AIR POWER

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Air Chief Marshal **Fali Homi Major** PVSM, AVSM, SC, VM ADC, Chief of the Air Staff, IAF, in his Special Address titled **Regional Imperatives for Change in the Employment of Aerospace Power** at the Centre for Air Power Studies, New Delhi, on May 22, 2009, emphasised that we will have to continue to maintain a credible conventional war-fighting capability that remains capable of dominating the conduct of operations. This is absolutely essential, because it is only credible and demonstrable capability which will ensure stability in our region. There is simply no alternative to the maintenance of a strong and capable air force, despite the knowledge that it may rarely be used in its classical role. But he believes that this is the premium we will have to pay. The Air Force, therefore, is faced with an unenviable paradox, where, on the one hand, we cannot afford to let our conventional guard down, while, on the other, we will probably face an increased frequency of sub-conventional conflict situations.

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India's Tibet Problem has existed from the very beginning when China invaded and occupied it in 1950. Over the decades, it has not been able to

assimilate the Tibetans into the Chinese polity primarily since Chinese institutions and political systems are not geared for allowing space for regional cultures and religions. **Prem Shankar Jha** has argued in his lecture that the disturbances in Tibet last year once again highlight this problem and this is already leading to greater Chinese assertiveness and hard line toward India. Given the outstanding territorial disputes and the broader divergence of interests and grand strategy values of the two rising powers, New Delhi would have to carefully nuance its policies and posture while maintaining sufficient capacity to take care of any adverse changes in China's policies.

In this seminal essay, Lt. Col. **R. Ghose** argues, based on facts, that the People's Liberation Army Air Force (PLAAF) has made impressive progress towards comprehensive force modernisation, and it may require an additional 10-15 years before the process is complete. Several obstacles stand in the way. The most visible impediments are hardware deficiencies and significant shortfalls in key weapon systems essential in offensive air operations. He believes that development of new operational concepts and doctrine are faced with the PLAAF's lack of recent combat experience though significant changes are underway in the training programmes.

Commodore **S. Sammadar**, IN, believes that no country can become an influential power in regional or global politics unless it manufactures its own armaments in its own arsenal. Force modernisation, he believes, must recognise this important parameter and steps must be taken to energise domestic defence industry through various means. The present era, he believes, is full of opportunities for the

modernisation of India's armed forces that must, together, formulate a plan that seeks specific investments with governmental support for procuring evolutionary systems to meet near term contingencies and also provide for generation-after-next systems that would catapult India into a major manufacturing base for defence products in the long term.

The Information Technology Revolution has been impacting strongly on how wars are to be fought in the future. Wing Commander **Sanjay Poduval** argues that the wars of tomorrow will increasingly be fought in cyberspace. Thus, intelligence services will need an increasing proportion of tech-savvy talent to track, target and defend against adversaries' IT capabilities. Since cyber wars will be played out on landscapes of commercial IT, intelligence agencies will need new alliances with the private sector, akin to existing relationships between nation states and will have to confront awkward problems such as performing intelligence preparation of cyber battlefields; assessing the capabilities and intentions of adversaries whose info-weapons and defences are invisible; deciding whether there is any distinction between cyber defence and cyber intelligence; and determining who in the national security establishment should perform functions that straddle the offensive, defensive and intelligence missions of the uniformed Services and intelligence agencies.

The use of commercial best practices, competitive sourcing and partnering, combined with a decreased in-theatre logistics footprint and infrastructure, reduced inventory and reduced numbers of maintenance personnel are all part of the strategy for focussed and dynamic logistics, as per Group Captain **J.V. Singh**. He believes that

not only would it remove the financial drain of underutilised assets, but a properly constructed and tested 'focussed' supply chain should ensure the right war-fighting assets are in the right place at the right time and in the right amount. The Indian Ministry of Defence (MoD) has not stated that they will adopt 'focussed Logistics' as such, and will have to implement a number of changes before they will have the capability to support such a system.

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Air Marshal **Vinod Patney** concludes that the significance and essentiality of securing aerospace domination are all too obvious. Aerospace domination that must include cyber space may not be readily achieved if the adversaries are well matched. Under these circumstances, the domination will have to be fought for with the aim of securing the highest degree of domination that is feasible commensurate with the military requirements. Like any capability, there are costs involved. There will also be many limitations but aerospace domination is a laudable objective; the degree to which it can be achieved will be a function of the respective hardware, training and planning. A strategy enunciation is the first step.

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There is no doubt about the inescapable requirement for air dominance in conventional warfare at the higher end of the spectrum of warfare. What Air Commodore **Arjun Subramaniam** is concerned about is the absence of adequate debate on the need for air dominance even at the lower end of the spectrum of warfare. Continued focus on building conventional air power assets for high intensity conflict is essential for democracies and large militaries to protect interests, influence geo-politics and retain certain coercive and deterrent capabilities. However, unless these assets are employable and employed across the

spectrum of warfare and more so in the realm of Information Warfare (IW) or 4th Generation (4G) Warfare, it is going to become increasingly difficult for air forces to cope with the emerging challenges of the 21st century.

EDITOR'S NOTE

Almost six decades have elapsed since China marched its armies into Tibet and occupied it by force of arms. This altered the basic dynamics of Indian security since the border with a friendly land-locked neighbour suddenly turned into one with a revisionist power rather fond of military interventions in neighbouring states. The 1954 China-India agreement, commonly referred to as the Panchsheel Agreement defining five principles of peaceful coexistence diplomatically committed China to the basic norms and principles of the UN Charter while it remained outside the international organisation. With this agreement, New Delhi had sought to encourage China to adopt policies of cooperative peace. The agreement also committed China to respect Tibetan culture, religion and socio-political structures and norms. The boundaries marked on Chinese maps included large parts of India's Himalayan territory. Prime Minister Zhou en-Lai's answer to Nehru's question was that these were "imperialist" maps and would be soon rectified. Unfortunately, China, at the same time, clandestinely built a road across the Aksai China plateau, making cooperative peace that much more difficult.

Within a decade, it had to contend with an uprising of the Tibetans which resulted in great violence and the Chinese government putting it

down with massive force (of which the Tiananmen incidents in 1989 in Beijing were a minor occurrence). The Dalai Lama fled to India, along with a large number of refugees, in March 1959 and India gave them asylum. Nearly 200,000 Tibetans are in India, settled mostly in the Himalayan regions. It is in this context that Prem Shankar Jha, a leading political-strategic observer and journalist in India, has argued, while delivering the Air Chief Marshal P.C. Lal Memorial Lecture in March this year, that China's failure to assimilate the Tibetans and attempts to change their culture and demographic changes of Tibet have failed. Hence, the disturbances in Tibet since last year and Beijing's assertive attitude toward India have to be seen as a potential source of future conflict in spite apparently good relations between the two countries. China's attitude at the Nuclear Suppliers Group (NSG) regarding their waiver for India to access nuclear fuel for power reactors last year, and now in opposing the banning of Pakistani terrorist organisations have to be seen as part of the assertive diplomacy. As far as our policy options are concerned, we need to continue to seek good relations with China. However, we also need to be fully prepared for any reversal in relations, and defence for ourselves. That is why an inordinately large unplanned drop in the Indian Air Force (IAF) combat force level is the type of occurrence that should never have been allowed to happen and must be reversed at the earliest.

We also need to re-visit the events that led to the Sino-Indian War of 1962. The Marshal of the IAF Arjan Singh, DFC, who led the Air Force to an unequivocal victory over the Pakistan Air Force even with nearly half of his combat force tied down in the east for possible Chinese intervention, in his recently published biography, is categorical that we were not defeated by the Chinese Army, but we failed to fight in 1962. Experts in the IAF, serving and retired, are closely looking at ways and means to ensure air dominance against any adversary. This also implies that our procurements of weapons and systems must also match the doctrine as it is evolving for

credible affordable defence in the future. And in so doing, we need to be fully conscious that, unlike the wars waged by the Western powers in the past two decades in which they did not encounter and hostile air power, what we face is rapid and extensive modernisation of air forces on two fronts.

EMPLOYMENT OF AEROSPACE POWER: REGIONAL IMPERATIVES FOR CHANGE

FALI HOMI MAJOR

INTRODUCTION

Marshal of the Air Force Arjan Singh, Air Chief Marshal Mehra, Air Commodore Jasjit Singh, Director, Centre for Air Power Studies; eminent Air Warriors; Ladies and Gentlemen. As always, it is a great pleasure to stand in front of such a distinguished and learned audience and share a few of my thoughts on the "**Regional Imperatives for Change in the Employment of Aerospace Power**".

There has been a dramatic shift in the manner in which conflict is being waged all over the world and especially in our region. Trained and well equipped, faceless transnational actors wage war against unarmed civilians in high visibility locations, with the singular objective of inspiring terror and disrupting normal life.

Neighbours remain not-so-friendly, and do not miss an opportunity to score, whenever we are seen to let our guard down. It is, therefore, very essential for us to carefully analyse the developing trends and take a cold, hard, practical

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look at the emerging environment. We must then reevaluate our options, so that we can create the required set of capabilities, in consonance with existing realities. The Indian Air Force (IAF), is after all, the ultimate instrument of aerospace power, and, therefore, its structure and capability must accurately reflect the prevalent circumstances.

That is why this is a particularly relevant topic to discuss. The magnitude of the problem demands that we shake off our existing mindsets and contemplate on the future shape and role of the Indian Air Force.

REGIONAL PECULIARITIES

Firstly, the many peculiarities of our region. Contemporary rhetoric the world over would seem to suggest that the concept of the nation-state as we know it today, is to be a thing of the past and that economic and social reconstruction would soon make geographical boundaries irrelevant. The example of the European Union and some others is often quoted in this context.

Whilst I do recognise that the manner and mode of intercourse between nations has definitely changed over the years, I do not really feel that it is indicative of the way things will be in our subcontinent.

We have our own set of idiosyncrasies, and notwithstanding the changes elsewhere, our region in the foreseeable future will continue to be associated with a strong feeling of nationalism, almost akin to tribal loyalties, with the associated inviolability of territories, borders and even reputations. The depth of sentiment and fierceness of emotional response, while seemingly irrational, is, in fact, the cold truth of our region.

But would such an environment result in conventional conflict? My reading is that such a development seems highly unlikely. There are a number of factors that in my view, preclude such an event. The first is that nations no longer go for large scale massed wars any more. The costs—economic, social, human and otherwise—are simply prohibitive. Victory, if any, can rarely be decisive since the victor is also hurt in equal measure. I know that similar sentiments were echoed after World War I, but massed conventional armies with large scale mobilisation, slugging it out face-to-face, does seem a bit

unlikely in today's context. On the contrary, I think that if ever there is a state sanctioned conflict in the future, it would be localised in time and space, with limited objectives.

The possession of nuclear weapons in our region also manifests itself in many peculiar ways. It creates a paradox wherein the weaker nation begins to carry out small scale activities against the stronger nation. It does so emboldened by the belief that the stronger nation would hesitate to initiate a response, apprehensive of possible escalation. Post-1971, you would recall that there was a long spell of relative peace and it was only after the covert nuclear tests at Lop Nor in China and Chagai in 1998, that Pakistan was emboldened enough to indulge in sub-conventional and low intensity adventurism against India.

Dealing with such events now requires military intervention and even the application of precise and overwhelming force. Consider the events over the past few years. Kargil, Kaluchak, the attack on our Parliament and, more recently, in Mumbai. Also recall the organisation and scale of effort that the Liberation Tigers of Tamil Eelam (LTTE) could muster. We must also consider and acknowledge the cancerous spread of Naxalism and its consequent effect on our sovereignty. The number of such challenges only seems to be increasing.

ROLE OF THE IAF

The question now emerges as to what role the Indian Air Force would play in the future. As it appears, we will have to continue to maintain a credible conventional war-fighting capability that remains capable of dominating the conduct of operations. This is absolutely essential, because it is only credible and demonstrable capability which will ensure stability in our region. There is simply no alternative in the maintenance of a strong and capable air force, despite the knowledge that it may rarely be used in its classical role. But that is the premium we will have to pay.

The Indian Air Force, therefore, is faced with an unenviable paradox, where, on the one hand, we cannot afford to let our conventional guard down

while, on the other hand, we will probably face an increased frequency of sub-conventional situations.

The IAF recognises this paradigm shift and as a first step, it has already shifted its focus from being adversary-centric to become a capability-based force. The basic premise is to develop a set of capabilities that in various combinations, can be used to address most conflict situations.

Our present plans are focussed towards dealing with threat scenarios, as conventionally envisaged. We rarely plan or cater to sub-conventional contingencies, except as an aside. Any emergent situation is usually dealt with as a crisis, and the best possible course of action with the available assets is employed. It is this aspect that needs a change.

The task before us, therefore, is to develop specific capabilities that allow us to deal with low intensity and sub-conventional conflict situations. This requires us to change our mindsets and the way we have viewed things till now. We need to recognise the new order of priorities and create capabilities accordingly.

To begin with, aerospace power already has an advantage. Most of our modern combat assets have multi-role capability and can be used in a multitude of roles. The inherent potential, therefore, exists, but we specifically have to acquire the requisite systems, weapons and expertise to develop capabilities in this field. To achieve this desired end-state, we will have to take a look at our acquisition plans, training, allocation of resources and development of doctrines so as to effect a change in the prevalent mindset. This effort has commenced, but will take a while to fine-tune and be viable.

In the light of the fact that we now consider sub-conventional scenarios to be as important as conventional threats, our planning and resource allocation will have to be equally meticulous. The kind of response that we seek to develop is akin to that of our air defence system reacting to an air space violation.

The response to a sub-conventional situation will obviously involve many different agencies, and, therefore, the operation will have to be "joint". We must develop the capability to plug into the local command and control set-

up and participate *ab-initio* in the formulation of the operational plan. On our part, we will have to put in place a robust and responsive command and control structure, that enables the Air Component Commander to requisition and employ the required air assets in a manner as thought operationally appropriate.

As can be visualised, such a scenario requires an entirely different set of equipment, training and Standard Operating Procedures (SOPs). The equipment list would perhaps include airborne command posts, inter-operable communications, Unmanned Aerial Vehicles (UAVs), helicopters, appropriate weapons for urban terrain, night capability, intrusive surveillance and any other required asset. Surveillance and intelligence gathering would be the primary objectives and, therefore, specialist equipment, that is able to penetrate and provide data and analysis in urban and difficult terrains is to be procured.

It is obvious that neutralising the terrorists without any form of collateral damage will be a challenge. The limitations of ground forces could be offset by intelligent use of air power. This will, however, require us to employ a very different class of weapons. We will need low-yield, directed-energy weapons, capable of precise targeting and controlled destruction. We will have to explore the possibilities of acquiring non-kinetic and non-lethal weapon systems. Acquisition of such weapons, their consequent mating to the delivery platforms, and training are the essential next steps.

The conduct of such an operation will require very robust SOPs and a well rehearsed organisational structure. This calls for realistic inter-agency training and coordination, alongside knowledge and competence in the application of aerospace power in sub-conventional scenarios. Flexibility and quick decision-making will hold the key to the success of operations. Therefore, this aspect will have to take the highest priority in all our considerations.

We will have to become leaner, flexible and comprehensively networked. It is only then that a quick and effective response can be provided. It also implies that we will no longer have the luxury of time for building up forces or positioning of stores and material, as we have done in the past. We will

have to find more efficient ways to facilitate this approach.

I also foresee that we will have to develop some kind of a composite group with expeditionary capability. Not that we have any designs on other territories, but this capability is essential to cater for the vastness of our territory. With most of our combat assets concentrated solely on our western and northeastern borders, it is sometimes difficult to marshal the requisite assets to mount an immediate response.

Let me elaborate. Sub-conventional situations, like I mentioned earlier, will require the comprehensive application of all components of aerospace power. Aerospace power can be effective only when utilised properly. If used randomly, in bits and pieces, it can be grossly inefficient. Therefore, we need to possess the potential wherein, at very short notice, we can transport an all inclusive combination of assets, command and control infrastructure, and trained operators to the required location, in a state of readiness, so that we can hit the ground running. We should not have to waste time and effort, in the allocation of assets, coordinating moves and putting them together. I wish to reemphasise that we will not have the luxury of time, and windows of opportunity will be extremely limited. Our effectiveness in the future will be determined by the speed of our response and if it is not timely, we stand the danger of being ineffective.

SUMMARY

Till now, I have only spoken about the role of aerospace power in responding to this form of conflict. But I do not even for a moment claim that the IAF will be able to operate alone. Effective capability will emerge from implementing a three-pronged approach. The first and the most important is at the strategic level. We need to incorporate joint planning, coordination and synergy among all national agencies, so as to create a comprehensive and effective response.

At the operational level, we must acquire the appropriate wherewithal, and create a viable mechanism to wage such an operation.

And, lastly, at the tactical level, we must train and develop the requisite in-house expertise, so as to translate this capability into action. In the future, I

visualise a more assertive role for the IAF, using the capabilities of aerospace power to address this form of conflict.

Therefore, our aspirations to be a globally strategic force will have to accommodate the compulsions of our regional imperatives. Budgets, as always, will be tight and resources scarce. Considering the very wide diversity of demands and the intense competition for resources, carrying out a balancing act will be a very complicated proposition. But priorities will have to be redefined and some hard decisions taken at all levels.

There is no doubt in my mind that the IAF will incorporate and assimilate these changes and continue to remain on top. Many steps to do just that have already been taken. In my 42-odd years in this Service, I have seen the Indian Air Force change a great deal indeed. From a small, tactical force, with very limited assets, it has grown into the formidable and capable Air Force of today. Many of you here today, in this audience, have been a part of this growth, and we acknowledge the vision, courage and pioneering efforts of our predecessors.

CONCLUSION

Today, circumstances have indeed changed and many compulsions and variables dictate the complex interactions between nations. Our security environment has taken on a different complexion altogether, posing new and different forms of threat. Recognising these developments and preparing for them well in time, is of the essence.

It was in this context that I felt it appropriate to highlight the changing nature of our security environment and the steps the IAF needs to take in order to provide the requisite set of response options to our national leadership. The most important factor for us is the recognition of the problem and reshaping our perceptions; the rest will automatically fall in place.

In the end, I thank you for this opportunity. The Centre for Air Power Studies (CAPS) has indeed evolved into a highly respected think-tank, furthering the understanding of the concepts of aerospace power. I compliment

Air Commodore Jasjit Singh, AVM Kapil Kak and the many other stalwarts, for their sterling work over the years.

Lastly, it is my proud privilege to have served in the IAF for more than four decades. It has been a very exciting and eventful career and as I get ready to hang up my uniform in a few days from now, I want to tell you that it has been a great journey. God speed and best wishes to all of you in the CAPS fraternity.

JAI HIND!

INDIA'S TIBET PROBLEM

PREM SHANKAR JHA

The terrorist attack on Mumbai, and the growing internal crisis in Pakistan have pushed Sino-Indian relations off the radar screen of Indian concerns. But to leave it there would be extremely short-sighted. For only nine days before 26/11, Sino-Indian relations had deteriorated to the point where another border conflict looked distinctly possible. This is not a conflict that either country wants. But it could lie at the end of the road on which both are travelling today. Were it to occur, it would not be over the border between the two countries in the Himalayas, but over Tibet. When we talk of our border problem with China, we confuse effect with cause. The hardening of China's stand on the border since 2006, and its reiteration of claims to the whole of Arunachal Pradesh, can be traced to its growing problems in Tibet and its increasing tendency to blame India for them.

But does China have a problem in Tibet?

If we are to believe writers like N.Ram of *The Hindu*, it does not. According to him, this is a concoction of the reactionary, autocratic and oppressive clique that surrounds the Dalai Lama , to whom the Indian government is mistakenly giving shelter . China has liberated Tibetans from their serfdom, modernised, and educated them. Tibet has infrastructure that we in Delhi would envy. Only a fringe group of revanchists whose

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* Shri **Prem Shankar Jha** is a leading journalist and author. This is the text of the "Air Chief Marshal P.C. Lal Memorial Lecture delivered by him on Marsh 30, 2009, at the Air Force Station, Subroto Park, New Delhi.

China's actions belie its words. If the Dalai Lama is no threat to the Chinese in Tibet, why did Beijing react so sharply to the uprising in March last year?

hold on power has been eroded is claiming otherwise.

But China's actions belie its words. If the Dalai Lama is no threat to the Chinese in Tibet, why did Beijing react so sharply to the uprising in March last year? Why did it take out its anger on India? And why did it blanket not only the Tibet Autonomous Region (TAR) but adjoining areas of China with troops and riot police a full three weeks before the 50th anniversary of the Dalai Lama's flight to India?

Clearly , there is something that is worrying the Chinese deeply. Pretending it does not exist will not make it go away.

The fact is that China has always resented India's decision to shelter the Dalai Lama in 1959. Its leaders have never forgotten that the present Dalai Lama's predecessor, the 13th, had fled to India when the Manchus invaded Tibet and established a garrison in Lhasa in 1909, but had returned three years later to drive the Chinese Army not only out of present day Tibet but all the way across the Mekong river.

That victory enabled him and the present Dalai Lama to declare Tibet independent, sign a treaty with Mongolia, initial another with the British, and govern Tibet as an independent country for the next 37 years. It also put a severe dent into China's claim to Tibet on the grounds that it had ruled it continuously for 700 years. None of this would have been possible if India had not been conveniently close by. So when the 14th Dalai Lama also fled to India in 1959, China's leaders began to wonder if history was not in danger of repeating itself.

The Sino-India border war in 1962 was at least partially an outcome of their anxiety. It was intended to cut India down to size and minimise its capacity to act as a rallying point for pro-Tibet sentiment across the world. In this, it was spectacularly successful. China–India comparisons stopped after 1962. Only in 1988, after 26 years of non-communication did India succeed in convincing China that it had no intention of challenging its claim to Tibet and would

not allow its territory to be used as a base for insurgency in that region. On the Chinese side, the thaw was facilitated by the confidence that the country's bounding growth instilled in its rulers. This made them confident that modern education, rapid economic growth, and rising incomes would enable them to assimilate the Tibetan people into the Chinese mainstream over the course of time..

The March riots forced the Chinese authorities to face two unpalatable facts: that their policy of assimilation had not so far succeeded and that Tibetan disaffection was not confined to the TAR but was spread over a far larger part of China.

ERUPTION OF VIOLENCE

This is the belief that was rudely shaken when first Lhasa, and then towns in three other provinces saw a sudden eruption of unrest that amounted virtually to a mini-insurrection in March last year. Violence broke out on March 14, 2008, in Lhasa when the police tried to break up a demonstration by about 400 Tibetans who were protesting against the government's decision not to allow monks to stage a march four days earlier on the 49th anniversary of the Dalai Lama's flight to India. In the ensuing disorder, the police opened fire and reportedly killed two Tibetans. The crowd vented its anger on the property and persons of ethnic Chinese who had settled in Lhasa. According to the Chinese authorities, this led to 18 civilian deaths, mostly of Chinese settlers, In the ensuing days, the disturbance spread to towns and monasteries outside the Tibetan Autonomous Region, into Gansu, Sichuan and Yunnan, all parts of what the Dalai Lama has consistently described as Greater Tibet. In all, the Chinese authorities claim that they arrested 1,315 persons. The Dalai Lama's people, however, have a very different tally. According to them, the Chinese security forces killed 220 Tibetans, injured 1,300 and detained nearly 7,000.[1]

The March riots forced the Chinese authorities to face two unpalatable facts: that their policy of assimilation had not so far succeeded and that Tibetan disaffection was not confined to the TAR but was spread over a far larger part

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1. "The Dalai Lama Speaks out in a Blistering Speech," *International Herald Tribune*, March 11, 2009, p.1 (India edition).

But its anger with India stems from a deeper cause. This is its fear that its policy of assimilation is failing because India has enabled the Tibetans to keep their culture, religion, and state structure alive.

of China. This set off a furious hunt for causes that inevitably degenerated into a search for someone to blame.

India was immediately elected. Beijing blamed what it called the "Dalai clique" for launching a carefully planned plot to discredit China before the Olympic Games. It published a detailed account of how this had been hatched during meetings in Brussels, New Delhi and Dharamsala over the previous ten months. It claimed that seven India-based and international Tibetan organisations had met in Delhi in January 2008 and issued a "Declaration of Tibetan People's Uprising Movement" in which they had claimed that China and Tibet were two different countries. This, to Beijing, was clinching proof that while the Dalai Lama spoke of autonomy within China, what he was after was the vivisection of China to create an independent state.

But its anger with India stems from a deeper cause. This is its fear that its policy of assimilation is failing because India has enabled the Tibetans to keep their culture, religion, and state structure alive. From this, it is only a short step to regarding the Tibetan presence in India , and Dharamsala in particular, as an existential threat to China.

The desire to blame India is sharpened by an awareness that has been growing within the Chinese Communist Party ever since it carried out a detailed survey of Party-People relations in 2000, that rapid growth is not leading to greater social harmony in China, but its exact opposite. The number of mass protests, in which groups of peasants or workers have actually confronted the state after exhausting all other avenues for gaining redress, has grown exponentially after 1993. In 2006, President Hu Jintao admitted that this had become a critically important issue, and announced a radical shift of emphasis from growth to social harmony. By then, the number of protests had grown ten-fold and the number of people involved by sixty

times. The unrest in Tibet has, therefore, added a new ethnic dimension to a problem that already had the Chinese state deeply worried.

Yet another cause of Beijing's anger with India is its changed perception of the Tibetan autonomy movement. In the past two decades, this has undergone a transformation that no one could have foreseen even as recently as a decade and a half ago. The spread of the mobile telephony and

The Tibetan nationalist community is no longer just a group of refugees who sought shelter from Chinese oppression in India and other countries.

internet across the world and across China has enabled Tibetans-in-exile to establish and maintain continuous contact with Tibetans within China. It has also linked up Tibetans living all around the world. This has eroded the capacity of the Chinese state, as indeed other states, to manage discontent by isolating the discontented from each other. On the contrary, the Tibetan nationalist community is no longer just a group of refugees who sought shelter from Chinese oppression in India and other countries, and would like nothing better than to find a political arrangement with Beijing that would enable them to return and live in peace. It has instead become a new kind of nation – a nation without a geographical territory – but one that is capable of raising awareness and coordinating action across international boundaries. Tibet , in short, is slowly emerging as a a 'virtual' nation – perhaps the first of the internet age – with Dharamsala as the seat of its 'virtual' government.

China also fears that this virtual government - in- the- making is slowly passing into the hands of younger people who feel fewer inhibitions against resorting to violence than their elders. Beijing's information from Dharamsala showed that three of the seven organisations were youth and women's organisations and a fourth was an organisation formed by former prisoners of the Chinese authorities. This was a clear sign of how far power had shifted away from the traditional leaders. Beijing's anger with India stemmed from the sanctuary that it was providing to these newer, more violence prone organisations.

The Dalai Lama has steadfastly maintained that autonomy needs to be granted not to present day Tibet (TAR) but to Greater Tibet.

This accounts for the sudden eruption of anti-Indian rhetoric on Chinese internet sites immediately after the March 2008 riots. While officially Beijing maintained a freezing politeness towards New Delhi, it gave full rein to semi-official and non-official websites to vent their wrath. But the anger was a mask for its growing consternation. Faced with a movement that was becoming more international, more integrated and more determined to push for independence, but unable to concede that its own failure to assimilate the Tibetans might be responsible, it had elected India to be its scapegoat.

BEIJING IS NOT WHOLLY TO BLAME

Although it has produced no concrete evidence of the Dalai Lama's involvement in the so-called March 10 plot, Beijing cannot be blamed for being deeply suspicious of his intentions. Although the Dalai Lama has steadfastly maintained that he wants only autonomy within China, two elements of his demand make the Chinese suspect that he is not sincere. The first is that through eight rounds of talks from 2002 till November 2008, the Dalai Lama has steadfastly maintained that autonomy needs to be granted not to present day Tibet (TAR) but to Greater Tibet. This includes the TAR, the whole of Qinghai, the southern part of Gansu Province, the western part of Sichuan Province and the northwestern part of Yunnan Province. In all, this makes up about a quarter of China's territory.

To do this, he proposes the separation of the Tibetan dominated areas from the provinces to which they presently belong, and their unification with the TAR to create a "single autonomous administrative unit."

The second key element of his proposal is "the right of Tibetans to create their own regional government and government institutions, and processes that are best suited to their needs and characteristics."

CONTENTS OF GENUINE AUTONOMY

The Dalai Lama wants the administration, thus, created to be responsible for eleven subjects that will include not just language , religion, culture and education, but also protection of the environment, the utilisation of natural resources, economic development, trade and public health.

New Delhi seems singularly unaware of the peril into which it is being dragged by the changing equation between Beijing and the Dalai Lama.

The Dalai Lama's proposal may only be a wish list or an initial bargaining position designed to start a negotiation, and not a declaration of what he would be prepared to settle for. But it contains two poison pills that Beijing finds impossible to swallow. The first is the need to redraw the boundaries of four provinces. The second is the creation of a second political system within the same country, in which power does not flow down from the state to the people but flows up from the people to the state. It is very doubtful whether any government in the world would be able to make such wrenching changes in its Constitution, except over a considerable period of time. But it is all the less feasible for the Chinese state, which embodies not only the totalitarian traditions of Communism but also the absolutist traditions of the Confucian state that preceded it. Beijing cannot believe that the Dalai Lama can be so naïve. So it has concluded that he is devious, and that his demand for genuine autonomy is only the thin end of the wedge in a push for eventual independence.

INDIA ASLEEP

New Delhi seems singularly unaware of the peril into which it is being dragged by the changing equation between Beijing and the Dalai Lama. It has been dismayed by the rapid deterioration of its relations with China in the past two years, but is at a loss to understand why this is happening. For 12 years, after Prime Minister Narasimha Rao signed an Agreement on Peace and Tranquillity in the Border Regions in 1993, New Delhi firmly believed that the border dispute would die out as economic interdependence developed between the two countries. This belief became stronger when China dropped claims to Sikkim.

Beijing, however, regards them as a well-knit insurgent group based in India, that skilfully mobilises international sympathy and uses the internet to reach Tibetans within China, to foment an insurgency.

So there was consternation when, on the eve of President Hu Jintao's visit to India in 2006, the Chinese Ambassador in Delhi asserted China's claim to Arunachal Pradesh. New Delhi's first reaction was the predictable one of denial: it dismissed the Ambassador's statement as an expression of his personal views and a diplomatic gaffe. It only realised that the remark had been made in deadly earnest when Beijing began to go back on tacit agreements arrived at during the previous round of talks on the demarcation of the Line of Actual Control in the Himalayas, began an aggressive patrolling of its definition of the line in the following year, and refused a visa to an official serving in the Arunachal Pradesh government who was to visit China as part of an official Indian delegation.

New Delhi's failure to link this change with China's growing problems in Tibet arises from the vast asymmetry in the importance China and India attach to Tibet. To India, the Tibetans-in-exile remain refugees who sought political asylum, and have now only to be discouraged from taking hostile political actions against China from Indian soil. Beijing, however, regards them as a well-knit insurgent group based in India, that skilfully mobilises international sympathy and uses the internet to reach Tibetans within China, to foment an insurgency. To understand how seriously Beijing views this, one has only to compare its problem in Tibet with India's problem in Kashmir . Both the Tibetan and Kashmiri communities are of the same size—about six million. But while Kashmir Valley accounts for only 0.13 percent, or 1/800ths, of India's land area, Greater Tibet accounts for a quarter of China's.

Whatever excuse New Delhi had for not understanding China's predicament in Tibet should have disappeared when Chinese think-tanks and internet sites launched a tirade of accusations against India of conspiring with Tibetan "splittists" to endanger China. New Delhi sought to placate Beijing by asking the Dalai Lama not to indulge in political activities that would hurt

India's relations with China. Mr Pranab Mukherjee reiterated publicly, "He is a respected guest in India….but during his stay in India, they should not do any political activity, any action that can adversely affect relations between India and China."

But somewhat surprisingly, New Delhi has still not fully realised that there is a link between this, and its growing disagreement with Beijing on the border issue. As a result, it has continued to send out confusing and contradictory signals that have irritated the Chinese and may have deepened their distrust of India. Thus, barely a fortnight after Prime Minister Manmohan Singh made his first visit to China in January 2008 to smooth out misunderstandings on the border and solicit China's support for India in the Nuclear Suppliers' Group, Dr. Singh visited Arunachal Pradesh and declared that it was an integral part of India.

Barely six month later, in July 2008, India's Defence Minister Pranab Mukherjee assured his Chinese counterpart at a Russia-China–Brazil-India meet in Yekaterinburg that India truly regarded Tibet as an integral part of China. But less than three months later, he too visited Arunachal Pradesh and declared that its status, as a part of India, was "not negotiable".

Mutual incomprehension reached a dangerous peak in November 2008, only days before the terrorist attack on Mumbai, when India ignored a warning from a spokesman of the Chinese Foreign Office given with reference to a forthcoming grand assembly of Tibetan leaders in Dharamsala, that China expected India to "ban activities aimed at splitting Chinese territory." India allowed the Dalai Lama to go ahead with a meeting whose avowed purpose was to chart a future course of action after China's summary and contemptuous rejection of his blueprint for genuine autonomy two weeks earlier. To India, it was apparent that the Dalai Lama had called the meeting to retain control of the Tibetan movement and steer it away from violence. But China saw it as the provision of another opportunity for the "Dalai clique" to work out strategies for fomenting insurrection in Tibet.

The six-day meeting did reaffirm the Dalai Lama's continuing leadership by endorsing, once again, his peaceful "middle way" for achieving autonomy.

But by reserving the right to start agitating for independence if his efforts failed, it in effect issued a veiled warning to China that the Tibetans' patience was not inexhaustible and the Dalai Lama was not irreplaceable.

China's warning to New Delhi and the Tibetans' warning to Beijing have eliminated whatever little room remained for New Delhi to continue playing ostrich This is not a problem that will go away if it pretends that it does not exist. On the contrary, if the Sino-Tibetan stand-off, continues every passing day will make India's position more precarious, and increase the temptation in Beijing to repeat what it did in 1962.

