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(July-September)



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CENTRE FOR AIR POWER STUDIES, NEW DELHI



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Journal of Air Power and Space Studies

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AIR POWER

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EDITOR'S NOTE

Just before this issue of the Journal was readied for the press, the Centre for Air Power Studies (CAPS), in association with the Indian Air Force (IAF), and Confederation of Indian Industries (CII) organised the 11th in the series of an annual conference on Energising Indian Aerospace Industry. The sub-theme for the conference this year was "The Changing Environment". The inaugural address was delivered by the chief of the air staff and we carry it as the lead article. The air chief emphasised the need for rapid indigenisation and explained what the government and air force is doing to help bring it about. The address set the tone for a rather successful conference.

Cruise missiles that can fly under the radar to attack targets at long distances represent an important addition to a country's armoury. Modern cruise missiles are more capable and the high speed varieties pose an even more serious challenge to the adversary's air defence systems. The missiles can be launched from the air, ships, submarines and can be land-based as well. Now mobile containerised versions are also available. In our region, cruise missiles are proliferating and **Dr Manpreet Sethi** examines the role and impact of such a weapon system. She deliberates over the advantages that cruise missiles enjoy, the capabilities in this field of Pakistan and China, and the role they are expected to play in the military strategy of these countries. The section on imperatives for India is perceptive.

China continues to interest the global strategic community and its continued exhibition of brinksmanship has raised concerns in many countries. It is true that, since 1979, China has not militarily used the ever increasing might of the People's Liberation Army (PLA) but the continuing and rapid increase in diverse military capabilities has to be included in the security calculus of its neighbours and other possible adversaries. This does not imply

that other countries will be forced to accept Chinese dictates or that China militarily attacking another country is a probability in the near or mid-term, but such growth in military might should caution others and goad them into formulating plans and acquiring the wherewithal needed to combat possible Chinese designs. To do so, continued study of China is needed and this issue has three articles on differing aspects that impinge on the Chinese growing capabilities or intentions, and by inference, the likely Chinese designs.

In December 2015, the Chinese military underwent a major reform. One noteworthy change was the creation of a new independent Service. The erstwhile Second Artillery Force that operated as an independent arm of the PLA was given the status of an independent force and the title of PLA Rocket Force. China's military strategy has always relied heavily on its missiles and an independent Service gave it that status. The change is more than a mere change of name. The PLA Rocket Force will now control both types of missiles, conventional missiles and missiles that are nuclear tipped. The situation can cause some ambiguities in the minds of the targeted countries on the type of ordnance in flight, but as long as the doctrines and strategy of the targeted country are well reasoned, there should be no cause for any additional concern. **Gp Capt Chatwal** discusses the composition of the PLA Rocket Force, its bases, and suggests some measures that India should adopt to mitigate the impact of Chinese missile capability.

On November 23, 2013, China surprised the world by unilaterally establishing the Air Defence Identification Zone (ADIZ) that covered a major part of the East China Sea. The announcement was met with both surprise and chagrin, particularly as the Chinese ADIZ overlapped the Japanese ADIZ. The purpose was obvious as the Chinese ADIZ covered the Senkaku Islands that are claimed by China but administered by Japan. The announcement elicited many queries on the meaning of an ADIZ, its import, and whether China had the right to establish one. **Gp Capt Tanmay Sharma** looks at the concept of ADIZ, some historical issues, the rules that China expects others to abide by, and how some of the rules are over and above the rules stipulated by other countries for flights through their designated ADIZ. Will China establish an ADIZ in the South China Sea as well and for the same reasons?

It was widely believed that after the Permanent Court of Arbitration gave its award on the Philippines-China- South China Sea dispute, China would announce the new ADIZ. This has not happened but the author examines the issue in some detail to assess the viability of such a move and whether it will be in China's interest to make any such announcement. The arguments advanced make interesting reading.

The third article on China is by **Dr Temjenmeren Ao**. Taking a vastly different theme, the author discusses the soft power of China. Terms and phrases generally associated with China are far-sightedness, economic power, military prowess, aggressive behaviour, opportunism, etc but soft power is not spoken of too often. The author argues that the great economic progress made by China has also heightened the appeal of China in the minds of others but appeal based on economic gains can be transient. He briefly traces the history of China's economic progress and suggests that the Chinese government has recognised that a soft approach also has value and politico-cultural influences have a role to play. Yet, the lesser powers in the region are apprehensive of China's growing power and suspicious of Chinese plans, and these aspects attenuate the gains that Chinese soft power may be able to achieve.

The Indian region is prone to natural calamities. The Indian armed forces have often been called upon to render humanitarian assistance to beleaguered people. **AVM Rajesh Isser**, a serving officer with vast experience in providing Humanitarian Assistance and Disaster Relief (HADR), discusses the theory, planning and preparedness required for effective disaster management. The article is well reasoned and comprehensive. It is inevitable that nature will test us again and occasions will arise where humanitarian assistance becomes an urgent necessity. The author shows us the way forward and his views should form part of essential learning for those who may be called upon to undertake or plan HADR operations. In fact, the article can form the basis of policy formulation on the subject.

The production of Unmanned Aerial Vehicles (UAVs) is on the increase and so are the different types of missions to which they can be beneficially tasked. Although UAVs started as an option that could partially replace manned combat aircraft, their commercial value soon manifested itself. Commercial aspects often

dictate governmental policy. Hence, when it was decided that commercial and military aircraft could, with some care, use the same air space, a piquant situation was forecast where operators of UAVs would also ask to be allowed to use the same air space concurrently. Thus, was born the need to assess how UAVs could be allowed to operate in a common non-segregated air space. The challenges are many and a number of agencies are seeking solutions. **Gp Capt Narang** looks at the work done or being done in different countries, particularly the USA. He discusses the technological and regulatory challenges that are indeed daunting. It requires a near leap of faith to believe that human ingenuity can find solutions to some seemingly intractable problems but then humans have been known to find answers to what were once assumed to be impossible tasks.

History is always of interest, particularly as it gives a better understanding of how and why events occurred. Such information can then be extrapolated to the present and the future. **Wg Cdr Nijjar** has undertaken a study on helicopters. In an article in this issue, he describes the evolution of the helicopter force in India, from inception up to, and including, the helicopter operations during the 1971 conflict with Pakistan that led to the birth of Bangladesh. In a well-researched and well written article, the author shows how the helicopter force developed from very humble beginnings into a force to reckon with. The reader is left asking for more and the author will certainly cover the further history in subsequent issues of the Journal.

The last article is by **Jai Raina** on India's relationship with the nuclear Non-Proliferation Treaty (NPT). Jai is a young law student who interned with us for a month or so and effectively used the time to research into the subject and produce an article that we are happy to publish. If he continues to maintain the same level of scholarship, he has the promise to write many more articles of quality.



Happy reading.

ENERGISING INDIAN AEROSPACE: THE CHANGING ENVIRONMENT

**ADDRESS BY THE CHAIRMAN, CHIEFS OF STAFF
COMMITTEE (COSC) AND CHIEF OF THE AIR STAFF, AIR
CHIEF MARSHAL ARUP RAHA, PVSM AVSM VM ADC**

INTRODUCTION

Air Mshl Vinod Patney, director general, Centre for Air Power Studies (CAPS), Shri T Suvarna Raju, chairman, Confederation of Indian Industries (CII) National Committee on Aerospace, and Chief Managing Director (CMD), Hindustan Aeronautics Limited (HAL), Shri Sujith Haridas, Shri SP Shukla, former air chiefs, distinguished members from the Indian corporate sector and aviation industry, serving and retired officers from the army, navy and Indian Air Force (IAF), ladies and gentlemen. I wish to convey warm greetings of the day to everyone present here. It is, indeed, a privilege and an honour to be here this morning amongst such a distinguished and eminent audience to talk on “Energising Indian Aerospace: The Changing Environment”.

THEME OF CONFERENCE

The theme of the conference is apt and contemporary considering the revitalised initiative on ‘Make in India’ and enhanced focus on the growth of the Indian aerospace industry. This initiative, coupled with the rapidly

Air Chief Marshal **Arup Raha** PVSM AVSM VM ADC is the Chairman, Chiefs of Staff Committee (COSC) and Chief of the Air Staff, India.

expanding Indian aerospace market, both military and civil, is likely to generate a huge demand for aerospace platforms, propulsion systems, avionics, aero-structures, simulators, other equipment and Maintenance, Repair and Overhaul (MRO) services. Such seminars will go a long way in understanding the issues involved, germinating new ideas, making recommendations and a roadmap to bolster India's efforts in developing a self-reliant aerospace industry. The growth projections for the aerospace industry in India are staggering, given the likely economic growth trajectory and India's security concerns and demographic realities. India will be the most populous country soon, with a large young workforce, a bulging middle class with rising aspirations, and a sustained economic growth, and this will boost civil aviation exponentially, connecting the 2nd tier of cities and metros.

