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EDITOR'S NOTE

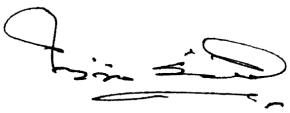
This issue (with the cover picture of the MiG-21 taking off) comes to you just short of the eve of the MiG-21 completing 50 years of service with the IAF. The aircraft's latest version is likely to remain in service for another 5-7 years. There is probably hardly a pilot or airman who has not flown and worked on the aircraft. When the first MOU was signed with the Soviet Union in early 1961 (a major factor that upset Mao Zedong), the aircraft that was offered, the MiG-21F, was based on the original design as a pure interceptor for defence against high altitude nuclear bomber threat faced by the Soviet Union. The only armament it had was the early version of K-13 air-to-air missile of which two were carried under the wings. However only eight aircraft were acquired and the MiG-21FL with the RD-13 engine entered squadron service by mid-1964.

At least 14 variants were in service with more than 32 countries and over 7,000 aircraft were manufactured (without counting the Chinese manufactured MiG-21F, re-designated by the PRC as the F-7 and its variants). HAL manufactured nearly 700 of three versions of the aircraft till it stopped its manufacture in late 1980s with the manufacture of the NiG-21bis. IAF later upgraded the aircraft with modern avionics and these are still in service. The MiG-21 actually became far more successful that its early competitors like the Lockheed F-104 *Starfighter* and British Electric *Lightning*. By mid-1980s IAF had 21 squadrons (out of 35) equipped with MiG-21FL/MF/M/bis. It served as the workhorse as well as the mainstay of frontline combat squadrons for five decades. Considering the comparatively low TBO (Time Before Overhaul) especially in the earlier versions it has been remarkable that the aircraft with numerous variations completing half a

century of service in the IAF with quite a few years' service ahead of it. Much of the credit goes to the technical officers and airmen.

The aircraft kept on being modified and finally upgraded essentially based on IAF requirements where a Mach-2 plus (2,125 kmph) of pure interceptor quite early on by the time of 1971 war had been transformed into a multi-role combat aircraft. Till now no other combat aircraft has served the IAF for half a century. Its flight safety record was one of the best --- a mere 1.7 per 10,000 hours in the 1970s, much lower than the famous Gnat and other combat aircraft.

The earlier version, the MiG-21FL (Indian name Type-77) which had an obsolete "ring and bead" sight for firing air-to-ground rockets and guns earned great credit during 1971 war providing it a remarkable finale when a four aircraft formation led by then Wing Commander (later Air Vice Marshal) BK "Bhup" Bishnoi achieved direct hits (without collateral damage) on the room where the East Pakistani Governor and the Cabinet were they were meeting in the Governor's house to discuss future course of action. Immediately after the strike the Governor knelt down to say his prayers and the Cabinet decided to surrender East Pakistan.



CHINA IN THE TWENTY-FIRST CENTURY: WHAT INDIA NEEDS TO KNOW ABOUT CHINA'S WORLD VIEW?

[SECOND ANNUAL K. SUBRAHMANYAM MEMORIAL LECTURE AT INDIA INTERNATIONAL CENTRE, ON AUGUST 29, 2012.]

SHYAM SARAN

Respected Ambassador Rasgotra, respected Shrimati Subrahmanayam, Chairman, Global India Foundation, Vice-Admiral Jacob,Vice-Chairman, Ambassador Salman Haider, Member Secretary, Shri O.P. Mishra, distinguished guests, ladies and gentlemen.

Thank you, Ambassador Rasgotra for chairing this memorial lecture. I am honoured by the presence of one of my most respected peers.

It's a privilege to have been invited to deliver the Second Annual K. Subrahmanyam memorial lecture. This gives me an opportunity to pay homage to the memory of a distinguished public servant, a meticulous scholar and one of India's great strategic thinkers. I thank Global India Foundation and its President, Shri O.P. Mishra, for according me this privilege. My own engagement with Shri Subrahmanyam goes back to 1979 when I met him on the eve of my travel to Geneva as a UN Disarmament

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Shri **Shyam Saran**, Special Envoy of the Prime Minister and Chairman RIS.

Fellow, on the advice of another very distinguished diplomat, the late M.A. Vellodi. I recall Secretary Vellodi telling me that there was no better informed and knowledgeable person in India who could acquaint me with the intricacies of disarmament and international security and India's own positioning in this domain. This began a process of education at the feet of an extraordinary individual, off and on, over the next three decades. There are scores of people like me who have imbibed a sense of India's geopolitical role, it's strategic compulsions and opportunities and, above all, the need to undertake dispassionate and rigorous analysis of issues, though I am not certain how many of us would measure up to his high standards. Nevertheless, I feel emboldened today to offer you some ideas on a subject that he was convinced, would remain a major preoccupation for India in the decades to come, the challenge of an ascendant China. Much of what I will say is drawn from my own experience of China, an abiding fascination with its unique civilisation and a deep respect for its philosophical and cultural heritage. My justification for indulging in this rather broad sweep analysis is that, managing the China challenge requires a much deeper understanding of the nature of Chinese civilisation, its cultural particularities and the worldview of its people, formed layer upon layer, over five thousand years of unbroken though sometimes tumultuous history. China is undergoing a dramatic transformation and its traditional culture and ways of thinking can no longer be sourced only to persistent templates derived from the past. One has to only look at how modern, digital culture has pervaded Chinese society, in particular, its youth, to be cautious in making judgments about the country's view of itself. Nevertheless, there are certain deeply rooted elements that shape China's psyche and its world view that are worth careful reflection, including where India fits into that broad consciousness. At various points, I will also try and contrast Chinese and Indian cultural and philosophical traits, so that one is better prepared in adjusting one's own template in judging Chinese behaviour.

If there is one singular and unique feature of Chinese civilisation that distinguishes it from other major civilisations, it is the use of Chinese ideograms and characters, that survive with few changes to this day, since

they first appeared on oracle bones, some three thousand five hundred years or more ago, during the ancient Shang dynasty. Chinese language has no alphabet. Each character is a word in itself and a decent vocabulary requires memorising at least three thousand characters. A scholar may aspire to a vocabulary of five thousand. "Classical Chinese", in the words of one scholar, Peter Hessler, the author of Oracle Bones, "connected people over space and time". "It provided a powerful element of unity to an empire that, from another perspective, was a mish-mash of ethnic groups and languages". After I had learnt Mandarin in Hong Kong in the early 1970s, I would often communicate with the local Cantonese using my new found knowledge of Chinese characters, because my Mandarin was as unintelligible to them as their Cantonese dialect was to me.

What is to be appreciated in this context is the importance of the written word in Chinese culture and the transformation of Chinese ideograms into an essential element in Chinese aesthetics.

What is to be appreciated in this context is the importance of the written word in Chinese culture and the transformation of Chinese ideograms into an essential element in Chinese aesthetics. Calligraphy is a much admired accomplishment and characters appear as an integral component in paintings as well as Chinese pottery.

Contrast this with Indian culture, where the spoken word is pre-eminent. The ancient Vedas were heard as "Srutis" and were then remembered as "Smritis". The written word came much later. Mantras get energised only when they are recited in the correct rhythm and tone. Beauty is imparted and sought through arrangements of sound; imagery is not of the same order. To an Indian, Chinese music sounds stilted and archaic, while Indian classical music is a breathtaking mastery of seven notes and several microtones in between, forever reinventing itself. It is for this reason that I consider Chinese to be a predominantly visual culture, a legacy of the ancient ideogram, while India's is a predominantly aural culture, where spoken word, the musical note, the sacred mantra, were to become the defining characteristics of the culture. This difference in civilisational trajectory has its impact on how our two cultures

perceive the world around us and interact with one another. The emphasis on the written word led to an immense treasury of historical documentation in China. The Chinese pilgrims, Fa Xian and Xuan Zhuang left elaborate records of their journeys to India and its great universities of Taxila, Nalanda and Vikramshila. In contrast, while it is estimated that the beginning of the 6th century A.D., the number of Indian Buddhist monks and teachers in China were upwards of three thousand, no accounts of China, as they perceived their adopted country, have surfaced so far. Only some legends survive in temples associated with the more famous among them, such as the Shaolin temple linked with the Zen master, Bodhidhama and the Fei Lai Feng temple, or the Peak that Flew Over, located in Hangzhou, associated with the Buddhist monk, known only by his Chinese name, Huili. Huili came from Rajgir and chose the location of his temple at the foot of a peak that resembled Gridhkuta in his native town. Hence, the Peak that Flew Over.

The great value attached to the written word, bound as it has been with Chinese aesthetics and the thought process of a complex culture, has combined with an enormous and detailed historical record to provide a contemporary reference point and multi-faceted prism through which the world is perceived. Even to this day much of Chinese discourse is conducted through historical analogies, some of which are explicit and well known. Some are artfully coded and the language lends itself easily to innuendo and ambiguity. The contrast with India will be apparent where history is often a distraction.

In Chinese diplomatic behavior, this cultural particularity poses unusual challenges to any interlocutor or negotiator.

The Chinese will insistently demand and sometimes obtain explicit formulations from friend and adversary alike on issues of importance to their interests, but will rarely concede clarity and finality in formulations reflecting the other side's interests. Thus, there is the recurring demand that India reaffirm, time and again, its recognition of Chinese sovereignty over Tibet. In 2003, during PM Vajpayee's visit, China conceded Sikkim as a part of India but this was not explicitly recorded in a written formulation. In 2005, during Wen Jiabao's visit to India, China went a step further and

handed over maps of China, showing Sikkim as part of India. Recently, some Chinese scholars have pointed out that the absence of an official statement recognising Indian sovereignty leaves the door open to subsequent shifts if necessary.

Deception, let me add, is not unique to Chinese strategic thinking.

I also recall seeing the record of conversation between R.K. Nehru and Chinese Premier Zhou en-lai in 1962, some months before the border war erupted in October that year. R.K. Nehru drew attention to reports that China was leaning towards the Pakistani position that Jammu and Kashmir was disputed territory. He recalled to Zhou an earlier conversation, where when asked whether China accepted Indian sovereignty over J&K, he had said, rhetorically- Has China ever said that it does not accept Indian sovereignty over J&K, or words to that effect. At this latest encounter, Zhou turned the same formulation on its head, to ask, Has China ever said that India has sovereignty over J&K? Much of the misunderstanding and lack of communication that has characterised India-China relations may be sourced to the failure on India's part to be conversant with Chinese thought processes. It is easy to accuse the Chinese of betrayal, as Nehru did after the 1962 war, but a clear awareness that deception is, after all, an integral element of Chinese strategic culture, may have spared us much angst in the past. Such awareness should certainly be part of our confronting the China challenge in the future.

Deception, let me add, is not unique to Chinese strategic thinking. The Mahabharata has examples of its efficacy and Chanakya is an ardent enthusiast. But in China it is accorded a value much more significant than in other cultures. I think many in this well-informed audience may be familiar with the Chinese classic, The Romance of the three Kingdoms, and the oft-quoted "Ruse of the Empty City", depicted therein, which is a favourite part of Chinese lore. This was resorted to by the famous Shu Kingdom general Zhuge Liang. The general was in danger of being besieged and over-run at the fortress city of Xicheng by the Wei army, while his main forces were located a long distance away. Zhuge Liang ordered all the city gates to be opened and asked his soldiers to don the clothes of ordinary householders,

going about their normal activities, while he parked himself on top of one of the city gates, calmly playing the Chinese string instrument, the Qin. The Wei general, Sima Yi, confronted with this strange spectacle, suspected that he would run into an ambush as soon as he entered the city gates and withdrew. And the day was saved for Shu. Zhu Geliang is credited with the observation that to win a war, it was necessary to steal into the mind of one's enemy, observe his thought processes, and then fashion the appropriate strategy. There is no moral or ethical dimension attached to deception and the Chinese would find it odd being accused of "betrayal", in particular, if the strategy of deception had worked. What is required from our strategists and diplomats is to understand this important instrument in the Chinese strategic tool-box and learn to deal with it effectively. Perhaps we should take to heart Zhuge Liang's advice and enter the mind of our Chinese interlocutor to judge his mental and psychological construct.

Another important feature of Chinese thinking is what I would call, "Contextualising". Significant decisions and actions must always be located in a broad assessment of political, economic, social and even psychological factors that constitute the stage setting for the proposed activity. This lends an inherent prudence to Chinese strategic thinking, but once events have brewed to the right mix and the timing is right, action must be swift and decisive. The Chinese strategist may wish to avoid war, if such a war carries inordinate risk. However, the use of force is an essential and accepted part of pursuing national interests and war is not necessarily an unmitigated evil. The Indian attitude towards the use of force and the dangers of war is more ambiguous. The use of force is often seen as a failure of diplomacy not an extension of it. And this is an important difference between the two countries. The conversations between Nehru and Mao in 1956 on the nature of war reflect this clearly.

Let me try and illustrate this by examining some of the events leading up to the 1962 border war. In January 2005, Chinese TV broadcast a documentary entitled "The Secret History of the China-India War". This documentary is important for two reasons. It painstakingly spells out the domestic, regional and international context within which the decision to

launch the attack against Indian border forces was taken. It refers to the hesitation within certain sections of the party leadership to "make an enemy out of India", at a time when China was still recovering from the ravages of famine and the disastrous consequences of the 1958-61 Great Leap Froward. The international situation was also not judged to be favourable. The ideological conflict with the Soviet Union, the commentary says, had now become a state to state conflict as well. The United States continued with its hostile policies towards China and the Chiang regime in Taiwan was becoming more aggressive. This is an example of the "contextualising" approach. This probably corresponded to the assessment of Chinese posture on the Indian side; briefly, that while border skirmishes would continue, China was unlikely to engage in a full-scale war.

However, from summer of 1962, the "context" had begun to change and the clues to this change were missed by the Indian side. After having retreated to the "second line of leadership" in the wake of the failure of the Great Leap Forward, Mao plotted his return to absolute leadership, using the PLA with the new Defence Minister Lin Piao, who had replaced Marshal Peng Tehuai, as an ally. The TV documentary points to differences of opinion within the Party leadership on the border issue. This, it said, was settled by the denunciation of those who counseled restraint, as "right opportunists". While having temporarily ceded the administration of the Party and the Government to other veteran leaders like Liu Shaoqi and Peng Zhen, Mao appears to have taken charge of issuing directives to the PLA personally, on handling border tensions with India. It was he who decided in August 1962, to engage in a full scale military assault on Indian forces, and to "liquidate the invading Indian army". But this was done only after his commanders had reported that the Indian side simply had neither the numbers nor the equipment to withstand a Chinese attack, particularly if the attack was of an unexpected scale. On the international front, too, there was a window of opportunity, mitigating some of the constraints cited earlier. In June, 1962, the Chinese ambassador, Wang Bingnan had enquired from his US counterpart in Warsaw whether the US would take advantage of India-China border tensions, to encourage a Taiwanese attack on the mainland.

Kissinger tried to persuade the Chinese to attack India along the Sino-Indian border as a means of relieving pressure on their common ally, Pakistan.

He obtained a categorical assurance which he claims, in his memoirs, played a big role in the decision to go to war with India. Thanks to the impending Cuban missile crisis, the then Soviet Union sought Chinese support by conveying its intention to side with China in the border conflict with India. China may not have known about the looming US-Soviet crisis, but it certainly profited from the Soviet change of heart, temporary though this proved to be. Perhaps it is too much to expect that Indian decision makers would have connected these dots together, but that is precisely what is necessary in dealing with China.

The other example of the importance of contextualising may be seen through a contrary example. In 1971, during the Bangladesh war, US and China were allies supporting Pakistan. Kissinger tried to persuade the Chinese to attack India along the Sino-Indian border as a means of relieving pressure on their common ally, Pakistan. In the papers of Alexander Haig, who was White House Chief of Staff at the time, it is reported that he did receive a formal reply from the Chinese side, conveying that China had decided not to move troops to the Sino-Indian border. On can confidently surmise that the constraining 'context' in this regard was the Indo-Soviet treaty of 1971.

Lest any one believes that Chinese strategists always get things right, I would like to recall what happened in 1986 during the Wangdung Incident in the Eastern sector. In 1985, China began to signal that the so-called "package proposal" for resolving the border issue, essentially legitimising the post-1962 status quo, was no longer on offer. In official talks, Chinese officials stated explicitly for the first time that since the disputed area in the Eastern sector was much larger than in the Western sector, India would have to make significant concessions in that sector and China would reciprocate with appropriate concessions (unspecified) in the West. It was also conveyed to us that at a minimum, Tawang would have to be transferred to the Chinese side. When we pointed out that just 3 years back in 1982 Deng Xiaoping had himself spelt out the package proposal as we had hitherto understood it, the response was

that we may have read too much into his words. The shift could have been related to a greater level of confidence following China's rapid growth and the fact that a young and as yet untested Prime Minister had taken office in Delhi. This was followed by the discovery in the summer of 1986 that the Chinese had crossed the Thagla Ridge and occupied a feature called Le, built permanent barracks as well as a helipad. In my view this was in some way linked to the hardening of the Chinese position on the border and the new insistence on India making concessions in the Eastern sector. I recall accompanying Ambassador K.P.S. Menon to lodge a protest with the then Chinese Assistant Foreign Minister and being witness to a most undiplomatic, offensive and vituperative harangue by the latter. He claimed that China was, of course, on its own territory, that it was only "strengthening border management" after the neglect of recent years and that India would be prudent not to over-react. Soon thereafter I was transferred from Beijing to Tokyo, but en route in Delhi I attended a strategy session called to discuss our counter moves. There was, I admit, a reluctance to take any military counter measures. However, a couple of weeks later I learnt that the then Army Chief, Sundarji, had airlifted troops and occupied the parallel ridge, known by the peaks Lurongla, Hathungla and Sulunga , overlooking the Sumdorung river. Two forward posts, Jaya and Negi, were set up across the river just below the ridge and only 10 metres from a Chinese forward post. The Chinese were taken completely by surprise as perhaps were our own political leaders. The then External Affairs Minister, Shri N.D. Tiwari was transiting Beijing on his way back from Pyong Yang after attending the Non-Aligned Coordination Bureau meeting that September, to try and assuage Chinese anger. I was accompanying him en route to Tokyo having been deputed to Pyong Yang to assist our delegation. Senior Chinese Foreign Ministry officials were at hand at the airport to receive our delegation. In the brief exchange that took place at the airport, our Minister's protestations of peace and goodwill were met with the not unreasonable comment that while our leaders were talking peace they were making aggressive military moves on the ground at the same time. China would only be satisfied if Indian troops vacated the ridge they had occupied. China would not be fooled; it would "listen to what is said, but see what action is taken." In later talks we agreed

The lesson to be drawn is not that we should be militarily provocative but that we should have enough capabilities deployed to convince the other side that aggressive moves would invite counter moves.

to vacate the heights on our side if the Chinese retreated behind the Thagla ridge, but since they were not ready to do so, we stayed put as well. While we may not have planned it this way, the Chinese judged our actions through their own prism: that we had countered their unexpected move by a well orchestrated counter move of our own. Subsequently, I am told, that the offensive and overbearing tone adopted by Chinese Foreign Ministry officials also changed to being more polite and civilised. The next several years were spent in the two sides discussing disengagement in this sector and finally in 1992, the eyeball to eyeball confrontation was ended and a number of confidence building measures adopted. The lesson to be drawn is not that we should be militarily provocative but that we should have enough capabilities deployed to convince the other side that aggressive moves would invite counter moves. This is the reason why it is so important for us to speed up the upgradation of our border infrastructure and communication links along all our borders, not just with China.

In dealing with China, therefore, one must constantly analyse the domestic and geopolitical environment as perceived by China, which is the prism through which its strategic calculus is shaped and implemented.

In 2005, India was being courted as an emerging power both by Europe and the US, thereby expanding its own room for manoeuvre. The Chinese response to this was to project a more positive and amenable posture towards India. This took the shape of concluding the significant Political Parameters and Guiding Principles for seeking a settlement of the border issue; the depiction of Sikkim as part of India territory in Chinese maps and the declaration of a bilateral Strategic and Cooperative Partnership with India. In private parleys with Indian leaders, their Chinese counterparts conveyed a readiness to accept India's permanent membership of the Security Council, though it was not willing to state this in black and white in the Joint Statement. Since then, however, as Indian prospects appeared

to have diminished and the perceived power gap with China has widened, the Chinese sensitivity to Indian interests has also eroded. It is only in recent months that the tide has turned somewhat, when China has been facing a countervailing backlash to its assertive posture in the South China Sea and the US has declared its intention to "rebalance" its security assets in the Asia-Pacific region. There has been a setback to Chinese hitherto dominating presence in Myanmar and a steady devaluation of Pakistan's value to China as a proxy power to contain India. At home, there are prospects of slower growth and persistent ethnic unrest in Xinjiang and Tibet. A major leadership transition is underway adding to the overall sense of uncertainly and anxiety. We are, therefore, once again witnessing another renewed though probably temporary phase of greater friendliness towards India, but it's a pity that we are unable to engage in active and imaginative diplomacy to leverage this opportunity to India's enduring advantage, given the growing incoherence of our national polity.

I will speak briefly on Chinese attitudes specific to India and how China sees itself in relation to India. While going through a recent publication on China in 2020, I came across an observation I consider apt for this exercise. The historian Jacques Barzun is quoted as saying:

"To see ourselves as others see us is a valuable gift, without doubt. But in international relations what is still rarer and far more useful is to see others as they see themselves".

It is true that through their long history, India and China have mostly enjoyed a benign relationship. This was mainly due to the forbidding geographical buffers between the two sides, the Taklamalan desert on the Western edges of the Chinese empire, the vast, icy plateau of Tibet to the South and the ocean expanse to its East. Such interaction as did take place was through both the caravan routes across what is now Xinjiang as well as through the sea-borne trade routes across the Indian Ocean and South China Sea, linking Indian ports on both the Eastern and Western seaboard to the East coast of China. India was not located in the traditional Chinese political order consisting of subordinate states, whether such subordination was real or imagined. In civilisational terms, too, India, as a source of Buddhist religion

and philosophy and, at some points in history, the knowledge capital of the region, may have been considered a special case, a parallel centre of power and culture, but comfortably far away. During the age of imperialism and colonialism, India came into Chinese consciousness as a source of the opium that the British insisted on dumping into China. The use of Indian soldiers in the various military assaults on China by the British and the deployment of Indian police forces in the British Concessions may have also left a negative residue about India and Indians in the Chinese mind. This was balanced by several strong positives, however, in particular the mutual sympathy between the two peoples struggling for political liberation and emancipation throughout the first half of the 20th century. To some extent, these positives continued after Indian independence in 1947 and China's liberation in 1949 and were even reinforced thanks to Pandit Nehru's passionate belief in Asian resurgence and the seminal role that India and China could play in the process. However, such sentiments were soon overlaid by the challenges of national consolidation in both countries and the pressures of heightened Cold War tensions. With Chinese occupation of Tibet in 1950, India and China became contiguous neighbours for the first time in history. When the 1959 revolt in Tibet erupted and the Dalai Lama and 60,000 Tibetans sought and received shelter in India, the differences between the two sides on the boundary issue, took on a strategic dimension, as has been pointed out most recently by Kissinger in his book "On China". The 1962 War was not so much about the boundary as it was a Chinese response to a perceived threat to China's control over Tibet, however misplaced such perception may have been. The comprehensive defeat of Indian forces in the short war and the regional and international humiliation of India that followed, allowed China to conveniently locate India in its traditional inter-state pattern, as a subordinate state, not capable of ever matching the pre-eminence of Chinese power and influence. Since 1962, most Chinese portrayals of India and Indian leaders in conversations with other world leaders or, more lately, in articles by some scholars and commentators, have been starkly negative. An Indian would find it quite infuriating to read some of the exchanges on India and Indian leaders in the Kissinger Transcripts. In recent times,

Chinese commentaries take China's elevated place in Asia and the world as given, but Indian aspirations are dismissed as a "dream". There are repeated references to the big gap between the "comprehensive national powers" of the two countries. India's indigenous capabilities are usually dismissed as having been borrowed from abroad. In an interesting research paper entitled "Chinese Responses to India's Military Modernisation", Lora Salmaan refers to the "over confidence" phenomenon that characterises Chinese comparisons of their own capabilities vis-à-vis India. She points outs that Indian claims of domestic production and innovation are frequently dismissed by Chinese analysts by adding the phrase "so-called" or putting "indigenous" or "domestic" under quotes. She concludes that

Lora Salmaan refers to the "over confidence" phenomenon that characterises Chinese comparisons of their own capabilities vis-à-vis India.

"These rhetorical flourishes suggest elements of derision and dismissiveness in Chinese attitudes towards India's domestic programmes and abilities".

This dismissiveness also colours Chinese analysis of Indian politics and society. The usual Chinese refrain is that, India is chaotic and undisciplined and does not have what it takes to be a great power like China. In an article entitled "Why China is Wary of India", the commentator Peter Lee relates an interesting story of what transpired at a Washington Security Conference:

> "A Chinese delegate caused an awkward silence among the congenial group at a post-event drinks session when he stated that India was "an undisciplined country where the plague and leprosy still exist. How a big dirty country like that can rise so quickly amazed us".

Currently, there are two strands in Chinese perceptions about India. There are strong, lingering attitudes that dismiss India's claim as a credible power and regard its great power aspirations as "arrogance" and as being an unrealistic pretension. The other strand, also visible in scholarly writings and

in the series of leadership summits that have taken place at regular intervals, is recognition that India's economic, military and scientific and technological capabilities are on the rise, even if they do not match China. India is valued as an attractive market for Chinese products at a time when traditional markets in the West are flat. China is also respectful of India's role in multilateral fora, where on several global issues Indian interests converge with China. I have personal experience of working closely and most productively with Chinese colleagues in the UN Climate Change negotiations and our trade negotiators have found the Chinese valuable allies in WTO negotiations. In such settings Chinese comfortably defer to Indian leadership. I have also found that on issues of contention, there is reluctance to confront India directly, the effort usually being to encourage other countries to play a proxy role in frustrating Indian diplomacy. This was clearly visible during the Nuclear Suppliers Group meeting in Vienna in 2008, when China did not wish to be the only country to oppose the waiver for India in nuclear trade, as it could have since the Group functions by consensus. China may have refused to engage India in any dialogue on nuclear or missile issues, but that does not mean that Indian capabilities in this regard so unnoticed or their implications for Chinese security are ignored. It is in the maritime sphere that China considers Indian capabilities to possess the most credibility and as affecting Chinese security interests. These two strands reflect ambivalence about India's emergence - dismissive on the one hand, a wary, watchful and occasionally respectful posture on the other. Needless to say, it is what trajectory India itself traverses in its economic and social development that will mostly influence Chinese perception about the country.

Additionally, how India manages its relations with other major powers, in particular, the United States would also be a factor. My own experience has been that the closer India-US relations are seen to be, the more amenable China has proved to be. I do not accept the argument that a closer India-US relationship leads China to adopt a more negative and aggressive posture towards India. The same is true of India's relations with countries like Japan, Indonesia and Australia, who have convergent concerns about Chinese dominance of the East Asian theatre. I also believe that it is a

question of time before similar concerns surface in Russia as well. India should be mindful of this in maintaining and consolidating its already friendly, but sometimes, sketchy relations with Russia. The stronger India's links are with these major powers, the more room India would have in its relations with China.

China is one power which impinges most directly on India's geopolitical space.

It would be apparent from my presentation that India and China harbour essentially adversarial perceptions of one another. This is determined by geography as well as by the growth trajectories of the two countries. China is one power which impinges most directly on India's geopolitical space. As the two countries expand their respective economic and military capabilities and their power radiates outwards from their frontiers, they will inevitably intrude into each other's zone of interest, what has been called "over-lapping peripheries". It is not necessary that this adversarial relationship will inevitably generate tensions or, worse, another military conflict, but in order to avoid that India needs to fashion a strategy which is based on a constant familiarity with Chinese strategic calculus , the changes in this calculus as the regional and global landscape changes and which is, above all, informed by a deep understanding of Chinese culture, the psyche of its people and how these, too, are undergoing change in the process of modernisation. Equally, we should endeavour to shape Chinese perceptions through building on the positives and strengthening collaboration on convergent interests, which are not insignificant. One must always be mindful of the prism through which China interprets the world around it and India's place in that world. It is only through such a complex and continuing exercise that China's India challenge can be dealt with.

Sometimes a strong sense of history, portions of which may be imagined rather than real, may lead the Chinese to ignore the fact that the contemporary geo-political landscape is very different from that which prevailed during Chinese ascendancy in the past. Merely achieving a higher proportion of the global GDP does not guarantee the restoration of pre-eminence. Ancient China was not a globalised economy. It was a world in

itself, mostly self sufficient and shunning the less civilised periphery around it. Today, China's emergence is integrally linked to the global economy. It is a creature of interdependence. Similarly, today the geopolitical terrain is populated by a number of major powers, including in the Asian theatre. A reassertion of Chinese dominance, or an assumption that being at the top of the pile in Asia is part of some natural order, is likely to bump up against painful ground reality, as it has since 2009, opening the door to the US rebalancing. The recent reports of a slowing down of Chinese growth should also be sobering.

On the Indian side, the failure to look at the larger picture often results, by default, in looking at India-China relations inordinately through the military prism. This also inhibits us from locating opportunities in an expanding Chinese market and in promoting a focus on the rich history of cultural interchange and the more contemporary pathways our two cultures have taken in fascinating ways. This covers music, dance, cinema, literature and painting. Chinese successes in development and its focus on infrastructure do have lessons for India which should be embraced. And if China, for its own reasons, is willing to invest in India's own massive infrastructure development plans, why not examine how this could be leveraged while keeping our security concerns at the forefront? There are many areas of grey and it is for dispassionate strategists on both sides to explore and help shape a future for China-India relations that aspire to be as benign as it has been for most of the past.

I thank you for your attention.

A DEFINING MOMENT OF THE DEBATE: MANNED VERSUS UNMANNED PLATFORMS OF AIRPOWER

MANOJ KUMAR

Why the debate?

The eulogies to airpower are easily available within the milieu dealing with national security as well as those using civil aviation for their personal use. Airpower has come to be symbolised by *'glamorous'* flying machines and an equally fascinating set of people, who sit inside, managing the *'stick and the throttle'*. While the machines are always in the forefront, the men have always been right behind, in the hierarchy of popularity. From the time combat flying (as we know it today) became a reality in the World War II, men and machine have been considered two sides of the flying business. However, unmanned flying machines (excluding the balloons) have also come into the limelight around the same time for use as the armed element of airpower. While unmanned machines that could be utilised as missiles (equivalent of present day cruise missiles) over long distances had caught the fancy of the military during the World War II, these were never really imagined to be the replacement of manned flights.

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Historically the development never took one as substitution for another. The debate on the substitution started not very far back, in 2001.

The cost of human lives and the *'lethality'* of the war post World War II ensured that serious consideration was given to unmanned flights. However, at that stage it was not thought that unmanned flights could ever be able to enter the realm of replacing manned flights. With advances in technology, new sensors, GPS navigation and radio control of the unmanned platforms, thereby extending their reach over long distances. This proved to be a parallel, burgeoning new generation of war-fighting methodology. So, as the manned flight platforms were evolving from one generation to another, the unmanned platforms were also finding new usages on the battlefield, increasing its employability and decreasing the risk of human attrition. The idea of exchangeability of platforms – from manned to unmanned, was a major driver for the debate on moving to the era of Unmanned Aerial Vehicle (UAVs).

The original purpose of drones (as the UAVs have come to be known) had been to provide quick intelligence, surveillance and reconnaissance of hostile terrain (ISR). Even at that time, it was considered that to a limited extent and owing to the stealthy nature of missions, drones could be utilised to undertake such missions over an adversary's airspace. Mixed with inputs from satellites, the ISR drones could provide services that manned flights would not have been able to afford. The genesis of the debate on substitution of manned flights by unmanned, thus, started while considering such missions.

UAVs also filled a void that existed considering the high cost of operations that are needed for sustaining manned operations. While developing a UAV requires high investment, managing it requires far lesser funding. Traditionally, the debate did not consider this aspect keenly, although it was always in the background. It was more driven by the fact that the limitations of manned flight primarily due to the presence of man in the machine could be overcome by a UAV. The proponent of manned flights never took these arguments seriously; it was felt that mostly the dirty

end of the business – one that required endurance flying, flying in dubious environment or highly dangerous missions, which did not require human intuition, could be flown by the UAVs. Historically the development never took one as substitution for another. The debate on the substitution started not very far back, in 2001 (since the entry of the US and the The North Atlantic Treaty Organisation (NATO) led International Security Assistance Force (ISAF) in Afghanistan) when the notable efficacy of the UAPs in undertaking pre-decided strikes over long distance, in extremely hostile environment, was proven. The killing of Anwar al-Awlaki and other al-Qaeda activists on September 30, 2011 in Yemen by the US combat drones, has again rekindled the debate. Another addition to the debate has been the ability of the UAVs to be stealthy as well as limit the scale of hostilities. In comparison, if a manned flight incursion of airspace takes place, the country at the receiving end takes huge umbrage. In fact, manned incursion of airspace in hot pursuit of anti national forces is normally not considered an option during offensive action. This again brings to the fore the requirement to now go for unmanned, technology intensive platforms that can surpass the practical usage of manned platforms. More and more advances in the UAVs have now been started with a view to initially complement, and eventually replace manned flights. The rationale is to use them for missions that are/were not yet considered to be in the domain of unmanned flights, like real time combat strikes and air-to-air combat in the Beyond Visual Range (BVR) scenario.

This paper would strive to study how far this debate can go considering mostly the limitations of technology, our imagination and straight-jacketing of the mindset with old cultural baggage. The historical timelines of development of the UAVs may throw some light on the direction-time responses of the contemporary technology development trajectory in this field. The US has already come up with a roadmap for integration of unmanned systems with the manned operations from 2011 till 2036[1]. In such a scenario, the path that the military, in a country like India, may follow

1. at http://www.defenseinnovationmarketplace.mil/resources/UnmannedSystems Integrated RoadmapFY2011.pdf , accessed on July 04, 2012

would definitely be an essential ingredient of the paper. The future course of this debate would throw many other questions, each more complex than the other. To analyse these issues would require some multifaceted scenarios to be unravelled.

Genesis and evolution: unmanned platforms

Before the history of unmanned platforms is discussed, it is essential to clarify that, this term is used in a very restrictive manner in this paper. In essence, the utilisation of unplanned platforms as long range missiles may be termed as a UAV. However, the same is definitely not true for manned flights (leaving aside the kamikaze missions flown by Japanese in World War II or the 9/11 event in the US) and since the paper is about doing a comparative analysis of the two platforms from all angles, the use of the term UAV is restricted to flying machines similar to a manned aircraft. Additionally, the comparison of these platforms is confined to military environment even though the UAVs, like manned aerial machines, have been used for various non-military purposes like spraying pesticides and disaster relief monitoring etc.

In the real sense the UAVs had been used for surveillance in combat support roles around or even before the first manned airplane in 1903. But these were primitive structures like balloons and are thus, not being discussed here. The first UAV that was to be used as a flying bomb or an 'aerial torpedo'[2] was actually developed during the World War I. However, the war ended before it could be deployed. But, the curiosity of military leaders had been aroused. Most of these developments were designed to achieve an advantage over a tough adversary and as a long range missile system. The Research and Development (R&D) efforts in using this relatively safer mode of combat airpower projection were seriously launched in the UK and the US after the World War I. The first generation of the UAVs were actually radio controlled drones, developed to be used as targets for training anti-aircraft gunners. These

2. For more information on evolution of UAPs readers may wish to access the site at http://www.pbs.org/wgbh/nova/spiesfly/uavs.html accessed on July 02, 2012.

continued to evolve till the World War II, with larger planes being developed as anti-aircraft targets or target drones.

The next generation (second generation) of drones could be categorised as assault drones, those that used radar and television sensors for terminal guidance; a project known as Project Fox of the US Naval Aircraft Factory in June, 1942.[3] During the tests it was seen that such a drone was capable of providing useable picture up to 30 miles distance and hitting a target with depth charges or torpedoes. Actually from 1941 onwards, combat drones carrying 2000 lb bombs were used actively in the World War II against Japanese artillery, emplacements, bridges, tunnels and munitions dump. A shift in the tactics saw use of an unmanned TDR-1 bomber carrying 500 and 1000 lb bombs against gun emplacements and then heading back home. This was the beginning of the new operational paradigm of using drones as Unmanned Combat Air Vehicles (UCAVs)[4].

One of the results of the Cold War was the increased need for reconnaissance by the two blocks. The drones thus developed were used for the purpose.

One of the results of the Cold War was the increased need for reconnaissance by the two blocks. The drones thus developed were used for the purpose even in the Korean War and the US' War in Vietnam. In 1960, the shooting down of U-2 by the Soviets and the subsequent public trial of its pilot was a major embarrassment for the US. Recognising this, the US Air Force launched a number of surveillance drone programmes. Due to the need of the hour, the technological development then moved towards enhancing the surveillance (as against combat) role of the UAVs. From the 1970s to the 80s, the development trajectory underwent a sea change. The focus shifted to inoculating Unmanned Aerial Vehicles (UAVs) in the active battlefields, albeit primarily for ISR missions only. Israel too emerged as a major player in the development race with its Scout and Pioneer range of UAVs.

3. Lawrence R. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicle*, (Virginia, USA: American Institute of Aeronautics and Astronautics, Inc. 2004) pp. 66-68.
4. Ibid. p. 69.

It was only in the 1990s that the third generation of UAVs came into active service. These UAVs had high endurance; they could be controlled over long distances and they could relay almost real time feedbacks using satellite data-links. The USA's Pathfinder and Predator UAVs were top of the line surveillance platforms. The Predator saw action in the Balkans and became an integral part of the Central Intelligence Agency (CIA) and the USAF operations in Iraq and Afghanistan[5]. The clock turned a full circle and the Predator series was converted into an attack platform by strengthening its wings and few other modifications that made it possible to have hard points and carry munitions like Hellfire missiles etc. Since the start of Afghanistan operations, the majority of strikes on Taliban targets on the Af-Pak border were carried out by UCAVs – the Predator or Reaper. It afforded the luxury of stand-off, to avoid retaliation against their pilots, few of the unmanned platforms were actually lost in operations either shot down or due to technical/handling issues. In fact, the first reported 'dogfight' between a manned and an unmanned (Mig 25 of Iraq versus Predator carrying air-to-air Stingers) took place on December 23, 2002 wherein the UCAV was shot down, **predictably,** and Mig 25 escaped even after being picked up and an air-to-air missile being launched at it by the UCAV[6].

The fourth generation of the UAV is around the corner. The development work for autonomous flights of UAVs is on with full vigour. The rationale is to remove the weakness in technology like delayed reaction time and chances of hacking the data link etc (these would be discussed later in the paper) that has prevented the unmanned platforms to really match the capabilities of its manned compliment. Following is an excerpt of a news article in the *Times of India*, New Delhi edition of July 04, 2012[7]. The future development trajectory is clearly reflected in this piece.

5. 'Predator Drones and other Unmanned Aerial Vehicles (UAVs) History, Uses, Costs, Advantages and Disadvantages' at http://middleeast.about.com/od/usmideastpolicy/a/predator-uavs-weaponry.htm, accessed on July 18, 2012.
6. At http://www.youtube.com/watch?v=wWUR3sgKUV8, accessed on July 5, 2012.
7. At http://timesofindia.indiatimes.com/world/uk/Pilotless-fighters-set-to-fly-over-Britain-from-2013/articleshow/14663399.cms, accessed on July 04, 2012.

Box 1: Flight of Next Generation of Unmanned Platform

LONDON: Pilotless fighter planes have come a step closer to reality as British Aerospace revealed that it would test such a new fighter jet next year. It is not a drone, but rather a robotic plane with a far wider range of equipment and capabilities, the company said.

The company is set to unveil a new super-fighter which can fly on its own for 24 hours with no cockpit and no human on board, *The Daily Mail* reported. If all goes as planned the artificial intelligence could mean the end of fighter pilots in the UK and bring down the curtain on conventional aircraft like the F-35. And the robotic fighter plane christened 'the Mantis' will be making its first flight in 2013 over Britain, as it is tested to see if it works.