A POLICY FOR TIBET

But what change should Delhi make to its present policies? Beijing has made no overt request, but members of Chinese think-tanks, and Foreign Ministry officials who have spoken to Indian journalists, have made it clear that Beijing would like New Delhi to stop the government-in-exile from functioning out of India altogether.

So long as India remains a democracy, and so long as the Tibetan movement remains non-violent, no Indian government can accede to this demand. Nor can it accept China's assertion that every outbreak of unrest in Tibet is the work of the "Dalai clique" operating out of Dharamsala, and not of the failure of its own policies in the Tibetan region. But India can, and should, give Beijing an undertaking that it will investigate its allegations concerning the March 2008 riots and take firm action to prevent plots from being hatched against China on Indian soil.

But so long as the basic issue of Tibet's status within China is not resolved, and Tibetans continue to press for autonomy from their sanctuary in India, such reassurances by New Delhi will not reverse the deterioration of relations that has set in. In fact, if the Tibetan movement passes into younger, pro-independence hands, it can only worsen.

For China's anxiety can only worsen. It knows only too well that in the current information age, Tibetan leaders-in-exile can issue orders, accept donations, buy arms, and beam messages to Tibetans within China, from

anywhere in the world. Their cause enjoys widespread support from people across the world, if not from their governments. In such circumstances, even closing down Dharamsala will not necessarily help India to allay China's suspicions, for with thousands of kilometres of common frontier, India will find it hard to convince Beijing that it is doing all it can to deny them a base of operations in India.

However, should Beijing and the Dalai Lama be willing, there is a good deal that New Delhi can do to help them reopen their dialogue on terms that are acceptable to both parties. It is perhaps the only country that can do this , because of its unique position as the de facto protector of the Tibetan national identity for half a century—a status that is being recognised even as I speak — and because no other country has even a fraction of our experience in devising innovative solutions to the problem of accommodating ethnic minorities within a nation-state without endangering its unity.

A STRATEGY FOR NEW DELHI

The starting point would be to persuade the Dalai Lama to make three amendments to his blueprint for genuine autonomy. The first is to drop his demand to create a Greater Tibet and limit his proposals to the TAR. This does not mean that Beijing cannot replicate it in parts of the other four provinces, but that should be taken up in a second phase if it proves successful in the TAR

The second would be to reduce the number of subjects to be devolved upon the administration of the TAR from the present eleven to four: religion, culture , education and personal and customary law.

The third, and in many ways most important, would be to drop the demand for an immediate shift from the present system of "government from above" to "government from below" and to propose a time-frame within which it should be carried out.

New Delhi should not find it too difficult to persuade the Dalai Lama that this is the best way to go. At the Dharamsala conclave, he admitted that the

Despite Chinese assertions to the contrary, the Dalai Lama's primary concern has never been the creation of a Tibetan political unit, but the safeguarding of the Tibetan ethnic and cultural identity.

failure of the eighth round of his talks with the Chinese had made it necessary to look for a new approach. His observation after the conference that "India has been too cautious" on the issue of Tibet, should, therefore, be read as a call for help — an invitation to Delhi to shed its reticence and help him find one.

The reduction of the number of subjects from eleven to four should also not prove an insurmountable obstacle. Despite Chinese assertions to the contrary, the Dalai Lama's primary concern has never been the creation of a Tibetan political unit, but the safeguarding of the Tibetan ethnic and cultural identity. For that, it is crucial for Tibetans to control the above four subjects. Reducing their demands to these four does not mean that the new Tibetan autonomous administration will have no say in other important issues such as the protection of the environment, the development of infrastructure and even on economic and trade policy so far as these affect the TAR. But in these areas, its role could be advisory and consultative rather than executive. The extent to which Beijing will heed its suggestions and warnings will depend on the degree of trust that develops between it and the TAR administration. This will require time and patience.

Lastly, although phasing the reforms over a number of years would make them vulnerable to future changes within the Chinese Communist Party (CCP) and, therefore, place a question mark over their continuation, the Dalai Lama's acceptance of the need to do so will reflect a sensitivity to China's internal constraints that has been absent from the dialogue. It will, therefore, go a long way to reassure Beijing that the Dalai Lama does not have a hidden agenda behind his overt proposals.

Beijing's reaction to an Indian offer of good offices is likely to be more complex. It will first need to shed more than a century of suspicion of any initiative on Tibet that originates south of the Himalayas. But if the

statement made by Zhu Weiqun, the head of the Communist Party's United Front Work Department , who led the team that examined the Dalai Lama's proposal, is to be taken at face value, China has not altogether closed its doors on dialogue and may still be receptive to a proposal that does not "aim at revising the Constitution so that this separatist group could actually possess the power of an independent state." So Beijing may welcome a proposal that takes the form described above, for it will allay its suspicion that the Dalai Lama intends to split China, disrupt its internal balance and lay the foundations for creating an independent state.

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Limiting the demand for autonomy to the above four subjects will reinforce the case for reopening the dialogue with the Dalai Lama because the devolution of power in these areas to China's minorities is already envisaged in the Constitution of the People's Republic of China (PRC). These are subjects that Beijing would, therefore, be least wary of ceding to a Tibetan authority.

But what China would find most reassuring would be an offer to phase in autonomy on the lines described above over a period of several years, for this would not only allow it to make the changes incrementally but to harmonise them with political changes that President Hu Jintao is already contemplating in his bid to contain social unrest in the country. Since he became the General Secretary of the CCP, Hu Jintao has launched four major programmes of reform. The first, lunched in 2004, was to root out corruption in the Party. The second, termed the "third rectification" was to weed out older , less educated cadres in the Party and replace them with younger ones; 170,000 cadres were replaced in 2005. The third, also launched in 2005, was to improve the health, education and other services available to the peasants, lower the burden of agricultural taxes and increase production incentives. The last and most recent has been to start feeling his way towards political reform.

The two key elements of this are to set up an independent judiciary , to make local elections at the village and township level genuinely competitive and to extend the election of officials up to the county level of local administration.

These were long standing demands of liberals within the Communist Party, but had been stoutly opposed by the leadership till the 17th Party conference in October 2007. But Hu Jintao had only done so in order not to appear to be taking important decisions without consulting the Party. Within two weeks of the end of the conference, the Central Party School in Beijing published a collection of essays titled *The Fifteen-Year Assault: A Research Report into China's Political Reform 2006-2020.* The book carried long essays on both subjects,. This and its title gave a clear indication of both the direction of future political reform and the time period over which the central leaders intend to carry it out. A proposal by the Dalai Lama to merge the political changes he wants in Tibet into the changes that the Chinese leadership is considering for the whole country, is likely to receive a much warmer reception than his proposal for genuine autonomy received at the beginning of November.

CHINA'S AIR FORCE IN THE COMING DECADES: TRENDS AND IMPLICATIONS

R. GHOSE

Most analysis of China's air force focusses on hardware and order-of-battle issues – how many aircraft, of what types, with what capabilities were produced, where they are located, and what systems are under development. While studies and analysis of strategy and doctrine concentrate on the People's Liberation Army (PLA) as a whole, there also lies a certain interest in historical precedence, strategy and doctrine for the aviation forces. The People's Liberation Army Air Force (PLAAF), to ease itself into credible power has to go through a change in situations over the coming decade. There are a number of factors which will decide the above process of transformation which also includes a comprehensive modernisation programme planned for the future.

During its 58-year history, most of the combat took place against the United States forces during the Korean and Vietnam Wars,[1] though it never evolved into a total war with the United States, and during small scale engagements with the Nationalist Air Force during the 1950s and 1960s.[2] Also, though the PLAAF deployed hundreds of aircraft during the 1979 border war with Vietnam, per

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1.   Nigel Thomas, Peter Abbott, Mike Chappell, *The Korean War 1950-53* (Oxford: UK: Osprey, 1986), p. 33.

2.   Xiaoming Zhang, "Air Combat for the People's Republic: The People's Liberation Army Air Force in Action, 1949-1969" in David Michael Finkelstein, Mark A. Ryan, Michael A. McDevitt, eds., *Chinese Warfighting: The PLA Experience Since 1949* (New York: M.E. Sharpe, Inc, 2003), pp.281-293.

The PLAAF is in the midst of a dramatic transformation aimed at transitioning from a benign defensive force to one that incorporates modern defences and robust offensive strike capabilities.

pilot sortie rate was minimal and there were no attacks across China's borders.[3] This was also the last time the air force was involved in any large scale military operations. Also, China's airborne troops, which belong to the air force,[4] are primarily organised for internal control and have been used only twice, during the Cultural Revolution in Wuhan (1967) and during the Tiananmen crackdown in Beijing (1989).[5] However, the PLAAF is in the midst of a dramatic transformation aimed at transitioning from a benign defensive force to one that incorporates modern defences and robust offensive strike capabilities. In the 1990s, PLAAF embarked on an expansive programme of reforms that targeted doctrine, leadership, force and organisational structure, officer and education enlistment, and training.

STRATEGY AND MISSION EMPHASIS

The air power doctrine has progressed through several steps since 1949 when the PLAAF was established. In the beginning, without much experience in developing aviation doctrine, the PLAAF used the Soviet Air Force as its model.[6] It was not until 1957 that the PLAAF began to develop and teach its own doctrine and make changes to the Soviet doctrine, based on the PLAAF's experience in the Korean War and operations against the Nationalists on the islands around Zhejiang Province.

In 1959, the air force created a Regulation Committee that wrote over 300

3. Kenneth W. Allen, "PLA Air Force, 1949-2002: Overview and Lessons Learned" in Laurie Burkitt, Andrew Scobell, Larry M. Wortzel, eds., *The Lessons of History: The Chinese People's Liberation Army at 75*(Pennsylvania: DIANE, 2003), p.90.

4. Harvey W. Nelsen, *The Chinese Military System: An Organisational Study of the Chinese People's Liberation Army* (Boulder: Westview Press, 1981), p.162.

5. Kenneth W. Allen, Glen Krummel, Jonathan D. Pollack, *China's Air Force Enters the 21stCentury* (Santa Monica: RAND, 1995), p. xiv.

6. Xiaoming Zhang, Joseph G. Dawson, *Red Wings Over the Yalu: China, the Soviet Union and the Air War in Korea* (Texas:Texas A&M University Press, 2002), p.27.

regulations, including the first elements of China's air power doctrine, and in 1962, the Committee published the draft PLAAF *Combat Regulations* that laid out the concepts for its air superiority mission.[7] In 1982, the PLAAF provided a written doctrine regarding its ground support role,[8] therefore, during the early years, 70 percent of the aviation force consisted of fighters, leaving the remaining 30 percent to be divided among the other types of aircraft (bombers, ground attack, and transport) and systems for the other branches like Surface-to-Air Missiles (SAMs), Anti-Aircraft

While the PLA has always had an active defence strategy, it was not until the intention to infuse new PLAAF doctrines that the air force formally stressed having a simultaneous offensive and defensive capability.

Artillery (AAA), airborne forces, radar and communications. It was not until 1988 that the General Staff Department finally published a document (*Science of PLA Air Force Campaigns*) that explained the characteristics of operational/campaign art, the development of operations/campaign theory, and the mission of the PLAAF's corps and regiments, and how these three elements pertain to a unified command organisation.[9] This was the first time that they included the idea of attack. The document also discussed the special characteristics of air power operations in an electronic counter-measures (ECM), nuclear, chemical, and biological combat environment.

While the PLA has always had an active defence strategy, it was not until the intention to infuse new PLAAF doctrines that the air force formally stressed having a simultaneous offensive and defensive capability.[10] A chronological account of PLAAF doctrinal development commenced in the mid-1980s, starting with campaigns, then tactics, and, finally, strategy.[11]

7.   Allen et al., n.5, p. 106.

8.   Melvin Gurtov, Byong-Moo Hwang, *China's Security: The New Roles of Military* (Boulder, Colorado: Lynne Rienner Publishers, 1998), p.120.

9.   Allen et al, n.5, p109.

10. John Wilson Lewis, Xue Litai, Litai Xue, *Imagined Enemies: China Prepares for Uncertain War* (Stanford: Stanford University Press, 2006), p.228.

11. Kevin M. Lanzit and Kenneth Allen, "Right-Sizing the PLA Air Force: New Operational Concepts Define a Smaller, More Capable Force", in Roy Kamphausen and Andrew Scobell, eds., *Right*

Doctrinal Title	Preliminary Approval	Publication Date
Science of PLA Air Force Campaigns	1984	1988
Science of Air Force Tactics	1989	1994
Science of Air Force Strategy	1992	1995
Introduction to Air Force Military Thought	1998	2006
Science of Integrated Air and Space Operations	2003	2006

The doctrine on PLAAF strategy was published in 1995; however, the culmination of the PLAAF's efforts on behalf of its own strategic doctrine did not truly come to fruition until 2004, when the Central Military Commission (CMC) incorporated the PLAAF component of "Active Defence" strategy into the National Military Strategic Guidelines. However, in 1996, Chinese leaders, including CMC Chairman Jiang Zemin and PLAAF Commander Liu Shunyao, had began to reemphasie publicly, the PLAAF's capability to fight offensive battles.[12] Although China's air force is also responsible for supporting the ground and naval forces, neither the air force nor naval aviation have yet engaged in this mission during combat and even if they can do so, it would be indirectly.

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Writings have also stressed that the most important element of China's air power doctrine is gaining air superiority. In the past, however, this concept pertained primarily to areas around China's airfields and cities since the PLAAF's primary mission has been positional air defence,[13] since their aircraft did not have the reach and their SAM coverage was limited. With new acquisitions and aviation development strategy, they hope to implement this doctrine beyond China's periphery which is evident

Sizing The People's Liberation Army: Exploring The Contours of China's Military (Carlisle: Strategic Studies Institute, US War College, 2007) pp.448-452.

12. Kenneth W. Allen, "PLA Air Force Operations and Modernisation", in Susan M. Puska, *People's Liberation Army After Next* (Pennsylvania: Strategic Studies Institute, 2000), pp.189-193.

13. Kenneth W. Allen, "Logistics Support for PLA Air Force Campaigns", in Andrew Scobell, Larry M. Wortzell, *China's Growing Military Power: Perspective on Security, Ballistic Missiles and Conventional Capabilities* (Pennsylvania: DIANE, 2002), p.252.

in the comment by *Jiefangjun Bao*, a PLA daily, *"If threatened from the air, China must have the ability to carry its defense strike capability to targets outside its own air space."*[14]

The rapid-reaction strategy introduced in the early Nineties is based on the premise that China will only be engaged in local wars for the foreseeable future and that it must strike to end the war quickly, meet the political objectives and cater to cost that is a big factor as equipment becomes more expensive to use and replace.[15] With the induction of long range SAMs and the

Prior to the mid-1980s, all of the PLAAF's leaders were ground force officers who moved into the air force command positions in mid-career. In 1985, Wang Hai became the first aviator to be selected as the commander.

desire to increase airlift capability, the trend in the air power doctrine and strategy has moved away from the myth of direct support for the ground forces.

LEADERSHIP AND PERSONNEL

Several trends in the air force's leadership since the mid-1980s have affected the PLAAF's status. Initially, only 29 of the 5,500 original members had any aviation background[16] and prior to the mid-1980s, all of the PLAAF's leaders were ground force officers who moved into the air force command positions in mid-career. In 1985, Wang Hai became the first aviator to be selected as the commander.[17] As a result of this, though there were reasons for them to not understand the strategic effects of air power during operational engagements in the past, the ongoing evolution of doctrine which stressed high-tech multi-

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14. "Calls For Stronger Air Force," *Jiefangjun Bao*, Hong Kong AFP, April 7, 1996 (*FBIS-CHI-96-068*, April 7, 1996) in Kenneth W. Allen, "PLA Air Force Operation and Modernisation" (Pennsylvania: Conference on PLA, 1999).

15. Nan Li, "The PLA's Evolving Warfighting Doctrine, Strategy, and Tactics, 1985-95: A Chinese View," in David S. Shambaugh and Richard H. Yang, eds., *China's Military in Transition* (Oxford: Clarendon Press, 1997).

16. Kenneth W. Allen, "PLA Air Force, 1949-2002: Overview and Lessons Learned" in Burkitt, et. al., eds., n.3.

17. David Shambaugh, *Modernising China's Military, Progress, Problems and Prospects* (New Delhi: Bookmart Publishers, 2004), p.159.

The PLAAF has also established age limits for its pilots, thereby making the average for fighter and ground attack` pilots 28 years.

role platforms capable of greater offensive and defensive roles gained steam, commencing with the leadership of PLAAF Commander Wang Hai.[18] The PLAAF has also made a concerted effort at reducing the age of its leaders. In 1988, Commander Wang Hai, who had already held the position for three years, was 60 years old. The succeeding three commanders took over at ages between 57 and 63(mandatory retirement age being 65).[19] The average age of officers holding the same positions as those in 1988 has been reduced by about 3-5 years (lieutenant generals are about 57 years old and major generals about 52), thus, indicating a move towards a younger force. The PLAAF has also established age limits for its pilots, thereby making the average for fighter and ground attack pilots 28 years.[20]

Other significant changes have taken place in recruiting pilots. In 2000, the PLAAF recruited its pilots from graduates with a four-year bachelor's degree from a PLA academy. In 2003, the PLAAF extended the programme to civilian college graduates, with specific bachelor's degrees. These graduates receive two years of flight training at a PLAAF flight academy and one year of transition training before being assigned to an operational unit.[21] This is indicative of a higher quality of intake from a wider base entering the operational force by 2006. Concerning experience, whereas almost every PLAAF leader in the 1980s had fought in the Korean War, they had all retired by the mid-1990s.[22] This leaves the current set of leaders without relevant combat experience. Although they have been "influenced" by the Gulf War and Kosovo War, the question remains as to whether they can implement the changes necessary to meet

18. You Ji, *The Armed Forces of China* (London: I.B. Tauris, 1999), p.125.

19. Kenneth W. Allen, "China's Aviation Capability", presented at Chinese Military Affairs: A Conference on the State of Field (Washington: National Defence University, 2000) at www.ndu.edu/inss/china_center/CMA_Conf_Oct00/paper1.

20. Allen, n.12, p.205.

21. Kenneth Allen, "Reforms in the PLA Air Force", *China Brief*, vol. V, issue 15, July 5, 2005), p.5..

22. Shambaugh, n.17, p.159.

the challenges of local wars under high technology conditions.

There are currently both positive and negative leadership trends for the PLAAF. Whereas all of the PLAAF's leaders have now come up through the air force ranks, as compared to the initial commanders who were ground soldiers, they are on the average younger than their predecessors of a decade ago, more mobile, but lacking in serious combat experience. We can expect the PLAAF to continue this trend of promoting younger officers, perhaps reducing the average age by yet another 1-2 years over the next decade. Their lack of combat experience may actually help if they do not prepare for the "last war". This transformation may come about as they have the opportunity to travel more and to learn in the information age. The PLAAF did not enjoy any substantial institutional clout [23] but a growing leadership role emerged when the CMC steadily assigned PLAAF officers to an increasing number of pivotal leadership positions in Beijing and Military Region (MR) Headquarters. In 2002, the first PLAAF general officer was appointed to serve as deputy director of the Nanjing MR Operations Department. In late 2003, the PLAAF began to augment each of the seven MR Headquarters by appointing a major general to serve as a deputy Chief of Staff in the Headquarters Department. In August 2003, Lt Gen Zheng Shenxia was elevated from Chief of Staff of the PLAAF to Commandant of the PLA's Academy of Military Science where he renewed the emphasis on integration of air operations into the PLA strategic doctrine. In 2004, PLAAF Commander Gen Qiao Qingchen was elevated as a member of the CMC, with two more PLAAF generals as deputies in General Departments but surprisingly with no appointment in the General Equipment Department.[24] This, however, represented a significant break with a past in which the army retained a stranglehold on senior leadership positions, enabling them to

These changes in senior officer appointments reflect a significant change in the PLA culture for notable implementation in future.

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23. Burkitt, et. al., eds., n. 3, p.93.

24. Lanzit and Allen, n.11, pp.448-452.

subordinate air force interests and potential contributions. These changes in senior officer appointments reflect a significant change in the PLA culture for notable implementation in future.

OPERATIONAL AND ADMINISTRATION STRUCTURE

The PLAAF is a multi-branch Service that is subordinate to the PLA. Since its founding, the PLAAF's chain-of-command has basically been organised into administrative and operational levels: Headquarters Air Force; Military Region Air Forces (MRAF); air corps, command posts, and bases; and operational units. Depending on the type of unit, operational units are organised into divisions, brigades, and so on. Operational units can be directly subordinate to Headquarters Air Force, the MRAF Headquarters, an air corps, a command post, or a base. The PLAAF over the years simplified its administrative command structure from a high of eleven first-level departments[25] to four.[26] Today, there are seven MRs, five air corps, and six bases that control the PLAAF's operational units. Bases are equal to an air corps, but most of the administrative functions are moved up to the MRAF Headquarters. Visible methods of force reduction have been seen in downgrading the air corps and restructuring the air bases to 12 command posts (two each in six MRs and none in Jinan MR)[27] further restructured to 13 command posts (two in each of five MRs, 3 in Lanzhou and none in Jinan MR).[28] The PLAAF has, thus, been marked by comparatively frequent changes on the administrative side and how well they prove functionality tests in combat scenarios and support operations is yet to be proved. These structural changes were necessary to reshape the PLAAF's operational command structure, but the changes have also adversely affected morale among officers at all levels whose jobs were eliminated or who have been denied an eventual promotion to the next level

25. Xiaobing Li, *A History of Modern Chinese Army* (Lexington: University Press of Kentucky, 2007), p.125.
26. Kenneth W. Allen, "Logistics Support for PLA Air Force Campaigns" in Scobell and Wortzell, n.13.
27. Allen, n.21, p.4.
28. Lanzit and Allen, n.11, p.465.

to secure their retirement benefits. On the basis of a proportional slice, the PLAAF was forced to cut 30,000 officer billets based on the specific goal of force reduction to replace junior officers with Non-Commissioned Officers (NCOs).[29]

The reduction in force from 50 to 33 air divisions[30] over a period of time is significant in that the PLAAF has been able to retire many of its F-6s, all of which were built more than 20 years ago. This consolidation has saved the PLAAF money on maintenance costs and has allowed it to focus on other reforms, including logistics for a smaller and more mobile force. As the PLAAF acquires new weapons systems (Su-27/J-11, Su-30s, Il-76s, J-10, and S-300 SAMs), there will be further changes in doctrine and the way the PLAAF supports a more mobile force.

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The PLAAF also includes the airborne troops. This was one of the PLAAF's most important changes in campaign strategy during 1992, when the air force's 15th Airborne Army changed into a Rapid Reaction Force (RRF).[31] The PLAAF's airborne forces began in the early 1950s as a single brigade and then expanded to become a division. By the mid-1970s, the army had three airborne divisions. Some time after 1984, the three divisions were reduced to brigades, but were again enlarged to divisions in 1993, each with about 10,000 troops. Training continuity with the organisational changes is one aspect and the other defining factor for the airborne force is the amount of additional airlift the PLAAF acquires.

In May 1957, the air defence was merged with the PLAAF. The PLAAF has tried various organisational structures for its AAA and SAM branches. Prior to 1985, they were organised into divisions, with their subordinate regiments. In 1985, the PLAAF began restructuring some of its AAA and SAM regiments

29. Ibid., pp. 464-465.

30. Kenneth W. Allen, "PLA Air Force Mobile Operations" in Mark Edmonds, Michael M. Tsai, *Taiwan's Security and Air Power* (New York: Routledge, 2003), p.77.

31. Allen, n.12, p.198.

With the evolution of radar brigades, the indications are that the number of radar units in each Military Region has grown considerably.

into combined brigades, but by the end of the 1990s, the PLAAF had re-instituted the division level, at least for SAMs, and had apparently raised at least some, if not all, of the combined brigades to a division level. This change probably reflects the PLAAF's acquisition of the S-300s from Russia[32] with an increased number of SAMs overall, plus the view that the combined brigades may not be the best solution to accomplishing the air defence mission. It is apparent that the organisational structures for the SAM and AAA forces were in a flux for some time and may still take a few years to streamline. Much will depend on the number and types of SAMs the PLAAF deploys and where they are located. It will most likely continue to increase the size of its radar force, including a more comprehensive Integrated Air Defence System (IADS) through better radars and communications capabilities. With the evolution of radar brigades, the indications are that the number of radar units in each Military Region has grown considerably. However, the overall trend is for further reductions in the size of the force as older aircraft are retired. The PLAAF could easily be down to 30 divisions, with most having two regiments each, by the end of the decade. This will equate to further savings on operating costs as well and allow the PLAAF to focus on the tactics and mobility aspects of its new aircraft. The administrative structure is not expected to change over the next decade, but certain elements such as the airborne forces, SAMs, and ECM/IW (Information Warfare), including space capability, will continue to receive greater attention.

AVIATION ASSETS: COMMAND, CONTROL AND INTEGRATION WITH SPACE

There is very little information available that specifically identifies command and control for China's air power elements which also include the naval and army aviation assets. The PLAAF and PLA Navy have a total of around

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32. M. Taylor Fravel, "China's Search for Military Power," *The Washington Quarterly*, vol. 31, no. 3, Summer 2008, p.133.

2,325 operational combat aircraft, air defence and multi-role fighters, ground attack aircraft, fighter-bombers, and bombers. An additional 470 older fighters and bombers are assigned to PLA flight academies or research and development. The two air arms also possess approximately 450 transports and over 90 surveillance and reconnaissance aircraft with photographic, surface search, and airborne early warning sensors.[33]

Gen Ma Xiangsheng, the head of the PLA's Army Aviation Department, revealed the current strength of the Army Aviation Corps for the first time on July 4, 2008, during a conference held by the Foreign Affairs Office of the Ministry of

Sichuan earthquake relief operations were conducted according to the PLA joint operations doctrine. Xinhua called it "its largest airlift yet" of some 11,420 troops. About 100 military helicopters (nearly one quarter of the Army Aviation inventory) were dispatched from all over the country.

National Defence (MND). There are "over 10 units and nearly 500 helicopters" and this is the first time that PLA officially confirmed the size of its helicopter fleet.[34]

The overall increase in the use of fibre optics, satellite communications, and computers indicates that the air power elements are also going to use these means of communication extensively. The changes in leadership demographics and administrative changes noted above will also influence the overall command and control system. This is an area which also needs attention in order to understand future trends. In the past, joint training (to include intra-Service training among the branches) was described as two or more elements training at the same time, but in different areas. This situation is gradually changing as more emphasis is put on real joint training. One of the biggest questions is whether a joint command and control relationship will be established between the PLAAF and naval aviation in time of war. A

33. Annual Report to Congress "The Military Power of The People's Republic of China, 2007" by the Office of the Secretary of Defence, p. 25, available at www.defenselink.mil/pubs/pdfs/070523

34. Available at http://www.sinodefence.com/news/2008/news08-07-04.asp.

The second doctrinal book lays out six steps for China in establishing a model in which the PLAAF is the leading organisation for "integrated air and space" and also the primary force for air and space combat.

plausible option is that they continue to operate as separate entities, but some naval aviation aircraft could be given under PLAAF control to conduct missions. Also, the Sichuan earthquake relief operations have revealed much about joint operational capabilities. Though no weapons were involved, deployment was conducted according to the PLA joint operations doctrine, providing a real-world test bed. Xinhua called it "its largest airlift yet" of some 11,420 troops. About 100 military helicopters (nearly one quarter of the Army Aviation inventory) were dispatched from all over the country. Civilian assets augmented these fleets. The *Liberation Army Daily* noted "the long-distance rapid insertion capability in a state of relative weakness." The *People's Daily* commented, "With this earthquake, we mustered as many helicopters as possible, but overall they were still too few, and their capabilities not yet improved"[35] (China will buy 150 helicopters of three different types, from Poland's PZL Swidnik over 10 years under an agreement signed between the Polish aircraft firm and China's Jiujiang aeronautics plant).[36] The deployment, however, offered an opportunity to evaluate joint performance.

China's 2004 and 2006 Defence White Papers clearly show the growing importance of the PLAAF and its missions. However, neither Paper references integrated air and space. In March 2004, the PLAAF published *Air and Space Battlefield and China's Air Force*, following in August 2006 with *The Science of Integrated Air and Space Operations*. The first doctrinal book does not provide linkage between space and the PLAAF; the second book lays out six steps for China in establishing a model in which the PLAAF is the leading organisation for "integrated air and space" and also the primary force for air and space combat. In 2006, the PLAAF published *An Introduction to Air Force Military*

35. Dennis J. Blasko, "China's Army Still Getting to Know Itself", online edition of *Asia Times*, July 12, 2008, available at http://www.atimes.com/atimes/China/JG12Ad02.html.

36. Available at http://www.defensenews.com/story.php?i=3394355&c=EUR&source=nletter-__AdditionalEmailAttribute1

Thought which professed that the PLAAF should use informationalisation to control the land and sea, and should move toward developing integrated air and space operations.[37] These declarations may be just the beginning of a long turf war over managing and employing China's military space.

TRAINING

A comparison of the two most recent sets of concepts, shown below, clearly demonstrates the shift in training philosophy that occurred between 1987 and 2001. In 1987, "safety" was the watchword; in 2001, every line points to practical, realistic training.[38]

Concepts issued in 1987
Adhere to reform
Enhance effectiveness
Improve steadily
Ensure safety
Concepts issued in 2001
Closely adhere to actual combat situations
Stress training agaist opposing forces
Be strict during training
Apply science and technology during training

The current training fleet comprises about 40 Su-27UBKs, 50 JJ-7s, 150 JJ6s, 100JJ-5s, all jet trainers and 1,000 CJ-5/CJ-6 piston engine primary trainers.[39] The L-15, revealed at the Beijing Air Show in September 2001, boasts of supersonic speed, modern cockpit systems, and the ability to train in counter-air and ground attack missions and would be the ideal modern trainer for the PLAAF, to allow pilots to transition to the Su-30MKK as well as the J-10,

37. Lanzit and Allen, n.11, pp.453-455.

38. Ibid., pp.459-460.

39. David Donald, "China, People's Liberation Army Air Force," *International Air Power Review,* Summer 2001, p.87.

A PLAAF pilot typically trains about 80 hours per year in the air—not enough time to master the complex skills of piloting, let alone grasp the handling of high-tech weaponry used in combat planes.

if the funding is adequate. While the numbers may be adequate to teach basic manoeuvring and air skills, they are woefully inadequate to teach combined air and ground attack with even the Su-27UBKs lacking the modern data-link and ground attack technologies. The FTC-2000 shown in the Zhuhai Air Show in November 2000 could also be preferred if the development period proves to be shorter. The PLAAF and naval aviation have also been involved in several complementary organisational changes that have resulted in more realistic flight training. As a result of certain changes in training, PLAAF pilots have been noted flying in more sophisticated simulated air-to-air combat, training in an ECM environment, flying over the Taiwan Strait and East China Sea, conducting live missile firings beyond the coast, dropping live bombs at ranges, flying at night and under different weather conditions, as well as flying at low altitudes. An ordinary PLAAF pilot typically trains about 80 hours per year in the air—not enough time to master the complex skills of piloting, let alone grasp the handling of high-tech weaponry used in combat planes. The gap between current military doctrine about modern war and the actual practices of the armed forces has resulted in a deficit of experience.[40] To help make up for the limited number of flying hours in tactical training per year, the PLAAF has increased use of flight simulators and reportedly it comprises almost 90 per cent.

They have also practised emergency mobility deployments to permanent and auxiliary airfields within and outside their assigned MRs. All of these changes have been aided by the acquisition of improved navigation equipment. Details about the exact types of training or the level of joint coordination between the air force and navy are not available. The PLAAF did not even begin flying over water until the late 1990s but with the turn of the

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40. Anatoly V. Bolyatko, "A View from Moscow: China's Growing Military Power" in Scobell and Wortzell, eds., n.13, p.92.

decade, cruise missiles were reportedly launched over the East China Sea by eight PLAAF bombers.[41] The FC-03 flight data recording and processing system has been fitted to provide a 3-D picture of the flight track and recording of the instrument panel. The PLAAF is also seeking modern Air Combat Manoeuvring Instrumentation (ACMI).[42] Airborne troop training over the past few years appears to have been focussed primarily in

The PLAAF has reconfigured logistics and maintenance systems, which traditionally have not been structured to support mobile, offensive operations.

western China and the Xingan mountains in northeast China. The PLAAF sent 8 JH-7A fighter-bombers, 6 IL-76MD transport aircraft, and an airborne company from the 15th Airborne Corps, totalling 460 personnel, for a joint exercise ("Peace Mission -2007") with Russia in Vladivostok and east China's Shandong Peninsula and nearby offshore waters.[43] Though it was publicised that such an exercise did not target a third country, there has been increased emphasis on airborne forces and the query remains as to whether the airborne forces are being trained primarily for internal or external use. The biggest question, however, is: how proficient are they, especially in terms of joint operations?

LOGISTICS AND MAINTENANCE

The PLAAF does not routinely conduct a high number of sorties per pilot in a short period of time,[44] so aircraft maintenance and logistics support are not under strain but as the PLAAF becomes a more mobile force, it has begun to adjust its logistics and maintenance operations to meet new challenges. PLAAF logistics and maintenance units have experienced significant reorganisation and restructuring since the 1990s. The PLAAF has reconfigured logistics

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41. Available at www.pladaily.com.cn/gb/pladaily/2002/04/20/20020420001010_TodayNews.html.

