IAF'S DEVELOPMENT TOWARDS GREATER CAPABILITY: 2032

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INTRODUCTION

As it moves towards its first centenary, the Indian Air Force (IAF) is in the process of enhancing its capabilities in a major manner. Most of this enhancement of capabilities is being obtained through induction of advanced equipment such as the C-130J and C-17 transport aircraft, Rafale Medium Multi-role Combat Aircraft (MMRCA), Fifth Generation Fighter Aircraft (FGFA) to name a few of the more prominent inductions underway. A common characteristic of these inductions is that they are sourced from foreign vendors. To be a truly effective and independent force, the IAF also requires to get full control over its technology. Thus, technology ownership is an issue of importance to the IAF. Likewise, with increasing networking of its forces, the IAF requires to put in place effective cyber warfare capabilities. With the reasonable expectation of future military operations requiring close cooperation between the different military arms of the government, effective jointness requires to be planned for and implemented on the ground. Further, ensuring deep imbibing of acceptable organisational values and modes of behaviour amongst its cadre is important for internal cohesion and operational effectiveness. This paper will dwell on these issues from the point of view of enhancing the IAF's

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effectiveness in the near and medium term future out to 2032 when the IAF completes one hundred years of existence.

ISSUES FOR GREATER CAPABILITY

Technology

The IAF by its very nature is technology intensive. Due to the constraints of domestically available scientific and technological capabilities, the IAF has, since its formation, been a technology importer, adapting its doctrine, strategy and tactics to the technology available from foreign sources.

IAF's Track Record of Proven Technical Skills: However, despite the constraint imposed by the need to import equipment, the IAF has proven its innovativeness and technical acumen since the early years of its existence. IAF technicians, in the 1940s during World War II, modified the tail skid unit of the British built Lysander aircraft which was then in IAF service to increase the controllability of the aircraft, during its take-off and landing runs, as well as to increase reliability of the aircraft's undercarriage. Modifications carried out by IAF technicians were examined by the manufacturer of the aircraft and subsequently implemented on the entire global fleet of Lysanders by the British[1]. The same aircraft type was thereafter modified to carry bombs on external weapon stations, a capability the original aircraft lacked[2].

After World War II, IAF technicians with the assistance of personnel from Hindustan Aircraft Limited (HAL)[3] were able to recover as many as 37 B-24 "Liberator" bombers from the "B-24 graveyard" at Chakeri airfield, Kanpur. At this location, the British had deliberately damaged B-24 aircraft to make them "unflightworthy and unrecoverable" in order to prevent these aircraft being used by any party apart from US and British forces, and dumped these in a 'graveyard'. The B-24 aircraft in question had been

1. SC Gupta, *History of the Indian Air Force 1933-1945* (Combined Inter-Services Historical Section India & Pakistan, 1961), pp. 4-10.
2. Ibid
3. Hindustan Aircraft Limited (HAL) was set up in India by the entrepreneur Seth Walchand Hirachand in 1940 and was the first aircraft manufacturing facility in South Asia. This facility was nationalised on April 2, 1942, by the Government of British India and in the 1960s, renamed as Hindustan Aeronautics Limited (HAL) by the Government of India. HAL, in its 1960s' avatar exists till today.

left as scrap metal by the British after World War II. These 37 rebuilt aircraft served the IAF till 1968[4].

During the Indo-Pak War over Kashmir in 1947-48, the IAF again displayed its innovativeness and technical acumen through using C-47 "Dakota" cargo aircraft as bombers. The 1947-48 War for Kashmir also saw the IAF utilising Tempest fighters to deliver essential food and ammunition supplies to Jammu and Kashmir (J&K) state forces besieged by the Pakistani raiders at Skardu fort when it was found that Dakota transports would be unable to fly to Skardu[5]. In this war, Srinagar airfield lacked replenishment facilities for IAF fighters, and the IAF improvised through decanting fuel from Dakota transport aircraft, that had landed at Srinagar, into drums and using this fuel for refuelling Harvard-II trainers and Spitfire and Tempest fighters, effectively making the Dakotas into mobile refuelling posts while these were on the ground at Srinagar airfield[6]. This period also saw the first landing by a Dakota at Leh airstrip flying at an altitude well beyond the manufacturer's specified altitude limit for the aircraft[7].

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The IAF has continued to regularly display its technical skills in the years since then. The Display Attack Ranging Inertial Navigation (DARIN) system, an indigenously integrated navigation and attack system with a performance superior to many foreign systems of the same era (1970s-1980s), was integrated domestically with IAF participation, albeit using imported

4. Gp Capt Kapil Bhargava (Retd), "India's Reclaimed B-24 Bombers", http://www.bharat-rakshak.com/IAF/History/Aircraft/Liberator.html, accessed on January 20, 2014.
5. Air Mshl Bharat Kumar, *An Incredible War: Indian Air Force in Kashmir War 1947-48* (New Delhi: KW Publishers Pvt Ltd, 2007), pp. 36-60.
6. Ibid.
7. Ibid.

components, and used to upgrade the IAF's Jaguars. The DARIN system is currently in its third iteration as the DARIN-III[8].

This brief look at a few of the innovations and demonstrated instances of exercise of technical skills by the IAF since 1932 clearly brings out that IAF personnel have the "right stuff" in possessing, and, more importantly, in being able to exercise, their technical skills in an innovative manner to address practical problems.

