by law (National Security Act of 1947) to examine in depth national security issues, strategic or tactical, and come up with policy responses for approval by the President and subsequent implementation by different departments concerned with national security. It is a multi-tiered structure which considers policy at three levels as follows:

- At the apex is the Principal Committee.
- There are several sub-committees to assist the Principal Committee. For instance, the Sub-Committee on National Security supervises the functioning of the Department of Homeland Security.
- Deputies Committee – a sub-Cabinet inter-agency which ensures adequate consideration of issues before they are presented to the NSC.

Policy coordination committees are formed to analyse the ongoing inputs and provide these to the senior committees. The principal task of

It was, however, laid down that he would report to the Cabinet Secretary and, through him, to the Prime Minister. the NSC, with the NSA acting as its manager and facilitator, is essentially to integrate the foreign and defence policies in such a manner as to protect national security and advance US national interests abroad. In this system, the NSA performs two roles: adviser to the President on all matters concerning national security and coordinator of the national security mechanism on behalf of the President. It is interesting to note that the Director, Central Intelligence, and the Chairman, Joint Chiefs of Staff, serve as advisers to the NSC and not to the NSA.

The Vietnam War, relations with Iran, the 9/11 incident, and the post-9/11 developments in Afghanistan, Pakistan and Iraq are not considered as testimonials to the good functioning of the US national security system which has come under constant criticism. But it needs to be acknowledged that the establishment of the Department of Homeland Security and certain other initiatives based on the advice of the NSC have shown encouraging results in preventing terrorist attacks on US soil since 9/11.

NSC, UK

In the British model that existed before May 2010, the Cabinet Secretary coordinated the functioning of the national security apparatus which included the intelligence agencies—civilian as well as military. The government uses a network of committees chaired by the Prime Minister and comprising the Cabinet Ministers for principal decision-making. The principal departments which dealt with national security were the Prime Minister's Office (PMO), Cabinet Office, Foreign and the Commonwealth Office, MoD, and Home Office. The Cabinet Secretary was assisted in his task by the Permanent Secretaries Committee on the Intelligence Services, the Chairman of the Joint Intelligence Committee (JIC), who wore a second hat as Director, Security and Intelligence Matters, and the heads of the agencies dealing with disaster and consequence management. It must be noted that the Cabinet Secretary was only a coordinator and had a very limited role in the formulation and implementation of foreign and defence policies, which

were largely managed by the respective political and professional heads of the Foreign Office and the Defence Department. The JIC Chairman was responsible for the assessment of the intelligence provided by the agencies, for monitoring their performance and for coordinating physical security.

As a consequence of the 9/11 attack in the US, repeated concerns were voiced over the need to institutionalise the national security mechanism further. Accordingly, Prime Minister Tony Blair in 2002 created the post of Security and Intelligence Coordinator and Permanent Secretary in the Cabinet Office to take over the responsibilities of security and intelligence from the Cabinet Secretary. It was, however, laid down that he would report to the Cabinet Secretary and, through him, to the Prime Minister. It was also laid down that the JIC Chairman would report to the Cabinet Secretary and the Prime Minister in matters relating to intelligence assessment and to the Security and Intelligence Coordinator in all other matters. The Security and Intelligence Coordinator had no role in foreign and defence policy matters. The Prime Minister had in his office an adviser on foreign policy who assisted and advised him on foreign policy matters but surprisingly had no role in foreign policy formulation and implementation. This task was being performed by the political and professional heads of the Foreign Office.

In an attempt to resolve these shortcomings, Prime Minister David Cameron established a National Security Council (NSC) in May 2010, to oversee all aspects of Britain's security. It was announced that the NSC would integrate at the highest level the work of the foreign, defence, home, energy and international development departments, and all other arms of government contributing to national security. The council which is chaired by the Prime Minister, has the Deputy Prime Minister, Chancellor of the Exchequer, Secretary of State for Foreign and Commonwealth Affairs, Home Secretary, Secretary of State for Defence, the Secretary of State for International Development, and Security Minister as members. Other Cabinet Ministers, including the Secretary of State for Energy and Climate Change, attend as required. The Chief of the Defence Staff, heads of intelligence agencies and other senior officials also attend as required.

The National Security Adviser, a new role based in the Cabinet Office, was tasked to establish the national security structures to coordinate and deliver the government's international security agenda.

Sir Peter Ricketts (Permanent Undersecretary at the Foreign and Commonwealth Office) was appointed as National Security Adviser, a new role based in the Cabinet Office and was tasked to establish the national security structures to coordinate and deliver the government's international security agenda.

The Task Force headed by K.C. Pant had observed the strong and weak points of the US and UK models closely before recommending a suitable structure of the NSC for India. Perhaps the NSC would have been more effective if the Indian government had established the NSC and defined the role of the NSA through legislation (as in the US) so that it derived more authority in advice as well as implementation of policies. The NSC of the USA was established and structured differently, and modified from time to time, to respond to the needs of a Presidential democracy where the President is the supreme authority on matters of security. It may, however, be noted that in the US model, the Chairman of the Joint Chiefs of Staff is the statutory military adviser to the Council, while in the UK, the Chief of the Defence Staff attends the council meetings as required. In the Indian model, neither the Chiefs of Staff nor the Chairman COSC are part of the apex decision-making body of the NSC. It appears that the UK has borrowed the concept of excluding the military leadership from the apex council from India. However, the NSC of the UK is at a nascent stage and needs to be allowed more time for establishing the necessary framework and demonstrating its functioning before its effectiveness is commented upon.

NSC OF INDIA: A PERFORMANCE AUDIT

When established in 1998, the NSC was expected to play a major role in identifying and addressing issues concerning national security. Though not openly articulated in any document, three main roles which the NSC should have attempted to undertake are:

- Aid the government in formulating a National Security Strategy and National Security Objectives from which the objectives of military, intelligence and other security organisations could be drawn.
- Collect and integrate the strategic inputs from strategic experts, academia and think-tanks for objective evaluation, assessment and recommendation.
- Facilitate decision-making by the highest political authority by providing collective and considered advice on all issues concerning security

If one were to consider these as vital objectives of the NSC and conduct a performance audit of its functioning since its inception, the results are unlikely to be encouraging. Its weaknesses were conclusively exposed for the first time during the Kargil conflict when it failed to play any meaningful role. It is reported that one meeting was convened during the crisis in which the NSAB members were urged to confine their intervention to three minutes without indulging in any criticism. The weakness of the NSC was once again exposed in the handling of the IC-814 hijack crisis in December 1999. Not only did the apex council not react quickly enough to retain the hijacked aircraft at Amritsar, it also failed to persuade the United Arab Emirates authorities to detain the aircraft at Dubai (as they did in 1984 with the hijacked IA plane). The delay in commencing negotiations at Kandahar, and the decision to release three dreaded terrorists exposed the limitations of the NSC and its advisory elements. Escalation of the proxy war in Jammu and Kashmir and other northeastern states, and the intensification of Naxal activities in at least six states over the last decade reveal serious shortcomings in the functioning of the NSC. Some vital observations are:

- The first major criticism against the NSC is that it has only met sporadically since its inception, and not at regular intervals as one would expect[6].
- A separate Secretariat should have been created to service the NSC, leaving the JIC to perform its specialist role. Experts have criticised that

---

6. Also commented by the GoM in its report – Reforming the National Security System, available at http://mod.nic.in/nuewaddditions/rcontents.htm

the merging of the JIC with the NSCS has proved counter-productive by removing even the limited analytical capability which we had before 1998[7]. Apparently, the JIC has been revived and a Chairman appointed to oversee its working[8] but this hasn't made any dramatic impact on the functioning of the intelligence establishment .

- The 32-member NSAB has a predominant representation of retired government officials, depriving it of the experience and guidance from experts in other fields. Experts have questioned the practical ability of retired officials in influencing decisions of the NSC. A former Secretary, Cabinet Secretariat, wrote, "In India, no advisory board manages to be the core. One must keep the realities of life in view while pondering over its (NSAB) efficiency and value[9]."

- The SPG, which mainly comprised Secretaries from various ministries, is not very different from the Committee of Secretaries. It is unlikely to serve as an independent think-tank capable of providing innovative solutions or even ensure precise execution during the implementation phase.

- The NSCS tends to work more as a post office for collecting the views of other departments/agencies, collating and analysing them and putting them up for the perusal of the SPG. There is very little innovation and new thinking in the policy-making process, the ground work for which must be done in the NSCS.[10]

- The NSCS is headed by the Deputy National Security Adviser (DNSA), an officer of the rank of Secretary to the government. He is accountable to the NSA and not to the Cabinet Secretary (initially, the NSCS was part of the Cabinet Secretariat, but in 2002, it was transferred to the PMO). The Cabinet Secretary, who presides over the SPG meetings and takes the necessary follow-up action, has very little control over the functioning of the NSCS.

7. B. Raman, "National Security Mechanism", *South Asia Analysis Group Paper1228,* January 2005.
8. "India's Comprehensive National Power: Synergy Through Joint Decision-Making," a study report by the Centre for Joint Warfare Studies (CENJOWS), 2009.
9. A. K. Verma, "National Security – An Eyewash?" *South Asia Analysis Group Paper*, December 1998.
10. Raman, n. 7.

- The Intelligence Coordination Group under the NSA was created to facilitate coordination between various intelligence agencies but regrettably this had fallen into disuse.
- Absence of Service Chiefs in the apex council has further divorced the military high command from the national security decision-making mechanism.[11]

In an ideal scenario, the NSAB should look into the future and provide considered advice in the form of alternative solutions to a given scenario. The SPG should take cognisance of the NSAB's advice in framing suitable policy options for consideration by the apex council. However, in reality, it has been observed by experts that the interaction between the NSAB and SPG is minimal and the contribution of the NSAB has been nominal. In effect, successive governments have failed to utilise the potential of the NSC as an effective national security apparatus. P.M. Kamath has written, "The non-use of the NSC exposes the ad hoc nature of our security policy process. Consequently, more Kargil-like crises are bound to occur in the future"[12].