HISTORICAL LEGACY

India always believed in peaceful coexistence and economic development. The foreign policy too focussed on the Non-Aligned Movement (NAM) and the role of military power, which includes aerospace power in Comprehensive National Power (CNP) to deter conflicts and maintain a conducive environment for economic growth, was, at times, underplayed. Civil aviation was considered a luxury, meant only for the rich and the powerful which stunted its growth potential.

INDIGENOUS EFFORT

Post independence, a lot of effort was in place to achieve self-reliance in defence hardware and several Defence Research and Development Organisation (DRDO) laboratories and Defence Public Sector Undertakings (DPSUs) were established. However, self-reliance in core technologies, especially in the aviation sector could not be achieved, despite HAL being the biggest aviation sector industry in the region. On the other hand, the success achieved by the Indian Space Research Organisation (ISRO) can be attributed to adequate funding, fast track approval of projects, and good leadership, with expert domain knowledge.

WHY INDIGENOUS?

As India's economy grows and her 'Comprehensive National Power' increases, India will be called upon to play a greater role in global affairs. India is well on her way to becoming a regional power and in the near future, would transform into a global power. With growing power comes greater responsibilities and we are already seeing this, as India is looked upon as a 'net security provider' in the Indian Ocean Region. To be a credible power, India needs to have a diverse range of capabilities of which aerospace capability is a key component. With its unique characteristics of flexibility, responsiveness and reach, aerospace power is more often than not, the preferred option for the nation's leadership for expeditiously mitigating emergent security challenges and contingencies, in both war and in peace. India is recognised as a leader in Humanitarian Assistance and Disaster Relief (HADR) operations because of its strategic reach through aerospace capabilities. The C-17, C-130, IL-76 and medium lift helicopters have conducted intensive and extensive HADR operations both within the country and abroad. The very nature of aerospace platforms and associated equipment, both military and civil, makes it the incubator of leading edge technologies and manufacturing processes. It is imperative that we as a nation are self-reliant in a majority of these core technologies. Only then can we attain true strategic autonomy and meet our aim of being a credible aerospace power.

INDIGENOUS DEFENCE INDUSTRY

India continues to be one of the largest importers of defence equipment. Even for the defence equipment and systems that are produced within the country, there is a sizeable dependency on foreign Original Equipment Manufacturers (OEMs) for their sub-systems and components. The story remains similar in the civil aviation sector. Reliance on substantial imports also has costs other than loss of strategic autonomy. It results in a significant portion of the defence budget getting consumed towards procurement from foreign OEMs. With the high cost of imported defence equipment and reducing defence budgets, this adversely impinges on the

numbers that can be procured and, hence, on our capacity development. In addition, associated spinoffs like generation of employment in a country with a large demographic bulge, technology gain in critical sectors, and commercial and strategic gains from export of defence equipment are lost.

ENVIRONMENT

The lack of adequate growth in the aerospace sector was due to many environmental factors like lack of technology available in the country, inadequate capital to invest in projects, inadequate infrastructure and, most importantly, lack of research and innovation. However, the environment has changed substantially in the recent times, due to various policy initiatives that have been taken by the government as well as by the IAF in this regard.

GOVERNMENT POLICIES AND INITIATIVES

The 'Make in India' initiative has been path-breaking in its vision of enhancing indigenous manufacturing capabilities. In addition, the new Defence Procurement Procedure (DPP-2016) and the amended Offset Policy would certainly facilitate a smoother transaction of procurement. The new policy addresses crucial challenges in defence procurement and creates a level playing field for the private sector. The introduction of the 'Buy-Indigenously Designed Developed and Manufactured' category, reducing the timeframe for Acceptance of Necessity (AoN) and the fast track route are expected to give a boost to the Indian industry. The policy to allow 100 percent Foreign Direct Investment (FDI) in the defence sector with government approval is also an important initiative. The government is also encouraging collaboration between the public and private sector companies for defence exports based on the Public Private Partnership (PPP) model. The strategic partners concept/model is another positive step taken by the Ministry of Defence (MoD) in creating capacity in the private sector. The policy framework for implementation of the strategic partnership model in aircraft, helicopters, submarines, armoured vehicles, and ammunition

including smart ammunition, is presently under formulation. The new policy on export of military equipment to friendly countries will provide a larger market for the industry.

IAF POLICIES AND INITIATIVES

I would also like to highlight the initiatives that have been taken by the IAF in this regard. Procurement of new equipment, maintenance and sustenance of legacy fleets and systems operated by the IAF offers a huge opportunity for indigenous development. The recent induction of the indigenous Light Combat Aircraft (LCA) 'Tejas' into the IAF and placement of orders for 120 Tejas aircraft is testimony to this initiative. In addition, the IAF has already inducted the HAL-built advance light helicopters in large numbers and will soon induct the light combat helicopters and HTT-40 basic trainers. The recent push by the IAF for manufacture of a modern transport aircraft in India by an Indian private sector company and the plan for the next fighter proposed for induction in the IAF to be through the 'Make in India' route are other big ticket projects on the anvil. The IAF is also wholeheartedly supporting and effectively contributing towards design, development and testing of indigenous weapons like the Astra, Nirbhaya and Aakash missiles, and several types of indigenous radars as well as communication systems.

To have greater clarity in the industry so that it can map its capability development with the requirements of the Indian Air Force, the 'Indigenisation Roadmap Indian Air Force (2016-2025)' was released in April this year during a seminar in Delhi, jointly organised by the IAF and CII. This was aimed at providing an insight into the IAF's indigenisation requirements for the next ten years and the opportunities it offers to the industry. This booklet has enabled the environment to get a better insight into the IAF's requirements and improved mutual interaction. As a result of concerted efforts, the IAF has been able to achieve indigenisation of more than 90 percent of the mandatory and Automatic Replenishment System (ARS) spares for a significant proportion of its fleets. However, many spares have not yet been indigenised due to either complexity of

the item or non-availability of the technology. There is still a large number of rotables and Line Replaceable Units (LRUs) for different aircraft fleets and systems, for which repair and overhaul facilities have not yet been set up in the country.

The defence MROs in the private sector in India are in an infant stage and need to grow at a much faster pace in the coming years. The concept of MRO is not new to the IAF and its Base Repair Depots (BRDs) perform the full range of MRO functions. These captive MROs were created as defence technology was exclusive and enough expertise was not available in the private sector within the nation. Also, we were bound by contract with the OEMs and Transfer of Technology (ToT) to Indian industry was constrained. However, now the situation has changed and creating a defence MRO in the private sector has not only become a reality but is also being facilitated by liberal government policies. Downsizing of the armed forces and improving the teeth-to-tail ratio is the order of the day: this would be achieved through outsourcing and long-term business commitments from the industry. The Indian industry has the opportunity to explore setting up of MRO facilities for the IAF in airframes and aeroengines, mechanical and electronic rotables, test equipment and ground support equipment and airfield safety systems.

INITIAL RESPONSE OF INDUSTRY ENCOURAGING

The impetus to increase the participation of indigenous industries has already started bearing fruit as several large domestic private sector groups and companies have entered the sector in the recent past. The business model should be based on long-term commitments and not immediate or short-term commercial benefits. Also, leading global OEMs have either established or are in the process of establishing their presence through Joint Ventures (JVs) with Indian companies. These are encouraging developments. However, to truly emerge as a credible aerospace manufacturing hub, many challenges still need to be overcome.

CHALLENGES

One of the biggest challenges for the aerospace industries would be the absorption of high-end niche technologies with which the aviation sector is closely associated. The industry would have to develop capabilities in terms of infrastructure and skilled and trained manpower. Another challenge is the non-availability of the required material and manufacturing technology in the country, especially for airborne equipment. Unless we develop these technologies within the country, we would remain dependent on foreign sources. Due to the very nature of its usage, aviation equipment has to meet highly exacting standards and stringent airworthiness certification. Accordingly, requisite quality assurance infrastructure would also have to be created. Indigenisation activity involves Research and Development (R&D), making it vulnerable to longer timeframes and uncertainties. The indigenisation efforts should have detailed planning and realistic timeframes projected so that fructification takes place in a timely manner. Delays in product deliveries have huge commercial significance for the civil aviation sector and even greater strategic and security ramifications for the air force and the nation. It is not viable for any single industry to start manufacturing finished aerospace products overnight. While the larger industries may be able to afford the funds and resources, the Medium, Small and Micro Enterprises (MSMEs) may not be able to afford them. Therefore, it is important for the larger industries to form an efficient supply chain through hand-holding of smaller MSMEs and create a self-supporting eco-system to sustain the product manufacturing.