Pitfalls of Dependence on Foreign Sources: Reliance on critical military technology that is not controlled by a nation itself can prove dangerous. The nation that the technology was sourced from, can impose control on the recipient's policies and available military options through denial, or restricted supply of spares and other essential support. India has faced such instances in the past. Indian Navy Seaking helicopters and Sea Harrier fighters faced a severe shortage of spare parts subsequent to the US led sanctions imposed on India post the 1998 Pokhran-II nuclear tests[9]. Such sanctions can be used by the supplier country of Indian arms imports to force India to toe its line politically and / or militarily. Such a situation can be detrimental to our national interest. Therefore, it is important for India to develop the ability to develop and field its own weaponry. For success in this endeavour in the aviation realm, the involvement of the IAF, the primary end user of aerial weaponry, is required to give direction, ownership and suitable oversight of the design and development process. Such a linkage would be beneficial in removing the end user's tendency to demand unrealistic performance parameters from domestic manufacturers who may be undertaking such a task for the very first time as well as to give tighter control over the activities of the designer, developer and manufacturer.

The Indian Navy's (IN's) system wherein the IN at its Naval Headquarters (HQ) has an entire directorate dealing with warship design and development (Department of Naval Design), leading on to interaction with the concerned domestic shipyards entrusted with the

8. Vishal Rathod, "Indian Air Force DARIN Upgrades for SEPECAT Jaguar", http://www.defenceaviation.com/2011/12/indian-air-force-darin-upgrades-for-sepecat-jaguar.html, accessed on January 20, 2013.
9. "Indian Navy", http://homepage.eircom.net/~steven/bombay.htm, accessed on April 12, 2013.

actual manufacture, deserves a serious look. The IN, through this system, ensures end user involvement at every stage, from initial design through manufacture till commissioning into service of domestic warships. This is helped further by having serving or retired naval officers in the upper echelons of the warship building shipyards. This model displays backward and forward integration and appears to have worked fairly well (despite primarily public sector shipyards being involved in warship building) given the fact that the IN has several frontline indigenous ships in service.

A Possible Technology Solution for the IAF: The IAF could adapt and use the IN system through setting up a separate Directorate of Aircraft Design and Development (Dte of ADD) at Air HQ. The Dte of ADD could be tasked with developing aircraft and weapon system designs to meet the IAF's future operational requirements. This new directorate could be manned by a mix of specially chosen engineers with design acumen and operational aircrew with test pilot and operational, including viable tactical solutions development, experience. A few suitably qualified representatives of Research and Development (R&D) laboratories under the Defence Research and Development Organisation (DRDO) could also be assigned here. Such a mix would ensure that the designs are grounded in capabilities required by the IAF while staying within the bounds of domestic technical feasibility.

Further down, from Air HQ, the bulk of the IAF's highly qualified engineers could be encouraged to undertake higher, Masters and Doctoral level, educational qualifications, in Indian as well as foreign institutions of higher education, specialising in aspects of aerospace technology. The IAF could actively interact with institutions such as the Indian Institute of Science (IISc), Bangalore, to reserve seats in aeronautical disciplines for IAF personnel detailed and nominated for such training by the IAF. These officers could then be posted to specific DRDO R&D laboratories as well as to 'upgraded' Base Repair Depots (BRDs) of the IAF to undertake R&D work required to meet milestones set out in the Ministry of Defence's (MoD's) and the IAF's long-term plans. Another batch of IAF engineers

could be deputed to work in aircraft manufacturing agencies in both the public and private sector. This body of personnel would ensure that the linkage from the apex at Air HQ, where designing is initiated, through R&D centres to manufacturing locations, till the delivery of the required equipment is maintained unbroken. The IAF would have unprecedented oversight over the entire domestic design, development and production chain in addition to involvement and ownership of the process. Such an integrated structure could be reasonably expected to deliver better than the current system has.

The IAF has several BRDs which today act as storage locations for spares while undertaking limited maintenance work on equipment. BRDs could be upgraded to full capability R&D centres specialising in different aspects of the required aerospace technologies. If manned by a mix of qualified and motivated IAF engineers and scientists from DRDO, these could develop into centres of excellence in their respective fields.

Such a system is likely to ease many of the problems that exist in today's sub-optimal deployment of skilled manpower as well as in indigenous production of aviation equipment. Total ownership of technology and development of technology to address the IAF's actual problems in operations could, through such a change in structure, be within the IAF's grasp. Engineers could be made to keep in touch with the realities in the field through innovative posting policies. Engineers may spend a few years at a junior level in operational units and later at suitable intervals, say, for six months every 10 years, rotate through tenures in field units in order to retain a feel for the actual issues and problems in operational field units.

Manpower planning and career progression issues obviously would be heavily involved in the solution suggested above. Manning and personnel issues are involved in other aspects of IAF development also and, hence, will intentionally not be expanded upon in this paper. These could form the subject of a separate paper.

Choosing the Right Technology: Recently the ability of indigenous design and manufacture organisations has increased manifold in several

different areas while some problem areas do remain[10].