42. Report on Zinhua Air Show, 2000 by Richard Fisher Jr, available at www.strategycenter.net/research/pubID

43. Information available at www.sinodefence.com/news/2007/news07-07-28.asp.

44. Michael D. Swaine, Andrew N. D. Yang, Evan S. Medeiros, *Assessing the Threat: The Chinese Military and Taiwan's Security* (Washington: Carnegie Endowment for International Peace, 2007), p166.

and maintenance systems, which traditionally have not been structured to support mobile, offensive operations. Historically, a single airfield has hosted one regiment fitted to a single type of aircraft. The PLAAF's emphasis on achieving new mobility goals aims at small logistics and maintenance teams deploying with the aircraft to any type of airfield. Furthermore, efforts are underway at PLAAF airfields to instruct specialised maintenance teams in the cross-servicing of multiple aircraft types.[45]

There are 21 repair factories employing about 40,000 workers carrying out major overhauls of aircraft and engines.[46] Aviation units also have repair factories which are equipped to conduct intermediate and minor repairs. Changes have included computerising and networking operations, establishing small rapid reaction teams capable of accompanying aircraft deployments, adjusting the logistics structure, acquisition, storage, and distribution of spare parts. While moving towards the above process for a leaner force, they have diversified the logistics and maintenance pattern of "guarantee" systems of six categories, providing from emergency guarantee to partial and independent guarantee to airfields, areas and departments concerned.[47] The PLAAF logistics forces have also been working on refuelling aircraft and techniques, which comprise one of its weakest links,[48] together with support of multiple types of aircraft at a single base. The PLAAF has also begun building hardened shelters for some of its aircraft. Although the clear trends are for more joint logistics, especially in common areas such as hospitals, fuels, quartermaster supplies and transportation, the more difficult areas will be spare parts for aviation and air defence equipment. One of the biggest challenges will be supplying the force with spare parts for all of the sophisticated weapons systems acquired from abroad and for domestically-produced systems composed of foreign parts. The logistics and maintenance

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45. Lanzit and Allen, n.11, p. 466.
46. James C. Mulvenon, Richard H. Yang, *The People's Liberation Army in the Information Age* (Santa Monica: RAND, 1999), p 82.
47. Ibid., pp. 87-90.
48. Allen, n.3, p.137.

of Su-27s is a good example of this predicament. Although some of the aircraft are assembled in China, only about 10 per cent of current production is of domestic content; airframes, engines and avionics are produced in Russia. Even the J-7s and J-8s with Chinese engines have Russian avionics.[49]

FOREIGN RELATIONS

The PLAAF began sending delegations abroad as early as August 1949, when the air force's first Commander, Liu Yalou, led a delegation to Russia to purchase aircraft and equipment which gained momentum only after 1979.[50] Most importantly, analysis shows that each of the PLAAF delegations is led by the commander or political commissar and includes directors from key headquarters departments, regional commanders, and/or personnel from air force research institutes and academies. In addition, most of the PLAAF deputy commanders and deputy political commissars have been part of delegations led by senior PLAAF officers. However, there could be limitations to the future growth of the PLAAF's foreign relations programme. The first limitation is that the PLAAF's Foreign Affairs Division officers must plan the itinerary for, and escort, all foreign and PLAAF delegations. Growth and size of this division have to be commensurate and over the years there has been no confirmative indication. Second, each commander is authorised one visit abroad under ordinary circumstances and the number of foreign air force leaders accepted for visits to China is guided by the overall PLA's visitors plan. Besides meeting with foreign commanders, the PLAAF also hosts or sends out an average of five to ten functional exchange delegations per year which brings in the overriding time/schedule factor. Third, the PLAAF must pay for all in-country expenses for visiting delegations and all international travel expenses for PLAAF delegations which factors in budgetary constraints. Fourth, the PLAAF has permanent military attachés posted in three locations–Washington, London, and Moscow–and there is

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49. Harold Brown, Joseph W. Prueher, Adam Segal, *Chinese Military Power* (New York: Council on Foreign Relations, 2003), p.50.

50. Allen, n.3, p.98.

The PLAAF's future aircraft are beginning to enter the force, although the total number and precise mix of foreign and domestic aircraft remain unknown.

a handful of countries with air force attachés assigned to Beijing. This would tend to limit frequent interaction between the PLAAF and foreign air forces.

NEW WEAPON SYSTEMS AND MODERNISATION

The PLAAF is looking to enhance operational capabilities through upgrading existing and acquiring new equipment. The transition is between a limited force consisting mainly of the obsolete capabilities that it fielded in the 1980s, and the more advanced force that it intends to field in the coming decades. Modernisation will also include larger numbers of more advanced air transports, Airborne Early Warning (AEW)/Airborne Warning and Control Systems (AWACS), aerial refuelling tankers, intelligence collection, and signal jamming aircraft which will enhance the effectiveness of PLAAF airborne forces for both internal security and external missions.

The J-6 fighters that once made up most of the fighter fleet have almost retired.[51] The PLAAF's future aircraft are beginning to enter the force, although the total number and precise mix of foreign and domestic aircraft remain unknown. An estimate given to the Congress by the Department of Defence of the United States in 2007 was 1,550 fighter aircraft, 775 bombers and 450 transport aircraft. The PLAAF now has 15 years of experience with the Su-27 (first regiment inducted in 1992)[52] fighters as well as with Su-30s from 2000, and J-10s. The J-10 is China's first domestically produced fourth-generation aircraft and will likely make up a large portion of the future force. It is a highly capable, multi-role fighter, strongly influenced by, and has benefited from, the Israeli Lavi project,[53] which was in turn influenced by the F-16. Serial

51. Harold Brown, Joseph W. Prueher, Adam Segal, *Chinese Military Power* (New York: Council on Foreign Relations, 2003), p.48.

52. Ibid., p.48.

53. Robert Hewson, "Chinese J-10 Benefited from Israeli Lavi Project," *Jane's Defence Weekly*, vol. 45, issue 21, May 21, 2008, p.5.

production has commenced and some 60 aircraft (enough to equip about three Chinese aircraft regiments) are reportedly deployed. The Su-27s and Su-30s, including the Su-30MKKs, are being complemented with the J-11 numbering around 300. The J-11 is the Chinese-assembled version of the Russian Su-27SK. Initial 'co-production'

The Su-27s and Su-30s, including the Su-30MKKs, are being complemented with the J-11 numbering around 300.

involved Chinese assembly of aircraft kits provided by the Russians, but the Shenyang Aircraft Corporation plans to increase the proportion of domestically produced components for the J-11s gradually and have also delivered around 95 J-11Bs reportedly assembled by mid-2007.[54] Development on a fifth generation fighter aircraft has also reportedly commenced by the Shenyang Aviation Corporation and Chengdu Aircraft Industrial Group but potential dates are speculative.[55]

The PLAAF may also field the Xiaolong/FC–1, an indigenously developed fighter that is the product of a Chinese-Pakistani joint venture. The Xiaolong/FC–1 would provide a less expensive alternative to fourth-generation aircraft. Serial production of the aircraft was scheduled by January 2006 but there seems to be uncertain enthusiasm by the PLAAF.[56]

Along with fighters, the PLAAF continues to modernise its ground-attack and bomber forces. China's efforts to improve its ground-attack capabilities include development of the JH-7/FB-7 Flying Leopard. Although the JH-7 is a multi-role aircraft, its limited capabilities against modern fighters suggest that it will be used mainly for ground attack and anti-ship missions. About 20 JH-7s are currently deployed with the PLAAF 28th Air Division in Hangzhou.[57] The air force is reportedly unenthusiastic about the JH-7 and would probably

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54. Brief on "China's Military Modernisation: Part One" in *Jane's Defence Weekly*, vol 45, issue 30, 23 July 2008, p.28.

55. Ibid.

56. Information available at www.globalsecurity.org/military/world/china/fc-1.htm.

57. Richard Fisher Jr, "PLAAF Equipment Trends," in Stephen J. Flanagan and Michael E. Marti, eds., *The People's Liberation Army in Transition* (Washington: National Defence University Press, 2003), pp.149-150.

The PLAAF is also set to develop and deploy force multipliers that will enhance the capabilities of its combat aircraft.

prefer to acquire more advanced multi-role fighters. It is uncertain whether China will decide to build or acquire new bombers, but production of the H-6/Badger has resumed with emphasis on a new variant capable of carrying anti-ship and land-attack cruise missiles.[58] The deployment of advanced cruise missiles should allow existing bombers to contribute more effectively to a variety of missions, including anti-ship and ground attack tasking. It is also unclear if the Chinese intend to upgrade the bomber fleet with the Russian Tu-22 and Tu-95 bombers. One of the reasons why the PLAAF would want to acquire new strategic bombers would be the deterrent factor and such acquisition will also mark a significant shift in the balance of power in Asia.

The PLAAF is also set to develop and deploy force multipliers that will enhance the capabilities of its combat aircraft. These systems will include tankers, AEW aircraft, Electronic Warfare (EW), intelligence collection aircraft, and transports that will support a rapid-response capability for internal and external contingencies. The Su-30s can be refuelled by the IL-78/Midas tankers, with four already ordered from Russia although not yet delivered because of a production problem. The J–10s can be refuelled by the HY–6 tankers, a modified H–6 platform. Expansion of the tanker force and delivery of the IL-76 will extend the range and endurance of the PLAAF refuellable combat aircraft. China had the basic capability since 1994 but with the order of IL-78 Midas tankers from Russia, it has indicated a growing ambition to project power off shore.[59] However, at present, even if China takes delivery of the IL-78 Midas tankers, they would be able to support at most a squadron of Su-30s in combat operations.[60]

China has made several efforts to acquire or develop AWACS capabilities, but current information suggests that only limited progress

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58. Richard Fisher,Jr, "China's 'New' Bomber," International Assessment and Strategy Center, February 7, 2007, available at <www.strategycenter.net/research/pubID.146/pub_detail. asp#>.

59. n.54, p28.

60. Fravel, n.32, p.135.

has been made. Some Chinese sources take the position that the AEW would be more beneficial to the PLAAF than the AWACS since it would require fewer changes in current operational practices. Present capability used the IL-76 as a platform for the KJ–2000, equipped with the indigenously designed phased-array radar. Research and development on this system had reportedly made significant progress, but the programme received a setback by the crash of a prototype in June 2006 that killed some 40 technicians.[61] A second domestic AEW programme, the KJ-2, is based on the Chinese Y–8X transport aircraft. Of course, the PLA already has an AWACS built around the Russian Beriev A-50, equipped with Chinese-made phased-array radar and has a data link capability; a data processing system, identification Friend-or-Foe(IFF) system and a Command, Control, Communication and Intelligence (C^3I) capability. It can exchange data with other aircraft and other platforms equipped with compatible data links. The aircraft loiter time on station, however, is only about 90 minutes. China's own Y-8, a four-engine turboprop, will be equipped with an Ericsson ERIEYE AWACS system, increasing China's airborne early warning and command and control capabilities.[62]

Some Chinese sources take the position that the AEW would be more beneficial to the PLAAF than the AWACS since it would require fewer changes in current operational practices.

The PLAAF is also making efforts to modernise its transport fleet, focussing primarily on the IL-76/Candid, the Chinese Y-8 and Y-9, and the Soviet Antonov An-12. If no additional Il-76s were being purchased, it would have indicated a greater internal role, but China had placed an order for 38 IL-76 transport planes and IL-78 tankers which Russia failed to honour. Therefore, presently it is handicapped with insufficient airlift. However, airlift would

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61. Joseph Kahn, "Crash of Chinese Surveillance Plane Hurts Effort On Warning System," *New York Times*, June 7, 2006, available at http://www.airliners.net/aviation-forums/military/read.main/47572/.

62. Larry M. Wortzel, "PLA Command, Control, and Targeting Architectures: Theory, Doctrine, and Warfighting Applications" in Kamphausen and Scobell, eds., n.11, p.214.

also include efforts from China's Large Civil Aircraft (LCA)[63] fleet comprising Western-built aircraft. As of July 2007, a total of 1,171 western-built LCA were registered in China, while regional jets accounted for 57 additional aircraft. It should also be noted that China's share of world order of LCA in 2006 accounted for 14 per cent and delivery during the same period was 12 per cent.[64]

INFLUENCES AND TRENDS

A number of influences and competing sets of perspectives have shaped what the air force looks like notwithstanding the modernisation programme under way, with aircraft and systems that will constitute the future PLAAF, projected capability and strategic intentions.

- The first perspective focussed on China's immediate external security environment, the military missions derived from potential threats, air force capabilities and force structure necessary to carry out these missions and Beijing's sense towards being a regional power also accelerated this process. Initially, the threat from Taiwan led the PLAAF to build near-term combat capabilities which implied greater emphasis on air bases and air defence assets along China's land and maritime borders and a relative neglect of long-range strike capabilities but gradually, through purchase and co-production of Russian multi-role fighters and assets such as tankers and strategic bombers, the emphasis shifted to a strategic air force.

- Most of the aircraft acquisitions and development programmes shaping today's PLAAF were initiated, including the acquisition of Russian Su-27/Flanker fighters and the J–10 fighter development programme, with the influence of the 1991 Gulf War, invasion of Iraq and furtherance of strategic capabilities of the Indian Air Force which indicated a sense of vulnerability and prompted intensified efforts to build a more advanced and capable PLAAF. This scenario had the air force focussing on power

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63. An LCA is one with a capacity of 100 seats or more.

64. Peder Anderson, *China's Growing Market for Large Civil Aircraft* (Washington: Office of Industries, US International Trade Commission, 2008), pp.2-4.

projection not only into the East China and South China Seas to ensure a PLAAF capability to protect vital Chinese sea lines of communication but also ingress from the western mainland. It not only involved greater attention to potential threats from India but also a scenario of an eastern ingress which is also a demanding scenario for the PLAAF. Redeployment of assets in order to increase capabilities to strike India may become a compulsion because lack of adequate air bases close to the Indian border constrains the contributions that tactical aviation assets (such as multi-role fighters) can make to the scenarios. This increases the requirement of aerial refuelling capabilities over land and water, long-duration maritime patrol and intelligence collection, and strategic bombing capabilities. It also implicates greater stress on training operations in conjunction with relocation and mobility with equipment. Air refuelling can help extend the operational range of tactical aircraft but is an imperfect substitute without supporting bases for large scale operations.

- The 2006 Defence White Paper calls for "coordinated development of national defence and the economy" which has a bearing on future capability development for the PLAAF and Beijing's modernisation, giving options to look at the potential military requirements and China's growing international interests. However, continued economic growth and global integration have increased dependence on foreign sources of energy (especially oil and gas). Therefore, the Defence White Paper raises concerns about resources and transportation links when it raises "security issues related to energy, resources and finance." In 2003, China became the world's second largest consumer and third largest importer of oil. China imports over 40 percent of its oil (about 2.5 million barrels per day as per 2005 estimates). By 2025, this figure could rise to 80 percent (9.5 – 15 million barrels per day). China began filling a strategic petroleum reserve in 2006. By 2015, Beijing plans to build reserves according to the International Energy Agency standard of 90 days supply.[65] For the PLAAF,

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65. Annual Report to Congress "The Military Power Of the People's Republic of China, 2007" by the Office of the Secretary of Defence, p.8, available at www.defenselink.mil/pubs/pdfs/070523.

The PLAAF's primary mission has long been air defence, with support for ground troops an important secondary mission.

it will not only depend on how Chinese leaders decide to pursue interests relative to the value of military instruments, especially air power but also tackle matters of operational logistics. With the present state of logistics and transportation networks, there is an element of inadequacy with regard to mobility of the strategic reserves of oil through definite time-frames.

- The PLAAF's primary mission has long been air defence, with support for ground troops an important secondary mission. The air defence mission requires close coordination of both aircraft and ground-based air defences such as SAMs and AAA. Despite the longstanding secondary mission of supporting ground troops, the PLAAF has seldom been able to perform close air support missions for ground forces and has had only limited capability to perform bombing and interdiction missions in support of ground operations. The 2006 Defence White Paper then stressed PLAAF efforts to speed up "its transition from territorial air defence to both offensive and defensive operations" and to increase "its capabilities in the areas of air strike, air and missile defence, early warning and reconnaissance, and strategic projection." The air defence mission is now conceived as a responsibility that incorporates both offensive and defensive actions. The emphasis is on offensive operations, air strikes, and strategic mobility (coupled with the wide emphasis on joint operations and joint campaigns) implying a higher level of cooperation for operations that support ground forces.

- An approach for sizing the capability of the PLAAF would focus on the priorities of civilian leaders, which encompass a range of strategic, developmental and political objectives. From this perspective, the future size of the force should be a function of the leadership's estimate of the return on investments in air force capabilities relative to other uses of the resources. China's defence budget for 2007 officially, was Yuan 350.92

billion (US$45 billion), an increase of 17.8 per cent ($6.8 billion) over the previous year[66] but analysis of budget data and International Monetary Fund (IMF) Gross Domestic Product (GDP) data for the period 1996 to 2006 shows average annual defence budget growth of 11.8 percent compared with average annual GDP growth of 9.2 percent.[67] Therefore, though civilian leaders should clearly be concerned with the need to keep defence expenditures in proper proportion to economic development,

China's defence budget data for the period 1996 to 2006 shows average annual defence budget growth of 11.8 percent compared with average annual GDP growth of 9.2 percent.

we can expect variations when it comes to achieving hardline goals. Defence and civilian industries can have positive synergies and so leaders might support some additional military expenditure (especially in research and development) due to the benefits for the civilian economy. The domestic aviation programme can be viewed in this light.

- Another approach would have emphasised building the PLAAF into a modern air force capable of engaging and defeating other air forces. The benchmark would be the ability to engage and defeat modern Asian air forces such as those of India and Japan in the near future. This implied development of advanced fighters and force multipliers such as tankers and AWACS aircraft. In terms of force structure, such an approach emphasised additional procurement of Russian aircraft, and efforts to acquire advanced Western technology for Chinese platforms, like the attempt to procure AWACS from Israel which was cancelled due to intervention by the United States.

The above outlines different ways of thinking that the PLAAF would have designed for its future capability. Each suggests a different view about the

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66. Brig Gurmeet Kanwal, "China's Rising Defence Expenditure: Implication for India", *IPCS Issue Brief,* no 65, April 2008, p2, available at ipcs.org/ipcs-Issue Brief-No65 pdf.

67. n.65.

role the air force might play and, therefore, incorporates the structure and capability that would be appropriate. There have been indications of 'looks' beyond the region which articulate the rationale for building a military capable of global operations in defence of China and expansion in global interests. The PLA recognises that both its new defence strategy and its capability to project military power beyond China's borders depend largely upon enhancing the air force.[68] Barring an economic collapse, air force budgets should increase even if China's real defence spending slows. Nevertheless, budget limitations will still force leaders to make difficult choices about air force modernisation.

FINDING THE ANSWER

In addition to the above perspectives, PLAAF capability will be shaped by narrower decisions about the division of labour on air defence and conventional strike missions, proper trade-offs between foreign and domestic production, high-tech versus lower-cost systems and relative emphasis on support aircraft. The most likely path for PLAAF capability building will be to maintain present efforts to build the air force using a variety of means, including ongoing procurement of advanced aircraft from Russia, continued domestic efforts to design and produce advanced aircraft, and incorporation of imported engines, avionics and munitions into Chinese aircraft designs. The preference is to gradually shift away from foreign procurement and use of foreign components as the domestic aviation industry's capabilities to produce advanced aircraft and components improve.

The PLAAF's ability to absorb and employ additional aircraft of the new generation would be constrained by its capacity to train pilots and maintenance personnel and the time needed to upgrade units to operate more advanced aircraft. A heavy reliance on simulators will never be a substitute for active flying or combat experience.

The PLAAF would resist efforts to replace foreign engines and avionics with Chinese-produced equivalents that do not deliver the same performance or reliability. This could entail an inherent contradiction of goals toward a

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68. Denny Roy, *China's Foreign Relations* (Lanham: Rowman & Littlefield Publishers, 1998), p.111.

more capable force with matching domestic technological advancement. In theory, the defence reorganisation of 1998 that established the General Armaments Department should give air force requirements greater weight in procurement decisions, but this may not be true in practice, given the hierarchical status of the PLA. The capability of conducting and supporting joint operations would rely heavily on networking and to employ air power effectively, therefore, the development capability and pace on this front will dictate the empowerment of the air force from acquisition

Both the ground forces and the navy have realised that they need a powerful air force to fulfill their own organisational aspirations, and thus will be inclined to devote significant funds and, consequently, efforts, to its modernisation.

to importance. The PLAAF enjoys at least one bureaucratic advantage: both the ground forces and the navy have realised that they need a powerful air force to fulfill their own organisational aspirations, and thus will be inclined to devote significant funds and, consequently, efforts, to its modernisation.[69]

CONCLUSION

The PLAAF has made impressive progress towards comprehensive force modernisation, but it may require an additional 10-15 years before the process is complete. Several obstacles stand in the way. The most visible impediments are hardware deficiencies and significant shortfalls in key weapon systems essential in offensive air operations. The PLAAF has a large inventory that contributes little to capabilities and will require substantial additional effort, time and resources to maintain till replaced. Modernisation has also been hampered by lengthy delays in fielding command and control and air surveillance aircraft, essential for the air force to extend its reach beyond the shoreline. Development of new operational concepts and doctrine is faced with the PLAAF's lack of recent combat experience though significant changes are underway in the training programmes. The PLAAF began building the overall

69. Ibid., p.112.

foundation during the 9th Five-Year Plan (1996-2000) for an air force capable of conducting simultaneous offensive and defensive mobile operations and has made reasonable progress on all fronts during the 10th Five-Year Plan (2001-2005). It is already clear that the future People's Liberation Army Air Force is marching towards a more modernised force and build-up rate during 11th Five-Year Plan (2006-2010). Key indicators for capability enhancement will rest not only on leadership perceptions but also the success rate of indigenous production and foreign procurement outcomes. The element of uncertainty will rest between accepting a lesser capable air force with a mix of equipment and personnel with varying degrees of deliverance capability or a significantly smaller but more capable air force.

FORCE MODERNISATION: PRINCIPLES AND PRACTICE

SUJEET SAMADDAR

Force modernisation has, in the recent past, become a blend of art and science. It is a science because it follows a well defined process of information gathering, analysis and generation of alternatives that facilitates objectivity and enables rational decision-making. But it is also an art. It requires careful drawing together of a complex mosaic of strategic and technological threats and opportunities that must not only reflect the big picture of the capabilities required but must also portray forces that produce these capabilities. Force modernisation is, thus, a complex process that must necessarily evaluate the strategic environment, available and forecast technologies, budgets, domestic industrial capacities and human skills to determine force generation, force structure and force composition options for the future. Force modernisation practitioners must balance the skills of the art of the possible with the science of the pragmatic.

Force modernisation has clear advantages and disadvantages. Force modernisation results in induction of cutting edge technology; improves the Mean Time Between Failures (MTBF) and thereby ensures higher reliability of critical systems; produces a more consolidated capability footprint; and,

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Since force modernisation is capital intensive and risky, substantial and sometimes frustratingly long analysis to overcome catastrophic consequences, becomes inescapable.

usually reduces the burden on and of manpower. But, there are disadvantages as well, of which the foremost is the high capital cost of induction. The necessity for extended trials which tie up existing resources and the risk that the technology/ platform choice can itself be so wrong that the modernised force may face a radically different threat requiring completely different capabilities than was determined at the time of the investment decision are some of the other pitfalls. Since force modernisation is capital intensive and risky, substantial and sometimes frustratingly long analysis to overcome catastrophic consequences, becomes inescapable. The moot principle must remain one of caution and deliberation. Wisdom lies in adopting a cautious approach that allows some forces to continue with legacy systems for today's combat environment, a little investment into future systems to cater for tomorrow's conflict and finally setting aside a definite proportion of the modernisation budget for generation-after-next technology systems. The expertise of the professional lies in determining these proportions.

In this paper, I will deal with the conceptual underpinnings of force modernisation. I will begin by describing the process, spell out certain principles and review the existing practice and finally sum up with some recommendations.

PROCESS

The force modernisation process has certain key components. Firstly, it requires analysis of the emerging strategic and technological environment. Secondly, a functional understanding of the role of modernised forces to serve the national interests in both the literal and regional contexts requires some knowledge of the foreign policy of the state. Thirdly, an objective assessment of the challenges, opportunities and vulnerabilities that exist or that may arise during the envisaged period of the modernisation process

must also be made. Finally, force modernisation programmes need to be firmly tethered to an objective assessment of the broad budgetary support that may be available. The last would, of course, be determined by the popular support that force modernisation programmes enjoy amongst the political leadership of the state.

Whilst the ends and means are clearly enunciated, the ways are dynamic, variable and sensitive to a host of uncertainties.

THE SECURITY NARRATIVE

The Legacy Security Narrative

Ways, ends and means have formed a strategic continuum over time. Nations have traditionally defined the objective of security as the ability to achieve a desired end state that would ensure robust economic progress, wholesome human development and the ability to conduct a sovereign foreign policy without encumbrances and restrictions. To achieve these ends, the objective is to, firstly, ensure that the shared global commons of the sea, air, space and cyberspace are not dominated by any one state alone; secondly, sovereign land and sea borders remain tranquil; and, finally, the country is internally stable. The means available to achieve these objectives are the diplomatic, military, information and economic resources of the nation, of course, underpinned on good governance. Whilst the ends and means are clearly enunciated, the ways are dynamic, variable and sensitive to a host of uncertainties. For force planners, the state's security apparatus must be vested with flexibility that is geared to make an effective response to a challenge, exploit an opportunity and overcome vulnerabilities. These tasks require a mix of forces that are able to deliver the three basic requirements of the legacy security narrative:

- Military force should be able to *deter aggression* by both punishment and denial.
- Military force should be able to *defend interests* through a direct action or an implied threat.

The competition for resources would be one of the important drivers of national strategy of the future.

● Military forces must at least *maintain the status quo* by achieving a military balance in one's own favour to prevent any revisionist action by an adversary.

The Neo-Security Narrative

The future security environment has thrown up certain new distensions which do not easily fit into the legacy security architecture. Energy, and with it the Sea Lanes of Communications (SLOCs), has become a crucial component of national security. The protection of under sea structures, trans-oceanic cables, fisheries and seabed mining; the vulnerability of strategic choke points and water ways; increased preponderance of maritime terrorism and piracy that upset the economic activity of a state have combined to devolve certain additional components to maritime security. There are also new ways of thinking that are emerging in the modern era – the revolution in military and marine affairs, rapid advances in information and communication technologies, new diplomatic mechanisms that create new-fangled instruments that restrict the ability of countries to exercise violence to achieve national objectives amongst others. Also, dwindling commodity, minerals and energy resources and heightened competitiveness of markets due new entrants who can sell cheaper are also posing serious economic threats to states. Whether these threats would be balanced through diplomacy and negotiation or settled by force – particularly in the case of scarce resources – is not known.

These trends and thought processes are converging towards creation of a neo-security narrative which has the following main features:

● The competition for resources would be one of the important drivers of national strategy of the future. Strategies of coalition and cooperation with states and territories which possess the resources or provide the access to energy, commodity and mineral resources – so vital for the generation of wealth of the nation and the well-being of its people – would be increasingly inclined towards achieving energy, commodity and mineral security.

- Command over resources that produce goods is alone not sufficient for progress. These must be sold or exchanged in international markets. Hence, the competition for markets would be the other driver. The emergence of the vast market potential of the Brazil, Russia, India, China (BRIC) economies is already fostering new alliances and partnerships. It is possible that the future security structure would support a revival of the mercantilist approach to the conduct of international relations.

This brings me to the emerging discipline of what I call secunomics[1], which is the study of security implications of the economic policies of a state. Fig 1 below depicts the broad subject classification of the science of secunomics.

Fig 1: Secunomics
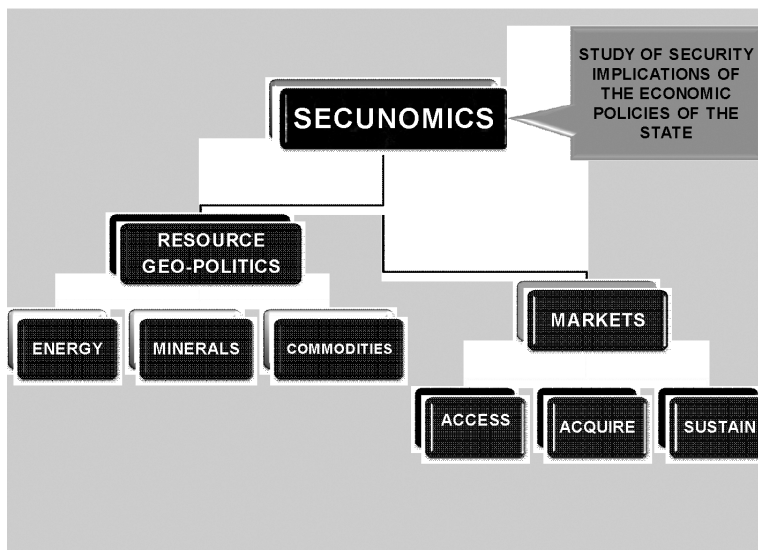
Force modernisation proposals that factor the neo-security narrative together with the legacy security architecture, have an element of risk. A likelihood and impact analysis of the risks creates a demand pull for naval capabilities, as summarised in Fig 2.

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1. Sujeet Samaddar, "Resource Geopolitics, Markets and Navies: The Competitive Advantage of Surface Combatants," Seminar on Future Surface Combatants, RUSI, London, UK. June 03-04, 2008.

Fig 2: Demand Pull for Naval Capabilities

DEMAND PULL FOR NAVAL CAPABILITIES

Catastrophic	LIMO
□ WMD Attack by a State	□ Unconventional Aggression
□ *Capability Requirement:* Nuclear Forces 　□ Denial Elements 　□ Punishment Elements	□ *Capability Requirement :* 　□ Coastal Security Forces 　□ Composite Forces
Conventional	Constabulary
□ Conventional Conflict	□ Breaches of the Municipal and Custom Law of the State
□ *Capability Requirement*: 　□ Sea Control 　□ Power Projection 　□ Sea Denial	□ *Capability Requirement :* 　□ *Law Enforcement Forces* 　□ *Patrolling and Safety*

Establishing Demand does not provide Force Modernisation Solutions, It only provides options, for decision makers to optimise

TECHNOLOGY ASSESSMENT

A second critical factor for determining the direction of force modernisation is the assessment of where technology would move and how it would impact upon the capabilities of future forces. Whilst this would be the subject matter of a seminar by itself, in this paper I would highlight certain concepts to illustrate its importance in the force modernisation process. These are:

- **Stealth**. Whilst rapid strides are being made in the design, creation and application of radar transparent materials and paints, infrared (IR) suppression, and acoustic reduction technologies, particularly in the production of aircraft, and unmanned aerial vehicles, there is also a movement towards counter-stealth technologies that move away from detecting the target and instead focus on determining the movement and, thus, locate the target. Advances in precision laser techniques that penetrate the airframe and attack specific components that render equipment dysfunctional are a challenge to stealth machines.

- **Network-Centric Operations**. Networking capabilities are being developed

to introduce multi-spectral data fusion, sensor-shooter segregation and real-time battlespace awareness. However, concurrent advances in anti networking capabilities are also beginning to take form. These relate to creation of systems and weapons that attack the core infrastructure that facilitates networking.

- **Weapons Technology.** Whilst highly sophisticated lethal weapons including tactical nuclear weapons such as the famed Daisy Cutter and bunker busters are being developed, the science of non-lethal weapons and directed energy weapons that reduce collateral damage and loss of life are also being developed.

- **Propulsion**. So far as propulsion technologies are concerned, the move is towards creation of hybrid systems such as electro-mechanical and electro-solar propulsion systems and the use of alternate fuels such as bio-fuel and fuel cells and, of course, highly enriched uranium micro nuclear reactors in ships and submarines

- **Signal Processing and Information and Communication Technology (ICT)**. Advances in signal processing and highly sophisticated software that enables reduction in signal noise ratios are creating new paradigms in sensor technologies, particularly integrated Electronic Warfare (EW) and radar detection systems.

- **Advanced Technologies**. The science of robotics, nano-technology and intelligent materials are moving rapidly towards highly efficient application in combat systems and augmenting personnel effectiveness in battle. Together with advances in biotechnology and cognitive science, a fundamental shift in how matter and mind can be exploited militarily is already at the conceptual state.

Once these technologies are coalesced, it would facilitate networking of air, sea, space and cyberspace forces. It would serve the twin purpose of ensuring full spectrum battlespace awareness and delivering integrated combat power at a place and time of own choosing. On the down side, such networked and technologically enabled forces would be vulnerable to electro-magnetic, cyber space and anti-satellite weapons.

Force modernisation planners have to proceed on some assessment of the anticipated budgetary outlays that would support committed liabilities and yet provision for new schemes.

BUDGETARY COMMITMENTS

Another factor that is an equally important determinant to force modernisation plans is the crucial consideration of the budgetary provisions that would support the venture. The picture, as far as allocation to the defence sector is concerned, is somewhat less than optimistic. Defence allocations have dwindled from a high of 4.3 per cent of Gross Domestic Product (GDP) in 1987-88 to 1.98 per cent in 2008-09. Defence expenditure as a percent of Central Government Expenditure (CGE) has also similarly been trounced from 22 per cent in 1971 to about 15 per cent in 2008-09.

Force modernisation planners have to proceed on some assessment of the anticipated budgetary outlays that would support committed liab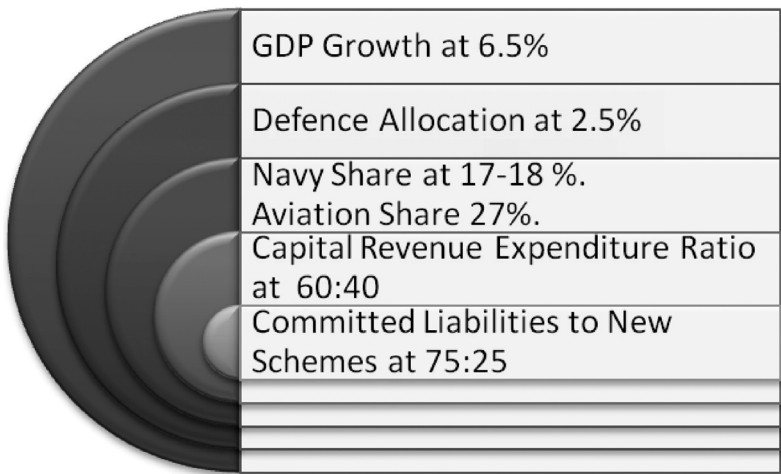ilities and yet provision for new schemes. This is a difficult task and some indicative benchmarks that are taken into consideration in the process of force modernisation are summarised in Fig 3.