CONCLUSION

The indigenous development and manufacturing of aerospace products is of great significance and needs to be pursued wholeheartedly. The environment is transforming, and enabling policies and initiatives by the government and by the IAF have set the stage. The concept of indigenisation in the IAF has metamorphosed into a broader idea that enables participative collaboration with the Indian industry. In our path

of transformation, we seek a high degree of availability, reliability and maintainability of all our assets. The industry needs to fully exploit the opportunities being created.

My compliments to the Centre for Air Power Studies and the Confederation of Indian Industries for having come together to address this pertinent issue. This conference may well be a catalyst in kick-starting a new era in indigenisation of vital aerospace technologies. Interactions such as these have the capability to grow into solid partnerships of the future and I invite all stakeholders to be our valued partners in this endeavour. Once again, I assure you of the unstinted support of the IAF and earnestly look forward to the emergence of a vibrant world class Indian aerospace industry.

Jai Hind!

CRUISE MISSILES: NEW CONCERNS IN INDIA'S THREAT ENVIRONMENT

MANPREET SETHI

Technological advancements in the military domain are progressing at an all time high in the 21st century. New weapon systems, as well as more sophisticated versions of existing weapon systems, are all vying for military attention and budgets. Amongst these, one weapon technology that is fast acquiring a formidable reputation and profile is the cruise missile. Of course, this is not a new technology. In fact, such missiles have been around since the 1970s. But, ironically, at the time, they were described as “weapons without a clear mission”¹. Much has happened since then for cruise missiles to acquire multiple roles and emerge as weapons of choice across nations.

In India, the supersonic, 290 km range cruise missile, the Brahmos, is deemed a big hit with the armed forces. The army already has three regiments equipped with the Block I and II variants of the Brahmos and recent reports have indicated the government's go-ahead for the induction and deployment of the more advanced steep dive, manoeuvrable Block III version for mountain warfare in the northeastern part of the country.² The naval version of the missile is already deployed on 10 warships and the air-launched Brahmos is in the process of undergoing testing from Su-30s.

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1. Rose E Gottemoeller, “Land Attack Cruise Missiles”, *Adelphi Papers* 226 (London: International Institute for Strategic Studies, Winter 1987-88), p. 3
2. Rajat Pandit, “Army to get Steep Dive Brahmos Missile Regiment for China Front”, *The Times of India*, August 4, 2016

The strategic force postures of Pakistan and China are beginning to reflect a much larger footprint of cruise missiles in terms of their capabilities, numbers and types.

Across Indian borders also, on both the east and the north, cruise missiles are making their presence felt. The strategic force postures of Pakistan and China are beginning to reflect a much larger footprint of cruise missiles in terms of their capabilities, numbers and types. Declared with a dual role capability in both these countries (unlike the case in India which has declared the Brahmos for conventional deterrence), these missiles signify a new element in the nuclear triads even as they add a host of complexities to conventional warfare.

However, the attention being devoted to these new developments is not apace with the rate at which these are occurring in India's neighbourhood. The more glamorous ballistic missiles have evoked greater interest. But the future seems to indicate a greater role for cruise missiles. As Dennis Gormley wrote in 2006, "Flying under the radar, both literally and figuratively, cruise missiles potentially present a far more pressing threat than their ballistic counterparts and the US quest to sell BMD is making matters worse"³. Indeed, most contemporary justifications for cruise missiles are being pinned on the need to negate the adverse implications of the Ballistic Missile Defence (BMD) on nuclear deterrence.

Consequently, over the last decade, the spread of these missiles has been significant. There are several attributes of the cruise missile that make it an attractive investment for militaries. This paper briefly identifies these. The larger focus of the paper, however, is on examining the current capability and future focus areas of Pakistan's and China's cruise missile developments. How are they seemingly integrating these into their militaries, including nuclear strategies? Given that no missile of any kind has ever been used in the region in past wars, and even the use of air power has been constrained owing to its escalatory potential, will countries be inclined to use cruise missiles? Or will this too breach a psychological threshold? Will the use of cruise missiles

3. Dennis Gormley, *Missile Contagion: Cruise Missile Proliferation and the Threat to International Security* (Westport, CT: Praeger Security International, 2008).

be seen as less escalatory than ballistic missiles? Most importantly, what does all mean this for India's security? What specific steps are needed to address this new challenge? This paper is an attempt to examine these questions.

ADVANTAGES OF MODERN CRUISE MISSILES

Modern cruise missiles offer six main advantages. Firstly, they are far more technologically and financially within the reach of nations compared to building and maintaining expensive air forces and ballistic missiles.⁴ They have even been referred to as a poor nation's air force. They are easy to acquire and operate, requiring no major specialised training as is necessary for flying combat aircraft. Neither are the technologies involved as sophisticated as in the case of ballistic missiles. Secondly, cruise missiles offer the advantage of evading detection as they speed towards their targets. Owing to their ability to fly at low altitudes, they can keep themselves well below ground-based radar horizons. With a small radar-cross section, such missiles can successfully avoid detection and penetrate enemy air defences. Thirdly, as compared to ballistic missiles reliant on conventional inertial guidance with the help of gyroscopes, cruise missiles offer the possibility more accurate navigation/guidance if equipped with Terrain Contour Matching (TERCOM) systems, on-board computers, and a radar altimeter that correlates data received from altimeter readings with maps in its memory. They could even be satellite linked, thereby further improving their accuracy, and making them suitable for hitting out at many alternative targets. The fourth gain of cruise missiles emanates from the deployment flexibility that they offer

Owing to their ability to fly at low altitudes, they can keep themselves well below ground-based radar horizons. With a small radar-cross section, such missiles can successfully avoid detection and penetrate enemy air defences.

4. According to one estimate, a Western cruise missile is available for anything between \$0.5 to 2 million, depending on its capability. Those from China are in the market at far lower prices, even a few hundred thousand dollars. For more, see Brian A Jackson, David R Frelinger, Michael J Lostumbo and Robert W Button, *Evaluating Novel Threats to the Homeland: Unmanned Aerial Vehicles and Cruise Missiles* (Santa Monica, CA: Rand Corporation, 2008), p. 6.

owing to their ability to be used from land, air or sea-based (surface and sub-surface) platforms. Fifthly, the missiles can carry variegated types of payloads – conventional, nuclear, chemical or biological. In the initial years, cruise missiles were relatively slow delivery platforms and were, hence, considered unsuitable as first strike nuclear weapons. But this situation has completely changed today with the development of supersonic cruise missiles and hypersonic versions on the anvil. Lastly, since they are lighter and can be placed in canisters, they are highly mobile, easier to handle and more suitable for shoot and scoot tactics. In fact, a major advantage of these missiles from the military point of view is the relatively limited support requirements for the mobile, ground-launched versions. A smaller logistics requirement enhances mobility which, in turn, enhances their survivability.

Given the above attributes, it is hardly surprising that cruise missiles have emerged as multi-purpose platforms that can be used for a variety of missions. Naturally then, they are being considered as a valuable strategic supplement to ballistic missiles in terms of nuclear deterrence, as well as being drafted for a clear role in conventional war-fighting strategies. Their use in the first Gulf War, and subsequently in Iraq and Afghanistan, demonstrated their offensive capability and utility.

In India's neighbourhood, these weapon systems are now beginning to make their presence felt. While China has had cruise missiles for a long time, it is only in the 2000s that newer and more effective variants entered its arsenal. In the case of Pakistan, the development is still more recent and the capability is slowly but steadily becoming operational. It is critical that the cruise missile capability build-up in these two countries, which are of the greatest national security significance for India, is consistently monitored so that an informed understanding of the threat scenario can enable the correct choice of responses.

PAKISTAN'S CRUISE MISSILES : CURRENT CAPABILITY AND FUTURE FOCUS

The presence of cruise missiles in Pakistan is only about a decade old. It was in 2005 that, for the first time, Pakistan declared the test of a ground-launched cruise missile, the Babur. But since then, the capability has shown

rapid development and the envelope has extended to include an air-launched cruise missile too, the Ra'ad. The two missiles have undergone as many as 15 tests over the last ten years.