Having seen the genesis, growth, effectiveness and shortcomings of the NSC, it is clear that its potential has not been exploited. It is the NSA who is normally in focus rather than the NSC. If the inadequacies are not addressed soon, the NSC would meet a fate similar to the erstwhile short-lived National Defence Council (NDC). It may be recalled that a National Defence Council was formed in November 1962 under the chairmanship of the Prime Minister Nehru. It had two sub-committees: the Central Citizens Committee and Military Affairs Committee[13]. The former consisted of retired senior government officials, eminent public workers and representatives of state governments besides the members of the Emergency Committee of the Cabinet. The Military Affairs Committee, chaired by the Defence Minister, comprised the Service Chiefs, Defence Secretary and two former Chiefs

---

11. Dr Subash Kapila, "India's National Security Council-A Critical Review", *South Asia Analysis Group Paper123,* May 2000.
12. P. M. Kamath, "National Security Council: Reluctantly Created and Under-Utilised", *The IUP Journal of Governance and Public Policy*, vol. I, issue I, 2006, p. 41.
13. Annual Report of the MoD 1964-65, p. 114.

The recent trend indicates the government's preference for consideration of major national security issues through the CCS rather than the NSC.

of Staff as members. The Citizens Committee was meant to review defence issues in general, whereas the Military Committee was meant to discuss the military aspects of defence. Though the council met a few times in the subsequent years, it was not as effective as envisaged and served no gainful purpose.

The recent trend indicates the government's preference for consideration of major national security issues through the CCS rather than the NSC. One possible reason for this strange phenomenon is the populous three-tiered structure of the NSC. The number of members in each component of the NSC complicates even the convening of a meeting – leave alone the idea of debating contentious issues. It would indeed be a time-consuming process to assemble the NSAB, ascertain its advice, debate it in the SPG for feasibility and finally put it to the NSC for consideration.* On the other hand, the CCS is a small group adequately empowered to take decisions on a fast track. But the question is: is the CCS sufficiently informed and advised to take the crucial decisions on issues affecting the nation's security? It would be of interest to study the function of the CCS.

CCPA AND CCS

The principal decision-making bodies in India are the various Cabinet Committees. The CCPA and the CCS are the most widely represented bodies of the Cabinet and comprise important Ministers of the Union Ministry. These two committees have also been in the past, sporadically established and dissolved at the pleasure of the government in office. The first Administrative Reforms Commission which submitted its report to the government in 1969, recommended creation of 11 Standing Committees of the Cabinet of which 'defence' was first in the list. Instead of creating

---

* Editor's note: The NSC was—and is—a committee of the Cabinet chaired by the PM, likes the CCS. Hence, the author and many others are wrong in assuming that all elements of the national security management world have to be present when the NSC meets.

a separate committee for defence, the government established the CCPA in 1969 with a clarification that all important questions relating to defence were to be dealt with by the CCPA.[14] This indirectly implied that the Defence Committee of the Cabinet (DCC) and the Emergency Committee of the Cabinet (ECC), which were existing on paper, were dissolved.[15] The CCPA was chaired by the Prime Minister and consisted of the Ministers for Home, Finance, Defence and External Affairs as members. For obvious reasons, the CCPA could not devote adequate time and attention to the critical security issues as it was seen to be handling domestic political issues more often. During Smt Indira Gandhi's later part of the term as Prime Minister and subsequently during Shri Rajiv Gandhi's prime ministership, a Parliamentary Board was set in place to consider important political issues and the CCPA became gradually redundant. During Shri Narsimha Rao's regime, the CCPA was reactivated since he chose to discontinue the concept of a Parliamentary Board. However, once again, the focus of the CCPA could not remain security alone as it gradually got engulfed in political issues.

Under the prime ministership of Shri A. B. Vajpayee, the National Democratic Alliance (NDA) government abolished the CCPA and established the CCS. The composition of the CCS was similar to that of the CCPA and in the absence of another body to deal with domestic political issues, this too gradually acquired a somewhat omnibus character, dealing with questions, which were strictly political in nature. The composition of the CCS during this regime reflected the political equations within the Bharatiya Janata Party (BJP) and alliance partners in the NDA but curiously included Mr. K. C. Pant in his capacity as Deputy Chairman of the Planning Commission as a member.

Dr Manmohan Singh, as Prime Minister in 2004, possibly considered the inconsistencies in the functioning of these committees and, hence, constituted both Sub-Committees of the Cabinet – CCS and the CCPA—with the Prime

---

14. Annual Reports of the MoD until 1970-71 emphasised this aspect.
15. Annual Reports of the MoD until 1969-70 mentioned the DCC and ECC as the highest decision-making bodies on security issues. No mention of the DCC or ECC was made in the report of 1970-71 or in any subsequent annual report and nor was any mention made about their fate after 1970.

Defence as a sector demands constant focus which cannot be provided by the CCS owing to its preoccupation with other internal security and other issues.

Minister as the Chairman and Cabinet Secretary as the Secretary for both committees. The CCS included the Defence Minister, Home Minister, Finance Minister and External Affairs Minister as members besides the NSA as an ex-officio member. The Service Chiefs were to be invited based on the nature of the issue discussed. The CCPA not only includes the key Ministers who are members of the CCS but also others such as the Minister for Agriculture and Food, Railways, HRD, etc. in an apparent bid to accommodate the political alliance partners in governmental decision-making.

The composition of the CCS has been changed from time to time, according to political realignments. However, as it stands today, the CCS deals with all issues of national security be it the purchase of arms for the armed forces or deployment/withdrawal of central police forces to deal with Naxal/insurgency crises. The CCPA deals with domestic political issues such as the Cauvery river dispute or the Sethusamudram project, on the one hand, and larger issues of international importance such as the Indo-US nuclear deal or India's vote on the International Atomic Energy Agency (IAEA) resolution, etc, on the other.

Considering the fact that the CCS is the highest decision-making body on all national security issues, including military issues, there is a tendency among some experts to equate it with the erstwhile Defence Committee of the Cabinet (DCC), positioning it at the apex of the Indian HDO. Though practically the CCS attempts to perform the role of the DCC, a conservative student of defence affairs would find it difficult to legitimise this arrangement because of the following reasons:

- The CCS addresses all issues encompassing the wider contemporary definition of national security, among which defence just happens to be one.
- The CCS lacks the necessary inputs from supporting structures such as the JIC, Joint Planning Staff or the Integrated Defence Staff. As a result, the CCS is unable to provide any defence policy guidance to the armed

forces or get involved in defence planning activities.

- The Chiefs of Staff have no permanent representation on the CCS as was the case with the erstwhile DCC.
- Defence as a sector demands constant focus which cannot be provided by the CCS owing to its preoccupation with other internal security and other issues.

Information sharing and inter-Secretarial coordination are critical to security issues which involve multi-agency participation. Otherwise, this can result in a serious information deficit at the highest levels during crisis situations.

While this is the scenario in peace-time, the CCS is expected to dictate the military objectives and approve the military plans during inter-state conflicts involving India. Does it have sufficient wherewithal to undertake this mandate? Some major inadequacies that would have a telling effect on the functioning of the CCS during war are:

- The JIC is under the NSC while the Defence Intelligence Agency (DIA) and the Defence Planning Staff are under the control of the Chairman COSC [through the Chief of Integrated Defence Staff (CIDS)]. Tactical intelligence would, hence, suffer.
- The Secretariats for the NSC, CCS and COSC are provided by three different agencies, namely, the NSCS, Cabinet Secretariat, and Headquarters Integrated Defence Staff (HQ IDS) respectively. Information sharing and inter-Secretarial coordination are critical to security issues which involve multi-agency participation. Otherwise, this can result in a serious information deficit at the highest levels during crisis situations.

The issue gets further complicated when seen from the nuclear standpoint, particularly in an inter-state conflict scenario. For a country like India which promises deterrence on a counter-strike doctrine, C2 is the soul of the nuclear strategy. C2 structures need to be capable of conceiving the role of nuclear weapons, plan their dispersal and deployment besides being adequately empowered to authorise their use when necessary. It would be

of interest to examine if the Nuclear Command Authority (NCA) of India meets these objectives.

NUCLEAR COMMAND AUTHORITY

One of the first challenging tasks that came the way of the NSAB soon after its institution was to script a nuclear doctrine for India. Having successfully conducted nuclear tests in 1998, the Indian government was under immense international pressure. In an attempt to apprise the domestic and global audience of India's strategy to employ nuclear capabilities and, in the same breath, assure the global community that India was a responsible regional power, the NSAB produced the draft nuclear doctrine in August 1999, laying out a robust C2 structure which validated India's credibility of nuclear deterrence. It stated, "Nuclear weapons shall be tightly controlled and released for use at the highest political level.[16]" It further stated, "An effective and survivable command and control system with requisite flexibility and responsiveness shall be in place"[17]. India produced a credible document within 15 months after the successful conduct of nuclear tests, whereas it took 15 years for the US to formulate its nuclear doctrine. This demonstrated to the world India's seriousness in deterrence and its commitment to No First Use (NFU). Summing up the doctrine, C. Raja Mohan wrote, "Maximum restraint in the use of nuclear weapons, absolute political control over decision-making and an effective interface between civilian and military leaders" were the positives[18]. The draft doctrine was made available for public scrutiny and debate and it was not until January 4, 2003 (four and half years after declaring itself a nuclear weapon power), that the government announced the creation of the Nuclear Command Authority comprising a two layered structure – the Political Council assisted by an Executive Council. The NCA is responsible for deployment, control and safety of Indian nuclear weapon assets. Chaired by the Prime Minister, the Political Council is the only body empowered to take decision on nuclear issues

16. Para 5.1 of the Draft Report of the NSAB on the Indian Nuclear Doctrine, August 17, 1999.
17. Ibid., para 5.2
18. C. Raja Mohan, *The Hindu* (New Delhi), January 4, 2003.

while the ultimate decision to authorise the use of nuclear weapons rests solely with the Prime Minister. The Strategic Forces Command, which is meant to manage the nuclear arsenal is composed of the representatives of the three Services besides a fair number of civilian staff, including experts from the Atomic Energy Commission (AEC), DAE and missile experts from the Defence Research and Development Organisation (DRDO).