As the IAF looks ahead, it needs to decide about the type and nature of the technology it should invest in for the future. The IAF requires being certain about the capabilities it would require in the 2032 timeframe and in subsequent further timeframes. This process should not be based upon just following the path earlier trod by more advanced countries of the West (such blind copying of the West may lead to commitment of resources towards very high end "gold plated "weapon systems such as the F-22 "Raptor" of which even the US found it could buy not more than 187), but should be an independent exercise with no pre-conceived notions about what future technologies should. The IAF should dispassionately analyse the available options and the real world practicality of new technologies. This would help it take informed decisions about the research and development efforts it should invest in for the future. For instance, while assured penetration of hostile air space could be a desired capability required, this capability could be achieved through the use of "stealth" aircraft or through hypersonic "space-planes" or even through attacks from platforms based in outer space. This elementary example brings out the fact that in most cases, there will be more than one way to achieve an operational end. Such choices between alternatives will carry an element of risk. The challenge for the IAF with respect to technology selection will be to arrive at reasoned decisions with adequate risk alleviation strategies built into its plans. Such a technology identification and selection process is likely to be best done at Air HQ in a specialised cell of the new Dte of ADD in order to marry operational needs with technical feasibility. The development of Long-Term Perspective Plans (LTPPs) at Dte of ADD could give direction to long-term R&D into enabling technologies for futuristic LTPP projects. In the US, the Defence Advanced Research Projects Agency (DARPA) carries out this function

10. The Light Combat Aircraft (LCA) is near Initial Operational Clearance (IOC), Dhruv and Rudra are in service, with the Light Combat Helicopter (LCH)near delivery, indigenous Airborne Early Warning and Control (AEW&C) near fructification, FGFA in development, Agni series of missiles up to Agni-V and Brahmos are in active service and INS *Arihant* is under trials for induction. Delays with the LCA's Multi-Mode Radar (MMR), delays with the Kaveri engine and the indigenous Intermediate Jet Trainer (IJT) HJT-36 "Sitara", delays in Scorpene submarine deliveries and delay in operationalisation of INS *Arihant* with its ballistic missiles installed indicate that there is still some way to go and work to be done.

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for the US armed forces as a whole. Concepts accepted by the organisation and government are contracted out by DARPA to private and public sector agencies for further development and "proof of concept" before being developed into operational systems for military use. The Dte of ADD could set up a department to serve a similar function as served by DARPA in the US till all three Services and the MoD can set up one combined central agency for this important task.

Deployment of Aeronautical Engineer (AE) Branch Officers: Most modern equipment whether for civil or military use comes with exhaustive documentation that includes fault identification and rectification checklists and flowcharts. These two aspects are most often covered as a series of block diagrams with the sequence of progression clearly defined. Availability of such documentation means that maintenance personnel in units do not require M. Tech. or even B.Tech. level of knowledge to carry out routine maintenance activities, especially with Line Replaceable Units (LRUs)[11] being the standard design aspect of most modern weapon systems. The IAF's large pool of highly educated AE branch officers requires effective deployment for tasks that are suitably challenging for them and which utilise their capabilities for the greater good. The paragraphs above cover some of these options.

Weapon Inductions for Effectiveness: The IAF would also require development / induction of suitable technologies for effective air-to-

11. LRUs: if a system, say the radar becomes unserviceable, a Built in Test (BIT) system checks all the radar's components for faults. On identification of the faulty component, say Item A1, the faulty Item is unplugged from the radar and replaced with a serviceable Item A1 while the unserviceable Item A1 is back loaded to a rear echelon repair agency. A simple pulling out and replacing of a part about the size of a UPS used for personal computers or of the size of a laptop computer is all that is needed to maintain serviceability. LRUs are designed for ease of removal and replacement. Their intricate innards are repaired at locations that have the advanced technical expertise to do this. These locations in the US case are usually the aircraft manufacturer's factory itself. In India, this rear echelon repair task could be done by HAL, civil manufactures or the IAF's own BRDs.

ground attack in the mountains given that India's disputed territories for the most part lie in the Himalayas[12]; in the 1999 Kargil War, effective attack in the mountains was a major challenge for the IAF.[13] Widespread induction of Precision Guided Munitions (PGMs) should be catered for. PGMs would find use in mountainous terrain as well as in the plains[14]. Widespread availability of PGMs could make Battlefield Air Strike (BAS)[15] freer from risks of fratricide apart from making it more effective. The IAF will need to identify leapfrogging technologies in order to retain the ability to counter the People's Liberation Army Air Force (PLAAF) and other air forces. The IAF's highly qualified AE officers could be deployed to address such challenges of technology and equipment development.

CYBER WARFARE (CW)

Another branch of technology that demands mention here is that of the cyber domain. The IAF is making rapid strides towards becoming a fully networked force able to execute networked operations[16]. The IAF is putting in place its Air Force Network (AFNET) which is a fibre optic-based high bandwidth connectivity backbone between all IAF ground locations and it is able to provide high bandwidth voice, data and video streaming facilities to its users. The IAF's Integrated Air Command and Control System (IACCS), an advanced automated command and control support system that enables near real-time information sharing and combat