Fig 3: Planning for Budgetary Support

GDP Growth at 6.5%

Defence Allocation at 2.5%

Navy Share at 17-18 %.
Aviation Share 27%.

Capital Revenue Expenditure Ratio at 60:40

Committed Liabilities to New Schemes at 75:25

REPLACEMENT OR RECAPITALISATION

Life Span of Combat Platforms. Assuming that the electronic generation era is at 12 years, 54 per cent of the platforms/assets are more than two generations old and their efficacy in battle is highly suspect. Therefore, whilst the combat *potential* in terms of ships, submarines and aircraft is premised on numbers of listed assets, combat *power* that can be delivered reflects the actual capability of the forces. It is evident that the combat *power* that is exercisable is less than half of the combat *potential*. This is an important aspect to determine the future course of modernisation. The choice for force modernisation planners is to either recapitalise an existing asset or replace it with a new one and this choice is not easy. The value addition that recapitalisation provides needs to be balanced against the cost and the period over which replaced equipment would remain combat worthy. Replacement decisions also need to factor the lead time in acquiring a new platform and whether the resultant intervening vulnerability is an acceptable risk.

> **Whilst the combat *potential* in terms of ships, submarines and aircraft is premised on numbers of listed assets, combat *power* that can be delivered reflects the actual capability of the forces.**

Industrial Capacity. Force modernisation plans must also take cognisance of the feasibility of operationalising its prescriptions. The foremost requirement is to first determine that the domestic defence industrial base is able to support the capability definitions and the induction timelines. This requires a formal calculation of the loading of each production centre in terms of its manufacturing capacity so as to determine what can be built in India and what needs to be sourced from abroad. Fig 4 illustrates the methodology adopted towards making a capacity assessment for a production unit. It can be seen that there is a shortfall in capacity till 2017 and, therefore, these projects would not be completed within the allocated time and resources. The conclusion such an assessment offers is that Project 'C' would need to be ordered on a separate unit if the force levels are to be achieved in the requisite time-frame.

Fig 4: Schematic for Assessing Domestic Capacity
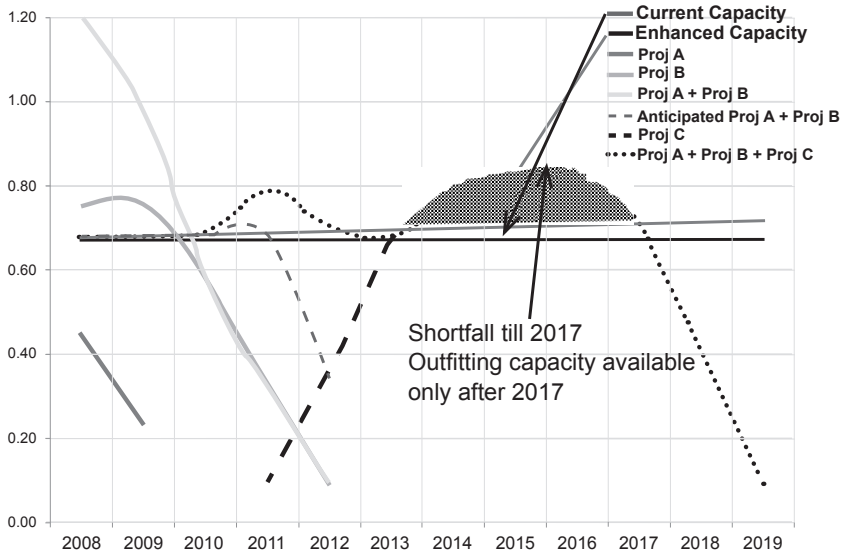
PRINCIPLES

In this section of the paper, I argue that the force modernisation programmes are likely to be more successful if they are conceived within a set of principles. These principles are not scientific in nature – in the sense that there is no firm causative relationship between input and output – but are instead a body of advice for the force modernisation professional. These principles may or may not work in tandem and neither can they be considered in isolation but for every modernisation programme, each of these principles would apply in a measure that is unique to that programme.

Focussed. A modernisation programme must remain focussed on the specific capability that is intended to be achieved for the future forces. Central to any modernisation programme for the armed forces is the overriding requirement to possess such capabilities that succeed in combat operations and sustain it for a defined duration before and after such operations are completed. Therefore, force modernisation must be anchored to a clear Concept of Operations (ConOps). Other capabilities that are sometimes factored in the modernisation process and which detract from the main focus of the modernisation effort are

issues such as operations other than war, support of friendly governments, non-combat missions such as humanitarian assistance and disaster relief operations and UN operations under Chapter VI, Chapter VII, etc. In building up a focus, the first principle is to modernise so as to effectively implement the ConOps first efficiently and subsequently, with cost implications examined in

The force modernisation programmes are likely to be more successful if they are conceived within a set of principles.

the end. National security is paramount and must be achieved at all costs since there is no half way house between victory and defeat in war.

Responsive. A second principle is that a modernisation programme should be clearly responsive to the combat environment. Strategically, modernisation programmes must take cognisance of possible alliances and coalitions that can create new challenges or lead to a competitive arena which could be a source of conflict. Emerging technological advancements and how to induct future technologies into present platforms and generation-after-next technologies into future platforms is the second consideration. Doctrinal changes in warfare such as concepts of asymmetric warfare, space-based warfare, cyber warfare and command and control warfare is a third input to which the modernisation programme could be responsive.

Competitive. This principle enunciates that the modernisation programme must secure a clear competitive advantage over the adversary. Such advantage can be brought about, firstly, through technological superiority; secondly, through higher combat capacity which includes volumes and numbers in excess of these possessed by the adversary; and, finally, greater capability (which is the product of capacity and competency) to exploit combat forces. For example, a capability in night fighting and waging of all weather operations results in a competitive advantage over an adversary who is blind by night and incapacitated by weather and thereby unable to fight – a fissure that can be leveraged for victory.

Time Horizon. Modernisation programmes should be considered along a continuum of time, with specific prioritisation for near-term, mid-term and

Modernisation planning is a visionary exercise and is only likely to succeed when the apex leadership supports intelligent initiative, innovative enterprise and progressive thinking rather than staid and conventional risk-averse decision-making.

long-term requirements that provide for a holistic integration of the capacity building process. For example, clearly in the near term, the prime requirement of a seamless coastal/border security structure that would prevent recurrence of the 26/11 carnage should be the foremost modernisation objective. Investment in sophisticated surveillance systems and procurement of high speed craft, helicopters and Unmanned Aerial Vehicles (UAVs), must first be addressed before oceanic or strategic forces are created. Similarly, in the mid-term, force modernisation programmes must accord priority to ensure the security of the national maritime and air zones. In the long term, force projections and other military-diplomatic forces can be considered. This is not to state that any one time horizon of modernisation needs to be at the exclusion of the other. Balanced force levels, through intelligent modernisation programmes that can meet each contingency to varying predefined degrees of capacity can be created simultaneously.

Rational. This principle states that the best is the enemy of the good. In striving to get the best Service Requirements (SRs), most modernisation programmes fail since the specified SRs are so stringent that they are usually not deliverable in the period envisaged. However, some cases have been successful and programmes with rather esoteric SRs have seen the light of day. Guidance for rational SRs formulation, that would support the force modernisation process, could be:

- Select SRs that are deliverable in the near-term.
- Formulate SRs that are feasible in the mid-term.
- Conceive SRs that are imaginable in the long-term.

Visionary. This principle states that there are no quick fix solutions to the process of modernisation. Modernisation planning is a visionary exercise and

is only likely to succeed when the apex leadership supports intelligent initiative, innovative enterprise and progressive thinking rather than staid and conventional risk-averse decision-making which only furthers personal ambitions and actually harms the modernisation process. Future security imperatives such as the military-diplomatic response to the neo-security narrative that has been discussed earlier in the paper calls for a consolidated approach towards building capacities that provide options exercisable in a war of resource geo-politics and market access. It requires conceptualising stratagems that address military vulnerabilities that prevent realisation of the objectives of the state. Such an approach requires enlightened staff work that can anticipate emerging trends and leadership that can act on them so as to significantly reduce decision risk in force composition and force structure as well as find new opportunities from future scenarios that these trends support.

Concurrent. The quality of a force modernisation proposal derived from classical project management theory is bound by the elements of time, scope and cost. If any one element is fixed, the other two need to be adjusted so that the quality of the force modernisation proposal is realised within the allocated budget, meets the defined scope, and is delivered on time. Whilst the modernisation of platforms and assets is being implemented, it is equally important that

Fig 5: Concurrent Modernisation
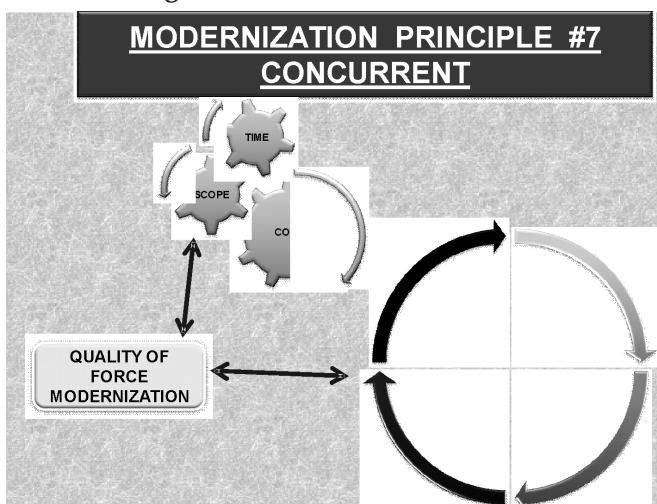
If India is to truly develop into a major military power, it is imperative that the nation's military forces have the full support of domestic industry.

concurrent attention is paid to development of newer skills sets and competencies in human resources, development of associated infrastructure which needs to be modernised, as well as modernisation of the procurement systems and process itself .

Build in India. If India is to truly develop into a major military power, it is imperative that the nation's military forces have the full support of domestic industry. These principles suggest that when examining modernisation options for equipment induction, the favoured vendor should be an Indian enterprise, albeit with foreign tie-ups, if necessary. The nation's domestic production base needs to be strengthened to support the needs of the military. Various options that can be considered in this endeavour include establishment of joint venture and production hubs that cater exclusively for products that have a high volume of demand among the three Services and possible applications in the paramilitary and civilian sectors as well. UAVs and helicopters are two such products from the aviation sector that come to mind immediately. Such products, and the list is far longer than the two items mentioned, must be domestically produced since they have applications in both the civil and military sectors. The way ahead would be to first create the production base in India and then explore markets abroad. Such an approach would result in development of an indigenous vendor/sub-vendor base and also contribute to the global supply chain for these products. The second aspect of building in India requires investment in defence Research and Development (R&D). Whilst the Defence Research and Development Organisation (DRDO) may have the over-arching responsibilities towards defence R&D, the private sector also needs to chip in with product improvement and technologically enhancing the existing version together with innovative applications as a joint partnership among industry, academicians, cooperative R&D centres and industry itself. Such initiatives must, of course, be supported, or, at least, encouraged, by the state.

Policy. Governmental support through innovative policies that encourage the private sector to invest in defence products is mandatory to support the modernisation process. Force modernisation practitioners should be vigilant to identify opportunities where well structured governmental intervention can be conducive to encouraging domestic industry to enter the defence sector. Firstly, a fixed 26 per cent cap on Foreign Direct Investment (FDI) for all defence products may not be attractive for foreign investors. Instead, FDI limits could be fixed at the Request for Proposal (RFP) stage on a case by case basis, including accepting a higher FDI in sectors or products where a specific competitive advantage can be gained. These advantages could accrue from access to specific niche technology or establishment of production facilities in specific geographic regions which are socially backward or undeveloped. A second way to provide support to the defence industry would be through specific sops, as have been offered to the Information Technology (IT) sector, to make investment in defence products an attractive option for Indian industry. Some other sops that can be considered are tax and duty exemption for investment into R&D of defence products, creation of exclusive Defence Industrial Zones which have a Special Economic Zone (SEZ) status, accord of deemed export status for offsets, and governmental support for assured orders for products developed by Indian industry which conform with Service requirements even on a single vendor basis.

Budget for a Plan. Force modernisation can only succeed if the appropriate budgetary support has been catered for, and modernisation contracts are fair and equitable to all parties. Considering the long gestation periods and associated risks of the modernisation process, budgeting realistically becomes an important consideration for successful modernisation. Hence, modernisation programmes must include a safety factor and defined exit points which ensure that budgets sought are in

> **Force modernisation can only succeed if the appropriate budgetary support has been catered for, and modernisation contracts are fair and equitable to all parties.**

accordance with a plan that has progressive and identifiable milestones towards achieving the required capabilities. This would also require force modernisation practitioners to structure contracts that provide for inflation and associated price escalation based on mutually agreed formulae. Such an approach leads to three modernisation options. Within the constraints of time, scope and cost of the modernisation programme, the options that can be exercised are summarised in Table 1 below. These options have been defined as the "modernisation," "modernisation plus" the "modernisation plus plus" options. The attendant benefits and risks associated with each programme are indicated in the table:

Table 1: Summary of Modernisation Options

| MODERNIZATION OPTIONS		
	RENOVATION (MODERNIZATION)	UPGRADATION (MODERNIZATION +)	TRANSFORMATION (MODERNIZATION ++)
APPROACH	• REPLACE LEGACY EQUIPMENT WITH CURRENT GENERATION TECHNOLOGY	• EVOLUTIONARY TECHNOLOGY ON EXISTING PLATFORMS • INFUSION OF NEXT GENERATION TECHNOLOGY IN NEW PROJECTS.	• REVOLUTIONARY TECHNOLOGY • INFUSION OF GEN AFTER NEXT TECHNOLOGIES IN NEW PROJECTS
OBJECTIVE	PRESERVE STATUS QUO	PREVAIL IN CONFLICT	PREVENT CONFLICT
CAPACITY	CONVENTIONAL	CONVENTIONAL & NON CONVENTIONAL	CONVENTIONAL, NON CONVENTIONAL, UNCONVENTIONAL.
RISK	TENUOUS BALANCE	FAVOURABLE ODDS	GAIN COMPETITIVE EDGE
FINANCIAL SUPPORT	MINIMAL / REVENUE	CAPITAL REVENUE	R&D, CAPITAL REVENUE

In concluding this section, it is reemphasised that the blended mix of adversarial forces and conflicts that characterise the neo-security environment requires a balanced portfolio of capabilities. Exchanging numbers for capabilities follows the law of diminishing returns since no matter how high-

tech a platform can be, it can only be in one place at one time and, therefore, quantity has a quality of its own. Sophisticated capabilities in high end war-fighting do not automatically take care of low intensity operations. Modernise, upgrade or transform, replace or recapitalise are key considerations for force modernisation and the central purpose of these principles is to provide indicative guidance to the planners.

PROCESS

The Defence Procurement Procedure, Edition 2008(DPP-08), specifies the methodology to be adopted for the acquisition of capabilities. The Procedure is no doubt transparent, objective and rigorous. Whether it is efficient, effective or economic is debatable. Be that as it may, it is the *de facto* procurement policy of the state and that fundamental position is unaltered and, therefore, force modernisation planners would do well to remain within the stipulated guidance and procedures that the DPP-08 provides. This means that beginning with the categorisation itself to the issue of RFP and subsequent technical and

Fig 6: The Acquisition Game
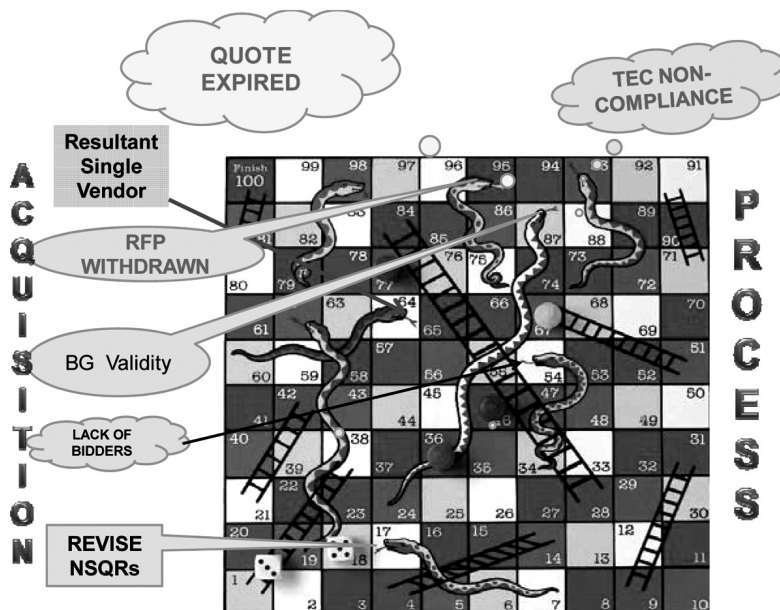
commercial evaluation of the options should all strictly conform to the DPP. Even if it takes a little longer to prepare the basic proposal, provided the end product is technically and procedurally compliant, this delay would be more than compensated by the ease with which the proposal would be processed. In a lighter vein, the acquisition process is quite like the snakes and ladders game (Fig 6). One never knows which roll of the dice (read mood of the government) will take you up the ladder or make you slide down the snake.

MODERNISATION OF THE FLEET AIR ARM

 Drawing from the earlier discussions of threats and interests that arise from the considerations of the primacy of resource geo-politics and markets as the possible central focus of future security policies of the state, the Fleet Air Arm would need to move much further, much faster, more often, and sustain for much longer durations. This essentially translates into an overwhelmingly strong focus on the sustainability and survivability of aviation assets. Provision of fuel and ensuring high MTBF of equipment become of paramount importance for greater sustainability. Options for fuel support can be through buddy refuelling or from accompanying tankers. High MTBF would require greater reliability through better product design, quality and materials. To reduce down time modular construction, canisterised weapons and repair by replacement as the maintenance philosophy, would need to be adopted. What these requirements dictate is a set of concurrent acquisitions that would have to be processed together with the main proposal. For example, if repair by replacement is the maintenance philosophy then a substantial float in spares would be required and this may well exceed the specified scales of present-day acquisitions. Similarly, some analysis of the buddy or tanker option would need to be undertaken to accordingly tweak the main proposal to include these assets.

Survivability of these expensive assets is a key consideration of the force modernisation programme. This would require specifying standards for features of stealth – optic, electro-magnetic (EM) or acoustic; capabilities for surveillance in the optical, radar, cyber and electronic support measures

(ESM) spectrum; and, a capacity for self-defence to ensure that last ditch defence is almost impenetrable. Hence, future aerospace forces must reflect flexibility in construction through plug and play systems, upgradeable expansion slots and essentially modular mission specific assemblies. Since the cost of acquisition will become increasingly prohibitive, airframes must be survivable for a life of at least 30 years. Such an approach would see through at least three generations of weapons and accessories and

Future aerospace forces must reflect flexibility in construction through plug and play systems, upgradeable expansion slots and essentially modular mission specific assemblies.

at least two generations of the propulsion plant on the same airframe with minimal rework on cabling, hydraulics and ducting. In summary, the force modernisation planner is seeking value for money in all his acquisition efforts. Assets must have short build periods and enjoy long MTBFs. They must be assured of high reliability and demand low maintenance and whilst they must look formidable, they must also have insignificant signatures.

The Indian Navy is seized of the awesome potential of aerospace power at sea. There is, today, hardly any facet of maritime operations that does not use some or the other component of aerospace power. Accordingly, almost a quarter of the modernisation budget is allocated towards aviation acquisition programmes and this does not include aviation related infrastructure or aviation equipment which is budgeted for separately. Some of the acquisition proposals, not including avionics and ground-based equipment, of the Navy are mentioned below:

- Eight P-8I LRMR aircraft being procured from M/s Boeing.
- Additional MiG 29Ks being processed with the RAC MiG.
- Additional KM 31 AEW helicopters along with associated equipment and stores being progressed with M/s ROE.
- Negotiations for Advanced Jet Trainers (AJTs) in an advanced stage with Hindustan Aeronautics Limited (HAL).
- Induction of Heron UAVs from M/s IAI Malat, Israel, as a repeat order under process

- Global RFP issued for procurement of six MRMR aircraft
- Global RFP issued for procurement of sixteen multi-role helicopters.
- Global RFP issued for upgradation of eleven Kamov 28 helicopters.
- Global RFP Issued for upgradation of 17 Seaking 42B helicopters.

SUMMATION

I have argued in this paper that force modernisation is a mix of art and science and requires substantial understanding of various factors such as the strategic and technological environment, technical and financial evaluation of the replacement and recapitalisation options, budgetary considerations and the crucial consideration of the future concept of operations. I have suggested some principles that the force modernisation planner can consider before an investment decision is made. Force modernisation needs to be anchored to specific objectives in the long, medium and short terms but these objectives are not at the cost of the others. Force modernisation programmes are not useful unless they achieve a competitive advantage to prevent conflicts. In essence the "modernisation plus plus" model is supported, provided budgetary allocations are available. Whilst formulating esoteric SRs for the future force, clear deliverables of specific capability with precise exit points, if timelines and costs are not adhered to, must be elaborated in every indigenous modernisation proposal that requires domestic R & D support. Force modernisation should be treated as projects and must, therefore, be bound by scope, time and cost within strict and fixed SRs. Whilst the platform or asset is under acquisition, the principle of concurrency should not be overlooked, and human resources (HR), infrastructure and systems and processes should be simultaneously modernised.

Force modernisation programmes are not useful unless they achieve a competitive advantage to prevent conflicts.
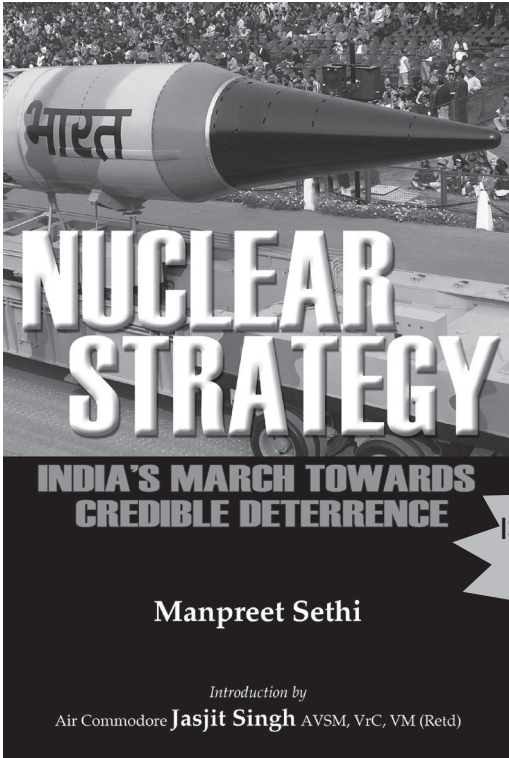
No country can become an influential power in regional or global politics unless it manufactures its own armament in its own arsenal. Force modernisation

must recognise this important parameter and the effort should be to "Build in India" even if it cannot be "Built by India" for the time being. Once factories are located in India, the vendor base would grow and indigenous participation would increase in these ventures. Quite obviously, the Services cannot alone take this up further. All stakeholders must join together in facilitating creation of a sound (niche) defence production base in India and if future force modernisation programmes are to succeed, this is indeed a necessary condition. To facilitate the success of such an initiative, mission driven collaboration among the Services, industry, DRDO and academicia for specific products (UAV/helicopters) to secure at least a regional leadership in a niche segment can be conceived.

The present era is full of opportunities for the modernisation of India's armed forces.

The present era is full of opportunities for the modernisation of India's armed forces. The Services must, together, formulate a plan that seeks specific investments with governmental support for procuring evolutionary systems to meet near-term contingencies and also provides for generation-after-next systems that would catapult India into a major manufacturing base for defence products in the long term. Most of the essentials are in place; land and skilled labour are inexpensive; markets exist; concessions and encouragement from the Services and the government are available; and, some indigenous R & D in certain areas is of world standards. However, it cannot be left to defence PSUs (Public Sector Undertakings) and the DRDO alone to develop new technologies and products but they must partner with the private sector to develop futuristic generation-after-next war winning technologies.

In effect, what is required is a comprehensive, all inclusive force modernisation strategy that will prepare India to meet every eventuality in an uncertain future on its own strength. That strength is a sophisticated indigenous defence industrial base.

भारत

NUCLEAR STRATEGY

INDIA'S MARCH TOWARDS CREDIBLE DETERRENCE

Manpreet Sethi

Introduction by
Air Commodore **Jasjit Singh** AVSM, VrC, VM (Retd)

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HISTORY AND EVOLUTION OF NETWORK-CENTRIC WARFARE

SANJAY PODUVAL

*Know your enemy and know yourself; in a hundred battles
you will never know peril.*

— *Sun Tzu*

The history of war is replete with instances of a player using superior knowledge garnered from various sources to gain a war winning advantage. The fact is that the more knowledgeable player has the advantage of being able to anticipate the opponent's moves and deployment patterns and is better poised to field to his assets to fashion the desired results. The "various sources" referred to are the extension of the eyes and ears into an adversary's domain which constitute the information deriving web. This, when properly coordinated and with proper security, timeliness and reliability, forms a war winning network. Referring to the "network," environment as a noun, means an interconnected group or system, while "to network" denotes the act of interconnecting. Networking is not novel; it has evolved over a period of time and its methods have changed. Network-centric operations deal with shaping networks to exploit the emerging environment to one's advantage. The fundamental philosophy of Network-Centric Warfare (NCW) is that the

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The roots of today's NCW can be traced back to the time when telegraphy was introduced.

network makes the difference. The aim of this paper is to trace the roots of NCW in the context of the present. The paper also endeavours to highlight a few of the important features which have developed to enhance the speed, precision and lethality of operations.

TRACING THE ROOTS

Historically, every nation has sought to create a "usable military advantage" over its enemies and potential adversaries to create an asymmetric advantage in its favour. Therefore, providing fighting forces the most accurate intelligence, surveillance and reconnaissance information is nothing new to the military. The need to be connected with the troops has been an essential requirement since times immemorial. Information was passed by means of hand signals, smoke screens, drum beats, etc for tactical positioning. Visual communications had reached a peak by the end of the 18th century and were the primary means of communications for forward control. Large and small flags, heliograph and oil lamps with shutters for night communications were utilised. Skilled operators could signal from 8 to 12 words per minute.

However, the search for usable military advantage relied heavily on acquiring superior technology and instruments of warfare, besides devising superior military strategy and tactics. The roots of today's NCW can be traced back to the time when telegraphy was introduced. The British used wireless telegraphy extensively during the Second Boer War 1899-1902 in South Africa. Strategically, the telegraph was used for communication with the home government in London by submarine cable. In the theatre, the land line was used to control formations down to the level of divisions and occasionally lower later in the war. During the Boer War, the telegraph battalion's section laid 18,000 miles of telegraph and telephone cable. A total of 13,500,000 messages were handled in four years. It was also the first time a telegraph battalion provided technical and strategic communications for

the army when Gen French used telegraph and telephones to control artillery fire.[1]

Radio Communication

The Russo-Japanese War which broke out in the year 1904 as a result of the conflicting interests between St. Petersburg and Tokyo was probably the first war which exploited the newly introduced radio systems to communicate plans with their respective forces at sea. The radio equipment was more user friendly, less cumbersome and did not require a specialist for operation. The Japanese fleet commanded by Admiral Togo, had set up a system of continuous

The Japanese fleet, because of better coordination between the ships and helped by Admiral Rozhestvenskiy's decision of a complete radio blackout, enabled the Japanese to have an information upper hand which resulted in a famous victory for Admiral Togo.

surveillance by carefully positioning their patrol ships at key locations. The success of Admiral Togo's plan relied on the premise that he would have maximum early sightings because of tactically positioned ships and, more importantly, swift early warning by radio. In short, the whole plan was based on the efficiency and speed of radio communication network without which the Russian ships commanded by Admiral Rozhestvenskiy could slip through. In the battle that followed, the Japanese fleet, because of better coordination between the ships and helped by Admiral Rozhestvenskiy's decision of a complete radio blackout, enabled the Japanese to have an information upper hand which resulted in a famous victory for Admiral Togo. The important issue here, even when networking was in its primitive stage, was that it was a double-edged sword. Had Admiral Rozhestvenskiy decided to disrupt the Japanese communication, which was very much possible, the outcome of the battle may well have been different.

The Austrians were probably the first to realise that this weakness was an excellent means of acquiring political and military intelligence which was

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1. "The Second Boer War 1899-1902", http://www2.army.mod.uk/royalsignalsmuseum/displays/boer_war/index.htm

previously obtained through costly and dangerous espionage missions. In fact, when a political crisis arose in 1908 as result of the Austro-Hungarian Empire's annexation of Bosnia and Herzegovina, the Austrians intercepted and deciphered Italian radio traffic through their network and used this intelligence to shape their foreign policy.[2] This was perhaps the first time in history that the course of a military campaign conducted hundreds of kilometres away was followed move by move by technical means.

Air Defence Systems

Networking progressed many notches with the advent of radars. Radar was developed in great secrecy in Great Britain, and from 1937 to 1939, it developed into the core of the world's first integrated Air Defence (AD) System known as Chain Home (CH). This consisted of twenty-one 300-foot masts sited along the east coast of Britain, its coverage stretched from the Isle of Wight to the Scottish border, forming a network of radar defence, supported by Chain Home Low (CHL) Stations, which were able to detect low flying aircraft. [3] Following the outbreak of World War II, they were put into action during the Battle of Britain. The Chain Home System was complemented by Ground Control Intercept (GCI) radars which vectored the air defence fighters on to the hostile aircraft formation. In addition to the control of air defence fighters, Britain had set up a defence system which brought all the weapons available into play.

Chain Home radar stations, which could 'see' an enemy raid, in some cases while it was still over France, were positioned all along the coast. The raid was reported to Fighter Command Headquarters (FCHQ) where it was passed down to the Group Headquarters, which further passed it on to the Sector Control Rooms affected by the plot. The entire system was meshed for information sharing in both directions. The height of the raid was provided by Observer Corps posts once the raid came within visual sighting range. The sector controller then knew exactly where the enemy were and alerted the

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2   Bartholomew Lee, "Radio Spies," http://www.trft.org/TRFTPix/spies9eR2006.pdf

3.   See http://www.radarpages.co.uk/mob/chl/chl.ht m

balloon sites in possible target areas to put up a balloon barrage. The balloons forced the German pilots to fly their bombers higher, which made bombing more difficult and also ensured that the intruding aircraft were in the radar envelope for as long as possible. The sector controller also forewarned the anti-aircraft gun sites along the route of the raid of the ensuing raid so that they were ready to fire when the enemy came within range. Most importantly, the sector controller could scramble fighters from his sector airfields and vector (direct) them towards the incoming raid. In order to vector the defending fighters on to an incoming raid, the controller had to know exactly where they were. The last link in the defence system, keeping track of the Royal Air Force (RAF) fighters, was Direction-Finding or D/F radio stations. These also reported to their local Sector Control Room. The RDF information was crude by modern standards, but was more than sufficient to give bearing and range information on an incoming raid. This information was transmitted to all other sectors in the command to keep the "big picture" spread throughout the system. By doing this, the loss of a single Sector Control Room did not destroy Fighter Command's ability to function as an effective defence. As a result of this deployment, when the German offensive actually began on August 12, 1940, the German bomber pilots, much to their surprise, found that the British fighters systematically placed themselves in advantageous positions and managed to time their confrontation over the English Channel. Winston Churchill summed up the effect of the battle and the contribution of the Fighter Command with the words, "Never in the field of human conflict was so much owed by so many to so few."

The Kammhuber Line
In 1940, Col, later Gen Josef Kammhuber was tasked to build a night air defence for Germany in 1940, which came to be known as the Kammhuber Line.[4] Initially, the Kammhuber Line involved an extensive network of searchlights, radars, and night fighters based in occupied France, Belgium, and Holland, covering approach routes of the British bombers. Early on, searchlights illuminated each

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4. Air Vice Marshal J.P.R. Browne and Wg Cdr M.T. Thurbon *Electronic Warfare*, Vol IV (Ritna Books).

bomber as a Messerschmidt Bf-110 or Junkers Ju-88 night fighter assigned to that area closed in for the kill. In 1941, a radar-controlled master searchlight was introduced which made the Kammhuber Line even more effective by locking onto bombers automatically and illuminating the target with a pale blue guide beam that manually directed searchlights could pick up.

Radar-directed searchlights gave way to a more elaborate system of search and tracking ground radar and radio stations, known collectively as the "Himmelbett" system. A Himmelbett station consisted of a Freya radar for early warning with a range of 60 to 150 km, a Würzburg radar for plotting bombers, and a second Würzburg radar was utilised for guiding the fighter aircraft. Each Himmelbett zone or "box" had a radius equal to the range of the Würzburg tracking radar (about 43 km wide and 34 km deep). These boxes were the building blocks of the improved Kammhuber Line. Target range, altitude, speed, and bearing data were sent to a ground control station that directed the fighters towards the British bomber stream. RAF bombers flying into Germany or France had to cross the Kammhuber Line at some point, and the Freya radar operators would detect them and direct Würzburg radars to illuminate the plane. All position reports were sent to the Himmelbett Control Centre thereby allowing controllers in the Himmelbett Centre to get continuous updates on the positions of both planes. The second Würzburg radar controlling the German fighters would direct them to intercept the now illuminated bomber. Thus, each night fighter was like a spider at the centre of an invisible web of beams.

The Bekaa Valley Conflict

Over the years, command, control and communications capability progressed steadily, improving the operating picture provided to commanders at various levels. The Bekaa Valley conflict carried this further. The conflict, known for bringing Electronic Warfare (EW) to the fore and the innovative use of Unmanned Aerial Vehicles (UAVs) in the battlefield was also important in the manner in which the more intangible network was used to decisive war-fighting advantage.