The quantum jump in combat technology

The entry of unmanned flights into the domain of precision strike manned aircraft has actually marked a turning point in the way the world looks at them. Till the time these platforms were used primarily for ISR missions, they were never considered a challenge to the manned flights. Since the fighting end was still in control of humans, the dull and drab end of war-fighting was easy to hand over to such machines. With the advent of present day UCAV technology, these platforms are now being seen as complementing the manned operations[8]. The technology has evolved to an extent that the Ground Control Station (GCS) can be far away from the place where the unmanned flights are taking-off/landing. Only a small van now needs to be positioned near the runway from where the UAVs operate, to control the take-off and landing. Rest of the control, including munitions firing is with the GCS. With advances in electronics, the time delay in sense-to-shoot has been all but removed. It is the analysis of the target or the sense part that still vests with humans, which is presently the cause of whatever delay that remains to be tapped. The precision of the munitions is the same as in manned flights. Even then whatever delay that remains and lack of manoeuvrability is sufficient to weaken the combat potential of the

8. n. 1.

The weakness in the whole unmanned system is that of the chance of data-link between the GCS and the UAV snapping or being hacked.

machines when compared with manned platforms. This lack of manoeuvrability stems from the fact that the UAVs needed a specific airframe design and their propulsion system were not powerful enough due to technological barriers. This means that at present there is hardly any scope for using the UAVs for air-to-air combat and multiple-target strike operations, which require human intuition and extremely fast decision making. This effectively rules them out in scenarios where a minimum favourable air situation does not exist for the UAVs to operate as they cannot yet evade every air defence elements of the adversaries. However, all these limitations are for machines that are in operation today, but the R&D trajectory points towards removing them almost completely.

The second weakness in the whole unmanned system is that of the chance of data-link between the GCS and the UAV snapping or being hacked, with the result that either the UAV goes out of control or the control of the machine is lost to hackers with devastating results. In the latter case, these could be used as missiles for crashing into targets. It can be argued that these shortcomings are similar to technical defects that may manifest in any complex machine like a manned fighter jet leading to so many accidents that we see and hear of in the business of military aviation. If the pilot is able to recover the aircraft due to his/her abilities, the countervailing argument would be that the UAV has a higher redundancy of systems that allows it to be recovered in many dangerous situations.

The parallel described above may not be completely accurate and thus, to offset some of these weaknesses, the designers are working to make the UAVs autonomous by the use of Artificial Intelligence (AI). This would mean that in the circumstances where the control data-link is broken due to any reason, the UAV would still be able to fly to the designated site, engage the target and even recover to the launch or alternate airfield. It would even be able to go for an alternate target if there is a mismatch with some parametre of the primary target. The autonomous mode of the UAV

would also ensure that the decision making reaction time of the machine is as fast (or slow) as the onboard computer.

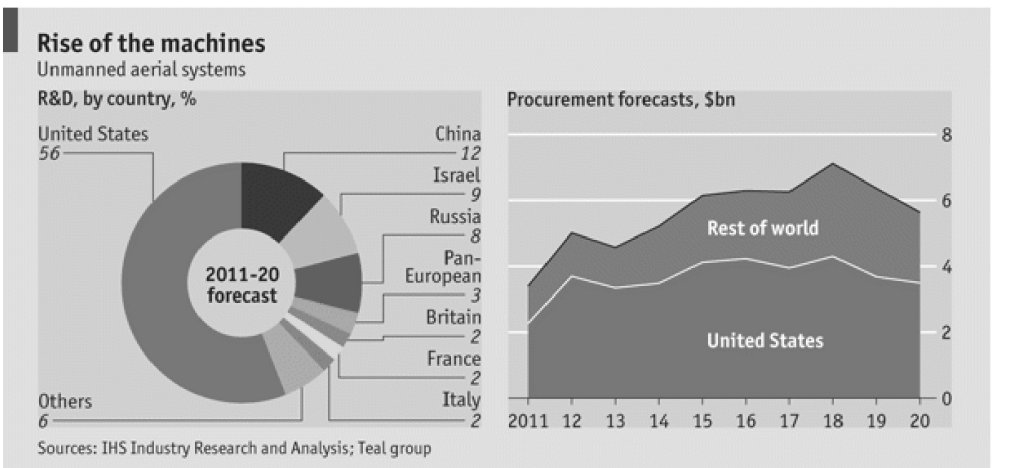
Removal of human limitations like ergonomics, atmospheric control and g-load tolerance allow the UAVs to provide for more redundancies, number of sensor systems and computational devices with superior response. Lower weight/higher payload is possible due to the fact that the person and life support systems are removed from the machine, though the extra sensors required, do not make it a one-to-one swap. With this comes the next limitation of power source that can withstand the higher demands. With next generation power devices, usage of solar panels, fuel cells and nanotechnology using batteries, a revolution of its own kind is expected in mini UAVs. However, this issue would be of an academic interest once the actual unmanned jet aircraft becomes operational as the power demand would be met by the onboard generator systems.

The next advancement in technology that is being witnessed in respect of the UAVs is the miniaturisation of systems leading to development of Mini Unmanned Aerial Vehicles (MUAVs). These systems are already in operation and being used by the US military and NATO in Afghanistan. So the unmanned flight development is taking place in both directions, towards bigger jet-engine fighters and smaller (even palm sized) flying machines, performing a variety of tasks, from reconnaissance to taking on snipers. The stealthiness of the UAV is in favour of such machines finding more and more roles. But the question that comes up is: Why the bigger machines (like the one described in box 1 above) are being developed? Since they would, presumably mimic the present day manned fifth generation fighter capabilities, why is there a need for converting them into unmanned machines of the same proportions? Some answers to these questions have already been given above, while describing the technology development process; however this is a simplistic argument unless one considers issues which go beyond mere technological developments, but to the cost of operations and attrition that a country is willing to endure.

The cost of military operations would be discussed first. The cost of developing unmanned platforms may almost be the same as manned

systems due to the requirement of high capability sensors and stealthy airframes. However, it is the cost of reduced training that can save large amount of money. In the present economic downturn around the globe, all talks of saving money are taken very seriously and specially from a non-contributing sector like the military. It is thus no coincidence that the US has already announced that the Joint Strike Fighter (JSF) is their last manned aircraft development programme. Consider the figure shown below on the amount that the developed and militarily powerful countries are spending on the R&D efforts to get an edge in obtaining the cutting edge UAVs. Indian figures are conspicuous by their absence and this would be a cause of worry in years to come.

Fig 1: Research and Development Efforts and Procurement by Countries for developing Unmanned Aerial Systems[9]



Reducing training reduces costs in other ways too. The airframe of the UAVs do not have to be flown often (mostly for operational missions) and thus, it could be designed with a service life of lesser flight hours, allowing for quick technical obsolescence. This would still allow as much operational action as on a manned fighter, but not having to worry about fatigue and

9. The article was published in *'The Economist'* at http://www.economist.com/node/21531433 accessed on June 22, 2012.

stresses from training flights would allow the UAV to be designed cheaper. Another dimension is that the machine would allow positioning of additional and latest systems without worrying for its human interface as finally all it has to do is to generate signal for onboard computer or the GHS. Without such a limitation, an up-gradation of the machine may be eminently possible and easier to handle for unmanned machines. Therefore, if one considers that the initial costs of developing a machine gets divided over a span of many years in which same platform provides for development of later generation of gadgets to be installed in the same machine, then costs get further reduced. And unlike the manned machines that require changing the airframe and matching engines for a new version machine, the UAVs would primarily require changes in internal electronic sensors and computational devices.

The real problem would come in managing airspace with larger UAVs and manned civil and military flights taking place.

With a reduced ground infrastructural requirement, the UAVs again tend to provide value for money. The technological changes would see MUAVs being launched from anywhere and controlled by sets carried by troops in their backpacks. The real problem would come in managing airspace with larger UAVs and manned civil and military flights taking place. Federal Aviation Administration (FAA) of the US has still not cleared the unmanned flights for the fear that if a pilot-controller was to temporarily lose control of a UAV, it might ram into an airliner in shared airspace. Additionally, it would require reliable data up and down-links for information transmissions to connect manned flight pilots, UAVs, their ground controllers, and air traffic controllers, in real time, to enable pilots and the UAV ground controllers to work together to avoid routing conflicts and plan the most direct and efficient flight routes through crowded airspace. This gains importance because in manned flights there is a human being to take last minute evasive action, if all other means fail. However, this problem is not insurmountable. Civil aviation authorities can learn from the military's experiences of integrating military and commercial aircraft in the same airspace. Many difficult issues of enabling civil and military

aircraft with vastly different flight capabilities in the same airspace could be applied to integrating manned and unmanned aircrafts. With technological advances that would equip the UAVs with Air Collision Avoidance Systems (TCAS), these challenges can be overcome. The task that would remain is to make them feel-safe and also ensure that cultural constraints – allowing unmanned and manned flights in the same airspace do not come in the way of allowing air traffic clearance for the UAV flights. Creating a separate corridor for the UAVs may also be considered within the airspace – civil or military, depending on the agency operating the unmanned machine. As more and more UAVs with matching abilities take flight, standard operating procedures would emerge within the developed technological paradigms. This would then become a safety management problem instead of retaining a pure technological fixation.

Now the only question that still remains to be resolved is the technological fix to increase the versatility of the UAV. Making the UAV similar to a modern multi-role fighter presents a three-fold challenge. One, it should be adaptable to the role that may not always be pre-decided and may be thrust upon it as the tactical battle progresses or if any changes take place. So it should have simultaneous multiple precision munitions carriage capability. For example, it should be able to carry and use simultaneous strike and limited air-defence munitions so as to switch roles at will. It should also have other roles, like Electronic Warfare (EW) pod carriage capability and it should be flexible to switch roles with ease. Second, it should have the capability to take on beyond visual range targets with high performance radar and then be able to manoeuvre in an air-to-air battle to save itself from an adversary's radar lock. Thirdly, it should have weather radars and be able to autonomously decide alternatives in case it encounters bad weather, looses control link and has to change plans. The UAVs/UCAVs now being developed by British Aerospace (BAe) Systems in the UK alone (Mantis and Taranis) or with partnership with Dassault Aviation (Telemos MALE –Medium Altitude, Long Endurance – a future combat air system) are considered "*critical to the sustainment of defence aviation skills and capabilities in Europe beyond the current generation of manned Gripen,*

Rafale and Typhoon jet fighters."[10] This would give an idea that the current progress in the UAVs/UCAVs is towards overcoming precisely the limitations that have always pushed them out of contention when being considered a replacement for sophisticated manned fighter aircraft. The work currently on in the UK shows how seriously this replacement for manned machines is being considered as a possibility, sometimes in the future.

Considering the past development trajectory, such machines may see operations anytime around or after 2030.

At present the race is on – unmanned platforms trying to emulate manned platforms and trying to match their capabilities. But with fast maturing technology and no restriction of a manned cockpit, the constrictions that have been faced in the development process of the UAV would be a thing of the past. The platforms that would be developed then would be out of the box and may be potential airpower game changers. The timelines for such machines is difficult to predict accurately but considering the past development trajectory, such machines may see operations anytime around or after 2030. Will this lead to complete changeover of airpower environment? The answer is almost certainly no. Till the time AI develops to such an extent that it can match human reactions to a very large extent (it is beyond the writer's imagination that a complete or superior match is technologically possible even in the distant future), manned flights would retain an edge and thus continue to be deployed, albeit in decreasing numbers. The numbers would continuously decrease also because of the second factor that had been mentioned earlier – acceptance of human attrition.

The main advantage of a UAV that can not be surpassed is the safety net that it provides to lives of its users. Considering the stand-off that is afforded to pilots flying the UAVs, a cool and calculated decision making is normally possible. The infrastructural requirement close to the field of operation is

10. More details are available at http://www.defensenews.com/article/20120620/DEFREG01/306200001/U-K-French-UAV-Contracts-May-Signed-Farnborough and at http://www.ainonline.com/aviation-news/2012-07-08/taranis-and-mantis-uavs-move-forward-towards-active-service accessed on July 11, 2012.

also minimal for operating the UAVs and thus the support personnel are not really required to move in a big group along with the machine. Thus, flying these machines in dangerous environment may be possible till it can be ensured that the risks from AD elements of the adversary are minimal. The latter is very important at this juncture because the UAVs are yet to develop effective evasive capabilities. Once the UAVs become more and more like, or superior to, the flying machines of today, the threshold for their launch for offensive missions would increasingly reduce. This brings us to the stark dilemma that is being faced by the military leaders and proponents of unmanned machines. Once the threshold of employing offensive airpower comes down due to lowering of the attrition costs, the obvious question would be whether coercive actions become a norm even without exhausting all alternatives of avoiding a conflict? This question is repeatedly being debated in the countries that are spending a big amount of money on developing the latest generation of UAVs. So even when ethics of employment are debated, the development process goes on unabated.

The state of the debate

The debate on the use of unmanned flights has assumed many more hues. It now actively considers the question of ethics of employability of the UAVs vis-à-vis manned platforms. The genesis of the debate would be the thought of machines shooting at humans as one would have seen in some hollywood motion pictures. Till the time the final button for launching munitions is under human control, some rationalisation for employment of the UAVs may be forwarded by the worst sceptics. Once the AI induced automation becomes a norm in the UCAVs of tomorrow, the dilemma of allowing machines to decide when and how to kill humans would be a tough call to make. But it is for sure that when weighing this deployment against the option of suffering human causalities in a dense AD environment, the former would win, without fail.

The ethical dilemma though real has not come in the way of developing the latest UAVs. Wars and militaries are a reality that the world has come to accept, some may say, grudgingly. So till the time innovative ways can

be found to keep the dirty end of war that leads to human causality away the UAVs would find favour with the military. The long term perspective is what merits consideration during the development process. The final control of aborting a mission or a kill has to remain in human hands, to lend some legitimacy to 'wars by machines'. The ethical debate would continue but this is the least concession that can be made to the sceptics. However, by the time ubiquitous use of the UAVs becomes a reality, most of the adversaries would also deploy UAVs of their own. The airpower and its deployment doctrine then would seem much different than how it is seen presently. This is a separate subject of discussion. Suffice to say that manned machines would be increasingly replaced or supplemented by their unmanned version as the technology matures to allow their free interference and versatile deployment.

Manned machines would be increasingly replaced or supplemented by their unmanned version as the technology matures to allow their free interference and versatile deployment.

A Mindset Change

Once it is accepted that the future of airpower would lie in unmanned platforms, what remains to be studied is the organisational impediments to their immediate acceptance in some countries, even as their global usage increases exponentially. The ethical issue discussed above, even though important, has not yet attracted much attention primarily as the UAVs/UCAVs are not at that stage in their cycle of development where such questions become an impediment. Reluctance in rampant development and thereafter deployment of UAVs stems from cultural blocks within the military organisation. It would be surprising to note that this mindset block is pervasive even among developed countries where UAVs are being developed with vigour. This block stems from the mindset in any aviator's mind that wants to see the supremacy of the man over machine. It is difficult for that aviator to see and accept that this position may change in future.

It is a known fact that in the military services, progress or lack of it, in developing new doctrines and procedures can be attributed to cultural attitude. Any Air Force's cultural baggage is that, men of action in the air have always been deemed responsible for operational policies. While this may have been, or still is, a necessity, the situation would definitely change with the UAVs arriving on the scene. In such a revolutionary scenario, it is absolutely possible that this community may feel threatened when a holistic view of the future wars is not available to them. In this context, analytical work on the UAV's deployment in future airpower engagements would be able to convince all, about the need to seriously consider their development and induction in today's forces. The asymmetry that a UAV builds in a conventional war is and would be a very sought-after attribute of future deployment of airpower. Rather than jeopardising its air warriors, if any air force can continue to utilise their talent effectively during the war without suffering attrition even while causing unsustainable damage to the adversary, the morale of its personnel as well as citizens of the nation would be greatly boosted. This asymmetrical advantage may prove to be the tipping point in future conflicts. It is thus essential for any military that at this juncture suitable budgetary and policy initiatives are taken to leapfrog the race for developing the next generation of UAVs.

It should also be appreciated that even now deployment of a UAV allows for controlling the scale of a conventional war. In the common man's perspective, UAVs are yet not treated at par with manned platforms in depicting a nation's aggressive stance in a conflict and their deployment is considered a notch lower than a full-blown war. Thus, they provide an ideal platform to launch surgical strikes, the kind India may have planned to carry out against insurgents (and their training camps) across the Line of Control (LOC). Even in a Kargil like conflict, the use of UAV allows for taking out miniscule targets in bunkers and such sheltered places in the hills (slow moving and allowing for easy pick-up), without affording reasonable chance of counter-attrition. Using UAVs for controlling escalation of conflicts is actually a huge advantage for the policy-makers. This is because owing to inherent offensive nature of airpower, its deployment is normally

regarded as an escalation of the conflict and thus the policymakers have been wary of its usage. UAV usage may also lead to escalation but to a lower level and thus the policy-makers may be more amenable to its deployment, thereby providing a useful tool in the hands of military planners.

It would be worthwhile for the military leaders to start treating UAVs as the latest expansion of war fighting paradigm.

At this point it would also be worthwhile to analyse the implications of unmanned machines for civil aviation. Most of the benefits of the UAVs during combat operations like flying dangerous, hostile opposition and monotonous long-duration missions over inimical territories cannot be visualised for civil passenger missions. The rationale for converting civil passenger/cargo flights to unmanned ones is not quite strong yet, other than an aside of saving on the costs incurred on account of salaries paid to the aircrew manning the flights. When weighed against the prospect of machines flying humans, this seems a bit far-fetched even in the future as the need is not really acute vis-à-vis the gains that accrue. So even if civil aviation sees unmanned flights, it would be much later than military aviation sector. However, right now it seems highly unrealistic for civil aviation to start using these machines even if bigger combat jets are becoming unmanned. Only cost considerations do not actually portend a just case for this to happen albeit the technological leap for making it a reality has been taken; a change in the mindset would take many, many years more. The possibility cannot be ruled out!

The Future…

Considering the issues mentioned above, it would be worthwhile for the military leaders to start treating UAVs as the latest expansion of war fighting paradigm. The technology behind UAV and its envisaged usages should serve as a wake-up call for changing the mindset that exists in many militaries. The UAVs are here to stay by being used more and more in combat operations. A military that does not possess the machines and related technology would find it severely handicapped and would have to undertake asymmetric missions exposing itself to unwanted attrition. The

present requirement of ensuring minimum air superiority for undertaking unmanned missions may also be a thing of the past when the next generation of UCAVs being developed by the UK, France and the US appear on the scene.

It is clear from the above that manned flights, at least for military use, would continue for a few more decades. In the civil sector it is difficult to predict if and when unmanned machines would make their foray. It would be some time before the air traffic management of the UAVs, AI facilitated autonomy and versatility, enhanced power source/load carrying capacity and superior control links, would mature to a level that would be able to give the manned machines a run for their money. It is also true that the road is clear for the development of UAVs to a level where the manned flights are now, and finally overtake them. The monetary costs involved in training on new machines and losses in terms of human lives make it prohibitive to keep on developing manned machines that would continue to challenge the frontiers of technology and always stay one step ahead of the adversary. Even though it may be a difficult call to predict at this juncture but the indications are there to point to a future that belongs to unmanned machines in combat operations. It is also being said that UAVs may "not just be a substitute for manned aircraft, but a tool with dramatically enhanced capabilities"[11].

(The paper reflects the views and conclusions of the author and not necessarily the opinion of the Centre or any other institution.)

11. Israel special - Israel broadens UAV use with advanced designs at http://www.flightglobal.com/news/articles/israel-special-israel-broadens-uav-use-with-advanced-designs-221444/, accessed on July 20, 2012

POSITIONING OF ISRAEL WITH ITS NEIGHBOURS AND ITS MISSILE DEFENCE SYSTEM

INDRANI TALUKDAR

Israel with a population of eight million people is situated along the eastern shore of the Mediterranean Sea. Its geographic location has significant consequence when it comes to threat perception. It borders Lebanon in the north, Syria in the northeast, Jordan and the West Bank in the east, Egypt and the Gaza Strip on the southwest, and the Gulf of Aqaba in the Red Sea to the south, containing geographically diverse features within its relatively small area. Its geo-political location creates security nightmare for Israeli defence planners as it is surrounded by hostile or potentially belligerent neighbourhood on each of its flanks in the West Asian region. The State of Israel is a geographic divide, the contiguity of the few Arab entities – the West Asia and the North African. For the countries in the West Asia, Israel has been a major strategic distraction. Israel constitutes a crucial factor in the domestic and foreign policy of these countries. It shares a 79 km boundary with Lebanon, 76 km with Syria, 238 km with Jordan, and 266 km with Egypt. Its distance from Iran is 1,558 km, 931 km from Turkey, 412 km from Cyprus and 1,253 km from Greece thus putting Israel in hotspot. Although, the Palestinians are still to be granted independence, the borders that the State of Israel shares with the West Bank and the Gaza Strip are

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approximately 307 km and 51 km respectively.[1]

The distances between these fragile regions and Israel poses security dilemma for Israel, the West Asian and Mediterranean region. It is a complex cobweb of insecurity embedded in religion, ethnicity and also in the treasures of energy, oil and other natural resources. Although Israel has been looked upon as a country that has been under threat from many countries for which it had to develop a strong defence system but one cannot overlook the other side of the coin as well. Islamic neighbouring countries in this region feel a threat to their religion and ethnicity due to the impact of globalisation based on the principles of liberal democracy and economy and not on religion and ethnicity. These regions especially Iran, Syria and the non-state actor Hezbollah of Lebanon feel the Western influence especially that of the US has been of neo-imperialistic dimensions and not of genuine humanity which would mislead the people towards misery and suppression. Another factor that could be seen behind the growing aggressiveness of Iran has been the constant portrayal of being "rogue states" by the West especially by the US and Israel. This portrayal could be a psychological impact leading to belligerence moves from these regimes. In addition to this, these countries see Israel not only as the US agent to have a control of the natural assets that this region holds but also an invader who took away the homeland of Palestinians. They also have been edgy over Israel's requirement of energy which they feel as a threat to their security.

Towards this security dilemma, two camps that could be perceived have been the nexus especially between Israel-US[2] and the nexus between Iran-Lebanon-Syria against each other. In this conundrum, seen from a larger angle, the main contenders have been the US and Iran who have been contesting against each other through their friends and allies. The distance between Israel and Lebanon and Israel and Syria, clarifies a lot of Iran's influence over these two countries to counter Israel. This insecurity for Israel has been created by the geographic distance. Therefore, Iran,

1. RSN Singh, "Israel's Threat Perception", *Indian Defence Review,* February 2, 2012, at http://www.indiandefencereview.com/author/rsnsingh/ accessed on August 2, 2012.
2. Earlier it was a strong nexus between US-Israel-Turkey which was seen as a shield from the threat of Iran and Syria with the help of Hezbollah. But with the strain in the relationship between Israel and Turkey after the *Mavi Marmara* incident this nexus has weakened.

Hezbollah, Hamas and Syria pose the main threats to Israel.

A wider angle to perceive this threat to Israel could be to get even with the US. These belligerent countries as well as non-state actors would keep Israel under the threat perception to counter the hegemony of the US. In this situation, Hezbollah and Hamas have been seen as the different sides of the same coin which has been in a two-front war with Israel. In fact, it has been regarded in Israel that, Hezbollah has been an extension of both Syria and Iran's aggressive foreign policy. It has been bred and is still continuing to breed to take advantage of the US's malaise in Iraq to reassert its influence and deny the "democratic project" of the US especially that of the former US President George W. Bush for West Asia.[3] Israel has been dealing with sub-conventional threats to its national security since its establishment in 1948. Its deterrence policy has traditionally concentrated on the prevention of full-scale conventional war. The reason behind this policy was due to the fact that such warfare could jeopardise not only Israel's basic security, but even its actual existence. At the same time, Israel although has a less clearly defined strategy for sub-conventional/low intensity threats but the vital feature towards this counter attack is of "massive retaliation". Its counter-terrorist/counter-insurgency strategy has undergone modifications over the years. To deter low-intensity conflict, Israel has consistently promised to retaliate disproportionately against terrorist and guerrilla organisations.[4]

Lebanon has always been in a contesting position against Israel regarding the maritime borders which is rich with oil fields and also with the cross-border violence. These two parties have been at loggerheads with each other from 1970s to 2000. In 1978 Israel had invaded Lebanon for the first time. Although, the reason for the clash was the Palestine refugees in Lebanon who became militants but the spill-over effect of Israeli-Palestine conflict was over Lebanon as well. In fact especially from 1977, the Israeli-

3. Clive Jones, "Introduction" in Clive Jones and Sergio Catignani (ed) *Israel and Hizbollah: An Asymmetric conflict in Historical and Comparative Perspective* (New York: Routledge, 2010), p.2.
4. Sergio Catignani, "Israeli Counter-Insurgency Strategy and the Quest for Security in the Israeli-Lebanese Conflict Area" in Clive Jones and Sergio Catignani (ed) *Israel and Hizbollah: An Asymmetric conflict in Historical and Comparative Perspective* (New York: Routledge, 2010), p.67. Also for further details regarding the modifications on the counter-terrorist/counter-insurgency strategy of Israel, refer Catignani's "Israeli Counter-Insurgency Strategy", pp.67-89.

Palestine conflict which was initially perceived within the context of a national and interstate dispute has been seen by the Israelis as a conflict of intercommunal and internecine war. The danger posed by the Palestine Liberation Organisation (PLO) became a strategic danger for Israel than just being a nuisance terror.[5] In 1982, Israel had invaded Lebanon[6] again but withdrew to a slim borderland buffer zone, held with the aid of proxy militants in the South Lebanon Army (SLA)[7].

In 1985, Hezbollah, a Lebanese Shia resistance movement sponsored by Iran[8], called for armed struggle to end the Israeli occupation of Lebanese territory. When the Lebanese civil war ended and other warring factions agreed to disarm, Hezbollah and the SLA refused. Combat with Hezbollah, weakened Israeli resolve and led to a collapse of the SLA and an Israeli withdrawal in 1999 to their side of the UN designated border. Citing Israeli control of the Shebaa farms territory, Hezbollah continued cross border attacks intermittently over the next six years. Hezbollah sought freedom for Lebanese citizens in Israeli prisons and successfully used the tactic of capturing Israeli soldiers as leverage for a prisoner exchange in 2004.[9] The capturing of two Israeli soldiers by Hezbollah ignited the 2006 Lebanon

5. Ibid, p.69. In fact, this mixing of religion could be seen as a main contesting point for Hezbollah's intervention, supported by the Iranians, against the Israelis.
6. Israel's traditional security concept based on a defensive deterrent posture to maintain the status quo was radically changed with the 1982 Lebanon War. This War was given a wider scope and transformed into an instrument which aided in the realisation of political objectives that were unrelated to any notion of deterrence. The intercommunal dimension was seen as not only as a physical threat to the state of Israel, but also as an existential menace against the Jewish community as a whole. Ibid, p. 69.
7. Christian militia army financed and trained by Israel with a view to control the Israeli security zone in the South of Lebanon. The SLA advocates for a pro-Western Lebanon and devoid of Syrian presence. In June 1999, after the election of Ehud Barak as Prime Minister of Israel, the SLA started withdrawing from the northern most part of the so-called "Security Zone", the Jezzine area of which it took control in 1985. "South Lebanon Army", *Sound of Egypt.com*, at http://www.soundofegypt.com/palestinian/adult/sla.htm, accessed on August 6, 2012.
8. Iran's support to Hezbollah marked the involvement of Iran in the Israeli-Lebanese conflict. Syria initially was apprehensive and alarmed at Iran's support to Hezbollah. But by the late 1980s Syria viewed Hezbollah as a valid proxy combatant against Israeli strategic aims regarding Lebanon. With direct support from Iran and with the passive connivance of Syria, Iran was able to provide the Islamic Resistance with substantial guerrilla tactics training as well as sophisticated weaponary such as BM-21 rocket-launchers and AT-3 guided missiles, SAM-7 anti-aircraft and Stinger. Catignani's "Israeli Counter-Insurgency Strategy", p.73.
9. This reaction from the Hezbollah was supported by the Shia communities because of the Israeli attritions against them which included arbitrary economic blocks, long curfews, and periodic cut-off of electricity and water provision from the 1980's.

War. Ironically, the major Israeli challenge in controlling Lebanon after its 1982 invasion was not actually contending with the remnants of the PLO fighters. Contending with new ethno-religious groups that were endangered more by the Israeli-Christian alliance than by the Palestinians became Israel's main preoccupation.[10]

The 2006 war with Hezbollah was a huge blow to Israeli defence strategy. The war named as the "Rocket War" or *Harb Tammuz* saw the plummeting of rockets and missiles from both sides.

The 2006 war with Hezbollah was a huge blow to Israeli defence strategy. The war named as the "Rocket War" or *Harb Tammuz* saw the plummeting of rockets and missiles from both sides. In fact this war was a war where Israelis couldn't claim a definite military victory although the magnitude of Israel's military onslaught was heavy. The Israeli air defence was badly affected by the militia's short range missiles.[11] This was the sixth war which had and still has the potentiality for a wider regional conflagration that would include Damascus and Tehran. This potential flashpoint poses dangerous consequences to Israel although a comparison between the other on-going conflicts between Palestine also cannot be overlooked. But the nexus of Iran-Syria with the help of Hezbollah could be seen as a cognisant step to deter the common threat from Israel and the US. This could be affirmed with the defence pact of June 15, 2006 between Iran and Syria. The reason of ire for Iran and Syria apart from the long held displeasure against the US and Israel had been the following:

- For Iran, the gain was to expose the division between Europe and the US at a time when Iran faced the threat of UN-backed international sanctions over its nuclear programme.

10. Catignani's "Israeli Counter-Insurgency Strategy", p.73.
11. The missiles of varying range and conventional capability of Hezbollah not only affirms of a confrontation with Israel or its need to affirm its hegemony but also a barricade against the US's struggle over Iran. Jones, "Introduction", p.2.

- For Syria,[12] the anger was because of the humiliation it had to take because of its well-founded suspicious involvement in the assassination of former Prime Minister Rafiq-al-Hariri of Lebanon. Syrian use of Hezbollah has also been a palliative to the US attempts to ostracise the Ba'athist regime over its link to Hamas and Hezbollah along with its apparent indifference to jihadists crossing from Syrian territory to fight alongside the insurgents of Iraq.[13]

In fact, towards this end, Israel has been witnessing a proliferation of air and missile threats from years especially after the 2006 war. Interestingly, these threats have been from insurgent and terrorist groups supported especially by the two regimes, Iran and Syria. By early 1990's, Israel had developed an intricate counter-terrorist/counter-insurgency strategy based on both active and passive defence measures. Its counter-guerrilla strategy and operational doctrine in Lebanon consisted of five interrelated elements:

- Passive defence where it consisted of defensive measures employed to protect the Israeli civilians from *Katyusha* and other rocket and heavy mortar attacks comprised of advanced fortifications embedded in the security zone-and high-tech security fences with electronic sensor capabilities. The core of Israel's passive defence measures was the high-tech security fence, which contained various early warning and detection systems in order to block any terrorist/guerrilla infiltration.
- Active defence consisted of limited operations such as infantry and Special Forces patrols and ambushes, which aimed to "search and destroy" Hezbollah units within the security zone.
- Offensive operations were those that entailed the Israeli Defence

12. Syria had acted as the main spoiler against Israel's plans to leave Lebanon on favorable security terms: the attainment of a peace agreement with Lebanon and the demilitarisation of south Lebanon. Syria which had the most influence over Lebanese politics could easily manipulate Lebanon into frustrating any Israeli attempts at resolving the Israeli-Lebanese conflict. This was effectively done by allowing Hezbollah to overtly maintain arms and to continue with its insurgency campaign against Israeli and SLA units. Syria's ire towards Israel could be found in Israel's capturating of Golan Heights in 1967 Six Day War. Catignani's "Israeli Counter-Insurgency Strategy", p.78.
13. Clive Jones, "Introduction" in Clive Jones and Sergio Catignani (ed) *Israel and Hizbollah: An Asymmetric conflict in Historical and Comparative Perspective* (New York: Routledge, 2010), p.2.

Force (IDF) units infiltrating areas beyond the security zone and into Hezbollah safe havens. The Israeli Air Force (IAF) was often at the heart of such offensive operations given that they usually included air sorties targeting Hezbollah infrastructure, training camps as well as the targeted assassination of important Hezbollah leaders.

- Deterrence although the main aim of these operations was that of improving Israel's deterrent posture vis-à-vis Israel's state and sub-state enemies involved in the Lebanon quagmire, Israel's retaliatory operations increasingly lost their deterrent effect against the 4,000 short range rockets fired from Lebanese territory into Israeli's settlements.

Negotiation and diplomatic efforts[14] which till date has remained unaffected.

In fact, with the new factor emerged in the form of Arab Spring in West Asia from 2010 has been of great concern to Israel's threat perception.[15] It has been assumed that Iran has been the main instigator behind this upheaval. Towards countering all kinds of threats, Israel's Defence Force has been developing its Air and Missile Defence programme. For Israelis, this programme would be a deterrent as well as a compellent threat against these hostile elements. Deterrent threats require the target to refrain from committing acts that the threatener does not like and compellent threats require the target to engage in actions that they do not wish to do.[16] The threats specifically from air for Israel has been categorised into manned combat aircraft, air launched standoff weapons, UAV, Missiles (ballistic, cruise and rockets), Land Attack Cruise Missile (LACM) and air borne attacks. Civil aviation has emerged as a new means of threat, post 9/11. The Israeli Air Force holds the command and control of this programme.

14. Catignani's "Israeli Counter-Insurgency Strategy", pp. 79-80.
15. Perception is the process of apprehending by means of the senses and recognising and interpreting what is processed. Psychologists think of perception as a single unified awareness derived from sensory processes while a stimulus is present. Perception is the basis for understanding, learning, and knowing and the motivation for action. Janice Gross Stein, "Threat Perceptions in International relations", p.2, at http://www.surrey.ac.uk/politics/research/researchareasofstaff/isppsummeracademy/instructors%20/Stein%20-%20Threat%20Perception%20in%20International%20Relations.pdf accessed on August 2, 2012.
16. Ibid, p. 2.

Iran has been developing extended range (ER) missiles which could be of grave consequences for Israel which could have a ripple effect on the entire region.

Iran's moves independently (building of nuclear weapons) and through the militias has made Iran the main threat driver. Iran's strategically emerging coalitions with Syria, Hezbollah and Islamic Jihadis detects its quest for hegemony over the region. Both Hezbollah and Hamas have proved to be the auxiliary arms for Iran and now Syria after the assassination of Lebanon's al-Hariri.

Analysing the air threats from Syria and Iran, one important conclusion that the Israelis have arrived at is that, these belligerent countries have been giving more importance to missiles although air power hasn't been completely ignored. Israel has categorised this air threat under several headings like Manned Combat Air Craft, Stand off Air Launched Missiles and Land Attack Cruise Missiles. In the case of Syria, it has been noticed that Syria has been stressing more on missiles than air power. It is opaque in military operations. Most of their aircrafts which have been MIG-29, SU-24, SU-22, and MIG-23 have been kept for museum use. The Syrians have been investing more in missiles. Meanwhile, Iran has F-14 Tomcat, MIG-29, SU-24, F4 Phantom. It has a Joint Command Structure. In 2010 they had the largest air force parade in Sastan where they showcased 220 aircrafts. It has Russian and the US aircrafts. But, Iran like Syria has shown interest in long-range missiles and not in modern aircrafts. In fact, aircraft purchase has been giving way to missile programmes. Iran has been collaborating with Russia for its defence equipments which Israelis perceive it as a strategic move.

In the Stand off Air Launched Missiles, the KH missile has a range of 2,760km, anti radar, AS-14 Molniya which of 10km could pose a threat to Israel. There have been Unmanned Aerial Vehicles (UAVs) like Missad, Ababil A, Ababil B which has the capacity to do a lethal attack especially the Ababil B. In the section of the LACM, Iranian "Karar" armed drone has approximately 1000km range; Iranian emulation of Kh-55 has 3000km. The specialty of these missiles which Iranian claims is that these missiles can bomb and return back. Israelies therefore do not want the Iranians to

develop LACM. Iran maintains that they have developed missiles with the range of 2000km which Israelies refuses to believe. The Missile Threat towards Israel could be categorised the missiles into four categories with its range:

- Theatre Ballistic Missiles (TBM): Range 300-2500km
- Tactical Ballistic Missiles : Range 120-300km
- Heavy and Medium Artillery Rocket: Range 40-250km
- Stand and Improvised Artillery Rocket: Range 4-40km

Iran has been developing extended range (ER) missiles which could be of grave consequences for Israel which could have a ripple effect on the entire region. Iran's missiles like the Shabab B variants have been of single stage, non storable liquid propellants. Iran has Shahab 3 with a range of 1,300km and warhead explosive, Shahab 3 ER with cluster and thermobaric explosives with a range of 2000km and Kadir 1 also with cluster and thermobaric explosives with a range of 2000km. This threat was visualised in 1998. The new missile Kadir has been more or less the same like the other missiles in Iranian possession. But, what gives an edge to Kadir has been the technological change and guidance system which have been different. Although, Iran has declared the range of Kadir to be of 200km[17]but Israelis suspect it to be 10 times more than what Iranians have announced. What is interesting to note here is that, these missiles were being sold by North Korea to both Iran and Pakistan. Iranians have specified their interest over the long-range missiles for which Shahab came into existence. An important point about these missiles is that, the difference lies in the maneuvering skills which have been obtained by changing the weight and balance of missiles and not only by changing the metal of the missiles, like the design of Shahab 3 could be seen as nothing but the basic design of the Ghauri. There has been a speculation in Israel that these designs might have been sold by Democratic People's Republic of Korea (DPRK) where the role of post-USSR also cannot be overlooked. According to Uzi Rubin, it could

17. At http://www.habermonitor.com/en/haber/detay/long-range-missile-iran-will-try-today/93235/ accessed on June 5, 2012.

have come from Russia which was declining under economic pressure via DPRK.[18]

Iran has been developing single stage propellant missiles and also the two stages solid propellants in the form of Asura/Sejjil which has a range of 2,200-2,500km with cluster, thermobaric explosives. It doesn't have similarity to Shaheen. The important part of this missile has been that, it is indigenous and not from Russia or North Korea. Although, Asura has been different from the other missiles but it has a resemblance with Shahab in the feature of diametre of 125m. It also uses the same body neck the rest being different. Iranian maintains that, its range is only 2000km but it has been estimated to be of 2,200. An important feature of this missile has been that, it has the capability to do a cyclic cowing/co swing in the air where the inter operability remains the key towards their success.[19]

Israelis have concern about the possession of Heavy Artillery Rockets, which are both guided and unguided and which are in possession of Iran and Hizbullah. They are Nazeet—range: C 150km. This rocket is still in possession of both Iran and Hizbullah. Secondly, Zitzal 2—range: C 250km. This rocket is also with Iran and Hizbullah. But what makes this rocket fatal is that this rocket can hit Tel Aviv, Fatah 110—range: C200km is a guided rocket which is possessed by Iran but not known whether Syria and Hizbullah possesses it or not. These rockets are of inertial navigational system with a guidance package and GPS kit. Apart from the rockets, a range of theatre ballistic missiles have been processed. Syria's possess a range of theatre ballistic missiles which is indigenous in nature and also been borrowed from both North Korea and Iran. The theatre ballistic missiles which Syria possesses have been that of the Scud variants:

- Scud B—range 300km.
- Scud C—range C600km. Its warhead is explosive and chemical. This is possessed by both Syria and Iran.
- Scud D—range 700km. Its warhead is explosive and chemical with a

18. Uzi Rubin, former Director of the Israel Mission Defence Organisation in the Israel Ministry of Defence (MOD) talk on "Israel's Air and Defence Programme" held on June 4, 2012 at the Centre for Air Power Studies, New Delhi.
19. Ibid.

cluster—runway, demolition, antipersonnel with both fuel/air. This is possessed by Syria.