The actual composition of the Political and Executive Councils has not been officially announced, but it is believed that the membership of the Political Council is similar to that of the CCS (PM, Defence Minister, Home Minister, External Affairs Minister and Finance Minister) though it was reported in 2003 that the Political Council includes only the PM, Deputy Prime Minister (if any), Ministers for Defence and External Affairs[19]. The Executive Council, which is chaired by the NSA, not only provides the necessary inputs for effective decision-making by the Political Council but is also responsible for executing the directives received from the Political Council. Membership of the council, it is believed, comprises the Service Chiefs alongside the Secretaries of key ministries. Without discussing the details, an official announcement regarding the alternate chain of command said, "It (CCS) has reviewed and approved the arrangements for alternate chains of command for retaliatory nuclear strikes in all eventualities"[20]. This is a reference to a situation in which the Prime Minister or the entire Political Council may be incapacitated during a crisis. It is believed that the US nuclear C2 system caters for the worst nuclear scenario and a 16-member line of succession has been designated[21]. Salient features of India's nuclear doctrine which have a definite bearing on the C2 structures are:

- Building and maintaining a credible minimum deterrent.
- Policy of "no first use"; and retaliatory attacks can be authorised only by the civilian political leadership through the NCA.
- Nuclear weapon assemblies are with the DRDO, the weapon cores are with the Atomic Energy Commission (AEC), and delivery systems are with the Services.

19. J.N. Dixit, "India's Nuclear Command Authority: Talks Ahead," *NEWS*, January 27, 2003.
20. Raja Mohan, n. 18.
21. Dixit, n. 19.

- In the event of a major attack against India or Indian forces anywhere, by biological or chemical weapons, India will retain the option of retaliating with nuclear weapons.

Some experts have commented that the Political and the Executive Councils do not confirm to a command structure and, hence, this raises doubts about their efficacy during a nuclear attack[22]. It has also been criticised that the NCA structure has added one more layer to the committee system which, in a crisis situation, would only result in waste of time[23]. It may be recollected that the CCS includes the Ministers of Defence, Home, Finance and External Affairs besides the NSA who is an ex-officio member. Given the fact that the Political Council of the NCA is advised by the Executive Council which is chaired by the NSA, the composition of both councils seems identical.

The doctrine places great emphasis on the safety of the nuclear arsenal not only during the peace-time but also in war. Given the importance of checks and balances in our nuclear policy, it is imperative that a divided control over the nuclear arsenal exists. While the nuclear forces are expected to be maintained in the form of separated components in the custody of the civilians and the military, the command over their use lies solely with the civilian leadership. But in the event of a necessity to launch nuclear weapons, the nuclear components would have to be integrated into a suitable weapon system and the custody along with responsibility of delivery is to be transferred to the military leadership. This seems quite simple on paper but is undoubtedly the most complicated part of the whole process and is bound to fail unless there is an optimum integration between the HDO and NCA. On the other hand, there has to be a high level of coordination between the NSC and NCA. This is because the inputs from NSAB and SPG would play a major role in the decision-making by the Political Council of the NCA (the composition of which is similar to the apex council of the NSC). The

---

22. Rear Admiral Raja Menon, *Nuclear Seminar Report*, Institute of Peace and Conflict Studies, March 12, 2003.
23. Ibid.

NSA serves as the conduit between the political and military segments of the NCA but the larger issues of functional and command relationships among the HDO, NCA and NSC have neither been specified nor discussed openly.

The structure and composition of the NCA keeps the leadership of the armed forces completely outside the decision-making loop, as in the NSC.

What makes matters worse is that the structure and composition of the NCA keeps the leadership of the armed forces completely outside the decision-making loop, as in the NSC. In complete contrast, the NCA of Pakistan which functions through two committees, namely the Employment Control Committee and the Development Control Committee has on the membership of both the Committees, the Chairman Joint Chiefs of Staff Committee and the three Service Chiefs. Besides, the Strategic Planning Division which provides secretarial support to the NCA, functions directly under the Chairman JCSC and is headed by a General from the army. On one end of the spectrum is Pakistan's Strategic Command Organisation, which is predominantly military while, on the other, is India's NCA. There is a definite case for higher representation by India's military leadership in the country's nuclear decision-making.[24]

It also needs to be recognised that the nuclear assets, unlike in the USA or China, are dispersed among the DRDO, DAE and the three armed forces, demanding a continual integration and coordination for training, deployment and application during war. Most of the delivery systems currently are conventional platforms meant for dual use. This demands the highest level of planning and integration not only among the Services but also with the components of the Strategic Forces Command.

THE WAY FORWARD

It is appreciated that the NSC, CCS and NCA have definitive and distinctive roles to perform though the composition at the apex may look similar. But

24. For more in support of this argument, see chapter 5 "Hand on the Button – Nuclear Command and Control", in Manpreet Sethi, *Nuclear Strategy- India's March Towards Credible Deterrence* (New Delhi: KW Publishers, 2009).

It is imperative to separate the military issues from other internal security issues by establishing a Cabinet Committee for Defence (CCD)

the effectiveness of these entities would depend entirely upon the ability to extract the maximum potential of their support structures through optimum lateral coordination and integrated thinking.

NSC: As regards the NSC, it is unfortunate that some experts have called for dismantling of the NSAB on the grounds that its contribution till date has been negligible and it has not served its purpose. But if analysed correctly, it would emerge that the NSAB could be a very effective tool if utilised correctly. With members of varied expertise and experience on board, the NSAB is easily the most enriched body of collective intelligence mandated to advise the government. The fact that most of the members are retired and not subject to political or peer pressures gives them the opportunity to be forthright in their opinions, without having to mince words. The first step in the process of its revitalisation has to be the reduction in its membership to at least just half the present number, preferably to ten members. This would provide more objectivity and ease in integration. Secondly, a mandated in-built mechanism for lateral coordination between the NSAB and SPG at regular intervals needs to be introduced if the NSAB is to be taken seriously. The presence of Service Chiefs in the SPG is not adequate when instant military opinion is needed. Hence, there is a need to create space in the apex council for the military leadership.

CCPA and CCS: Given the political pressures of running coalition governments, the current model of continuing with the CCS as well as the CCPA is understandable. But there is still a need to handle the security issues with a clinical sense of super-specialisation – meaning, that it is imperative to separate the military issues from other internal security issues by establishing a Cabinet Committee for Defence (CCD) or a Cabinet Committee for Military Affairs (CCMA) to provide defence policy guidance and focus on the aspects of defence planning and management. Since the current composition of the CCS and apex council of the NSC is almost

identical, the latter can conveniently undertake the former's task. In other words, the CCS can be reconstituted as the CCD/CCMA with Serving Chiefs serving as ex-officio members of the committee. The NSC, which deals with all security issues, should take complete charge of internal security management, for which it is suitably equipped.

The close inter-linkage between conventional war and nuclear deterrence, makes it imperative that the interface between the political and military leadership must be far more than the present Political Council envisages.

NCA: India's nuclear doctrine which is based on the belief that nuclear weapons are to be seen as political instruments of deterrence rather than as tools of war-fighting possibly influenced the minds of policy-makers in keeping the military leadership out of the nuclear decision-making loop. "This cannot be an optimum model for credible deterrence" and "the close inter-linkage between conventional war and nuclear deterrence, makes it imperative that the interface between the political and military leadership must be far more than the present Political Council envisages," writes Manpreet Sethi, regarding nuclear command and control in India. Arguing that the level of alert of the nuclear arsenal will be determined by the unfolding conventional crises and more importantly the dispersed elements of the nuclear arsenal will have to be congregated even as the conventional operations are on, Sethi calls for a review of the nuclear command and control for India wherein the three Service Chiefs are made members of the Political Council since they can provide the necessary military advice directly to the decision-making body.[25]

But this recommendation has been challenged by a counter-argument that the Political Council is meant to take decisions with a view that nuclear weapons are essentially political instruments and, hence, the presence of military members on the council would "impact the complexion of India's approach to nuclear weapons altogether". Besides, to have the Chiefs alongside the civilian Ministers "would be to privilege them beyond the

25. Ibid., pp. 164-165.

limits of the Indian system of military subordination to civilian control"[26]. First, it needs to be appreciated that the presence of the Service Chiefs on the Political Council is only meant to provide the political leadership with timely military advice, assuming that they would normally be unaware of the operational capabilities and limitations of the various weapon systems, knowledge of which is essential before a political decision is made with regard to the nature and quantum of a retaliatory nuclear strike. It is, indeed, unfortunate that the concept of 'military subordination to civilian control' is understood in such a distorted fashion which, in the right sense is nothing more than emphasising the primacy of the elected democratic leadership over all the instruments of state, including the military. There is also an impression that the Political Council need not have all the three Chiefs as members but only the Chairman COSC, who will be replaced by the Chief of Defence Staff (CDS), when appointed. This suggestion has some merit though there are inherent limitations in leaving the responsibility of advice to a single individual – whatever be the appointment. The bottom-line though, is the inescapable necessity of military representation on the Political Council.