Pakistan claims the Babur to have been indigenously developed by its National Engineering and Scientific Commission (NESCOM), which was established in 2001. It may be recalled that during the 1990s, Pakistan had expressed keenness to get off-the-shelf Land Attack Cruise Missiles (LACMs) and had hit upon Ukraine as a source. By August 2001, the engineering design of one such missile, the Korshun, had been smuggled out of Kiev as part of an effort led by AQ Khan that had been going on since 1997.⁵ China and Pakistan are believed to have collaborated (reverse engineered) to create their own versions of this missile, including using the six American Tomahawks launched on targets in Afghanistan in 1998 that had fallen into the hands of Pakistani scientists. As Gormley writes, "Given the unreadiness of Pakistan's purely indigenous capabilities to undertake a sophisticated LACM program entirely on its own, it appears reasonable to believe that the Chinese government or its military-industrial entities assisted Pakistan in acquiring a LACM capability".⁶ According to some reports, the Chinese created six prototypes of their version, called the DH 10A, which began to be tested from 2004 onwards.⁷ One of this was tested in early 2005 and became the Babur. China also gave NESCOM the production engineering designs as well as the moulding/machining/milling tooling necessary for fabricating the sub-assemblies of the missile.

After having been tested at 500 km range and subsequently at 700 km, the Babur is believed to have been in service from 2010 onwards. It can carry conventional and nuclear payloads [10-30KT(Kilo Tonne)].⁸ According to press releases issued by the Inter-Services Public Relations (ISPR)⁹ after each test, the missile has a high subsonic speed of 880 km/h provided by a

5. Prasun K Sengupta, "Trishul: Babur LACM and Ra'ad ALCM Detailed", blog by Sengupta, posting of December 10, 2008, available at <http://www.trishulgroup.blogspot.in/2008/12/babur-lacm-raad-alcml-detailed.html>.

6. Gormley, n.3, pp. 84-85.

7. Sengupta, n. 5.

8. Naseem Shah, "Babur Missile Vs Brahmos Missile", Pakistan Defence Forum, Web Discussion, January 2, 2013.

9. One such ISPR Press Release is No. PR 135/2012, May 31, 2012, available at <http://www.ispr.gov.pk>. Accessed on March 31, 2014.

turbofan engine. Once thrown out by a booster rocket that provides additional thrust to accelerate the missile away from the launch vehicle, it moves along a low-level, terrain-hugging trajectory that enables it to avoid radar detection. It uses a special high-density blended aviation turbine fuel that has more energy for a given volume than standard fuels, and can endure harsh weather conditions and long storage periods. The ISPR claims also equip the Babur with an advanced and modern navigation and guidance system which combines the Inertial Navigation System (INS), Terrain Contour Matching (TERCOM), Digital Scene Matching and Area Co-relation (DSMAC) and Global Positioning System (GPS) satellite guidance! It is being speculated that in the future, Pakistan will also make the missiles GLONASS, Galileo or Beidou enabled!!

The ISPR also attributes a high degree of manoeuvrability to the Babur. In fact, if the claims are to be believed, the radar altimeter enables the missile “to fly as low as 20 m over water, 50 m over moderate hilly terrain, and 100 m over mountains, making it impossible to be detected with ground-based radars. The turbofan engine is capable of flying a cruise missile up to 2,000 km ranges at low altitude and 50 per cent more, if the first 1,500 km is flown at higher altitude with the rest at tree-top level.”¹⁰ Such assertions do appear to be currently beyond the capability of Pakistan, especially since China too is yet to operationalise such TERCOM and DSMAC enabled missiles. But there is no doubt that these capabilities are on the wish list of Pakistan.

Meanwhile, it is worth noting that the Babur does enjoy the advantage of being road mobile, launched as it can be from a three-tube assembly mounted on a truck. The Transporter-Erector-Launcher (TEL) is reportedly a Chinese reverse-engineered variant of an 8X8 Russian vehicle, but it has been procured by Pakistan from North Korea.¹¹ Amongst other ground support requirements of the cruise missile is a separate 10 KW (Kilo Watts) electrical generator to power the missile's pre-launch operations and two hydraulic pumps to raise the missile canisters to their launch positions. The number of Baburs in service is not known. Some reports suggest that the Pakistan Army has ordered the

10. Pravin Sawhney, “Being Ready for any Eventuality”, *The Pioneer*, June 6, 2013

11. Sengupta, n. 5.

formation of two battalions with cruise missiles, with each having four batteries with six TELs housing 24 Baburs and another 24 reloads.

Relatively less is known about the Raád, an air-launched cruise missile which had been under development since 2003 and was finally tested for the first time on August 25, 2007. The missile was launched from a Pakistan Air Force (PAF) Mirage IIIE or Mirage 5 and declared to have a range of 350 km. It will also be usable from the JF-17 that Pakistan is co-producing with China in large numbers. According to an ISPR statement, the Ra'ad is described as a "state-of-the-art cruise missile with stealth capabilities... a low altitude, terrain hugging missile with high manoeuvrability, and can deliver nuclear and conventional warheads with pinpoint accuracy"¹². In January 2016, the seventh test of the missile was carried out. Given that it enjoys effective standoff range, it may be surmised that it could be used to hit fixed installations such as radar posts, command and communication nodes, ports and refineries or missile launchers, etc.

As far as the sea leg of cruise missile deployment is concerned, Pakistan has procured the C-602 anti-ship cruise missile, with an estimated range of 280 km and a speed of 0.8 Mach, from China. An order for 120 of these had been placed in 2009 and the first batch arrived by 2011. A news report of 2014 stated that the missiles had been deployed on "frontline units of the Pakistan Navy"¹³, making Pakistan the first, and until now, the only, foreign recipient and operator of the Chinese missiles.

Amongst the future areas of focus for Pakistan in its cruise missile capabilities, three can be easily identified. The first of these could be an enhancement of the range of its ground-launched cruise missile. Babur II is slated to have an increased range of 1,000 km and there are reports that Pakistan is working on this with help from Turkey. A second capability on the wish list is a sea-launched variant to be placed on its Agosta submarines after necessary modifications to the dimensions of the missile to fit into the submarine torpedo tube. The tubes are attributed to have a diameter of 533

12. "Pakistan Tests Self-Developed Cruise Missile", *The Hindu*, February 2, 2015. However, South African technical help on this missile is believed to have been used. It bears a close resemblance to the South African MUPSOW and Jorgos missiles.

13. "Pakistan Navy Deploys Chinese C-602 Cruise Missile", *The International News* (Pakistan), April 12, 2014.

That Pakistan considers this weapon system rather seriously is evident from the fact that it has been described as constituting a part of the country's pursuit of full spectrum credible nuclear deterrence against India.

mm while the diameter of the missile is 560 mm. A third development would be of supersonic cruise missiles. High speed with long range would give Pakistan an ideal platform to evade interception and mount surprise attacks. China is known to be working on supersonic and hypersonic cruise missiles and it is not unlikely that these would be handed down to Pakistan at some time in the future.

CRUISE MISSILES IN PAKISTAN'S MILITARY STRATEGY

Having acquired this capability, the important question is: what purpose do cruise missiles serve in the Pakistani military strategy? How does it intend to use this capability? Of course, the impact of these missiles on Pakistan's military strategy will depend on how quickly these evolve and the kinds of capabilities that begin to enter operations. But the issues that need to be considered are their utility as strategic weapons, their role in conventional war-fighting strategies, and the problems of ambiguity if they are used as dual capable platforms.

For Nuclear Deterrence

That Pakistan considers this weapon system rather seriously is evident from the fact that it has been described as constituting a part of the country's pursuit of full spectrum credible nuclear deterrence against India.¹⁴ After one of the recent tests of the Ra'ad in February 2015, the former Director General (DG) of the Strategic Plans Division (SPD), Lt Gen Zubair Mahmood Hayat commended the development for "strengthening Pakistan's full spectrum credible minimum deterrence capability"¹⁵.

Such pronouncements clearly bestow a nuclear dimension to the cruise missile. Apparently, Pakistan wishes to use the threat projection capability of

14. It may be recalled that the Nasr, the very short range ballistic missile that Pakistan has propagated as a tactical nuclear missile, is also a constituent of full spectrum deterrence.

15. n.12.

the missile more for nuclear deterrence than its actual military potential in a conventional role. This is an interesting formulation and not a matter to be dismissed lightly. Unlike India that does not refer to its cruise missiles for nuclear delivery, Pakistan has not shied away from flaunting these missiles as carriers of nuclear weapons. Given that the missile diameter of the Babur at 560 mm is the same as that of its Hatf-1, it is plausible that a nuclear warhead could be carried by the cruise missile. Its low detectability and, hence, high penetrability could make a salvo launch of such weapons effective in a first strike mode.

If supplemented with ballistic missiles, a combined first strike would become even more lethal and indefensible by a nascent BMD.