Apart from the Hezbollah threat, strengthened by the nexus of Iran and Syria, Israelis also face threat from Hamas, the Islamic Jihadis.

SS21 "Tochka" is a precision battlefield missile with a range of 120km. According to Uzi Rubin, these tactical ballistic missiles' designs of Syria must have been copied from North Korea. Many heavy artillery rockets have been converted into the M600 TBM. Sk600 with a range of approximately 200km is an unguided low accuracy missile. The SM 600 has a range of 300km which is a guided one with good accuracy. The Medium Artillery Rockets have been possessed by Iran, Syria and Hezbollah. They are Fazer3 with a range of C45km, "220mm" with a range of C70km which is possessed by only Syria and Fajeer 5with a range of C75km which is possessed by Iran and Hezbollah. There have been light rockets which are in possession of Hezbollah like the Military Issue Mobile Launchers with a range of 122mm, Improvised Mobile Launcher with 107mm. Through the GRAD BM21 extended range rocket, there was an attack on Haifa Seaport in July 2006.[20]

Apart from the Hezbollah threat, strengthened by the nexus of Iran and Syria, Israelis also face threat from Hamas, the Islamic Jihadis. These groups have been resourceful who makes homemade rockets through animal fertiliser, sugar and metal. Some of the rockets are "Kassam" with a range of 4-12km, Grad 122mm artillery rocket with a range of 20km, Grad ER 122 mm artillery rocket with a range of 43 km etc. They are more or less of same capabilities with resourceful techniques as well. The speaker pointed out the air threat on Israel through these countries of Iran, Syria and Lebanon's Hizbullah because of the Scud rockets, heavy and light rockets etc. The implications of these air threats through these missile programs by Syria, Iran, Hezbollah and Hamas on Israeli security is fatal. These programmes of Israel's adversary have the capability to disrupt military bases and inflict economic damage, terror and nuclear threats. In order to counter these threats, Israel has come up with a strong air and missile defence programme:-

20. Ibid.

- The Israel Navy has been equipped by the Long Range Surface to Air Missile (LR-SAM) mission. This defence is against multiple threats which can intercept up to a range of 70km. It is under the Israeli joint operation command.
- The Israeli Air Force/Air Defence Command Equipment is the Air Defence Wing. The air defence command system is using MIM 23 Hawk and PAC2, which is a Missile and Air Defence System.

Israelis have built a Multi-layered Ballistic Missile Defence (BMD) Concept. Arrow Intermediate Tier Capability which optimised against Theatre Ballistic Missiles. This has full operational capability. The Augmented Arrow's Upper Tier Capability has been optimised against evolved, long range TBM. The Arrow3 Interceptor's capability has more than equivalent capability compared with SM3 mission of US. The Super Green Pine L Band EW/FC radar system has been operational. There have been augmented early warning capabilities which have also optimised against evolved, long range TBM. The TPY-2X Bamd EW Radar has been operationalised in Israel is the US owned and operated. The most important part of this radar has been that it can accurately differentiate between debris, decoy and target.[21]

In the second level of Israel's BMD is the David Sling Intermediate/ Lower Tier Capability optimised against heavy and medium rockets air threats and cruise missiles. The Israelis have the Stunner Interceptor, ELM 2084 Multi Mission Radar (MMR) and Elevated Sensor System which have been kept above 3000km to see everything. In the lower level of BMD is the Iron Dome Lower Tier Capability optimised against short range rockets of the type extensively used by Hezbollah in 2006 war against Israel. Its status is operational combat proven. The main system requirements are:-

- It intercepts rockets launched from up to 70km range;
- It's an all weather operational system;
- "Defended zone" of over 150km;
- Threat warhead detonation;
- Effective against salvos;

21. Ibid.

- Ignoring rockets predicted to hit unpopulated areas.

This is a protection shield from the rocket campaign against southern Israel by Islamic Jihadis. Israel's defence from 2006 has become active which was previously quite passive. In 2008 there was a military operation against Hamas to counter the 2000 rockets being shelled over Israel by this group. After this faceoff, Israel started with its first combat interceptor system from April 2011. It has also started with their Short Range Missile Defence which is in action from 2011-2012. More batteries have been in various stages of production and delivery which have been funded by the US. For Israelis, this programme was actually a life saver for people as the system successfully discriminated between non threatening targets, scoring 75-85% kill rates against the threatening targets. This was important as Israelis were questioned by the world community against the killings of the Palestine civilians. A significant part of the interceptors which are being operationalised is that they won't get exploded over populated areas.[22]

With the Arab Spring's consequences spilling over the region, Israel sees dangers looming around. Israel has been apprehensive about the strong connection between Libya, Yemen, Egypt and Syria from the start of the upheaval. For example, all suspected stockpiles of Libya were moved to Yemen during the crisis and Syria's to Lebanon. In this scenario, some future challenges knocking at Israel's door would be:

- There would be threat on Israel homeland security from the standoff of BMs and rockets, cruise missiles etc. The relative weight to manned air craft are decreasing with the coming of the air and missile defence system.
- Missile rockets are likely to become accurate and more lethal.
- Threats from Nuclear BMs are likely to emerge in future.
- All these above challenges would be factored into Israel's long term air and missile defence architecture.
- Israel's extensive investment in missile defence already has prompting responsive counter factors.[23]

22. Ibid.
23. Ibid.

These possessions of missiles and rockets by these belligerent regimes and non-state actors have kept Israelis alert.

CONCLUSION

Israel as a strategic country in the fragile region of West Asia has been living under a constant threat which till now is countered by its own Air and Missile Defence Shield. These possessions of missiles and rockets by these belligerent regimes and non-state actors have kept Israelis alert. Israel has not only been alert towards these regimes and militias but has also turned its focus towards a future conflict zone which lies in the Eastern Mediterranean Zone of Resources. These new threats would come from the countries eligible for offshore resource exploitation like Turkey, Syria, Cyprus, Lebanon, Israel, Palestine and Egypt. Israel has discovered Leviant, Tamar, Dalit and Mari-B field as the potential field for future explorations for natural gas.[24] A future tug of war between Turkey and Southern Cyprus over the area along with Lebanon already claiming the Leviant line would be a grave matter of concern not only for Israelis security but also of the region as a whole.

The upheaval of the Arab Spring has added on Israel's realisation of the fragility of its security and also its existence. Israel is well equipped with military defence with the latest technology be it the air power or missile defence shields. But sensing the potentiality of a future flashpoint due to the Syrian crisis or the future Eastern Mediterranean crisis, somewhere it is important to maintain or revive its old allies for its own security sake. Israel's Defence Minister Ehud Barak's proposal to renew friendship with Turkey in the wake of the Syrian crisis is a strong move on Israel's side. This move would be beneficial for both the countries to evade a looming crisis and solve it responsibly. In fact, the way the Syrian crisis is taking shape, it would be wise on both the countries part to come together and renew their alliance.

24. Michael Ratner, "Israel's Offshore Natural Gas Discoveries Enhance Its Economic and Energy Outlook", *CRS Report for Congress,* January 31, 2011, p.2, at http://www.fas.org/sgp/crs/mideast/R41618.pdf, accessed on August 3, 2012.

REFORMS IN PLA TRAINING

J.V. SINGH

For almost over three decades, since formation of People's Republic of China (PRC) in 1949, a regular system of Professional Military Education (PME) and training for the People's Liberation Army (PLA) had not evolved. With Soviet assistance, it introduced a Soviet-style military academy system that was limited to imparting a few basic military skills. PLA officers primarily learned their business through practical experience and from the lessons learnt during various wars that the PLA was involved in.[1] From the experiences gained during these wars, it was clear that the PLA faced new challenges in order to transform itself from a largely low tech, poorly educated force into a modern military with navy, air force, armoured units, and other specialised units capable of defending the PRC.

Chinese military training, until recently, was widely dismissed as infrequent, unrealistic and overly scripted. In the 1980s and 1990s, outside observers and internal critics alike, raised doubts about the utility of the PLA exercises, and it was clear that, training deficiencies represented one of the most serious challenges. As far as People's Liberation Army Air Force (PLAAF) is concerned, it was believed that its pilots flew an insufficient number of hours on a yearly basis and that the limited training they received was unrealistic and heavily scripted.[2]

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1. Yuan Wei and Zhang Zhuo, chief eds., *Zhongguo junxiao fazhanshi* (*History of the development of China's military schools*), (Beijing: Guofang daxue chubanshe, 2001), pp. 890-894.
2. Ken Allen, Glenn Krumel, and Jonathan Pollack, China's Air Force Enters the 21st Century, (Santa Monica, CA: RAND), 1995, pp. 127-134.

PLA has been concentrating on training and Professional Military Education (PME), especially since 1979 Vietnam War. Having learnt its lessons from recent wars, Chinese military has understood the importance of military training and has identified deepening of troops' training and academy education reforms as a long-term strategic task. Under the new system conducting integrated training based on the information system, is the key to innovating training mode and further promoting transformation in military training. In recent years, the PLA has implemented a series of training reforms, and many units have been engaging in considerably more frequent, realistic and challenging training.[3] Moreover, as part of its reforms, the PLA has begun to employ more rigorous standards of evaluation to improve quality and effectiveness.

Information now plays the leading role throughout the whole training process, and PLA is focussing on core military capabilities to improve comprehensive qualities of the officers and men. Military academies stress on deepening education reform, optimise the teaching contents and vigorously build up the faculties to promote their transition in knowledge and abilities in light of the development of the PLA's information construction and military struggle preparations.

EVOLUTION OF CHINESE PME

Development of Chinese PME got a boost in 1980's with Deng Xiaoping's strategic decision and the founding of China's National Defence University (NDU). In June 1985, during a critical meeting of the Central Military Commission (CMC), Deng Xiaoping advanced his strategic decision which justified the deepening of China's economic reform and modernisation, as well as its opening to the outside world. It rejected Mao's notion of imminent war and argued that the international system would be dominated by peace and development. This set the stage for a major change in Chinese defence policy, including a dramatic downsizing of the PLA and a change in PLA strategy away from traditional people's war and luring in deep toward

3. Yang Huicheng and Liu Xingan: "GSH Makes Arrangements for Military Training in 2006," *Liberation Army Daily*, January 18, 2006.

a strategy of limited warfare fought at or just beyond China's borders.

The strategic decision ushered in a number of PME reforms. First, in conjunction with the decision to downsize the PLA, a decision was made in 1986 to downsize the number of military academies.[4] More reductions were discussed, though the next major round of reductions did not occur until after 1995. Another important change made was the decision to create graduate programmes at military academies. After 1985, a small number of academies were granted permission to begin building master's programmes. Since then, the programme has expanded, and the number of military academies allowed to grant advanced degrees has steadily increased, with most of the PLA's educational institutions now offering graduate courses.

Reporting directly to the CMC, the creation of the National Defence University (NDU) was a crucial development in Chinese PME because, until this time, PME was essentially single service in nature.

The other significant change was the creation of the NDU in 1985 by merging the PLA's Military Academy, Political Academy, and Logistics Academy. Known as the "Cradle of Generals" and reporting directly to the CMC, the creation of the National Defence University (NDU) was a crucial development in Chinese PME because, until this time, PME was essentially single service in nature. NDU became first truly all-service PLA academy.[5] For the first time after its founding, the PLA finally had an educational institution that had the ability to promote jointness across the PLA. These initial efforts to improve and reform PME were given further importance following the Gulf War of 1991. China then instituted new strategic guidelines emphasising the importance of both modern hi-tech conditions and of having officers educated in the new technologies necessary to fight under such conditions. This led to further deepening of

4. Yuan Wei and Zhang Zhuo, *Zhongguo junxiao fazhanshi* (*History of the development of China's military schools*), (Beijing: Guofang daxue chubanshe, 2001), p. 895.
5. "China National Defence University: Cradle of Generals," *Kuang Chiao Chuang*, in *FBIS-CHI*, December 16, 1998.

educational reforms and an even greater emphasis on officer education, reflecting a major rethink of the PLA's basic strategy.[6]

The "Two Transformations" announced in 1995 marked another major turning point in the development of the Chinese PME. While the reforms in PME that have followed, built on the trends that had already started in the 1980s, they also represented a revaluation of what kind of officer and PME the PLA needs. The two transformations focussed on an army preparing to fight local wars under normal conditions to an army preparing to fight under modern high-tech conditions, and from an army based on quantity to an army based on quality.[7]

The 1991 Gulf War, the conflict in Kosovo, and the 1995-96 crises in the Taiwan Strait, all served to convince Chinese leaders that they had to reassess how they should prepare for future conflicts, and this has included reassessing how they should conduct PME and train more technologically proficient officers and men for the 21st century.[8] Another set of important changes in PME revolve around the turn to civilian education since 1999.[9] These efforts have centred on; recruiting college graduates, creating a national defence scholarship and reserve officer training programme, developing research and teaching arrangements with civilian universities and sending military personnel to civilian institutions for postgraduate work. China now has a large, well-funded, and better quality civilian education system from which the PLA can recruit the officers and enlisted personnel it needs for warfare under informationalised conditions.

With regards to training in the PLAAF, during early days since formation of PRC, the then USSR sent experts to China to build a flight academy and supply training aircraft, and continued to provide valuable training to PLAAF pilots during the Korean War in actual air warfare and from 1953 to 1955 including night flying, advanced combat manoeuvres and training in adverse weather conditions. By1957, PLAAF had developed its first flight

6. Yuan and Zhang, p. 927.
7. "Hi-Tech Local wars' Basic Requirements for Army Building," *Zhongguo Junshi Kexue* no. 4, in *FBIS-CHI*, November 20, 1998.
8. Ibid.
9. "Major Reform of the Concept of Military Education: Guo Anhua Discusses Questions of Carrying Out Innovative Education," *Jiefangjun Bao* in *FBIS-CHI*, 1999.

training manual based on the Soviet training manual and experiences from Korean War and past training. From this point until 1964, PLAAF pilots regularly underwent training once in a year matching Warsaw Pact standard.

PLAAF also proved to be woefully inadequate in large scale exercises because it rarely had integrated training at that point.

Even though the PLAAF knew the importance of training, the PRC leadership thought it was capitalistic to train. Mao even gave orders to compress flight school programme from two years and four months to one year. Much of the flight training and aircraft related manuals were destroyed as part of the Cultural Revolution (CR); the training programmes and flight school recovered after Cultural Revolution and was back to normal by 1983. However, PLAAF doctrine, tactics and training had not changed much since the Korean War.[10] Although PLAAF was a separate air force on paper, but it was just a tactical support force for the army. In all of the PLA's conflict since its formation, PLAAF has never attacked or defended on its own. Its ground support mentality was not just a function of equipment limitations, but also part of the general doctrine/mindset within PLA. On the other hand PLAAF does not seem to have undertaken any air-to-ground operations in any war starting with the Korean War.

As a result, PLAAF continued to be stuck with outdated training procedures and faced a dilemma of developing training that strikes a balance between maintaining safety while increasing difficulty level. Not only being outdated in doctrine and training, PLAAF also proved to be woefully inadequate in large scale exercises because it rarely had integrated training at that point. It was only after the establishment of Flight Training Test Centre (FTTC) in 1987, that the best pilots were sent to conduct testing of flying training and of new aircraft and equipments, while developing new techniques and tactics. In the 90s, FTTC spent more time on routine training than trying out new flying techniques due to its lack of experience in modern tactics.

10. Available at www.informationdissemination.net/2011/08/evolution-of-plaaf- Doctrine/ Training. Accessed on July 23, 2012.

The next important part to the transformation of the PLAAF training was the establishment of a new air force test training test base in Dingxin built in June of 1999.[11] Since its establishment, the number of aircraft and the complexity of simulated war scenarios have increased every year. The simulations have really showed the disparity in the training level and intensity of different forces around the country. They have also given PLAAF a much clearer view of the regiments that are better trained than the others are, therefore, often rewarded with newer aircraft. Using new tactics from FTTC and simulations, PLAAF have learnt to better utilise Su-27s and conduct different aerial combat missions.

Since 1999, Dingxin has also undergone three large scale expansions to double its size and allow the training for an entire aviation corp. This is the only large scale aviation & air defence integrate training base in the country. Since 2005, PLAAF has been doing red sword/blue sword integrated tactics exercises to copy USAF's red flag/blue flag. By Red Sword 2008, exercises at Dingxin had progressed to complex division level or even military region level confrontations. PLAAF started training and developing tactics as a whole rather than just within individual Military Region (MR). This shows that PLAAF's role has changed from just serving for ground units to being able to operate independently to carry out attacks. The induction of Airborne Warning and Control System (AWACS) also allows PLAAF to command & control over 100 aircraft. PLAAF aims to form several AF strike groups under the direction of Beijing MR for offensive missions. Each individual MR will simply exist for training and logistics.

PLAAF tactics and training have also been undergoing a rapid transformation. PLAAF is actively trying to learn better training programmes and flight school programmes from the West. It has increased training with other air forces in the recent years. During the past years, PLAAF has held exercises with Turkey and Pakistan. People's Liberation Army Navy (PLAN) is also undergoing a similar transformation, although it seems PLAN's training hasn't evolved as much as PLAAF training.

11. Available at www.china-defence-mashup.com/1952.html. Accessed on July 24, 2012.

LESSONS FROM WARS AND PME REFORMS

PLA war experience spans from the Korean War of 1950-53, the Sino-Indian border war of 1962, the Sino-Soviet border war of 1969, the Sino-Vietnamese naval battles of 1974, and the Sino-Vietnamese border war of 1979 (there were also naval skirmishes with Vietnam in 1988 and with the Philippines in 1994 over the Spratly Islands).[12]

As for the lessons and experiences from the air wars, the PLAAF had very limited wartime operational experience upon which to draw. Indeed, the only significant air combat operations conducted were in Korean War of 1950-53 and over the Taiwan Strait in 1958. The fighting in Korea constituted an important experience for the newly formed PLAAF, not only as a test case for this fledgling service but also in the development of Chinese air power. [13]

During the Korean War, the inexperience and lack of rigorous combat training of Chinese Communist airmen, as well as technical deficiencies of their aircraft, cost the PLAAF serious personnel and aircraft losses. An important lesson learnt from the war was the importance of air defence. The US air force wrought tremendous devastation on North Korea and seriously impaired Communist Party of Vietnam (CPV) ground operations, especially ravaging supply lines. Indeed, because of Korea, the Chinese gave concerted attention to improving air defences for military installations and cities throughout China. Since Korean War, the PLAAF has had little occasion to be tested in combat. Although PLAAF air units from Hainan afforded air cover for the Chinese Communist assault on the Paracel Islands in January 1974, the lack of South Vietnamese air opposition precluded any opportunity for combat testing of either the men or machines of the mainland air force.

Prior to its self-defence counterattack into the territory of the Socialist Republic of Vietnam (SRV) on February 17, 1979, there were increasing

12. Kenneth W. Allen, "PLA Air Force, 1949-2002: Overview and Lessons Learned," in Burkitt, Scobell, and Wortzel, eds., *The Lessons of History*, pp. 89-96.
13. Yu Bin, "What China Learned from its 'Forgotten War' in Korea," in Ryan, Finkelstein, and McDevitt, eds., *Chinese Warfighting*, pp. 123-142.

The decision to restrict the role of the PLAAF in the punitive war against Vietnam may have also been influenced by political considerations.

doubts about the combat readiness and effectiveness of the PLAAF.[14] PLAAF aircraft had severely limited troop support and ground attack capabilities in any reasonably sophisticated anti aircraft environment. The Vietnamese enjoyed effective battlefield air defence systems of Soviet derivation. Under these circumstances the Chinese Communist air command had every reason not to want to commit its aircraft to battle during this conflict.

The decision to restrict the role of the PLAAF in the punitive war against Vietnam may have also been influenced by political considerations, in addition to the known equipment deficiencies. Pilots and crew of the PLAAF were not sufficiently well trained to carry out the complex procedures associated with tactical air support. The decision not to commit Chinese Communist air units to air combat or troop support was the consequence of recognising the inferiority of PLAAF air combat and ground support capabilities in addition to the political constraints and general strategic concerns of the PRC.

Regarding Chinese lessons from the Gulf War, the PLA writings suggest that these two wars have been very influential, affecting Chinese tactical, operational, and strategic thinking. Not only have these wars affected Chinese military doctrine, promoting greater jointness, but they have also underscored the impact of information technology. This is reflected not only in an emphasis on increasing access to information within all aspects of Chinese military operations, the informationalisation of the PLA, but also has led to renewed emphasis on political warfare, as embodied in the concepts of psychological warfare, public opinion warfare, and legal warfare.

Operation Desert Shield/Desert Storm in 1991 and Operation Iraqi Freedom in 2003, provided indications of the consequences of war in the post-Cold War environment, unconstrained by the superpower stand-off,

14. Xiaoming Zhang, "China's 1979 War with Vietnam: A Reassessment," *China Quarterly*, 2005.

might entail. They showed the way the US fought, what the Chinese term "local wars," and showcased modern military technology, not only in terms of long-range, precision strike weapons, but also command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR). Indeed, the two wars highlighted for the PLA the evolving role of information, not only at the tactical level, but also at the operational and strategic levels.

According to the PLA Encyclopaedia, the first Gulf War showed the importance of securing dominance of the electromagnetic spectrum, the role of aerial attacks as a strategic factor, deception, coordinated operations among different services, and deep attacks in the rapid attainment of campaign objectives besides logistical support to sustain high-technology weapons. The Chinese military followed the progress of the first Gulf War closely which had a great effect on the PLA. [15]

At the strategic level, perhaps the most fundamental lesson learnt is that, the nature of warfare had radically changed and such wars are marked by several characteristics. Firstly, they generally involve the large-scale use of information technology, advanced materials, aerospace systems, and other advanced technologies in weapon systems. These weapon systems do not operate in isolation, but instead are integrated with each other. Combat operations involve the linkage of reconnaissance, communications, command, weapons, and logistics systems into an integrated or unified combat system. Secondly, local wars under high-tech conditions often cover vast expanses, which requires much more extensive command and control capability and the rate of expenditure of weapons is much higher in such wars. In the Gulf War, the expenditure of munitions is assessed as 10 times that of the Korean War, and four times that of the Vietnam War.

The PLA in order to prepare for such wars, formulated a new national military strategy in 1993, termed as the "Military Strategic Guidelines for the New Period". These strategic guidelines for the new period laid out an assessment of the new nature of modern war and how the PLA should deal

15. Major General Wang Baocun, "China and the Revolution in Military Affairs" *China Military Science*, no. 4, 2001, p. 151.

with the resulting challenges. Embodied within these new military strategic guidelines were the main areas for PLA modernisation and reform. These included the incorporation of more science and technology within the PLA; enhancing the quality of PLA personnel; improving the PLA's organisation and logistical infrastructure; and continued emphasis on ideological and political work.

The importance of campaigns can be seen in the new combat regulations published in 1999, generically referred to as the "New Generation Operations Regulations". These represented a wholesale change to PLA doctrine, placing campaigns at the forefront of the conduct of future operations. Furthermore, the capstone of these new operational directives is the joint campaigns of the Chinese PLA. These regulations made it clear that the PLA had to be prepared to fight future wars through the interplay of all of its services and the Second Artillery, rather than primarily relying on the ground forces. That is, for the PLA, future wars would be joint wars, fought at the campaign level.

In some ways, the second Gulf War served to reinforce and refine the lessons from the first Gulf War. Thus, at the strategic level, Chinese assessing the significance of the Iraq War concluded that the world marked by "Peace and Development" was not very peaceful. According to a group of PLA officers drawn from the Academy of Military Sciences and the NDU, weakness or backwardness meant that one will be beaten.[16] In this regard, weakness refers not only to military capabilities, but to the full range of factors comprising comprehensive national power.

In addition, the second Gulf War further refined the PLA's understanding of local wars. From local wars under high-tech conditions, the PLA transitioned to viewing future conflicts as local wars under informationalised conditions. This was reflected in the 2004 PRC Defence *White Paper*, which observes, "The forms of war are undergoing changes from mechanisation to informationalisation. Informationalisation has become the key factor in enhancing the war fighting capability of the

16. Guo Meichu, *Discussion of High-Tech Local Wars*, (Beijing, China: AMS Publishing, 2003), pp. 174-176.

armed forces".[17]At the operational level, this means a greater emphasis on information and the range of technologies associated with it, as well as operations to exploit the related advances that information technology has generated.

The forms of war are undergoing changes from mechanisation to informationalisation. Informationalisation has become the key factor in enhancing the war fighting capability of the armed forces.

PLA began to increase both informationalisation and integrated jointness after the second Gulf War. The Nanjing MR, for example, organised a war-zone joint-combat communications training event in July 2004 to discuss Army, Navy, Air force, and Second Artillery combat communications requirements. Improvements in information technology have also accelerated command decision-making, allowing for more rapid actions and responses. In the view of the PLA, precision munitions will only become more important in the future, given their accuracy and lethality. Employed against an enemy's command and control infrastructure, as they were in the second Gulf War, an enemy's defences will be rapidly disrupted, reducing their ability to resist and shortening the length of the conflict.

PLA Training Reforms: At the end of 2007, *PLA Daily* announced that PLA's new generation training doctrine is being studied to improve PLA operational performance in future hi-tech conflicts and wars. The new training doctrine has one special part for Joint Combat Training (JCT) and the other seven parts for troops and serviced personnel from the Army, Navy, and Air Force, Secondary Artillery, Armed Police, Testing Support units and reserved armed forces. Comparing with previous training programmes, five new features can be found to outline the PLA's training improvement.[18]

Firstly, training subjects related to non-war operation like peace-keeping

17. PRC State Council Information Office, *China's National Defence in 2004*, *Beijing*, China: State Council Information Office, 2004.
18. Available at www.china-defence-mashup.com/plas-training-is-in-transformation -html. Accessed on July 24, 2012.

have been added. Secondly, JCT is given greater attention by PLA. Thirdly; more new systems and equipments are involved in training in order to fully realise warfare systems performance in war time. Fourthly, most of the training is now designed under sophisticated Electronic-Magnetic (EM) condition. Finally, the training and evaluation standards are getting closer to real combat.

Simulations, virtual exercises, and other forms of technology-assisted training are mainstays for the modern military. Not only do these forms of training reduce costs and lower physical risk to military personnel, they also offer the opportunity to experiment with new operational concepts and bridge vast geographic and bureaucratic divides to improve operational performance. As the PLA rapidly modernised, it also aggressively pursued technology-assisted training because of the efficiencies it offers to an institution operating in a relatively resource-constrained environment.

In recent years, the PLA has modified its core military guidance to reflect the goal of winning local wars under informatised conditions. Advocates of informatisation have concluded that it is not necessary to completely follow the entire mechanisation process of the developed countries and then carry out informatisation. Instead, the military plans to strengthen mechanisation building while at the same time attempting to speed up the pace of informatisation, thus following the path of development by leaps and bounds. The critical factor enabling this leap ahead is the larger information technology revolution underway in China.

The limited funds for the informationisation of weapons and equipments require a prioritisation of the digital and informationised refitting of existing weapons and equipment. The PLA is crafting a new path, using its relatively advanced command, control, communications, computers, intelligence surveillance, and reconnaissance (C4ISR) architecture as a force multiplier to network together its relatively primitive conventional forces in ways that can defeat a more technologically advanced adversary,

In the process of developing and interpreting the PLA's guidance on winning local wars under informatised conditions, the military leadership has promulgated parallel sets of guidance on professional military education

and operations training. After Hu Jintao's first speech on training in April 2005, the PLA began with small steps. While informatised conditions were mentioned in the 2005 and 2006 directives, it was not characterised as the main theme. The principle tasks of the 2006 directives were to train with realistic combat scenarios, to raise the level of standardised military training, and to actively and prudently study integrated training. The 2005 main theme likewise emphasised integrated and standardised training. In 2006, the General Staff Department (GSD) directives called for enhancing officers' and soldiers' knowledge of informatised technologies to solve problems.[19]

The 2007 GSD training directive builds upon these evolutions, calling for the PLA to increase research on military training under informatised conditions, develop training in a complex electromagnetic environment, focus on improving units' integrated joint operations capabilities under informatised conditions, and continue to explore integrated training, which includes training that integrates the key factors of joint operations under informatised conditions.

In its current form, the primary modalities for informatised training reform are eight-fold and include: the regional joint training, networked and synchronised training, simulation training, distributed interactive training, reality simulation training, systems integration training, fuzzy authorisation training and long-distance monitoring and control training.

PME Concepts for Jointness: The PLA continues to develop a more complex form of joint operations capability. A system of systems integrated communications network, building joint military talent and development of a joint operations doctrine are fundamental to this effort; yet, the PLA perceives the persistence of significant problems. The PLA is taking a multi-faceted approach to find solutions including professional military education reform to educate and train joint commanders and staff; construction of an integrated command, control, computers, communications, intelligence surveillance and reconnaissance (C4ISR) system; and experimentation and testing concepts and communications systems in joint exercises.

19. James Mulvenon , *Technology and Simulation in the Chinese Military Training Revolution*. Available at www.strategicstudiesinstitute.army.mil/pdffiles/pub858.pdf.

Despite years of the development, PLA self-assessments in 2011 continued to identify joint command methods and integrated communications as problem areas limiting the development of a joint operations capability. The PLA publications discuss command and control problems, including the need to resolve the issue of overlapping command relationships in the current command and control structure and the need to optimise the command network for effective integration of forces with a joint C4ISR architecture. [20]

PME Reforms for Jointness: An important component in achieving a joint operations capability is building a team of joint commanders and staff. The PLA is continuing to implement the 2003 strategic programme to develop military talent by reforming professional military education. The PLA initiated reorganisation of the military institutions and training in 2011 with a focus on improving training and education of joint operations commanders and staff officers. The PLA is also stressing the training of commanders, placing an emphasis on developing and promoting staff with great potential and has reformed graduate training programmes to cultivate joint operations commanders.

The General Staff Department (GSD) has initiated a reform and reorganisation of military educational institutes and training organisations to better support the development of military talent. The plan includes efforts to optimise structures, adjust training, integrate resources, and improve training and curricula. Mergers and readjustments of the PLA academies have already begun and the GSD created a new training department.[21]

Combined courses including the PLA and foreign military officers and increased joint training with foreign countries are also a part of the overall effort. These plans attempt to address the lack of interdisciplinary command talent and high-calibre information technology talent. Recent PLA press reports have highlighted programmes for joint operational commanders and staff officers at the NDU and National University of Defence Technology (NUDT).

20. *PLA Daily*, July 14, 2011.
21. *PLA Daily*, September 20, 2011 and November 04, 2011.

An integrated C4ISR architecture with "system of systems" operations capability based on modern information systems will act as the foundation of the PLA's joint operations capabilities. The lack of integration has, according to the PLA, caused the services to spin their wheels for many years, because of the inability to share a common operating picture and communicate laterally.

The PLA press has reported rapid developments made during the 10th and 11th Five Year Plans, yet integration remains problematic. According to the PLA, important components of the integrated system are early warning and reconnaissance, command and control, firepower attack, network warfare and comprehensive support, some of which were tested in joint training this year. Although the importance of information projects has been recognised at the national level, construction of integrated C4ISR systems has remained an ad hoc effort within individual MRs as evidenced in recent exercises.

In November 2011, the PLA announced that the research institute of the GSD Informationisation Department, until then, known as the Communications Department has finally developed a new-generation information system to integrate the ground forces, PLAN, PLAAF and PLA Second Artillery Force at all echelons. The new system was hailed as a major breakthrough supporting command and control in joint operations and filling a gap in the C4ISR network. It is difficult however to assess the veracity of the report, whether this really represents central direction to replace the individual regional efforts, how far the new system has progressed in the development process or how well it supports joint command and control, especially horizontal integration. Whatever the true state of the technology's development, the PLA is looking to correct the technical inability of its forces to communicate across the services and branches.

PLA Exercises and Operational Reforms: Exercises provide the laboratory for experimentation and testing joint doctrine and integrated communications systems in a resistant medium that is as close as the PLA can get to real combat. Joint exercises in 2011 have continued the focus on experimentation to develop the joint command methods and C4ISR

Many of the exercises were described in the Chinese press as experimental, indicating that problems establishing joint command and control methods continue to remain.

architecture that are fundamental to developing a modern joint operations capability. The continuing focus of experimental joint exercises on command methods and communications indicates that the PLA is still struggling with significant issues.

Several of the important PLA joint exercises in 2011, had high level observers, featured command and control coordination within joint task forces, testing of integrated C4ISR or both. Many of the exercises were described in the Chinese press as experimental, indicating that problems establishing joint command and control methods continue to remain. While ground force units still appeared to command many of the joint task forces in the exercises, the PLAAF or PLAN also led joint formations to provide joint command experience.

The GSD 2011 Military Training Plan emphasised improving integration of command information systems between the services, campaign planning and preparation, and joint command drills. Attempts to improve communications integration and command and control were evident in 2011 exercises. The PLA joint exercises have continued to experiment with command and control models in a joint task force. In the past, the Lianhe-series of experimental joint exercises in Jinan MR have tested command and control, and coordination methods within a joint task force.

Joint training in 2011 included joint air defense training led by the PLAAF, and joint disaster relief training featuring an integrated military-civilian emergency command system. According to Chinese press reports, some of the more important joint exercises in 2011 that tested command and control, and C4ISR issues include the following:

- A Nanjing MR joint amphibious landing exercise in August with first Group Army leading a multi-service joint task force, including the PLAAF and the PLAN. The exercise tested joint command integration of the force, based on an effort initiated in 2009 to construct an integrated

command and control system extending to units at the campaign and tactical levels designed to correct difficulties experienced over the past decade. This effort also included cross training the service personnel and developing joint operations staff personnel. The integrated communications system allowed the campaign-level joint task force to exercise joint firepower strikes, joint maritime defence and ground and air electronic countermeasures. Although the system was considered to function at a basic level and was incomplete, the press report did state that it integrated the joint forces and allowed the services to share operational information.

- The experimental "Qianwei-211" exercise, held at the Queshan Combined Arms Tactical Training Base (CATTB) in mid-summer, was directed by the Jinan MR employing a ground-air joint task force testing multi-level joint command and control, mobile command posts, transfer of command between command posts, and integrated command systems against a simulated "Blue Force".
- The experimental "Lianmeng 211" joint exercise, held from 22-26 October 2011, featured a multi-service joint task force formed by Jinan MR Units and led by the North Sea Fleet. General Staff officers of the Jinan MR, and the other PLA organisations observed the exercise indicating its importance. This is one of the few examples of the PLA following through on its stated plan to alternate lead services for joint exercises to give each service experience in leading a joint task force. It however, needs mention that a unit given the lead in an exercise to gain joint experience does not mean this will be the case in wartime. This joint exercise had an amphibious landing phase, included PLAN, PLAAF, ground forces, the Second Artillery Force, People's Armed Police (PAP) and reserve units. Training objectives included joint campaign planning, joint command coordination, political work and comprehensive logistics support.
- "Fuxiao-11", a Lanzhou MR opposing force exercise in October 2011, included the 21st Group Army, providing the joint operation group commander. A multi-service joint task force included a ground force division and PLAAF and Second Artillery Force elements. Integrated

command and control, including coordination of air and ground firepower strikes and synchronisation of unit movements and actions during operational phases was exercised from mobile joint command posts to test multi-service command and a new joint C4ISR system.

- "Jingwei-2011" in Chengdu MR exercised a ground-air joint task force in late October 2011 testing informationised mapping and navigation support. Qi Jianguo, Director of the First Department (Operations) of the GSD, directed the exercise, accompanied by personnel from the four General Departments (Staff, Political, Logistics and Armament), national-level organisations, each MR and scientific research institutes. In addition to mapping and navigation support to joint campaign planning, joint objectives included precision command, coordination, fire strikes and logistics.
- Shenyang MR held the Lianhe-2011 joint exercise in October, exercising a ground-air joint task force coordinating air firepower support and a precision logistics system as well as testing a joint tactical integrated communication system.
- The "Qianfeng-2011 Queshan" exercise held at the Queshan Component Advanced Technology Test Bed (CATTB) in the fall featured a joint tactical exercise by an armoured brigade and PLAAF airborne troops to test innovations in command methods to improve the command process, combat planning and preparation; reduce redundancy in command functions; and improve target planning, preparation, and decision making.
- The Guangzhou MR directed a joint amphibious exercise with a multi-service joint campaign task force comprised of the 42nd Group Army, PLAN and PLAAF units testing a joint command system. The joint exercise was dispersed across 13 training sites testing the ability of the exercise headquarters to simultaneously control units from multiple services over a wide area of operations within a single scenario.
- An exercise of a ground-air joint tactical task force at the Zhurihe CATTB in Beijing MR, involving a mechanized infantry division of the 38th Group Army and a Beijing MR Air Force (MRAF) air division,

tested joint communications and information sharing under real combat conditions and in a complex electromagnetic environment. The PLA press reported that a new information system was tested.

The PLA focused on three areas to solve fundamental problems that are retarding operationalisation of a joint operations capability. The PLA continues experimenting with a new joint operations doctrine in exercises and reforming education and training of joint commanders and staff who will execute the new doctrine. However, it will take time to overcome identified problems in developing joint command and control models, testing joint operations concepts in exercises, constructing an integrated C4ISR architecture, and developing the command talent to lead joint task forces at the campaign and tactical levels.

The ad hoc development of an integrated C4ISR system, which will serve as the foundation for developing a modern joint operations capability, is undoubtedly slowing the PLA's efforts to develop a joint operations doctrine, and command and control structure and methods. C4ISR integration issues are limiting the results of experimentation and testing in exercises. While the GSD's announcement of a new integrated information system appears to be the type of high-level direction required to address the problem, the systems capabilities and deployment are unknown and likely to remain so for some time.

The PLA press notes some progress, but recognises that problems still remain. A focus of the 12th Five Year Plan is in the area of informationisation to refine and expand joint developments and use informationisation of the force to improve combat effectiveness. Experts in military technology at the NUDT are focussing on the need for the PLA to quicken the pace of developing an integrated C4ISR system, capable of supporting joint operations. While the PLA is making progress, development of a modern joint operations capability and deployment of a force wide integrated C4ISR system will take considerable time. Near-term modernisation and military talent reforms are planned for times much ahead.

Pilots Training on New-Generation Aircraft: As the Chinese air force moves out to meet the larger operational objectives of the PLA, change ultimately comes down to pushing the capabilities of airframes and the personnel who fly them or maintain them. For pilots, new training standards and regimens are requiring them to fly longer sorties in terms of time and distance, as well as mastering the abilities to fly over water, fly at night, fly at lower altitudes, and train in a complex electromagnetic environment. They are also flying from airfields other than their home bases. These are all major paradigm shifts for PLAAF pilots.

Overall, for PLAAF air units, the first decade of the 21st century has been an important period of transition during which older generation aircraft have been replaced or supplemented by new aircraft with significantly better capabilities. Transitioning to these new-generation aircraft has been one of the more daunting challenges facing PLAAF air units not only for the pilots, but also for maintenance and logistics support personnel. As new, more complex aircraft have entered the inventory, maintenance demands have gone up, and retraining to fly and maintain these aircraft has been the order of the day. In some cases, the pilots assigned to the new aircraft not only had to fly the aircraft, but they also had to become qualified as flight instructors and as flight commanders in the Air Traffic Control (ATC) tower. Pilots, maintenance, and logistics personnel helped to write tailored training manuals for flight operations and maintenance.

Finally, as is the case for the rest of the PLA, the PLAAF is now placing greater emphasis on more realistic combat training regimens than it has in the past, adopting a "train as you will fight" approach. For all of the branches of the PLAAF, this has meant more plausible exercise scenarios, less scripted exercises than had previously been the norm, increasing use of "Blue" OPFOR units, practicing operations in a hostile cyber and electromagnetic environment, expanded use of simulators, and more emphasis on lessons learned.

Training by Flight Simulators: China's air force is expanding the use of flight simulation technology to hone fighter pilots' skills and air battle tactics. One of the earliest institutes to study flight simulation in China, the

Flight Simulation Technology Research Institute of the Air Force is now able to develop simulators of the latest fighter jets that China produces. China's air force is expanding the use of flight simulation technology to hone fighter pilots' skills and air battle tactics

As China has increased the training flights for its pilots, it has also abandoned the old Soviet style rigid tactics.