It was the first combat operation involving the use of the modern Airborne Early Warning and Control system (AEW&C) aircraft, the E-2C Hawkeye.[5] It could scan three million cubic miles of air space, monitor over 200 aircraft simultaneously and control up to 130 separate air-to-air engagements at ranges up to 250 miles.[6] This capability enabled the Israeli Air Force (IsAF) to detect Syrian aircraft as they took off, allowing it to determine how many

The Bekaa Valley conflict provided the first example of warfare in real-time in which air reconnaissance and distribution of its results to attacking forces was carried out almost simultaneously.

hostile aircraft were inbound and from which direction. The Israelis also used F-15s in the rear as "mini-AWACS" to help manage air-to-air engagements. The integration of these systems ensured a high level of situational awareness. The Israeli aircraft were vectored to the 'blindside' of Syrian MiGs which had only nose and tail threat warning receivers. They also effectively neutralised the Syrian radar and communication systems, leaving them isolated and vulnerable to AWACS directed attacks from F-15s and F-16s. The result was chaos within the Syrian formations.

Another technological innovation was the use of UAVs. They were used not only as decoys but also as intelligence gathering platforms for finger printing the Surface-to-Air Missile (SAM) radar frequencies and streaming almost 'real-time' video to the E-2C Hawkeye and to the command and control centres on the ground. The SAM complexes were neutralised as soon as they were switched on. They were targeted by surface-to-surface missiles or by anti-radiation missiles launched from F-4 Phantoms. Overall, the Bekaa Valley conflict provided the first example of warfare in real-time in which air reconnaissance and distribution of its results to attacking forces was carried out almost simultaneously in rapid succession, closely coordinated by AWACS and ground stations using

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5.   Frank J. O'Brien, *The Hungry Tigers: The Fighter Pilot's Role in Modern Warfare* (Blue Ridge Summit, Pa.: Tab Books, 1986).

6.   David M. Russell, "Lebanon Proved Effectiveness of Israeli EW Innovations," *Defense Electronics*, October 1982.

secure and reliable communication and video links in an electromagnetic intense environment.

A magnified version of this was evident in both the Gulf War of 1991 and Iraq War of 2003. The shift in focus from the platform to the network is obvious. The emphasis now is to view actors as part of a continuously changing ecosystem rather than as independent entities.

THE WEB AS WE KNOW IT

Network-centric warfare can trace its immediate origins to 1996 when Admiral William Owens introduced the concept of a "system of systems" in a paper of the same name published by the Institute National Security Studies. Owens described it as the serendipitous evolution of a system of intelligence sensors, command and control systems, and precision weapons that enabled enhanced situational awareness, rapid target assessment, and distributed weapon assignment. As a distinct concept, however, NCW first appeared publicly in a 1998 US Naval Institute Proceedings article by Vice Admiral Arthur K. Cebrowski and John Gartska. "Network-Centric Warfare: Its Origins and Future." It described a new way of thinking about military operations in the information age and highlighted the relationship between information advantage and competitive advantage. Given the short period of time that has transpired since then, there has been an enormous amount of progress in getting the fundamental tenets of network-centric operations understood.

The term "network-centric warfare" broadly describes the combination of emerging tactics, techniques, and procedures that a fully or even partially networked force can employ to create a decisive war-fighting advantage. Network-centric warfare is an information superiority enabled concept of operations that describes the way forces will probably organise and fight in the information age. NCW generates increased combat power by networking sensors, decision-makers, and shooters to achieve shared awareness, increased speed of command, high tempo of operations, increased lethality, and greater survivability.

NCW TODAY: A BIRD'S EYE VIEW

The utility of networked information produced by integration of radars, communication systems, AWACS, Joint Surveillance Target Attack Radar System (JSTARS), etc is beyond dispute. NCW today envisages the integration of information from all sensors and making it available, as required, wherever required, to the authorised recipients. The objective is to provide a very high level of situational awareness that will, in its wake, lead to greater efficiency in the prosecution of war. The availability of information is not intended to be a one-way street, but field units can also demand information in real-time and vice versa. With an effective network, the geographic location of the controlling authority becomes irrelevant. It could occupy a permanent/relocatable location, immaterial of where the battle is being waged. With good situational awareness and communications, quick decisions can be arrived at, transmitted and implemented. This is a considerable advantage. A few of the factors which have ensured that NCW plays a prominent role in today's conflicts are discussed below.

> **NCW today envisages the integration of information from all sensors and making it available, as required, wherever required, to the authorised recipients.**

Advancements in Information Technology

Armed forces are going through a transformation due to advancements in Information Technology (IT) in a network-centric enterprise. Though the concept may be relatively new and still developing, many commercial organisations have achieved considerable success by tapping their potential. For example, Wal-Mart, originally had a central purchasing department. But when the decision was made to share information directly with suppliers, instead of a central organisation, the need for this part of the organisation went away. Costs were reduced and performance increased. This shift to point-of-sale scanners to track weekly store sales enabled it to price goods at less than the prevailing rates.

The growing importance of IT in warfare will also change the way intelligence agencies support conventional conflicts.

By providing information directly to suppliers, Wal-Mart eliminated the platform-centric purchasing department at each store, thus, reducing operating costs and improving control over its stock. Sharing information to reduce its sales cost below the industry average enabled Wal-Mart to exploit its already dominant position in the retail sector.

This has been made possible because IT is undergoing a fundamental shift from platform-centric computing to network-centric computing. The significant investment the IT sector makes in Research and Development (R&D) and product development (in some cases up to 18 per cent of sales) has led to key technologies that have created the conditions for the emergence of network-centric computing. This shift is most obvious in the explosive growth of the internet, intranets, and extranets and the development of Transmission Control Protocol/Internet Protocol (TCP/IP)[7], Hypertext Transfer Protocol (HTTP)[8], Hypertext Mark-up Language (HTML)[9], Web browsers (such as Netscape Navigator, and Microsoft's Internet Explorer), search engines, etc. These technologies, combined with high-volume, high-speed data access (enabled by the low-cost laser) and technologies for high-speed data networking (hubs and routers) have led to the emergence of network-centric computing. Information "content" now can be created, distributed, and easily exploited across the extremely heterogeneous global computing environment ideal for business and being adapted to suit the requirements of the defence forces.

The growing importance of IT in warfare will also change the way intelligence agencies support conventional conflicts. New technology will collect real-time

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7. TCP provides reliable, ordered delivery of a stream of bytes from one programme on one computer to another programme on another computer. IP handles lower-level transmissions from computer to computer as a message makes its way across the internet.

8. HTTP is an application-level protocol for distributed, collaborative, hypermedia information systems. Its use for retrieving inter-linked resources led to the establishment of the World Wide Web.

9. HTML is the software which allows one to move around the web by clicking special text called hyperlinks identified by mark-up tags.

intelligence for fast changing tactical engagements, but the communications systems available at present are far too slow for disseminating these high-tech indications and warnings. Faster means of delivering—and protecting—raw collection are being devised, so that real-time intelligence can be sent directly to shooters without detouring through multiple echelons of military intelligence analysts. Super-high-speed free-space laser communications links will be the technological cornerstone of future military satellite communications.

Compressing the Time Factor in the OODA Loop

The Observation, Orientation, Decision and Action (OODA) loop identified during the 1970s by US Air Force strategist John Boyd, is an abstraction which describes the sequence of events which must take place in any military engagement. The opponent must be observed to gather information, the attacker must orient himself to the situation or context, then decide and act accordingly. The OODA loop is fundamental to all military operations, from strategic down to individual combat and has been an inevitable part of reality since the first tribal wars centuries ago, as it is fundamental to any predator-prey interaction in the biological world.

At a practical level, what confers a key advantage is the ability to stay ahead of the opponent and dictate the tempo of engagement to maintain the opposition off balance. The quest to reduce timelines has been central to war-fighting which entails operating inside the OODA loop. In effect, the attacker forces his opponent into a reactive posture and denies him the opportunity to drive the engagement to an advantage. The impact of reduction in timelines for tactical purposes fully emerged in Operation Iraqi Freedom (OIF) during the unsuccessful but audacious attempt on April 7, 2003, to decapitate the Iraqi leadership. The strike was especially noteworthy for the way it saw information on the whereabouts of the Iraqi dictator, which emerged at very short notice, transmitted rapidly to Allied air planners and then to the B-1B. "We confirmed the co-ordinates and then it took about 12 minutes to fly to the target and release the weapons," said Lt Col Frank Swan, the weapons systems officer on the aircraft. The crew had previously been tasked with attacking

Throughout history, military leaders have recognised the key role of information as a contributor to victory on the battlefield.

an airfield in western Iraq.[10] It is noteworthy that the OODA loop which took 3-4 days during Operation Desert Storm, was reduced to just 45 minutes during OIF. In effect, the player with the faster OODA loop, all else being equal, will defeat the opponent with the slower OODA loop by blocking or preempting any move the opponent with the slower decision cycle attempts to make.

Information Superiority

Throughout history, military leaders have recognised the key role of information as a contributor to victory on the battlefield. Commanders have always sought—and sometimes gained—decisive information advantage over their adversaries. The writings of both Sun Tzu and Clausewitz reflect the key role of information in warfare.

While network-centric operational concepts are being adopted and applied by different nations, the evolving concepts are underpinned on the understanding that information will play a critical role in increasing the military effectiveness. Technological advances in recent years have vastly increased the capability to collect, process, disseminate, and utilise information. Airborne and space-based sensors are, for example, capable of providing real-time pictures of increasing dimensionality (hyper spectral) and resolution. Perhaps the most significant advances have come in the technologies related to the distribution of information. The ability to broadcast information, distribute it to a large audience, or to deliver it in a more focussed manner (narrowcast), even to individuals on the move, has dramatically increased. The sharing of information across an organisation and its partners affects and influences all aspects of an operation.

The key factor in warfare that will prove decisive is the ability to acquire and move information rapidly and deny the enemy the ability to do the same, or at

10. "What Went Right"?, *Jane's Defence Weekly*, April 30, 2003. http://www.oft.osd.mil/library/library_files/article_63_Jane.doc.

the same pace. Information processing will become central to the outcome of future battle scenarios. While information has always played a major role in any past conflict, establishing information superiority/dominance over the enemy will become a major focus of the operational art in the future. Information systems will be required to collect data in a form that is directly interpretable and useable by the shooter because one of the key elements of this information dominance will be

The key factor in warfare that will prove decisive is the ability to acquire and move information rapidly and deny the enemy the ability to do the same, or at the same pace.

sensor-to-shooter fusion. Conventional tactics effectively used in conjunction with information gathering assets and high speed networks will be crucial to victory in future conflicts.

C4ISR

Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) is the domain where information gathered is converted to actionable knowledge. This forms the central nervous system of a defence organisation. The key technologies in information age warfare are remote-sensing, communications and computer technologies. One of the main steps and something many nations are now trying to implement, in becoming an efficient military at waging warfare is bringing all elements of C4ISR and weapon systems into a common actionable network. The trend started with the US operations in Afghanistan when the predator UAV armed with Hellfire missiles controlled by operators in Nellis Air Force Base in California were able to identify, track and shoot the vehicle carrying Al Qaida operatives in Yemen on November 3, 2002.[11]

The military's ability to move data from the reconnaissance platform to the weapon system able to take action, the so-called sensor-to-shooter sequence, generally required at least 80 hours in Operation Desert Storm, as imagery

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11. Chelsea Emery, "Unmanned-Flight Technology Takes Off," Reuters. http://www.usatoday.com/tech/news/techinnovations/2003-11-17-drone-flight_x.htm

from a satellite or reconnaissance aircraft had to be analysed, identified as a target, turned into hard-copy, and intensively studied by the aircrew before a weapon could be dropped accurately. In Operation Enduring Freedom, the personnel of land-based Special Operations Forces (SOF) identified a Taliban troop concentration, relayed the target coordinates to the Combined Air Operations Centre in Saudi Arabia and received permission to call in an air strike. Before calling the strike, the exact coordinates of the enemy were again determined using the Global Positioning System (GPS), and the coordinates were transmitted to a loitering B-52 bomber which again used GPS to guide bombs onto the target. The whole operation was completed in less than 20 minutes of the original identification of the target. Similarly, Predator UAVs have been able to transmit live video pictures to waiting AC-130 gun ships, which were able to attack moving targets.[12] These operations taking place at short notice, against time critical targets illustrate the importance of amalgamation of C4ISR assets. This is particularly relevant in today's context where non-state actors present dispersed and fleeting targets. Technologically, the challenges are in integrating present day platforms to provide one coherent picture of the battlespace, reducing the need for operator intervention between systems of basic technical data.

Reach and Richness

Historically, one was forced to choose between a rich information exchange with very limited reach (e.g. face-to-face discussion aided by graphics, maps, etc) or a restricted information exchange that had a wider reach (e.g., memos, dispatch). This choice was forced because in the past the economics of information dictated an inverse relationship or a trade-off between the richness of the information that could be exchanged and the number of individuals it could be exchanged with. As the state-of-the-art in information technology advanced, military communications progressed from runners to smoke signals and signal flags to telegraph to radio to telephone to video

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12. David A. Fulghum, "Intel Emerging as Key Weapon in Afghanistan," *Aviation Week &Space Technology*, March 11, 2002, p. 24.

teleconferencing to a fully functioning collaborative work environment. The explosion of information and communications technologies has dramatically altered the richness and reach of information. The key variables are the state-of-the-art IT and its underlying economics. As individuals and organisations have become better able to extend their reach, they have begun to focus on the quality of reach as well as the quantitative aspects of reach. It has only been within the last decade or so that individuals and organisations have been able to provide high quality information to those who need it and in the manner they need it.

The quality of reach and richness was clearly evident in the video Teleconferencing (VTC) between Gen Wesley K Clark, Supreme Allied Commander Europe (SACEUR) and North Atlantic Treaty Organisation (NATO) leaders from 19 counties during the Kosovo conflict. They would collectively view the results of the previous day's bombings over a secure transmission environment and go over the plans for the coming day. The meeting seemed like a normal one except that the participants were hundreds of kilometres apart. [13]

Common Operating Picture

A Common Operational Picture (COP) is a single identical display of relevant (operational) information (e.g. position of own troops and enemy troops, position and status of important infrastructure such as bridges, roads, etc.) shared by more than one command. A COP facilitates collaborative planning of operations and assists all echelons to visualise the development of threats by integrating pictures from all information gathering sensors. It facilitates commanders at lower formations to act without intervention from the 'top'. This has the effect of making operations smoother, faster and less confusing. This is analogous to a pride of lions attacking their prey. Each member operates in a manner to augment the actions of the other, in effect making the result superior to the sum of the different parts.

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13. Micheal Ignatiff, *Virtual War* (New York: Metropolitan Books Henry, Holt and Co, 2000), p. 102

The real significance of NCW is the value addition it provides to the required range of participants engaged in prosecuting a mission.

With timelines in the conduct of war getting compressed, it has become necessary to speed up the pace of conflict to put the adversary at a disadvantage. The aim is to provide a high level of situational awareness collaboration, and a shared common mechanism, leading to greater efficiency and speed. A COP enables its users to receive and transmit near real-time situational updates to all systems connected to the shared network, thus, maintaining operational relevance in a push- pull fashion across the network. It also enables commanders to share critical information in a secure, distributed data network, reinforced by commonly understood procedures, training and policy.

Value Addition

The real significance of NCW is the value addition it provides to the required range of participants engaged in prosecuting a mission. Military operations in support of Operation Enduring Freedom highlighted the emergence of near-real-time information sharing as a source of war-fighting advantage. The source of power was not new platforms, but rather the networking of the legacy platforms with SOF. The extent to which ground-based SOF were able to share precision information with AWACS and attack aircraft was unmatched in military operations. It represented an order of magnitude increase in value addition in terms of information sharing over what had been previously demonstrated anywhere in the world in combat operations.

In air-to-air combat, a major contributor to enhanced survivability and lethality is an increase in shared situational awareness and enhanced situational understanding. With audio-only communications, pilots and controllers must share information generated by onboard sensors about opposing forces as well as their own position and status via voice. Communicating the minimum essential information required to take offensive or defensive actions takes time, and the resulting situational awareness can often differ significantly

from reality. In contrast, when data links are employed on fighter aircraft, digital information on friendly and opposing forces is shared instantaneously, adding value, and enabling all participants to share a common tactical picture. This improved information position constitutes a significant information advantage vis-à-vis an adversary fighting with voice-only communications. This information advantage, in turn, enables a cognitive advantage in the form of dramatically increased shared situational awareness and enhanced situational understanding. The result is that pilots flying data link-equipped aircraft can achieve much higher levels of shared situational awareness and understanding on a timeline previously unachievable with voice-only communications. They can translate these advantages into increased survivability and lethality.

THE GREY AREAS

Net-centricity has shown great promise but is still in its infancy. NCW is not a panacea, nor can it ever be. It has a number of limitations, and the intention here is to view these broadly and leave the analysis under a magnifying lens for later.

Cyber Space: The New Frontier

The attack on Estonia's paperless government was the most publicised event in the recent past. The borders were quiet, there were no incursions or air space violations but Estonia was still under attack; banks were under siege, communications were down and government machinery was unable to function properly. This was because the country was attacked by botnets[14] through its least protected border – the internet. The salient aspect of these

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14. 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. Generally, botnets are a group of computers infected with th e malicious kind of robot software, the bots, which present a security threat to the computer owner. Once the robot software has been successfully installed in a computer, this computer becomes a zombie or a drone, unable to resist the commands of the bot commander. The owners of the zombie computers usually are unaware that their computers and their computers' resources are being remotely controlled and exploited by an individual or a group of malware runners.

types of attacks is that it cannot be traced to a particular nation or computer. The intrusions into the systems are through the so-called 'back- doors'. Once infiltrated, finding the attacker is complicated because of the array of electronic screens available to mask the intruder's locations. This was the first time that a botnet threatened the national security of an entire nation. The digital invasion is new and something which most countries are trying to grapple with and find solutions to overcome the potential threat.

Queuing Up

Metcalfe's Law states that the "utility" of a network increases with the square of the number of nodes in the network: ten nodes (platforms) permit a hundred possible connections, a hundred nodes ten thousand. Unfortunately, this law is not particularly relevant to the behaviour of networked military forces. Metcalfe's Law presents a possible best case scenario for distribution of information collected by sensors on platforms in a military system. At best, it is an indicator of gains in situational awareness, assuming the data being distributed is valid, timely and relevant. The real limits to capability gains in networked systems arise from the decision-action phases of the OODA loop. Networking can accelerate operational tempo by speeding up the observation and orientation phases of Boyd's OODA loop. Unfortunately, the bounds on the capability of the 'system of systems' are imposed by the decision and, especially action, phases of the loop.

The decision phase sees a commander exploiting knowledge acquired in the observation-orientation phases, and conferring as required with his superiors and subordinates to determine the best choice of action. In the action phase, the commander must deploy his assets and effect the engagement. Both of these phases of the loop, in mathematical terms, are queuing systems. The commander must wait for others to respond, and must marshal and position assets to engage. All of these events involve one entity waiting for another, in effect queuing up.

The mathematical model which constrains such systems is Amdahl's Law, like Metcalfe's Law, a defining equation in the computer industry. The reality

Amdahl defines is simple: increasing the number of assets in the system increases the achieved work or effect at best only by the number of assets added. The actual improvement is limited by the queuing effects seen in marshalling and positioning assets to perform engagements.

The mathematical bottom line in NCW is a very simple one: networking can permit a significant improvement in operational tempo where a shortage of targeting information is the bottleneck. For example, attacking strategic and *in situ* battlefield targets like deployed armoured divisions or airfields whose targeting information is already known; networking the force will not dramatically increase the combat effect because the number of aircraft and ordnance delivered will produce the desired result. However, networking produces its greatest gains in combat during battlefield strike and close air support operations, especially against highly mobile and fleeting ground targets. In such an environment, where the opponent is continuously on the move, networking can produce spectacular gains since the bottleneck limiting force capability lies in the flow of targeting information to strike aircraft.

Overconfidence about the Effectiveness of NCW
Proponents of NCW say that shared situational awareness enables collaboration and self-synchronisation and enhances speed of command, which increases mission effectiveness. Critics, however, are concerned that dangerous assumptions are being made by military planners about how future forces will benefit from "information dominance" to such a degree that fewer soldiers will be needed, or that forces will not require as much protection because they will be able to act ahead of enemy action. They believe that the doctrine of "see first, act first" that underlies Network-Centric Operations (NCO), may be flawed because the tempo of operations may outpace the ability of forces to assess and respond. While a network may provide better access to information, usually about the activities of one's own side, that information may not be complete and may not necessarily enable an accurate understanding of the situation. For example, if NCO are intended to make wars short in duration, then inferior adversaries are likely try to draw

There is no substitute for good human judgement, as yet, and making best use of a powerful NCW apparatus requires exactly that.

forces into a protracted conflict of lower intensity, and will seek to win merely by avoiding defeat by simply denying a target for the weapon systems.

Training for Operations in a Computer Battlefield

Wars have traditionally been conducted in tangible space, but information warfare, in addition to occurring in tangible space on the ground, at sea and in the air, is conducted even more in intangible space such as in electromagnetic fields. It is not only a battlefield in which guns and bombs proliferate, but also a "computer battlefield" in sheltered laboratories and control rooms where manipulated bits and bytes can create an equal amount of chaos. One of the main steps and something many nations are now trying to implement in becoming an efficient military at waging information warfare, is bringing all branches of the military into an information network. One must not forget that electronic war is conducted by the people against the people. The combat personnel are not only the warriors who charge enemy lines for face-to-face struggles, but sometimes are the operating technical personnel who sit in front of computers and instruments where vital information and real-time communication is shared. They stand at the first line in electronic warfare and in the resistance against C4I systems. Combat personnel must, therefore, be familiar with the technical and operational aspects of the weapons and equipment in their hands and must be very well trained in their operation. They must be able to understand accurately the combat plan and resolutely and flexibly utilise weapons and equipment to wipe out the enemy. To successfully absorb NCW into a defence force, it is vital that personnel not only have appropriate practical skills, but also a proper understanding of the limitations of the machinery. There is no substitute for good human judgement, as yet, and making best use of a powerful NCW apparatus requires exactly that.

Seamless Connectivity

Provision of digital seamless connectivity between combat platforms is a major technical challenge which cannot be understated. While civilian networking of computers can largely rely on cabled links, be they copper or optical fibres, with wireless connectivity as an adjunct, in a military environment centred on moving platforms and field deployed bases, wireless connectivity is the central means of carrying information and the area is most vulnerable to interference.

The fact that military networks and civilian networks co-mingle provides another set of vulnerabilities which must be addressed, for example, during Operation Iraqi Freedom, US and coalition forces reportedly did not execute any computer network attacks against Iraqi systems, even though comprehensive Intelligence Operations (IO) plans were prepared in advance. US officials may have rejected launching a planned cyber attack against Iraqi financial computers because Iraq's banking network is connected to the financial communications network also located in Europe. Consequently, according to Pentagon sources, an information operations attack directed at Iraq might also have brought down banks and ATM machines located in parts of Europe.[15]

Many nations are now on a 'networking spree', trying to interconnect their old and new systems on a common grid with the help of optical fibre cables, copper wires, data links *et al*. The success of NCW is dependent on the ability of these systems to communicate with each other. But since there is no standardisation of architecture, software and protocols followed, each system poses a new set of challenges which impedes or prevents the smooth transfer of information even after all efforts are made to overcome them.

Information Overload

The information age has forever changed the nature of warfare. Commanders are no longer hindered by the slow delivery of information in which to

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15. Charles Smith, "US Information Warriors Wrestle with New Weapons," NewsMax.com, March 13, 2003 http://www.newsmax.com/archives/articles/2003/3/12/134712.shtml .

The proliferation of sensors in the battlefield has created what some call "data overload", where large inflows of real-time data can overwhelm users, and jeopardise the decision-making process.

make decisions that impact military operations. They are now, in fact, affected by a problem exactly opposite in nature—information/data overload. The proliferation of sensors in the battlefield has created what some call "data overload", where large inflows of real-time data can overwhelm users, and jeopardise the decision-making process. Effective engagement of a target requires location and identification of the target, which must be accurate and precise, along with other critical information such as target vulnerability (e.g. thickness of armour or fortification), speed, direction of movement, and time of sighting. Practically any one of these information pieces, if it is delayed, would only constitute bits of traffic on the electromagnetic (EM) highway. Waiting to get all the information of the target before taking a decision may actually hamper time critical decisions. The best operations picture is the enemy of the optimum one. The US Department of Defence is examining using new "data fusion" centres, which would use special software to filter out battlefield data not required by war-fighters. Also, to make sure that radio frequencies in use don't encounter interference, the US Air Force Electronic Systems Centre is working to design a universal tool which is intended to manage all radio communications traffic in tactical situations.

IS KNOWLEDGE WARFARE NEXT?

Collection, organisation and analysis of information generate knowledge. Rudimentary decision-making is already being performed by machines. Modern fuses, in cluster bomb units, for example, have basic IF, THEN, ELSE logic built in. In the case of a smart bomb, it is sufficient to know when and under what conditions to detonate. In battle, knowledge is power and is the domain of the decision-maker. In this information age, net-centricity has ensured an abundance of information. However, mere collation and

storage of information does not mean actionable intelligence. The information available should be distilled to provide the required intelligence. Considering the amount of intelligence available at present, it will be a stupendous task for operators to derive the required intelligence as it would entail coalescing information from myriad sources collected not just a few hours earlier but perhaps also spanning a few days, weeks or even months. It is possible that intelligent systems capable of doing so may be developed to derive the requisite intelligence from available information.

Right now, technology serves primarily the observation and action elements of the OODA loop. Sensors help observe targets while communications speed decisions to subordinate units or weapon systems for appropriate action. But it may not be long before technology aids begin helping commanders orient their observation tools and participate in the decision-making process and perhaps take part in the action itself. The research into artificial intelligence for the past twenty years is a step in this direction. Knowledge-based systems need to be different from the conventional ones which follow a strictly prescribed sequence of steps and operations. These systems need to be able to 'reason' and handle imprecise and fuzzy data. This, at present, is a tall order. Knowledge is represented by a set of rules and facts representing concepts and ideas. Therefore, a knowledge-based system requires an inference engine that provides reasoning and has an interface with the user. Some progress has been made in this direction for identification and prioritisation of threats, selecting and timing of counter-measures, including carrying out evasive manoeuvres – these systems, however, are still in their embryonic stage at best. But because of all the work being done on knowledge systems these days, it is quite possible that the rapid advances of information systems and information technology will give rise to a knowledge age and also to knowledge warfare. The information age won't go away, any more than the industrial age or the agrarian age has gone away. They're still important aspects to society, but they've been supplanted in importance by new conditions. Knowledge is liable to be the next revolutionary condition, but its Desert Storm-like manifestation is still a way off.

While information has always played a major role in any past conflict, establishing information dominance over the enemy will become a major focus of the operational art in the future.

CONCLUSION

The effectiveness of NCW has greatly improved over the years mainly due to development in IT. The increasing dependence on the electromagnetic spectrum can be gauged from the fact that in Operation Desert Storm a 500,000 force was supported with a 100 megabit per second (Mbit/s) of bandwidth. In OIF, about 350,000 war-fighters had more than 3,000 Mbit/s of satellite bandwidth, which is 30 times more bandwidth for a force 45 percent smaller.[16] The critical factor in warfare, that will prove decisive is the ability to acquire and move information rapidly and deny the enemy the ability to do the same, or at the same pace. Information processing will become central to the outcome of future battle scenarios. While information has always played a major role in any past conflict, establishing information dominance over the enemy will become a major focus of the operational art in the future. One of the key elements of this information dominance will be sensor-to-shooter fusion. Information systems will be required to collect data in a form that is directly interpretable and useable by the shooter. Conventional tactics effectively fused with space-based assets and high speed networks providing information superiority/dominance over the adversary will be crucial to victory in future conflicts.

The wars of tomorrow will increasingly be fought in cyberspace. Thus, intelligence services will need an increasing proportion of tech-savvy talent to track, target and defend against adversaries' IT capabilities. Cyber wars will be played out on landscapes of commercial IT; intelligence agencies will need new alliances with the private sector, akin to existing relationships between nation-states and will have to confront awkward problems such as: performing intelligence preparation of cyber battlefields; assessing capabilities and intentions of adversaries whose info-weapons and defences are invisible;

16. Lt. Gen. Harry D. Raduege Jr "Net-Centric Warfare Is Changing the Battlefield Environment", Defense Information Systems Agency" http://www.stsc.hill.af.mil/crosstalk/2004/01/0401

deciding whether there is any distinction between cyber defence and cyber intelligence; and determining who in the national security establishment should perform functions that straddle the offensive, defensive and intelligence missions of the uniformed Services and intelligence agencies.

Network-centric warfare between equals is akin to a chess game where situational awareness alone is not power and neither is pure knowledge by itself. The movement of pieces in anticipation of the opponent's move is more important than the power and position of the pieces. In NCW, knowing the move to make in relation to an anticipated enemy movement is the key.

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FOCUSSED AND DYNAMIC RESPONSE LOGISTICS

J.V. SINGH

The fact that the future is uncertain is no excuse for failing to make adequate prepa-rations. The changing threat requires that logistics be flexible, mobile, integrated, compatible, and precise in targeting support to the point of need.

– USMC Operational Manoeuvre from the Sea
US Marine Corps, Strategic Logistics Plan

Information technology must be leveraged to improve command and control which is key to timely and accurate decisions.

– Global Engagement,
A Vision for the 21st Century Air Force, USAF

Logistics management is the integrated management of the functions required to acquire, store, transport, and maintain the material necessary to support combat forces. The task of the military logistician is to establish the appropriate balance among these functions to achieve the required level of operational support while using the least amount of resources. Future logistics concepts will evolve primarily from recognition of new environments, technologies and processes. The transformation in military logistics and shrinking defence budgets has led to the evolution of what is commonly termed as "focussed logistics". For an operational commander, the basic issue

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For an operational commander, the basic issue is that of responsiveness from his logistics elements. is that of responsiveness from his logistics elements. This requirement of responsiveness of a logistics system is intimately related to the study of usage data, planning factors, the "logistics snowball", to flexibility and to "readiness". In a computer-based system, it is possible to integrate all the functions for exercising control at an appropriate level. But, sometimes, individual responsibilities or processes are neither very clear nor well defined. Large and complex organisations such as the armed forces need a rigorous management control system to ensure that each staff element performs its tasks in a manner that provides the troops with all their essential requirements in an economical and more reliable manner.

With the end of the Cold War and the dissolution of the Warsaw Pact and Soviet Union, and, hence, the disappearance of a monolithic threat to Western Europe, there has been an increasing desire to reduce defence spending and divert scarce resources into other public sector services. This increased pressure on the defence budgets has been felt in most countries and more so in democracies such as the US and most of the European countries in the West and closer home in the case of India as well. This has led to a search for ways of making a shrinking budget stretch further. In some ways, the UK Ministry of Defence (MoD) is facing the same challenges as many commercial companies did in the late 1980s and early 1990s with the recession, in their bid to reduce costs in order to maintain profitability. Thus, the Strategic Defence Review (SDR) has generated new initiatives such as "Smart Procurement" and the creation of a Defence Procurement Agency (DPA) and Defence Logistics Organisation (DLO) in order (for some, at the behest of the Treasury) to reduce costs in the procurement and sustainment of the UK's armed forces. This, however, can be seen as important due to the fact that defence inflation has for many years exceeded normal economic inflation, leading to the spiralling cost of new weapon systems. With logistics having become more important as the 20th century has progressed, and particularly since the end of the Cold War, the need for more efficient and effective logistics is becoming paramount,

as it is seen as both a "competitive advantage" and a "force enabler". In our case also, based on the Arun Singh Committee report and the recommendations of the Group of Ministers, the defence procurement organisation consisting of the Defence Acquisition Council (DAC), Defence Procurement Board (DPB), Defence Production Board (DPB), Defence R & D Board and Acquisition Wing has been created.

Logistics operations of the future will operate under an integrated, flexible, and seamless system from the vendor to the battlefield, which will govern logistics decisions and operational strategy.

"Focussed Logistics" is the latest term to enter usage in the US and this paper will examine how different it is from what has gone before, and whether it is applicable to some of the operational challenges that the armed forces might face in the near future. In addition, logistics operations of the future will operate under an integrated, flexible, and seamless system from the vendor to the battlefield, which will govern logistics decisions and operational strategy in a system called Dynamic Response Logistics. The model discussed in this paper is primarily derived from the US armed forces vision and experience.[1] However, it is now equally relevant to most of the modern armed forces including India's, as we are evolving to gain a regional role and even beyond that in today's ever shrinking boundaries.

FOCUSSED LOGISTICS

Focussed, joint and combined logistics comprises one of the four pillars of the US Joint Vision 2010, which demands that logistics support and systems "enable joint forces of the future to be more mobile, versatile, and projectable from anywhere in the world." Professor Milan Vego of the Naval War College recently observed, "Logistics is a critical element of combat power that assumes even greater importance at the operational level. It is realised that joint integration of logistics is crucial to unity of effort and the concept of joint logistics cannot be fully realised until accountability and acquisition

1. Department of Defence, US Army Home Page, Army Vision 2010 and related documents.

procedures are completely integrated." An in-depth study of combined operations conducted during the Cold War concluded, "Logistics procedures must be standardised and harmonised to provide flexibility between nations."

Clearly, several factors are fostering the change to current logistics operational doctrine. The large, cumbersome forces of the Cold War are being replaced by smaller, more agile, and more lethal forces that require a modern logistics infrastructure that can provide efficient and effective support. The current and foreseeable resource environment will continue to be constrained, with all of forces being required to do more with less. Technological advances of the information age are providing excellent opportunities for increasing productivity and efficiency. The possibilities for improving operational logistics structure are limited only by the imagination.

If the aforestated recommendations are accepted, then the US will have a real-time, web-based information system providing total asset visibility. It will provide military capability by ensuring delivery of the right equipment, supplies and personnel, in the right quantities, to the right place, at the right time to support operational objectives. The *Focussed Logistics Roadmap* charts the course for gaining full spectrum supportability across the range of possible missions envisioned in the US Joint Vision 2010.[2] It leverages the key enablers of technology innovation and information superiority in linking with the other operational concepts of dominant manoeuvre, precision engagement, and full dimensional protection. Together, these concepts for future joint operations represent an integrated approach to achieving full spectrum dominance in joint war-fighting. The purpose of this roadmap is to outline key joint initiatives that will lead to the desired future logistics capability. It describes *six tenets* of focussed logistics to emphasise a systematic, relational approach in developing full spectrum supportability. These tenets are the framework for designing a logistics template in joint war-fighting, joint theatre logistics, joint deployment/rapid distribution, information fusion, multinational

2.   R.A. Kallock, "Glimpse of the Future; Joint Vision 2010", Presented at the RUSI Focussed Logistics Conference, London, January 18-19, 1999.

logistics, joint health services support and agile infrastructure.