Understandably then, Rawalpindi emphasises the nuclear role of its cruise missiles in an attempt to indicate diversity in targeting options and greater flexibility in operational deployments. Some Pakistani military analysts have even argued against the suitability of these missiles for a conventional role. Air Cmde (Retd) Kaiser Tufail, for instance, has ruled out the possibility of the Ra'ad being employed in a conventional mode "because a payload of 450-kilograms [at best] can do little harm unless launched in a shower of a few score, something that would be outrageously costly".¹⁶

This, however, may not be strictly true. In fact, it is quite likely that Pakistan's projection of the cruise missile in the nuclear role is exactly that – a projection to further its deterrence. But the greater chances of credible use lie in the conventional realm.

As Conventional War-Fighting Weapons

Cruise missiles offer the advantage of surprise and precision that could be effectively used for the purpose of degrading capability, mounting a

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16. Usman Ansari, "Pakistan Tests Cruise Missile", *Defense News*, February 2, 2015

psychological impact while remaining below the nuclear threshold. For a Pakistan keen to keep a conflict from escalating to the nuclear level, the use of the Babur and Ra'ad with conventional payloads would possibly fatigue India's air and missile defences to open it to follow-on air strikes. Such use has the potential to upset India's military choices and cast a deterrent effect.

Given that the US is developing its newer hypersonic versions of cruise missiles for conventional global prompt strikes, the general trend seems to be towards accepting these missiles as conventional platforms. China too has indicated its use of these missiles for long range ground attack or anti-ship operations in a strategy of conventionally degrading US capabilities and morale. There is no reason to believe that Pakistan too will not see merit in using this weapon as a conventional platform.

Ambiguity From Dual Use

Pakistan claims that its cruise missiles are dual use delivery platforms. This ambiguity comes in useful to enhance deterrence. Writing at the time of the Cold War, in the context of the US and USSR, Gotemoeller had noted about cruise missiles, "In terms of strategy, they can be used to increase risks to the opponent, diversifying the long range strike capability of the air force and navy and expanding the number of nuclear warheads available".¹⁷ This is what Pakistan seems to believe too — that this capability could be a significant addition to the deterrent ballistic missile force, particularly if it was perceived to be invulnerable to an Indian BMD. In this context, the dual use capability of the weapon system proves handy to obscure the thresholds between conventional and nuclear war.

However, such dual use deployments are not without their problems. For instance, the deployment of nuclear-tipped cruise missiles alongside conventional variants on multi-purpose naval platforms can complicate the naval strategy. If the platforms carrying nuclear missiles must survive to enhance strategic reserve, they should remain out of harm's way in the early stages of conventional war. But if they are to simultaneously carry out conventional land attack missions, they must deploy to areas from where

17. Gotemoeller, n.1, p. 28.

they can undertake these missions even if they face the risk of taking a hit themselves. So, how must the naval vessels, on which both conventional and nuclear missiles are deployed, behave? What if such a ship was to be hit by a conventional missile of the adversary in the absence of his knowledge that it was carrying nuclear-tipped cruise missiles too? Would it be taken as an attack on nuclear capability, leading to a nuclear retaliation?

In its desire to reap maximum deterrence benefits from such a capability, Pakistan has not thought through some of these issues and their dangerous potential repercussions. Cruise missiles, which are difficult to detect and can lead to surprise attacks, particularly if seen to be capable of decisive results without recourse to nuclear weapons, may tempt states to risky actions, and Pakistan could begin to think so too. This does pose challenges of misperception and inadvertent escalation, severely threatening crisis stability.

CHINA'S CRUISE MISSILE CAPABILITY

China first began to explore cruise missiles in the 1950s largely from the perspective of using them for coastal defence. In fact, before the rupture in its relations with the USSR, China had already procured "models, blueprints and technologies relevant to ASCM development". As a result of this initial help, some modest types of cruise missiles were made and the first generation of SY-series of Anti-Ship Cruise Missiles (ASCMs) had been inducted into the People's Liberation Army (PLA) by the late 1960s. Nearly five decades down the line, the Chinese Navy today is believed to be one of the "most ASCM equipped compared to other major naval powers"¹⁸. Most of its surface ships and many of the conventionally powered submarines are equipped with these missiles. In the Western Pacific, China has an overwhelming asymmetry over American ASCMs that are outnumbered seven to one.¹⁹

Given that Taiwan constitutes a core interest of China, the emphasis on ASCMs is not surprising to cater for a counter-intervention strategy in the Taiwan Strait. The Aegis missile defence equipped American warships push

18. Dennis Gormley, Andrew Erickson and Jingdong Yuan, *A Low-Visibility Force Multiplier: Assessing China's Cruise Missile Ambitions* (Washington DC: National Defence University Press, 2014), p. 89.

19. *Ibid.*, p. 91.

the Chinese to find ways of defeating the defences and they have found a way of doing so by using the older versions of cruise missiles to saturate/overwhelm the BMD. China can afford this because several new variants of the ASCM have been developed and are operational with the Chinese Navy today. These range from the 25-km short-range YJ-7, to the 42-km YJ-8, to the 120 km YJ-83. Meanwhile, the YJ-62 is claimed as a modern, indigenously developed missile, which is presently outfitted on the LUYANG destroyer. The latest in the impressive arsenal of Anti-Access Area Denial (A2AD) weapons of the PLA is the YJ-12 (400km) air-launched ASCM and the YJ-18 (200-220 km) ship/submarine-launched ASCM. Both are supersonic, with top speeds of 2.5 to 3 Mach. They can manoeuvre in the final stages to avoid air defence. The newest class of Chinese destroyers, the LUYANG III has the new vertically launched YJ-18.²⁰ Meanwhile, YJ-12 can be launched from H-6 bombers and from the J-11 aircraft.

An important attribute of the Chinese ASCM capability is that all its ASCMs of the different ranges, speeds and accuracies have variants that are capable of being launched from ships, submarines, air or land. According to US estimates, the PLAN is "training to launch cruise missiles from multiple platforms; many surface vessels and conventionally powered submarines are also taking ASCM delivery as their priority operational roles".²¹ Its new array of frigates and destroyers, as well as the Song, Kilo and Shang class SSNs (nuclear powered attack submarines) are capable of carrying ASCMs. In fact, some analysts have described this tendency as treating "every surface combatant to be the aquatic equivalent of a missile Transporter-Erector-Launcher."²²

The different types of these missiles are also equipped with varied types of navigation systems ranging from electro-optical signals (YJ-7) to inertial/active radar (YJ-83) to those that can receive targeting updates in flight through GPS (YJ-83 A and YJ-62). The range of sophistication available across the platforms is not the same. But it can provide greater flexibility and choices for making missions more cost-effective.

20. Office of Naval Intelligence, Government of USA, *The PLA Navy: New Capabilities and Missions for the 21st Century* (Washington, 2015).

21. Gormley et al., n.18, p. 5.

22. William Murray as quoted in *Ibid.*, p. 43.

One major limitation, however, of the Chinese ASCMs that are operational today is in their ability to undertake detection and monitoring in real time of enemy surface ships which are over the horizon. China is yet to develop the full panoply of relevant enabling technologies and systems to resolve this problem. For instance, intelligence support, command and control, stealth and survivability features on its own platforms are yet to reach full maturity. For submarine-launched ASCMs, the limited range of radar detection is a handicap and since using own active sonar could lead to revelation of its own position, the submarine has to necessarily depend on targeting information communicated via radio. But this necessitates some form of antenna to receive data, making the platform vulnerable to revealing itself and opening up the risk of attack. Moreover, as pointed out by one analyst, "The accuracy of the data can be degraded by computer processing issues, data latency, and particularly for long range missiles, weapon flight time, all of which make a successful attack by cruise missiles less likely"²³. A moving target demands real time data cueing which can best be done through satellite navigation aids such as relay stations as part of a distributed sensor network. China is moving in that direction but is still a fair distance from arriving at such a sensor fusion for long range targeting capability.

While this may be so, the point to note is that through the very development of this capability, China has managed to enhance its deterrence and sowed the seeds of doubt in the minds of adversaries. At the same time, it has also managed to impose peace-time costs on adversaries by compelling them to develop defensive counter-measures. As put forward candidly by American analysts, "In the event of a maritime conflict with US forces, PLAN is likely to undertake massive multi-axis ASCM attacks against US Carrier Strike Groups (CSGs) and their Aegis air defense perimeters."²⁴ Once China develops and inducts supersonic ramjet powered variants, it would have serious implications for how, where and to what extent the US would be able to deploy its carrier battle groups to honour its security commitments to Taiwan. ASCMs are also deployed by China along its

23 Ibid., p. 52.

24. Ibid., p. 62.

A more modern, second generation version, with a 1,500-2,500 km range, the DH-10 has GPS/inertial guidance equipped with TERCOM that enables digital scene matching to ensure 10 m accuracy.

coast to provide defence for naval bases and to block an enemy fleet from getting too close to the base to conduct reconnaissance, missile attacks or deploy any blockades. Seen in the context of active defence, these are considered best suited for carrying out surprise attacks to degrade the enemy.