LATERAL INTEGRATION IMPERATIVE
Elected representatives in India who enforce the accountability of policy-makers often lack an in-depth understanding of the increasingly complicated security related issues. It is not surprising then, that the country had to wait for more than 60 years after independence to see an NSC in formation. Unfortunately, successive governments have failed to utilise the NSC as an effective, coordinated and well articulated national security policy-making apparatus. The NSC needs to be provided with long-term and current intelligence assessments. The CCS and NSC need to complement each other's roles and, if need be, combined into one single entity to address all issues of national security, with special focus on internal security management. Defence has to be handled by a separate committee of the Cabinet which would also replace the Political Council of the NCA. This is important since

26. Ali Ahmed, "Re-visioning the NCA," *IDSA Comment,* September 2009.

our nuclear doctrine and strategy is tailored to provide national (nuclear) self-defence.

To realise our true national potential as a regional power involved in peace-keeping, counter-terrorism operations, maritime security and disaster relief operations all over the globe, it is imperative that a National Security Mechanism is in place which would take an integrated view of the challenges faced, the options available, and take proactive steps to counter threats. This calls for close integration between the conventional HDO and other institutions of national security.

TECHNOLOGY:
A HISTORICAL PERSPECTIVE

A.K. SINGH

Don't stop thinking about tomorrow. Don't stop, it'll soon be here.
— Fleetwood Mac

Technology is among one of the essential determinants for the study of military history along with other factors such as political, social and cultural foundations, military doctrine, logistics, leadership, strategy and tactics. Technology has often had a pervasive effect on the battlefield, with victory often the result of possession of superior weapons, with other factors remaining the same. The role of military technology as a force multiplier has been well established in lessons learnt from the past wars of the 20th century. It is more likely that military technology will play a dominant role in future wars.

Nations have endeavoured to develop new and more advanced technologies with the goal of achieving military advantage throughout history. New technologies resulted in new weapons and brought dramatic change in military strategy and tactics. The increase in the destructive power of soldiers in the US Civil War and the resulting horror and futility of the frontal assault ushered in a change to trench warfare. The military aircraft, tanks, and the newly developed radio and radar made a new kind of dynamic warfare possible during World War II.

---

* Wing Commander **A.K. Singh** is a Research Fellow at the Centre for Air Power Studies, New Delhi .

Technological advances of the last 50 years have surpassed the developments of the past 300 years, resulting in drastic changes in all spheres of human thinking and actions.

World War II ended with a remarkable technological achievement—the development of the atomic bomb. In response, the Soviet Union detonated its first atomic bomb in 1949, followed by the successful test of a hydrogen bomb. By the early 1950s, missile programmes were underway in two leading countries – the USA and USSR. In the absence of knowledge and accurate threat assessments of each other, their responses were based on the worst-case scenario approach. Recognising the dangers of this uncertainty, the USA took up the development of a new generation of sensors and reconnaissance satellites. In response to the Soviet quantitative advantage in military forces, the US conceived a new "system of systems" of intelligence sensors, smart weapons and stealth aircraft. These new systems were developed during the late 1970s, produced in the early 1980s, and they entered into force in the late 1980s—just in time for Desert Storm. Thus, two leading nations of the world, apart from others, continued with their enhancement of military technology and subsequent weaponry. The technological advances of the last 50 years have surpassed the developments of the past 300 years, resulting in drastic changes in all spheres of human thinking and actions.

Today, the threats of terrorism and proliferation are the greatest threats to the world. This can lead to a nightmare scenario where a terror group may attack any nation with Weapons of Mass Destruction (WMD). Advanced information is critical to counter this threat. There are technological opportunities, necessities and challenges in all the components of security: intelligence, prevention, protection of infrastructure, detection of attacks, surveillance, reconnaissance, counter-attack and consequence management. But these improvements will not evolve automatically. It will demand single-minded dedication and will power to acquire the technological competencies to effectively deal with the future demands. As a nation, India must mobilise all the resources and support to develop cutting edge

technologies and respond to the challenges even before it is needed.

This paper aims to deal with the historical perspective of technology in general and military technology in particular in order to generally highlight the evolution of military technology as part of military history. It also aims to bring out the relevance and importance of military technology in the past major conflicts of the 20th century. The historical process and the mechanism behind the spread of military technology are of significance for broadly identifying the order at which India is today in the world. It also intends to advocate and create awareness for the necessity to attain technological leadership and be a strong and powerful nation—militarily, economically and politically.

> **Technology includes the entire infrastructure necessary for the design, manufacture, operation, and repair of technological artefacts, from corporate headquarters and engineering schools to manufacturing plants and maintenance facilities.**

TECHNOLOGY AND DIMENSIONS

What is Technology?[1]

Technology is the process by which humans modify nature to meet their needs and wants. Most people, however, think of technology in terms of its artefacts: computers and software, aircraft, pesticides, water-treatment plants, tanks, and ships, to name a few. But technology is more than these tangible products.

Technology includes the entire infrastructure necessary for the design, manufacture, operation, and repair of technological artefacts, from corporate headquarters and engineering schools to manufacturing plants and maintenance facilities. The knowledge and processes used to create and operate technological artefacts – engineering knowhow, manufacturing expertise, and various technical skills – are an equally important part of technology.

---

1. http://www.nae.edu/nae/techlithome.nsf/weblinks/KGRG-55A3ER

Technology is a product of engineering and science, the study of the natural world. Science has two parts: (1) a body of knowledge that has been accumulated over time; and (2) a process—scientific inquiry—that generates knowledge about the natural world. Engineering, too, consists of a body of knowledge—in this case, knowledge of the design and creation of human-made products-and a process for solving problems. Science aims to understand the "why" and "how" of nature, and engineering seeks to shape the natural world to meet human needs and wants. Engineering, therefore, could be called "design under constraint," with science—the laws of nature—being one of a number of limiting factors that engineers must take into account. Other constraints include cost, reliability, safety, environmental impact, ease of use, available human and material resources, manufacturability, government regulations, laws, and even politics. In short, technology necessarily involves science and engineering.

The Nature of Technology

The nature of technology has changed dramatically in the past hundred years. Indeed, the very idea of technology as we now conceive it is relatively new.

For most of human history, technology was mainly the province of craftsmen who passed their knowhow down from generation to generation, gradually improving designs, and adding new techniques and materials. By the beginning of the 20th century, technology had become a large-scale enterprise that depended on large stores of knowledge and knowhow, too much for any one person to master. Large organisations were now required for the development, manufacture, and operation of new technologies. Complex networks of interdependent technologies were developed, such as the suite of technologies for the automobile. These include gas and oil refineries, filling stations and repair shops, tyre manufacturers, automobile assembly plants, the highway system, and many more. The government began to play a larger role in shaping technology through technological policies and regulations.

The meaning of the word "technology" evolved to reflect these changes. In the 19th century, technology referred simply to the practical arts used to

create physical products, everything from wagon wheels and cotton cloth to telephones and steam engines. In the 20th century, the meaning of the word was expanded to include everything involved in satisfying human material needs and wants, from factories and the organisations that operate them to scientific knowledge, engineering knowhow, and technological products themselves.

Technology and Science

Science and technology are tightly coupled. A scientific understanding of the natural world is the basis for much of technological development today. The design of computer chips, for instance, depends on a detailed understanding of the electrical properties of silicon and other materials. The design of a drug to fight a specific disease is made possible by knowledge of how proteins and other biological molecules are structured and how they interact.

Conversely, technology is the basis for a good part of scientific research. The climate models that meteorologists use to study global warming require supercomputers to run the simulations. And like most of us, scientists in all fields depend on the telephone, the Internet, and jet travel.

It is difficult, if not impossible, to separate the achievements of technology from those of science. When the Apollo 11 spacecraft put Neil Armstrong and Buzz Aldrin on the moon, many people called it a victory of science. When a new type of material such as lightweight, super strong composites, emerges in the market, newspapers often report it as a scientific advance. Genetic engineering of crops to resist insects is also usually attributed wholly to science. And although science is integral to all of these advances, they are also examples of technology, the application of unique skills, knowledge, and techniques, which is quite different from science.

Technology and Innovation

Technology is also closely associated with innovation, the transformation of ideas into new and useful products or processes. Innovation requires not only creative people and organisations, but also the availability of technology

Technology and culture refer to the cyclical co-dependence, co-influence, co-production of technology and society upon each other. and science and engineering talent. Technology and innovation are synergistic. The development of gene-sequencing machines, for example, has made the decoding of the human genome possible, and that knowledge is fuelling a revolution in diagnostic, therapeutic, and other biomedical innovations

Technology and Culture

Technology and culture refer to the cyclical co-dependence, co-influence, co-production of technology and society upon each other. This synergistic relationship occurred from the dawn of humankind, with the invention of the simple tools; and continued into modern technologies such as the printing press, computers and the Internet.

ECONOMICS AND TECHNOLOGICAL DEVELOPMENT

Looking back into ancient history, economics can be said to have arrived on the scene when the occasional, spontaneous exchange of goods and services began to occur on a less occasional, less spontaneous basis. It probably did not take long for the maker of arrowheads to realise that he could probably do a lot better by concentrating on the making of arrowheads and barter for his other needs. Clearly, regardless of the goods and services bartered, some amount of technology was involved—if no more than in the making of shell and bead jewellery. So, from the very beginnings, technology has spurred the development of more elaborate economies.

In the modern world, superior technologies, resources, geography, and history give rise to robust economies. In a well-functioning, robust economy, economic excess naturally flows into greater use of technology. Moreover, because technology is such an inseparable part of human society, especially in its economic aspects, funding sources for new technological endeavours are virtually illimitable. However, while in the beginning, technological investment involved little more than the time, efforts, and skills of one or a few men, today, such investment may involve the collective labour and skills of many.

TECHNOLOGY AND FUNDING

Consequently, the sources of funding for large technological efforts have dramatically narrowed, since few have ready access to the collective labour of a whole society, or even a large part of it. It is conventional to divide up funding sources into governmental and private business or individual enterprises.