Given the scope of this effort, the *Focussed Logistics Roadmap* is being developed in phases. The Phase I roadmap targets initiatives that are rooted in current realities, but directly tied to enhanced future capabilities. The emphasis is on resolving near to long-term deficiencies identified by the Unified Commands and Services. Through Phase I, the US will establish the capabilities required to achieve the 2010 focussed logistics vision and provide the war-fighter both the capability and confidence required to effectively and efficiently succeed on the 2010 battlefield. In Phase II, the US

The US will continue to be faced with the daunting task of committing forces on short notice to potentially hostile environments of unknown duration. It will not have the lead-time necessary to develop the "traditional" logistics infrastructure.

will continue to refine their vision and include updates of the capabilities via electronic access to the *Focussed Logistics Roadmap*. The Phase II roadmap will enhance the direct linkage to the other operational concepts of the Joint Vision 2010 as they evolve. As such, the roadmap will remain a "living document" to serve in guiding efforts for addressing the broad range of logistics challenges in future joint operations.

In the foreseeable future, the US will continue to be faced with the daunting task of committing forces on short notice to potentially hostile environments of unknown duration. Unlike in Operation Desert Shield/Storm, it will not have the lead-time necessary to develop the "traditional" logistics infrastructure. The political leaders will come under continuing pressure to decrease defence expenditures through downsizing yet maintain high states of readiness. Force structure, particularly logistics force structure, will come under close scrutiny in an attempt to generate cost savings/avoidances. Future military operations are likely to find a great many logistics functions privatised or outsourced. The contribution of the reserve component will be an important part of the national military strategy. Joint Vision 2010 (JV2010) prescribes an operational template for dealing with this dynamic environment. It describes focussed

logistics as the fusion of logistics information and transportation technologies for rapid crisis response deployment and sustainment, the ability to track and shift units, equipment, and supplies even while en route, and delivery of tailored logistics packages and sustainment directly to the war-fighter. The goals of focussed logistics can be achieved by concentrating energies on innovative and efficient processes and products. Focussed logistics will require logisticians to more fully examine the big picture (joint and combined operations) while maintaining functional and/or service stovepipes as the other concepts of JV2010 are developed. JV2010 highlights "six critical considerations" as being essential to the armed forces reaching the next level of jointness namely, doctrine, organisations, training, material, leadership and people. These same considerations need to be taken into account in pursuit of focussed logistics. Failure to simultaneously address each of these key elements is a prescription for failure. Processes such as the Joint Monthly Readiness Review (JMRR)/Joint War-fighting Capability Assessment (JWCA) and contingency lessons learned are be factored into the efforts to achieve the goals. At the intersection of the tenets of focussed logistics and the six critical considerations are the various initiatives needed to achieve the focussed logistics vision. There is a host of possible interpretations of focussed logistics, but each has a common frame of reference, the imperative of technological advantage, the need for faster, more reliable and integrated logistics systems; and instilling "confidence" in the war-fighter that critical supplies will be in the right place, at the right time, and in the right quantity. Logisticians must now demonstrate the capability to tailor forces and resources by both expanding and contracting as the nature of the threats changes from large scale Major Theatre War (MTW) to Smaller Scale Contingencies (SSCs). Effective execution of these missions requires an adaptive, responsive and reliable logistics system to make it happen. Logistics systems envisioned by focussed logistics will include refined techniques for ensuring combat readiness and sustainment. The goal is "full spectrum support" from deployment to redeployment, reconstitution or forward deployment, enhancing both combat effectiveness and the quality of life of US forces. Logistics organisational structures will

be streamlined to right size the logistics footprint and make genuine progress in such vital areas as logistics command and control and theatre distribution. The days of multiple requisitioning of an item in the hopes that at least one will arrive when needed will become a thing of the past. The logistics footprint of the future will be a more precise balance between "just in case" and "just in time" with a goal of "just enough." Developments in Automatic Identification Technology (AIT) integrated into the Automated Information Systems (AIS) and interface with industry will enhance automated tracking of assets throughout the world. A rapid air, sea, and land transportation

The desired end state is full spectrum supportability to the war-fighter from a source of supply to a point of need, whether that be a foxhole, cockpit, deck plate, or base, while maximising the benefits to be gained from information superiority and technological innovation.

system will enable reduction in Logistics Response Time (LRT) and lead to a streamlined effective, efficient, and economical logistics system. Goals of this magnitude will require a clear understanding and synchronisation of a high-level strategy process. Information fusion and transportation technology will enable the war-fighter to replace mass with velocity and to have the confidence needed to make it work. The focussed logistics vision calls for improved support to the war-fighter through increased responsiveness, visibility and accessibility of logistics resources. The desired end state is full spectrum supportability to the war-fighter from a source of supply to a point of need, whether that be a foxhole, cockpit, deck plate, or base, while maximising the benefits to be gained from information superiority and technological innovation. To achieve that end, the *Focussed Logistics Roadmap* draws from the Office of the Secretary of Defence (OSD), Services, Unified Commands, and Combat Support Agency (CSA) strategic logistics plans. The *Focussed Logistics Roadmap* is an integral part of high-level strategy. Focussed logistics programmes have become high-profile issues within the Chairman's Programme Recommendations/Chairman's Programme Assessment (CPR/

CPA). The CPR/CPA feeds the Defence Planning Guidance (DPG), which, in turn, provides the Programme Objective Memorandum (POM) guidelines for the National Military Strategy (NMS).JV2010, and the Quadrennial Defence Review (QDR) served as the overarching structure for developing the *Focussed Logistics Roadmap* while the JWCA, JMRR, Commander-in-Chief (CINC), and Integrated Priority List (IPLs) provide the baseline issues. Understanding the relationships and interactions involved in the development of these products is key to understanding the role of the roadmap in the overall scheme. These processes and programme, along with strategic guidance provided by JV2010, provide a unique opportunity for logisticians to have significant influence on defence issues at the highest levels. As they migrate from strategic concerns to operational ones, attention turns to the enablers of JV2010, namely, information superiority and technology.

What is Focussed Logistics?

As the 21st century dawns, the rate of change in technological progress is, compared to earlier times, astonishing. With this change, mankind is potentially facing a revolution in Information Technology (IT), which will be equal to, if not greater than, the agrarian and industrial revolutions of previous centuries. With this technological change, allied with the end of the Cold War and the seeming necessity to be able to intervene effectively far away from the home base, attitudes to war are changing, along with the approach to business. In many ways, the two are converging, as the military tries to take on board some of the 'best' practices of the business and commercial world, as both are faced with significant alterations in political and economic structures, geo-political balance, technological progress and perceptions of the 'threat'.

The term "Focussed Logistics" originates with the US armed forces and is defined as "the fusion of information, logistics and transportation technologies to provide rapid crisis response, to track and shift assets even while en route, and to deliver tailored logistics packages and sustainment at the strategic, operational and tactical level of operations" (Department of Defence, 1999). The key elements here are the embracing of emerging technologies

(particularly IT), transportation techniques, business methods of asset control and the concept of 'tailoring'.

There are a few authors who suggest that focussed logistics is what in civil parlance is termed as lean and six sigma logistics. To understand the similarity and dissimilarity between the two seemingly synonymous terms, it would be prudent to first look at what lean logistics is as such.

What is Logistics?

There are as many definitions of "logistics" as there are logisticians. This is not a bad thing. Logistics is so far reaching, so integrated into businesses that it is hard for one definition to ever meet the challenge of summing up what we do in a few short sentences. Although logistics does span the entire scope of any business, it is fair to say that any definition of logistics will need to involve the management of inventory. Whether inventory is in the form of hard goods (materials-people) or soft goods (information), logisticians manage it.

What is Lean?

Lean logistics concepts are deeply rooted inside the lean manufacturing of the Toyota Production System. Jim Womack summarises the key principles of the Toyota Production System as Lean Manufacturing in his book *Lean Thinking*. Lean Manufacturing has now been abbreviated to simply being called "Lean". Lean and Six Sigma joined forces in Michael George's book *Lean Six Sigma*.

In its purest form, lean is about the elimination of waste and the increase of speed and flow. Although this may be over-simplification, the ultimate objective of lean is to eliminate waste from all processes. At the top of the list of known wastes, according to the lean theory, is the elimination of inventory. More simply, any inventory should be eliminated that is not required to support operations and the immediate need of the customer.

Lean Logistics Understanding

Supply chain management was designed to take waste out of supply chains – waste as to excess inventory, time and cost. Supply chains are meant to

pull, not push, inventory through the supply chain. This is exactly what lean logistics is also about: removing waste and variation from supply chains; it is what pull is about with lean logistics. Wholesalers, manufacturers, retailers, distributors, suppliers, 3PLs and every party involved in the supply chain feels the pressure to reduce, and balance cost, time and inventory to be lean. This is true with domestic supply chains; but it is especially true with global supply chains.

Articles titled "Japanese Automakers Taking Market Share From Big Three" or similar titles are misleading. The title would lead the average reader to think that the "Japanese" as a culture somehow have a secret that is allowing them to take over the automobile industry. However, many in the automotive industry are aware of two critical points. The first is that it is not the "Japanese" who are building the cars that are winning the car wars, as these cars are being built by North Americans in Canada and the United States. The second key point is that it is not the "Japanese" who are reducing manufacturing costs and increasing quality, but rather it is the "lean manufacturers". With all of this in mind then, the newspaper article should headline "Lean Manufacturers Taking Automobile Market Share Over Mass Producers". This headline would be more appropriate and more accurate.

Lean logistics has many challenges. Global lean logistics especially has the challenge of the additional time required for shipments to move door-to-door over long distances. In addition, there are many parties involved with each shipment. Some reports say that up to seventeen parties can be involved with one shipment: suppliers, truckers, freight forwarders, terminals, customs brokers, railroads, ocean/air carriers and more. Bringing lean across such an extended, multi-transactional supply chain is daunting. Often, the parties are working together and at odds with each purchase order/shipping transaction.

As the competitive environment changes the way companies do business, companies are embracing lean and six sigma initiatives to support cost reductions and quality improvements. Although lean and six sigma

programmes were initially separate initiatives in most organisations, today's firms see that lean and six sigma do not compete with each other, but rather the two complement each other and provide for dovetailing of continuous improvement activities.

But what does this have to do with logistics. The quick answer is "everything." Once we are grounded in lean and six sigma principles, the logistician will realise that logistics, lean and six sigma form a natural union. This union leverages the strengths and weaknesses of each discipline to create a cultural and operational model that will aid the logistician to solve age-old issues, while improving operations at all levels. To truly understand lean and six sigma logistics, the best place to start is to learn about the logistics, lean and six sigma.

Lean and the Logistician

The impact of lean on the logistician is significant, as the goal of lean is to eliminate waste (inventory) which will decrease work in process inventories which, in turn, will decrease process and cycle times and ultimately increase supply chain velocity and flow. Lean also has a vital cultural element to it that is crucial to the logistician. This is the concept of "Total Cost." The lean practitioner does not focus on individual cost factors such as transportation or warehousing, but rather on "total cost of ownership". With inventory carrying costs representing 15-40 per cent of total logistics costs for many industries, making decisions based on total cost has dramatic implications for the logistician. Unfortunately, though, many organisations never fully embrace total cost concepts, as poor decisions are continually made based on traditionally visible cost drivers like transportation, warehousing and ill-fated sourcing practices.

Six Sigma

Six sigma is a management methodology that attempts to understand and eliminate the negative effects of variation in our processes. Based on an infrastructure of trained professionals (Black Belts), six sigma delivers a

problem-solving model armed with the voice of the customer utilities and statistical process control tools. The DMAIC (Define-Measure-Analyse-Improve-Control) process is a map, or step-by-step approach, to understand and improve upon organisational challenges to reduce variation in processes and attempt to achieve "Six Sigma Quality".

At the heart of six sigma is the principle of variation reduction. Essentially, the theory is that if we can understand and reduce variation in our processes, then we can implement improvement initiatives that will centre the process and ensure accuracy and reliability of the process around customer expectations. For example, if the purchase order-delivery cycle required for your supplier in China is 60 days, and you are averaging 60 days, then you may think all is fine. However, your average of 60 days may reflect the fact that some orders arrive in 45 days and others are delivered in 75 days. It is this variation that results in expedited transportation, out of stock and all the evils of non-confidence result, the worst of which is inventory build-up.

Six Sigma and the Logistician

The concept of variation reduction is paramount to the logistician. As stated above, logistics is about managing inventory. And managing inventory is about managing variation, a driver in both the amount of inventory carried and in stock-out potential. Given the basic types of inventory, variation plays a vital role in how inventories are managed at all levels.

For example, safety and buffer stock are inventories needed to hedge against unknowns. These unknowns really represent variation. Safety stocks are maintained because of variation with supplier quality, transportation reliability, internal operations process capability and customer demand patterns. If variation from supplier to customer can be understood and controlled, then firms will be able to dramatically reduce reliance on safety and buffer stocks. Implicit in this is the seeming addiction that business seems to have to inventory.

Lean Six Sigma Logistics

Now that the three elements of lean six sigma logistics have been presented, they need to be put together to fully appreciate how they dovetail and complement each other. Remember, logistics is about managing inventory, lean is about speed, flow and the elimination of waste inventory, six sigma is about understanding and reducing variation. Therefore, lean six sigma logistics can be defined as: the elimination of unnecessary inventories through disciplined efforts to understand and reduce variation, while increasing speed and flow in the supply chain. Put this into the global supply chain and the impact can be significant to retailers, wholesalers, distributors, manufacturers and suppliers. Logistics service providers need to understand this too and their impact on reducing waste and controlling variance.

The military have a requirement for their supply chain to be as flexible as possible given the uncertain environment they now face.

Getting Started

Both lean and six sigma bring disciplines and tools to logistics. Using these disciplines and tools will allow an organisation to uncover and deal with waste (inventory) and gross inefficiencies. Although the tools are very powerful from both lean and six sigma, companies should remember that for lean and six sigma to work in logistics, a fundamental mind shift must occur. This mind shift requires that firms begin making decisions based on the concept of "Total Logistics Costs" and, second, they must have the courage to eliminate inventories that are unnecessary. This may sound simple, but reality will prove otherwise. Organisational norms and financial accounting traditions will fight against "Total Cost" and the addiction to inventory will make it difficult to reduce inventory levels.

All in the international supply chain must practice lean logistics in order to obtain dramatic, significant improvements. Waste must be identified and removed. Variation must be identified and removed.

"Focussed logistics" seeks to reduce the logistics footprint, that is, to reduce the amount of equipment and consumables that the MoD needs to store and that commanders need to take on operations.

Focussed Logistics: Evolution or Revolution

Is "focussed logistics" a new concept or an evolution from present ideas? Is it a military version of "Lean Logistics"? Lean logistics has five principles: specify value, identify its stream, make it flow, pull just in time and strive for perfection. [3]Additionally, the objective of integrating information, logistics and distribution systems is also known as "supply chain logistics". This includes "the functions of purchasing, transportation, inventory control, materials handling, manufacturing, distribution and related systems. Its primary focus is the physical flows and storage of materials and the system flows of related information."[4] It seems that "focussed logistics" is similar to "lean logistics" in many ways, but it can be argued that it is not exactly the same. Where they differ is the intention to adopt the principles of "lean logistics" in the military environment. The military have a requirement for their supply chain to be as flexible as possible given the uncertain environment they now face. In essence, they are seeking a leaner supply chain, which can support forces anywhere in the world, at short notice.

However, given that the overriding imperative seems to be that of reducing costs, the need to have a more efficient supply chain must be seen in that light. Ultimately, if revisions in the supply chain are going to be costly, then despite the military benefit, governments are unlikely to give the go-ahead as the objective for them is the reduction of defence spending. Even if the go-ahead is given, is "focussed logistics" achievable? Is it possible to utilise a leaner, more responsive supply chain tailored for the operational environment (whatever that may be)?

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3. David Taylor "Supply Chain Improvement: The Lean Approach", Logistics Focus, Corby, January 1999.

4. J.J. Coyle, E.J. Bardy, C.J. Langley, *The Management of Business Logistics* (West Publishing Company, 1992), p. 9.

The Lean Supply Chain

"Focussed logistics" seeks to reduce the logistics footprint, that is, to reduce the amount of equipment and consumables that the MoD needs to store and that commanders need to take on operations. This could be undertaken either by better predicting the rate at which resources are used, which would enable the defence industry to better

By reducing the amount of maintenance needed, it logically follows that the amount of spare parts that have to be moved through the supply chain can, thus, be reduced.

gear their rate of production within the supply chain to match the usage of the 'customer'. Therefore, the current philosophy of "just in case" (where equipment and supplies are stockpiled to cover as many eventualities as possible) would have to be replaced by a "just in time" one.[5] However, it may be that commercial just in time is too risky in an operational environment, and that the MoD will move towards a compromise position of "just enough", which should reduce inventory and make the supply chain more efficient.

The second method would be to build a greater level of reliability into systems in order to reduce the maintenance burden. By reducing the amount of maintenance needed, it logically follows that the amount of spare parts that have to be moved through the supply chain can, thus, be reduced. Correspondingly, the number of faulty parts moving back up the chain is reduced as well. As an example, during the Gulf War, the Challenger 1 main battle tank was found initially to have a poor mean time before failure rate, of around 723 km, instead of the planning figure of 1,235 km.[6] Thus, as the Challenger was substantially less reliable than anticipated, far more spares had to be moved down the supply chain, more man hours of work had to be put in to fix the problems, and more faulty parts had to move back up the supply chain.

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5. P.G. Kaminski, "The Revolution in Defence Logistics," Prepared Remarks to the 12th National Logistics Symposium and Exhibition, Alexandria, Va, October 1995.

6. David Moore, M. Bradford, Jeffrey P. Antill, D. Peter, *Learning From Past Defence Logistics Experience*: *Is What Is Past Prologue*? Whitehall Paper No .52, Royal United Services Institute , p.57.

By reducing the amount of inventory held in the combat area, reducing the throughput in the supply chain, and having a greater visibility in the supply chain, it would be possible to reduce the logistics infrastructure. Less inventory requires fewer people to maintain it and less space to store it, as well as fewer troops to guard it in the theatre of operations. Fewer consumables will mean fewer personnel and less transport assets will be needed to move these items (which, in turn, will mean fewer consumables will be required to keep those assets running) but it is important that the right material be loaded on the correct transport, at the correct time and place. The concept of tailoring resources is an important one and will be vital if a leaner supply chain is to be set up.

Focussed Logistics: The Advantages

The setting up of a "focussed logistics" system could have several advantages:

- The availability of global real-time logistics information for all those who need it (as in the United States discount chain "Wal-Mart" model). Automatic identification technology (bar codes, optical memory cards, radio frequency tags, etc.) will enhance worldwide asset tracking.
- Electronic commerce systems would allow on-line ordering and payment.
- Logistics will be centred around speed instead of mass, relying on rapid transportation systems on both land and sea, as well as in the air.
- Integrated distribution systems (supply chain integration) should improve response times, accurate delivery scheduling and forward delivery.
- The enhancement of civil-military integration should mean that the military capitalises on best business practices. Commercial lift can be used and brought onto the battlefield as a part of the force, as happened in the Gulf War. The contracting of civilian firms to provide a broad range of logistics services can be viewed as a potential force multiplier, especially in peace-keeping or humanitarian situations in countries that have little infrastructure.

- The accurate identification of future logistics requirements should allow industrial base planning, allow the MoD to target investment in critical material the supply of which in times of war is too uncertain or lead times too great.
- Logistics supply planning tools would allow real-time awareness of unit and weapon system readiness, enabling the logistician to be 'proactive' and using a 'pull' supply chain. The redesign of unit organisation should allow it to have a smaller logistics 'footprint' and act as a broker of information and integrator of supplies and services.
- Personnel should receive additional training in the use of IT and its acquisition.
- It would enhance overall acquisition reform, such as the move to the paperless contracting procedure, electronic commerce, the growth of civil military integration and the use of life-cycle management.

Overall, "focussed logistics" is designed to reduce response times and costs, produce a more agile infrastructure, and improve quality and readiness. This "faster, better and best value" support is arrived at by first identifying and then concentrating on the key elements of the logistics system, and substitutes speed of response for large "just in case" inventories. The real question is whether "focussed logistics" can actually be made to work in an operational environment, or whether it is merely a buzzword for an inappropriate business philosophy shoehorned into a military context. There is a danger of being seduced by the theory of cost saving and efficiency building implementing "focussed logistics" and then cutting overall logistics capability (or in classic British government parlance, "improving the tooth-to-tail ratio"). The Falklands campaign reminded the MoD that the "need to get the logistics right determined the ability of a formation to conduct its operations".[7] The Gulf War could have been a good opportunity to test many of the concepts

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7. Maj M.W. Proffley, "The Logistics Lessons from the Falklands Campaign and Their Relevance to Future British Army Operations, Within Defence Role 3", MA (Mil Studies) , Dissertation, September 1994, p. 16.

The immense power of emerging technology (which continues to advance at a rapid rate) has created its own myths, and produced a myopia in which technology and automation is the panacea for all situations.

now grouped under the banner of "focussed logistics" but the Coalition instead chose to build up a logistic "insurance policy". Why was this apparent lack of trust exhibited when the crunch came?

Focussed Logistics: The Disadvantages
The difficulty for the armed forces is knowing what they want and need as well as finding out what is "just enough" in order to accomplish the goals set for them. Allied to this are the possible disadvantages with "focussed logistics":

● A possible over-reliance on technology, where "a soldier who is a true information warrior may be so fascinated by what he is seeing on his laptop, that he fails to notice that his virtual battlespace is about to be violated by a real warrior with a machete who has crept up behind him."[8] The immense power of emerging technology (which continues to advance at a rapid rate) has created its own myths, and produced a myopia in which technology and automation is the panacea for all situations. As the US Deputy Undersecretary of Defence (Logistics) has said, "Information and technological advances will revolutionise warfare."[9] There is very little in the concept of "focussed logistics" that makes imaginary use of such advances.

● While many factors in the post-Cold War world have created a drive for new ideas (low threat perception and financial pressure among them) we should not "make the mistake of equating reception of concept and volume of debating noise with strategic truth." Purely basing a paradigm shift on upcoming technology (and, hence, changing the fundamental structure of our armed forces) without any true regard or appraisal as to

8. Colin S. Gray, "The Revolution in Military Affairs" in *The Nature of Future Conflict: Implications for the Force Development*, SCSI Occasional Paper 36, September 1998.

9. Kallock, n.2.

the nature of future opponents has its own dangers. Even if we make our logistics cleverer, we have not altered the conditions in which they will be tested. Technology has many advantages, but in many areas in the world, "the ultimate determinant in war is the man on the scene with a gun."[10]

- Future warfare is increasingly seen as being dominated by coalition or international cooperation. "We take it as a 'given' that the future battle space will be joint and multinational." [11] True integration between nations will be very difficult given the disparity between the budgets and size of armed forces.

- Not only is there disparity between frontline forces, but also in strategic lift. The UK has just over 60 Hercules transports and a few surface ships. The USA used some 350 transport aircraft in the Gulf War. It is capability differences such as these that raise questions about full integration. Asset tracking depends on an uninterrupted stream and a capability mismatch anywhere along the line, could prove dangerous. [12] Modern deep battle doctrine stresses the need to strike at the enemy's rear areas, where he is vulnerable and his supply system is located. If we are fighting a reasonable competent and technologically sophisticated opponent (given that we are conducting deep battle) then we can assume that he will be looking to do the same to us, that is, dislocate our fighting forces from our supply line. "Focussed logistics" has not addressed the issue of its own vulnerability to enemy action. Even an asymmetric opponent will be out to try and make sure that "just in time" becomes "just too late".

- Transportation is another central tenet of "focussed logistics". Many of the current transport methods use sophisticated technology and are thus open to exploitation. The balance between "just in time" and "just in case" as indicated by Paul Kaminski seems to rely heavily on delivery rather than storage. It requires "the substitution of fast transportation for logistics

10. Rear Admiral J. C. Wylie in Gray, n. 8.

11. Col Dick Applegate, "Towards the Future Army" in *The Nature of Future Conflict: Implications for Force Development*, SCSI Occasional Paper 36, September 1998.

12. John Campbell, I"S/IT and Organisations," Lecture to MDAI3, RMCS, March 22, 1999.

Commercial organisations are unlikely to want, or be able to leave production capacity unutilised whilst awaiting MoD requirements.

infrastructure" (Kaminski), which focusses on actual customer requirements when those requirements arise. Transportation assets are vulnerable, not only to a sophisticated opponent employing deep battle, but also to a well placed insurgent. Ships, planes, trucks and trains however mobile, are soft targets, while supplies carried with the forces are protected inside their own battlespace.

- There are risks in becoming too dependent on corporate outsourcing in that the military may cease to be an 'intelligent customer'.

- Is one of the true drivers behind "focussed logistics" that of cost? While cost and value have a legitimate place in all defence policy calculations, it is dangerous to dress them up as military advantages. "Cost was the ever present limitation. Before Hitler came to power, there seemed very little prospect of the British Army being called upon to fight a (European) land battle. Theorists spoke of the 'expanding torrent' in which armored forces, with close air support, would make deep penetrations through fortified fronts. Such expensive ideas were far too Napoleonic for an army mainly concerned with putting down riots in the colonies."

- If 'tailoring' is a cost cutting exercise, then it should be acknowledged as such and adapted to. Cutting the cloth to produce a more elegant fit is valid, stretching it until the seams go, is not. User confidence in "focussed logistics" will be essential, and cost-cutting is a great disincentive to the acceptance of innovation, particularly if it is dressed up to be something it is not.

The Tailored Supply Chain

Whatever happens in the way of moving the supply chain towards a more "just in time" approach, the MoD must match the logistic capability with its war-fighting capability. This is actually pretty diverse, with high intensity conventional warfare at one extreme and peace-time training at the other, and many other types of conflict in-between. The logistics requirements of these

two scenarios are quite different, and for the UK's armed forces to be an effective tool in foreign and defence policy, it may seem that the best solution would be to have a system that could cope with the worst case scenario – a conventional war. But that may incur additional costs in peace-time, with significant capability going unused.

It would, thus, appear that the concept of "focussed logistics", advocating as it does the tailoring of the supply chain to the operational need, provides the answer. In peace-time, the assets and resources that the military needs will be quite small. But as they begin to move along the spectrum of conflict, more assets and resources could be allocated to meet the increasing requirement. This, however, may not only have implications for the production capacity within the supply chain, but for the relationships between customers and suppliers.

Financial pressure may mean the increased outsourcing of certain services such as the maintenance of equipment, to a greater extent than happens now.

Firstly, there will be implications for the supply of material to formations on the ground that are at the end of the supply chain. Because of the rising costs of running and maintaining equipment, coupled with the high costs of certain consumables (such as ammunition, missiles and torpedoes), there is a move towards a greater reliance on simulation to cover the needs of peace-time training. If this is combined with the concepts of lean supply management, that is, keeping the minimal amount of inventory and producing goods as and when required, it is possible that the production of such goods will be small or even zero in peace-time, with the intention to gear up or even restart production if necessary. The problem, however, is that commercial organisations are unlikely to want, or be able to leave production capacity unutilised whilst awaiting MoD requirements. Chances are they will want to employ these resources, satisfying other customers, and are unlikely to divert these resources back to the MoD if it adversely affects other commercial relationships. In order to guarantee supply, it might have to purchase production capacity that lies dormant, and that could be expensive.

Secondly, financial pressure may mean the increased outsourcing of certain services such as the maintenance of equipment, to a greater extent than happens now. This may also become more commonplace as systems become more complicated and the MoD has to rely on the system's producers to maintain their product in service. While in a peace-time role, this may not present a problem, the MoD has to prepare to engage in, if need be, other operational deployments, up to, and including, high intensity conventional warfare. How the MoD satisfies this need, either by having civilian contractors or sponsored reserves is not the question. What matters is that the operational commander can be guaranteed their participation, particularly where it is a foreign company, whose government does not support the actions of the UK. Of course, the same problems could recur with regard to the tailoring of the transportation needs of the supply chain. Transport assets need to be earmarked and contracts placed, to acquire the necessary resources as the MoD's needs expand and contract according to the situation. This principle isn't new, but the SDR identified a number of flaws in the system, as did the National Audit Office (NAO) report regarding the contractoring of sealift for Operation Granby (NAO, 1993). These flaws would have an impact on one of the central tenets of "focussed logistics" – that of rapid response.

Automatic Identification Technology (AIT)

AIT ensures the capturing of current and accurate source data for existing and future Service, Agency and CINC Automated Information Systems (AIS). AIT devices include bar codes for individual items, optical memory cards for multipacks and containers, radio frequency tags for containers and pallets, and a movement tracking capability using satellite links for convoys, trains, and barges. A joint AIT implementation strategy is being developed, including use of standard data formats/media. This will maximise the efficiency of technology options while ensuring effective support of the CINCs' asset visibility requirements. The next requirement is to see, then use the data. Two key initiatives in this area are Joint Total Asset Visibility (JTAV) and In Transit Visibility (ITV).

Joint Total Asset Visibility (JTAV)

JTAV is the capability to provide users with timely and accurate information on the location, movement, status, and identity of units, personnel, equipment, and supplies. It also includes the capability to act upon that information to improve overall performance of the DoD's logistics practices. JTAV includes in-process, in-storage, and in-transit business processes. In process assets are items that are being either repaired or procured. They include items that are in repair at depot-level repair organisations, both organic and commercial; in repair at intermediate-level repair organisations; or on order from the Department of Defence (DoD) vendors and not yet shipped. These assets are categorised as either "due in from maintenance" or "due in from procurement" in DoD inventory management systems. Visibility of items being repaired begins with the turn-in of an unserviceable asset to supply for repair at either an intermediate or depot-level maintenance facility and it ends when the repaired asset is shipped to a customer or placed in storage. For items being procured, visibility begins when an item manager prepares a request to procure an asset and ends when a DoD component representative inspects and issues a receipt for the ordered asset.

Moving to in-storage, material assets encompass all classes of supply, whether categorised as wholesale or retail. For JTAV purposes, visibility of wholesale assets in storage means information on stock balances by condition code and purpose code, while visibility of material requirements means information on reorder points, requisitioning objectives (ROs), and retention limits. Visibility of retail assets consists of stock balances by condition code and assets on order. JTAV implementation focusses on both a global perspective and a near term in-theatre capability based on an operational prototype deployed in support of the Operation Joint Endeavour (OJE). As JTAV evolves, the objective is to minimise duplication of data while optimising visibility of that data within the GCSS vision by any box, by any user, anywhere in the world. The global perspective includes visibility of the increasing focus on direct vendor delivery operations. The JTAV vision also includes full integration with the Joint Personnel Asset Visibility (JPAV) initiative and

comprehensive medical asset visibility initiatives such as the Theatre Medical Information Programme (TMIP). To address ordnance total asset visibility, the DoD established a Corporate Management Information Strategy to develop a common ammunition automated information system. This system, called the Ammunition Management Standard System (AMSS), will provide the war-fighter peace-time and war-time ammunition support. Full implementation of JTAV is completed as targeted by FY99; however, complete implementation will depend upon the Final Operating Capability (FOC) of the Global Transportation Network (GTN), AIT implementation, and systems selection to track assets in process, in storage, and in theatre. JTAV is the foundation upon which DoD-wide asset visibility and accessibility is based. This requires horizontal integration of the supply and transportation activities and one-time data capture. It also requires using automated information systems all the time, every time. Source data can then be electronically positioned. AIT can be used for nodal update and to provide source data in the event of a communications failure. It can also be used for real-time tracking of units. The end state is a seamless information capability that replaces the traditional division of the logistics pipeline into wholesale, retail, and in theatre.

In-Transit Visibility (ITV)

While JTAV includes in-process, in-storage, and in-transit functions, the functional proponent for in-transit visibility is USTRANSCOM. ITV specifically refers to the ability to track the identity, status, and location of DoD unit and non-unit cargo, passengers, and medical patients from origin to the foxhole, during peace, contingencies, and war. As the single manager for the Defence Transportation System (DTS), USTRANSCOM has developed the GTN as its command and control automated information system. GTN provides the automated tool for command and control and business operations of the DTS. ITV is a by-product of USTRANSCOM's operations, and GTN provides ITV for all DoD customers. GTN gathers data from a number of DoD, Services, agencies, and commercial transportation systems to satisfy USTRANSCOM's command and control needs and DoD's ITV needs. GTN will provide the

visibility to improve both movement efficiencies and command and control of the transportation pipeline. One of the key systems to provide information is under development. Transportation Coordinator's Automated Information Management System II (TC-AIMS II). TC-AIMS II was selected as the joint migration system to integrate disparate Service unique, installation level systems. It will provide actual source data on people, equipment, and sustainment throughout the deployment/ redeployment process as well as the day-to-day movement of people and cargo. GTN achieved Initial Operating Capability in March 1997 and Final Operating Capability in January 1999.

Total Asset Visibility
The theatre logistics structure must include the capability to redirect or cross-level critical items of supply from one organisation to another. For maximum efficiency, the senior operational logistics commander must have total asset visibility and control of all available resources and supplies. The existing and proposed logistics systems do not provide a logistics commander with total asset visibility or with the authority he needs to accomplish this cross-levelling task. For example, during the war with Iraq, over 41,000 containers of supplies were delivered to the theatre of operations, and approximately 28,000 of them had to be opened just to determine what they contained. Additionally, if the marine corps in the theatre were short of Ml tank ammunition, it was the joint theatre logistician who had to try to cross-level supplies from an army organisation if possible.