Built through considerable Russian technical assistance, Chinese LACMs offer another impressive capability. Being mobile, these are difficult to detect prior to launch.

From the indigenous HY-4, popular in Western literature as the Silkworm and exported widely, China has graduated to the DH-10. A more modern, second generation version, with a 1,500-2,500 km range, the DH-10 has GPS/inertial guidance equipped with TERCOM that enables digital scene matching to ensure 10 m accuracy. In fact, China is known to be working hard to improve further its navigation and timing information in order to improve accuracy. China's geostationary satellite navigation system, the Beidou, is steadily being built with every satellite launch. Though full operations for global coverage would be possible only after a 35-satellite constellation has been installed, enough is already available for the immediate regional context. When launched from Chinese aircraft, with 500 kg warheads, the DH 10 could threaten hardened aircraft shelters, command and control nodes and other high value targets such as sensors that would disrupt enemy air attacks.

Considering the amount of resources – financial and human – being invested in cruise missile developments, it is clear that this capability is being seriously followed by the country as a viable deterrent strategy. The future of cruise missiles in China is certain to include a number of new technologies.

Supersonic and hypersonic cruise missiles appear to be a predominant area of Chinese focus in the future. The former are powered by ramjet engines and operate in the range of Mach 2-4, while the latter have scramjet engines

that give them a speed of more than Mach 5.²⁵ High speed condenses the sensor to shooter to target time, making defences against such vehicles extremely difficult. If Cruise Missile Defences (CMDs) are going to be developed in the future, then defeating them naturally means allowing less reaction time to the adversary to defend himself. Also, the increased speed would make them more accurate against mobile targets. Secondly, it would increase their kinetic energy, which, in turn, would increase the explosive power of the warhead even if the payload is not much. This would then enable range enhancement of the missile. Therefore, a hypersonic missile would have implications for speed, range, accuracy and precision. A usage of mix of supersonic LACMs/ ASCMs with subsonic versions and also ballistic missiles would create huge processing difficulties for any Electronic Warfare (EW) or missile defence system.

Hypersonic reusable cruise missiles comprise a technology of the future. Propelled by dual mode ramjet/scramjet engines, these would have a speed of Mach 7 and be sustained by hypersonic air breathing.

Hypersonic reusable cruise missiles comprise a technology of the future. Propelled by dual mode ramjet/scramjet engines, these would have a speed of Mach 7 and be sustained by hypersonic air breathing. The Qian Xuesen National Engineering Science Experiment Base in Beijing is believed to be working on developing scramjet engines at a new wind tunnel. Though this is currently placed at testing models capable of reaching speeds of 5.6 Mach, some reports also suggest wind tunnel modelling capabilities for supersonic devices at Mach 9.²⁶ It is also reported that the China Aerodynamics Research and Development (R&D) Centre and the National University of Defence Technology are engaged in scramjet propulsion, pulse detonation engines and turbine-based combined cycle engines that will help them develop

25. The US DARPA is known to be working on an air breathing cruise missile that could deliver a 5,000 kg payload over 17,000 km in two hours by travelling at speeds of Mach 6. Gormley, n. 3, p. 73.

26. J Michael Cole, "Russia, China, and America's Hypersonic Missile Race", *Flashpoints, The Diplomat*, August 20, 2012.

hypersonic missiles.²⁷ Armed with conventional warheads and high kinetic energy, such cruise missiles are seen as useful to attack ships, radars and communication systems, command and weapons bunkers, airfields, missile launchers, etc.

The other capability that will emerge more prominently in Chinese cruise missiles is stealth. According to American estimates, "Stealthy cruise missiles would be used to achieve operational surprise while hypersonic missiles would run past heavy enemy defenses".²⁸ Development of new stealth materials and technologies, such as plasma stealth technology and high power jammers are all strides in this area.

In order to use own offensive capability while staying clear of harm's way, firing at enemy targets from longer and longer ranges is required. But long range missiles can be more accurate and effective only if capable of mid-course programming and an active terminal seeker warhead, particularly in the case of mobile targets. Chinese ASCMs which are part of its anti-access and area denial strategy are not yet of very long ranges. But reports abound on the DH-10 LACM of 3,000 km range being converted into an anti-ship variant.

In order to further enhance the accuracy of its missiles, there is no doubt that China will focus on electro-magnetic attack technology, data links and distributed sensors/networks and improved artificial intelligence to autonomously hunt targets in denied environments. Terminal evasion manoeuvres too would be the future focus of Chinese cruise missiles in order to defeat missile defences.

ASCMs bring for the Chinese Navy the flexibility of employing subsonic or supersonic variants, of short or long ranges and with conventional or nuclear warheads. Nevertheless, a very clear picture is not available on whether the Chinese ships have met with much success in the integration of these missiles into effective operations. Can the Command, Control, Computers Communications, Intelligence, Surveillance, Reconnaissance (C4ISR) hardware

27. Kalyan M Kemburi, "High Speed Cruise Missiles in Asia: Evolution or Revolution in Fire Power?", RSIS, Commentaries, No. 044/2014, March 4, 2014.

28 Jeffrey Lin and PW Singer, "China Shows off its Deadly New Cruise Missiles", *Popular Science*, March 10, 2015.

and software undertake the pressures of deployment? Testing has proved the capabilities of the missiles, but their actual employment in the hands of the users has never been proved in any combat scenario. Unlike the US which has used missiles in wars and, thus, tested and improved their capabilities, China has not.

Joint training between the PLA Air Force (PLAAF) and PLA Navy (PLAN) to optimally use cruise missiles in offensive and defensive roles remains an untested issue. Chinese documents, including its White Papers on national defence, indicate an emphasis on joint operations and inter-Services coordination, including with the strategic rocket forces missile units, which are also the custodians of China's cruise missiles. "It is unclear how sophisticated and realistic is firing training for SLCMs or how advanced and effective are the C4ISR to cue their targeting..."²⁹ Issues such as retaining effective positive controls over nuclear-tipped Submarine-Launched Cruise Missiles (SLCMs) when they are deployed in operational areas will also become a live issue.

CRUISE MISSILES IN THE CHINESE NUCLEAR STRATEGY

Going by its own military doctrine that envisages future wars to be intense and localised, fought with high technology weapons, China lays immense store on the right weapons to fight such wars in order to ensure victory and attainment of its objective. What role would cruise missiles play in this context?

Enhanced Conventional Combat Capability

Given the accuracy of cruise missiles, their all weather capability, long range, low detectability and compatibility with a range of launch platforms, the missiles pose a deadly, stealthy and flexible weapon against the adversary. The use of cruise missiles by China to degrade Indian air defences or attack command and control nodes seems plausible to jeopardise retaliatory actions, while leaving the country vulnerable to follow-on air or missile strikes.

Another development to watch out for, which currently is some distance away, is operationalisation of conventionally armed hypersonic cruise

29. Gormley, n. 3, p. 66.

missiles. This could give China the ability to conduct a conventional first strike to degrade India's nuclear retaliatory capability. Coupled with a BMD on Chinese assets, this capability would seriously erode nuclear deterrence, compelling India to recalculate the numbers in its 'minimum' deterrence. As pointed out by a Chinese scholar in the context of American efforts towards hypersonic missiles, "Nations concerned about the survivability of their deterrents might build additional nuclear facilities deep underground – or begin to demonstrate less transparency about their nuclear policies".³⁰ Both trends point towards greater strategic instability, and will demand an Indian consideration.

Cruise Missiles for Nuclear Delivery

If one was to go by the historical experience of the Cold War and the stated Chinese nuclear doctrine of no first use, there can be no real logic and strategic purpose of cruise missiles as nuclear delivery vehicles. There certainly is one school of thought in Chinese literature that upholds the belief that nuclear weapons are for strategic deterrence and that no nation can cross the threshold of use of nuclear weapons that easily. Command and control challenges and inconsistency with the nuclear doctrine are identified as complicating factors in developing and deploying such a capability.

But, given the Soviet influence on China, it cannot be ignored that the Soviets (as also the US) did employ cruise missiles as nuclear delivery platforms. More pertinent is the ongoing debate in the US (which is sure to be keenly watched by China) on the development of the new Long Range Stand-Off (LRSO) cruise missile for nuclear delivery.³¹ A PLAN officer, Capt Liu Yang has been quoted to have advocated consideration of cruise missiles as a foundation to carry out a low-weight nuclear burst, or as a fuel air explosive warhead, especially against aircraft carriers³².