12. "India's Boundary Disputes with China, Nepal, and Pakistan", http://www.boundaries.com/India.htm, accessed on January 28, 2014.
13. "1999 Kargil Conflict", http://www.globalsecurity.org/military/world/war/kargil-99.htm, accessed on May 28, 2012.
14. In the 1999 Kargil War, the IAF used large numbers of "iron" bombs with limited destruction of the enemy's hardened shelters. Use of just two PGMs led to the destruction of a vital enemy bunker on Tiger Hill, helping in its liberation. [Discussion with Air Marshal Vinod Patney, SYSM, AVSM, VrC (Retd) Air Officer Commanding-in –Chief (AOC-in-C) of Western Air Command during the Kargil War 1999, on July 27, 2012, at IDSA.] This brings out the importance of PGMs in the modern period for ground attack in mountainous terrain.
15. BAS was earlier referred to as Close Air Support (CAS). Contrary to the impression carried by some non-air force personnel, the IAF has never said that it will stop, nor has stopped, CAS to surface forces and still does and always will, whenever it is required, only under a different, possibly more accurate, name (BAS).
16. "The Indian Air Force Today", http://indianairforce.nic.in/show_page.php?pg_id=13, accessed on January 30, 2014.

The IAF's Integrated Air Command and Control System (IACCS), an advanced automated command and control support system that enables near real-time information sharing and combat decision support operates on the AFNET backbone. AFNET also enables Internet Protocol (IP) based communications amongst its users.

decision support operates on the AFNET backbone[17]. AFNET also enables Internet Protocol (IP) based communications amongst its users. IACCS nodes are rapidly expanding over the IAF; a total of ten nodes is planned to cover the entire country. While the AFNET architecture provides seamless connectivity between ground locations aircraft and satellites for real-time voice and data, including high definition video sharing amongst users, the IAF is progressing towards even greater connectivity through putting in place a wideband Code Division Multiple Access (CDMA) 3G portable wireless network. This network is reportedly meant to ensure complete connectivity among more than 80,000 IAF personnel and their bases. High end smart phones manufactured by HCL are expected to be issued to all officers and other air warriors down to sergeant rank towards this end[18]. The IAF is, thus, well on its way towards achieving a fully networked and integrated organisation able to share relevant information rapidly, thus, achieving significant force multiplication effects. These networked operations and capabilities reside in the availability of computers and reliable infrastructure to connect them into one seamless entity. Networking can achieve significant force multiplication effects through near instantaneous sharing of information amongst all war-fighters. Such information sharing could significantly reduce the "fog of war" and make the IAF's networked forces significantly more effective.

17. "Indian Air Force Gets 3G Network To Heighten Operational Efficiency", http://www.defencenow.com/news/107/indian-air-force-gets-3g-network-to-heighten-operational-efficiency.html, accessed on February 2, 2014.
18. n.17.

Such new capabilities bring new vulnerabilities in tow.[19] Enemy attacks on this network and its component parts could be devastatingly paralysing to the extent that the IAF is made non-functional through denial of networking. In a situation where the war plans are based upon availability of the network, its absence could throw these plans into disarray. At best, reversion to non-networked operations could be resorted to, in the face of denial of the networked capability, with accompanied loss of efficiency. Therefore, along with induction of cutting edge technology, the IAF requires to devise effective means of insulating itself from the new vulnerabilities that accompany the new technology inducted.

The IAF is relying upon a dedicated self-owned fibre optic cable network for high bandwidth data transfer. Fibre optic cables provide a degree of safety from leakages as intercepting the "on fibre" data would require a relatively difficult direct tapping into the network through cutting into fibre optic cables or access to AFNET linked computers, both of which can be protected physically. Discipline must be enforced to prevent unauthorised equipment being connected to the IAF's secure computers. The hacking of the Indian Navy's computers in Eastern Naval Command is suspected to have been caused in part through the use of an unauthorised storage (USB Pen Drive) device[20]. India's Computer Emergency Response Team (IN -CERT), set up by the central government, is already hard-pressed in dealing with the many attacks on Indian computer systems[21]. The need to extend the IAF's ground-based network till the sensors and war-fighters in the air means that wireless data-links are also needed from the secure ground network (net) to the airborne net. The CDMA-based 3G wideband wireless network could also be tapped into by malicious elements, apart from the real danger of

19. Dave Lee, "Flame: Massive Cyber-Attack Discovered, Researchers Say", http://www.bbc.com/news/technology-18238326, accessed on January 29, 2014.

20. "Govt Confirms That The Naval Computer Network Was Hacked In November ", http://www.techtree.com/content/news/1727/govt-confirms-naval-computer-network-hacked-november.html#.UZMJwkrxg0Q, accessed on January 30, 2014.

21. "Hackers Pick Holes in Indian Cyber System, Hit Government Websites 1030 Times in Three Years", http://economictimes.indiatimes.com/tech/internet/hackers-pick-holes-in-indian-cyber-system-hit-government-websites-1030-times-in-three-years/articleshow/19936557.cms, accessed on January 30, 2014.

some of the 80,000 handsets issued to personnel falling into hostile hands. These handsets could be configured to require a frequent authentication through biometric means tied to the authorised user to continue to have access to the AFNET. In the case of theft of a handset in such a situation, it would fail to open a vulnerability window for attacking the AFNET even if the theft is not reported to the IAF authorities immediately. Securing of wireless data-links cannot be done through physical protection alone but requires technological means such as possibly a combination of advanced encryption, to defend against eavesdropping, and spread spectrum ultra wideband transmission characteristics to defend against jamming. It should be borne in mind that a static system, if attacked continuously by hostile elements, is likely to finally succumb. Therefore, the defence of a network requires being dynamic in nature and continuously evolving to deal with ever more complex threats as these, in turn, evolve. This brings out that instead of relying upon an architecture designed and put in place at a discrete time, safety would lie in the network's defences continually evolving towards ever more sophistication to deal with more advanced attacks as time passes. In view of the numerous attacks continually taking place on Indian computer networks and IN-CERT involved in dealing with these[22], it would be prudent and even necessary for the IAF to have its own cyber security personnel.