China's air force began to train fighter pilots with simulators a decade ago. So far, the institute alone has given at least 70 simulators to the air force and other units, which have provided 15,000 hours of training since 2002, which means huge amount of flying training costs are saved. Thanks to simulators, pilots can quickly master flying skills necessary for a certain type of fighter jet.

As China has increased the training flights for its pilots, it has also abandoned the old Soviet style rigid tactics. Pilots are now expected to show initiative and innovative flying tactics. To take advantage of this, last year the Chinese air force instituted a fighter pilot competition that culminates in an annual exercise that determines the ten fighter pilots would who be able to wear a "Golden Helmet" for the next year. This is a regular flight helmet, decorated with a special blue, red and gold pattern that marks the wearer as one of the elite combat pilots in the Chinese air force.

University Training for PLAAF Pilots: China's top science and technology university has set up a four-year pilot training course in association with the country's air force to train 32 pilots every year. Beijing-based Tsinghua University will set up a four-year pilot training course with China's air force, an official of the university said that aviation course will enroll 32 male high school graduates aged under 19 from across the country and train them to meet the challenges of high-tech and information-based instrument flying, state-run *China Daily*, reported. The trainees will study at the university's school of aerospace for the first three years and at the Aviation University of the PLA Air Force in the final year.

PME towards Greater Interoperability: A clear emphasis emerging from ongoing training reforms is the idea of systems conformation as a guiding principle for modern warfare. In no uncertain terms, this concept

will figure prominently in future training. These reforms may even entail revision and reform of the Outline for Military Training and Evaluation (OMTE), promulgated in 2009. The director of the military training and Service Arms Department estimates that the essence of this revolution in military affairs is that military training must form the military's systems operations capabilities based on information systems, achieving the integration of various operational forces, operational units, and operational elements in accordance with the operational requirements of information dominance, systems confrontation, and joint victory.

The January 14, 2011 directive on military training released by the GSD of the PLA represents a roadmap for the Chinese military's training, and offers important indicators about the PLA military planning priorities and evolving threat perceptions. In general, the PLA training in the coming year appears poised to continue experimentation and modification of force structures to accomplish the long-term objectives of preparing the Chinese armed forces (PLA, People's Armed Police, and militia), supported by civilian capabilities, to execute longer-distance joint operations for deterrence, war fighting, and non-traditional security missions under complex electromagnetic conditions.[22]

In addition, the PLA in 2011 established the Military Training Department under the General Staff Headquarters, in accordance with an order issued by Hu Jintao, chairman of the CMC. The organ grew out of a department of military training and arms and services under the PLA General Staff. It is a historic overhaul for the military training of the PLA and a major step to strengthen joint training of different branches of the armed forces in the face of new situation and tasks. The department's reshuffling will enable the overall management of military training for the land army as well as the navy, air force, and the strategic nuclear force.

CONCLUSION

In order to recruit and retain the personnel, the PLAAF needs to fight high-

22. David Chen "2011 PLA Military Training: Toward Greater Interoperability", *China Brief*, vol 11, no 2, January 28, 2011.

tech 21st century warfare which remains a tough challenge, than acquiring the airframes the air force must have. Like the rest of the PLA, the PLAAF has put programmes in place aimed at attracting, educating, and retaining the people it needs, with increasing levels of technical competency and general education. The Chinese are taking the PME system, which is the product of many different trends and historical experiences and moving it in a direction different from the past; as the PLA tries to adapt to what it sees as its educational needs for the early 21st century.

Chinese military writings are clear that informatised training must begin with informatisation of professional military education.

Chinese military writings are clear that informatised training must begin with informatisation of professional military education. Informatisation is judged to be the best hope for solving a core problem within the PME system wherein the development of talented people urgently needed by many units is limited to book study and classroom work. To solve this problem, the PLA has introduced robust simulation training into the PME, and is integrating the effort with simulation and actual training in units.

With the approval of the CMC, the General Staff Headquarters (GSH) of the PLA, recently issued the general plan of military training reform in the 12th Five-Year plan period, providing the guiding principles, objectives and tasks as well as the measures and steps for military training reform. The plan proposes that by 2015, the IT based training conditions centred on bases, simulation and network will be greatly improved. The Chinese military officers of the future will be brighter tacticians, better educated and adept at commanding the highest tech weaponry under an innovative training plan to build better armed forces in the information age. PLA's implementation of the strategic project of personnel development of the PLA military by 2020, aims to establish a new personnel training and educating system, which combines basic and continuing education, academic and military education, and the domestic and overseas training.

CHINA'S MILITARY SPACE PROGRAMME

K.K. NAIR

Antiquity and modernity are generally perceived to be partners in opposing camps; apparently antithetical, but enormously potent when fused together. China's military space programme is a classical example of the above blend; it mixes traditional military wisdom with the advantages of modern science, enabling it to forge way ahead of regional rivals and also bridge the technology divide vis-à-vis superpowers like the US. China, as of now, fully comprehends the enormous advantage space capabilities confer onto traditional military missions and hence earnestly pursues the acquisition of space based capabilities for military prowess and national development. It harnesses space for both the afore-mentioned purposes, but the accent apparently is on military space capabilities as evidenced by the number of satellites it has launched for military purposes in the new millennium. Its Anti Satellite (ASAT) endeavours (established and speculated), its opacity regarding its space programme and a host of other factors discussed in detail later in the paper. Its military space programme is modest compared to those of the US and Russia, nonetheless, within Asia it is the undisputed leader.

Overall, it attempts to harness space not in isolation but as an essential appendage to its lager aim of enabling a modern military transformation; a *"Revolution in Military Affairs (RMA) with Chinese characteristics*". The above

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China is in the process of fulfilling its aim in a very studied, systematic and deliberate manner and has already forged way ahead of India.

is an essential component of its national strategy of beefing up its Comprehensive National Power (CNP). Efficacious wielding of CNP for national advancement would demand a modern military apparatus in addition to economic power. The above rationale drives the quest for acquisition of long range air, space and maritime capabilities which would enable containment of trans-continental super-powers and also consolidation of continental military prowess.

China is in the process of fulfilling its aim in a very studied, systematic and deliberate manner and has already forged way ahead of India. The above scenario is perhaps not ominously or immediately threatening; cooperation rather than conflict is the mantra of the new millennium. Nevertheless, it surely is enough cause for concern. Even after divesting oneself of the historical baggage of China's wanton aggression in 1962, and dismissing such a possibility as paranoia in the new millennium; it goes without saying that the impact of China's military modernisation needs to be studied and understood in our national context, the strategic challenges, needs and future strategies require to be dwelt and deliberated upon so as to prepare ourselves and prevent the possibilities of worst-case scenarios. Prevention is always better than cure, by extension, deterrence is always better than war, and hence a semblance of deterrence would be essential to maintain peace and. This paper attempts to comprehensively assess the extent of malaise so as to enable measures for containing the malaise well in time rather than expending disproportionate efforts later for curing or preventing the malaise.

MILITARY ORIGINS OF CHINA'S SPACE PROGRAMME

As in the case of India, the seeds of China's national space competencies were sown by expatriates returning from scientifically advanced Western nations in the late 50s, thus international assistance was critical to initial development. However, the similarity ends there. The Indian government

isolated space and placed it under the aegis of the Indian National Committee for Space Research (INCOSPAR) with the aim of targeting economic, social welfare and other civil needs. Four decades hence, the targets and aims continue largely unchanged. The military, then and now, has no role in the national space programme.

By contrast, the Chinese space programme was initiated at the behest of the Central Military Commission (CMC) for fulfilling national defence needs. The potential military utility of space was the central reason for China embarking on its national space programme since 1956. The programme was aimed at developing China's aviation, guided missiles, rockets and missile defence needs. Accordingly, the highly classified Fifth Research Academy, under the Ministry of National Defence was established to develop the space effort.[1] The Chinese perceived the initial utility of space for military ordnance delivery by Ballistic Missiles (BM) followed by high level observation. Hence, though Earth observation satellites were on the agenda since 1958, offensive military needs took priority and concentration was devoted on development of BMs rather than application satellites. The next priority was accorded to missile defences, and passive application satellites took last priority.

In keeping with its unique military priorities, within the first decade of the launch of a Chinese R-2 in November 1960, Chinese rocketry evolved to produce missiles like the *DongFeng*-1 (DF-1)[2], DF-2, and DF-3 etc. This formed its conventional missile strike force followed by missiles like the DF-4 and DF-5 which developed as its nuclear strike force. Thus, from its very beginning, the conceptualisation, design, and evolution of China's space programme has always had a pronouncedly military orientation and consequently its overall control has always rested with the CMC.

1. For details, ref Brian Harvey, "China's Space Programme – From Conception to Manned Spaceflight", (Chichester, UK: Praxis Publishing, 2004), Ch. 2, p. 22.
2. The organisational set-up has been sourced from the US *DOD Annual Report-2011*, "Military and Security developments involving the PRC", p. 21.

DUAL-USE PROGRAMME

The common nature of technology enabled adaptation of BMs into Satellite Launch Vehicles (SLVs). Thus, China's medium range DF-4 missile was adapted into its first SLV-the *Chang Zheng*-1 (CZ-1) or Long March-1. Similarly, the DF-5 Inter Continental Ballistic Missile (ICBM) became the CZ-2. By the late 60s, efforts had been put in for a national space tracking and control system. Thereafter, while China's first satellite; the *Dong Fang Hong* (DFH) launched in April 1970 and experimental *Shi Jian*-1 (SJ-1) had no military overtones, its next endeavour, the *Ji Shu Shiyan Weixing* (JSSW) were highly classified and for declared military purposes.[3]The recoverable satellite programme, *Fanhui Shi Weixing* (FSW) which followed thereafter was also for military observation. Many more launches like these followed.

China's civil and military space programmes are strongly intertwined. China's space programme continues to have a military bias; apart from dedicated military satellites, it also derives military capabilities from existing civil satellites. The overwhelmingly 'dual-use' character of the programme ensures that opinion on the Chinese space programme is strongly divided; some see it as an increasingly threatening enterprise and others dismiss it as militarily inconsequential. However, most such perceptions and mis-perceptions on the subject are largely American or Western in character and do not necessarily apply in a regional or continental context.

In a regional context, the fact prevails that the Chinese space programme especially in military terms, is evolving at an extremely rapid pace. Apart from out-racing every other worth-while space power in the Asian region, it has now out-distanced them to the extent that it has decisively altered the "balance of power" overwhelmingly in its favour and is likely to tilt the scales further in the next few years. Secondly, owing to its common origins and common industrial infrastructure, its aviation, space and BM

3. The official announcement stated that the satellite was part of "preparations for war". See op.cit., Brian Harvey, ch.4, p.70.

('*aerospace*') development programmes are also intertwined[4], overlapping each other and also evolving and driving each other at an equally rapid pace. It is known to be making earnest attempts to operationally integrate the above into its conventional military and nuclear apparatus. The homogenous origins and nature of its aerospace, nuclear and mammoth conventional military apparatus would endow it enormous military dividends. Lastly, China's growing ambition, economy and populace would ensure that the imbalance only accentuates further until the scales touch the earth. In view of the foregoing, an examination of the Chinese military space programme is undertaken as below.

Very little information is made public by the Chinese; information when made public is subjected to deliberate obfuscation or at times downright misinformation.

The Secrecy, Opacity, Chaos and Confusion of China's Space Effort

Before comprehensively examining China's space programme, it would be essential to appreciate the fact that the Chinese space programme has always been enormously secretive, complicated and opaque. Apart from the fact that China's space programme is one of the least publicised in the world. This is one aspect because of which it has largely succeeded in shrouding its military space programmes under a cloak of secrecy and multiple civilian nomenclatures.

Most of the afore-mentioned situation is apparently brought about by design and the rest by accident. Very little information is made public by the Chinese; information when made public is subjected to deliberate obfuscation or at times downright misinformation. For example, a variety of

4. China apparently interprets 'aerospace' to include aircrafts, space and BMs as evidenced by the common origin of the programme and the common defence industrial base for developing aerospace capabilities. For example, the Fifth academy, which pioneered China's early space programme was largely a product of China's attempt to establish a national defence aeronautics industry, as a consequence, it was staffed largely by aviation and rocket engineers. China further reorganised its military industrial complexes in the late eighties and combined the Ministry of Aviation Industry and Ministry of Space Industry (BM and Space) to form the Ministry of Aerospace, thereby putting all three under a common development umbrella. By the mid-nineties, it again reorganised to focus individual attention onto aviation and space development, nevertheless, enormous overlap continues and developments in one generally affect the other and as a consequence operational integration is easier.

designations and names are attributed to the same satellite, a particular name is registered with the UN registry of space objects while another is publicly declared, a separate Western nomenclature is also made public at times and these names are further revised, changed and applied retrospectively. Further, the inherently dual nature of space technology complicates matters. China's military and civil programmes are deeply intertwined and disentangling them is an enormously complicated exercise. The accidental factor of linguistic complications and inconsistent translations serves to add on to the chaos. Numerous examples of the chaos prevailing due to the above causes exist; nevertheless, the lead indicators of military satellite programmes - satellites, BMs and budgetary allocations are examined below to validate the above contention.

- **Multiple Designations of Satellites**: The China Brazil Earth Resources Satellite (CBERS) was a joint project developed a 70:30 China and Brazil ratio. The Chinese accorded it a public designation of *ZiYuan* (ZY) or resource. The following year, in September 2000, China launched its own domestic version of CBERS, named *Zhangguo ZiYuan* or China resource, but largely referred to by the Chinese media only by the common suffix of ZiYuan thereby obfuscating matters. The orbital path of this ZY was different; it was manoeuvred extensively, had a much better resolution of 12 mtrs unlike the 20 mtrs of CBERS and was accused by Taiwan of obtaining military Imagery Intelligence (IMINT) over it. *The Washington Times* also corroborated the above.[5]China then renamed the CBERS as ZY-1 and the new domestic ZY as ZY-2. ZY-2 was joined by another satellite in a similar orbit in October 02. The designations of the domestic ZYs were now changed to ZY-2A and ZY-2B. By 2003, the companion of the original CBERS was launched and media reports completed the obfuscation by referring to it alternately as ZY-1B, ZY-2, ZY-2B, etc.
  Similarly, China's indigenous navigation satellites known variously as *BeiDou* (BD), Twin Star, Big Dipper, Plough etc appeared without any forewarning in October 2000. Following the third BD in May 03, China

5. Estimated numbers contained in Indian military publications like SP's and Indian Defence Year Book for the year 2005 are identical to Military Balance (2003-04) and hence are not mentioned separately.

obfuscated matters by referring to the new satellite alternately as BD 1-3 or BD 1C. The fact that BD-1 had been registered as ChinaSat 32 and BD-2 as ChinaSat 31 and BD-3 as BD1/03 at the UN certainly did not help matters.[6] The situation has now been exacerbated because China since 2004 has apparently given up the practice of officially communicating launch of its space objects with the UN[7].

- **Numerical confusion**: Apart from designations, no common agreement exists on China's numerical capabilities in terms of BMs as apparent from the chart below. Not only are the numerical statistics different, the periodical fluctuation in numbers within a span of two years is also quite large. The above is compounded by the fact that no official declaration of China's BM inventory has been made.

Fig. 1

Ballistic Missile		**Type**	**Estimated Numbers**[8]			
Chinese Designation	Western Desig		SIPRI (2004)	Mil Balance (2003-04)	SIPRI (2006)	Mil Balance (2005-06)
DF-31	CSS-9	ICBM	00	08	00	06
DF-4	CSS-3	ICBM	12	20	22	20
DF-5/5A	CSS-4	ICBM	20	24	20	20
DF-21A	CSS-5	IRBM	48	60	21	33
DF-3A	CSS-2	IRBM	40	32	16	02

l **Obscure Space Budget:** Space budgets are generally a reliable indicator of a nation's commitment to its endeavours and also roughly suggest its future road map. However, Chinese opacity on the subject prevails and at times appears as a deliberate effort to promote ambiguity to obfuscate inferences based on observable and quantifiable data. Secrecy and dissimulation are the defining characteristics of Chinese space

6. Ref Richard Fisher Jr, "China's Scary Space Ambitions", *Wall Street Journal*, January 20, 2010.
7. As revealed by Xu Guanhua, the Chinese Minister of Science and Technology at the 18th plenary session of the International Committee on earth observation satellites. See website of Ministry of Science and Technology's Newsletter No.385, November 20, 2004 at http://www.most.gov.cn/eng/newsletters/2004/t20050202_19006.htm.
8. Richard Fisher, Jr., "China's Manned Military Space Ambitions", *International Assessment and Strategy Centre*, October 10, 2005, p.10.

efforts. China's space budget was a secret until 1994 and even now it is not publicly revealed in any detailed fashion. Estimates in 2003 place it variously between $ one Billion and $ three billion per year, for both military and civil space programmes. For example, while the Chinese themselves estimate that government support for space activities is at ¥ 1.45 billion annually[9], the Western European Union (WEU) is known to have estimated it in the region of $ 3 billion and American estimates place it at $ 1.35 billion a year, of which $ 0.5 billion is directed towards civilian Research & Development (R&D) and $ 0.8 billion to military space activities. Several authoritative Western estimates have also been made. These range from€ 1.5 billion (Aviation Week and Space Technology) (AW&ST) to € 1.68 billion (Britain's Flight International) to $ 2 billion (Teal Group) and $2.2 billion (Beijing Review).

However, it must be borne in mind that the above are only estimates. Even considering China's low labour costs, it is doubtful whether its self proclaimed budgetary figure of $ 1 billion (mentioned during speeches) could sustain the great diversity of its programmes in areas of launch vehicles, manned space flights, space systems, applications etc. Considering China's planned historic high of ten launches in 2004 and the planned expansion of the Chinese space programme in the 10th five-year plan (2001-2005), it could be safely inferred that budgets much in excess of even $ 3 billion have been presently dedicated to its space programme.

BROAD STRATEGIC & DOCTRINAL DRIVERS OF SPACE EFFORT

Fundamental Doctrine & Strategy : While the potential military utility of space systems was at the heart of China's decision to undertake its own space programme, the centrality of space technology in bolstering the RMA and by extension overall military force capabilities was comprehended significantly only after Gulf War-1. Driven largely by the Chinese Academy of Military Sciences (CAMS/AMS), the Chinese meticulously studied the tremendous force-multiplication "effects" enabled by space during the 1991 Gulf War and the recent conflicts in Kosovo, Afghanistan and Iraq and reached upon

9. Eric Hagt "Vulnerabilities in Space", *China Security 2006*, Issue no.2, p. 91.

the conclusion that space power is an essential element of effective military action. In particular, the tremendous contribution of space to RMA[10] and hence modern high-technology warfare was well understood by Chinese analysts and thereby a strategic re-think of military concepts and doctrines was carried out leading to traditional concepts being replaced with modern warfare strategies and space-enabled techniques. It was such comprehension that led to the modification of the guiding principles for People's Liberation Army (PLA) modernisation from "*local, limited war*" to "*limited war under high-tech conditions*". Most Western analysts are of the opinion that China understands its break chances against technologically superior opponents like the US, and hence the desire to have some chances of success against a technologically superior opponent drives China to investigate inherently riskier asymmetrical advantages. Notwithstanding Chinese and Western perspectives on the subject, the bottom line is that, China doctrinally comprehends the tremendous impact of space on conventional capabilities and has earnestly begun the pursuit of 'operationalising' space enabled capabilities.[11]

The physical environment of space unlike that of land, sea and air continues to be daunting; largely unknown and technologically challenging.

Doctrines at Environmental Levels: The physical environment of space unlike that of land, sea and air continues to be daunting; largely unknown and technologically challenging. Hence, no clear cut space doctrine exists as in case of land, maritime and air power doctrines which evolved with significant inputs of experience, technology and geographical characteristics. The existing globally accepted operational space doctrine is that of '*Aerospace*' which builds on the premise that air and space are a

10. The above contention is validated when considering the fact that until the first three-year long duration FH-1 dedicated military communications satellite débuted in Jan 2000, China's military endeavours were largely confined to crude, primitive Electronic Intelligence (ELINT) payloads like the short duration JSSW of the seventies or recoverable satellite programs like the FSW-0 series for Imagery Intelligence (IMINT) which had enormously limited military advantage and duration. Its duration of flight was barely five days in the 1980s and gradually advanced to 16 days duration by the late 1990s. Since its transmission was not real time and subject to its recovery on earth and subsequent analysis its military utility was limited.
11. Numbers sourced from Air Commodore Jasjit Singh "Modernising the IAF, Why and How?" *India Strategic*, February 2006.

unitary entity for the conduct of military operations. As a natural corollary, typical airpower missions like counter air operations are extended to space to become counter space operations, air-borne force application is converted to space-borne force application, force multiplication by air (air-borne combat support) gets converted to space-based force enhancement and support operations for sustaining air power is transformed into space support operations. The Chinese apparently do not expend enormous time and effort in contesting the above as evidenced by their ready acceptance, adaptation and organisation of their operational space doctrines on similar lines. Their characterisations include[12]:

Space Safeguard Operations: This mission area is roughly equivalent to space support operations but only includes the launching and recovery of space vehicles and does not include operations involving satellite control.

- **Space Support Operations.** This mission area corresponds entirely to force enhancement missions or what China interprets as '*power enhancement and support capabilities*'.
- **Attack Operations.** This mission area is very expansive and includes all elements of the mission areas of space control and force application. It includes the use of space-based weapons against terrestrial targets, the use of terrestrial weapons against space-based targets and the use of space based weapons against other space-based assets.

China's Operational Space War Theory: At the operational level, the primary missions are:

- Control of the environment of space.
- Integration of air and space operations.

Achievement of space control by China is considered as a fundamental condition for achieving air, sea and electromagnetic control; hence space control assumes greater significance than air, sea and electromagnetic

12. For details, see Nandita Vijay, "*Narayana Hrudyalaya moves out of ISRO satellite for telemedicine, switches to Skype*", PharmaBiz.Com July 13, 2012.

control. It considers space and air operations to be mutually supporting and hence aims at operationally integrating both for successful conduct of military operations. It holds the perception that air and space is linked by information, they are mutually supporting and are essential for coordination of C4I systems etc. Hence, it needs to be properly synchronised and integrated for successful conduct of overall military operations[13].

China certainly appears to be putting its theories into practice as witnessed by its burgeoning military space apparatus and the fast pace at which its air and space capabilities are growing in the new millennium. A broad examination of China's prevailing military space apparatus and forecast military capabilities are also indicative of the same.

CHINA'S PREVAILING MILITARY SPACE APPARATUS

As in most cases the information on China's precise military capabilities, intent and future course of action would neither be available for public knowledge nor open to scrutiny. Nevertheless, a judicious review of what China builds; launches and other quantifiable and observable data would be indicative of its prevailing capabilities and suggestive of its likely course of action. The same would form the bedrock on which implications in our context would rest and hence are discussed below in some detail. As of date, China trails the US and Russia in terms of national space capabilities. Nevertheless, Russian space capability is severely degraded and is only likely to degrade further without the requisite economic wherewithal to match. China's economy on the contrary is on an upswing and while it would be some time before it matched Russian capabilities, the possibility no longer seems remote or impossible. The European Space Agency (ESA) is a multi-nation conglomerate, has enormously limited interest in military space affairs and hence it would be fair to assume that China's continental stewardship is set to expand to global levels.

LAUNCH CAPABILITIES

China has developed two families of launchers, the *Chang Zheng* (CZ) or Long

13. For details, see ibid, pp. 334-336 , p.338.

China's 11th Five Year Plan 2006-2010 also reinforces the importance the government accords to space.

March and the *Feng Bao* (FB) or storm. The FB is no longer in service and the CZ looks after China's launch requirements. China already possesses an impressive inventory of launch vehicles and earnestly pursues the quest for acquisition of better capabilities. It has carried out 93 orbital insertions up to December 05 and ever since its last failure in 1996, has recorded 47 successful launches in a row. Nevertheless, historically, China's launch rates were miniscule, had never crossed unitary figures and rarely came close to even four or five until 1996. Post-1996, China's launch rates increased dramatically and touched an all time high of 10 in 2004. It plans to launch up to nine satellites in 2006 and aspires for an average launch rate of 25-30 satellites per year for the next five years[14]. *Sun Laiyan,* president of the China National Space Agency (CNSA) and Deputy Minister of Commission of Science, Technology and Industry for National Defence (COSTIND), states that, China's goal through 2010 is to triple the number of satellites it will launch[15]. At the executive level, statements by Deputy Director *Zhang Wei* of the System Engineering Department under COSTIND are also on similar lines and assert that during the 11th Five-Year Plan Period, China intends to launch 50-60 satellites into space.[16] China's 11th Five Year Plan 2006-2010 also reinforces the importance the government accords to space[17]. The previous Five Year Plan-10 (2000-05) pioneered the above trend and the future Five Year Plans are expected to be no different.

As a matter of fact, since its ninth Five Year Plan of 1996, China's launch rates have been growing as never before. While the launch rates of

14. "China Launches nine Satellites in 2006," *Sat News Daily*, March 13-19, 2006, available at http://www.satnews.com/frames.html
15. "Seize Opportunities and Promote the Development of Space," speech by Sun Laiyan, Deputy Minister of COSTIND and President of the CNSA, at the ceremony for the 35th anniversary of China's first satellite launch on April 29, 2005. Sourced from Eric Hagt "Vulnerabilities in Space", *China Security* -2006, Issue no.2, p. 88.
16. "China to launch 50 satellites in next 5 years" web site of CSSA, available at http://www.newcssa.net/read.php?tid=27246
17. See Communist Party of China (CPC) Central Committee's Proposal on the Formulation of the 11th Five-Year Plan (2006-2010) for National Economic and Social Development, approved by the Central Committee of CPC on October 11, 2005 at http://theory.people.com.cn/GB/40746/3781965.html.

the Americans and Russians have fallen, China has registered a dramatic upturn. At present, it registers the fastest growth in launch rates in the world as evidenced from the chart below.

Fig. 2: China's Growing Launch Rate

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
USA	37	34	27	28	21	17	27	17	19
Russia	26	24	26	20	25	25	24	15	15
China	06	06	04	06	02	08	09	10	06
India	01	00	01	00	02	01	02	01	02

As China's 11th Five Year Plan progresses, the upswing would register higher growth rates, considering that it plans to blast off 100 more satellites into space by 2020.[18] It pursues the development of new generations of launchers and modifies existing vehicles to fulfill its foreseen needs by adopting the strategy of "making the big, bigger and the small, smaller."[19]Thus, the prevailing inventory by the year 2008 would be augmented by the development of heavy lift vehicles like CZ-5 capable of putting up to 25 tons in Low Earth Orbit (LEO) and 13 tons in Group on Earth Observations (GEO) as well as modification of the diminutive 1970s CZ-1 into small, powerful solid fuelled truck based launchers called *Kaitouzhe*-1 (KT-1) or Pioneer. The KT is aimed at placing 40 kg to 100 kg into 300 km high polar orbit from mobile launchers and because it is solid fuelled it can be prepared for launch quickly. Time and terrain limitations are hence effectively contained. Certain reports claim that the KT on commissioning would be capable of launch within 20 hrs from fixed or mobile launch pads. In addition to the above, it also plans to develop "*airborne carrier rockets*" to

18. As revealed by Xu Guanhua, the Chinese Minister of Science and Technology at the 18th plenary session of the International Committee on earth observation satellites. See website of Ministry of Science and Technology's *Newsletter No.385*, November 20, 2004 at http://www.most.gov.cn/eng/newsletters/2004/t20050202_19006.htm
19. Guo Linli, Shen Lin, Yang Yong and Hu Defeng, "Study on the Development Stratagem of China's Space Transportation System," *Missile and Space Vehicles*, Issue no.1, 2006.

enable mobile, flexible and fast launch of mini-satellites.[20]

Launch site limitations are a critical payload restricting factor for China, nevertheless, by 2010; China's new launch site at *Hainan* Island is expected to be functional and would more than double the payload launch capability for putting satellites into the geosynchronous and polar orbits, a capability it critically lacks.[21]Overall, its prevailing capabilities are potent as evidenced from the chart below and the potency is only set to increase by 2010.

Fig. 3: Prevailing Chinese Launch Vehicle Capabilities

SLV	Capability	Reliability	Remarks
CZ-1	300 kgs to 440 kms	100%	Derivative of DF-4 ICBM
CZ-2C	2.5 – 2.8 Tons to 170 – 300 kms	100%	Derivative of DF-5 ICBM
CZ-2D	3.4 Tons to 200 kms	100%	Used for FSW spacecraft.
CZ-2E	8.8 Tons to LEO,3.4 Tons to GEO	71%	
CZ-2EA	14-16 Tons to LEO	-	Design frozen.
CZ-2F	7.6 Tons to LEO	100%	Used for ShenZhou.
CZ-3	1.4 Tons to GEO	77%	
CZ-3A	2.3 Tons to GEO	100%	
CZ-3B	4.8 Tons to GEO	80%	Equal to Russia's Proton & Europe's Ariane-4.
CZ-4	3.8 Tons to LEO, 2.8 to SSO.	100%	Used for Feng Yun metsats.

Apart from the above, China also pursues the development of Expendable Launch Vehicles (ELVs) etc. and the Shenyang Aircraft Company has reportedly undertaken the task of developing a single stage to orbit space plane[22].

20. Ministry of Science and Technology of the Peoples Republic of China, *Science and Technology Newsletter No. 366* ,May 10, 2004 at http://www.most.gov.cn/eng/newsletters/2004/t20041130_17766.htm
21. Hainan to Build a Space Harbor in 2010," *Hainan Economic Daily (Hainan Jingji Bao)*, October 12, 2005.
22. Richard Fisher, Jr. "China's Manned Military Space Ambitions" *International Assessment and Strategy Centre* , October 10, 2005. p.10.

SPACE SYSTEMS

Of these 50 satellites in orbit, up to 26 have been launched since the year 2000

China had 72 satellites in orbit as of December 05 and even excluding commercial ventures like Iridium, joint ventures like the CBERS, second-hand satellites like Asiasat, Apstar etc. It still notches an impressive array of up to 50 satellites which is set to grow rapidly as indicated by Chinese governmental pronouncements, budgetary allocations of its 10th and 11th Five Year Plans, and trends since beginning of the new millennium. While the above number appears miniscule as compared to that of the US, certain analysts from the West aver that, when measured in terms of national GDP, the significance of China's satellite base increases dramatically and when compared in terms of GDP per capita it actually rises to levels on par to that of the US[23]. The above indicates that in the context of China's overall development, its current interests in space are already substantial and rising dramatically.

Of these 50 satellites in orbit, up to 26 have been launched since the year 2000, of which up to eight are for dedicated military uses; while the balance like the *FengYun, HaiYang, Tsinghua*, etc are capable of dual military and civil uses and are known to provide the same. As a matter of fact, while the major military space system efforts prior to the millennium were sporadic and largely in terms of primitive recoverable observation satellites like the FSW or JSSW, post-2000, the efforts are apparently systematic, studied and deliberate, as a consequence, availability of on-station military satellites have registered a dramatic upswing[24]. The above ostensibly is in keeping with its maturing military space doctrines of '*power enhancement and support capabilities*' or 'force enhancement' in Western parlance, which essentially conotates acquisition of information capabilities in terms of space based observation, communication,

23. Eric Hagt "Vulnerabilities in Space", *China Security* -2006, no.2, p. 91.
24. The above contention is validated when considering the fact that until the first three-year long duration FH-1 dedicated military communications satellite débuted in January 2000, China's military endeavours were largely confined to crude, primitive Electronic Intelligence (ELINT) payloads like the short duration JSSW of the 70s or recoverable satellite programmes like the FSW-0 series for Imagery Intelligence (IMINT) which had enormously limited military advantage and duration. Its duration of flight was barely five days in the 1980s and gradually advanced to 16 days duration by the late 1990s. Since its transmission was not real time and subject to its recovery on earth and subsequent analysis , its military utility was limited.

meteorology, navigation, positioning etc. Development and deployment of a viable architecture of space-based sensors, communications and weather systems is a fundamental requirement for expanding battle-space awareness as also is the need of navigational systems for Positioning Navigation and Targeting (PNT) etc. Thus, the PLA's efforts have expanded beyond episodic 14 day photo-reconnaissance missions of the FSW to permanent positional presence of dedicated IMINT, navigational and military communication satellite constellations etc. for enabling comprehensive information dominance at least in an initial regional context. Accordingly, during the period of the 10th Five Year Plan (2000-05), a BD constellation of three military satellites for PNT is in place, three ZY-2 series satellites for military observation are in orbit, two Frequency Hopping (FH) military communication satellites which are part of a five satellite constellation are also in place. The above capabilities are also augmented by intermittent launches of the FSW as well as dual-use satellites like the Feng Yung (FY) weather satellite constellation, the HY for ocean reconnaissance, manned missions like the *ShenZou* and microsatellites like the *Tsinghua* etc. Considering that China opened its account in 2006 with the launch of a fourth dedicated military IMINT satellite, its capabilities can only be expected to increase further as it marches into its 11th Five Year Plan which has allocated greater resources to developing air and space capabilities. In order to comprehend the full impact of China's quest for space enabled informationalisation and consequent RMA, its existing capabilities are dwelt upon as below.[25] As they span the entire spectrum of force-enhancement missions like observation (ISR), navigation (PNT), communications, weather etc. they are categorised and described accordingly.

OBSERVATION (ISR) SATELLITES:

Until the period of the ninth Five Year Plan, earth observation in China was largely the mainstay of airborne remote sensing platforms. The system is world class and comprises of 80 airplanes, 25 airborne sensors and variety of instruments ranging from airborne Pushbroom Hyperspectral Imagers

25. For a more complete and detailed account of China's historical evolution of its launchers, military space sytems etc., ref Sqn Ldr KK Nair, "Space: the Frontiers of Modern Defence", ch.6: The Great Asian Space Militarisation Race. pp. 117-133.

(PHI), airborne Synthetic Aperture Radar (SAR) systems to high resolution Charge Couple Device (CCD) cameras etc.[26]Nevertheless, permanent on-orbit presence of military satellites is crucial for information-based military operations, China lacks the same and hence by the period of the 10th Five Year Plan, Chinese investments in military IMINT systems have registered an upswing and are likely to continue. Consequent to it, space based observation has become an important element of Chinese space systems, several systems have been developed and launched and as a result it constitutes the largest category of satellites launched by China. Nevertheless, amongst observation missions, the Chinese display a clear bias for IMINT systems rather than Signals Intelligence (SIGINT).

SIGINT systems: China's space programme does not accord a very high priority to SIGINT and its important components of ELINT and Communications Intelligence (COMINT). This could be partly attributed to the fact that it has a massive terrestrial SIGINT network which has been widely described as being the most extensive in the entire Asian region. Secondly, its dual-use satellites like the SZ and Shi Jian (SJ) also intermittently supplement its SIGINT needs as also do the occasional piggy-back payloads strapped on other satellites. Thirdly, its attempt to obtain domestic and regional SIGINT through off-the-shelf purchase of two Asia Pacific Mobile Telecommunications (APMT) satellites resulted in enormous avoidable controversy and national embarrassment[27]. Lastly, it has not given up attempts for acquisition of the same and perhaps waits for a more opportune moment. From the foregoing, it could be safely surmised that it has no pressing need for space based permanent SIGINT systems and has a high degree of proficiency in covertly deploying additional SIGINT payloads. Hence, its present focus is on building up its on-orbit IMINT capabilities, which it seriously lacks.

IMINT Satellites: China's early IMINT endeavours like the Fanhui Shi Weixing (FSW) had definite limits. It was not real time, the IMINT films were sent back from space in recoverable cabins (some recovered,

26. Quoting from presentation by Cao Xuejun of MOST, "Earth Observation in China", *Dragon Symposium*, Santorinin Greece, June 27 – July 01 2005.
27. For details, see Airpower journal

others not) and military analysts had to wait until the film was developed before they could analyse points of interest. The above scenario changed with China's launch of its indigenous ZY-2A in September 2000. ZY-2A was highly manoeuvrable, could transmit images in real time and had better resolution capabilities; some reports placed it at 12 mtrs[28], some at 05 mtrs[29]. This was followed by a second IMINT satellite, the ZY-2B in October 2002. Both satellites operate in tandem and between them cover the same ground path every five days enabling the capacity to cover any ground location every two and a half days. By November 2004, a third ZY-2C also joined them and all three satellites are positioned equidistant in the sun synchronous orbit, giving a full coverage of the earth at all times[30]. As of April 2006, a fourth military remote sensing satellite has been launched. In keeping with Chinese proclivities at assigning multiple nomenclatures, this satellite has been named "Remote Sensing Satellite-1".

Some reports have indicated a military designation code of JianBing-5, the military codes have been applied retrospectively (since 2003) with ZY-2A being designated as JB-1, ZY-2B as JB-2, ZY-2C as JB-3 and to confuse matters, FSW3-1 has also been designated as JB-4. Irrespective of the precise nomenclatures, it goes without saying that Chinese imaging systems and capabilities have improved substantially over the five-year period of the 10th Five Year Plan and while precise resolution details have not been made public, the fact that JB-5 or Remote Sensing Satellite-1 carrying its first SAR system would endow it with tremendous military advantage. Unlike conventional passive optical imagery satellites, space based SAR systems can see through clouds, rain, fog and dust to detect targets on the ground, underground, on oceans and even under ocean, enabling tracking of surface as well as sub-surface vessels like submarines in shallow waters etc. They can also track moving targets and enable military mapping.[31]

Dual-Use Observation Systems: In addition to the above, China's

28. Brian Harvey, "China's Space Programme", Ch.6, p 156.
29. Bill Gertz, "Chinese civilian satellite a spy tool", *Washington Times*, August 1, 2001.
30. Chinese Defence Today, "Jianbing-3 (ZY-2) Earth Remote Sensing Satellite" at http://www.sinodefence.com/strategic/spacecraft/ziyuan2.asp -->
31. Chinese Defence Today, "Jianbing-5/Remote Sensing Satellite-1 Synthetic Aperture Radar" at http://www.sinodefence.com/strategic/spacecraft/jianbing5.asp

Information, Surveillance, Reconnaissance (ISR) needs are also augmented by dual-use satellites. For example, the *ShiJian* (SJ) scientific experimental satellites have been known to carry payloads with SIGINT characteristics[32], as also the atmospheric research DaQui-1 (DQ-1) satellites and the manned as well as unmanned SZ versions. All *ShenZhou* (SZ) missions since November 1999, inclusive of the four unmanned test missions and the manned test mission of October 2003 were known to have performed military missions. SZ-1 and SZ-2 carried an Electronic Intelligence (ELINT) payload to monitor communication signals in the Ultra High Frequency (UHF) band as well as radar transmissions. SZ-3 and SZ-4 were known to carry an IMINT payload of CCD cameras with a resolution of as much as 1.6 mtrs.[33] Enormous realms of literature in the West have been written on the SZs carrying out military IMINT and ELINT missions in addition to their civilian tasks and the Chinese have gone to great lengths to refute or justify the same[34]; nevertheless, the overwhelming evidence points to military missions having been conducted and finally, the entire manned SZ mission is a PLA endeavour and all the data collected has gone into military rather than civil scientific research.[35] China's microsatellite endeavours like *Tsinghua* are also known to be capable of performing ISR missions. Thus, even after discounting civilian Earth observation missions like the CBERS capable of dual-use imagery, China has a formidable capability for space enabled military specific observation.