30. Tong Zhao, "Banning Hypersonics: Too Much to Hope For", Development and Disarmament Roundtable, *Bulletin of Atomic Scientists*, June 26, 2015.

31. For more on this, see Aaron Mehta, "Senators Urge Obama to Cancel Nuclear Cruise Missile", *Defense News*, July 21, 2016. <http://www.defensenews.com/story/defense/policy-budget/congress/2016/07/21/senators-obama-nuclear-missile-lrso/87384128/>. Accessed on August 6, 2016.

32. Gormley, n. 3, p. 74.

Though China's cruise missiles have not traditionally been attributed with a nuclear payload, in an article in 2013, Hans Kristensen, a nuclear weapons specialist with the Federation of American Scientists, mentioned the CJ 20 as a nuclear capable cruise missile, which, he said, was the first such listing he had seen in an official US publication crediting a Chinese air-launched cruise missile with nuclear capability. The CJ-20 can be carried by the long-range H-6 bomber in a land-attack operation that could strike targets all over Asia and eastern Russia as well as the US military base hub on Guam Island, in the Western Pacific.³³ More recently, another US report mentioned the possibility of China opting to nuclear tip its SLCMs.³⁴

Ambiguity in Use of Platform

Dual use cruise missiles carry the risk of miscalculation or misperception in times of crisis, leading to inadvertent escalation. Indeed, the use of highly accurate, long range and stealthy weapons that enjoy the further benefit of flexibility of employment to carry out disabling nuclear strikes against strategic targets such as command centres, silo launch installations, nuclear weapons storage sites, etc add to the dangers. These would only multiply as and when manoeuvrable hypersonic missiles enter the fray. As pointed out by Dr Rajaram Nagappa of the National Institute of Advanced Studies (NIAS), misunderstandings would arise about a missile's intended destination, "A nation might conclude, for example, that its nuclear forces were under attack when, in fact, its conventional forces were the intended target."³⁵ The implications of this for stability can be well imagined.

IMPLICATIONS FOR INDIA

It is evident that the advent of cruise missiles complicates the Indian security environment. While the intuitive response to the developments in the neighbourhood is to mirror image adversary capabilities, besides

33. Michael Richardson, "Cruise Missile Threat in Asia", *Japan Times*, June 18, 2013.

34. "China May Pursue Nuclear Cruise Missiles, US Military Study Warns", *Global Security Newswire*, Nuclear Threat Initiative, June 3, 2014.

35. Rajaram Nagappa, "New Technology, Familiar Risk, Development and Disarmament Roundtable," *The Bulletin of the Atomic Scientists*, June 26, 2015.

The Brahmos is already a formidable system. But further enhancement of its range (by using it as an air-launched vehicle) or on other ground/sea-launched variants (as now possible with India's entry into the Missile Technology Control Regime – MTCR) would enhance deterrence.

building cruise missile defence, the need of the hour, however, is to consider the options with greater clarity of purpose. India has a finite amount of technical expertise and financial resources and the areas where these should be invested must be carefully thought through.

The first point to acknowledge is that the cruise missile is a potent weapon system with many unique attributes. It appears particularly suitable for targeting high value, heavily defended enemy assets. In this context, it cannot but be recommended

that the country must effectively exploit the potential of cruise missiles to undertake precision attacks on specific high value targets that are likely to be far more protected through air defence. Building own capabilities on cruise missiles is important to signal an effective deterrent. The Brahmos is already a formidable system. But further enhancement of its range (by using it as an air-launched vehicle) or on other ground/sea-launched variants (as now possible with India's entry into the Missile Technology Control Regime – MTCR) would enhance deterrence.

However, as for the use of cruise missiles for nuclear delivery, the case needs deeper examination. Miniaturisation of nuclear warheads and their mating with cruise missiles is no technological marvel and is within the reach of most nuclear armed states. What is essential to determine, however, is the *need* to do so, based on the national nuclear strategy. In the case of India, the role of its nuclear weapons is essentially premised on deterrence in order to obviate the chance of use of such a weapon against ourselves. India does not brook the thought of fighting a war with these weapons since it can serve no rational political purpose. With India's deterrence philosophy resting on the promise of punishment, it should be possible for India's designated nuclear delivery systems, which are consistently improving their range, accuracy and reliability, to undertake a punitive response. In fact, nuclear-tipped cruise

missiles would not add any more to the task of deterrence that the panoply of other systems could not. This would remain true till such time as the adversary's BMD capabilities evolve to such a degree as to make them invulnerable to unacceptable damage – which is pretty difficult in the foreseeable future. Point or area defences may be deployed by China and Pakistan, but nuclear deterrence would continue to rest on population centres remaining vulnerable to qualify for being inflicted with unacceptable damage as punishment for first use of nuclear weapons against India.

Since the adversary will not be sure of how the missile is armed, there could be a tendency to assume the worst, triggering a nuclear war when there might have been no such deliberate design.

Therefore, it would serve India better to retain the declared distinction between nuclear and conventional delivery systems even when a dual use option exists and may easily be operationalised if ever found necessary. Retention of this difference would help enhance strategic stability. Nuclear weapons comprise ordnance that falls in a different category altogether. Mixing them up on dual use delivery vehicles may enhance deterrence, but it, nevertheless, significantly raises existential risks of inadvertent use and miscalculation. Since the adversary will not be sure of how the missile is armed, there could be a tendency to assume the worst, triggering a nuclear war when there might have been no such deliberate design. So, while Pakistan is compelled by its circumstances and self-created existential delusions to project first use of nuclear weapons, it remains well cognisant of India's ability to retaliate with nuclear weapons to nullify any gains it hopes to so make.

In fact, in the face of the adversary's dual use projection of cruise missiles, India's no first use strategy gains even greater relevance since it has opted to retaliate only after being impacted by a nuclear weapon. In view of an incoming missile, India has the option of interception (even if limited) through its nascent BMD capability, and it certainly has the option of assured nuclear retaliation as laid down in its nuclear doctrine. So, irrespective of the mode of delivery, nothing changes for India as far as its nuclear doctrine

is concerned. The focus of the country's nuclear efforts must be retained on enhancing the credibility, reliability and effective integration of its nuclear declared ballistic missile force, including operationalising the deployment of Agni V, extending the range of Submarine-Launched Ballistic Missiles (SLBMs), and enhancing survivability measures over the other two legs of the triad, and nuclear command and control.

At a third level, in the more defensive capacity, it would be necessary to enhance air defences over high value military targets that might be on the adversary's list for the use of his cruise missiles. Improving the sophistication of early warning systems and detection capabilities spread across platforms [aircraft, aerostats, Unmanned Aerial Vehicles (UAVs), shipborne radars, etc] and as over the horizon as possible, including through space assets, naturally fall within the purview of future development areas since the benefits of these would be widely reaped across other areas too. The ability to fuse data obtained from variegated sensors to obtain a common operating picture to provide real-time responses and to reduce the clutter is equally important.

Lastly, India must explore possibilities of Confidence-Building Measures (CBMs) and arms control that aim to reduce nuclear risks. Included amongst these would be measures that retain a sharp distinction between conventional and nuclear delivery systems since multiplicity of warheads and missions linked to a single weapon system like the cruise missile exacerbates nuclear dangers. Political engagement on nuclear risk reduction measures with both adversaries is an idea whose time has been here for long. And yet it remains a chimera. The longer this situation continues, the greater the chances that China, Pakistan and India will be sucked into an offence-defence spiral based on a worst case assessment of each other's capabilities and intentions.

ENTER THE PLA ROCKET FORCE: ASSESSING CHINA'S MISSILE CAPABILITIES

RAVINDER SINGH CHHATWAL

INTRODUCTION

China celebrated the 70th anniversary of its victory over Japan in World War II with a grand military parade in Beijing on September 3, 2015. Normally, China holds military parades every ten years to commemorate the Communist takeover of power in China in 1949. But, apparently, President Xi Jinping did not want to wait for another four years to display China's military might and send a signal to Japan, the USA and regional countries. The massive parade comprised 12,000 troops, 500 pieces of military equipment and 200 aircraft of different types. In addition, almost 1,000 troops from 17 foreign countries, including Pakistan, participated in the parade. India did not send any delegation of marching troops but was represented at the celebrations by Minister of State for External Affairs Gen VK Singh (Retd).

The Chinese announced that almost 84 percent of the military hardware on display was being shown to the public for the first time.¹ On display were China's most advanced indigenously produced weapons, including

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1. Xinhuanet, "Highlights of China's Military Parade to Mark End of WWII," http://news.xinhuanet.com/english/2015-09/03/c_134584176.htm, September 3, 2015. Accessed on June 12, 2016.