Government Funding: The government is a major contributor to the development of new technology in many ways. In the United States alone, many government agencies specifically invest billions of dollars in new technology. Many other government agencies dedicate a major portion of their budget to Research and Development (R&D). Technology has frequently been driven by the military, with many modern applications being developed for the military before being adapted for civilian use. However, this has always been a two-way flow, with industry often taking the lead in developing and adopting a technology which is only later adopted by the military.

Private Funding: R&D is one of the biggest areas of investments made in the developed countries by corporations towards new and innovative technology. Many foundations and other non-profit organisations contribute to the development of technology. In the Organisation of Economic Cooperation and Development (OECD), about two-thirds of R&D in the scientific and technical fields is carried out by industry, and 20 percent and 10 percent respectively by universities and government. But in poor countries, the industry's contribution is significantly less. The US government spends more than other countries on military Research and Development (R&D).

SOCIOLOGICAL FACTORS AND EFFECTS OF TECHNOLOGY

The use of technology has a great many effects; these may be separated into intended effects and unintended effects. Unintended effects are usually also unanticipated, and often unknown before the arrival of a new technology. Nevertheless, they are often as important as the intended effects.

Values and Ethics: The implementation of technology influences the values and ethics of a society by changing expectations and realities. The

implementation of technology is also influenced by values and ethics.

Lifestyle: In many ways, technology simplifies life with better communication, specialisation, global networking and multi-tasking capabilities, etc. However, technology also complicates life by increasing pollution, traffic congestion, and obesity.

Institutions and Groups: Technology often enables organisational and bureaucratic group structures that otherwise were simply not possible: the rise of very large organisations such as governments, the military, health and social welfare institutions and corporations would not have been possible. The commercialisation of leisure and almost instantaneous dispersal of information, especially news and entertainment, around the world has become a reality.

ENVIRONMENT AND TECHNOLOGY

Technology provides an understanding, and an appreciation for the world around us. Most modern technological processes produce unwanted by-products in addition to the desired products, which are known as industrial waste and pollution. While most material waste is reused in the industrial process, many forms are released into the environment, with negative environmental side effects, such as pollution and lack of sustainability. Different social and political systems establish different balances between the value they place on additional goods versus the disvalues of waste products and pollution. Some technologies are designed specifically with the environment in mind, but most are designed first for economic or ergonomic effects. Historically, the value of a clean environment and more efficient productive processes has been the result of an increase in the wealth of society, because once people are able to provide for their basic needs, they are able to focus on less tangible goods such as clean air and water.

The effects of technology on the environment are both obvious and subtle. The more obvious effects include the depletion of non-renewable natural resources (such as petroleum, coal, ores), and the added pollution of air, water, and land. The more subtle effects include debates over long-term effects (e.g. global warming, deforestation, natural habitat destruction,

coastal wetland loss). Each wave of technology creates a set of waste previously unknown to humans: toxic waste, radioactive waste, electronic waste. One of the main problems is the lack of an effective way to remove these pollutants on a large scale expediently. In nature, organisms "recycle" the wastes of other organisms, for example, plants produce oxygen as a by-product of photosynthesis, and oxygen-breathing organisms use oxygen to metabolise food, producing carbon dioxide as a by-product, which plants use in a process to make sugar, with oxygen as a waste in the first place. No such mechanism exists for the removal of technological wastes.

HISTORY OF TECHNOLOGY[2]

The history of technology is the history of the invention of tools and techniques, and is similar in many ways to the history of humanity. Background knowledge has enabled people to create new things, and conversely, many scientific endeavours have become possible through technologies which assist humans to travel to places we could not otherwise go to, and probe the nature of the universe in more detail than our natural senses allow.

Technological artefacts are products of an economy, a force for economic growth, and a large part of everyday life. Technological innovations affect, and are affected by, a society's cultural traditions. They also are a means to develop and project military power.

EARLY TECHNOLOGY

Stone Age
During the Stone Age, all humans had a lifestyle which involved limited use of tools. The first major technologies, then, were tied to survival, hunting, and food preparation in this environment. Fire, stone tools and weapons, and clothing were technological developments of major importance during this period. Stone Age cultures developed music, and engaged in organised warfare. A subset of Stone Age humans developed ocean-worthy outrigger

---

2. http://en.wikipedia.org/wiki/History_of_technology

ship technology, leading to an eastward migration, across the Indian Ocean to Madagascar and also across the Pacific Ocean, which required knowledge of the ocean currents, weather patterns, sailing, celestial navigation, and star maps. The early Stone Age is described as Mesolithic.

The later Stone Age, during which the rudiments of agricultural technology were developed, is called the Neolithic period. During this period, polished stone tools were made from a variety of hard rocks largely by working exposures as quarries. The polished axes were used for forest clearance and the establishment of crop farming. They were very effective and remained in use when bronze and iron appeared.

Copper and Bronze Age

The Stone Age developed into the Bronze Age after the Neolithic Revolution. The Neolithic Revolution involved radical changes in agricultural technology which included development of agriculture, animal domestication, and the adoption of permanent settlements. These combined factors made possible the development of metal smelting, with copper and later bronze, an alloy of tin and copper. The polished stone tools continued to be used for a considerable time due to their abundance compared to the less common metals, especially tin.

Iron Age

The Iron Age involved the adoption of iron smelting technology. It generally replaced bronze, and made it possible to produce tools which were stronger and cheaper to make than bronze equivalents. In many Eurasian cultures, the Iron Age was the last major step before the development of written language. It was not possible to mass manufacture steel because high furnace temperatures were needed, but steel could be produced by forging iron to reduce the carbon content in a controllable way. Iron ores were much more widespread than either copper or tin. In Europe, large hill forts were built either for refuge in time of war, or sometimes as permanent settlements. The pace of land clearance using the more effective iron axes increased, providing more farmland to support the growing population.

TECHNOLOGY IN ANCIENT CIVILISATIONS

It was the growth of the ancient civilisations which produced the greatest advances in technology and engineering, advances which stimulated other societies to adopt new ways of living and governance.

The Egyptians invented and used many simple machines such as the ramp to aid construction processes. The Indus Valley Civilisation, situated in a resource-rich area, is notable for its early application of city planning and sanitation technologies. Ancient India was also at the forefront of seafaring technology. Indian construction and architecture, called *Vaastu Shastra*, suggests a thorough understanding of materials engineering, hydrology, and sanitation.

The Chinese made many first-known discoveries and developments. Major technological contributions from China include early seismological detectors, matches, paper, cast iron, the iron plough, multi-tube seed drill, suspension bridge, parachute, natural gas as fuel, magnetic compass, raised-relief map, propeller, crossbow, south pointing chariot, and gunpowder.

Greek engineers invented many technologies and improved upon pre-existing technologies. Ancient Greek innovations were particularly pronounced in mechanical technology, including the ground-breaking invention of the watermill which constituted the first human-devised motive force not to rely on muscle labour. Apart from their pioneering use of water power, Greek inventors were also the first to experiment with wind power and even created the earliest steam engine, opening up entirely new possibilities in harnessing natural forces whose full potential came to be exploited only in the industrial revolution. Of particular importance for the operation of mechanical devices became the newly devised right-angled gear and the screw.

In other fields, ancient Greek inventions include the catapult and the crossbow in warfare, hollow bronze-casting in metallurgy, and in infrastructure, the lighthouse, central heating, the tunnel excavated from both ends by scientific calculations, the ship track way, the dry dock and plumbing. In transport, great progress resulted from the invention of the crane, the winch, the wheel barrow and the odometer. Further, newly

created techniques and items were spiral staircases, the chain drive, sliding calipers and showers.

The Romans developed intensive and sophisticated agriculture, expanded upon existing iron working technology, created laws providing for individual ownership, advanced stone masonry technology, advanced road-building, military engineering, civil engineering, spinning and weaving and several different machines like the Gallic reaper that helped to increase productivity in many sectors of the Roman economy. Roman engineers were the first to build monumental arches, amphitheatres, aqueducts, public baths, true arch bridges, harbours, reservoirs and dams, vaults and domes on a very large scale across their empire. Because Rome was located on a volcanic peninsula, with sand which contained suitable crystalline grains, the concrete which the Romans formulated was especially durable.

TECHNOLOGY IN MEDIEVAL AND MODERN CIVILISATIONS

Medieval Europe

Genuine medieval contributions include, for example, mechanical clocks, spectacles and vertical windmills. Medieval ingenuity was also displayed in the invention of items like the watermark or the functional button. In navigation, the foundation to the subsequent age of exploration was laid by the introduction of lateen sails, the dry compass, the horseshoe and the astrolabe.

Significant advances were also made in military technology with the development of plate armour, steel crossbows, counterweight trebuchets and cannon. Perhaps best known are the Middle Ages for their architectural heritage: while the invention of the rib vault and pointed arch gave rise to the high rising Gothic style, the ubiquitous medieval fortifications gave the era the almost proverbial title of the "age of castles".

Arab Agricultural Revolution

From the 8th century, the medieval Islamic world witnessed a fundamental transformation in agriculture known as the "Arab Agricultural Revolution", or "Islamic Green Revolution". Islamic traders' movements across the Old

World during the "Afro-Asiatic Age of discovery" enabled the diffusion of many crops, plants and farming techniques, as well as the adaptation of crops, plants and techniques from beyond the Islamic world. The diffusion of numerous crops during this period, along with an increased mechanisation of agriculture, led to major changes in the economy, population distribution, vegetation cover, agricultural production and income, population levels, urban growth, distribution of the labour force, linked industries, cooking and diet, clothing, and numerous other aspects of life in the Islamic world.