A dynamic cyber defence option would require highly skilled teams of experts continually working to identify weaknesses in the network, analysing the state and sophistication of attackers and, in turn, dynamically updating / upgrading the network to deny hostile elements access to it. The IAF could achieve this end through entering into contracts with the parties that designed the AFNET and IACCS. In addition, it could hire "ethical hackers" on a permanent basis. These "ethical hackers" could be tasked by the IAF to continually probe the IAF's network to identify potential weaknesses. Such identification of weaknesses should lead, in turn, to development of suitable patches to secure the potential weaknesses found. This latter option could be applied in parallel with the former for greater

22. Ibid.

redundancy. A purely defensive approach is unlikely to be adequate. Therefore, the IAF may need to develop Offensive Cyber Warfare (OCW) capability to supplement its Defensive Cyber Warfare (DCW) capability[23]. This OCW capability should comprise the ability to trace back the path of cyber attacks (from hacking, denial of access attacks to virus insertions) to their source and then counter attacking such sources, once identified, with "overwhelming, but precise, retaliation"[24]. Given the complexity of cyber attacks, this task of identification of the actual initial attacker itself would require very high end skills and capabilities as attackers routinely conceal their identity through the use of drone or hijacked computers and "false flag" Internet Protocol (IP) addresses to launch their attacks. Merely training regular IAF personnel by putting them through computer skills courses may not suffice in building up highly skilled manpower for OCW and DCW. The IAF may require inducting personnel who have both the aptitude for cyber technology and already possess advanced cyber skills as "cyber combatants"; such "cyber combatants" possibly forming a new branch in the IAF. Selection of personnel with basic language skills aligned towards the likely adversaries may be beneficial. For forces aligned towards China, suitable personnel from northeast India may be inducted at as early as school level and put through intensive Chinese language courses in parallel with advanced computer skills courses. Those who show the aptitude and skills required in language and computers could then be offered permanent commission in the IAF as "cyber combatants" for DCW and OCW tasks. Similarly, selection of specific people could be carried out for manning cyber forces aligned towards other potential adversaries. In this manner, a suitable Cyber Warfare (CW) capability specialised towards potential adversaries could be built up. The IAF would, thus, also be able to leverage the diversity in India's population to its advantage. CW personnel would require deployment at levels from the highest at Air HQ down to the field

23. "Air Force Details 6 Cyber Capabilities That Are Now Weapon Systems", http://fortunascorner.wordpress.com/2013/04/18/air-force-details-6-cyber-capabilities-that-are-now-weapon-systems/, accessed on January 29, 2014.
24. "Japan Develops Defensive Cyber Weapon Arsenal", http://www.techweekeurope.co.uk/news/japan-develops-defensive-cyberweapon-arsenal-52170, accessed on February 6, 2014.

The IAF must include a tie-in with the army and navy when planning its new inductions to ensure that the capability for joint operations is enhanced progressively leading to the ideal of seamless joint operation capabilities. The challenge arises in developing a model of jointness most suitable for India's current and future needs.

units to ensure total integrity of the AFNET, wideband wireless 3G mobile network, and IACCS. At Air HQ, Air Command and air base levels, CW personnel would interface with the cyber personnel of the army, navy and other government organisations [such as IN-CERT and National Technical Research Organisation (NTRO)[25]] involved in CW. At lower levels, CW personnel would need to interact with their counterparts in the other two Services and elements of the civil administration in their vicinity.

JOINT OPERATIONS

Joint Operations

Future wars are likely to require joint operations of a much greater magnitude than in the past. Therefore, the IAF must include a tie-in with the army and navy when planning its new inductions to ensure that the capability for joint operations is enhanced progressively leading to the ideal of seamless joint operation capabilities. The challenge arises in developing a model of jointness most suitable for India's current and future needs. The tendency to copy models developed by other armed forces for their own peculiar needs is strong but should be avoided with effort being expended towards developing a specific model suitable for India.

Examination of Models of Jointness

The need for change in India's current modes and methods for jointness is brought out most clearly by an assessment of the US' defence organisation post the Cold War by the renowned management and organisational

25. "NTRO: India's Technical Intelligence Agency", http://www.indiandefencereview.com/news/ntro-indias-technical-intelligence-agency/, accessed on January 31, 2014.

development guru Peter F Drucker. Peter Drucker wrote of the US Pentagon that each headquarters staff in the Pentagon, "*…the office of the secretary of defense (OSD), Joint Staff, service secretariats, and military staffs – is organized along traditional lines with manpower, intelligence, logistics and other functional activities. The input nature of defense budget categories reinforces this functional orientation. Although this structure provided the needed stability during the Cold War, it does not adjust well to new missions*[26]. Peter Drucker's assessment is relevant not only to the Pentagon but also to India's defence organisation which in many respects, when viewed in a macro manner, is arranged in a similar way as the Pentagon's organisation.