Flexibility and Responsiveness
In times past, there was an assumption in the MoD that transport assets could be obtained from commercial sources if the need was sufficiently great. In the SDR, the MoD announced its intention to purchase four more roll-on/roll-off ships and four large strategic lift aircraft (C-17 or equivalent) (MoD, 1998) in recognition that while resources such as these may be obtainable, given sufficient lead time, the time-frames that the MoD may sometimes have to deal with makes it unlikely that commercial resources would be available. This is another

Environment, technology and process changes have enabled military and business logisticians to significantly increase support while achieving dramatic reductions in total cost.

possible Achilles heel with "focussed logistics".

Of the few definitions that exist of "focussed logistics" none defines rapid response in terms of time-frame. The British Army holds combat units at varying states of readiness, some as little as 24 hours. As a benchmark, however, it anticipates being able to deploy a fully operational brigade in 30 days. Any logistics support for this formation must, therefore, be able to respond in the same time-scale. It is unlikely then, that in a normal situation, civilian production facilities, support assets and transport assets will be available at such short notice unless they remain uncommitted to other ventures and earmarked solely for MoD use, which in all probability will command a premium price. It may, therefore, be more cost-effective in certain situations to rely on military assets rather than civilian ones. If the operation then becomes a prolonged one, the commercial assets could be used in the longer term, thus, releasing military assets to once again be held for short notice contingencies.

DYNAMIC RESPONSE LOGISTICS

Logistics, combined with strategy and tactics, will continue to shape command planning and decisions into the future. Commanders will continue to have "the responsibility to create, to support, and to employ combat forces." Logistics will play a major role in the command of aerospace forces through "the creation and sustained support of weapons and forces to be tactically employed to attain strategic objectives."

A task at hand is to reduce the logistics 'footprint' and decrease the size of the logistics 'tail'. This statement is easy to articulate but challenging to achieve. The paramount goal for the military logistician in 2025 will be to provide a responsive, agile logistics system to support military operations in an effective and efficient, manner (dynamic response logistics). A critical requirement for any logistics system in 2025 will be that it operate similarly in

both war-time and peace-time environments.

Environment, technology and process changes have enabled military and business logisticians to significantly increase support while achieving dramatic reductions in total cost. For example, deregulation of transportation modes in the 1970s and 1980s allowed organisations to achieve higher levels of customer service through the trade-offs of inventory and safety stocks for faster, less expensive, and more reliable transportation. Changes in technology and information management have resulted in logisticians trading "inventory for information" and using more timely information to anticipate customer requirements. Process changes have also significantly affected logistics support by reducing cycle and repair times, reducing non-value-added interfaces and transactions occurring among logistical functions, and more clearly focussing on those activities that provide the greatest value to the customer.

The environment, technology and process innovation will continue to act as the major agents of change within military logistics. The environment will shape logistics practice through changes in air and space missions, resource availability and business logistics practice. Technological changes and improved information management will allow the logistician to bring state-of-the-art decision-making and hardware to bear on logistical problems. Process changes will streamline the flow of material from source of supply to the ultimate customer. The future logistics structure will be dominated by a "pull" process rather than the predominant "push" process in use today.

Changing Environments

By the mid-1990s, changes in the environment in which military logistics operates were already blooming. By 2025, the fruits of these changes will transform the current logistics system into one barely recognisable as a peculiarly military system.[13] The environment has been especially affected by three significant changes. First, the end of the Cold War has impacted the structure of a military force which had for a generation been prepared

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13. D. Craig, M. Brant, Lt Col Karen W. Currie, Ph.D, "Dynamics Response Logistics, Changing Environments, Technologies and Progress," a Research Paper presented to the Air Force 2028, p. 5.

for a global struggle against a powerful adversary, including the possibility of widespread nuclear war. Second, commercial business practices have undergone major modifications as companies have focussed on quality, productivity and international competitiveness. Finally, as a subset of business, logistics processes have benefited from greater attention paid to customer service, leaner organisations and strategic alliances. All three areas will influence military logistics in 2025.

Military Changes

With the disappearance of the Soviet Union as the United States' (US) central adversary, scenarios for future wars will likely focus on ethnically and nationalistically based regional conflicts rather than global conflicts, with the possibility of simultaneous regional conflicts. Thus, the US must plan for quicker, more intense and conceivably more lethal wars. The US may find that higher proportions of logistics needs are related to various humanitarian missions, interspersed with brief but intense sessions of supporting battlefield needs.

The US will develop dynamic response logistic support, capable of both rapidly tailoring support packages to particular circumstances and responding with standardised kits for shorter, higher tempo operations. As recent US military operations have shown, there will be more work with, and support from, allies. However, the US must be prepared to muster a force independent of that provided by allies, either from collateral assistance by way of direct support(troops and material) or through indirect support (basing rights).

The growth of the joint responsibilities for many logistics functions – the roles of the Defence Logistics Agency in supply and distribution, the Defence Contract Administration Service in contract administration, and the Defence Finance and Accounting Service for billings and payments – demonstrates an inexorable trend toward a unified and consolidated military logistics system. Only a systems approach to all military logistics operations will achieve organisational harmony and inter-functional integration to work seamlessly across the DoD.

Because logistics support systems will no longer be Service, or even country specific, all US military systems will be supported by a joint logistics system that will also be designed for compatibility with systems operated by allies. Interoperability and interchangeability will be essential not only for major system components, but also for many of the database and information systems used to manage materials.

Changing Technologies

Technology advances will drive some of the greatest changes to logistics in the future. Technologies, especially in communication and data transmission will change the face of logistics and make possible new organisational structures. New technologies will include many that are already in use in the civilian sector, such as FedEx's ability to monitor the delivery progress at the item level. The changes in this area will be so great as to result in a qualitative difference in the way logistics is applied.

Integrating operations across distribution channels requires flexibility to switch rapidly from one mode of transportation to another based on availability of transportation and the need for the assets.

Integrating operations across distribution channels requires flexibility to switch rapidly from one mode of transportation to another based on availability of transportation and the need for the assets. Inventory will be containerised and kept in motion rather than stored in a fixed warehouse. Battlefield support of the future will depend upon both military and commercial transportation built upon a network of standard shipping containers utilising automatic identification technologies and Radio Frequency Identification Devices (RFID), coordinated through electronic commerce and global communication capability.

A. Brathwaite and M. Christopher discuss the need for global logistics and supply chain management strategies, and summarise the central elements of each.[14] They list several factors as critically important to the development of

14. A. Braithwaite, and M. Christopher, " Managing the Global Pipeline ." *The International Journal of the Logistics Management*, vol.2, no. 2 , 1991.

"The management of global logistics is in reality the management of information flows". global supply chains, including extended supply lead times and uncertain transit times, multiple freight nodes, and opportunities to ship intermediate components for local assembly. The greatest challenge, in their view, is to determine what information is needed for a global supply chain strategy and to use it effectively for planning. According to them "the management of global logistics is in reality the management of information flows".

CONCLUSION

The United States armed forces see "focussed logistics", once fully implemented, as a seamless system where there is total asset visibility to enable logistics to be based on velocity of distribution rather than stockholding. Rapid force projection will be possible thanks to an adequate but small logistic footprint and an "agile supply chain" (Christopher, 1999). The use of commercial best practices, competitive sourcing and partnering, combined with a decreased in-theatre logistics footprint and infrastructure, reduced inventory and reduced numbers of maintenance personnel are all part of the strategy. It will reduce costs, increase flexibility and provide them with the tailored support to take on an enemy anywhere in the world at short notice. It, thus, seems an answer to budgetary prayers. For those who resent paying for war-fighting assets that remain under-utilised in peace-time, "focussed logistics" advocates lean supply and a flexible supply chain that should enable the 'tailoring' of logistics requirements on a case by case basis. Not only would it remove the financial drain of under-utilised assets, but a properly constructed and tested "focussed" supply chain should ensure that the right war-fighting assets are in the right place, at the right time and in the right amount. The MoD has not stated that they will adopt "focussed logistics" as such, and will have to implement a number of changes before they will have the capability to support such a system. The United States has the advantages of having the required funding, economies of scale and readiness to innovate,

which means that they have every chance of pulling this off.

While some operations (such as in the former Yugoslavia) have shown "focussed logistics" at work, it would be inappropriate to draw the conclusion that it can, therefore, work in all scenarios. In large scale conventional operations, the dependence on technology and logistics based on velocity of distribution, may leave the forces involved vulnerable to whether there are enough transport assets available to accomplish the mission, unanticipated weather, capability mismatches with other allies, maintenance problems, enemy interdiction and the 'fog' or 'friction' of war. 'Tailoring' needs to provide the best, and not just the cheapest, if the troops on the ground are going to have confidence in the system. The final shape of the supply chain, whether it is closer to "just in case" or "just in time," must be constructed and tested under the concept of kaizen or the eternal drive for perfection. The system must be constantly tested under conditions as close as possible to what will be found under operational deployment. As such, logistics planning must take into account the huge variety of scenarios that is possible in the post-Cold War world. In the commercial world, the supply chain that works for cars may not work for computers or fresh food, just as high intensity conventional conflict is far removed from many of the operations other than war that we have seen in the past few years. While the exploitation of technology for military advantage has always been an important part of the race to win wars, it should not be sought in isolation. Just as important is an understanding of its best use, the risks, how it can change or not change the operational environment, and how an enemy might respond to its use.

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will be the integral part of the purchasing system and will have direct access to both consumables and repairable demands information. Visibility into projected requirements provided to vendors through long-term contractual relationships will allow vendors to manufacture and distribute components based on projected requirements, current demand history, and repair capability. Furthermore, commercial carriers will project freight movements based on the manufacturer's projected date and DoD need dates. Coordination will entail improved methods of contracting, especially in the use of systems contracting or blanket-order agreements. The trend will be toward fewer suppliers with longer contract periods rather than contracting on a single-order basis. The contracting function of the future will be expedited, requiring much less daily oversight after the establishment of the initial system between the commercial supplier and the DoD. In connection with the increasing reliance on local purchase, bases will procure with blanket contracts negotiated at a wholesale level, thus, avoiding a contracting burden at the local level.

As regards dynamic response logistics, the dynamic relationship among various logistics elements, namely, order processing, warehousing, inventory levels, organic and commercial transportation, organic and commercial repair information systems and weapon system availability will reshape the future structures of the logistics. These dynamic relationships will be formed through a combination of synergy and balancing activities among logistics elements. Logisticians recognise that numerous trade-offs will occur between logistics processes. Rapid transportation allows for frequent inventory replenishment, thereby lowering inventory levels and reducing the need for fewer and smaller warehouses. Precise delivery of information will reduce the uncertainty associated with the inventory and lead to reduction of the safety stocks. Logistics operations of the future will operate under an integrated logistics system, or "supply chain management" which will govern logistics decisions and operations. Logistics decisions in one area will be made with a recognition of their impact on the other areas as well. Increasingly, an awareness of the cost of the logistics trade-offs will impact logistics decision-making, especially in the notion of trading inventory for information. Information is

cheap, while inventory is expensive. The fusion of the wholesale and retail logistics structures will provide for a streamlined flow of goods and equipment and complete supply chain visibility. Logistics will move from the just-in-case system to dynamic response logistics.

Increasingly, an awareness of the cost of the logistics trade-offs will impact logistics decision-making, especially in the notion of trading inventory for information.

The Indian armed forces are fully in sync with the contemporary trends in the management of military logistics as obtaining in some of the developed Western countries. Our armed forces also are looking at the futuristic trends in logistics management in Vision 2020 and beyond. Whether it is in the ways and means of acquisition and procurement, including life-cycle management concepts, public-private partnerships and long-term support agreements, development of indigenous capabilities, smarter ways of using information technology for managing the entire gamut of military logistics management, the process of transformation is on and is being continuously calibrated and refined. The fact that our armed forces are going in for force modernisation and acquiring cutting edge technology weapons to meet the futuristic threat scenario for both conventional and other than war kind of quick response contingencies makes it incumbent on the logisticians to look for best logistics practices. The creation of the Headquarters Integrated Defence Staff (HQ IDS) under the Chiefs of Staff Committee (COSC) has been able to give the desired thrust toward a joint and integrated approach for logistics management amongst the three Services to meet these contingencies. However, as of now, only a beginning toward this direction has been made. It would need to be more broad-based and consolidated, leaving single Service preferences aside to make it more meaningful. The present approach is more aligned to a threat-based concept as the requirements of the capabilities are aligned to the nature and type of the threats faced by the country, these mostly being territorial in nature. Each Service tends to enlarge its threat perception for a greater share of the budget pie. In a larger context, the nature of the threats facing the country has enlarged

from the primarily territorial threat to a larger level affecting both internal stability and development. In addition, the internal scenarios in which the armed forces of India may be required to operate in the future are also on the increase. There is, thus, a need to create the requisite capabilities to meet such contingencies, backed up by adequate logistics support to launch and sustain the operations The fact is that the changing international scenario and its growing power in both the economic and military fields will propel India into the international limelight in a very short time span. India would soon be required to participate in fulfilling its commitments in the international field. The growing threats facing India are more than just a territorial problem and, therefore, require a far more integrated approach and a very broad range of capabilities. In the internal construct, there is a requirement to consider synergy not only within the armed forces but also the other security agencies which are operating within the country.

AIR DOMINANCE:CONCEPT AND PRACTICE

VINOD PATNEY

Many years have elapsed since we witnessed a conflict where the opposing air forces were of comparable capability and it became necessary to wage a war for supremacy in the air. Possibly, the last occasion was in the 1971 Indo-Pak conflict that led to the birth of Bangladesh. That was over 37 years ago! In the 1973 Arab-Israeli "Yom Kippur" War, the Israeli Air Force was challenged to start with but essentially by ground fire. There were few air battles and Israel got the upper hand in the air dominance stakes rather easily with the use of electronic jammers and good tactical flying. After that, air power played a major role in the victory that followed. In the 1982 operations in the Bekaa Valley, the Israeli Air Force outclassed the Lebanese defences to win total air superiority. Before the 1991 Gulf War, it was envisaged that an air battle could ensue but the Iraqis put up a very weak challenge, stayed on the defensive and preferred to fly their aircraft to Iran. Thereafter, in the subsequent conflicts that have occurred—in the Balkans, Kosovo, Afghanistan, Iraq, Lebanon and more recently in Gaza, etc — there has really been no viable opposition to the North Atlantic Treaty Organisation (NATO) or 'allied' or Israeli air power. During Kargil 1999, Pakistan had a reasonably good air force but elected not to use it or was wary of the consequences of its use.

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Whilst it would be wrong to only "prepare to fight the last war," it would be equally incorrect to forget the lessons of previous wars.

Although the military victory in the ongoing conflict in Iraq and Afghanistan was quickly achieved, peace is yet to be restored in those troubled lands. Again, there is a large and increasing number of areas on the globe where terrorism and 4th Generation Warfare are taking their toll. In these types of operations, the importance of air power, though still significant, is somewhat reduced.

The one-sided air operations over the last many years in a number of varied types of conflicts in different types of terrain has led some to question the need for the expensive weapon systems needed to win the air battle. It is argued that the nature of conflict has altered; major battles are highly unlikely in a globalised world; we must prepare for the type of conflicts that are far more likely to occur; and that defence budgets would be better utilised for procurements and training that suit the needs of the conflicts that are ongoing or those that are more likely to occur in the near future. It is also stated that in anti-insurgency and 4th Generation War, we need more manpower and far more specific to task equipment. Therefore, it is argued, that we must have "more boots on the ground," and that programmes like the F-22 can and should be curtailed. Such sentiments are expressed in many parts of the world, and most often, presumably by military practitioners and others who have but a distant relationship with aerospace power, and a consequent lack of appreciation of what air power implies and what it can achieve.

History teaches us that whilst it would be wrong to only "prepare to fight the last war," it would be equally incorrect to forget the lessons of previous wars. Moreover, it takes a long time to develop capabilities and we cannot legislate to the enemy on the type of war to be fought. In fact, the type of war the enemy chooses to prosecute will in all likelihood take advantage of our weaknesses. Hence, we must be prepared to fight throughout the spectrum of conflict. Air dominance has a part to play, in varying degrees, in sub-conventional, conventional, even nuclear

wars or even the threat of a nuclear war. Such capability would also have deterrence and coercive power. Again, there is an old and trusted adage that since the maturity of the air arm, no country has ever won a war without winning the air war, and no country that has won the air war has ever lost the war. This is a very pertinent statement and we will do well to bear it in mind.

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Doubts are expressed on the need for air domination assets as, more often than not, we tend to read recent history from the point of view of the victors. The impact of air power could be better understood if we were to place ourselves in the shoes of the Kosovars, the Iraqis, the Taliban in Afghanistan, or, for that matter, the Palestinians and Lebanese that faced the wrath of Israeli air power. The lack of adequate air capability was acutely felt and a military defeat was beyond doubt.

The requirements of current conflicts and the types of conflicts that are envisaged must be met. The immediate needs demand higher priority. At the same time, the military option by itself can never bring about the desired end results, and a multi-dimensional approach is necessary. However, this article is restricted to military issues only and concentrates on the meaning of air dominance and the advisability of securing air dominance. Other equally important considerations like geo-politics, the nuclear factor, Comprehensive Test Ban Treaty (CTBT), Missile Technology Control Regime (MTCR), Fissile Material Cut-off Treaty (FMCT) and the all important consideration of international relations and diplomacy are all beyond the pale of this article. Also, in this article, the phrases "air dominance" and "air domination" are used interchangeably. It is presumed that there are degrees of air domination and air domination exists from the time one side gains the upper hand and extends to when full air dominance is achieved.

The purpose of air domination is to have as near as possible full freedom of the skies. The 'freedom' has also been described as "freedom to attack and freedom from attack."

WHAT IS AIR DOMINANCE?

In simple terms, air dominance implies the dominance of the air medium. That is just a phrase but if the concept of air dominance is well understood, it will be easy to appreciate that it is the prime objective of the 'armed forces,' it supports all the armed forces, and is not only an air force task although air power will have a significant part to play in achieving it. Unquestionably, securing air dominance is the *raison d'etre* of air power. It must also be emphasised that achieving air dominance is not an end unto itself. No capability ever is. However, air dominance is a means to an end and facilitates, in no uncertain measure, the early and favourable outcome of conflict. If air dominance is only a means to an end, the question arises as to how much air effort should be devoted towards winning it? This is an important consideration but the answer is implicit in the understanding of the concept of air domination. Some will argue that almost the entire capability of air power should be used for the mission to win dominance. Others will again find fault with the air force for giving undue priority to 'fighting its own battle.' The optimum use of air assets for the air dominance battle will depend on circumstances that prevail at the time. There could also well be major differences amongst protagonists in the manner in which available assets are used. The differences will come about because of the relative strengths and capabilities, planning parameters that could vary, and the overall strategy adopted by the adversaries to bring the conflict to an early and satisfactory conclusion as seen from their own respective points of view. No hard and fast rules can be formulated. The importance and salience of air domination will be better gauged by an examination of the purpose and implications of air dominance.

PURPOSE AND IMPLICATIONS OF AIR DOMINANCE

The purpose of air domination is to have as near as possible full freedom of the skies. The 'freedom' has also been described as "freedom to attack and

freedom from attack." Although reasonably accurate, the phrase does not fully describe the concept of air dominance. Greater elucidation is called for and the different purposes should be enumerated.

The first purpose that air dominance serves is to ensure air defence of our territory or area of interest. The area of interest could even be in enemy country. The primary objective is to inhibit enemy aircraft from attacking our sea, air or ground assets. It will be a major achievement if we can ensure that enemy aircraft cannot successfully attack any of our armed forces or centres of industry or population. The basic requirements are effective radar cover or other means so that we can ensure detection at maximum possible ranges; a sound identification system, and kill capability to engage enemy aircraft identified as hostile as far away as possible from the intended target. If we can achieve the kill in enemy territory itself, so much the better. Radar cover could be markedly augmented with the use of the Airborne Warning and Control System (AWACS) or aerostat balloons. Identification system will involve data links and data processing, and the 'kill' systems could be aircraft armed with missiles and guns, ground- based weapon systems that will include Surface-to-Air-Missiles (SAMs) and Air Defence (AD) artillery. As and when available, lasers and directed energy weapons could also be used. Over and above these essential requirements, there must be a robust communication and control system. Air defence is a difficult operation of war. Perforce, there will be a number of vulnerable targets and it may take a few days for us to discern the enemy strategy. Again, we would not wish for our air defence assets to be spread out too thinly. Compromises will have to be made and the optimum utilisation of resources worked out and plans altered progressively, depending on the circumstances. Given the perennial scarcity of resources, it will be nigh impossible to provide effective air defence throughout our country and other areas of interest. However, we should be able to protect defined areas over stipulated time-frames. Even then, prioritisation is essential. Such calculations and related decisions should form part of the joint planning system.

The second purpose of air dominance is to progressively move from achieving a favourable air situation to air superiority and onto air supremacy.

Leading on from air defence requirements, the second purpose of air dominance is to progressively move from achieving a favourable air situation to air superiority and on to air supremacy. This can be brought about by lowering the enemy air capability slowly but surely. It will involve good air defence systems as well as attacks on the air and command and control assets of the enemy. The idea is to relentlessly push the enemy onto the defensive. The degree of air superiority that we can muster is an important consideration for the prosecution of war by our surface forces and air forces. However, although the concepts of air defence and air superiority are very important considerations, they remain somewhat passive aspects with the limited objective of preventing the enemy from harming us. It is probably more important to cause harm to the enemy forces by inflicting the desired degree of damage to enemy targets and target systems.

The enemy will also try to field an effective air defence system and vie for air superiority. Hence, the third purpose of air domination is to ensure that our air operations are not hampered by enemy air or ground defences. This will involve Electronic Warfare (EW), techniques for Suppression of Enemy Air Defences (SEAD) or Destruction of Enemy Air Defences (DEAD) by hard or soft kills and, probably most importantly, by shooting down enemy air defence aircraft in air-to-air engagements. In addition, deception and other tactical considerations will also impact on this requirement.

Fourthly, and probably most importantly, air domination also encompasses the ability to hit air and surface targets effectively and speedily within the defined area where we exercise air domination. This is the essence of air domination. The previous three considerations or purposes were but a prelude to the use of air assets against enemy forces unhampered by enemy air. The same holds true for attacks on enemy economic or other targets. The success of the previous three aspects of air domination will determine the freedom to attack and, consequently, the accuracy and effectiveness of the air

attacks. Enemy military assets have to be attacked to inflict damage or destruction to the required extent in order to force a military victory. At the same time, with air domination, air assets can be used against enemy forces in close vicinity of our forces with considerable impunity. Aircraft can now fly over the battle area over extended periods of time, carefully select targets and hit

The effectiveness of air attacks against enemy forces will be directly dependent on the degree of air domination that we have achieved.

them. Air domination will also permit the luxury of immediate battle damage assessment and near immediate reengagements if required. Moreover, the need for the very expensive stand- off weapon systems will decrease and attacks on enemy surface forces can be carried out more cost effectively. What is stated above will apply when full air domination has been achieved. In practice, such instances will indeed be rare, particularly if the adversaries are reasonably well matched, but the effectiveness of air attacks against enemy forces will be directly dependent on the degree of air domination that we have achieved.

Fifthly, the attacks on surface forces must also include attacks on enemy missile sites and AD artillery that can target areas in our country or areas we wish to protect. The ranges of ground-to-ground missiles have increased considerably and they can be fired with effect from well within the enemy country. The option of choice to neutralise them is the use of our air assets, be they aircraft or some form of unmanned vehicles. With air domination, it will become easier to locate, acquire and destroy such targets.

Another important purpose of air domination is intelligence gathering. Gathering intelligence with surveillance and reconnaissance (ISR) is a prime task for an air force. The means available could be visual reconnaissance or sensors of different types placed aboard aircraft, Unmanned Air Vehicles (UAVs) or satellites. The sensors will include those required for eavesdropping on enemy communications and interception of all types of information that is relayed from one enemy source to another. Mapping the enemy electronic order of battle should be a priority task. Gathering intelligence is an ongoing

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exercise in peace and war and aerospace assets are the prime instruments for the task. In the same breath it must also be mentioned that Human Intelligence (HUMINT) has an equally important role to play and often, the different sources complement each other and offer corroboration where needed. Air domination will also permit enhanced safety in intelligence gathering, collation, analysis and timely dissemination. Air assets can also be used as relay stations.

It will be appreciated that air dominance is a major military requirement and it represents the all embracing use of air power. Its impact on the prosecution of war is indeed significant and, for this reason alone, achieving air dominance should be a high priority task in the planning of joint military operations.

The impact of air domination would be that the side that is able to win it will be able to 'see' what it wants to see, 'hear' what it wishes to hear, discern what is necessary, hit targets at will and operate with freedom. Air domination represents the unfettered use of the air medium.

In spite of the gains that will accrue with air dominance, the question must be asked as to whether a country like India can hope to achieve it against our possible adversaries. Many would equate our quest for air dominance with chasing a mirage. It is true that fighting for air dominance will require a much stronger air force than what the adversary can bring to bear on us. However, air dominance can also be progressively achieved with better planning and optimum use of extant resources. The fundamentals should be clearly understood. Gaining air dominance will always be a worthy objective and its attainment will ease the way to military success. It must also be mentioned that although full air dominance may not be possible, any level of air dominance will be of considerable benefit. Again, much will depend on the nature of war, its likely duration and limits of action that may be placed on the armed forces.

Such issues will hopefully be considered in the joint planning, and consensus reached on the desirability of maximum possible level of air dominance.

BENEFITS OF AIR DOMINANCE

Unchallenged use of the air medium promotes obvious military advantages, some of which have been described earlier. The situation permits many options in the choice of targets, and the weapon systems to be used against them. For instance, it will not be necessary to move the battle front progressively. Parallel war can be conducted with impunity. With no or vastly reduced enemy air interference, planning and prosecution of military options is considerably simplified. Greater choices also become available in the choice of weapons to be used. Lesser number of precision guided weapons would be required, as many target systems could be engaged, at reduced costs, by unguided weapons whilst retaining the ability to cause the desired degree of damage.

Our Special Forces are highly trained to carry out tasks in enemy country. Apart from the chance element inherent in such operations, a major drawback is the inherent risk in infiltration and exfiltration. With air domination, the passage to and from target areas will be safe from enemy air and the target area could also be sanitised from the air. Under the circumstances, even normal troops could be tasked for missions where otherwise the requirement would have been for Special Forces only. Similarly, air dropping of agents and their retrieval will be much easier and involve no detailed planning requirements. Again, air evacuation of combat casualties could be more readily carried out. Indeed, a number of operations that carry high levels of risk would be simplified beyond recognition.

Military operations involving airborne or heliborne troops are complicated and often dangerous, essentially because of high vulnerability at launch pads, air transportation to the target in machines that can be readily downed by enemy air or ground fire, problems in linking up with the main forces if necessary and resupply requirements. All these 'problems' are considerably eased with even a modicum of air dominance, leave alone full air dominance.

Air dominance implies that the enemy territory, and the otherwise highly defended areas therein, are laid bare for attack.

Thus, air dominance implies that the enemy territory, and the otherwise highly defended areas therein, are laid bare for attack. It would be a planner's dream if we could achieve it in full measure. However, even with reduced levels of air dominance, it would then become progressively less problematic to increase the domination quotient. In time, the enemy would be rendered incapable of offensive action. This recognition will result in the stronger adversary exercising escalation dominance and fighting the battle at intensity levels of its own choosing; and relegating the other side to either vie for peace or fight on terms dictated by the side that enjoys air domination. Air power capability is highly visible and the likelihood of one side attaining a fair degree of air domination, with consequences that will automatically follow, increases the deterrence level and, for that matter, the capability to exercise coercion as well. May be there is some substance in the claim made by an official of M/s Lockheed Martin that the F-22 aircraft is nearly as good a deterrent as nuclear weapons! There could be some exaggeration but the import of the statement is all too clear.

ACHIEVING AIR DOMINANCE

Achieving air dominance is not a factor of brute force alone. Considerable planning and forethought is necessary. Air power characteristics of flexibility, speed of action and reaction, etc have a major part to play. It is often mooted that air power tasks like air defence, counter-air operations, interdiction, close air support, air maintenance, etc are considered separately only for greater clarity. This is indeed true. In fact, there is a close inter-relationship and inter-dependence amongst all these tasks and others as well. In one way or the other, all air power tasks aid the battle for air dominance. In some scenarios, a major part of the entire force capability may be used to secure the essential task of air dominance. At times, surface forces must also play their part with special reference to the use of the Army and Naval Special Forces. Hence, the

requirements to fight the battle for air domination will, *inter alia*, include a sufficient number of appropriate aircraft of adequate range and capability; weapons and missiles; radars and other sensors; AWACS and Air-to-Air Refuelling (AAR); data links and command and control systems; space systems; air and ground infrastructure; expertise as required; analytical systems; Electronic Warfare (EW), INFOWAR; Network-Centric Warfare (NCW) capabilities and cyber warfare assets. The increasing importance of cyber warfare cannot be over-emphasised and, in the years ahead, such assets and their judicious use will significantly aid the winning of air dominance.

The one factor that can make the difference between victory and defeat is the quality of intelligence inputs made available.

The quality of situational awareness is an important factor in the fight for air dominance, particularly if the opposing sides are evenly balanced. In a fluid battle environment, situational awareness will remain of concern even when air dominance has been largely won. Surprises can occur in terms of equipment fielded, tactics and possible antidotes to our strengths. We cannot let our guard down till the war is over and not even then thereafter.

Sound training schedules are also necessary to optimise the use of available systems. Very often, a well trained force used with deft planning can get the better of another force that boasts of superior equipment. Our equipment is way superior to that of our possible adversaries and we must not allow inadequate training or preparation to lower the effectiveness of the weapon systems.

The one factor that can make the difference between victory and defeat is the quality of intelligence inputs made available. Intelligence has a central role to play. Actionable intelligence that is timely, adequate and accurate will always be a force multiplier. For instance, in the battle for air dominance, the defences around the targets, enemy dispositions, definition of target systems and their exact location are inputs that will result in good and cost-effective results. Equally importantly, it will be a great help if we know the impact of our military activity not only on the battlefield but in the enemy corridors of power as well. The importance of intelligence inputs can never be over- stated.

WINNING THE BATTLE FOR AIR DOMINATION

If there is considerable asymmetry in air power capability, adequate air dominance can be readily and quickly enforced. If the capability is more or less at par, air dominance has to be fought for. In the last conflict India was engaged in, Kargil in 1999, Pakistan handed over air dominance to India without a fight. Had Pakistan offered combat, as indeed they should have, given the fact that their soldiers were being killed by our air attacks, the pattern of air activity would have been very different. We would have had to fight for air dominance, even if it was to be at the cost of other air operations of war.

There cannot be any hard and fast rules on how to win the air war. Much will depend on the strategies adopted, the type of weapon systems available on both sides and their effectiveness in the types of operations envisaged. The likely duration of war and the possibility of one side or the other being in a position to limit the duration is another important consideration. Such imponderables may alter the nature of the air war but the imperative of winning air domination to whatever extent is possible will always remain. Again, if a particular plan does not work, the flexibility of air power will permit ready and quick alteration to the plan.

Both adversaries will vie to achieve air domination. As a rule, the extent of air domination will be a function of military power. Resources will always be important but possibly more important is the planning and utilisation of resources. A sound doctrinal approach will produce better results. As one side begins to gain advantage in the air domination stakes, it will attempt to capitalise on the gains and seek even greater dominance. However, at no stage can anyone let their guard down. Continuous effort is necessary to maintain the air dominance or improve on it. Good intelligence information is also needed to ensure that we are not surprised by the introduction of more effective equipment, and the enemy can always learn from experience and alter tactics to their advantage. Nothing should or can be taken for granted in war.

Air power is an offensive weapon and must be used offensively. The first requirement is to try and attenuate enemy offensive capability. The object

is to force the enemy onto the defensive. One way to achieve this is by attacks all over his country whereby he is forced to not only thin down his defences, but also lower his capability for offensive action. Offensive and defensive counter-air operations will have to be launched and it must be our attempt to challenge enemy air power at every possible opportunity. It is also a corollary in air operations that the optimum use of air power is towards targets where the likely gains are maximised consistent with a low attrition rate.

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The winning of air dominance requires knowledge, capabilities and suitable equipment. Such information and capabilities are required for both air combat and air-to-surface attacks. The effectiveness of air power will be governed by the degree of air dominance that can be achieved. The greater the air dominance that one is able to create, the more effective will be the support to surface forces. Undoubtedly, with air dominance, our ability to mount ISR missions and attacks on surface targets will be with greater surety, confidence and effectiveness.

The reverse is equally true with the added disadvantage that the enemy air will be permitted greater freedom of action against our surface forces. These factors should be well understood and be duly considered in the joint planning for different contingencies.

Air power can be a potent weapon if used well, and could be ineffective if the essentials of air operations are ignored. In our case, in both the Kargil conflict and in Operation Parakaram, our potential for air domination was not applied and, hence, wasted.

Much has changed in air capabilities in the last few decades but the concept of air domination is a classic one—never changing. What has markedly altered is the ability to exercise air domination and, by extension, the increasing need to do so.

APPLICABILITY OF AIR DOMINANCE

The applicability of air dominance extends throughout the entire spectrum of conflict that encompasses sub-conventional war, conventional war of different intensities and nuclear war as well. The concept is also applicable immaterial of the type of terrain. However, the means to achieve air dominance to whatever degree is possible or desirable will vary.

It would be incorrect to try and launch any operation with whatever objectives, or howsoever small, without air power. Otherwise, the full potential of military power will not be brought to bear on the enemy. Undoubtedly, a single Service operation is a valid operation of war but that should be reserved for special occasions and specific situations only. A good joint planning mechanism that operates regularly and continuously will ensure the optimum use of military power under all circumstances. One factor that must be shunned is the belief that if we do not use air power, somehow, the adversary will also desist from using his air power. Air power will be used if it is advantageous to use it, and the side that uses air power first will always be at an advantage.