As mentioned previously, the Chinese had already achieved proficiency in obtaining real time imagery from airborne systems. Nevertheless, the PLA has gone in for space based systems also since it views space based imagery as vital for consistent information gathering and information-

32. Thompson, David J. & Morris, William R., "China in Space: Civilian and Military Developments", *Maxwell Paper no.24,* August 2001, Air War College,.
33. For details, see Sqn Ldr KK Nair, "China's Space Programme: An Overview", *Airpower Journal*, vol.1 no.1, Monsoon 2004, p.154. Also ref Richard Fisher Jr., "China's Manned Military Space Ambitions" *International Assessment and Strategy Centre* , October 10, 2005.
34. For the Chinese version on the SZ's military missions, see ChangXianqi and SuiJunqin, "China's Space Mission" as well as Sun Dangen, "ShenZhou and dreams of Space", *China Security*, Issue no. 2, 2006.
35. Liu Cheng and Chai Yongzhong, "CAST group donates SZ databases to military scientific research institutes", *PLA Daily*, December 26 at http://english.chinamil.com.cn/site2/columns/2005-12/26/content_373517.htm -->

dominance. Thus, since the new millennium, China's on orbit presence of military observation satellites has increased as never before. While on-orbit military IMINT presence prior to the new millennium was as good as nil, it has burgeoned to as much as five satellites by 2006 and going by prevailing trends, the presence is set to increase further.

NAVIGATIONAL SATELLITES (NAVSATS):

China's first navigational satellite BD-1A appeared without any forewarning in October 2000, taking the entire world by surprise. It was in response to declared defence requirements[36]and was part of a three satellite first generation navigational system. The system works at 2491.75 Mhz and covers the region between Longitude 70°~140° E and Latitude 5°~55° N. Two satellites are positioned in geosynchronous orbit at 80° E and 140° E and the third satellite is positioned at 110.5° E[37]. It enables both limited PNT services within China and its contiguous areas and also enables reasonably accurate targeting of certain US targets by Intercontinental Ballistic Missiles (ICBMs). It provides positioning data accurate up to 100 mtrs, which Western sources claim by using ground correction stations which can be increased to 20mtrs[38] whereas the Chinese claim the system coupled with their wide area augmentation system can enable an increased accuracy of up to 12 mtrs[39].

Going by available accounts, the original plan was to follow it up with an improved second generation system[40] and also go in for international endeavours with NavSat providers like the European Galileo and Russian Glonass. Nevertheless, apparently neither options now appeal to the Chinese, given that Glonass capabilities are severely degraded and with regards to Galileo; not only is China denied the military specific Premium Regulated Service (PRS), but also many commercial applications available to other European partners. As a matter of fact, Chinese cash deposits of $ five million

36. Zhu Yilin, "Fast track development of space technology in China", *Space Policy*, May 1996. pg.139.
37. Chinese Defence Today, "Beidou-1 Satellite Navigation System" at http://www.sinodefence.com/strategic/spacecraft/beidou1.asp -->
38. Ibid.
39. Most, NLS-382 October 20, 2004.
40. See MOST, Newsletter No.499.

in the Galileo project are likely to be refunded and chances of China being pushed out of Galileo are high.[41] The Chinese have hence reportedly decided to go in for an indigenous full-fledged 24 satellite navigational constellation in Medium Earth Orbit (MEO), akin to NAVSTAR and Galileo which would enable unencumbered global utility. It has for the above purpose registered 32 slots in the International Telecommunication Union (ITU) and also placed orders for Rubidium atomic clocks which are the heart of navigational satellites and enable highly accurate timing that is the basis of satellite-based position location and navigation. Akin to Galileo, whose frequency is close to and overlaps that of the US NAVSTAR GPS, thereby enabling interoperability and also securing Galileo against possible jamming[42], China also proposes to place Compass in frequency bands close to Galileo, so as to guard against deliberate jamming by the US. The above has caused considerable consternation amongst the Europeans and the Americans.

Chinese cash deposits of $ five million in the Galileo project are likely to be refunded and chances of China being pushed out of Galileo are high.

MILITARY COMMUNICATION SATELLITES:

With regard to military communications, China's military forces are already connected extensively within China by fibre-optic communication networks. Nevertheless, these are apparently inadequate to complement the extended reach enabled by its recently acquired long range fighters like the SU-30's, its Air-to-Air refuellers and its maritime elements. Since the PLA was allotted only limited channels amongst China's eleven DFH communication satellites, it attempted to rectify the situation and proposed a network of defence communication satellites. Its FH-1 (*Feng Huo*-1) military communication satellite (first of the series) was launched

41. Peter B. de Selding, "Europeans Raise Red Flags over Chinese Satellite Navigation Plans", *Space News,* June 12, 2006.
42. Deliberate jamming by the US of Galileo would in turn lead to US's NAVSTAR also experiencing interference and degradation. For a more detailed discussion, see Taylor Dinerman, "Will China compel the development of GPS-4", *The Space Review*, June 19, 2006 and Ryan Caron, "Letter: Galileo and Compass", *The Space Review*, August 7, 2006.

in January 2000, which consists of the *Qu Dian* C[4]I (Command, Control, Communications, Computers and Intelligence) system.The network as per its registration with the ITU would consist of up to five satellites, China Sat 21-25. This network would enable PLA commanders to communicate with their in-theatre forces in near real time,[43] and also enable data transfer with all units under joint command in addition to providing the Chinese military with a high speed and real-time view of the battlefield thereby enabling effective command and control. The Chinese military describes the new tactical information system component of the *Qu Dian* system as being analogous to the American Joint Tactical Information Distribution System (JTIDS). The satellites would reportedly provide the military with both 'C' and UHF band communications. Thus, once fully deployed, the FH series constellation would establish space-based military tactical communication networks to support Chinese military operations.

WEATHER SATELLITES

Although not designed primarily for military uses, Chinese weather satellites do support military activities. Designed primarily for civil users, these satellites provide earth observation, weather and other related data that are vital to military forces when determining useable ground manoeuvre routes, aircraft flight paths and visible target areas, amongst other things. China's weather satellites are listed as the *Feng Yun* series, up to four series and a total of eight satellites have been launched till date. With every launch, capabilities and performance witness greater improvement. In addition to visible and infrared scanning radiometers, they now carry microwave sensors and imaging devices and are capable of identifying highways from a height of 870 kms.[44]

EARLY WARNING SATELLITES

It is surprising that China has not put in dedicated measures for the above mission, considering that it has developed the entire complement of BMs,

43. John Pike, "The military uses of outer space", *SIPRI Year book 2002: Armaments, Disarmaments and International Security.*
44. Most newletter no. 399.

possesses a triad of nuclear forces and is enormously concerned with the US's Ballistic Missile Defence (BMD) programme as well as the cover it might provide to Japan and Taiwan. As a matter of fact, China's greatest vulnerability is its lack of strategic reconnaissance platforms; neither does it possess a functioning Over-The-Horizon (OTH) radar network, nor high altitude strategic reconnaissance aircrafts, nor dedicated satellites to provide early warning. It could be speculated that some covert capability exists or that it plans to develop it in a phased manner.

MICRO-SATELLITES (MICROSATS)

Microsats have numerous civil and military applications. Their primary military appeal lies in the fact that they are expendable, cheap to produce and launch, are flexible and difficult to detect. They offer a cheaper alternative for fulfilling a range of both active and passive military space activities. For example, microsats can be offensively utilised in ASAT roles as well as for disrupting satellite reception signals. They can also provide a surge capability for crises besides providing a less expensive replacement platform for larger passive military platforms in space providing military communications, IMINT, SIGINT etc. As a matter of fact, the entire panoply of military missions ranging from 'force-enhancement' to 'counter space operations' **(SPACING BETWEEN WORDS)** can be effectively fulfilled by microsats. Nevertheless, its gainful military utility demands a high degree of technological sophistication, precise tracking and orbital manoeuvring accuracy as well as commensurate launch capabilities. As of 2006, the Chinese have apparently made significant advances in all the above three and are continuing investments for pursuit of better microsat related capabilities.[45] Evolving technological sophistication is

45. Chinese commitment and investment to microsatellites can be gauged from the fact that it established a 8,000 square metres site for a National Research Centre (NRC) for Small Satellites and Related Applications in April 2003 and followed it up with the world's largest "Microsat Industrial Park" in Beijing in December 2004. The park stretches over 16,000 square metres, and has an annual capacity to manufacture and test six to eight advanced small and micro-satellites as well as their application technologies. Other governmental efforts include the Small Satellite Research Institute of CAST and the Shanghai Institute of Microsystems and Information Technology. The above is in addition to prevailing collaborative efforts of *Tsinghua* university with SSTL, UK as well as *Haerbin* University's joint efforts with the European company Astrium.

a foregone conclusion and the ability to launch multiple payloads on a single launcher was successfully demonstrated in 1981. Ever since, the Chinese have made tremendous advances and the highly mobile KT-1, capable of mobile and fixed launch within 20 hours would enable it to fulfil it's much desired 'launch-on-demand'capability. This in turn would entail continuous on-orbit presence and gap-free coverage of its areas of interest as also significant ASAT capability. It has mature space detection, tracking and manoeuvring capabilities in place which would multiply the utility of microsats in ASAT roles.

China's microsat endeavours have increased substantially in the new millennium. A China and Surrey Satellite Technology Ltd (SSTL), UK partnership project enabled the June 2000 launch of a 50 kg *Tsinghua*-1 micro-satellite and companion Surrey Nanosatellite Application Platform (SNAP) nano-satellite weighing 6.45 kgs. On-orbit rendezvous capabilities of both were put to test and were reportedly successful[46]. The *Tsinghua-1* is a precursor to a larger 07 satellite *Tsinghua* constellation aimed at providing high resolution imagery. While the first *Tsinghua* has a resolution of 30 mtrs which is not of enormous military significance, later satellites display improved military grade resolution.

Microsatellite efforts were later formalised and financed under the aegis of the 10th Five Year Plan and a major project "high performance microsat ground observation technology and associated applications" was approved. Under it, Beijing-1 or *Tsinghua-2* was a product of the same project. The *Tsinghua-2* launched in October 2005 has a resolution of 4 mtrs and a swath of more than 600 mtrs which is of significant military value[47].

Additionally, as disclosed by the China National Space Administration (CNSA), during the period of the 11th Five Year Plan[48], China plans to put into orbit a *Huanjing* constellation of 11 microsats for environmental observation and disaster watch in two phases. The first phase would include 02 optical satellites and a third SAR satellite to be launched by 2007. The second phase

46. Brian Harvey, ch.6, p.161. *Tsinghua* is reffered to as *Qinghua*, nevertheless, the above is a matter of mixed nomenclatures and the subject microsatellite is the same.
47. MOST, NLS-441.
48. As quoted by the Ministry of Science and Technology, *Newsletter No.339*, August 10, 2003.

would include 04 small optical and 04 SAR satellites to be launched by 2010 enabling a 12 hourly revisit.[49] The project was apparently slated to begin in 2005 and has been delayed. Overall, China of date has the following microsats in orbit which are set to multiply as it progresses into its 11th Five Year Plan.

Fig. 4: Chinese Microsats in Orbit- December 2005

Micro-Satellite	Launch Date	Weight	Role	Remarks
Tsinghua-1[50]	20 Jun 2000	50 kgs	Imagery	Res: 30mtrs, 03 optical bands (NIR, green, blue) Swath: 600 kms
Tsinghua-2[51] (Also named as Beijing-1.)	27 Oct 05	150 kgs	Imagery	Res: 04mtrs panchromatic camera + 32 mtrs res 3-band multispectral
Tansuo-1	18 Apr 04	150 kgs	Imagery	camera. Swath: 600 kms. Carries 10 mtrs stereo resolution camera[52].
Tansuo-2	18 Nov 04	300 kgs	Imagery	Not Known (N/K)
Naxing-1	18 Apr 04	25 kgs	N/K	N/K
Chuangxin-1	21 Oct 03	100 kgs	Data relay	Launched piggy-back on CBERS-2

ASATS

The military mission area of counter space ops aims at controlling the realm of space for own use and denying it to the adversaries. The same in Chinese parlance is termed as *'Attack Ops'* and includes the pursuit of ASAT and other capabilities aimed at denying, degrading and destroying the space assets of the adversary. The essential precursor to any counter space capability is the ability to detect, identify and track objects in space which is referred to as

49. "China to set up world's first satellite constellation for disaster monitoring", *People's Daily Online*, June 25, 2004 at http://english.people.com.cn/200404/27/eng20040427_141719.shtml
50. Data on *Tsinghua* sourced from a variety of sources, weight sourced from site of SSTL, technical parameters from Stoney, W.E., "Guide to Land Imaging Satellites,' *The American Society for Photogrammetry and Remote Sensing*, Updated February 2, 2006, available at http://www.saniita.com/pdf/Guide%20to%20Land%20Imaging%20Satellites.pdf
51. For details, see "Beijing-1 (China-DMC + 4, Tsinghua-2)…." *Space News Feed*, October 30, 2005 at http://www.spacenewsfeed.co.uk/2005/30October2005_25.html
52. Brian Harvey, ch.6, p.162.

'aerospace surveillance' and the same is hence dwelt upon as below.

Aerospace Surveillance: The above in a military sense is aimed at obtaining space situational awareness which is the first step to denial, destruction or degradation by ASATs or any other means as also for protection of own assets (by evasive manoeuvres) in space. As of date China has a mature world-class space surveillance and TTC system and earnestly pursues the acquisition of better technologies related to spacecraft navigation, attitude control, simulation, integrated rocket measuring and launching control. The above are essential for any credible space faring nation and are not directly indicative of military aims but certainly endow enormous incidental military capabilities essential for counter space ops. For example, the ability to track objects is essential for keeping a track of own satellites as also for detecting and identifying foreign satellites to conduct ASAT ops like putting objects in the orbital path or aiming ground-based lasers for destroying sensors during overpass timings or taking deception, camouflage and concealment measures to deceive space based surveillance etc.

China claims that its space control network has reached an orbiting accuracy at the metre level, which makes the flawless control and management of 85 orbiting vehicles possible.[53] It also claims to have developed software to enable it to orbit multiple satellites at the same time, with an accuracy reaching centimetre level. Trial applications show that the system has centimetre-level positioning accuracy, with an advanced function to orbit multiple satellites in multiple arcs at the same time[54]. If the above claims are taken as accurate, then the possibility of China successfully undertaking satellite interception missions becomes enormously credible. It would have the requisite orbital data to calculate the proper path to the target, to launch the booster at the precise moment, the ability to track and plot the precise intercept course to the target and detonate, dock, rendezvous or inspect as need be. The above appear to be enormously credible considering that Chinese microsats like *Tsinghua*-1 have been known to carry out successful

53. Ministry of Science Technology, News Letter No. 370.
54. MOST, NLS-397.

rendezvous manoeuvres with other microsats[55].

ASAT capabilities: Western and Chinese writings on ASAT capabilities (both established and speculative) are profuse. Chinese R&D for ASAT weaponry has been going on since 1960 under the 640 programme of the space and missile industry's Second Academy. The programme was abandoned in the 1980s. Nevertheless, ASAT efforts were not given up altogether and funding continued under programme-863. Western reports on Chinese ASAT capabilities were profuse in the late 1990s. Since 1998, there were reports that China's Central Committee of Communist Party had been giving highest priority to the development of an anti-surveillance ASAT system. This system comprises of ground based lasers capable of damaging sensors of LEO imaging satellites[56]. America's Cox report of 1999 also judged that China had the technical capabilities to develop CSS-2 or DF-3/3A Intermediate Range Ballistic Missile (IRBM) into a direct ascent ASAT weapon. Some reports also mention the possible modification of China's solid fuelled missiles, the DF-21 or DF-31 as a direct ascent kinetic kill weapon[57]. Reports on Chinese ASAT capabilities reached a crescendo in the new millennium with the Department of Defence (DoD) Annual Report on the Military Power of the People's Republic of China for the Fiscal Year 2003 (FY 03) and FY 04 both containing references to Chinese "parasite" satellites for potential use as ASATs. The source of the report on parasitic ASATs was not credible and was traced to a self-proclaimed "military enthusiast" named *Hong Chaofei* from a small town in *Anhui* by

55. Brian Harvey, pg 161.
56. Paul Beaver, *Jane's defence weekly*, December 02, 1998, p.18.
57. Kinetic energy attacks that are launched from the earth and attempt to destroy the satellite without placing an object into orbit are referred to as direct-ascent attacks. Such an attack may use a homing interceptor. The ASAT would be launched on a missile that carries it above the atmosphere and releases it in the direction of the target satellite. The interceptor would then use its sensors to detect the target satellite and its thrusters to guide it to collide with the satellite. Shortly before intercept it might release a small cloud of pellets to increase the possibility of collision. Since the attack can be direct-ascent and does not require the interceptor to be placed in orbit, attacking satellites in low earth orbit requires only a relatively short-range missile to loft the interceptor to the satellite's altitude.

the American Union of Concerned Scientists.[58] DoD reports ever since are extra cautious and the FY 06 very guardedly state that "China can currently destroy or disable satellites only by launching a ballistic missile or space-launch vehicle armed with a nuclear weapon".

The fact of the matter is that, though China has not conducted ASAT tests like the Soviets or the US to conclusively establish ASAT capabilities, it undoubtedly possesses a range of enabling capabilities for prosecuting ASAT operations. For example, while the prospect of launching nuclear payloads would not appeal due to the inherent risks involved, it goes without saying that conventional kinetic-kill payloads could perform the same tasks effectively with lesser collateral damage[59]. Similarly, China's direct-ascent ASAT capabilities are a foregone conclusion in view of its prevailing potent launch capabilities which would only multiply in the near future.

Additionally, lasers, RF energy, High Powered Microwave (HPM) and such-like Diverted Energy Weapons (DEW) have potent ASAT applications. Lasers, in particular both solid-state and chemical have immense ASAT applications. Laser technology in China is mature, and a variety of laser materials and techniques have been developed with a range of power levels. Laser ASAT systems also require a tracking and pointing system. Movable mirrors are used both for directing the laser beam toward the satellite and to focus the beam. China earnestly pursues acquisition of all the above and has acquired world-class proficiency in these systems. To cite a case in point, China's first femtosecond high powered solid state laser device

58. The US Department of Defence, "Annual Report on the Military Power of the People's Republic of China" July 2003 p. 36 also claimed that China was developing killer microsatellites based largely on a January 2001 Hong Kong newspaper article. However, Gregory Kulacki and David Wright of the Union of Concerned Scientists traced the story to a web site run by a self-described 'military enthusiast' named Hang Chaofei who ran a Chinese language internet bulletin board filled with crude illustrations and "fanciful stories about secret Chinese weapons to be used against Americans in a future war over Taiwan". For details, see Greogory Kulacki and David Wright, "A Military Intelligence Failure? The Case of the Parasitic Satellite" (Cambridge: MA: Union of Concerned Scientists, August 2004), p. 3.

59. Attacks that attempt to damage or destroy a satellite through high-speed collisions with another object are called kinetic energy attacks. Since satellites move at high speeds, a collision with even a small object can seriously damage them. Even a collision that leaves the satellite largely intact could cause it to tumble. Prevailing Chinese launch capabilities enable potent capabilities.

with an output of 300TW (3×1014W) has been recently put into successful operation in *Mianyang, Sichuan.* It has also acquired proficiency in utilising lasers and mirrors for accurate ranging and positioning. SZ-4 reportedly carried a space mirror, laser reflector which enabled accurate ranging and positioning to the extent of 01 centimetre.

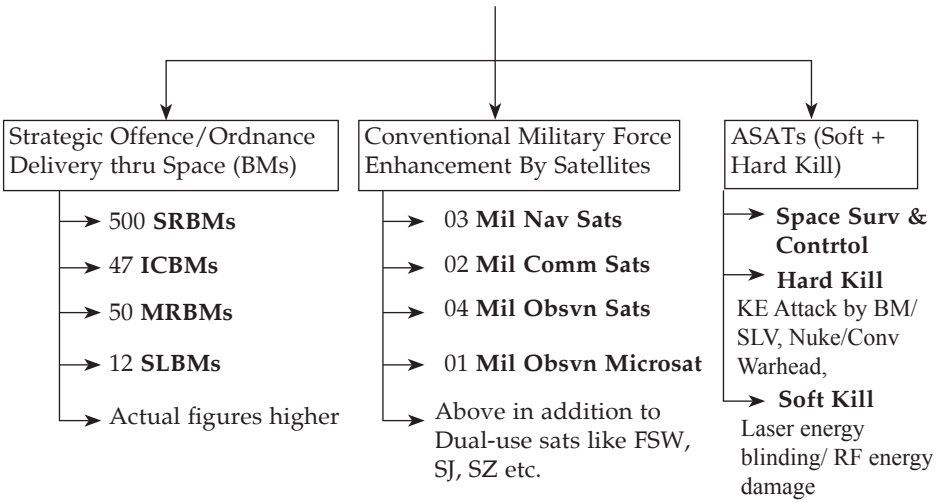
Speculation on China's build-up of ASAT capabilities is on the rise. Apart from proficiency in launch and surveillance, its increasing proficiency in microsats would also endow incidental ASAT capability. Microsats have immense applications as ASATs. Operationalisation of its highly mobile KT-1 for launching microsats would make its military counter space mission more potent as also its pursuit of airborne carrier rockets as well as ASAT aircrafts like the MiG-31.

China's launch abilities, its ability to rendezvous and inspect, accurate orbital control and multiple satellite navigation, accurate ranging by lasers and mirrors etc would make a credible ASAT capability possible. Following the demise of the Cold-War, the need for mutual chest-thumping braggadocio between equal partners is no longer necessary and considering that the above are part of China's quest for acquisition of 'asymmetric capabilities' vis-à-vis the lone super-power, the question of going in for declared ASAT tests just does not arise. A common-sense approach would demand the discrete build-up of capabilities, which is ostensibly what is being done.

TIPPING THE AEROSPACE BALANCE

In view of the foregoing, it is comprehensively apparent that China fully appreciates the impact of composite aerospace capabilities in furthering CNP and hence since its ninth Five Year Plan has put in enormous efforts and investments for modernising its antiquated military machinery. The process of modernisation spearheaded by its growing air and space capabilities would make it enormously powerful both in quantitative and qualitative terms. Its composite military space capabilities are the most powerful in Asia and evidently globally formidable considering its military space apparatus below.

Fig. 5: China's Present Military Space Apparatus



To complement the above, Chinese airpower is also rapidly expanding and modernising. China's comprehensive pursuit of air and space power is evidenced by the fact that as in case of space, China laid the foundations for building modern airpower capabilities during the ninth Five-Year Plan (1996-2000), made significant progress on both the civil and military elements during the 10th Five-Year Plan (2001-05) and going by trends will continue to build on all aspects of this foundation during the 11th Five-Year Plan (2006-10) also. Chinese airpower is growing rapidly and apart from People's Liberation Army Air Force (PLAAF) which enables it military force projection, China's civil aviation industry is also growing at an equally rapid pace.

With regards to PLAAF, in sheer quantitative (numerical) terms, it has for most of its history maintained its position as the largest Air Force in Asia and the third largest in the world. Nevertheless, in qualitative terms, it has lagged behind many nations. As a matter of fact, even within Asia, in qualitative terms it has at times lagged behind Taiwan and India also. Nevertheless, the Chinese fully comprehended the military dividends yielded by the extensive reach of modern airpower and began corrective actions around the period of the ninth Five Year Plan. Thus, as it progresses into the new millennium, its airpower capabilities are expected to shrink quantitatively and grow qualitatively. Its

antiquated tactical aircraft inventory is being replaced by modern third and fourth generation strategic fighter aircrafts like the SU-30, long range transport aircrafts like IL-76s, Air-to-Air refuellers, Airborne Warning and Control System (AWACS) etc which would enable it to complement its expanding global influence and interests. In 2005 China announced plans to buy approximately 30 IL-76 transport planes and eight Il-78 tanker planes from Russia, which would greatly increase its troop airlift capability and offer extended range to many aircraft.

Military fighter aircraft are the most visible manifestation of a nation's long range military force projection capability and strongly impact national power and security dynamics. Hence, a qualitative audit in numerical terms of modern fighter aircraft of the two leading Air forces of Asia; the PLAAF and IAF has been undertaken as below.

Fig. 6: Comparing Periodical Modern Fighters of PLAAF & IAF Inventory

	PLAAF			Indian Air Force		
Period	**2nd gen**	**3rd gen**	**4th gen**	**2nd gen**	**3rd gen**	**4th gen**
1979	80 J-7/ Mig-21.	Nil	Nil	200 Mig-21	Nil	Nil
1989	300J-7 + 200 J-8	Nil	Nil	320 Mig-21 +267 Others.	49 Mig-29 + 52 Mir-2000.	Nil
1999	700 J-7 +J-8.	48Su-27	Nil	632 Mig-21,etc.	99 M-29+ Mir	08 Su-30s.
2000	950 J-7 + J-8.	50 Su-27	10 Su-30	618Mig-21, etc.	99 M-29+ Mir	08 Su-30s.
2001	950 J-7 + J-8.	65 Su-27	38 Su-30.	618 Mig-21, etc.	99 M-29+ Mir	18 Su-30s.
2002	794 J-7 + J-8.	70 Su-27	57 Su-30.	557 Mig-21, etc.	103M-29+Mir	16 Su-30s.
2003	854 J-7 +J-8.	90 Su-27	58 Su-30.	534 Mig-21, etc.	103M-29+Mir	30 Su-30s
2004	858 J-7 + J-8.	100 Su-27	100 Su-30	533 Mig-21, etc.	103M-29+Mir	40 Su-30s
2005	858 J-7 + J-8.	116 Su-27	76 Su-30	466 Mig-21, etc.	105M-29+Mir	40 Su-30s

It is evident from the chart above that while the IAF was qualitatively superior to the PLAAF till the 1990s; the situation began changing since the period of China's ninth Five Year Plan. Ever since, PLAAF has not only closed in, it has actually overtaken the IAF in qualitative terms. It is evident that China is in the process of undertaking a phased retirement of its antiquated inventory and by 2010 would possess a diverse air force with hundreds of third and fourth generation modern fighter aircrafts. The above would be in addition to its vast inventory of improved second generation aircrafts. More alarmingly, PLAAF's modernisation pace as opposed to the IAF is enormously fast and by 2010, the qualitative balance also would be almost irrevocably in its favour. Most modern air forces aspire to a 'lean and mean' capability; PLAAF is evidently getting meaner though not necessarily leaner. By contrast, the IAF has depleted from its force levels of as much as 64 squadrons (50 combat and 14 transport) in 1961 to around 33 at present and is likely to stay at that or even lesser in the following years.[60]

Airpower is generally regarded as the total aviation capability of a nation, civil and military, existing as well as potential and hence any analysis of Chinese airpower would be incomplete without an exploration of its civil aviation sector. China's civil aviation industry is also booming and set to expand as never before. While global civil aviation industry plummeted post September 11, China's soared as never before. China's aviation industry has leaped from the 37th place in 1978 to the fifth in 2003. Its passenger traffic has also risen from 35th place to the 5th in the world and would continue to grow as evidenced by the fact that in the first half of 2006 itself, it has registered a 17.5 % growth with a passenger traffic volume of 73.99 million.

In view of the foregoing, it is conclusively evident that China's aerospace capabilities have transformed as never before and the transformation would only gather further momentum as it progresses further into the 11th and 12th Five Year Plan. The aerospace balance has conclusively in qualitative and quantitative terms shifted entirely in its favour. As a matter of fact, the scales have touched the earth!

60. Numbers sourced from Air Commodore Jasjit Singh "Modernising the IAF, Why and How?" *India Strategic*, February 2006.

PROGNOSTICATING THE FUTURE

In addition to a growing economy, the critical supporting factors of an indigenous aerospace industry along with suitable manpower for sustained development and efficacious application of aerospace power also exist and as they mature would yield greater dividends in the near future. It is common knowledge that China's economy is growing and set to peak in the period of its 12th Five Year Plan (2010-15). Going by prevailing trends, it would be safe to assume that economic support for developing aerospace capabilities would only be facilitated even more; by extension its capabilities would only expand even further. Secondly, although China's indigenous aerospace industry doesn't exactly inspire PLAAF's confidence (in view of the fact that it rejected the indigenous JH-7 after a two and a half decade wait and went in for Su-27s finally), four decades hence, its industry finally appears to be maturing and would soon begin delivering to its aerospace apparatus[61]. Thirdly, by 2010, China's pool of military draft age personnel would be the highest in the world at 61.73 million[62] and hence the critical mass essential to ensure efficacious development and application of aerospace power would also be available to it.

In view of the foregoing and China's declared emphasis on building up air and space capabilities, it would be safe to assume that the following 'Aerospace' capabilities would be available by 2010.

Fig. 7

Aerospace Elements	9th FYP (1996- 99)	10th FYP (2000- 05)	11th FYP (2006 -10)
4th Gen Ftrs	Nil	128 SU-30s	220 + 350 SU-30s
Mil Sats in Orbit	Nil	09	20+
ICBMs	20	47	61

In addition to the above, manpower is critical to consummation of vision and more so in case of military visions. Secondly, the critical supporting

61. China's aerospace industry
62. "Modernising China's military: Opportunities and constraints" p.38-39.

factors for military modernisation and force projection; of a robust economy and manpower would be entirely in China's favour by 2010. Therefore, it would be safe to assume that Chinese military superiority would tip the balance of power entirely in its favour.

CONCLUSION

From the foregoing it is apparent that China's development of aerospace capabilities is aimed at enabling its transition from antiquated military machinery focussed on territorial defence to a modern military focussed on long range strategic power projection. The above would be instrumental in complementing its growing political and economic might and interests. By 2010, the numbers, doctrines, strategy etc. would all be firmly in place and the homogenous nature of its air, space, BM & Nuclear programme would enable operational integration into its mammoth conventional military apparatus, making it a formidable power not only in Asia, but the entire world.

THE POLITICS AND STRATEGY OF ENVIRONMENTALISM

DHANASREE JAYARAM

We have wished, we ecofreaks, for a disaster or for a social change to come and bomb us into Stone Age, where we might live like Indians in our valley, with our localism, our appropriate technology, our gardens, our homemade religion -- guilt-free at last!

— Stewart Brand, Editor, Whole Earth Catalogue

Environmentalism is a broad, social and philosophical movement that has redefined human history on account of not only its enormous reach but also its future repercussions. Today, protection of environment has become the top-most 'priority' of every actor in the world, both the state and non-state, due to internal and external pressures that may not culminate in the 'common good.' The importance of the concept has enhanced since the identification of global warming and climate change as the biggest threats to humankind. India is one of the most vulnerable countries and hence has to find solutions to tackle the effects of environmental change as well as take steps to stop it to the greatest extent possible. This endeavour would indeed require the State to join hands with non-state actors to not only devise solutions but also implement them effectively. Among non-state actors, the Environmental Non-Governmental Organisations (ENGOs) have a significant say as far as environmental governance is concerned. They play

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a prominent role in formulating a country's stand on environmental issues at the international level and also act as a bridge between the government and the public. Instead of acting as a bridge these organisations could also be at loggerheads with the government justifiably or unjustifiably, if the latter fails to take the former and the people into confidence both with good governance as well as astute public diplomacy efforts. Just as the nation states indulge in the politics of environment so do the ENGOs.

The paper discusses the impact of environmental groups on policy formulation and implementation at both the international as well as national levels. In this respect, it analyses the challenges of governance and accountability to environmental movements by highlighting specific examples of ENGOs. They have played both positive and negative roles, the former by raising awareness as well as assisting the establishment in data generation and dissemination and the latter by misinforming the public and the governments as well as indulging in corrupt practices for vested interests. A comparison between the West's treatment of the ENGOs and NGOs dealing with environmental matters and that of India would give an interesting background to the lack of strategic thinking among India's policy makers. In this context, issues such as economics, strategy and diplomacy take the centre-stage. The Corporate-ENGO confluence and lack of transparency on the part of the government of India are some of the factors that have provided an impetus to the increasing role of the ENGOs in environmental governance in the country. Their influence on the government could be both progressive and detrimental. These aspects would be closely studied in this paper encompassing both governance and strategy. The attempt has been to deal with every issue, mostly from the state's perspective although other perspectives are provided adequate focus simply because the state does occupy the core of international relations to this date. Also, the paper does not touch upon any specific policies of any specific government. The focus is more on a classical, liberal and democratic setup and the recommendations are also directed towards the State and in the process, also to the ENGOs.

THE INTERACTIONS AND COUNTER-INTERACTIONS IN A WORLD OF MULTIPLE RELATIONSHIPS

The Prospects for Environmentalism and Diffusion of Governance

Environmental politics is one of those rare domains in which policy-making have indeed witnessed wider participation from the civil society, especially the ENGOs. However, the ENGOs have also faced criticism from various quarters on two grounds – first, the ability of ENGOs in influencing the promotion of environmental sustainability might be overstated, though they provide for popular participation; second, the democratic nature of the ENGOs has been viewed by many with scepticism primarily because of the fact that with increasing institutionalisation of these ENGOs, the participatory tradition is giving way for a more elitist or hierarchical tradition. The activities of the ENGOs are multifaceted. First, they might take on the role of agents of policy-makers by carrying out the task of implementing the policy-makers' agenda in the society. This activity is also aided by the government through funds. Second, ENGOs could take the views of the citizens of the society to the policy-makers, thus representing either their supporter base or the general public. Third, the ENGOs also play an important role in terms of transforming the behaviour and attitudes of the citizens towards environment. In this regard, besides engaging themselves in creating publicity for their cause and galvanising communities or even joining hands with the existing communities in order to manage local environment, the ENGOs have also begun to promote non-governmental environmental governance by mobilising support for their visible objectives and indirectly influencing the government policy. Fourth, as the ENGOs take the citizens' views to the policy-makers, they also attempt to change the views of the policy-makers through various means such as lobbying, participation in formal environmental institutions, public campaigning and so on.

It is also highly important to analyse the strategies of the ENGOs to disseminate an 'ecological sensibility' among the masses. Some ENGOs produce educational material and indulge in civil disobedience or

campaigning primarily to attract media attention. Other ENGOs such as Greenpeace and Friends of the Earth (FoE), invest considerable amount of their resources in scientific research in order to directly present scientific evidence to the citizens as well as to the government. At the same time, as discussed earlier, ENGOs such as Greenpeace have gone to the extent of indulging in actions that "excite the eye". Paul Wapner comments, "By offering spectacular images to the media, Greenpeace invites the public to bear witness; it enables people throughout the world to know about environmental dangers and tries to pique their sense of outrage."[1] Both Greenpeace and FoE initially believed in using direct action, that is confrontational methods, usually within the law. Greenpeace shot to international fame in 1985 during the Rainbow Warrior incident in which its ship was blown up by the French government agents and one of its crew members was killed. The ship was used to protest against the French nuclear testing. Similarly, if the ENGOs protest against the moral wrongs of the government and not injustice, the ENGOs tend to lose their credibility.

Government-ENGO Partnership

If one delves more deeply into the role of the ENGOs as independent agents undertaking various steps to influence the government policy, one could clearly see that the ENGOs contribute not only their views but also the citizens' views to the policy process. Representation is an important factor that forces governments to take the ENGOs with sufficient seriousness. Apart from representation, the ENGOs are also approached by the government for their expertise as they could provide the latter with relevant information which the governments would otherwise never come to know. As already mentioned earlier, the gap between the ENGOs and the scientific community is slowly reducing as the ENGOs themselves are devoting considerable amount of their resources to social science and natural science research in environmental issues. For example, The Energy and Resources Institute

1. Derek R. Bell, "Sustainability through Democratisation? Assessing the rule of environmental NGOs in a liberal democracy," *NGOs, sustainability and democracy* (Newcastle: Political Studies Association, University of Newcastle), p. 12, see at http://www.psa.ac.uk/journals/pdf/5/2003/Derek%20Bell.pdf, accessed on December 12, 2011.

(TERI) have been focussing on research activities related to climate change, efficient utilisation of energy, sustainable development and large-scale adoption of renewable energy technologies. It has also played a pivotal role in formulating the developing world perspective in the international climate debate apart from providing vital inputs for the Intergovernmental Panel on Climate Change (IPCC) process. The institute's areas of focus in climate change research are "impacts and vulnerability assessment, adaptation strategies, exploring Green House Gas (GHG) mitigation options and issues therein, climate change policies and climate modelling activities."[2] Internationally, it is involved in several collaborative projects with institutions in other parts of Asia, the Asia Pacific, Europe and America. In fact, it is already on the path of making efforts to help Africa build capacity to mitigate and adapt to climate change. The majority of reports and documents of the Ministry of Environment and Forests (MoEF) and the Planning Commission are replete with data generated by TERI, whether it is the sector-wise inventory of GHG emissions or even policy recommendations in terms of options and potential for GHG emissions mitigation. The Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth of the Planning Commission is one of them.[3] Another example of an ENGO in India that works closely with the MoEF is Development Alternatives (DA). It was chosen as the ENVIS (Environmental Information System) node # 4 by the MoEF. It is linked to the global environmental information system called INFOTERRA/UNEP. ENVIS # 4 has been "assigned the task of collecting, organizing and dissemination of information, globally on Environmentally Sound and Appropriate Technologies (ESAT)." Its primary objective is to create databases and update them.[4] It not only releases timely information to the public free of cost but also assists the government in generating data which could be used both in the domestic as well as international

2. Earth Science and Climate Change, see for more information, at http://www.teriin.org/index.php?option=com_division&task=view_div&id=26, accessed on December 15, 2011.
3 "Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth," *Planning Commission, Government of India* (May, 2011), see at http://planningcommission.nic.in/reports/genrep/Inter_Exp.pdf, accessed on June 20, 2011.
4. "The ENVIS CENTRE at Development Alternatives," Development Alternatives Information Network, see at http://www.dainet.org/envis.htm, accessed on January 8, 2012.

setups such as for the Nationally Appropriate Mitigation Action (NAMA) documents that are submitted to the United Nations Framework Convention on Climate Change (UNFCCC). The entity has always worked towards rural habitat policies and promotion of green jobs in a great manner. These organisations, therefore, have been influencing the energy policies of the country, particularly in terms of diversification of the energy mix and enhancing the share of alternative sources of energy.

Impact of the Environmental Non-Governmental Organisations at the International Environmental Negotiations

The role of the ENGOs has expanded to the arena of international environmental institutions. Earlier, NGOs were given limited access to international negotiations on environment and they were seldom acknowledged in the multilateral environmental treaties. The criteria for inclusion of the NGOs was very rigid as the ENGOs were expected to be qualified in a particular field such as protection of ozone layer or fields related to hazardous wastes. The emergence of a revitalised global civil society is largely being attributed to the robust NGO activity. Therefore, there is an existing view that the General Assembly of the UN must be revamped in order to include the corporations and people and their associations besides the governments. The States have had an upper hand in State-ENGO relations despite the fact that the NGOs have also been successful in enhancing their visibility and power through their specialised and useful resources. States have eclipsed the role of the ENGOs at all the negotiations by being highly 'realistic' in their approach in comparison to the highly 'idealistic' approach of the latter. Since the State is the highest decision-making authority in the world, its position on all issues related to environment has prevailed over that of the ENGOs. In the UNFCCC process the prominent NGO constituencies include: BINGO (Business and Industry NGOs), ENGO (Environmental NGOs), TUNGO (Trade Union NGOs), IPO (Indigenous People's Organisations), LGMA (Local Government and Municipal Authorities), RINGO (Research-oriented and Independent Organisations), YUNGO

(Youth NGOs), Faith (Faith-based NGOs) and Gender (Gender-based NGOs).[5]

The role of the ENGOs at the international environmental negotiations took shape at the first Climate Change summit, commonly referred to as the Rio Summit in 1992.

The role of the ENGOs at the international environmental negotiations took shape at the first Climate Change summit, commonly referred to as the Rio Summit in 1992. They deserve to be acknowledged for their efforts to bring to the attention of the world community, the impending disaster that was awaiting them and to compel the world leaders to devise concrete measures in this regard. In her article, "Rio Diary: A Fortnight at the Earth Summit," Fiona Godlee reports, "Their (campaigners from Greenpeace and three other NGOs) 10 point plan to save the summit from failure included the things they felt had been left off the agenda: legally binding targets and time-tables for reducing greenhouse gas emissions, a reduction in consumption by the North, global economic reform to improve the terms of trade for the South, more financial commitment from the North and an end to the World Bank's control of the Global Environment Fund, a ban on the export of hazardous waste, recognition of the rights of indigenous people, and an end to nuclear weapons and nuclear power."[6] At the end of the Earth Summit, the parties came up with a treaty that was legally non-binding that set no mandatory limits and contained no enforcement mechanisms, quite contrary to the pleas of the ENGOs.