Drucker has written, "The Functional Principle…… has high stability but little adaptability. It perpetuates and develops technical and functional skills, that is, middle managers, but it resists new ideas and inhibits top-management development and vision."[27]

In order to determine the most suitable model of jointness for India, possible jointness models from other countries and put forth by thinkers who have written on the subject will be critically examined.

The first model is the "De-confliction Across Environments"[28] model. This model is characterised more by a lack of jointness than by jointness as here, three single Service campaigns are apparently planned and executed, with de-confliction being carried out in order to reduce mutual interference, rather than truly joint campaigns and plans aimed at achievement of synergy. The Indian armed forces have in the past mostly followed this model. The most outstanding example of success within this model is the 1971 Indo-Pak War on the eastern front. There were essentially single Service plans in force, with de-confliction carried out; early achievement of eastern war zone objectives of achieving total air superiority over East Pakistan and cooperative action taken at the tactical or field level (from dedicated air strikes to facilitate swifter army movement and deploying

26. Sam Nunn " Future Trends in Defense Organization" *JFQ,*/ Autumn 1996, pp.63-66.
27. Peter F. Drucker, "New Templates for Today's Organizations", in *Harvard Business Review on Management* (New York: Harper and Row, 1975), p.631.
28. Gen R.R. Henault "Jointness, Expeditionary Force Projection and Interoperability: The Parameters of the Future", paper provided as reading for DCDS Retreat, February 2003. http://dcds.mil.ca/other/retreat/pages/reading_e.asp, accessed on January 22, 2013.

"air-bridges" through the use of IAF helicopters to help the army overcome water obstacles) delivered outstanding success. While this model of "De-confliction Across Environments" has at times delivered a degree of success in specific circumstances, it remains an obsolete model, not worthy of being pursued further, as it does not strive for synergy and, hence, this model is discarded.

The "Joint HQ"[29] model is characterised by the top-down joint campaign planning, leading, in turn, to single Service planning. The Integrated Defence Staff (IDS) and Strategic Forces Command (SFC) in India could to an extent be said to be modelled on this concept of jointness. The same model appears to form the basis for the demands for a "Theatre Command" in some sections of India's armed forces. This model, however, though at first glance quite seductive, has major lacunae. There is a very real danger in this model of smothering of the core competencies of technologically intensive forces in the overall plan due to lack of knowledge of the intricacies of specific force utilisation, expert advisors notwithstanding. Group think becomes a very real danger in such a set-up. Moreover, in this plan, once the overall plan is decided, the individual planning is still left to the individual Services, thus, reverting to effectively single Service war plans with the required de-confliction. Hence, this model too, despite its vocal proponents, is felt to be eminently unsuitable for adoption by India's armed forces.

In the "Integrated Organisation"[30] model of jointness, a single organisation is formed by submerging the individual Services into an all encompassing combined defence force. There are no longer any individual Services but a combined defence force with branches such as the "air" branch, "maritime branch," etc. This model has most famously been actually tried out practically in Canada where the Royal Canadian Army (RCA), Royal Canadian Air Force (RCAF) and Royal Canadian Navy (RCN) were merged to form the Canadian Defence Forces (CDF) all in one common uniform and answering to a common hierarchical chain of command, much like personnel of different specialisations on an air base fall under the command of the same Air

29. Ibid.
30. Ibid.

Officer Commanding (AOC) in the IAF. Quite surprisingly, and contrary to expectations, it was found that the loss of individual Service culture and traditions led to a loss of domain specific core capabilities and competencies wherein soldiers and aviators who had earlier fought tenaciously for the pride and honour of their individual units and Services were found to have lost that intangible *josh* which is a vital ingredient of battle success in combat. Additionally, in the Gulf War of 1991, of all the participants in the US led "Coalition of the Willing," the CDF was found to suffer from a surprisingly excessive lack of jointness in comparison to the armed forces of nations that followed more 'obsolete' organisational models[31]. The Canadian experience clearly brings out that, especially in view of the rich traditions and history that our three military Services possess, the "Integrated Organisation" model of jointness is unsuitable to our environment. A further lesson is that blindly aping the more advanced nations in this matter could prove disastrous for us. Hence, we need to develop our own model or "Jointness with Indian Characteristics" as it were.

The Integrated Systems Model Moving Towards a Model of Jointness for India: In the ultimate analysis, jointness matters most at the sharp end in the actual battle where synergistic joint application of military power can totally overwhelm the enemy at minimum cost to friendly forces. However, for such a synergistic application of force to be achieved, it is essential that all arms of the military approach the problem together, critically and dispassionately examining the situation, desired aims, problems, own capabilities and limitations, and without any own Service jingoism, strive to develop a joint approach that can deliver synergy. This envisions true joint planning flowing backwards even to the weapon systems development and induction phases on to development of the war plan and its subsequent execution. The "Integrated Systems"[32] model of jointness addresses this need to quite an extent. This model envisages true interoperability among the equipment of the three Services with all personnel being delivered true transparency through compatible Operational Data-Link (ODL) systems so