It is generally accepted that air power has a decided impact in conventional war and provides an important leg of the triad in the nuclear deterrence stakes. The role of air power in sub-conventional or 4th Generation War, merits some explanation. There are three major characteristics of air power that impact war. The first is the ability to see from a vantage position. The 'see' includes the ability to eavesdrop on communications, intercept data transmissions and the entire ambit of assessing the enemy electronic order of battle. With better sensors mounted on satellites and UAVs as well, persistence can be ensured to a considerable degree and intelligence information corroborated with inputs from more than one sensor mounted on different platforms. Persistent surveillance can also support the guiding of our troops to make contact with the enemy and to keep our forces abreast of the changing situation. Secondly, air power permits the rapid, fast and safe movement of men and material to wherever required. Resupply and greater concentration can also be effected. Thirdly, air power can hit

targets in the air and on the surface accurately, efficiently and effectively. These are all important capabilities that can always be brought to bear on the enemy in all types of warfare including sub-conventional war. The effectiveness of air power will be dependent on the capabilities. Much can be done from the air but we have to have the required wherewithal. Technology will play an increasing role in the conduct of 4th Generation Warfare and well planned technological advances towards a defined purpose can only improve the effectiveness of air power. There can be no denying the impact of air power. Finally, the example of the Liberation Tigers of Tamil Eelam (LTTE) air force could happen elsewhere as well and the most effective counter can only be air power.

AEROSPACE DOMINATION

Space is but an extension of the air medium. Similarly, the term air domination should be extended to aerospace domination. The rapidly increasing civilian use of space, and the great advantages that the use accrues, make a space war of sorts highly probable. The civilian space industry is worth over $200 billion and conflict often follows commerce. Similarly, use of space assets in military operations is of increasing significance and, once again, competition for unchallenged use of such assets and their denial to the adversary should be expected and planned for.

It is not yet certain as to how conflict regarding the use of space assets will be conducted. The options are numerous but the importance of aerospace domination is easy to comprehend.

Use of space assets can be countered by either hard kills or soft kills. Apart from the unlikely use of lasers or other destructive means to destroy enemy satellites by use of our space assets, hard or soft kills have to be carried out by using ground-based systems or airborne systems. These can be readily targeted by aircraft and missiles. The ground segment of space capability including control stations, Research and Development (R&D) facilities, launch pads, and the like are very vulnerable to air attacks, especially if air domination has been achieved. Thus, air domination and space domination do actually coalesce.

There will also be many limitations but aerospace domination is a laudable objective; the degree to which it can be achieved will be a function of the respective hardware, training and planning.

The term aerospace domination is accurate; it should form part of military lexicon.

Cyber warfare impacts both air power and aerospace power. The obvious advantages of controlling the cyber space are again too obvious to enumerate. Much work is ongoing on developing techniques and safeguards to engage in cyber warfare. Domination in this field is also an attractive proposition. As the air, space and cyber space represent closely integrated mediums, their control should be by a single agency. In our country, the Indian Air Force automatically suggests itself.

CONCLUSION

The significance and essentiality of securing aerospace domination are all too obvious. Aerospace domination that must include cyber space may not be readily achieved if the adversaries are well matched. Under these circumstances, the domination will have to be fought for with the aim of securing the highest degree of domination that is feasible commensurate with the military requirements. The quest for aerospace domination is far too important to merit anything short of a very high priority, if not the highest priority.

There are costs involved. There will also be many limitations but aerospace domination is a laudable objective; the degree to which it can be achieved will be a function of the respective hardware, training and planning. A strategy enunciation is the first step. Any degree of dominance is better than lesser dominance.

There will always be those who will doubt whether the objective of aerospace domination is feasible and categorically state that the high costs are unwarranted. Again, they will argue that we cannot afford the high costs. The more relevant counter argument is that we cannot afford NOT to find the requisite funding for the best aerospace domination we can secure.

AIR DOMINANCE IN 4TH GENERATION AND IRREGULAR WARFARE

ARJUN SUBRAMANIAM

4th Generation warfare is not novel but a return, specifically a return to the way war worked before the rise of the state. Now, as then, many different entities, not just governments of states, will wage war. They will wage war for many different reasons, not just "the extension of politics by other means." And they will use many different tools to fight war, not restricting themselves to what we recognize as military forces.

— William Lind[1]

UNDERSTANDING 4TH GENERATION WARFARE

At a time when established militaries are grappling with the rapidly changing nature of warfare and trying to match assets and orchestrate training regimens with roles and missions, it is important not to get saturated with terminologies that try to fingerprint the various genres of warfare. Is it sub-conventional warfare, or is it irregular warfare (IW)? What happens when sub-conventional warfare escalates to levels wherein non-state actors use tactics and equipment that lend themselves easily to conventional warfare? Amidst the din of all this debate, what happens to guerrilla warfare, wars of liberation, terrorism and proxy wars? It is in this context that 4th Generation or 4G warfare best describes the broad genre of warfare waged by non-state

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1. William Lind, "Understanding Fourth Generation Warfare",www.antiwar.com, January 15, 2004.

The 21ˢᵗ century saw a distinct shift to warfare in which the state lost its monopoly on warfare with its proven ability to win wars with mass, mobility, speed or firepower.

actors of the 21ˢᵗ century against the state and irregular warfare fingerprints the micro war-fighting techniques adopted by them to prosecute 4G Warfare. In order to understand 4G Warfare, it is imperative to track when it replaced 3ʳᵈ Generation Warfare. The two Gulf Wars of recent times epitomised what 3ʳᵈ Generation Warfare is all about viz speed, surprise, physical dislocation and non-linear operations that seek to bypass and collapse the enemy[2]. 3rd Generation Warfare had no inbuilt mechanisms for issues like reconstruction or "winning the hearts and minds of the defeated enemy". All of a sudden, the 21ˢᵗ century saw a distinct shift to warfare in which the state lost its monopoly on warfare with its proven ability to win wars with mass, mobility, speed or firepower. Instead, it found itself staring down the barrel of a powder keg that comprised culturally distinct, militarily well trained and sometimes fanatic non-state actors who had perfected a `pot pouri' of guerilla tactics with conventional firepower, terrorist ideology and religious Islamic fervour. Suddenly the state found itself woefully untrained to cope with such an enemy. Lo! Overnight, 21ˢᵗ century warfare was suddenly transformed into 4G Warfare, with military theorists groping and arguing to give it a name. With large nation-states willing to grant more autonomy to ethnic groups and engage in meaningful economic upliftment, as a means of reducing conflict, the major challenge for nation-states and democracies like India, the US and even Russia, when it comes to 4G Warfare is the increasing threat of non-state actors who are driven by religious fundamentalism primarily emerging from the spread of Islamic fundamentalism as seen in Iran, Iraq, Pakistan and Afghanistan. The belt stretching from Palestine to Pakistan and running through what is known today as the Middle East has always been a powder keg from the days of the Crusades, the collapse of the Ottoman Empire and subsequently, the birth of Israel and the Palestinian problem.

2.   Ibid.

With almost the entire Mid-East carved up between the US and Russia during the Cold War, some amount of artificial stability was maintained. The void created by the absence of any ideological reasons to perpetrate conflict in an established state was quickly filled by religious and ethnic struggles. The Nineties saw the civilised world slip into periods of uncontrolled IW with genocides and brutality proliferating across continents. Whether it was the Serb led genocide against minorities and the subsequent backlash from the Croats and Bosnians in the Balkans, or the Chechen rebellion , or even the resurgence of Islamic terrorism in the Middle East or the Liberation Tiger of Tamil Eelam (LTTE) struggle in Sri Lanka, the world saw the emergence of a new genre of IW. Features of these conflicts include relatively uncontrolled conflict control mechanisms, with the UN emerging as the only institution that has attempted conflict resolution albeit with very low success rates. It is in the wake of this chaos that one has seen the US leading loose coalitions against those who waged war against what the US terms as the civilised world, but actually more against US interests and global dominance. The two defining moments that changed the nature and intensity of 4G warfare in the world and gave it a fundamentalist flavour were the Iranian revolution led by Ayatollah Khomeini and the rise of the Taliban in Afghanistan. The Iranian revolution galvanised Shiite aspirations across Asia, with Iran providing spiritual, moral, financial and military support to Shia groups in diverse locations as the clerics perceived the US brand of capitalism as a threat to the Islamic faith. Not wanting to be left behind, radical Sunni groups with overt/covert aid from wealthy Saudi fundamentalists like Osama Bin Laden, started asserting themselves in semi -developed areas like Afghanistan and Pakistan, thus, creating a new, more assertive, and at times fanatic, non-state actor who would wage the most

The two defining moments that changed the nature and intensity of 4G Warfare in the world and gave it a fundamentalist flavour were the Iranian revolution led by Ayatollah Khomeini and the rise of the Taliban in Afghanistan.

The factor that has propelled the USAF into the forefront in IW is the ability of air power to facilitate reduced attrition by increasing engagement from the air, thereby allowing commanders to reduce ground forces in specific areas.

ruthless kind of war against established nation-states like India, the US, Russia and even China in the Sinkiang province.

DISSECTING UNITED STATES AIR FORCE (USAF) DOCTRINE ON IW[3]

Even though the USAF has contributed significantly in most of the 'small wars' that the USA has fought since World War II, the US Army and US Marine Corps (USMC) have always considered that warfare at the lower end of the spectrum of warfare was predominantly their domain, with the USAF mainly playing a supportive role. Keeping with this thought process, the US Army and USMC were first off the block when it came to articulating their respective doctrines for fighting 'small wars' and tackling IW. Quickly realising that warfare in the 21ˢᵗ century would differ significantly from wars of the 20ᵗʰ century in terms of methods, scope, strategy, tactics and end states, the USAF realised that it needed to hone its capabilities and operational focus by addressing the entire spectrum of operations. By doing so, the USAF wants to demonstrate both its intent and capability of staying relevant, irrespective of the nature of conflict. Air power's impact on conventional conflict is well proven. In recent times, the precision strike revolution, mobility, speed and surprise and shock effect have proved to be very effective even in sub-conventional scenarios, without paying the associated penalties of collateral damage/death to the extent that prevailed in earlier times because of the various inaccuracies of weapons. Technology has proved to be a significant factor in making the USAF relevant in IW, particularly so in recent times in the US war on terror in Afghanistan, the Kosovo conflict and continued conflict in the urban environs of Iraq. The other factor that has propelled the USAF into the forefront in IW

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3. This part of the article attempts to analyse the AFDD-2-3 on IW that was published in 2007.

is the ability of air power to facilitate reduced attrition by increasing engagement from the air, thereby allowing commanders to reduce ground forces in specific areas. Though it is recognised that ultimate conflict resolution would require 'boots on ground', air power has come to stay in IW. Like all doctrines, this doctrine too is not directional as it merely lays down certain key strategic and operational levels of IW, with specific focus on dissimilarities with conventional warfare. The key issues that are addressed relate to the following:

- Complexities of irregular warfare.
- Air force capabilities that are required to address these complexities.
- Blending air power capabilities into a joint war-fighting model that transcends Services to include civil and paramilitary organisations.
- *The last major issue that is discussed throughout the doctrine and that could be of great significance in the Indian context comprises the various processes to retain the existing command and control structure for the employment of USAF assets with particular reference to a unity of command and an airman remaining in charge of employment of air power as he knows the capabilities best.*

FUNDAMENTAL DOCTRINAL STATEMENTS

It is important to understand the reasons for large air forces like the USAF to look closely at developing an effective doctrine for IW. It was also becoming increasingly evident that smaller nations and non-state actors were increasingly finding it difficult to 'fight conventionally' or traditionally. After years of brainstorming and assigning difficult terms like 'small wars', 'sub-conventional war', Low Intensity Conflict Operations (LICO), Counter-Insurgency Operations (COIN) or guerrilla warfare, it was considered appropriate to assign a generic term that encompasses the entire spectrum of warfare below conventional warfare. Thus, as per the USAF, IW is defined as:

> *A violent struggle among state and non-state actors for legitimacy and influence over the relevant population. IW favours indirect and asymmetric approaches though*

There is a feeling that the USAF doctrine is reaching out to airmen to integrate their capabilities with those of the other Services in order to prosecute what they see as a long war against terror and unseen enemies.

it may employ the full range of military and other capabilities in order to erode an adversary's power, influence, and will.

As seen, the definition is simplistic, covers a wide and easy canvass, and from an Indian perspective, allows us to even categorise border skirmishes like the Chinese incursions into Arunachal Pradesh and the Kargil conflict as IW. Flowing from the definition are some concepts that lend a lot of weight to this genre of warfare that has existed for thousands of years whenever unequals have warred against each other. The difference now being that victory by the larger protagonist is becoming increasingly more difficult, thus, forcing him to question his basic tenets of warfare. Some key takeaways from the USAF doctrine are:

- Irregular warfare concentrates on asymmetric and innovative approaches to erode an adversary's overall war-waging potential.
- By no yardstick is IW a lesser form of warfare in intensity. In fact, it is a notch above conventional warfare in terms of speed, ferocity and unscrupulous war-fighting techniques.
- The main challenge for air power in IW is developing capabilities to fight both a conventional and IW side by side.
- More than in any other form of warfare, air power in IW focusses not merely on military objectives alone, but on the end-state of winning legitimacy.
- Unlike classic air power roles, IW missions have no fixed templates – hence, they need to be flexible and responsive, attributes that lend themselves easily to air power as compared to land and sea power. This alone strengthens the case for increased involvement of air power in irregular warfare.

More than specifying missions and roles, there is a feeling that the USAF doctrine is reaching out to airmen to integrate their capabilities with those of the other Services in order to prosecute what they see as a long war against terror and unseen enemies. There is an attempt to look beyond the articulated strategic capabilities of air power that enable it to influence conventional war almost all on its

The information technology revolution has made it possible for a non-state actor to effectively interface on a daily basis with the intelligence agencies of a supportive state.

own, and look at joint war-fighting capabilities. In that context, the doctrine attempts at educating airmen on the characteristics of IW, the importance of the war for legitimacy and the resilience required to wage long IW conflicts like the ones being waged in Iraq and Afghanistan. In that context, we in India too need to leverage the competencies of air power in the fight against non-state actors. More importantly, there is a need to sensitise all echelons of leadership on the nature and complexities of 4G/IW.

EXPANDING IRREGULAR WARFARE

To imply that the non-state actor focusses mainly on the population and government while trying to make the military irrelevant, as implied in the USAF doctrine, is not entirely correct. With a wide range of lethal weapons and the concept of 'proxy war' creeping in, non-state actors, with active support of the state, have the wherewithal to engage security forces with some amount of success just as the Lashkar-e-Tayyeba and Hizb-ul Mujahideen have done in Jammu and Kashmir (J&K) and the Hezbollah achieved in Lebanon. Today's non-state actor has the capability and does manage to muster external support to focus on, and impact, all three structures of a nation viz government, population, military. How does he manage it? The information technology revolution has made it possible for a non-state actor to effectively interface on a daily basis with the intelligence agencies of a supportive state and undermine the day-to-day functioning of a legitimately elected government. The tools of coercion have proliferated

Where it falls short is in its inability to provide clear directions for conduct of counter-terrorist operations and other forms of 4G Warfare, including urban operations.

alarmingly, making it easier than before to intimidate and exploit the local population and take on underprepared paramilitary and police forces. Taking on the established military along conventional lines with sophisticated weaponry has become commonplace across the world. One needs to look no further than the tactically well thought out engagements by the Shia militia in Basra, the Hezbollah rocket tacics in Lebanon and the remote controlled Lashkar-e-Tayyeba operations in Mumbai during the 26/11 terror attacks. Further south and within the subcontinent, the LTTE has taken on all organs of the Sri Lankan state simultaneously with significant success over the years. The only difference being that the direct aim of IW is not to topple the government, but to influence its downfall after weakening it significantly. Thus, contrary to contemporary perceptions, 4G and IW in the 21st century have progressed to include military targets as Centres of Gravity (COGs) and not only the local population.

INDIAN ARMY'S DOCTRINE ON SUB-CONVENTIONAL WARFARE

Following the relative success of their WHAM (Winning the Hearts and Minds of the People) campaign in J&K in recent years, the Indian Army came out with their doctrine on sub-conventional warfare in 2006. Though the doctrine attempts to address various types of conflict at the lower end of the spectrum of warfare, it essentially remains a doctrine for the conduct of COIN. Where it falls short is in its inability to provide clear directions for conduct of counter-terrorist operations and other forms of 4G Warfare, including urban operations. With the Indian Air Force (IAF) having supported the Indian Army in COIN operations, in both J&K and the Northeast for over 50 years, one would have expected that employment of air power would have featured in the doctrine. Granted that there is widespread reluctance to talk about offensive employment of air power in COIN operations within our own

geographical boundaries, there is very little mention of even the employment of non-kinetic roles of air power like casualty evacuation and air mobility that are so important for successful prosecution of sub-conventional warfare. However, what is commendable is that an honest attempt has been made at articulating the nuances and difficulties of waging war against non-state actors by a force that is probably the most battle-hardened in this genre of warfare.

AIR DOMINANCE IN 4G/IW

Air dominance as a concept is not new. Douhet propounded it with vigour during the early years of air power. Goering and the Luftwaffe aimed for it over the skies of Great Britain in World War II but failed. The Israelis stunned the world with their brand of air dominance in 1967 and 1982, and the IAF displayed its prowess by dominating the skies over East Pakistan in 1971. The last big battle in which air dominance was conducted as a stand-alone air campaign paved the way for spectacular all-round success during the Gulf War of 1991.

Since then, the quest for air dominance has seen different approaches being followed. While the US and a few other Western Air Forces have focussed on a platform-centric and technology intensive-based approach to air dominance that cuts across the spectrum of war and seeks the desired effects, smaller air forces like the IAF have had to tailor their approach based on specific threats and availability of limited resources. To give a typical example of the first approach, the F-22 story is all about air dominance, with the entire case for air dominance in the West revolving around the capabilities of platforms like the F-22 and the Typhoon, and their capability to roam the skies like heavyweight boxers, armed to the teeth, aided by unblinking Intelligence, Surveillance, Reconnaissance (ISR) sensors and facilitators like Airborne Warning and Control System (AWACS) that ensure total situational awareness in conventional war-fighting. The IAF's SU-30 MKIs are also geared with similar capabilities and have all the typical characteristics of air dominance fighters that have so comprehensively been

Air dominance is: *"The ability of a nation to exert relentless pressure on an adversary from the medium of air and space to achieve strategic objectives/ or effects across the spectrum of warfare."* showcased in recent times. But what happens when you have high altitude battlegrounds like the ones in Afghanistan, Kashmir and Kargil, or the densely populated urban landscapes of Baghdad, Gaza and Mumbai, where enemies are unknown and targets are fleeting, capable of being tackled primarily by small and compact teams — a far cry from the established norm of large formations of aircraft sanitising large swathes of air space and allowing unhindered operations on the ground and over the sea? Food for thought!!As against the present trend of seeing air dominance as dominating the medium of air in conventional warfare at the upper end of the spectrum of warfare, a contrarian view suggests a small change that looks at air dominance as not only dominating air and space but also as dominance being imposed on the other two mediums from the air. When you see it this way, you would realise that the coercive effect caused on the ability of an enemy to use the air effectively in a conventional conflict by a pair of F-22s or Su-30s on a fighter sweep mission under close control of AWACS, is the same as that caused by a loitering Predator, a fighter aircraft, or attack helicopters on a group of terrorists or insurgents who want to move from place A to B. Therefore, a broad spectrum definition of air dominance that retains relevance irrespective of the intensity and genre of warfare is: *"The ability of a nation to exert relentless pressure on an adversary from the medium of air and space to achieve strategic objectives/or effects across the spectrum of warfare."*

Recent conflicts at the lower end of the spectrum of warfare in Kargil, Iraq, Afghanistan, Lebanon, Gaza and Sri Lanka have shown that air power, if used decisively, has the potential to dominate the path to conflict mitigation, de-escalation or even conflict termination. The Kargil conflict of 1999 is a classic example of air dominance in joint operations in a high altitude conflict that swathed through the lower spectrum of

warfare. Some called it a limited high intensity high altitude conflict between India and Pakistan, while some called it the first high altitude conflict between an established state and a combination of state and non-state adversaries. While air power purists would say that the IAF mainly conducted a classical high altitude interdiction campaign that choked the intruders and allowed the Army to push them back, the bare facts reveal that a combination of intimidating air defence missons and well executed interdiction missions allowed the IAF to dominate, coerce and intimidate the adversary, and acted as a major catalyst that forced his withdrawal. Imagine if the Pakistan Air Force (PAF) had interfered with our operations, both in the air and from the air. Would the situation have de-escalated so quickly? The firm answer is no! So it can safely be assumed in this case that air dominance can be decisive in de-escalation or conflict resolution across the spectrum of warfare and not only at the upper end. Two other examples in recent times wherein air power has been used to dominate the adversary in sub-conventional scenarios have been by the Sri Lankan Air Force (SLAF) against the LTTE and by the Israeli Air Force against the Hamas in Gaza.

Shifting focus onto Sri Lanka where the LTTE is holed up in its last bastion for what is going to be certainly its last fight, after it had attacked Katunayake airfield in Colombo and Anuradhapura airfield by bombing them with light aircraft, but inflicting heavy casualties, many analysts had predicted the resurgence of the LTTE. In an article published recently in this journal, it was predicted that if the SLAF attempted to dominate the LTTE from the air, the LTTE would not last beyond end 2008/ early 2009 and that is precisely what is unfolding. In short, a small air force like the SLAF has shown what it takes to dominate from the air against a powerful insurgent non-state adversary. Yes, there has been significant collateral damage and loss of civilian lives — but if the LTTE is wiped out and the government shows magnanimity and restores normalcy soon, the SLAF should take tremendous credit for escalating, only to facilitate rapid de-escalation. However, the employment of air power has had its own

The air dominance campaign has to include roles and missions that impact immediately on the land/maritime campaign and it is the seamless integration of all these that would constitute a well orchestrated air dominance campaign.

problems in influencing the outcome of irregular warfare, be it against insurgencies, terrorists or other non-state actors. A classic example in recent times was the inability of the Israelis to dominate the Hezbollah exclusively from the skies. They repeated the strategy against the Hamas with some success because they executed it differently by dovetailing land operations almost simultaneously, as they should have done in Lebanon in 2006. Contrary to existing perceptions that air dominance is a private and exclusive air battle that is fought in isolation between two air forces, and whose effects are not immediately felt on the land/maritime battle, nothing could be farther from the truth. In today's fast moving battlefield, there is no time for individual campaigns. Instead, the air dominance campaign has to include roles and missions that impact immediately on the land/maritime campaign and it is the seamless integration of all these that would constitute a well orchestrated air dominance campaign.

DOCTRINAL CLARITY

There is a need for air forces like the IAF also to have clarity on the employment of air power in 4G/IW just as the Indian Army has on a similar subject through its recently published doctrine on sub-conventional warfare. Similarly, the Indian Navy too has to clearly articulate its thought process so that gradually, even in the Indian context, a joint model to tackle 4G Warfare/IW emerges in the years to come. Only then will our armed forces be capable of effectively and jointly tackling this genre of warfare that is eating away at the fabric of our robust democracy. So let us look at air dominance in irregular warfare from a different perspective and begin with a definition that could provide a clear direction for the future: *the ability to unleash the entire range of kinetic, non- kinetic and coercive capabilities*

of air power with the primary objective of protecting the sovereignty of a state and its citizens and nullifying the impact and influence of non-state actors. Some of the key extraneous factors that would dictate the ability of a nation to strive for air dominance in this domain are:

- Political will to use air power in IW and brushing away misplaced perceptions that air power is essentially escalatory.
- Willingness to accept limited collateral damage in pursuit of larger objectives.
- Availability of a steady stream of synergised and actionable intelligence and a heavy reliance on Human Intelligence (HUMINT) for immediate targeting.

It is also important to establish a link between geography and type of governance in a nation with its ability to use kinetic or offensive air power against non-state actors. Countries like Sri Lanka or Israel which face situations that threaten their existence, would find it much easier to justify the use of offensive air power to their own people and ignore international condemnation, as would near totalitarian regimes like Russia in the fight against Chechen separatism. However, large democracies like India which do not face threats to their very existence, have geographic depth and are confronted by non-state actors like the Naxalites from within their own populace, find it difficult to employ offensive air power readily, though I believe that if the situation deteriorates, air strikes against non-state actor leadership can break the back of an insurgent outfit and must not be ruled out. Similarly, in J&K, where the Indian state is involved in a campaign to win the hearts and minds of the people, use of offensive air power does not find favour and probably rightly so! However, if the proxy war waged by Pakistan gets more intense, the option to use offensive air power against large groups of infiltrating terrorists from across the border, in tandem with the Indian Army and other paramilitary forces, can be a deterrent and thwart any concerted attempt to step up the proxy war primarily by coercion and the 'fear factor' associated with the offensive employment of air power.

AIR DOMINANCE PLATFORMS AND ROLES IN IW

Let us now briefly brush through the kind of platforms, weapons and systems that would lend themselves easily to the prosecution of air dominance in IW or 4G warfare:

- Fixed wing multi-role fighter assets and attack helicopters with precision capability that can carry out strikes against COGs of non-state actors, like leadership, training camps and weapon storage areas.

- ISR assets to support acquisition, monitoring, tracking and engagement of both static, fleeting and mobile targets.

- Attack/armed helicopers and armed Unmanned Aerial Vehicles (UAVs) like the Predator to engage time sensitive and fleeting targets.

- Medium lift transport aircraft and helicopters to support Special Forces and small teams.

- Non-lethal weapons and other weapons like the Small Diameter Bomb (SDB) for maximum effect with minimum damage.

- Night fighting devices.

- Compatible and interoperable laser designation systems with high end communication systems that supports data transfer and video streaming, all of which are focussed on targeting.

- From an Indian point of view, the operationalisation of a few abandoned airfields in the high altitude areas of the northern Himalayas like Daulat Beg Oldi and Phukche [4]after almost 50 years is an example of how a deterrent capability lends itself easily to both state and non-state adversaries. On hindsight, had these airfields been active in 1999, the incursions and occupation of the Kargil heights by soldiers of the Northern Light Infantry and other `irregular' fighters from Pakistan may have been monitored well in time. It is also an indirect way of exercising air dominance.

- "Show of Force" missions and "Eye in the Sky" missions are mainly

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4. From *The Hindu*, April 7, 2009.

flown to exert both kinetic and non-kinetic pressure on a non-state adversary. They could comprise fighter and attack helicopter missions to enforce "no fly zones", or armed/attack helicopter sorties to minimise incursions via porous borders. The recent incidents of large scale crossings by the Lashkar militants in J&K that led to prolonged encounters could have been assisted by air power, had the option been explored and exercised. Even if the terrorists were holed up in caves, fairly accurate coordinates would have been available for attack from the air.

What is of concern, however, is the absence of adequate debate on the need for air dominance even at the lower end of the spectrum of warfare.

SUMMARY

Traditional practioners of air power may continue to feel that air combat, large formations of ground attack aircraft striking multiple targets simultaneously, corridor formations of medium and heavy lift transport aircraft dropping a division size airborne force remain the *raison d'etre* of air dominance. It is probably time to review that mindset and make air dominance relevant across the spectrum and train to accept that 4 vs 2 engagements are relevant, but so are stealthy missions to take out terrorist leadership. Translating this into force structures means that there is no scope, as some may feel, that proliferation of conflict at the lower end of the spectrum of warfare calls for downsizing of conventional force structures. In reality, however, it is a wake-up call to speedily complement conventional force structures with platforms and capabilities that can address 4G conflict. Training and leadership assume added significance in 4G and IW. To be successful, the leadership must learn and train their command, and perceive and react expeditiously with minimum force to neutralise the target, without causing any collateral damage. Suitable

"frames of reference" coupled with the ability to generate hard intelligence in a synergised manner and its real-time exploitation are, as such, key to the success of such operations. Proactive, unpredictable and unconventional tactics are called for to push the non-state actor onto the back foot by seizing the initiative and making him reactive, insecure and unsure. The modern non-state actor is tech-savvy, capable of handling sophisticated weaponry and comfortable while operating independently or in small teams. To tackle such an opponent, there is a need to stay ahead in terms of flexibility, initiative and decision-making of the junior leadership and creative/ out of the box thinking on the part of the senior leadership. Only then can the state stay ahead in 4G/IW.

There is no doubt about the inescapable requirement for air dominance in conventional warfare at the higher end of the spectrum of warfare. What is of concern, however, is the absence of adequate debate on the need for air dominance even at the lower end of the spectrum of warfare. Continued focus on building conventional air power assets for high intensity conflict is essential for democracies and large militaries to protect interests, influence geo-politics and retain certain coercive and deterrent capabilities. However, unless these assets are employed across the spectrum of warfare and more so in the realm of IW or 4 G Warfare, it is going to become increasingly difficult for air forces to cope with the emerging challenges of the 21st century. Winning the hearts and minds of the common people who are the worst affected by 4G warfare is the only way to a lasting solution in any such conflict. However, in the process of achieving that, a nation-state like India cannot afford to get labelled as a "soft state". To ensure this, the state has to be more decisive in authorising the use of deterrent force like air power without worrying too much about any of the consequences except that of 'punitive' protection for its citizens, *Collectively, we have to move beyond blaming others for wanting to practise terror in India. Instead, we must turn our attention to reforging and sharpening our blunted instruments*

to fight terror[5]. Air power is a powerful instrument of the established state and must be used to dominate the non-state actor— there can be no other way in the future.

5.   Harish Khare in *The Hindu*, July 18, 2007.

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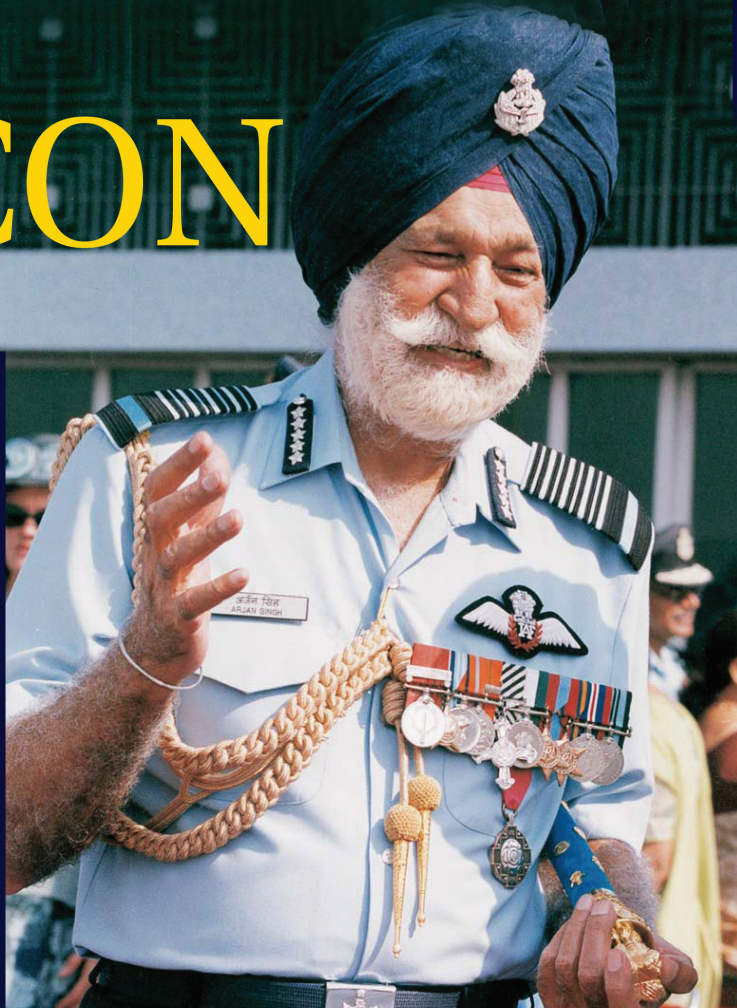
Marshal of the Indian Air Force
ARJAN SINGH, DFC

An Authorised Biography

Air Commodore **Jasjit Singh** AVSM VrC VM (Retd)

The ICON

Marshal of the Indian Air Force
The biography of **Arjan Singh**, DFC

This is the story of one man - but in reality it is also the history of a family called the Indian Air Force. Arjan Singh joined this family in his teens when the Second World War started, and rose to be the sole Marshal of the Indian Air Force, the highest military rank attainable which before him only two army chiefs, Carriappa and Sam Manekshaw had achieved. At the ripe old age of 24 he commanded No. 1 Squadron flying Hurricane fighters in defence of Imphal in 1944 beseiged by the Japanese where the Supreme Commander South-East Asia Command, Lord Mountbatten, in an unprecedented step, personally awarded the DFC (Distinguished Flying Cross) to him on the battlefield itself for his leadership and performance in defeating the Japanese.

Arjan Singh had a meteoric career and led the Indian Air Force to an unequivocal victory in Pakistan's War in 1965. In spite of enormous difficulties, shortages, internal challenges and restraints, the IAF clearly dominated Pakistan Air Force, stopping their armour offensive on 1st September in its tracks while providing near 100% of the required direct offensive air support to our army.

This biography by India's leading defence expert, a former pilot decorated for gallantry in the face of enemy, unambiguously debunks the myths of Pakistani superiority promoted by their pro-paganda and our own negligence of history and empirical evidence. And it does so on the basis of hard facts, a large number of them brought to light for the first time and explain the political and operational restrictions that applied to an operation. The enormous air support to the Indian Army, the shooting down of an F-104 supersonic interceptor by a Mystere ground attack aircraft, Hunters downing the famous Sabres, besides of course the well-known Gnat as a "Sabre Killer", the Canberras flying day light missions to provide direct air support to the Indian Army are all chronicled along with empirical evidence of the victory of IAF. Arjan Singh, of course, has been the icon of the Air Force. The biography of the Marshal, written by a well known expert, also tells us the story of the Air Force through the turbulent decade he actively served. A must read volume for the professional military leaders as well as the general reader interested in India's history, defence and military performance.

Air Commodore **Jasjit Singh** AVSM, VrC, VM (Retd), awarded the Padma Bhushan for a lifetime's contribution to national defence and security and former Director of IDSA, is the Founder Director of Centre for Air Power Studies, New Delhi. He is the author of a number of books, including Air Power in Modern Warfare, India's Defence Spending and Defence from the Skies.

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