Muslim engineers in the Islamic world were responsible for numerous innovative uses of hydropower, and early industrial uses of wind power, and petroleum. Watermills were in widespread use from the 8th century onwards. A variety of industrial mills were developed in the Islamic world, including fulling mills, gristmills, hullers, sawmills, shipmills, stamp mills, steel mills, sugar mills, and windmills. By the 11th century, these industrial mills were in operation throughout the Islamic world, from North Africa to the Middle East and Central Asia. Muslim engineers also developed crankshafts and water turbines. A number of inventions were produced during this time.

A particularly important contribution from the Islamic world was the "water management technological complex" which was central to the "Islamic Green Revolution" and, by extension, a precondition for the emergence of modern technology.

Age of Exploration
The sailing ship enabled the age of exploration. Pioneers like Vasco de Gama, Cabral, Magellan and Christopher Columbus explored the world in search of new trade routes for their goods and contacts with Africa, India and China which shortened the journey compared with traditional routes overland. They also rediscovered the Americas while doing so. They produced new maps and charts which enabled following mariners to explore further with greater confidence. Navigation was generally difficult, however, owing to the problem of longitude and the absence of accurate chronometers. European powers rediscovered the idea of the civil code, lost since the time of the Ancient Greeks.

Industrial Revolution

The British Industrial Revolution is characterised by developments in the areas of textile manufacturing, mining, metallurgy and transport driven by the development of the steam engine. Above all else, the revolution was driven by cheap energy in the form of coal, produced in ever-increasing amounts from the abundant resources of Britain. Coal converted to coke gave the blast furnace and cast iron in much larger amounts than before, and a range of structures could be created, such as the Iron Bridge. Cheap coal meant that industry was no longer constrained by water resources driving the mills, although it continued as a valuable source of power. The steam engine helped drain the mines, so more coal reserves could be accessed, and the output of coal increased. The development of the high-pressure steam engine made locomotives possible, and a transport revolution followed.

19th Century

The 19th century saw astonishing developments in transportation, construction, and communication technologies originating in Europe, especially in Britain. The steam engine which had existed since the early 18th century, was practically applied to both steamboat and railway transportation. The first purpose built railway line opened between Manchester and Liverpool in 1830, the Rocket locomotive of Robert Stephenson being one of the first working locomotives used on the line. Telegraphy also developed into a practical technology in the 19th century to help run the railways safely.

Other technologies were explored for the first time, including the incandescent light bulb. The Portsmouth Block Mills was where manufacture of ships' pulley blocks by all-metal machines first took place and instigated the age of mass production. Machine tools used by engineers to manufacture other machines began in the first decade of the century, notably by Richard Roberts and Joseph Whitworth. Steamships were eventually completely iron-clad, and played a role in the opening of Japan and China to trade with the West. Mechanical computing was envisioned by Charles Babbage but did not come to fruition. The Second

Industrial Revolution at the end of the 19th century saw rapid development of chemical, electrical, petroleum, and steel technologies connected with highly structured technology research.

20th Century

20th century technology developed rapidly. Communication technology, transportation technology, broad teaching and implementation of scientific methods, and increased research spending all contributed to the advancement of modern science and technology. Due to the scientific gains directly tied to military research and development, technologies including electronic computing might have developed as rapidly as they did in part due to war. Radio, radar, and early sound recording were key technologies which paved the way for the telephone, fax machine, and magnetic storage of data. Energy and engine technology improvements were also vast, including nuclear power.

The National Academy of Engineering, by expert vote, established the following ranking in descending order of the most important technological developments of the 20th century: electrification, automobile, airplane, water supply and distribution, electronics, radio and television, mechanised agriculture, computers, telephone, air conditioning and refrigeration, highways, spacecraft, Internet, imaging, household appliances, health technologies, petroleum and petrochemical technologies, laser and fibre optics, nuclear technologies, materials science.

21st Century

In the 21st century, technology is being developed even more rapidly, especially in electronics and biotechnology. Broadband Internet access became commonplace in the developed countries, as did connecting home computers with music libraries and mobile phones.

Research is going on into quantum computers, nanotechnology, bioengineering, nuclear fusion, advanced materials (e.g., enhanced armour), the scramjet, superconductivity, genetics and green technologies such as alternative fuels and more efficient LEDs and solar cells.

The newly-invented airplane contributed its share to the defence, for aerial reconnaissance made it difficult for surprise in attack.

The understanding of particle physics is also expected to expand through particle accelerator projects. Theoretical physics currently investigates quantum gravity proposals such as the M-theory, superstring theory, and loop quantum gravity. Despite challenges and criticism, the National Aeronautics Space Agency (NASA) and European Space Agency (ESA) have planned a manned mission to Mars in the 2030s.

TECHNOLOGY AND 20TH CENTURY WARS

Technology has often had a pervasive effect on the battlefield, with victory often the result of the possession of a superior weapon. Although the importance of technology has been proven from time to time, it becomes a more relevant determinant of victory if used in the right mix with other important determinants such as political, social and intellectual forces. While the terms 'political forces' and 'social forces' are self-explanatory, the term 'intellectual forces' would include factors like theory, strategy, tactics, doctrine, organisation, leadership and morale, etc. War is a complex affair, hence, no single determinant can be visualised to ensure victory in all circumstances. However, all things being equal, an army with better weapons must surely overwhelm an army with inferior weapons.

The importance of military technology as a determinant in the modern battlefield can be experienced from the lessons of some of the major wars that have taken place in the 20th century.

World War I on the Western Front

Technology was mainly responsible for shaping the battlefields of World War I. Decisive battles which were possible in previous wars were now out of the question because of the use of a range of weapons which gave immense power to the forces. Rifles and artillery were now of longer range and greater accuracy. For protection against their deadly barrage of iron and explosives, the armies had to dig in. The humble spade became an

indispensable tool for the individual soldier. And to protect themselves against infantry assaults, obstacles were created and covered by machine guns which spewed death at the hapless troops caught crossing. The newly-invented airplane contributed its share to the defence, for aerial reconnaissance made it difficult for surprise in attack. Under such circumstances, infantry troops could no longer mount an attack without suffering frightful casualties. The impact of technology was, therefore,

Tanks, artillery and motorised infantry were combined in cohesive Panzer divisions with dive bombers providing tactical support.

huge. The intellectuals of the time were unable to rise to the challenges of modern technology. Indeed, the war was fought with 20th century weapons by leaders drilled in 19th century tactics. Neither commanders nor thinkers were able to devise new strategies and doctrines to overcome the new technology, to bring victory. In short, technology outran strategy, tactics and doctrine.

Western Europe in World War II
World War II was, in contrast to World War I, a war in which the opening moves by the German forces brought spectacular victories. In the conquest of Western Europe, extensive use was made of the tank, airplane and artillery. Tanks, artillery and motorised infantry were combined in cohesive Panzer divisions with dive bombers providing tactical support. In the attack, tanks supported by artillery and dive bombers would break through enemy lines, and then penetrate deeply to his rear areas to destroy his headquarters and lines of communications. Using this tactic, swift and devastating victories were won in Western Europe. There was no reliance on a single technology. It was not only the use of weapons that was the determinant of the victories but the way in which they were used by the Germans that also made the difference.

War on the Korean Peninsula
Technological developments during World War II ushered in the age of

nuclear weapons. Two concepts emerged: one, that the atom bomb had made land warfare relatively obsolete; the other that possession of the bomb conferred on its owner exceptional power or immunity against attack. When a 135,000-strong North Korean Army invaded South Korea in June 1950, these concepts were shattered. The US, a victor of World War II, could not use the bomb to stem the North Korean offensive. The use of the bomb in pursuit of a foreign policy objective which had nothing to do with US security would have established a dangerous precedent for other nuclear powers in the future. Besides this, the US would have lost its moral standing with the rest of the world. The new technology was a war-winning weapon, but only if it could be used.

From June to August 1950, North Korean forces surged down the peninsula, forcing South Korean forces and American reinforcements from the Eighth Army to retreat. The first victory went to the North Koreans. This outcome was partly due to the poor state of readiness amongst the American troops, as well as to North Korean superiority in equipment, for their Soviet-built T-34 tanks were invulnerable to the 2.35 inch bazookas of the Americans.

As is to be expected of a developed country fighting a Third World enemy, the Americans had technological superiority over the Communists in armour, artillery and aircraft. Between 1951 and 1953, US aircraft downed 850 MiG-15s for the loss of only 58 of their own. However, the outcomes of offensives at each stage of the war were decided not only by the technological merit but by politics and skill in the operational art.

The Egyptian Front in the Yom Kippur War
On October 6, 1973, Egyptian and Syrian forces attempted to recapture territories lost in the Six-Day War when they attacked Israel simultaneously on two fronts at 1405 hrs.

To protect the bridgeheads, the Egyptians had earlier infiltrated some 8,000 troops armed with man-portable anti-tank weapons and anti-aircraft missiles 2 km into Israeli-held territory. Thus, when the Israelis attacked, their tanks ran into a deadly barrage of guided-missiles. The Israelis were aware that the

Egyptians possessed this weapon and knew of its capabilities but it was the scale and the coherent manner in which they were used that caught them by surprise. Israeli aircraft which attacked the Egyptians were also effectively countered by a dense air defence barrage consisting of SA-2, SA-3 and SA-6 missiles on the West Bank and the lighter, previously-infiltrated SA-7 missiles on the East Bank. At least half of the first attacking Israeli planes were shot down by the missiles' unexpectedly accurate and devastating fire.

The Egyptians' success in achieving strategic and tactical surprise and their clever use of technology up to October 8 inflicted upon the Israelis their worst defeat in history. The main component of the Egyptian plan was neutralisation of Israel's superiority in the air and in armoured warfare. This had been accomplished admirably but beyond the well-rehearsed crossing operations and use of anti-tank and anti-air weapons, the Egyptians were not able to exploit their success.