31. Ibid.
32. n. 23.

that all combatants operate with full information of their own and other domains at all times, thus, optimising force utilisation in quantity as well as time and space. Such compatible equipment induced true transparency would deliver true networking down to the grassroots level, doing away with the traditionally mistrustful attitude towards sister Services. This model implies a truly joint approach towards national security, moving away from the earlier Service-centric and myopic set-up that focussed more on turf protection than actual jointness. Beyond the initial truly joint planning and, hence, total understanding of individual capabilities and limitations brought to the table by the individual Services, it is reasonable to expect that a synergistic joint plan would flow down to lower execution levels that are empowered to do this efficiently while continuing to enhance jointness through information empowerment across narrow Service boundaries. Thus, true jointness would be available in the actual battle space. This model requires, firstly, a coordinated system of systems approach to development and induction of new weapon systems as well as upgrades to currently deployed weapons. In new weapon development and induction, interoperability needs to take pride of place. This model has the potential to deliver true jointness in several disparate scenarios and, thus, should form the starting point in the development of the Indian model of jointness. This is especially relevant today as the three Services stand poised to upgrade currently in Service equipment and induct new equipment from both indigenous and foreign sources. The IAF's AFNET hosted IACCS aims to deliver such transparency down to the lowest levels, including at interfaces with army and naval forces. A further development of this system to encompass all surface forces as well as the IAF could lead to a base from which to go further in enhancing jointness.

The "integrated systems" model of jointness, due to its merits, should form the foundation of jointness for India's armed forces. Once this basic model has been implemented at the field level, on the basis of hands-on experience gained in the current scenarios of operation from Low Intensity Conflict (LIC) to anti-piracy, the model could be tweaked to fine-tune it further.

Resistance to this model is likely to emerge from an unlikely source – the lower and higher echelons of the current military and civil hierarchy. This is simply because this model empowers the actual combatants in the field through total transparency of the battlefield, beyond and across domains, and could potentially lead to two different situations. Firstly, commanders at the lower levels could be tempted to overstep their laid down boundaries in view of more information being available to them, thus, feeding resistance from higher command echelons; secondly, at the other end of the spectrum, commanders at higher levels could be tempted to micromanage events at lower levels due to more complete detailed information being available, thus, feeding resistance from lower level commanders. For maximum benefits to be derived from this model, field commanders must have the power to assess the situation and take decisions and implement these in a fast Observe, Orient, Decide and Act (OODA) loop for success. These field commanders would in essence be usurping a few limited powers and functions of current higher commanders up to general rank. This is a strength of this model and also its main weakness as it makes it vulnerable to attack from within. In this model, at the full implementation stage, the role of higher formations and headquarters may decline to the provision of resources, issuance of broad strategic directives, and supervision of the progress of operations. Within broadly set boundaries, the field level could have full operational freedom last witnessed when generals and commanders such as Alexander the Great and Chengiz Khan led from the very frontline of the battle. Alternatively in this model, higher commanders, who have access to more complete real-time information than ever before, could effectively direct even field operations through the use of the very comprehensive information on progress of activities at the field level now available to them through the integrated information technology system of the highly networked warfare enabled armed forces. This would represent a large step towards a matrix-like organisational structure for the armed forces. In this model, the hierarchical structure within each Service would still most likely be retained.

The IAF must work in concert with the other organs of state security to ensure that the most appropriate model of jointness for our situation is implemented effectively, while also building up the required capabilities for scenarios that require single force (aerospace force, land force or naval alone) missions.

It is opined that the "integrated systems" model of jointness, later leading on to a "heirarchical command, networked control and empowered field commanders" model of jointness would be able to address the jointness needs of the Indian armed forces for all envisaged scenarios [from LIC, conventional war and Out of Area Contingency Operations (OOACO)] in the foreseeable future. In this model, through availability of real-time and very complete fused information on the actual progress of all activities at the battlefront, the higher hierarchical command levels could exercise far more effective control on operations than they have hithertofore. A major advantage in this model is that unlike today, wherein if the higher commander controlling the operations is made ineffective or communications fail, and the operations suffer due to incomplete information at the field level, the availability of information at all levels would permit effective continuance of the battles till the higher commanders are effective again. It is opined that this basic model should be taken up by India for further development into an Indian model of jointness to deliver truly synergistic application of military power in the service of the nation.

In sum, the IAF must work in concert with the other organs of state security to ensure that the most appropriate model of jointness for our situation is implemented effectively, while also building up the required capabilities for scenarios that require single force (aerospace force, land force or naval alone[33]) missions.

The country's security apparatus must give due attention to futuristic models of jointness in order to develop a suitable model for India. After

33. Such single force missions could be precise delivery of weapons at large distances at short notice, physically securing ground positions, and "anti-piracy" patrols at sea to name three. In the foreseeable future, there is still likely to be need at times for single Service operations based upon specific circumstances. Hence, these capabilities should be retained.

adequate detailed study, the armed forces should commence their implementation of the developed / chosen model of jointness for the nation to remain secure from a military standpoint.