In order to gauge the degree of influence of the ENGOs on international environmental organisations, Elisabeth Corell and Michele M. Betsill outlined seven parametres in one of their essays. They are: "(1) being present at the negotiations; (2) providing written information supporting a particular position (such as newsletters, research reports or papers, or information leaflets) to relevant government ministries or to the negotiation

5. See for more information, "**ICC and the Business and Industry Coordination process at UNFCCC,"** at http://www.iccwbo.org/policy/environment/unfccc/cop15/id33610/index.html, accessed on January 14, 2011.
6. Fiona Godlee, "Rio Diary: A Fortnight At The Earth Summit," *British Medical Journal* (Britain: July 11, 1992), v. 305, n. 6845, p. 103, see at http://www.jstor.org/stable/29716265, accessed on January 4, 2012.

sessions; (3) providing verbal information supporting a particular position (through statements, information meetings or seminars during negotiation sessions); (4) providing specific advice to government delegations through direct interaction; (5) opportunity to define the environmental issue under negotiation; (6) opportunity to shape the negotiating agenda; and (7) ability to ensure that certain text supporting a particular position is incorporated in the Convention."[7]

The role of the ENGOs in the signing of the Kyoto Protocol has been investigated by many analysts. The influence of the ENGOs in this case was highly contingent on the intangible nature of the issue, the delineation of highly technical solutions, the politically and scientifically driven history of the issue, the framing of the issue based on economics and so on. The political opportunity for the ENGOs at the Kyoto Summit was highly restrictive. Interestingly, the summit was dominated by the ENGOs from the North (developed world) despite the presence of a significant number of ENGOs from the South (developing and under developed world). The four major objectives of the ENGOs during the Kyoto Protocol negotiations were: "the Protocol should (1) require industrialised countries to reduce their GHG emissions 20 per cent below 1990 levels by 2005; (2) include strong review and compliance mechanisms; (3) not allow industrialised parties to meet their commitments through emissions trading; and (4) not allow parties to get credit for emissions absorbed by sinks." None of these recommendations were included in the Protocol. The commitments made by industrialised nations were least stringent, especially since state delegations doubted the feasibility of a 20 per cent reduction target. There was no scope whatsoever for any compliance or review mechanisms. Article 17 and Article 3 of the Kyoto Protocol quashed the last two objectives of the ENGOs by permitting the States to do emissions trading and to get credit for emissions absorbed by sinks respectively. From this example, it is evident that though the ENGOs

7. Elisabeth Corell and Michele M. Betsill, "A Comparative Look at NGO Influence in International Environmental Negotiations: Desertification and Climate Change," *Global Environmental Politics* (Massachusetts Institute of Technology: November 2001), v. 1, n. 4, p. 90, see at http://www.colostate.edu/dept/PoliSci/fac/mb/Comparative%20Look.pdf, accessed on December 15, 2011.

undertook numerous activities throughout the Summit under the umbrella of the Climate Action Network, they could hardly make any impact on the final outcome. It is said that, though the ENGOs did not have direct access to the plenary or closed-door sessions, their representatives were in constant touch with selected delegates who sought their opinion on various issues, thus giving them the opportunity to participate in the debates indirectly. In terms of resources, they had superior technical knowledge compared to the other participants including government delegates. Another privilege that the ENGOs enjoyed during the negotiations was the backing of the public. The biggest achievement of the ENGOs was their success in shaping the debate over emissions trading by coining the term "hot air" (referring to the ability of a country whose emissions are already below its legally binding limit to trade the difference). The insertion of sinks into the Kyoto Protocol was also debated extensively due to apprehensions raised by the ENGOs.[8]

Another example of the role of the ENGOs and the civil society at the international environmental organisations is the Klimaforum or People's Climate Summit held at both Copenhagen and Cancun in 2009 and 2010 respectively. At both the summits, nearly 50,000 members of the civil society called for 'System Change, and not Climate Change.' At Klimaforum 09 held on the sidelines of the Copenhagen Summit, nearly 202 debates, 70 exhibitions, 43 films, 16 concerts and 11 plays from all over the world were organised. Klimaforum 10 was again a grassroots initiative from Mexico during the UNFCCC conference in Cancun, which gave a fruitful platform for the people, grassroots movements and the NGOs to voice their opinion over climate change issues and add to the seriousness of the discussion at the official forum. Both the summits came up with 'A People's Declaration from Kilmaforum 09' and 'A People's Declaration from Klimaforum 10' that were submitted to the Conference of Parties. However, the states deemed their demands too far-fetched at that stage and therefore, disregarded most of them. Some of them included "phasing out fossil fuel, reparations and compensation for climate debt and crimes, an immediate global ban on deforestation of primary forests, opposition to purely market-oriented

8. Ibid., p. 97.

and technology-centred solutions, equitable tax on carbon emissions" etc.[9] Personalities such as Vandana Shiva, founder of Navdanya, Nnimmo Bassey, chair of Friends of the Earth International, and author Naomi Klein were the chief architects of these initiatives. There is discrimination between the different non-state actors as well. At Copenhagen, it is alleged that the business-related nuclear and coal groups as well as the RINGOs (to some extent) dominated the discourse while the ENGOs and other independent organizations were absent from the scene as they were completely sidelined.[10] At the end of the day, business interests involved in the global carbon market matter more than anything else associated with the environmental concerns.

PASSING THE BUCK AND STOPPING IT

Governance and Accountability of the Environmental Non-Governmental Organizations

The governance and accountability of the ENGOs came into the spotlight in the 1990s. This development was a direct consequence of their role in the creation of a global civic society that tries to influence the practices and policies of international institutions. It was also due to the supposed "roll back of the state" that has divided not only the implementation of policies but also the accountability. The ENGOs can only lead a successful campaign if they remain accountable as their primary task is to ensure accountability and transparency in other social and political sectors. Some critics say that the growing engagement between the ENGOs and major corporations has eroded the legitimacy of the ENGOs. Another section believes that this engagement would usher in more professionalism, good governance and accountability into the ENGOs. IT revolution in the form of electronic communication and shrinking of distances between the donors

9. System change – not climate change: A People's Declaration from Klimaforum09, December 2009, see for more information, at http://old.klimaforum09.org/IMG/pdf/A_People_s_Declaration_from_Klimaforum09_-_ultimate_version.pdf, accessed on December 14, 2011.
10. "Copenhagen climate change conference: John Vidal goes behind the scenes," *the guardian* (December 8, 2009), see at http://www.guardian.co.uk/environment/video/2009/dec/08/copenhagen-climate-change, accessed on January 7, 2012.

and the ENGOs have also been exerting considerable amount of pressure on the ENGOs to be more accountable. It is also important to note that with increasing environmental consciousness and social pressures, the corporate sector has woken up to the realities of Corporate Responsibility for Environment Protection (CREP), which borrows principles from Corporate Social Responsibility. This in turn drives them into participating more actively in the environmental activities of the ENGOs especially in the form of private funds that largely remain unaccounted for. Besides, some of them have opened their own environment offices to enhance their image as an environmentally responsible entity. As a case in point, the JSW-Times of India Earth Care Awards for excellence in climate change mitigation and adaptation is being seen by some with high amount of scepticism due to the amount of pollution created by the JSW companies. Even corporations are now in the public diplomacy mode as this helps them sell their products. Accountability within the ENGOs has come under the scanner for yet another reason – recruitment of managers and bureaucrats – whose view may not be compatible with the traditionalist view of environmentalism. Environmentalism tends to overtake profit and sovereignty while managers and bureaucrats are products of these constructs respectively. In 2003, Washington Post sent shockwaves by publishing high-profile accounting scandals in one of the biggest ENGOs in the world- The Nature Conservancy. Its finances, management and even scientific practices were found to be fraudulent.[11] This was a major setback for the environmental movement.

Greenpeace was accused of manipulating details and making inaccurate claims in the case of the Brent Spar's drilling rig disposal. The Greenpeace activists occupied the platform to prevent sinking of Brent Spar at the North Feni Ridge on the basis of the allegation that it contained 5,550 tonnes of crude oil; later on these claims were rejected by an investigation commissioned by Shell UK and Greenpeace was forced to apologise.[12] The whole episode

11. David B. Ottaway and Joe Stephens, "Inside the Nature Conservancy - Washington Post Expose," *Washington Post* (May 4, 2003), see at http://lists.envirolink.org/pipermail/ar-news/2003-May/000054.html, accessed on January 4, 2012.
12. See for more information, "Brent Spar Greenpeace Vs Shell," http://wn.com/Brent_Spar_Greenpeace_vs_Shell, accessed on January 7, 2012.

Most of the NGOs start gaining prominence due to two reasons – lack of governance or that of transparency on the part of the establishment.

tarnished the image of not only Greenpeace but also the entire environmental movement to a great extent. In addition, Greenpeace has very often been accused of being an elitist, hierarchical and undemocratic organisation that hardly gives any organisation rights to local groups and individual supporters. In fact, a former Greenpeace activist, Paul Watson complained that "Greenpeace has turned begging into a major corporate adventure."[13] Also, the ENGOs are clearly seeking the leadership of Information Communication and Technology (ICT) sector to generate IT innovations. Greenpeace believes that the catalysis of an energy revolution, which would help developing countries to activate a swift transition from heavy dependence on non-renewable sources of energy to renewable sources, is possible only with the assistance of the ICT sector, primarily because of their potential to provide large scale solutions required to cut greenhouse gas emissions. Ironically, the ICT sector's carbon footprint is not commendable as it is responsible for approximately 10 per cent of global carbon emissions. One of the Greenpeace studies claims that India is on the way to becoming the second largest carbon emitter after China by 2020, chiefly owing to the expected 12-16 per cent annual growth rate in the ICT sector in the coming years.[14] This has raised several questions with regard to the methods adopted by the ENGOs in terms of devising solutions. Thus, while environmentalists bank on the ICT sector in devising strategies and technologies to create low carbon economies, they have also been forced to look into the growing challenges emanating from this sector.

THE ART OF ENGAGEMENT

It is very clear that most of the NGOs start gaining prominence due to two reasons – lack of governance or that of transparency on the part of the

13. Neil Carter, *The Politics of Environment (Second Edition)* (New York: Cambridge University Press, 2007), p. 151.
14. "Enabling IT innovations," Cool IT, see http://www.greenpeace.org/india/en/What-We-Do/Stop-Climate-Change/Green-Electronics/, accessed on January 5, 2012.

establishment. In a highly bureaucratic country like India, every process is highly time-consuming; this is one of the reasons why the government very often falls short of showcasing its commitment to the public. This gives the NGOs to fill the void and show the loopholes in the government's policies besides recommending other options that may or may not be accepted by the government. A lot of NGOs including ENGOs have come under the scanner due to ambiguity or anonymity associated with the sources of their funds. It cannot be denied that some of them are run on vested interests. When it comes to funding, one needs to throw light on the possibility of rise of conflict of interests. According to a report by Steven Lawrence, in the US between 2000 and 2008, "The number of grants for combating climate change doubled and the dollar commitment from foundations surveyed increased from less than $100 million to more than $900 million…about one in six U S foundation climate change grants focussed on policy initiatives, with the total giving in 2008 to policy efforts in the range of $112.2 million…Oil and gas industries have contributed $834 million over the past 10 years."[15] The Department of Defence itself has been backing research associated with climate security, energy security and national security. Even then, reports suggest that funding on the climate security issue is very limited and needs to increase in future.[16] The ENGOs in India are said to be receiving funds from huge multi-national corporations and transnational corporations; very often these foreign entities could even manage to influence the country's decision-making process indirectly through the ENGOs. This could be treated as a breach on the country's sovereignty and such sort of manoeuvrings may not even be in India's national interest. The government has also been funding projects being run by think tanks and the NGOs. This clearly puts the limelight on the economics of existence which drives these ENGOs towards business proposals from entities other than the government agencies. Due to conflict of interests, the studies conducted by the NGOs could be biased and they may not be in a position to tell the government

15. Planet Heritage Foundation, Inc., "Climate Change and National Security: A field map and analysis of funding opportunities," July 1, 2010, pp. 9-10, see at http://www.sherryconsulting.com/Final%20Climate%20Report.pdf, accessed on January 17, 2012.
16. Ibid ., p. 7.

which policy is in the nation's interest and which is not. The government on its part has been trying to regulate funding by enacting legislations such as the Foreign Contribution Regulation Act (FCRA), 1976 by which any NGO or organisation in India who "want to receive contribution from foreign source must get permission from the Ministry of Home Affairs."[17] On the State's part, regulation of the ENGOs or funding them in order to prevent them from releasing publications against the government may not be considered good strategies in a liberal democracy in the long run. While the other side of the debate would be that, that these efforts have actually proven to be defunct as the foreign funding, as already discussed, is large.

The word ''commitment'' is harped on by individuals and organisations in every sector. It is one thing to 'show' commitment and work towards it; it is a completely different thing to 'showcase' commitment (even while working towards it) and build confidence amongst the larger society. It is a well-established fact that environmental commitment is on top of the agenda of a majority of stakeholders in the contemporary society. Corporate organisations seem to be ahead of the government agencies in their initiatives to prevent environmental degradation. The Conservation Reserve Enhancement Programme (CREP) has ensured that the same companies, which were shown in a negative light due to their profit oriented practices, indulge in social service that could transform their image. The situation is rather desperate for they understand the adverse impact potential of being seen in a negative light on the environment front when the common man and policy makers alike are concerned of looming global warming. Ironically, every department in and affiliated to the government has also been doing its bit to advance environment protection, but without a stated policy like the CREP. The only difference between the two is that the former has successfully trumpeted their achievements as an image-building exercise so that their business does not suffer while the latter are yet to publicise their work in the public domain in a comprehensive manner, due to a perceived lack of need. The Central government has launched the

17. See for more information at http://www.ashanet.org/munich/fcra.html, accessed on January 17, 2012.

National Action Plan on Climate Change (NAPCC); in the similar vein even most of the state governments have embarked on this path by launching State Climate Change Action Plans (CAP). Since the launch, the government has not created one forum or website that could showcase the NAPCC's progress. Instead, different agencies and ministries have been highlighting different events or developments on their respective websites; this makes it all the more difficult for the public to keep track of a landmark Action Plan in the history of India. The State Action Plans have been taken seriously by few states only. Besides, the state governments' public relations exercises have been restricted to just releasing the official version of the document. In fact, the information displayed on the states' official websites does not cater to the needs of governance. Gujarat is again an exception in this case with fairly well-documented websites, but the coordination between different agencies is still lacking. At a juncture when media attraction is relatively easier to obtain, the Indian establishment should be exploiting these readily available resources to garner support for their initiatives and create goodwill.

As a well-reasoned strategy, the government departments in the Western countries have used and continue to use their associations with think tanks to hold consultations on pertinent issues related to environment as well as release them for the public to take note of. This custom is absent in India as the association between our handful of think tanks and the establishment is limited to small-scale consultations that are rarely highlighted. These are indications of lack of will to initiate diplomatic missions on the part of the Indian authorities handling environmental matters. The youth in India is largely ignorant of strategic issues that are pertinent to national security of which environmental security is an integral part. There is a dire need to involve them through the aegis of these think tanks so that these future leaders have a serious appreciation of the issues related to the country's security when they rise to be the policy makers of tomorrow.[18] For example, the West defence think tanks (consisting of military personnel mostly) first

18. Manoj Kumar and Dhanasree Jayaram, "Diplomacy and Military: Talk the Walk," *Defence and Diplomacy* (Centre for Air Power Studies, New Delhi: October, 2011), vol 1, no 1, pp. 54-56.

recognized the need for putting more 'energy' into environmental security related research. This process can only start if the government accepts the role of defence think tanks and consults them for policy formulations. Centre for Air Power Studies is the only defence think tank in India that has a serving military officer working in this area. In India, the engagement between the MoEF and the various think tanks/NGOs is acknowledgeable. India's international stand on environmental issues is shaped greatly by these organisations. Even in the case of the MoEF, many claim that it is with Jairam Ramesh's induction that the role of the think tanks/NGOs got augmented.[19] Therefore, there is no reason that the process cannot be emulated by all the other ministries that also deal with environmental issues. The MoEF itself has restricted its engagement with only a few ENGOs and the ones with which it engages may be influenced by foreign entities. This is the real danger to guard against by the policy makers of any developing country.

Strategy of Environment

It is adequately clear that by the 21st century, the entire focus of attention has shifted to climate change and its security implications in the West. In the US, there are many NGOs that conduct research in this area; some of them include the American Security Project (whose projects include Environmental Security's Climate Change and Military Project), Bipartisan Policy Centre also known as the National Commission on Energy Policy (with three main areas of study: workforce preparedness for future energy jobs, regional climate change impacts and adaptation planning, and climate policy impacts on energy-intensive manufacturing), the Brookings Institution (focussing on energy security, economics and environment), the Centre for Naval Analysis (CAN) Corporation (that runs a project on National Security and Climate Change), Centre for New American Security (CNAS, that has a project on Energy Security and Climate Change), Centre for Strategic and International Studies (CSIS) (whose Energy and Climate Change programme

19. Interaction with Dr. Lavanya Rajamani, Professor, Centre for Policy Research (CPR), at CPR (New Delhi), on July 11, 2011.

also includes the Asian Regionalism Initiative, which explores the ways in which the Asia-Pacific can work together to address the challenges of energy insecurity, climate change, and humanitarian crises), Council on Foreign Relations (that released a report in 2007 – "Climate Change and National Security: An Agenda for Action"), and National Security Network, to name just a few. When it comes to the other Western countries, some of the prominent ones comprise Adelphi Research (that has undertaken more than 50 projects in the EU, the US and developing and transition countries on international environmental policy, European environmental policy and policy integration, climate change and institutional aspects of environment, conflict and cooperation), Advisory Council on Global Change (WBGU, that was created by the German federal government), Chatham House (a London-based organisation that has one of its research areas as the Energy, Environment and Development Programme), E3G (otherwise known as Third Generation Environmentalism which is an independent, non-profit European organisation), The Institute for Environmental Security (IES) (whose programmes include Climate Change and International Security, Climate Change and the Military, Environmental Security for Poverty Alleviation, the FUEL project to integrate energy needs in humanitarian crisis situations, Greening European Society, Global Policy Coherence, the Hague Environmental Law Facility, the Inventory of Environment and Security Policies and Practices, and the Pathfinder Programme to restrict the import of illegally extracted resources from conflict zones), Royal United Services Institute (RUSI, that is engaged in cutting edge defence and security research), and so on.[20] Out of these, a majority are funded heavily by the government as well as private agencies alike. The involvement of policy-makers in these bodies is also well-known. For example, take the case of the CNAS, a research institution where Sharon Burke was the Vice President for National Security and she concentrated on national security implications of global natural resources challenges and climate change; in 2009, she was nominated by President Barack Obama to the post of Director of Operational Energy Plans and Programmes (OEPP) at the Department

20. n. 15, pp. 14-27.

It is important to note that all these NGOs/think tanks/research institutes are not dedicated to environmental research.

of Defence.[21] This is the kind of coordination that is required in India between the government and the research institutes/think tanks. Another example would be the Bipartisan Policy Centre which was established in 2007 by former senate majority Leaders Howard Baker, Tom Dasche, Bob Dole and George Mitchell.[22] This is another form of coordination between the decision-making bodies and the research and development agencies, wherein the current or former policy-makers themselves take the plunge into research activities to generate policy proposals for the establishment. Apart from these, the CNA Corporation is a federally funded research organization that operates the Centre for Naval Analyses and the Institute for Public Research.[23] This is a classic example of how the government itself takes complete control of a research entity in order to carry out bipartisan study on issues of national security. In India, the main challenge in terms of engaging with the NGOs and ENGOs is not the lack of resources but political will, rather "bureaucratic will''.

It is important to note that all these NGOs/think tanks/research institutes are not dedicated to environmental research. In a highly-interconnected world, in which every issue is connected to every other issue, it is totally ludicrous to have such organizations with single focus. Take the case of RAND Corporation that was established with the mission of connecting military planning with research and development decisions in the US. Its core research areas now include: Children and Families, Law and Business, Education and the Arts, National Security, Energy and Environment, Population and Aging, Health and Health Care, Public Safety, Infrastructure and Transportation, Science and Technology, International Affairs and Terrorism and Homeland Security.[24] In India, organizations

21. n. 15, p. 17.
22. n. 15, p. 15.
23. n. 15, p. 16.
240 For more information, see at http://www.rand.org/research_areas.html, accessed on January 17, 2012.

such as TERI and DA are wholly devoted to environment-related research. The defence think tanks deal mostly with the traditional national security threats. There are a few think tanks that have been carrying out multi-faceted research including environmental security such as Institute for Defence Studies and Analyses, Centre for Air Power Studies, Centre for Policy Research etc. However, neither the quantum of research nor the amount of human resources doing research on environment is adequate besides the fact that the government hardly pays heed to the work being done in these organisations. This is the reason why the fresh researchers are completely dependent on Western literature on this subject which makes their understanding of it highly skewed and biased. The need of the hour is to form the Indian perspective on the subject and formulate policies that would be in India's interest. The fact of the matter is that the environment cannot be segregated as it is clearly part of every nation state's strategy. The West has realised this and is using its organisations even to influence policy-making in other countries by accomplishing rigorous environmental diplomacy. In fact, since most of these organisations are non-profit and independent, it is easier for them to build a global network by which they could interact with their counterparts in developing countries where this culture is absent or negligible. These networks could easily come in handy at the negotiations too with the Track II diplomacy shaping Track I diplomacy. With their presence cutting across political boundaries, they could even become ambassadors of their respective countries, thus projecting a favourable image of their countries.

India is far from achieving the Western standards. India is yet to recognise how environment can be a part of its strategy at the regional and international levels. The West started by treating the NGOs as part of a "collective bargaining" formula; now they have progressed to a stage in which environmental issues are being exploited by them to influence decision-making all over the world. However, in India's case if the right decisions are made at the right time, the situation could change. India should follow the Western model which advocates the use of think tanks to carry out environment-related research as well as an extension of its foreign

policy. Just as there is a need for coordination among various agencies, there is also a need for having more think tanks with wider agendas and not restricted to one or two issues. The dividing line between the ENGOs and the NGOs has to be erased so that the research conducted in this area is much more comprehensive, strategic and could be used to enhance India's influence elsewhere in the world. The divide between the think tanks and the government also has to be bridged. India has to identify its target countries to establish its Track II diplomatic efforts in the field of environment. The various ministries dealing with the environment have to converge besides the think tanks which are a potent knowledge base.

Culture: Progressive or Regressive? A Challenge

The reason for diplomatic failures on the part of the government, in terms of engaging with the public, cannot be lack of resources or expertise alone as it does not require high-end technology. The answer is simple: culture. It is more important to realise that the need of the hour is not only to occupy the moral high-ground but to go one step ahead after the constructive results are achieved - to throw light on them. Culture has to be dynamic and progressive; disregard of diplomacy of any sort can only harm the cultural ethos of a country. In the similar vein, the government will end up harming themselves by neglecting environmental diplomacy. This is one subject that has the potential to immediately attract public attention as they are able to relate to the subject due to an information blitzkrieg on the subject already unleashed by the media – both, print and electronic.

The benefits of environmental diplomacy are numerous. It has to be kept in mind that diplomatic initiatives serve the interests of the government, the ENGOs as well as the general public. First, if the government takes interest in launching such initiatives, they will reflect the efficient functioning of the government which would supplement its public diplomacy strategy besides enhancing credibility and integrity. Second, the emergent image of the government as a cohesive unit is expected to give confidence to the people about the nation's progress. The all-important "connect" between the organs of the government and the people could help the former firmly

hold the reins of power. Third, it would motivate the people to take up responsibility to work on environmental issues. Environment is such an all-encompassing subject that the coordination between the different government agencies as well as between them and the ENGOs is crucial. Similarly, implementation of the government policies at the grassroots level would be facilitated by healthier public participation. It is a time-tested fact that any policy of the government, when implemented, can reap benefits in a sustained manner only if the public is kept attuned of these policies as well as involved in a full-fledged manner; this would ensure that the "fruits" of the policy could be "consumed" in future too irrespective of the various uncertainties associated with the establishment.[25] This would also guarantee that instead of creating friction between the government and the ENGOs, bridges would be built that would be used by the public for communication.

The impact of the ENGOs on environmental policy formulation is minimal, especially in a developing country like India.

THE MEETING POINT OF DIFFERENT STRANDS OF THOUGHT

It is very clear that the role of environmentalism has been immense since time immemorial. The traditionalists would argue that their role has largely been restricted to creating awareness (both positive and negative) among the masses and putting pressure on the government from time to time; and that the systemic change that the ENGOs have been demanding for years has not been realised despite the impending environmental catastrophe. Thus, on the one hand, environmentalism has indeed played a significant role in propelling critical environmental issues such as global warming and climate change. On the other, the impact of the ENGOs on environmental policy formulation is minimal, especially in a developing country like India. Others would emphasise on the point that the government has been actively involving the ENGOs in policy implementation due to reasons ranging from lack of resources and expertise to a conscious effort to increase public

25. n. 18, pp. 56-58.

participation in nation-building. The other reason why the government would like to join hands with them is to ward off criticism and protect the vote-bank. An inefficient government may be susceptible to the looming influence of the ENGOs.

The evolution of environmentalism and the emergence of various environmental organisations have led to multi-layered governance. This has been possible despite the stronghold of the state because of the indivisible nature of environment and the pervasive plus destructive nature of environmental problems. One cannot deny the fact that the ENGOs have turned into political actors, either attempting to represent the citizens who are marginalised by the state system or influencing policy formulation in public interest. The strategies used by the ENGOs have been dynamic. From distribution of pamphlets and production of literature before the advent of information revolution, to the use of technologies by the current generation environmentalists, environmentalism has come a long way.

The question of who represents who has been partially resolved by the states by opening the doors of governance to actors, that is ENGOs, who have the resources to manage local communities as well as local environment. However, a few sacred doors are yet to be opened that could mainstream environmentalism in national policy formulation that has not taken off in many countries and is progressing at a very slow pace in others. The monopoly of the states over climate change policy is stringent to such an extent that not a single international agreement has been successful since the beginning of the negotiations. The possibility of governance (environmental governance) without a government is thus next to impossible. There are instances where the governments have clearly diffused some of its responsibilities to the NGOs, empowering them to a certain extent. On the other hand, some of the NGOs have been integrated with the formal system that essentially erases the line dividing the state and the larger civil society as well as negates the independent character of these NGOs. At the end of the day, one could also suggest that some of the NGOs that begin by representing the citizens end up representing the states in order to be heard.

Diffusion of governance is best exemplified by the so-called partnerships between governments and the NGOs. Very often national governments and international financial institutions (IFIs) such as the Global Environment Facility direct money to local environmental projects via NGOs. Policy-makers could take the assistance of the NGOs in effectively implementing environmental policies if they feel that the NGOs are more equipped and experienced in dealing with the local communities. International donors sometimes prefer NGOs to governmental organisations as the latter might not have adequate infrastructure and resources to implement the projects besides the fact that in a country like India, the will to entertain such projects is also low-key. However, policy-makers have also been accused of using the ENGOs to sell their policies to local communities which they would not be able to do themselves or through governmental organisations as the NGOs are believed to have closer ties with the local communities. The ENGOs have also been charged with accusations of being agents of capitalism as they thrive on the principles of liberalism based on free market economy. This accusation cannot be legitimised against an ENGO; it is more appropriate in the case of a developmental NGO. However, a few ENGOs such as the World Wildlife Fund (WWF) would be more in the line of fire as they work in tandem with the governments and the IFIs, while certain others such as the FoE have openly declared their resistance to a neoliberal economic world order.

In global environmental governance, the need for the States to acknowledge and empower the ENGOs is expected to gain salience in the years to come. With the free flow of information and close scrutiny of government policies at every stage, the ENGOs would be in a better position to challenge the States' authority. For this, the legitimacy of the ENGOs itself has to remain intact. One can conclude that the urgency for increased collaboration between the scientists, policy-makers, ENGOs and the civil society could pave the way for a number of positive outcomes – mitigation of the effects of environmental change both at the global and the domestic levels.

Finally, the economics and strategy of environment is equally as important as any other issue. The ENGOs in India are short on resources and thinking. The government has also contributed to the parochialism that pervades research institutes (both governmental and nongovernmental) in the country by not giving them enough voice that is heard in the corridors of power, resources and space to function independently. In the West, the efforts of these organisations are completely backed by the government. There need not be any distinction between the NGOs and ENGOs. The Indian NGOs and think tanks should now look forward to using environment as a strategy in regions such as South Asia, Southeast Asia, Africa and Latin America. International relations are all about give-and-take in the twenty-first century; the world is no longer uni-polar. Therefore, unless India takes proactive steps to engage at different levels with the countries in the above-mentioned regions it can never be a great power.

CHINESE ACUPUNCTURE IN AN IAF-PAF FACE-OFF

VIKRAM MUNSHI

TRIO TRIBULATIONS

While war with China and simultaneous armed engagement with Pakistan was on the anvil in 1965 and 1971, various factors contributed to its absence. Chief among them was pressure by both USA and USSR in 1965 to keep China out of the fighting[1] and the time of war in the winter of 1971 which ensured that the People's Liberation Army (PLA) could not, even if it wanted to, fight across snow blocked mountain passes. As China grows in future as a world power, it might find it even more difficult to explain a conflict with India on the border issue. The intervening period is crucial especially if India's economic emergence is seen as a challenge to Chinese economic prominence.

The Chinese and Pakistani nexus against India started when Mao offered Ayub Khan nuclear weapons to neutralise India in the 1965 war.[2] Currently, China is one of the major arms suppliers to Pakistan in military hardware including aircraft and missiles.[3] China has used Pakistan to counter a rising Indian military threat by supporting it militarily and aiding its nuclear

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1. RD Pradhan, *Debacle to Revival: YB Chavan as Defence Minister, 1962-65*, (New Delhi: Orient Longman Limited, 1998), p. 89.
2. Interview with Air Cmde Jasjit Singh, February 14, 2012.
3. At http://www.cfr.org/china/china-pakistan-relations/p10070, accessed on April 26, 2012.

The current Indian Air Force (IAF)-Pakistan Air Force (PAF) force ratio appears adequate to prevail over any Pakistani air offensive but will reduce in the near future.

weapons programme.[4] From Mao's famous statement of "Teaching India a Lesson" in 1962 to presently aiding a Pakistani build up, the Chinese modus is quite clear; strategic encirclement of India by militarily supporting Pakistan.

In the past, military conflicts with Pakistan have clearly established the might of the Indian armed forces when engaged with a single adversary. However, splitting the Indian defence by threatening a two front offensive, widening the frontage would scatter given forces and thus result in smaller concentration of force than desired, thus giving rise to ineffective Indian defence. Any potent adversary would choose and concentrate his force in an area of critical Indian vulnerability to breach the resultant weaker defences and achieve its limited objectives in a local border war. Going by the Chinese strategy of achieving complete surprise, it is probable to see war commencing from an unexpected geographical or even political, economic or financial realm. China has kept the resolution of its border issues with India as a goal for future generations, keeping alive a possible volatile reason for conflict.[5] A possible "Teaching India another Lesson", only this time for trying to match-up China's emergence as a world power.

The current Indian Air Force (IAF)-Pakistan Air Force (PAF) force ratio appears adequate to prevail over any Pakistani air offensive but will reduce in the near future. In the past, the People's Liberation Army Air Force (PLAAF) had inadequate airfield infrastructure in the Tibetan Autonomous Region (TAR) and obsolete, though numerous aircraft. That is set to change as the PLAAF modernises to win a high tech local war under informationised conditions. The pace and the extent of modernisation is aimed at achieving a force structure that will ensure superiority over an adversary who is technologically better in a local border war as China extends its influence into mainland Asia. Chinese writings point to the fact that they would not

4. Ibid.
5. At http://www.rcss.org/publication/policy_paper/Policy47.pdf, accessed on April 26, 2012.

fight a major power in the near future which effectively rules out the US[6] (supporting Taiwan) and Russia which has no serious issues with China.[7] India with its long pending border resolution with China and increasing economic prowess might force China to act belligerently in the near future. The rapid modernisation of the PLAAF and the belief that air forces would lead in future confrontation point to its major role. In Chengdu and Lanzhou Military Region Air Force (MRAFs), the PLAAF assets equal 15 divisions or 80% of the present IAF force structure.[8] A realistic assessment during actual war of augmented deployment would be at least more than half of the PLAAF strength of fourth generation aircraft in these two MRAFs. Considering the total IAF strength of 34 combat sqns[9] and a major number of those deployed against the PAF, India could spare a small number against a Chinese contingency. Despite the largely third generation or more composition of such a force, the numbers would be woefully inadequate and relative capability marginal if war breaks out in 2012. Thus, the Chinese acupuncture has the ability to tilt the balance in favour of India's adversaries in a future two front confrontation; which is indeed a game changer. The combined effect of Air Launched Cruise Missiles (ALCM), a conventionally armed low CEP ballistic missiles and long range bombers apart from airborne troops by the PLAAF, none currently matched by the IAF would further skew the capability and numerical deficit in favour of the Chinese or the PAF.

The PLAAF has traditionally outnumbered the IAF in its aircraft inventory but in the past, a majority of its aircraft have been obsolete second generation fighters like F-5, F-6, Tu-2, Tu-4 and some F-7s, making the threat manageable from the Indian perspective.[10] This balance of air power between the PLAAF and the IAF persisted until 1994 or so when on

6. Roger Cliff, John Fei, Jeff Hagen, Elizabeth Hague, Eric Higginbotham, John Stillion, *Shaking the Heavens and Splitting the Earth*, (Santa Monica: RAND Corporation, 2011), p. 34.
7. At http://www.eastasiaforum.org/2009/09/03/renewed-tension-on-the-india-china-border-whos-to-blame/ accessed on April 26, 2012.
8. *International Institute of Strategic Studies*, The Military Balance 2012, (London: Oxford University Press, 2012), pp. 234-236. 15 Regt=26-27 sqn of the 32 sqn IAF; 26/32=.83
9. At http://indiatoday.intoday.in/story/the-incredible-shrinking-air-force/1/119731.html, accessed on April 26, 2012. CAG report 2011-12, p. 104.
10. Appendix 3.

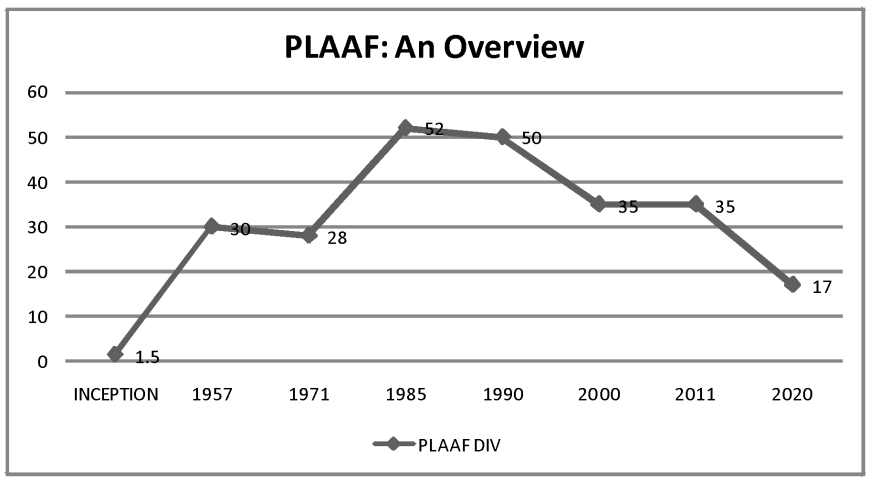
account of concerted modernisation; the largely obsolescent PLAAF combat inventory was replaced by modern capable platforms. Accordingly, the PLAAF inventory has shrunk dramatically from over 5,000 combat aircraft during the 1980s to less than half the figure with an increasing component of advanced combat aircraft like the Su-27/30, J-10, F-7MGs, JH-7/ FBC-1 and J-8II Cs.[11] The thrust towards capability replacing numbers has been clear as new technology machines replace older ones and the PLAAF transforms from territorial defence to a purely offensive future capability.[12] The induction of new multirole aircraft and the tilt away from dedicated ground attack or air defence aircraft is indicative of the thrust from numbers to capability. The proportion of advanced combat platforms in the PLAAF will keep increasing through 2015 and beyond, in addition a small complement of fifth generation J-20 fighters are also likely to join the PLAAF by 2020.[13] The end of this decade would be defining for the PLAAF as it is likely to again transform from a largely fourth generation to an emerging fifth generation capable force which is when the combination of enhanced capability and numbers would make the PLAAF a force to reckon with.

ORIGIN OF THE PLAAF

The PLAAF was formed on October 1, 1949 with a collection of 159 mixed vintage aircraft and 202 pilots.[14] This meant over six Regiments in one and a half divisions or the IAF equivalent of nine sqns to defend mainland China which area wise equals thrice the size of India. The next ten years saw PLAAF grow twenty times to around 3000 combat aircraft[15] in over a hundred Regiments due to active Soviet support under the Valentine's Day Treaty of February 14, 1950. The souring of relations between China and the USSR led to the scrapping of the treaty by 1960 and a quest for self reliance in aircraft production. Though China tried to overcome this crisis by reverse engineering and locally manufacturing MiG-15/ 17 and MiG-

11. Appendix 3.
12. n. 6, p. 33.
13. n. 8, p. 212.
14. Air Cmde RV Phadke, *People's Liberation Army Air Force (PLAAF): Shifting Air power Balance and Challenges to India's Security*, (Stanford: CISAC Stanford University, 2002), p. 3.
15. Ibid.

19s but eventually the force levels dropped slightly to 2800 aircraft in over 28 divisions as China tried to facilitate aircraft production, operations and maintenance without Soviet support.



Sources: *Military Balance 1955-2012, Air Cmde RV Phadke, People's Liberation Army Air Force(PLAAF): Shifting Air power Balance and Challenges to India's Security, SIPRI 2011, Shaking the Heavens and Splitting the Earth, (Santa Monica: RAND Corporation, Ten Pillars of the PLAAF: An Assessment. Appendix 3).*

In 1950, China used air power during the liberation of Tibet and subsequently in the Korean War and Taiwan Straits encounter in the 1950s and 60s. During the Korean War, the US Sabres achieved an outstanding exchange ratio of nearly 14 to 1 in combat with the Soviet-built MiG-15.[16] After the Soviet volte-face, Mao's disastrous Great Leap Forward caused serious problems which were exacerbated by the ten year long Cultural Revolution (CR) (1966-1976) which severely disturbed the PLAAF's new programmes in their quest for self reliance.

Chinese employment of air power has not been spectacular so far as the PLAAF was equipped for and has focused on territorial air defence. Without external assistance, the PLAAF remained largely an air defence oriented 2,500-3,000 combat aircraft air force for two decades after the Soviet's withdrew military help till subsequent refocus on the PLAAF during the

16. At http://www.strategypage.com/militaryforums/6-71391.aspx#startofcomments, accessed on April 26, 2012.

late seventies stepped up indigenous production. By the early eighties the PLAAF was equipped with 5000 aircraft with over four divisions of long range bombers.[17]The second spurt in the PLAAF force structure was in the late seventies when change in political leadership revitalised the aviation sector and indigenous production was stepped up. This period also saw the induction of heavy bombers and MiG-21s into the PLAAF. This phase was preceded by valuable lessons learnt in the war with Vietnam.

It was the re-entry of Russians in 1992-93 with fourth generation aircraft at a time when the PLAAF was seeking high technology platforms which set in motion the current modernisation of combat platforms in the PLAAF. This induction of Sukhois and AL-31F engines for the initial J-10s further accelerated the transition of the PLAAF towards a modern fourth generation air force. As technology improved, so did capability necessitating a reduction in aircraft numbers especially of older fleets like J-5 and J-6. The shift to multirole aircraft like J-10s and Su-30s of foreign and local origin resulted in a leaner, more capable force. By the beginning of this century, the PLAAF had reduced to less than half its combat fleet and inducted platforms, aimed at enhancing multirole capability and transforming PLAAF from one geared for territorial defence to one actively transforming and equipped for long range precision strikes; evolving from a defensive force to a purely offence oriented one. The current force level is a mixture of fourth generation aircraft like the Su-30, J-11 variants, J-10 and earlier generation upgraded platforms like J-8IIIC, H-6K (ALCM carrier) and some JH-7As and J-7s. The latter are likely to be phased out in favour of indigenous modern fighters like the J-10s and Su-30 variants to form a formidable fighting force by 2020 against a qualitatively better equipped adversary. In the current scenario, this could only imply Japan and India.