In the final phase of the war on the Suez front, an Israeli armoured force crossed to the West Bank to execute an operation. Superior initiative and daring skill at mobile warfare explained the Israeli success as much as the lack of them explained the Egyptians' inability to exploit the earlier opportunities granted by technology.

Arab-Israel War, 1982

In the summer of 1982, the Israelis fought the Syrians in the battle of the Bekaa Valley. The short operation was an enormous success for the Israelis who destroyed a complete air defence system, including 20 Surface-to-Air-Missile (SAM) batteries and 85 fighter aircraft in aerial combat for the loss of only two aircraft to ground fire.

Falklands War, April 1982

One modern British submarine kept the entire Argentine Navy at home while one Exocet missile destroyed a British ship. Thus, technology will forever be an essential element of combat power and an important determinant of victory on the modern battlefield along with intellectual, political and social forces that can influence operations to a great an extent.

HISTORICAL PROCESS OF THE SPREAD OF MILITARY TECHNOLOGY

The historical process and mechanism behind the spread of military technology has well been explained by Barry Buzan[3].

During the 19th century, only a handful of states managed to acquire the capability for sustained industrial development that was the key to manufacturing modern weapons. Britain was the leader in the early stages. Germany, France, the United States and some smaller European countries caught up quickly. Russia and Japan joined before the end of this first wave of industrialisation. Trade and investment provided a major mechanism for the transfer of technology among the members of this group. Technological leaders were generally more than willing to sell their products, and investments from Europe ushered the industrialisation of the United States and Russia. The later entrants to the group were able to use this transfer of finance and technology to bring their own process of industrialisation up to the point at which it became self-sustaining. All of these countries fairly quickly attained sufficient command of basic industry to develop and manufacture weapons up to the leading technological standard of the day. As they did so, their dependence on arms purchases declined, and some of them entered the market as sellers.

The leaders of the first wave, particularly Britain and Germany, did good business selling such military products as artillery, machine guns, and warships to countries unable to manufacture them. Late industrialised nations such as Japan, purchased major weapon systems like battleships until they developed the capacity to manufacture their own. Many countries, like Brazil and the Ottoman Empire, were not at this time serious entrants in the industrialisation process. Others, like Belgium and the Netherlands, were industrialising, but did not command the scale of industry or markets necessary to make domestic production of the whole range of modern arms an economic proposition. Both types of countries were forced to depend on the arms trade in order to keep pace with progress in military technology.

---

3. http://www.cia.gov/nic/pubs/research_supported_by_nic/conference_paper/chenghu. htm(1of12)[10/11/2002

The industrialised group contained most of the states that were already established as imperial powers—Britain, France and Russia. Germany, Belgium, Japan and the United States became imperial powers during the last rounds of empire-building. In their imperial roles, these powers spread elements of the revolution of frequent technological change all through the areas of the planet over which they exercised control, including most of Africa and large parts of Asia. But since the local peoples were not independent, there was no arms trade on a scale comparable to that between the industrialised powers and the other countries. Most of the industrial products that were transferred to colonial areas remained under the control of the colonising power, especially those associated with military capability.

Europe and America continued to be the focus of qualitative innovation in technology, and Japan and the Soviet Union caught up in terms of independent production capability.

The spread of military capability remained very much in this quite concentrated pattern until World War II, especially in terms of the capability for producing advanced weapons. Europe and America continued to be the focus of qualitative innovation in technology, and Japan and the Soviet Union caught up in terms of independent production capability. Technology was taken to the areas under colonial control, but seldom implanted there. Independent non-arms producers like the Latin American countries mostly made little progress towards industrialisation. After World War II, and as a result of it, the spread of military capability picked up speed across the planet. This acceleration was closely linked to decolonisation. In three decades, the number of states in the international system tripled. This added to the number of non-producing countries whose rulers needed to get their military equipment. Instead of being denied modern arms, the new rulers were treated as legitimate customers. Their need arose not only from the domestic order requirements of self-rule, but also from the complex pattern of relations with neighbours. India and Pakistan and the smaller states of South Asia that now worry about

each other, fell in this category. Decolonisation, thus, facilitated the spread of military capability both by creating many new independent centres of political power, and by providing a new focus for a host of local disputes and rivalries.

Because most of the new states had little or no industrial base, decolonisation initially just increased the number of arms non-producers in the system. Some of these countries had never had any industrial base. Others, such as Egypt and India had been major pre-modern centres of technology and production. They had been subordinated to, and in some ways deliberately deindustrialised by, the colonial powers in order to eliminate them as economic competitors and reduce them to the status of suppliers of raw materials and consumers of manufactured goods. The military imbalance between the producers and the newly independent non-producers was rectified to the extent that arms were now available rather than denied. But it was maintained in as much as the non-producers remained dependent on a small number of suppliers for their weapons. Non-producers of arms in both the newly independent areas of Africa and Asia, and the older ex-colonial area of Latin America, were not satisfied to remain economically and industrially dependent. Many of them actively set about acquiring industrial economies of their own. In several of the less industrialised countries—India, Egypt and China, and later Argentina, Brazil, Iran and South Africa—acquiring the capability for at least some military production was a priority. These industrialisation projects have been a mix of failure and partial success. This resulted in a broadening group of countries able to supply some of their own military needs. In a few of these, most notably India, Israel, South Africa and China, the quality and quantity of production were high enough to enable them to compete in some of the lower technology sectors of the arms trade

The mechanisms by which arms production capabilities have spread to these countries are similar to those that created the first group of producers. Straight transfers of arms do not assist development of production capability unless a sufficient industrial base already exists to enable local

copies to be made. Civil industrial capability carries military potential, and so some of the new production capability simply reflects spin-ons from a broader process of economic development. But in many cases, the development of arms production has also been stimulated by the direct transfer of manufacturing capability from producer to non-producer countries, though even here the success of the transplant depends on the existence of a civil industrial base. The Soviet Union played this role in China during the 1950s and in Eastern Europe up to 1989. Several Western suppliers were doing the same in Iran up to 1979, and both East and West have done so in India.

Such transfers reflected economic and political competition among the supplier states. After World War II, the arms trade was dominated initially by the United States and Britain. The small number of suppliers created a seller's market. As other industrial states such as France, the Soviet Union, Germany, Czechoslovakia, Belgium and Italy recovered from the war, the number of arms suppliers increased. This trend has been reinforced by the development of arms industries in some Third World states, especially China, which has become a significant arms supplier. As the number of suppliers increased, competition among them for the export market became more intense, with the result that buyers have more leverage. In the buyer's market that the increase in the number of suppliers has now created, many states have used that leverage to get production facilities and knowledge as part of their major arms purchases. India, for example, negotiated many such deals with the Soviet Union, Britain and France. From being almost solely a purchaser during the 1950s, India has steadily built up an indigenous arms production capability of some sophistication.

Licensing production arrangements seldom transfer even production technology quickly, and do not represent a short path from dependence to independence. Despite the well-established view that licensing does not lead to independent production, India has demonstrated that over the years, such arrangements can promote the development of local component suppliers as well as capability for maintenance and design. India has built up some independent capability in the

Without devoting the much larger resources necessary to bring its own R&D up to the pace and standard of the leading edge of qualitative advance, even a country like India will not be able to achieve more than semi-independence in arms supply.

less technologically advanced areas of military production, and some foundations on which to wrest advantageous licensed production arrangements for more sophisticated weapons. Its partial success in this development would not have been possible without possession of a broadly based industrial economy, and even so has been expensive and not very efficient. Without devoting the much larger resources necessary to bring its own R&D up to the pace and standard of the leading edge of qualitative advance, even a country like India will not be able to achieve more than semi-independence in arms supply. Although it will be able to produce a variety of less sophisticated weapons independently, it will remain partly dependent on more advanced suppliers if it wishes to deploy weapons close to the highest standard of technology available.

Advanced military technology has spread throughout the international system in three ways: by the physical and political expansion of those states possessing it; by the transfer of weapons from those capable of manufacturing them to those not; and by the spread of manufacturing capability to ever more centres of control. In historical terms, these three mechanisms of spread have operated simultaneously, but not evenly. The mechanism of direct physical expansion was prominent during the colonial period, and has declined in importance since 1945. It is now relevant principally in the form of the overseas deployments and bases of a few great powers, and the end of the Cold War has brought about the closure and scaling down of many of these. Conversely, the spread of independent centres of manufacture has been increasing in importance, especially in the period since decolonisation. The mechanism of the arms trade has been steadier than either of the other two. It has been central to the spread of military technology throughout the period from the late 19th

century to the present day, and it has been increasingly important as the number of states has increased.

The key to understanding the apparent permanence of the arms trade is the powerful constellation of vested interests that support it: 'supply push' from producers, and 'demand pull' from consumers. Supplier interests can be both political and economic. Possession of an arms industry serves the basic security value of self-reliance, and also supports the pursuit of power and influence. Traditionally, any state seeking to attain a leadership position in the international power hierarchy has needed its own arms industry. One important aspect of great power status is the independent ability to wage war: hence, a substantial measure of domestic arms production is an essential requirement. Once attained, an arms industry can add to the tools of influence at the government's disposal. Arms supply is one of the classical ways in which great powers compete for the allegiance of lesser powers.

Political motives for states to acquire arms production capabilities are entangled with economic ones. In a trading environment, the market has some impact on setting standards of both quality and price that determine whether the pursuit of self-reliance by any state is a viable or desirable policy. The economic motives for states to spend money on domestic arms production are to save the cost of importing weapons and to improve the balance of payments by exporting them. Once an arms industry exists, it generates vested interests in profits, in jobs and in preserving high technology capabilities and these interests can lead to pressure to export in order to sustain the companies concerned. In the Cold War, spending on arms for economic motives was justified by reference to external military threats. Now state expenditure on technological innovation is being represented as a necessary part of industrial policy.