OPTIMAL UTILISATION OF RESOURCES

The IAF, being a technology intensive Service, requires investing in expensive equipment on a regular basis. Towards the end of the 1980s and in the early 1990s, as India was undergoing a major economic crisis, funds were unavailable for the purchase of new equipment. Subsequent to economic liberalisation and the faster growth of the economy, by the early part of the first decade of the 21st century, lack of funds was no longer an issue; while, at the same time, the earlier reluctance of a few Western nations to export technology to India reduced. With funds not an issue, the IAF embarked upon a re-equipment plan to overcome the obsolescence forced on it during the lean period (early to mid-1990s). New fighters, force multipliers, etc were inducted from various sources, while also upgrading some types of aircraft. Most of these purchases have come from foreign sources. The issue of possible sanctions adversely affecting force availability has been discussed earlier as has the need to control and own one's technology. These issues apart, import of equipment, even with licensed manufacture, at best, looks after immediate needs. Licensed manufacture brings "knowhow" (basically screwdriver level, building to foreign blueprints with foreign tooling, etc without knowing the reasoning and theory behind all that is being done) level technology. Replacement then requires foreign involvement again. Each time the equipment is replaced or upgraded, there is significant foreign exchange outflow. At times, availability of specific technology may be restricted by the technology exporters. A more cost effective albeit slower process could be to invest in a planned manner in developing indigenous

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design and manufacture capabilities. In the short term, this is likely to lead to delays and development of equipment that falls below global specifications. However, in the long-term, it should lead to equipment equal to, or exceeding, globally available equipment (especially as it can be specifically tailored to local conditions from the word go). The money spent on such indigenous equipment, would, in the long-term, contribute to the economy and, hence, to the nation's power as it stays within the country and does not go abroad. The section on technology earlier in the paper suggests a path towards this end.

A small point here on costs. It is often brought out that making, say, a Jaguar aircraft in India costs more than the same product bought from British Aerospace, the Original Equipment Manufacturer (OEM). This, as we are seeing in press releases on the current MMRCA deal and in discussions on the offsets clause of the current Defence Procurement Policy (DPP) is primarily because the foreign supplier compensates himself for his losses in manufacturing due to licensed production or offsets by increasing the costs of critical parts that may still be imported for the locally built aircraft or by increasing the final contract price by an amount sufficient to recover these losses[34]. For instance, until its production line was shut down, the MiG-21, built in different variants in India since 1967, and till the very end even aircraft "built from raw materials" locally by HAL incorporated a few critical parts directly imported from the Soviet Union[35]. The supplier naturally recovered some of his losses through very high prices for these parts. Stories about spare parts priced close to the current bullion rates surface from time to time in the open press. Only through indigenous design and complete manufacturing can a nation free itself from such external constraints and exploitation. This, in turn, can be achieved best through the facilitation of the growth of a viable aircraft sub-components ancillary industry to support large public and private sector full system integrators in the domestic aviation field.

34. "Offsets of Foreign Military Sales, FMS Offsets And Other Issues Affecting FMS Procurements Frequently Asked Questions (FAQs)", http://www.acq.osd.mil/dpap/cpic/ic/offsets_of_foreign_military_sales.html, accessed on January 23, 2014.
35. Discussion with Gp. Capt. S Chenna Keshu (Retd), formerly managing director of HAL's Bangalore Complex, in July 2008, at his residence in Bangalore.

Resources, if utilised in this manner domestically, after a period of some amount of pain caused by teething troubles in the challenges in design, development and procurement, could lead to better utilisation of the available resources.

ACCEPTABLE ORGANISATIONAL VALUES

The IAF necessarily draws its personnel from the Indian population. While military socialisation has always endeavoured to insulate military personnel from the ills affecting civil society[36], over time, some leakage into the military of the ills prevalent in civil society is only to be expected. There is need to ensure that seepage of undesirable activities does not take place in the IAF. The IAF needs to include a strict code of conduct while socialising its recruits from the initial induction stage itself. Such socialisation could include a set of hard and fast "Acceptable Organisation Values" that all entrants must understand fully and live by at all times. Such a code of conduct must be imbibed by new entrants through the example of their seniors. Such a code of values could be modelled on the Honour Code system used by the US Marine Corps. Such a system could emphasise that each and every air warrior is a warrior first and member of his branch, etc later. It may be driven home through instruction and example that air warriors do not "free-load" ever. A policy of "zero tolerance" to moral turpitude could be promulgated and enforced mercilessly. Here it will be the example of seniors which will carry more weight than just slogans, songs, statements, lists and orders. From the basics of human behaviour, it is well known that subordinates in all walks of life will do as the leaders do and not as they say[37]. Initial steps in this direction have already been taken. These require to be followed through fully.

36. Maj R. B. McKittrick, "An Analysis of Organizational Socialization in the Marine Corps", http://www.globalsecurity.org/military/library/report/1984/MRB.htm, accessed on January 23, 2014.
37. Kenneth E Lloyd, "Do as I Say, Not as I Do", *New Zealand Psychologist*, vol. 9, no. 1, May 1, 1980, pp. 1-8.

CONCLUSION

The IAF will complete a century of existence in 2032. It faces several internal challenges in the years till 2032. These include technology ownership and indigenous aerospace equipment development, cyber security, joint operations and inculcation of acceptable organisational values. Through innovative changes to the way the IAF is structured and deploys its resources, both equipment and manpower, it can successfully meet these challenges and increase its capabilities, in turn, leading to a greatly enhanced air power capability for the nation. Through interaction with other stakeholders, it can also contribute towards development of a suitable model of jointness for India to enable synergistic application of military power, if and when required.