Probably, learning from the first Gulf War, it was decided to induct modern multirole platforms for a greater offensive role of the PLAAF. The subsequent drop in the late nineties was due to a majority of F-5, F-6 and older versions of the F-7s being phased out and replaced by fourth generation aircraft as the PLAAF started its quest towards a modern

17. Appendix 3.

fourth generation air force capable of long range precision strikes.[18] The change over from primarily air defence platforms to multirole ones saw better and lesser new aircraft replace numerous and obsolete older generation ones. The drop in the PLAAF force structure became gradual after 2005 when additional Su-30 MKKs were inducted and the J-10 went into mass production.

The Chinese firmly believe that air battlefields have become decisive battlefields and victories in air have become ultimate victories.

FUTURE PLAAF: OFFENSIVE–DEFENSIVE

The Chinese firmly believe that air battlefields have become decisive battlefields and victories in air have become ultimate victories.[19] This thinking has spread after the Chinese studied the Gulf war of 1991, Kosovo war in 1999 and the Afghan war in 2001. It was clear that attainment of war objectives is possible through the sole use of air strikes.[20] The PLAAF must build strategic capabilities to become a top air power nation. In modern local wars, this far exceeds that of nuclear weapons. The Chinese Air Force will turn largely offensive as it matches the great power status of China. Therefore, it becomes necessary to build an offensive air power so as to defend its expanding interests. The Chinese have gradually moved away from the People's war concept of Mao because People's war is defensive and aimed at trading space for time misaligned with the nature of modern war. Mao's concept relied on strategic depth to devour the enemy's military resources whereas the modern concept of striking from the sky defies notions of strategic depth and tilts towards the use of offensive air power to circumvent distances and strike deep. Therefore, even Chinese writers like Liu Yazhou consider air power as the most powerful deterrent of all time and the best tool for enforcing national will. Learning from the US, even they would send aircraft as a reaction to any incident which warrants Chinese intervention. The emphasis is to expand the PLAAF into a modern air force capable of defeating any

18. n. 6, p. 75.
19. Liu Yazhou, "The Centenary of the Air Force," Chinese Law and Government 41, no. 1 (January–February 2008), p. 17.
20. Lt Gen Liu Yazhou, *Building an Offensive and Defensive PLAAF*, p.18.

air force including advanced Asian Air Forces like those of India or Japan. This translates to emphasise on advanced fourth generation fighters and force multipliers. In force structure terms, it would mean greater capable Russian fighters like Su-30MKK, MK2, J-17, advanced western avionics and reluctance to procure less capable indigenous systems. The new PLAAF would be equipped with fourth and higher generation multirole aircraft and upgraded third generation bombers armed with ALCMs. A mixture of high to low technology i.e., imported Russian to domestic aircraft would remain in the PLAAF. In the current scenario it would mean Sukhoi variants (both Russian and Chinese) and the J-10 multirole fighter apart from few regiments of the upgraded J-8IIC multirole fighters.

The PLAAF is currently devoid of a supersonic high speed nuclear and cruise missile platform. Certain reports also point to the likely induction of the supersonic Tu-22/55 strategic Russian bomber to the PLAAF in a tit for tat buy if the IAF leases the same within the next decade but is unlikely as the option of an indigenous bomber (H-6) with ALCMs appeals more to the PLAAF. The PLAAF in future will project power from the mainland into Asia and has decided that accurate long range missiles delivered by air/ land and sea can substitute supersonic strategic bombers.[21] So it is unlikely to induct long range supersonic bombers or any such platform apart from variants of the H-6 bomber. Between aircraft, the PLAAF can opt for FC-1 and JH-7A combination or the Sukhoi and J-10 option. It is likely to choose the latter to equip the entire force in future due to limited manveourability, low performance and fixed roles of the former. The future PLAAF would be significantly smaller and only political decisions to boost export sales of the FC-1 and JH-7A would force the PLAAF in the opposite direction of having a larger but less capable fleet of aircraft. If trends are pointers then the decision to procure Russian tankers and Airborne Early Warning (AEW) aircraft i.e., IL-78 and A-50 show the way towards a smaller yet more capable high technology air force.

Depending on the necessity, China may even restrain near term acquisition of non-stealth aircraft in anticipation of more capable airframes

21. Phillip C Saunders and Erik Quam, Future Force Structure of the Chinese Air Force, *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military*, Edited by Roy Kamphausen, Andrew Scobell (US DoD, Strategic Studies Institute 2007), p. 405.

being available in future. This may lead to higher induction of J-20 and the J-17 (Chinese modified Sukhoi stealth aircraft) in future.

The only deficiency in the PLAAF modernisation is the lack of exposure to advance beyond visual range tactics and modern force packaging elements. However, a large number of senior PAF pilots have been known to impart this training in PLAAF units on J-11 fighters. The PLAAF in the past has not seen spectacular success in the Korean War, Vietnam War or in the confrontation over the Taiwan Straits. This is bound to change as the PLAAF transforms itself to enter the next decade as a modern equipped and trained force.

PLAAF FORCE LEVEL

The detailed force level in 2011 as compared to the projection in 2020 of the PLAAF is as given below:

2011			**2020**	
SNo.	Type	Regt	Type	Regt
1.	Su-30 MKK	3	Su-30 Variants	7.5
2.	J-11B	1	J-11B	3
3.	Su-27	3	Su-27	3
4.	J-11	4	J-11	4
5.	JH-7/ 7A	3	JH-7/ 7A	3
6.	J-10	6	J-10	20
7.	Q-5/5D/5E	5	--	--
8.	H-5/ HJ-5	1		--
8.	H-6 H/E	6	H-6 H/E	4
9.	H-6 M/K	--	H-6 M/K	2
10.	J-7	24	--	--
11.	J-8	11	J-8III/C	4
12.	J-20	--	--	2

Source: Project 2049, Airpower Trends in NE Asia (Oriana Skylar Mastro and Mark Stokes), Military Balance 2011, SIPRI 2011, Annual Report to Congress (Military Security Developments Involving the People's Republic of China 2011), China and India, 2025 (A Comparative Analysis), US – China Military Contacts: Issues for Congress (Shirley A Kan), Analysis - China's Airpower: The Sleeping Giant Awakens (Carlo Kopp), PLA Air Force (Richard D Fisher Jr), Shaking the Heavens and Splitting the Earth: RAND. China's Air Force Modernisation, Phillip Saunders and Erik Quam.

The force projection by the PLAAF in 2020 would comprise 1600[22] combat aircrafts out of which all the fighter fleet would be fourth generation or more. The Sukhoi/ J-11 fleet would increase to 450 aircraft[23] and the largest increment would be in the indigenous J-10 combat assets some variants of which (at least 100) fly with the Full Authority Digital Engine (FADEC) and thrust vectored AL-31FN M1 engines.[24] Undoubtedly, the Q-5 would be phased out as would the J-7. The J-10/ Su-30MK2 would replace these ground attack aircraft. PLAAF operates a number of H-6 series (Tu-16) bombers some of which are being modified and manufactured for enhanced ALCM carriage and range. The modifications extend to avionics upgrade, increased range due additional fuel capacity in the internal bomb bay of 9000kg and provision to carry four ALCMs by the H-6M variant to an engine upgrade with D-30 (IL-76) engines, six ALCMs, glass cockpit for the H-6K series. 25 aircraft of each kind are expected to enter service in the near future with the YJ-10 ALCM which has strike range of 2200 km.[25] The current J-7 strength to be replaced is 24 Regiments and considering the capability jump and quantitative reduction would mean requirement of 18 to 19 J-10 sqns in the PLAAF. It would be logical to replace numerous J-7 units with an appropriate number of indigenously manufactured fourth generation aircraft to keep up the induction rate, cost and dependability of spares. The H-5 could be replaced by H-6 versions as bomber trainers. 100 J-8IIIC would continue in the PLAAF after upgrades to their avionics and Zhuk MS Phazatron radar (of Su-30 lineage). By 2016-17, the Chinese fifth generation stealth aircraft J-20 would have joined the PLAAF. Catering for a rather low production rate of this ultra modern fighter, it is expected that two or three regiments would be available to the PLAAF by 2020 with numbers likely to grow in future. The likelihood of a stealth version of the Su-30 called J-17 joining the PLAAF is highly probable as China modernises its

22. The anticipated 52 Divisions @ 24 to 40 combat aircraft each would amount to 1250 to 2080 aircraft or an average of 1600 aircraft at current manning level of a Regiment.
23. Richard D Fisher, Jr, *PLA Air Force Equipment Trends*, RAND, p. 144.
24. Ibid, Janes All the World's Aircraft 2011-2012, p. 92-96.
25. n. 6, pp. 205-206.

fleet of fourth generation fighters to nearly fifth or 4++ standards using technology developed for the J-20. The J-17 has advanced stealth features like internal weapons bay, S-shaped intakes, canted fins, advanced wave reducing technology in the intakes. Future Chinese versions of the Sukhoi family would be configured with more active stealth features, enhancing the capability of this fourth generation fighter towards higher levels.

Presently, the PLAAF comprises over 67 Regiments and the number of aircraft totals roughly 1600 or at best 2680 aircraft.

Presently, the PLAAF comprises over 67 Regiments and the number of aircraft totals roughly 1600 or at best 2680 aircraft (depending whether a force level of 24 or 40 aircraft are taken per sqn). The median value is around 2100 aircraft[26] and this fleet comprises less than a quarter fourth generation aircraft today. Relating to the IAF structure, a division is made of two to three Regiments or equivalent of four to six IAF sqn whereas a Regiment with 24-40 aircraft has slightly more assets than a fighter wing. Thus, the PLAAF in 26 divisions has the equivalent of 104-153 (136 approx) IAF sqns and in South western China bordering India around 15 Regiments in almost five Divisions[27] (or the equivalent of over 26 IAF sqns are deployed). As per present figures of 26 divisions having 67 Regiments[28], the current regimental strength may be safely assumed at 2.6 Regiments per division.[29] However, the phasing out of old technology aircraft would reduce the total numbers to approximately 52-53 Regiments in 17 divisions comprising between 1250 – 2080 combat aircraft or an average of around 1650 combat aircraft. To aid in quick comparison with IAF force levels, this equals around 92 (or between 69 – 115 sqns) IAF equivalent sqn in 2020.

The PLAAF currently has 42 air defence and 25 offensive Regiments which point to a greater defensive capability, satisfying the traditional

26. In IAF equivalent strength it equals 115 combat sqns.
27. *International Institute of Strategic Studies*, The Military Balance 2011, (London: Oxford University Press, 2011), pp. 234 -236.
28. n. 27, pp. 234-236.
29. 67 Regiment/26 Division=2.6 Regiment per Division.

PLAAF mandate of territorial defence.[30] With focus on enhanced offensive capability in future, high technology multirole aircraft are likely to increase in the PLAAF in place of earlier generation air defence aircraft. The PLAAF would reduce in size like all modern air forces and improve offensive and defensive capability using modern aircraft as a mix of the high and low end of new technology aircraft; much like the USAF did when it optimised using F-15 and F-16 in the past and as it now wants to achieve using F-22 Raptors and F-35 JSFs as a operationally healthy and cost effective mix of high and low end of modern technology without capability trade-offs. The PLAAF is on the path to incorporate advanced Russian fighters like Su-30 variants in the top of the high technology spectrum and J-10s in the low end of the spectrum.

From a purely defensive air force in the 1990s entrusted with territorial defence to the now modernising force capable of offensive and defensive operations, the PLAAF strategy has altered to incorporate a largely offensive element along with territorial defence. The present high technology offensive component comprises modern multirole platforms like Su-30MKK, J-11B and J-10 whereas H-6, Q-5 and the JH-7A form part of the earlier generation offensive platforms. Only the Su-27 and J-11 comprise the modern air defence component, whereas, the J-7 and some versions of the J-8 comprise earlier generation air defence elements. At present, the MRAF deployment of concern to us has fighter aircraft of mixed types.

30. Appendix 1.

CURRENT INDIA SPECIFIC PLAAF DEPLOYMENT

PLAAF Regiments in Neighbouring MRAFs

SNo.	Chengdu MRAF(7 Regt[31])	Regt	Lanzhou (8 Regt)	Regt
1	J-11	1	J-11	1
2	J-10	1	J-8H	1
3	J-7 E/	4	J-7/E/G	4
4	H-5	1	H-6 M/H	2

31. n. 27, p. 234-236. Appendix 2.

Though, it is only Xizang province in Chengdu MRAF which adjoins India and South Western Xinjiang in Lanzhou MRAF which borders India in the N/ NE, the deployment in both MRAF's is considered while in a possible confrontation with India. The current PLAAF deployment in the MRAF's adjoining India i.e., Chengdu and Lanzhou totals 15 Regiments. This gives the weight of the air force available against a standoff with the IAF. It has been assumed here that any threat emanating from the Vietnam sector would be countered by forces in neighbouring Guangzhou MRAF. Therefore, in total without altering existing deployment, the PLAAF can face up India with a minimum of 15 Regiments in almost five divisions or 460 combat aircraft. Incidentally, this is today more than 75% of the size of the IAF.

CURRENTLY DEPLOYED PLAAF OFFENSIVE AND DEFENSIVE CAPABILITY AGAINST THE IAF: 2011

Offensive

2011 (Deployed)			**Augmented for War**	
SNo.	Type	Regt	Type	**Regt**
1.	Su-30 MKK	--	Su-30 Variants	2
2.	J-11B	1	J-11B	2
6.	J-10	1	J-10	4
8.	H-6 H/E/ H-5	3	H-6 H/E	
9.	H-6 M/K		H-6 M/K	3
Total		**5**		**11**

Defensive Capability

2011			**Likely in War**	
SNo.	Type	Regt	**Type**	**Regt**
1.	Su-27/ J-11	1	Su-27/ J-11	2
2.	J-8	1	J-8IIC	2
	J-7	8		
Total		**10**		**4**

Therefore, the deployed assets are mostly defensive in the region against the IAF. The Chinese are doctrinally known to use their best (high technology) assets in an area of conflict. With the emphasis on long range

precision strikes and offensive capability to ensure command of the air at least in the area of operation, the likelihood of an altered deployment by shifting fourth generation air assets to critical areas (against India) from adjoining MRAF's to ensure superiority in capability and numbers over what the IAF would field in its two front contingency. This means that two Su-30 MKK Regiment, three J-10 Regiments and one each J-11B, H-6K and J-8IIC Regiment would be withdrawn from other lesser critical MRAF's in war to counter an Indian contingency by the Chinese. This limited seven Regiment augmentation would be a little above 10% of the PLAAF strength and replaced by eight regiments of older J-7s and H-5 Regiment available in Chengdu and Lanzhou. The PLAAF in the altered deployment is likely to oppose the IAF with 11 offensive and four air defence Regiments.

So while the deployed strength is defensive in nature, the augmented forces likely to be used in war would be majorly offensive. This force of 15 Regiments equals 26 IAF sqns.[32] The Chinese could surge a greater number of regiments if the situation turns critical to 17 Regiments or 30 IAF sqn equivalent.

DEPLOYED PLAAF OFFENSIVE AND DEFENSIVE CAPABILITY AGAINST THE IAF: 2020

The dominance of fourth generation combat aircraft in the PLAAF arsenal deployed against India is clear. The likely scenario after augmentation from various MRAF's is also projected and shows the possible maximum PLAAF strength which may be spared against the IAF in 2020.

2020			**Deployed Likely**	
S No.	Type	Regt	**Type**	**Regt**
1.	Su-30 MKK	2	Su-30 Variants	3
2.	J-11/ J-11B	2	J-11B	3
3.	J-10	6	J-10	7
4.	H-6 M/K	2	H-6 M/K	3
5.		--	J-20	1

32. A Regiment has between 24 to 40 aircraft or 32 aircraft as a median, so 15 Regiments= 11x 32=468 aircraft which @ 18 aircraft per sqn=26 sqn (approx).

The IAF future build up is derived from current vintage and planned future procurements. It would drop to 31 sqns between 2012-17 and increase to a maximum of 40 sqns by 2020 subject to Rafale's finalisation by 2013 and induction by timeline of the Light Combat Aircraft) LCA.[33]

As is quite evident, by 2020 the PLAAF would have no dedicated air defence fighters for defensive duties but modern multirole aircraft. Though, the deployment in our area of interest is 15 Regiments in 2012, it is likely to reduce to 12 Regiments by 2020 which considering the IAF's force levels are sufficient. In case of escalating hostilities and increasing need, it may even go up as other MRAF's would augment force levels in the conflict zone. It is only a predicted approximate catering for at least five additional augmented Regiments, a very small percentage of the PLAAF. This 17 Regiment surge totals 30 IAF sqns and is considered the maximum which the PLAAF can field without compromising on the existing threat scenario in the East and the North. It is expected that the existing Su-27/ J-11 aircraft at Yinchuan and Baishiyi would be modified indigenously to J-11B multirole standards. Out of the eight J-7 Regiments, around six would be equipped with J-10s. The decrease in the future total PLAAF structure is from 67 Regiment to 53 Regiment which is a 23% reduction in numbers and so is the reduction in Chengdu and Lanzhou MRAFs from 15 to 12 Regiments.

THE PRESENT NUMBER GAME

In a two front scenario in the event of confrontation with Pakistan, the force ratio is likely to decrease for the IAF in the West, much to Pakistan's advantage. From the existing 1.4: 1 to an equal balance, if forces are redeployed to balance the threat from the PLAAF in the North and East. Deployment of less than a quarter of its combat sqns in the East against Chinese intervention would eliminate even the marginal superiority of numbers which the IAF

33. At http://news.oneindia.in/2009/02/18/iaf-to-have-42-fighter-squadrons-by-2022-antony.html. At http://www.thehindu.com/news/national/article3297800.ece accessed on April 25, 2012. The current induction plan is for 42 sqns by the end of the 13th plan in 2022 and 35 sqns by the 12th plan in 2017. But the Vice Chief of the Indian Air Force told the Parliamentary Standing Committee on Defence on April 09, 2012 that the force level by 2017 would be four sqns short of the earlier projected at 31 combat sqns.

enjoys in the West.[34]Depending on the extent of threat facing the IAF in the East; if the need arises to augment greater numbers in the face of higher PLAAF aircraft, the resultant combat strength of the IAF could then swing the force balance in PAF's favour, completely to India's disadvantage.

The IAF may have to confront two adversaries, Pakistan and China, who will deploy more than 800 combat aircraft.

In numerical terms, the IAF may have to confront two adversaries, Pakistan and China, who will deploy more than 800 combat aircraft (450 PAF[35] and 460 PLAAF[36] = 910 aircraft or 24 PAF + 26 PLAAF = 50 sqn) against India which at present levels exceed the IAF's current arsenal by 16 sqns. Although Indian superiority over Pakistan's air power in capability will continue in the foreseeable future, however the scale of superiority of the IAF will diminish as capability and relative numbers of the PAF improve till 2016. China poses a greater challenge. Not only is the IAF poised to lose forever its traditional numerical superiority in advanced combat aircraft, this segment of the PLAAF alone is likely to exceed the size of the entire IAF by 2020.[37] When the larger transformation of the Chinese military is taken into account, the situation becomes serious indeed.

FORCE DEFICIT: IAF VS PAF + PLAAF

The PAF is made up of 22 combat sqns.[38]While the PAF traditionally has been equipped with 16 aircraft per sqn, the situation may not be the same now with a large number of Mirage-III, F-16 and JF-17 sqns equipped over the traditional PAF unit aircraft strength of 16 aircraft per sqn. Therefore, it may be more accurate to consider an equivalent sqn force derived from the total number of aircraft. The PAF has 453 combat aircraft and at the rate of 18 aircraft per sqn amounts to the combat potential of 25 equivalent sqns of the

34. Against 24-25 PAF combat sqns, India has a total of 32 sqns resulting in a force ratio of 1.28: 1. Removing even seven-eight sqns or less than a quarter of the force leaves the West equally balanced in numbers.
35. n. 8, p. 273.
36. 15 Regiments equal 468 aircraft @ average of 32 aircraft per sqn. (24 to 40 aircraft)
37. At http://www.thehindu.com/news/national/article3297800.ece accessed on April 25, 2012. n.23.
38. At http://indiatoday.intoday.in/story/the-incredible-shrinking-air-force/1/119731.html, accessed on April 26, 2012. n.27.

IAF but catering for reserve strength of 5%, the effective fighting potential of the PAF is 24 combat sqns. A quick comparison of the IAF force levels in a two front war brings out the likely force deficit. Against Pakistan which would field all its 24 sqn equivalents against India, an almost equal deployment would leave a balance of ten sqns against China following a purely aircraft type matched counter deployment to hold-off the PAF. This is the best anti-PLAAF deployment after catering for the barest minimum combat force to stem a PAF advance without considering any quantitative edge.

Though, the total IAF structure caters for 34 combat sqns as per Indian and western open sources[39]; if the actual force level is lower, it will deplete the force available further for an Eastern contingency against China. Alternatively, the choice is to fight the western front with an unfavourable force balance in the air as we have never done in the past. On the whole, it would be fair to comment that at the moment, the IAF has adequate numbers to counter a threat by the PAF only.

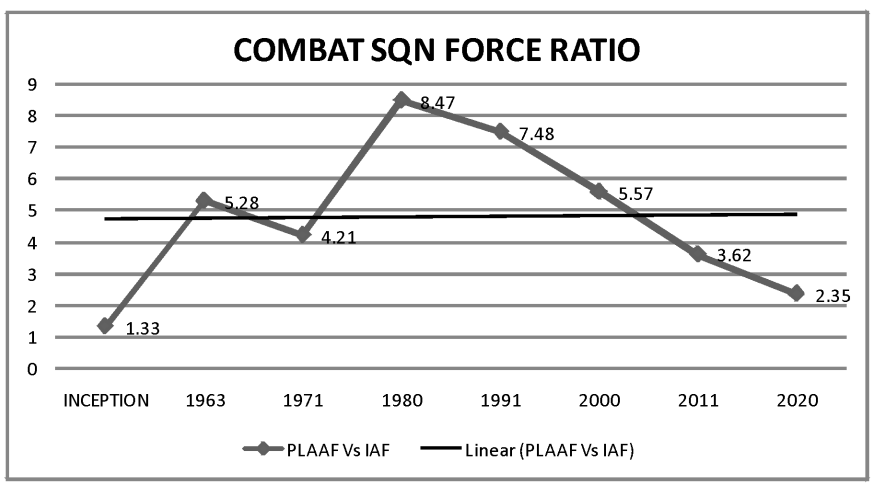
The IAF response to the PLAAF may improve after 2016-2017. The IAF is likely to be 40 sqn strong by 2020 but the PAF would have expanded to 26 sqns and as it happened in 1971 and before, could get augmented with combat aircraft flown in from China at short notice if the need so arises.[40]The available combat sqns of IAF fighters deployed for a PLAAF contingency in 2020 would increase to 14 sqns for an eastern contingency after a balancing deployment to safeguard against an expanding PAF. These 14 sqns would comprise Su-30s, Rafales and the LCA. Unfortunately, it would be lesser than the PLAAF's current deployment of 15 Regiments (26 IAF sqn equivalents) and the future augmented deployment of 17 Regiments (30 sqn equivalents).

The actual game changers would be the additional force of one or more Regiment of fifth generation J-20s and numerous Regiments of J-17 stealth Sukhois included which would transform the air battle beyond the scope

39. n. 8. CAG Report 2011-12, p. 104.
40. China gave Pakistan 60 F-6 after the 1971 war at no cost. During the 1965 war, it agreed to supply warplanes and other supplies at short notice when Asghar Khan visited Beijing in September 1965. *The Story of the Pakistan Air Force: A Saga of Courage and Honour*, (Lahore: Shaheen Foundation, 1988), p.114. M Asghar Khan, *The First Round Indo-Pakistan War 1965*, (Ghaziabad: Vikas Publishing House, 1979), pp. 39-40.

of fourth generation IAF opposition. This is where in future; the force ratio aspect would get irrelevant in the face of superior and unmatched fifth generation capability which the IAF would not be able to counter in numbers or capability in the near future, though by some reports the Prospective Airborne Complex of Frontline Aviation (PAKFA) is expected to join the IAF 2017.[41] A timeline of early mid next decade would appear plausible considering that the aircraft is still in the developmental stage and substantial numbers with Hindustan Aeronautics Limited (HAL) aided local production could stretch timeframes. The FGFA (twin seater) would need redesigning and configuration changes from the T-50 PAKFA which would commence once the single seat version is production ready. By that time the PLAAF would have consolidated and trained on the J-20 for five to six years and on the J-17 for more than a decade.

A timeline of early mid next decade would appear plausible considering that the aircraft is still in the developmental stage.



The true picture appears when the IAF-PLAAF combat force ratio is considered. It was a meagre 1.33 when both air forces were formed and

41. At http://indrus.in/articles/2011/12/19/fgfa_what_sort_of_plane_is_it_14029.html, accessed on April 26, 2012.

grew to above 5: 1 when the Chinese went to war against India in 1962. Interestingly, there was a drop when India and Pakistan fought the liberation war in 1971 but that was because of the IAF buildup to counter the PAF war machine. The large scale production and expansion of the PLAAF, planned in the late seventies saw the force ratio peak at over eight to one. The subsequent transition to a modern high tech fighting force has negated the need for a higher number of older generation aircraft and is being replaced by lesser number of more capable platforms. As the PLAAF transforms totally to modern high tech aircraft and the IAF builds to 40 sqns by 2020, the numbers of the Chinese Air Force would further decrease but still maintain an overall force ratio of over 2.35: 1 with the IAF. This also defines the extent of surge capacity available with the PLAAF. This would mean the IAF facing an entirely transformed modern high tech force with a majority of fourth generation aircraft and emerging fifth generation capability. Though limited in numbers by 2020, this would be invaluable in potential against the IAF which would still be in the process of expansion and induction of largely fourth generation aircraft against the emerging Chinese fifth generation capability.

TWO AGAINST ONE: COMBINED FORCE

Simultaneous confrontation on both the Eastern and Western fronts would mean, facing combined assault by both the PAF and the PLAAF. In pure numerical terms, this would mean an opposition greater than any faced by the IAF both in numbers and capability. China-Pakistan military encirclement of India would mean a simultaneous threat by 26 PLAAF sqns and 24 PAF sqns adding to a faceoff with almost 50 combat sqns in 2011-12. As a consequence, the IAF now finds itself in an adverse combined numerical force ratio of 1.47: 1.[42] The IAF plan to build numbers and capability is limited to 42 sqns by 2022.[43] Also, if we consider the Chinese capability at 30 equivalent sqns or 17 Regiments against India in 2020, the force level facing the IAF is 56 combat sqns. This is assuming a perfectly balanced force ratio on the Western border which we have never considered adequate. But if we maintain the same superior force ratio against

42. 50 combined sqns against 34 IAF sqns, i.e., 50/34=1.47.
43. CAG report 2011-12, http://articles.timesofindia.indiatimes.com/2009-02-18/india/28011953_1_squadrons-force-multipliers-iaf.

the PAF as we possess in a single front contingency which currently is 1.4: 1,[44] it would mean strength of 36 sqns in the West against Pakistan leaving a balance of only six sqns for a simultaneous Eastern contingency. The PAF may receive four-five sqn equivalent combat force from China in the event of facing shortage in numbers.[45]This happened in 1971 (96 F-6 from China and three sqn combat fighters i.e., F-86E, F-104 from Iran, Jordan and Syria) just before hostilities commenced to augment the PAF force structure. So maintaining a superior force ratio with the PAF is a necessity. Such an augmentation in 2020 would increase the total PAF-PLAAF combine to 66 combat sqns i.e., 30 sqns (against the PLAAF) and 36 sqns (against the PAF) at a force ratio of 1.4: 1 by 2020[46]. This clearly shows that even in 2020, the force ratio is the same as in 2012 at 1.4: 1. As given in the CAG report of 2012, the IAF force level would drop to 31 combat sqns in the 12th Plan, raising the force ratio in favour of our adversaries to 1.6: 1 in 2016 but this would be temporary as fresh inductions commence. This means increase in numbers for the IAF to counter 56 sqns while maintaining an equal force balance across both fronts and 66 sqns while maintaining a superior force ratio of 1.4: 1 vis a vis the PAF in 2020. So the IAF finally needs a 54 sqn air force[47] to balance a combined Chinese and Pakistani threat in 2020 as a minimum and 66 combat sqn force to guarantee an adequate balancing response to China and winning response to the PAF in a two front air offensive in the coming decade. Any delay or lower deviation would result in the IAF having neither an upper hand in capability nor numbers.

SUMMARY

The expansion of the IAF, post 1962 was aimed at securing India from future threats from Pakistan and China independently. But generally the buildup of the IAF subsequent and even before that was mainly PAF centric. The PLAAF of the sixties and seventies was mainly air defence oriented with a small complement of light bombers like Tu-2, Tu-4 and IL-28 bombers.

44. 34 IAF sqn/ 24 PAF sqn=1.41.
45. Interview with Air Cmde Jasjit Singh on April 24, 2012.
46. 66 combined sqns/ 40 PAF sqns= 1.4
47. Considering either a minimum 11 Regiment PLAAF deployment or a 15 Regiment deployment of already stationed PLAAF assets in South Western China.

The airfield infrastructure in areas adjoining India was primitive and the penalty of taking-off from high elevation airfields imposed severe payload restrictions on bombers making air offensives from neighbouring areas a remote possibility. The change occurred as the PLAAF started looking to alter strategy after the lessons of the war with Vietnam in 1979. Subsequently, learning from wars fought by the Western nations, the PLAAF outlook gradually altered to offensive strategy from a primarily territorial based air defence. This prompted a deliberate change to multirole aircraft and emphasis on long range precision strikes extending Chinese influence into mainland Asia. Though, the PLAAF is still in the process of transition, the tilt in focus and capability build up is a cause for concern for India. The Pakistan-China combine has been up against India since the early sixties. This partnership has grown in all spheres aimed towards a common foe-India. Therefore, it is in Indian national interests to expect and prepare for a combined PAF-PLAAF threat in future confrontation with either Pakistan or China. The prominence in building air forces of both countries is indicative of the likely dominant role they would play in tomorrow's war. The IAF war fighting capability presently is limited to just 34 combat sqns against 24 equivalent sqns of the PAF and 15 Regiments of the PLAAF (26 IAF sqn capable) in Chengdu and Lanzhou. The added threat of the full PLAAF machinery behind this force is overpowering. The current force deficit against China is one-third the combat sqns when the Western front against the PAF is equally balanced. Switching numbers and types between fronts would still make no difference to the overall asymmetry which stands at 1.4: 1 against the IAF in 2012 and would remain same even in 2020 if the current rate of aircraft induction and phasing out is followed by the IAF, PAF and PLAAF. The need is to augment the existing IAF establishment to a 54 sqn air force to minimally balance the emerging PAF threat by 2020. This figure rises to 66 combat sqns to balance an augmented PLAAF force of 17 Regiments in Chengdu – Lanzhou MRAFs while maintaining current force asymmetry of 1.4: 1 with the PAF in the next decade. Capability flows from numbers and the need is to build sufficient force levels to possess the capability to counter the adversaries in a two front scenario for India.

The IAF is in the process of expansion and building qualitatively and quantitatively. History has caught us having to fight in the same process of expansion and consolidation in 1965 and hopefully it does not again.

APPENDIX 1

Total PLAAF Offensive and Defensive Capability

Offensive	
Su-30 MKK/ J-11B:	4 Regt
J-10:	6 Regt
Q-5	5 Regt
JH-7A	3 Regt
H-6	6 Regt
H-5	1 Regt

Total offensive	25 Regt
Defensive	
Su-27/ J-11	7
J-7	24
J-8	11
	---------
	42 Regt

Source: *Military Balance 2011 and 2012*.

APPENDIX 2

Current PLAAF Deployment
Chengdu MRAF (Total Deployment: 7 Regt)
J-11: 1 Regt (Chongqing Baishiyi Air Base)
J-10: 1 Regt
J-7: 3 Regt (Chinese version of the MiG-21 with enhanced thrust and WP 7B engine)
J-7E: 1 Regt (Upgraded version of the J-7 with an up rated engine, advanced avionics, enhanced wing area, four wing stations, PL-8(Python-3) AAM included.
H-5: 1 Regt (Training bomber with the PLAAF)

Lanzhou MRAF (Total Deployment: 8+ Regt)
J-11: 1 Regt (Yinchuan AFB)
J-7: 1 Regt
J-7E: 2 Regt
J-7G: 1 Regt (Upgraded F-7E with new radar, HUD, IFF)
J-8H: 1 Regt (Multirole J-8 B capable of max external stores of 4.5 t, KLJ-1 radar, anti-radiation missiles and modern avionics.
H-6M: 1 Regt (Chinese version of the Tu-16 capable of carrying four ALCMs and additional 9000 kg fuel.
H-6H: 1 Regt (2 x ALCM carrier platform)

Source: *Military Balance 2011 and 2012. SIPRI 2011.*

APPENDIX 3

PLAAF AT A GLANCE

Sl No.	Year	Acquisitions	Div/ Sqn Equivalent	Nos
1.	1949		1.5/ 8.5	152
2.	1959		30/ 167	3000
3.	1962	M-15, 17, 19,IL-28		3000
4.	1963		20/ 111	2000
5.	1967		25/ 139	2500
6.	1967-68	150 IL-28	16	2500
7.	1971-72	30 Tu-16, 12 Tu-4, 150 IL-28, 1700 M-19, 800 M-19	28/ 156	2800

8.	1973-74	300 F-9	13	3800
9.	1975-76	60 Tu-16, 12 Tu-4, 300 IL-28, 100 Tu-2, 200 M-15, 1500 M-17, 1500 M-19, 50 M-21	38/ 211	3800
10.	1976-77		23	3800
11.	1978-79		23	5000
12.	1980-81		52/ 288	5200
13.	1981-82		29	5300
14.	1982-83	4000 Ftrs, 280 F-7, 580 H-5	23	5300
15.	1983-84	1 DIV= 3 REGT	25	5300
16.	1984-85		27.5	5300
18.	1985-86		53/ 294	5300
19.	1986-87		27	5300
20.	1987-88		27	5300
21.	1988-89		27	6000
22.	1989-90			5000
23.	1991-92	24 F-6 out, F-7PG in 2002	50/ 277	5000
24.	1992-93		20	5000
25.	1993-94		22	5000
26.	1994-97		22+	5000
27.	1995-96		50/ 277	5000
27.	1997-98	H-6 110	23	3740
28.	1998-99	120 H-6, 200 H-5, 400 Q-5, 1800 J-6, 500 J-7, 150 J-8, 46 Su-27	23	3566
29.	1999-2000		35/ 195	3520
30.	2000-01			3000
	2001-02			2900
	2002-05			2300
	2004-05	72 ac/ div	32/ 128	2300
	2005-07	32 Div		2643
	2009	82 H-6, 1136 J-7,8, 84 J-10, 116 J-11, 73 Su-30, 18 J-11B, 72 JH-7, 120 Q-5		1653
	2010			1617
	2011	144 J-10	26/ 116	2080
	2015		23/ 108	1885
	2020	25-35 J-20	21/ 94	1690

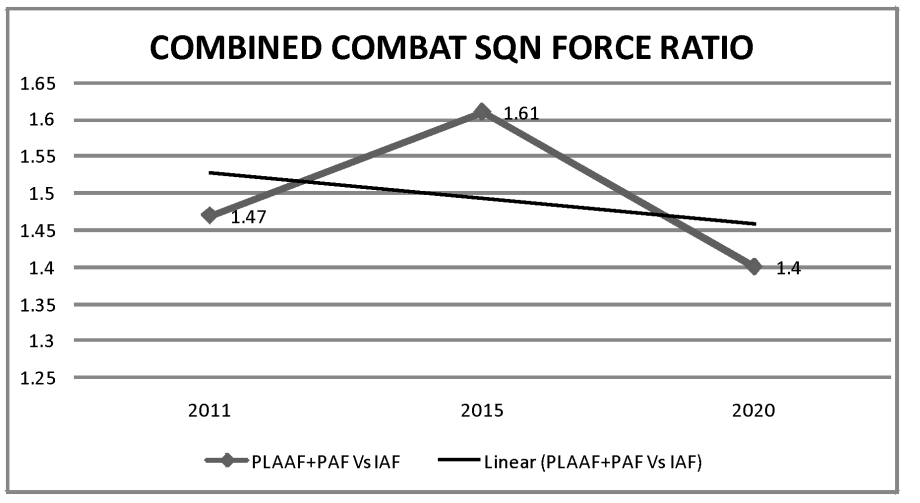
*UE @ 18 combat aircraft per sqn

Source: *Military Balance 1961-2012, Jane's All the World's Aircraft 2006-07, SIPRI 1971-2011. Air Cmde RV Phadke, People's Liberation Army Air Force (PLAAF): Shifting Air power Balance and Challenges to India's Security.*

Indian Vulnerabilities
Airfields
Platforms
Numbers
Industrial Back up

Maintaining one on one parity with the PAF and the PLAAF, the IAF needs 10 additional sqns totaling 42 combat sqns (32 existing plus 10) to balance a possible PLAAF intervention in a faceoff with Pakistan in 2011-12. However, if we need to maintain existing force asymmetry with the PAF, then the requirement would be to enhance IAF force levels by 20 combat sqns from the present declared state to 52 combat sqns to balance conventional combat air power with the PLAAF.[48]This figure would increase to 24 combat sqns and 56 combat sqns if the IAF wants to maintain the same force superiority of 1.2: 1 across both fronts.

The Chinese are known to use superior force doctrinally to gain command of the air and affect maximum attrition in the initial phase of war.



48. 32 IAF sqns deployed against PAF and additional 20 sqns to combat a PLAAF threat.

NUCLEAR WASTE: INDIA'S GORDIAN KNOT?

SITAKANTA MISHRA

The Nuclear Power Corporation of India Ltd. (NPCIL) has planned to launch 16 more reactors – eight 700 MW Pressurised Heavy Water Reactors (PHWRs) and eight Light Water Reactors (LWRs) – at an outlay of Rs 230,000 crore during the 12th Five Year Plan period (FYP) (1012-17).[1] This is in addition to NPCIL's four 700 MW PHWRs under construction at an outlay of Rs 22,000 crore. In the pursuit of ensuring energy security and harnessing nuclear source as a viable option in the national energy mix, around three dozen more nuclear plants have been proposed. In the process, the requirement of nuclear fuel will become significant, necessitating more domestic and external sources of uranium to tap. But, addition of single mw electricity from the nuclear source during the years ahead will add to the existing radioactive waste. Apprehensions have been raised about the safe disposal of radioactive waste generated in India.[2] Allegedly, there is no official disclosure about the volume of radioactive wastes generated so far. As is the case with other nuclear powers that have not been able to find a lasting solution, will the nuclear waste generated in India be India's Gordian Knot?

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1. "Nuclear Power Corporation of India to Launch 16 New Nuclear Reactors", *The Economic Times*, June 1, 2012.
2. Rashme Sehgal, "India Needs Proper N-Waste Disposal Tech", *The Asian Age*, May 13, 2008.

THE PROCESS AND THE BASICS

In India, radioactive materials are used in many sectors like medicine, industry, agriculture, energy, etc. During all these activities, some amount of 'waste' – "material left over for which no further use is foreseen" – is produced which need to be safely disposed off. "The underlying objective that governs the management of all such waste is protection of man and environment today and in future."[3] This study examines only the waste generated in the Indian nuclear energy sector during the various stages of nuclear fuel cycle which includes mining and milling of uranium ore, fuel fabrication, reactor operation, and spent fuel reprocessing. In India, waste out of reactor operation includes waste generated from PHWRs, BWRs and other activities, waste may arise out of accident condition and waste generated out of decommissioning of plants which may need safe disposal.