Another potent pressure to export is the fact that only states with large domestic requirements for arms have any hope of achieving economies of scale in their own production. Longer production runs lower the unit cost of the items produced. If the number of sophisticated items like tanks and aircraft required for domestic consumption is small, then home production

Another potent pressure to export is the fact that only states with large domestic requirements for arms have any hope of achieving economies of scale in their own production. will result in high unit costs unless exports can be found to lengthen the production run. Long production runs are especially necessary to amortise investment in advanced technology items where R&D accounts for a high proportion of total cost. Very few states have domestic requirements large enough to achieve economies of scale. Consequently, nearly all arms producers have strong incentives to export in order to achieve reasonable costs for that part of their production that they wish to buy for their own use. Second rank powers like Britain and France are the most vulnerable to this squeeze, as they are just big enough to be arms producers but have small requirements for arms. The need to export between one-third and almost half of their production is one reason why they have been aggressive in seeking export markets. Small arms and anti-personnel weapons such as land-mines, grenades and cluster bombs are easy to produce in economic quantities and so do not involve the same questions about economies of scale as do large weapons platforms. The need to guarantee economically attractive production runs for expensive modern weapon systems explains why the Western European arms producers are increasingly attempting multinational arms production projects like the Jaguar, the Tornado and the Euro fighter aircraft.

Even the United States has not been, and Soviet Union was not, immune from the need to achieve economies of scale, despite their starting advantage of large domestic arms purchases. The process of qualitative advance means that the unit cost of sophisticated modern weapons is usually higher than the cost of the previous generation. This cost, which tends to outrun the general rate of inflation, and the fact that the newer weapons are more capable than the older ones they replace, create pressure to acquire smaller numbers. This process is likely to accelerate now as the Cold War can no longer be used to justify large deployments. Shrinking domestic demand in terms of numbers of weapons in turn raises the incentives to lengthen production runs by finding export markets. The United States will increasingly find itself

faced with difficult choices between maintaining its technological lead by keeping leading edge weapons to itself (e.g. stealth bombers, cruise missiles and BMD systems), or exporting them. Not exporting will mean bearing the extremely high unit costs of small production runs. Exporting them will mean loss of US leverage (whether with potential foes or dependent allies).

The right to buy arms is closely related to the maintenance of an international society based on sovereign equality of states. There is, thus, a potent shared interest between suppliers and recipients in maintaining the arms trade.

TECHNOLOGY AND INDIA

India, a one-time leader of international trade and commerce, became a victim of systematic deindustrialisation during more than 200 years of colonial rules and missed the wave of the industrial revolution. From a 'golden bird', it became a poor and developing nation.

Independent India seized the first available opportunity and gave due importance to development of technology by means of creating institutions *par excellence*, and showed preference for heavy industries within the politico-economic scenario prevailing in the world in general and in the country in particular. This raised great hopes for building India from scratch with the help of a leading role for technology and industry. In the past over 60 years, the country has progressed significantly and exceptionally on many fronts. Still, in order to increase the pace of the growth, attain self-sufficiency and a leadership role, a lot is yet to be done. India, with a large scientific community and many other advantages on her side, needs to accelerate the growth of, and strengthen, its technological and industrial base in both military and civil domains.

India has demonstrated technological acumen in many fields such as space, nuclear, information and communication, software and pharmaceutical, etc. However, India should strive to expand the area of influence in other areas by acquiring cutting edge emerging technologies

which could take it into the league of technologically advanced nations with its strong political, economic and military strength.

CONCLUSION

History shows that nations have endeavoured to develop new and more advanced technologies with the goal of achieving military advantage. There are a number of different dimensions of technology. Before the 17th century, inventions were diffused by imitation, while improvement was established by the survival of the fittest. Now, technology has become a complex but consciously directed group of social activities involving a wide range of skills, exemplified by scientific research and managerial expertise. The powers of technology appear to be unlimited. While some of the dangers may be great, the potential rewards are greater still. This is not simply a matter of material benefits for, as we have seen, major changes in thought have, in the past, occurred as consequences of technological advances.

It is likely that military technology will be even more visible in the way defence forces plan and fight in the future. Although the experiences of 20th century conflicts show that superiority in technology is no guarantee for success, it is undeniable that technology is a great 'force multiplier'. The fact is that technology is an all time relevant, along with other factors that are equally important, and should, therefore, also be considered in peace-time planning, development and training. It will be appropriate to say that the superiority of armaments may increase the chances of success in war: it does not, of itself, gain battles. Therefore, to repeat a point made earlier, all things being equal, an army with better weapons must surely overwhelm an army with inferior arms. It pays to remember that during the Falklands War in April 1982, one modern British submarine kept the entire Argentine Navy at home, while one Exocet missile destroyed a British ship. Technology will forever be an essential element of combat power and an important determinant of victory on the modern battlefield along with intellectual, political and social forces.

Hence, India should strive for, and acquire, the emerging technologies to attain the leadership position in global order by exploiting its strength. An all-out effort must be made to achieve and maintain political, economic and military superiority.

RESEARCH FELLOWSHIPS – 2011-2013

Centre for Air Power Studies, New Delhi invites applications from Indian citizens for research fellowships to undertake a 2-year study on Indian defence and aerospace issues, including China's military modernisation and Pakistan's military, at three levels:

(i) **Senior Fellow**, with a Ph.D. and over 5 years research experience or 15 years experience in defence;

(ii) **Research Fellow**, with a Ph.D or 10 years experience in defence; and

(iii) **Associate Fellow** with minimum 3 years experience in research or 5 years experience in defence. Remuneration according to experience and expertise (within the scales of Rs. 14,300-450-22,400; 12,000-375-18,000 and 8,000-275-13,500 respectively).

Applications along with a Project Proposal of not more than 1500 words must be sent to **Director, Centre for Air Power Studies, P-284, Arjan Path, Subroto Park, New Delhi-110 010** not later than **March 31, 2011** by post or Email to diroffice@aerospaceindia.org complete with the bio-data giving full details.

NOTES FOR CONTRIBUTORS

Articles submitted to Air Power Journal should be original contributions and should not be under consideration for any other publication at the same time. If another version of the article is under consideration by another publication, or has been, or will be published elsewhere, authors should clearly indicate this at the time of submission.

Each typescript should be submitted in duplicate. Articles should be typewritten on A4/ Letter paper, on one side only, **double-spaced (including the notes)** and with ample margins. All pages (including those containing only diagrams and tables) should be numbered consecutively.

There is no standard length for articles, but 5,000 to 8,000 words (including notes and references) is a useful target. The article should begin with an indented summary of around 100 words, which should describe the main arguments and conclusions of the article.

Details of the author's institutional affiliations, full address and other contact information should be included on a separate cover sheet. Any acknowledgements should be included on the cover sheet as should a note of the exact length of the article.

All diagrams, charts and graphs should be referred to as figure and consecutively numbered. Tables should be kept to a minimum and contain only essential data. Each figure and table must be given an Arabic numeral, followed by a heading, and be referred to in the text.

Articles should be submitted on high-density 3~ inch virus free disks (IBM PC) in rich text format (RTF) together with **an exactly matching double-spaced hard copy** to facilitate typesetting; notes should be placed at the end of each page. Any diagrams or maps should be copied to a separate disk separately in uncompressed TIF or JPG formats in individual files. These should be prepared in black and white. Tints should be avoided, use open patterns instead. If maps and diagrams cannot be prepared electroni-cally, they should be presented on good quality white paper.

Each disk should be labelled with the journal's name, article title, author's name and software used. It is the author's responsibility to ensure that where copyright materials are included within an article, the permission of the copyright holder has been obtained. Confirmation of this should be included on a separate sheet included with the disk.

Copyright in articles published in *Air Power* rests with the publisher.

STYLE

Authors are responsible for ensuring that their manuscripts conform to the journal style. The Editors will not undertake retyping of manuscripts before publication. A guide to style and presentation is obtainable from the publisher.

Current Journal style should be followed closely. Dates in the form January 1, 2000. Use figures for 11 and above. British spellings are to be used. Authors should provide brief biographical details to include institutional af-filiation and recent publications for inclusion in About the Contributors. Sub-headings and sub-sub-headings should be unambiguously marked on the copy.

NOTES

Notes should be **double spaced** and numbered consecutively through the article. **The first line of a note must align with subsequent lines. Each note number should be standard size and have a full point**.

a) References to books should give author's name: title of the book (italics); and the place, publisher and date of publication in brackets.

e.g. 1. Samuel P. Huntington, *The Common Defense* (NY: Columbia UP, 1961), Ch. 2, pp. 14-18.

b) References to articles in periodicals should give the author's initials and surname, the title of the article in quotation marks, title of the periodical (italics), the number of the volume/issue in Arabic numerals, the date of publication, and the page numbers:

e.g., Douglas M. Fox, "Congress and the US Military Service Budgets in the Post War Period," *Midwest Journal of Political Science*, vol. 16, no. 2, May 1971, pp. 382-393.

AIR POWER

Journal of Air Power and Space Studies

Centre for Air Power Studies, P-284, Arjan Path, Subroto Park, New Delhi 110010

AIR POWER Journal

SUBSCRIPTION FORM

In India
- ☐ **Rs. 275/- per copy**
- ☐ **Rs. 1100/- per annum (4 Issues)**

Overseas
- ☐ **US $ 35 per copy**
- ☐ **US $ 130 per annum (4 Issues)**

PLEASE PRINT

Name...

Complete Address...

....

....

....Pin.....................Phone...................................

Please find enclosed cheque/draft number:................. dated...................drawn

on..favouring KW Publishers Pvt. Ltd.,

for ☐Rs ☐US$ ....

Please mail this form t**o: KW Publishers Pvt. Ltd., 4676/21, Ansari Road, Daryaganj New Delhi 110 002   T: +91.11.23263498 / 43528107 E: mail@kwpub.in / knowledgeworld@vsnl.net W: www.kwpub.in**