Safe disposal denotes: "Emplacement of waste in a repository without the intention of retrieval or approved direct discharge of waste into the environment with subsequent dispersion." The technical process, starting from origin of the waste till the final process of safe disposal, involves many coordinated steps. Most important is the 'conditioning' or 'treatment' that transforms the waste into a form suitable for transport and/or storage and/or disposal. The administrative and chain of operational activity involved in the handling, treatment, conditioning, transportation, storage and disposal of the waste is called 'waste management'. Broadly, radioactive waste is generated in three forms – liquid, solid and gaseous – which are further characterised on the basis of their degree of radioactivity and hazard involved: (a) High Level (HL), (b) Intermediate Level (IL), and (c) Low Level (LL). Each category requires separate process of handling. In India, "the safe and effective management of radioactive waste has been given utmost importance from the very inception of nuclear industry."[4]

3. K. Raj, K.K. Prasad, N.K. Bansal, "Radioactive Waste Management Practices in India", *Nuclear Engineering and Design*, March 11, 2004, p. 914.
4. Ibid.

VOLUME OF WASTE

Much concern has been in the air regarding the volume of radioactive waste that India would generate and can amicably dispose them when the major nuclear power countries have not been able to do so? In the Parliament, questions have been repeatedly raised "whether government has … assessed the quantity of nuclear waste likely to be generated by the nuclear power plants in the country".[5] And, the standard explanation furnished during all these debates is that "the quantity of this waste in our country is much smaller due to our adoption of the closed fuel cycle".[6] The interim storage facility is adequate and can store waste generated for 30-40 years by which time it will lose some radioactivity. Therefore, it is asserted that, "nuclear waste is not an immediate problem for India", and at the current level of nuclear power generation, India will not have any problem related to waste management which it may face by the year 2020-2030.[7]

Undoubtedly, considering the previous and current rate of nuclear energy production, the volume of waste already generated in India could be very small. The nuclear waste disposal issue in India at present, therefore, cannot be compared with the situation in the United States. Deliberate or otherwise, there is not available exact information in the public domain on the current inventory of radioactive waste in India and the amount that will be added in the decades ahead. Therefore, the issue has become a subject of intense speculation. Answering to the question by N.R. Govindarajar on handling of nuclear waste in the Rajya Sabha, Prithviraj Chavan, the Minister of States in the PMO and Ministry of Personnel, Public Grievances and Pensions, revealed on February 26, 2009 that:

5. During the last four years (2009-2012) four unstarred questions have been raised in the Lok Sabha and Rajya Sabha on February 26, 2009; July 28, 2010; August 17, 2011; and March 14, 2012, specifically regarding the quantity of nuclear waste generated in India.
6. *Lok Sabha Debate*, Unstarred Question no. 2747, "Nuclear Waste", asked by Nishikant Dubey, answered by V. Narayanasamy on August 17, 2011.
7. "Nuclear Waste not an Immediate Problem for India: Ramesh", *Times of India*, January 03, 2011.

> In India about 500-600 litres of high level waste is generated per tonne of spent fuel processed. Also about 1000 litres of intermediate level waste is generated per tonne of spent fuel. The quantities generated depend on the type of fuel, cooling period before reprocessing and the process adopted in the reprocessing plants. Low level nuclear waste is generated during normal operation and maintenance of nuclear plants. About 20,000-30,000 m3 of low level of nuclear waste is generated from a typical twin 220 Mwe PHWR nuclear plants per year.[8]

To estimate the approximate amount of waste produced, one needs to rely either on secondary sources based on individual predilections or to calculate the amount of fuel irradiated, taking into account the average figures revealed during the Parliament debate. Since the exact amount of fuel irradiated is again unknown, one need to calculate backward from the amount of nuclear energy produced over the years. Mostly, the media and the individual scholars have advanced their own estimation some times exaggerating and at other times overestimating leading to public outcry. For example, according to the study by MV Ramana a decade ago (2001), waste produced out of uranium mining and milling was 4.1 million tonnes; waste generated out of fuel fabrication was 2000 m3; low- and intermediate-level waste generated out of reactor operations is 22,000 m3 and 280 m3 respectively; from spent fuel storage (not to be reprocessed) 400 tonnes; from reprocessing 5000 m3 high-level waste, 35000 m3 intermediate-level waste, and 210,000 m3 low-level waste was generated.[9]

8. *Rajya Sabha Debate*, Unstarred Question no. 1012, "Handling of Nuclear Waste", by N.R. Govindarajar, answered by Prithviraj Chavan, on February 26, 2009.
9. MV Ramana, "Estimating Nuclear Waste Production in India", *Current Science*, vol 81, no 11, December 10, 2001, p. 1461.

Total Nuclear Waste Generation in India (Ramana, 2001)

Step in nuclear fuel cycle	Waste estimate (2 significant digits)
Uranium mining and milling	4.1 million tonnes
Fuel fabrication	2000 m^3
Reactor operations (low-level waste)	22000 m^3
Reactor operations (intermediate-level waste)	280 m^3
Spent fuel storage (not to be reprocessed)	400 tonnes
Reprocessing (high-level waste)	5000 m^3
Reprocessing (intermediate-level waste)	35000 m^3
Reprocessing (low-level waste)	210000 m^3

Source: *Current Science*, Vol. 81, No. 11, December 10, 2001, p. 1461.

Cumulative Low Level and Intermediate Level Waste Production (Ramana, 2001)

Name	Date of commencement	**Intermedate level waste (m^3)**	Low level waste (m^3)
RAPS 1	16 December 1973	35.1	2700
RAPS 2	1 April 1981	24.7	1900
MAPS 1	27 January 1984	20.7	1600
MAPS 2	21 March 1986	18.2	1400
NAPS 1	1 January 1991	13.0	1000
NAPS 2	1 July 1992	10.4	800
KAPS 1	6 May 1995	9.1	700
KAPS 2	1 September 1995	6.5	500
TAPS 1	28 October 1969	49.6	3875
TAPS 2	28 October 1969	49.6	3875
CIRUS	10 July 1980	32.0	2400
Dhruva	10 August 1985	12.0	900
Total		281.0	21650

Source: *Current Science*, Vol. 81, No. 11, December 10, 2001, p.

According to NS Sunder Rajan, the former Head of Waste Management Division, Bhabha Atomic Research Centre (BARC), with the aim to produce 10,000 MWe by the year 2000, India would generate 107,000 m3

of primary solid wastes, 771,00 m3 of low-level waste concentrates, 19900 m3 of intermediate-level wastes, and 8000 m3 of high-level wastes.[10] The production rate estimated by him for the year 2000 is in sharp contrast to the figures during 1985.

India's Estimated Waste Arisings (Rajan, 1986)

India's Estimated Waste Arisings

Primary solid wastes and low-level waste concentrates constitute the bulk of the estimated waste arisings in India up to the year 2000, at a projected electric power production of 10,000 megawatts. These consist of contaminated process equipment, protective clothing, used particulars filters, concentrated precipitates, and sludges from the low-level liquid waste treatment plants. The volume of the intermediate- and high-level waste generated in small, yet it constitutes the bulk of the radioactivity.

	1985	2000
Installed capacity (megawatts-electric)	1,350	10,000
Primary solid waste" (cubic metres)	1,850	107,000
Low-level waste concentrates (cubic metres)	3,000	77,100
Intermediate-level wastes (cubic metres)	450	8,000

* Up to 10^4 rontgen per hour

Source: *IAEA Bulletin*, (Spring) 1986, p. 40.

If the above trend is followed to estimate waste generation out of India's envisaged nuclear energy programme, by 2020 India would pile up double the volume of waste currently reserved in different facilities. If the government assurance on existing facilities' sufficient waste storage capacity is to be believed, India can comfortably manage additional nuclear wastes for the next three decades. But, as India has expedited domestic uranium exploration activities in recent days, the waste out of mining and milling would be manifold than the previous decades. The commercial uranium recovery plant at Jaduguda treats around 1000 tonnes of ore per day from the

10. N.S. Sunder Rajan, *IAEA Bulletin*, (Spring) 1986, at http://www.iaea.org/Publications/Magazines/Bulletin/Bull281/28104693740.pdf, p. 40.

Jaduguda mine, containing around 0.05% U3O8.[11] Taking into account the low quality of uranium ore reserved in India, the amount of tailings out of extensive mining would pose "reclamation" challenge of tailing ponds.[12] Negative perception of the public about mining as a polluting industry would complicate it further.

As India follows a closed fuel cycle, the second stage of its three stage programme will start soon where plutonium produced during the first stage as waste will be used as fuel.

As India follows a closed fuel cycle, the second stage of its three stage programme will start soon where plutonium produced during the first stage as waste will be used as fuel, the amount of high-level waste will reduce drastically. India has around 40 years of experience in the spent fuel reprocessing based on Plutonium Uranium Extraction (PUREX) process which has given the confidence that this technology can be successfully employed for the recovery of both uranium and plutonium with yield exceeding 99.5%.[13] Moreover, the high-level waste in India, essentially generated at reprocessing plants, is "much smaller due to the closed fuel cycle" it follows. These wastes are "vitrified into a glassy form, contained in multiple barrier containers and stored for an interim period of three to four decades in engineered vaults with necessary surveillance facilities".[14] Indian government is aware and has carefully assessed the quantity of nuclear waste generated, and accordingly a systematic management guideline and philosophy is adopted for integrated recycling, management, and geological repository in the long-run.

11. G.V. Rao and S. Prakash, "An Approach to Reduce Load on the Acid Leaching Circuit of the Commercial Uranium Recovery Plant at Jaduguda, India", *Magnetic and Electrical Separation*, vol 9, 1998, p. 27, at www.downloads.hindawi.com/archive/1998/032360.pdf
12. UCIL, "Uranium Mining and Milling Industry in India", at http://www-pub.iaea.org/mtcd/meetings/PDFplus/2009/cn175/URAM2009/Session%201/9_63_Gupta_India.pdf
13. At http://www.barc.ernet.in/publications/eb/golden/nfc/toc/Chapter%206/6.pdf, p. 51.
14. *Lok Sabha Debate*, Unstarred Question No 2747, "Nuclear Waste", asked by Nishikant Dubey, answered by V. Narayansamy on August 17, 2011.

GUIDELINE AND PHILOSOPHY

To keep the effective doses of radiation to individual and the environment As Low As Reasonably Achievable (ALRA), the Atomic Energy Regulatory Board (AERB) prescribes necessary codes and safety guidelines (2004) on safe handling, treatment, storage, transport and disposal of radioactive waste in conformity with the formulations by International Commission on Radiation Protection (ICRP). The guideline prescribes that a Waste Management Plant (WMP) along with a nuclear surface disposal facility shall be available prior to the commencement of nuclear power plant operation as a mandatory 'operational requirement'.[15] The plant management interact with the designer of WMP during design and construction phase to ensure plant capability to meet waste management objectives. So far, all seven Indian WMPs are co-located with waste generating facilities which help avoiding undue radiation exposure during transportation.[16]

The first philosophy followed in India is "waste minimisation" (clause 2.3.1 of Guidelines No. *AERB/NPP/SG/O-11*) at all stages of design, operation and maintenance through "volume reduction" and innovative treatment process. India's overall policy is based on universally adopted philosophy of (i) delay and decay of short lived radionuclides, (ii) concentration and containment of radioactivity as much as practicable, and (iii) dilution and dispersion of low-level activity to environment well below the nationally accepted levels.[17] As listed by the Nuclear Recycle Group of BARC, India's national policy for radioactive waste management broadly includes the following:

- Discharge through gaseous, liquid and terrestrial routes are as low as reasonably achievable.
- Low and intermediate level solid/solidified waste are emplaced in specially engineered near surface shallow land repository.
- High-level and alpha contaminated liquid waste from spent fuel

15. AERB, *AERB Safety Guide – Management of Radioactive Waste Arising from Operation of Pressurised Heavy Water Reactor Based Nuclear Power Plants*, "Operational Requirements", Clause 2.3.1, Guidelines No. AERB/NPP/SG/O-11, March 2004, p. 3.
16. Raj, Prasad, and Bansal, 2004, n. 4.
17. Ibid, p. 915.

processing and other radio metallurgical operations are immobilised in a suitable matrix and stored in an interim storage facility with appropriate cooling and surveillance for a period necessary. Thereafter, these waste products will be emplaced in a suitably engineered deep geological repository.

The waste generated out of uranium mining and milling requires separate set of management.

- Alpha contaminated waste not qualifying for nuclear surface disposal is provided suitable interim storage pending its disposal in a deep geological repository.
- Spent radiation sources are either returned to the original supplier or handed over to a radioactive waste management agency identified by the regulatory body.
- Co-location of near surface disposal facility with the nuclear installations.
- As spent fuel is a resource material in India and needs to be processed for recovery and recycle of fissile material, each reprocessing plant has a collocated vitrification plant.
- The regulatory body determines the period for which active control for the shallow land repository should be maintained by the waste management agency. Institutional control may span a period of 300 years comprising 100 years of active and 200 years of passive control so as to allow decay of most of the radionuclides.

The waste generated out of uranium mining and milling requires separate set of management. As Indian uranium ores are mined by the method of wet mining, proper ventilation is ensured to protect against undue radiation concentration. According to N.S. Sunder Rajan, the then Head, and Waste Management Division of BARC: "The 'barren liquor' produced from the uranium recovery process is treated with lime and barites for precipitation of radium and other uranium daughter products. Along with the mill tailings, it is disposed into a tailing pond, which is a natural depression to ensure settling".[18]

18. Rajan, 1986, p. 38, n. 11.

PROCESS AND TECHNIQUE

In answer to an unstarred question by Vinay Kumar and Nishikant Dubey in Lok Sabha, the Minister of State for Personnel, Public Grievances & Pensions and Prime Minister's Office V Narayanasamy on in March 9, 2011 and August 17, 2011 respectively informed that the government has, "an effective plan in place for the disposal of nuclear waste" and "latest technology" is used for safe management of the nuclear waste.[19] The entire process is claimed to be "a transparent" system and "efforts are continuously on to update and have a balanced Nuclear Waste Management System (NWMS)".[20] For example, extensive efforts are made in the field of research and development for new technologies to manage wastes generated in the future from the new reactor systems like advanced HWRs and Fast Breeders Reactors (FBRs).

The High Level radioactive wastes in India are stored temporarily within the plant boundary, and with regard to Low- and Intermediate-Level Waste (LILW), India's experience has been claimed to be fairly good.[21] This is mainly because of the comprehensive stages of waste management process that includes characterisation, treatment, conditioning, storage, disposal, surveillance/monitoring, etc., that is adopted. Characterisation is the first process to determine the physical, chemical and radiological properties for record keeping, segregation of materials for reuse, exemption and disposal or storage. Storage of wastes in designated facilities is mainly undertaken to ensure isolation and environmental protection. Some wastes require short storage period for decay of radionuclides and many other types are stored for interim period for subsequent treatment. In the process, waste is collected, segregated, decontaminated through chemical adjustments. Some waste requires conditioning to transform radioactive waste into solid form suitable for handling. It involves immobilisation of the waste and putting

19. *Lok Sabha Debate*, "Nuclear Waste", Unstarred Question No 2747, asked by Nishikant Dubey, answered by V Narayanasamy on August 17, 2011; *Lok Sbha Debates*, "Disposal of Nuclear Waste", Question No 2088, Question asked by Vinay Kumar, answered by V Narayanasamy on March 9, 2011.
20. *Rajya Sabha Debate*, "Nuclear Waste Management System", question raised by Ramachandra Khuntia, answered by the Minsiter of State for Parliamentary Affairs, Personnel, Public Grievances & Pensions and PMO V. Narayanasamy on March 10, 2011.
21. Rajan, 1986, n. 11, p. 37.

them in containers and additional packaging. The final step in the process is the emplacement of radioactive waste in a repository with reasonable assurance of safety. As per current practice, most types of wastes are disposed by concentration and containment but some effluents are discharged into the environment within authorised limits, specific to sites and vary from coastal to inland sites, with subsequent dispersion.[22]

India practices variety of "self reliant" management and treatment procedures for all types of radioactive wastes generated during operation of its nuclear facilities. For treatment of gaseous waste, it is ensured that all nuclear installations have an elaborate off-gas cleaning system. Indian scientists claim to have developed "very efficient gas cleaning techniques, employing different types of wet scrubbers like venturi, dust, packed bed, cyclone separators, high-efficiency low-pressure drop demisters, chillers and High-Efficiency Particulate Air (HEPA) filters to practically retain most of the particulate radionuclides".[23] All Indian nuclear facilities have emergency air clean-up systems, indigenously developed filter banks, ruthenium absorber, particulate respirator like the HEPA filters, charcoal impregnated sampling filter, and stack-sampling cartridges. The HEPA filters are provided in the exhaust systems which are standard filters of capacity m^3 /h with collection efficiency of more than 99.97% for submicron particles.[24] To contain effectively the environmental release of radioactive-iodine – the main radiological concern; proper ventilation and containment systems of combined particulate and iodine filters are deployed. To absorb and retain the radio-iodine, coconut shell-based activated charcoal impregnated with potassium iodide and potassium hydroxide is used.[25]

Large volume of low and intermediate level liquid waste are generated from reactor operations, off-gas scrubbers of nuclear facilities, fuel reprocessing facilities, active floor drains, decontamination centre, laboratories, drain from change room and showers as well as during

22. Ibid, p. 917.
23. Ibid.
24. S. Kumar, S.S. Ali, M. Chander, N.K. Bansal, K. Balu, "Integrated Radioactive Waste Management from NPP, Research Reactor and Back End of Nuclear Fuel Cycle – An Indian Experience", Waste Management Division, BARC, IAEA-SM-357/38, p. 8.
25. Ibid.

Depending upon the nature of the waste generated, different methods of treatment and disposal are adhered to.

management of high and intermediate level waste. For the treatment of this type of waste, chemical precipitation/coprecipitation process, ion exchange, evaporation, reverse osmosis, etc., are employed.[26] Some of the liquid waste management plants in India are:

- Effluent Treatment Plant in Trombay
- Solar Evaporation Pond in Rajasthan
- Ion Exchange Plant in Tarapur
- Waste Immobilisation Plants in Trombay, Kalkakkam
- Rasin Fixation Plants in Narora, Kakrapar and Tarapur
- Reverse Osmosis Plant in Trombay
- Vitrification Facility in Trombay

The high level liquid wastes generated during reprocessing of spent fuels are managed by a three-step strategy: (1) immobilisation of waste oxides in stable and inert solid matrices; (2) interim retrievable storage of the conditioned waste under continuous cooling; (3) disposal in deep geological repository.[27] First, these wastes are concentrated by evaporation, stored in stainless steel tanks and kept under constant cooling and surveillance. India is claimed to be "one of the seven countries in the world to have mastered the technology of High Level Waste Management".[28]

The management of solid waste has been in practice in India since the early sixties and six solid waste management sites are presently under operation.[29] Depending upon the nature of the waste generated, different methods of treatment and disposal are adhered to. All solid waste management plants are equipped with segregation, repacking, compaction, incineration and embedment process.[30] All spent radiation

26. Ibid.
27. K. Raj, et al, p. 920, n. 4.
28. *Rajya Sabha Debates*, Unstarred Question No. 1012, "Handling of Nuclear Waste", by Shri N.R. Govindarajar, answered by Shri Prithviraj Chavan, February 26, 2009.
29. M.P. Gupta, et al, "Indian Experience in Near Surface Disposal of Low Level Radioactive Solid Waste", Proceedings of the Symposium on Experience in the Planning and Operation of Low Level Waste Disposal Facilities, IAEA, Vienna (1996),
30. Kumar, et al, p. 4, n. 25.

sources from radiography units, hospitals, industry, agriculture, medicine, research centres, etc. are collected at Trombay or Kalpakkam and packed in standard steel drums. As some wastes, like contaminated equipments or components are not amenable to any treatment, they are packaged in appropriate containers. To reduce the volume of the waste, compaction and incineration method is followed. Presently, incinerators are in operation at Trombay, Kalpakkam and Narora.

The approach followed in the disposal of solid waste is multi-barrier: first, beta gamma emitting wastes are disposed in earth/stone lined trench, Reinforced Concrete (RC) trench and the tile hole (waste packages up to radiation field of 200-500 mGy/hr). Alpha contaminated waste is disposed of along with beta gamma waste. The trench is unlined shallow excavation in soil for disposal of low level waste and are covered by one metre of soil and backfill materials like vermiculite and bentonite to uptake the radionuclides and prevention of spread of radioactivity.[31]

The wastes with higher alpha activity are temporarily stored to be finally deposited in a permanent geological site in future. But before they are shifted to the permanent repository, they need to be cooled to a level where transportation and disposal become viable. One such storage and surveillance facility co-located with a vitrification plant is operational at Tarapur with a capacity for storing nearly 1700 over packs with an inventory of nearly 80,000,000 TBq of radioactivity.[32] Extra precautions are being taken for temporary storage sites at Narora and Rajasthan, considering seismic and less soil coverage respectively. The trenches are constructed totally or partially above the ground with sufficient arrangement for remote handling and preventing ingress of rainwater. For viewing the hot cells, either the direct viewing systems such as radiation shielding windows or radiation resistant CCTV systems are used. A radio controlled remote inspection device with remote traction and steering capability has been developed for in-service surveillance of storage tanks for high and intermediate level waste tank.

31. Ibid, p. 5.
32. Raj et al, p. 928, n. 4.

India has also begun experimenting on a new technological option, the accelerator-driven sub-critical reactor systems (ADS), which will incinerate nuclear waste.[33] Such a programme has been evolved for stage-wise development of systems and technologies in India. This is based on proton linear accelerator development in the first stage and cyclotron as a complementary one.[34] The ADS system "merges accelerator and fission reactor technologies into a single system that has the potential to efficiently generate electricity for nuclear fission and/or transmute the long lived waste material".[35]

WASTE OUT OF DECOMMISSIONING

India is known to have considerable experience in the field of decommissioning of nuclear facilities and major systems and successfully replaced several times the coolant channels after deconditioning.

Nuclear waste out of decommissioning of nuclear facilities needs special care; therefore, the AERB has made it mandatory for all nuclear installations to incorporate provisions for in situ decontamination and de-commissioning provisions from design stage until end of the operational phase. Keeping the future need for decommissioning of nuclear plants in India, a six-axis gantry servo robot has been developed especially for decommissioning of glove boxes or similar equipments.[36]

In the year 2000, it was decided to decommission the the thorium plant at Trombay, commissioned in 1955, due to ageing, structural weakness, extensive corrosion, and build up of radiation dose on the process equipment. The decommissioning was planned so as to minimise both the radiation exposure to working personnel and the generation of radioactive waste. The steps taken were decontamination of tanks and equipments, removal

33. G.S. Mudur, "Site Hunt for Nuclear Graveyard", *The Telegraph* (Kolkata), February 15, 2012.
34. S.S. Kapoor, "Accelerator-driven Sub-critical Reactor System (ADS) for Nuclear Energy Generation", *Panama Journal of Physics*, vol 59, no. 6, December 2002, p. 948.
35. A. Stanculescu, "Accelerator Driven System (ADS) and Transmutation of Nuclear Waste: Options and Trends", IAEA, http://users.ictp.it/~pub_off/lectures/lns005/Number_2/Stanculescu.pdf
36. "Waste Management: Remote Handling & Transportation", Nuclear Fuel Cycle, *BARC HIGHLIGHTS* at http://www.barc.gov.in/publications/eb/golden/nfc/toc/Chapter%2014/14.pdf, p. 95.

of the tanks and equipment from the plant and subsequent removal of civil structures, segregation of waste, and disposal of radioactive waste in dykes. The radioactive solid waste about 2,150 m3 consisting mainly of 70% concrete and 30% metallic waste was disposed in the dykes of size 25m x 25m x 3.5m and 33m x 37m x 3.5m.[37] During the decommissioning, about 300 m3 of contaminated soil excavated from three main drains was disposed in the dykes. A total of about 3,465 man-days were required for decommissioning with a radiation exposure of 122 person-mSv.[38]

ENMASSE COOLANT CHANNEL REPLACEMENT

Major portion of Indian nuclear power programme consists of PHWRs which require Enmasse Replacement of Coolant Channels (ECCR) of each unit with zirconium niobium tubes. The main components of this coolant channel that needed disposal were End Fittings (EF), Pressure Tubes (PT), and Garter Springs (GS). The disposal of waste materials out of this process requires meticulous planning and concerted efforts due to high radiation fields, and large quantities and odd dimensions of the components. This requires creation of additional facilities for their handling, transport, cutting, sizing, disposal and conditioning for which India has developed new technologies and existing technologies have also been improved upon.

Radioactive waste management during many ECCR campaigns has been carried out safely in India. Removal of coolant channels was carried out for MAPS-II during May–July 2002 and for MAPS-I during January-March 2005. ECCR of unit-2 of Rajasthan Atomic Power Station (RAPS-II) was carried out during April-September 1996.[39] During all these operations valuable experience has been gained. As a result, according to Nuclear Recycle Group of BARC, "Technology for the management of decommissioning

37. S. Kumar, P.M. Satya Sai, S. Manohar, R.R. Rakesh, "Studies for Onsite Disposal of Waste from Decommissioning/Revamping of Nuclear Facilities and NPPS in India", in IAEA, *Disposal Aspects of Low and Intermediate Level Decommissioning Waste Results of a coordinated research project 2002–2006*, December 2007, at http://www-pub.iaea.org/MTCD/publications/PDF/TE_1572_companion_CD_web.pdf, p. 54.
38. Ibid; P.B. Savant, et al, "Health Physics Experience on the Decommissioning of Thorium Plant of I.R.E. Ltd at Trombay", BARC/2004/I/011 (2004).
39. For more detail on India's capabilities on onsite disposal of waste from decommissioning see Kumar et. al., December 2007, ibid.

of reactors and other facilities is getting established in the Indian nuclear power programme."

INTEGRATED NUCLEAR RECYCLE PLANT AND GEOLOGICAL REPOSITORY

With a long-term perspective, India has a plan to set up three indigenous and state of the art Integrated Nuclear Recycle Plants with facilities for both reprocessing of spent fuel and waste management. Design of the first plant at Tarapur has been started and is expected to be functional by 2017. The remaining plants will be commissioned with a two to three years gap.[40]

With an aim to develop capacity for permanent disposal of radioactive waste that may arise in three-four decades ahead, research activities for the development of geological repository have been undertaken, though no substantial headway has been achieved. While answering the unstarred question "whether the government has any proposal to set up underground laboratories to study the effects and desirability of storing nuclear waste in deep underground sites", V. Narayanasamy informed the Lok Sabha that:

> Presently, work related to host rock characterisation with a view to develop comprehensive data bases are in progress. The DAE has a proposal to construct an Underground Research Laboratory during the XII Five Year Plan. The proposed laboratory will be of generic nature. Such laboratories are used for the development of methodology and technology related to emplacement of solidified waste in the repository. Experiments in such laboratories will form a basis for the development and construction of underground geological repository for storing high level nuclear waste in the future.[41]

40. *Lok Sabha Debate*, "Integrated Nuclear Recycle Fuel", Unstarred Question No 389 by PT Thomas, answered by Prithviraj Chavan on November 10, 2010.
41. *Lok Sabha Debate*, "Nuclear Waste", Unstarred Question no. 3419, answered on April 25, 2012.

Reportedly, India has begun scouting for deep underground sites to build a repository about one km below land surface and is also setting up a laboratory to develop the required technology.[42] The waste is planned to be disposed "at a depth of 800-1,000 metres to isolate radioactivity from the environment".[43] The then AEC Chairman Srikumar Banerjee told that the nuclear establishment is "looking for a rock formation that is geologically stable, totally impervious and without any fissures". In that case, the site should not have experienced any event in recorded history and should have a cooling mechanism using air draft. The DAE scientists have begun looking for options that vary from underground storage in rocky central India to plains where the storage may be housed inside layers of clay. Dr Banerjee is quoted saying "We will use an existing underground mine to study conductivity, heat management and percolation and rock stability. The site has to be totally impervious, geologically stable and without any fissure."[44] In their search for such a future repository, scientists have reportedly screened some 600,000 sqkm of India's landmass; mainly zones occupied by granites, and found a few zones between 5 sqkm to 25 sqkm for more detailed studies.[45]

According to K.K. Prasad, the former head Back End Technology Development Division of BARC, the geo-scientific studies for an Underground Research Laboratory (URL) have already been completed.[46] The work related to repository programme in India includes (1) heating experiments by multi heaters and single heater in an abandoned underground mine at Kolar Gold Fields (KGF); (2) site screening, selection and characterisation of host rock are ongoing programmes; (3) ongoing programmes include design and construction of a URL in a captive site. The main goals of the URL programme are:

42. "India to Get First Underground Repository for N-Waste", *Times of India*, May 06, 2012.
43. Lok Sabha Debate, Unstarred Question No.3419, "Nuclear Waste", answered On April 25, 2012. At http://www.dae.gov.in/parlqa/2012/budget2012/lsus3419.pdf, p. 2.
44. Kalyan Ray, "India keen on having nuclear waste repository", *Deccan Herald*, February 12, 2012.
45. G.S. Mudur, Site Hunt for Nuclear Graveyard, *The Telegraph* (Kolkata), February 15, 2012.
46. K.K. Prasad, "Underground Research Laboratory (URL) Programme In India", at http://www.iaea.org/OurWork/ST/NE/NEFW/WTS-Networks/URF/documents/Status/2004/MS/India.pdf

- To develop engineering technology for repository construction, operation and closure;
- To develop the disposal technology and validation of the disposal concept with modeling;
- To develop site characterisation techniques and methodology; and
- To demonstrate the geological disposal to the public and confidence building.

Geologically, India is endowed with a number of suitable rocks to serve as host rocks for geological repository. A few promising areas lying in the North west and Central India, occupied by good quality granites have been systematically investigated. According to BARC, for assessment of the rock mass response to thermal load from disposed waste over pack, an experiment of eight-year duration was carried out at a depth of 1000 m in an abandoned section of Kolar gold mine.[47] Some more in situ experiments pertaining to testing of full-scale engineered barriers i.e. simulated waste over pack, bentonite clay buffers and clays sand admixture, are planned to study the behavior of thermal, chemical, mechanical and hydraulic processes around over pack. Also for development of methodology and technology for charecterisation of field scale fractures as pathways for radionuclide and gas migration, experiments are planned in abandoned underground mines in future.[48]

However, no site for such a repository has been finalised. According to News reports, there were several unsuccessful attempts by authorities during the last few years in Madhya Pradesh's granite belt, in Karnataka's Kolar gold mines, and in Sanawada village in Pokhran district in Rajasthan.[49] To that extent, so far, no country in the world has succeeded in preparing a deep geological repository for nuclear waste. The United States has found no politically acceptable site yet. Work on the proposed site at Yucca Mountain has been controversial. However, if DAE succeeds in such an endeavour, "India will help boost people's

47. "Waste Management: Disposal of Radioactive Waste", Nuclear Fuel Cycle, *BARC HIGHLIGHTS*, at http://www.barc.ernet.in/publications/eb/golden/nfc/toc/Chapter%2017/17.2.pdf
48. Ibid.
49. Rashme Sehgal, "India Needs Proper N-Waste Disposal Tech", *The Asian Age*, May 13, 2008.

confidence in nuclear energy" says C. Ganguly, former head of Nuclear Fuel Cycle and Materials section at the International Atomic Energy Agency (IAEA) in Vienna.[50]

URANIUM MINING AND WASTE DISPOSAL

At present, India does not have sufficient domestic uranium supply that is capable of supporting its nuclear energy expansion programme. India's target to produce 10,000 MWe by 2020 would be entirely unachievable without a three-fold increase in uranium supply. In this pursuit, India is building up civil-nuclear cooperation networks with around twenty countries. Meanwhile, it is exploring new uranium reserves within the country. Indigenous output can only triple if the mines located in different states are approved and achieve full production, although presently they are only in the initial stages of exploration. However, there are many difficulties involved in exploring the new found reserves. Technologically, there are constraints in locating large tonnage high grade uranium deposits in the country; this may lead to dependence on exploiting more of low-grade, low-to-medium tonnage deposits. Socially, the negative perception about mining as a polluting industry, exaggerated safety concerns regarding tailing ponds, and spreading of misinformation by activists are major hurdles that require effective and urgent solutions.[51]

50. Ray, 2012, n. 45.
51. "Uranium Mining & Milling Industry in India", at http://www-pub.iaea.org/mtcd/meetings/PDFplus/2009/cn175/URAM2009/Session%201/9_63_Gupta_India.pdf

State-wise Uranium Reserve in India

Source: http://www-pub.iaea.org/mtcd/meetings/PDFplus/2009/cn175/URAM2009/Session%201/9_63_Gupta_India.pdf

As per the IAEA *Red Book*, the total Uranium reserve in India as on March 2007 is 1,07,268 te. In 2011, the DAE, after several years of survey, found that the Tumalapalli mine near Hyderabad (Andhra Pradesh) could be world's largest uranium reserve. It could provide up to 49,000 tons and there are indications that the total quantity could be as large as three times that amount (150,000 tons).[52] The Uranium Corporation of India (UCIL) in late 2011 has commissioned an underground mine and processing plant at Tummalapalle. But, anti-mining protests were triggered by the reported large-scale death of fish in the Ranikor River, allegedly from toxic waste caused by drilling and dumping into the river. The local government officials ruled out radiation poisoning as the cause, rather some officials claimed that miscreants had dumped poisonous materials into the river to

52. "Largest Uranium Reserves Found in India", *The Telegraph*, July 19, 2011.

create a scare and scuttle the mining project.[53]

Such incidents are no more sporadic in India these days. Since 1996, the Domiasat Uranium mining project has been stalled by large public protests, triggered by concerns over radiation. The National Alliance of Anti-Nuclear Movements (NAAM) organised a rally in Delhi in October 2009, supporting the Khasi Students Union's anti-uranium mining crusade. At Jantar Mantar, speakers from Meghalaya, Karnataka, Andhra Pradesh and Jharkhand highlighted the ill-effects of uranium mining and the dangers of setting up of nuclear power plants.[54] In Karnataka, the Gogi and surrounding village residents demanded relocation before start of uranium mine as they are worried about the consequences for future generations.[55]

There are also reported incidents of mining and waste management related incidents that have spread panic and resentment among local population. For example, an accident that occurred on December 24, 2006 near Jaduguda when one of the pipes carrying radioactive wastes from the uranium mill to a tailing pond burst, and thousands of litres of radioactive waste spilled into a nearby creek for nine hours before the flow of the radioactive waste was shut off.[56] While the DAE officials have called it a "small leak" and of no risk to anyone, the local population and the anti-nuclear lobby viewed it as a threat to the health of thousands of villagers who are "living in the deadly shadow of uranium".[57] There are many other reported issues like uranium mill tailings spillover during flash floods, concentration of uranium in local water sources, congenital deformities, sterility, cancer among people living within 2.5 km of the mines that have generated critical debate on uranium mining safety and waste management in India.

53. "Uranium Projects Show India's Nuclear Ambition Undiminished", at http://www.cleanbiz.asia/story/uranium-projects-show-india%E2%80%99s-nuclear-ambition-undiminished, May 02, 2012.
54. *The Telegraph*, October 02, 2009.
55. *Deccan Herald*, September 10, 2011.
56. U.A. Shimray, M.V. Ramana, "Uranium Mining in Meghalaya: Simmering Problem", *Economic & Political Weekly*, December 29, 2007, pp. 13-17.
57. Harsh Kapoor, "TS: Living in the Deadly Shadow of Uranium", *The Toronto Star*, October 10, 2010.

The nuclear establishment asserts that all uranium mines operations, including the Jaduguda, are safe.[58] Contrary to the allegations of no independent survey is conducted by UCIL or DAE, there were in fact two independent surveys commissioned: the first one was by the faculty from Radiotherapy and Radiology Department of the Patna Medical College and the second survey was undertaken by a medical team composed of civil surgeon, physician and nuclear medicine specialists from the Tata Main Hospital, Jamshedpur and Senior Medical Officer from the Mercy Hospital. Both the surveys found that all reported diseases are caused due to thalassaemia, chronic malaria, and malnutrition and alcohol drinking.[59]The Environment Survey Laboratory collects the environmental samples for analysis and found that concentration of uranium in Gara Nala, Subernarekha River, Gara River, etc. have been always less than the limits set by AERB and WHO. The Health Physics unit regularly monitors the concentration levels and discharges if any and ensures that the activity is not polluting the environment in any way.[60]

Advanced and systematic techniques are followed in the waste management at uranium mining areas: (1) waste rock of mines are used for back-filling of stopes; (2) coarser fraction tailings (deslimed) are used for back-filling; (3) slimes are stored in impoundment facility (Tailings Pond); and (4) plant effluent are treated before discharge to public domain. The tailing ponds are well engineered with natural barriers on three sides; channel ways and well-laid drainage system for discharge of effluents; and reclamation of Tailings pond after use with soil cover and plantation is strictly carried out.[61] Newer concepts like TTD System are under implementation to minimise the tailings pond area as the production and processing of large quantity of ore results in generation of large volume of tailings.

58. "Jaduguda Operations Safe", *The Hindu*, April 09, 2000.
59. Ibid.
60. Ibid.
61. "Uranium Mining & Milling Industry in India", at http://www-pub.iaea.org/mtcd/meetings/PDFplus/2009/cn175/URAM2009/Session%201/9_63_Gupta_India.pdf

INDIA'S GORDIAN KNOT?

There is no international consensus regarding the best technological solution for waste disposal.

Problems associated with radioactive waste management on a long-term are major ones that humanity has not been able to come to terms with so far. Although, there are undoubted technical solutions to finding various disposal routes for radioactive wastes, like shallow burial, deep mines, disposal under the sea-bed, and even shooting them to sun, amicable disposal options are comparatively limited. Even in the USA, shallow burial sites have been closed following the discovery of poor containment of wastes and sloppy management. In January 2012, the Blue Ribbon Commission concluded that there is no alternative to burying the waste underground. Sweden, France, UK, etc. are opting for the deep burial option as well. However, there is no international consensus regarding the best technological solution for waste disposal. The options available are also enmeshed in the dichotomy between scientific understanding and human values.

India, in this context, though does not feel the heat of nuclear waste at this stage as the volume piled up is comparatively small, it may become a Gordian Knot in the decades ahead for many unique issues. First, with the increasing institutionalisation of anti-nuclear movements in India, the trend in opposition from "Not In My Back Yard" (NIMBY) is likely to shift towards "Not In Anyone's Back Yard" (NIABY). Though India has variety of land and rock forms to build a geological repository, the issue of burying hazardous waste for future generations and guaranteeing an institution which can survive and be responsible for 1,000 years to safeguard the repository would pose serious hurdle for arriving at a national consensus. Second, the management of waste generated out of the reactor operations in India though perceptibly well planned and may not pose any problem for the next few decades, waste out of uranium mining projects and new exploration activities may experience strong social discontents. As quality of uranium reserve in India is poor and more quantity of ore to be processed to obtain a small quantity of Uranium, the amount of tailings produced

in the process would be much more. This would pose bigger challenge for the industry to manage. Third, most of the uranium reserves in India are located in areas where tribal population lives who may not agree to vacate. As rehabilitation issues related to developmental projects in India in the past have become very contentious, uranium exploration induced displacement of local population in future would lead to further escalation of public resentment. Fourth, rampant corruption in every sector in India brings home the fear that, nuclear waste management undertaking may not be spared. Will India be able to set up an institution, for upkeep of deep buried radioactive waste, which has to survive for centuries without dilution of its integrity? Lastly, uranium is a strategic mineral and hence the property of the union government. But, state governments are poised to play greater role in future where conflict among states and union government over management of social acceptance of nuclear projects may arise. This would further delay the nuclear energy programme. Therefore, instead of slicing hurriedly the nuclear waste management spiral, India must untie the knot deftly and painstakingly before it becomes the Gordian. This can be managed by evolving a well-structured 'nuclear information management system' and a value-based 'Corporate Social Responsibility Culture' in the country.

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