President Xi Jinping heralded the entry of China's new armed service by emphasising the importance of the PLA Rocket Force as China's core instrument for strategic nuclear deterrence and long/medium range precision strike with conventional missiles.

fighter aircraft like the J-10, J-11, J-15 and KJ-2000 AWACS (Airborne Warning and Control System). Also on display was a wide array of missiles: the DF-26 Intermediate Range Ballistic Missile (IRBM) with anti-ship capabilities, DF-21D medium range Anti-Ship Ballistic Missile (ASBM) claimed to be a "carrier killer", DF-15B Short Range Ballistic Missile (SRBM), DF-16 Medium Range Ballistic Missile (MRBM), DF-5B liquid fuelled Intercontinental Ballistic Missile (ICBM), and the road mobile solid fuel ICBM DF-31A. This was the first time that the Chinese had displayed two ASBMs, the DF-21D, with a range of 1,550 km², and DF-26, with ranges of 3,000-4,000 km.³

On December 31, 2015, as part of its military reforms, China upgraded its second artillery as an independent new Service like the army, air force and navy and renamed it the People's Liberation Army (PLA) Rocket Force. Earlier, the Second Artillery Force (SAF) was only an independent arm of the PLA. Speaking at the inauguration ceremony of the PLA Rocket Force, President Xi Jinping heralded the entry of China's new armed service by emphasising the importance of the PLA Rocket Force as China's core instrument for strategic nuclear deterrence and long/medium range precision strike with conventional missiles.⁴

This article assesses the capabilities of the PLA Rocket Force and the implications for India.

CHINA'S RELIANCE ON MISSILES

China's defence strategy has always been to concentrate on development and deployment of unmanned ballistic/cruise missiles as its main long range

2. Range figures are from *IHS Jane's Weapons: Strategic 2013-2014*.

3. Range figures are from Eric Tegler, "China's New Ballistic Missile Puts Guam in the Crosshairs," <http://www.popularmechanics.com/military/weapons/a17182/chinas-missile-df-26/> September 2, 2015. Accessed on September 2, 2015.

4. Ministry of National Defence, People's Republic of China, "China Establishes Rocket Force and Strategic Support Force", January 1, 2016, <http://eng.mod.gov.cn/ArmedForces/second.htm>. Accessed on February 2, 2015.

strike weapon. This policy has been there since the days of Mao, in the 1960s, when China developed nuclear weapons and long range missiles for nuclear weapon delivery. While missiles are an effective option for nuclear warhead delivery, China has also deployed them with conventional warheads. China has achieved considerable success in missile development which has been referred to as a “pocket of excellence” by the Federation of American Scientists.⁵ China’s DF-21D missile, developed in 2010, is the world’s first anti-ship ballistic missile with a range of more than 1,500 km. This missile, that has been called the “aircraft carrier killer,” is aimed at deterring US aircraft carrier battle groups from entering the East China Sea in case of any Chinese invasion of Taiwan. China’s decision to use ballistic missiles for targeting ships shows the growing capabilities of its missile industry to develop such advanced weapons.

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China’s strategy to heavily rely on unmanned ballistic and cruise missile for long range precision strikes is in contrast to force projection by deployment of manned platforms like aircraft and ships by most other countries, including the USA and UK. A missile is a single use weapon for delivery of ordinance whereas aircraft and ships can be employed for multiple roles, and once they return safely to the base, they can be launched for the next mission. However, China has a number of reasons to be adopting a missile-based strategy. The most important reason is that China has been very successful in the space and missiles industries. Whereas it has not been able to produce world class combat aircraft and naval ships to compete with those of the USA and other advanced countries. China’s defence industry has been having problems in producing high performance aero-engines for the J-10 and J-20 stealth jet fighters and, consequently, it has had to buy a large number of engines from Russia. On the other hand, China has successfully produced rocket motors and even small turbofan engines for Unmanned Aerial Vehicles (UAVs).

5. Lora Horta “The Dragon’s Spear: China’s Asymmetric Strategy” Yale Global Online, October 17, 2013, <http://yaleglobal.yale.edu/content/dragon%E2%80%99s-spear-china%E2%80%99s-asymmetric-strategy>. Accessed on December 20, 2013.

China also realises that the state of training of its air force and navy is inferior to that of the American forces. The Americans have combat experience due to their extensive involvement in recent conflicts. On the other hand, the PLA Air Force (PLAAF) lacks actual combat experience. The last major war in which the PLAAF was involved was the Korean War in the early 1950s. In the war against Vietnam in 1979, the PLAAF was employed in a very limited way. The Chinese forces also suffer due to the inherent flaws in the Communist system of subjecting career officers to long years of political indoctrination, thus, discouraging high calibre professionalism.

The second reason for China opting for a missile-based strategy is that in the Taiwan theatre, Chinese long range missiles can threaten US naval ships, carrier battle groups and air bases from their missile sites on the mainland. The Chinese can shoot and scoot, taking advantage of the geographical depth, whereas the Americans will be exposed in the Western Pacific. The US Air Force and naval aircraft carriers can, of course, operate from long distances from the battle zone but will suffer due to increased travel time resulting in reduced sortie generation rates. In any high intensity conflict, combat aircraft should be ideally within 200 to 300 km of the battle zone. If the American combat aircraft have to operate from longer distances, then the reduced sortie rates will impinge on their ability to achieve air superiority.

Another reason for China relying heavily on missiles is that it can produce a large number of these weapons at cheap rates due to the lower labour costs and reduced Research and Development (R&D) costs compared to the Western countries. In the West, a lot of money has been spent on R&D for advanced weapons but the Chinese do not need to spend so much on this because they have been able to procure classified technology illegally through their agents in the West.⁶

China's missile strategy is also based on the fact that "gaps exist in the international law that can be exploited in China's favour".⁷ The most

6. US DoD Annual Report to Congress "Military and Security Developments Involving the People's Republic of China 2013", www.defense.gov/pubs/2013_China_Report_FINAL.pdf. Accessed on September 21, 2015, pp.11-13.

7. This part draws from Ian Easton, "China's Military Strategy in the Asia-Pacific: Implications for Regional Stability", Project 2049 Institute, September 26, 2013.

important gap in the international law which China has taken advantage of is the Intermediate Nuclear Forces (INF) Treaty of 1987 which bans all ground launched nuclear and conventional ballistic and cruise missiles with ranges from 500–5,500 km. The five countries which are signatories to this treaty are the USA, Russia, Ukraine, Belarus, and Kazakhstan. China is not a signatory to this treaty and can, therefore, continue to increase its arsenal of missiles in this range.

PLA ROCKET FORCE MISSILE CAPABILITIES

The PLA Rocket Force is equipped with both ballistic and cruise missiles armed with nuclear or conventional warheads. In the last two decades, China has greatly improved its nuclear and conventional ballistic missile capabilities. While the ICBMs are nuclear armed, the SRBMs, MRBMs and DF-26 IRBMs can be nuclear or conventionally armed. The force structure of the PLA Rocket Force, with strength and type of missiles, is shown in Table 1 below.

Table 1: China’s Missile Force⁸

System	Missiles	Launchers	Estimated Range
Ballistic Missiles			
ICBM (DF-4, DF-5A, DF-5B, DF-31, DF-31A)	50 -75	50 - 75	5,500 + km
IRBM DF-3A ⁹	5 - 20	5 - 20	3,000 – 5,500 km
MRBM DF-21	75 - 100	75 - 100	1,000 – 3,000 km
SRBM (DF-11= 700-750); (DF-15=350-400); (DF-16=12 ¹⁰)	1,000 - 1,200	200 - 250	<1,000 km
Cruise Missiles			
GLCM (DH-10/CJ-10) Note: This missile has been renamed as DF-10 .	200 - 500	40 - 55	1,500 + km
ALCM (YJ-63)	Not known	Not known	200 km

8. US DoD. “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2012”, http://www.defense.gov/pubs/pdfs/2012_cmpr_final.pdf. Accessed on September 4, 2014.

9. *Military Balance 2015* gives a figure of only 6 DF-3As in China’s inventory.

10. DF-16 figures are from *Military Balance 2015*.

Inter-Continental Ballistic Missiles (ICBMs): China's nuclear armed ICBM force consists of newer models of the DF-5A missiles and DF-31 missiles. The older model, Dong Feng-4 (DF-4), is also nuclear armed but it is in the category of an IRBM, due to its less range of 4,750 km. The DF-4 is a liquid fuelled missile which entered service in 1980 and is reported to have an accuracy of 1,500 m Circular Error Probable (CEP); it is likely to be phased out soon. The PLA Rocket Force has only about 10 of these missiles in service and they are deployed in Delingha, Tongdao and Sundian.¹¹ The DF-4 will be replaced by the DF-31 missiles. As with the rest of the missile force, ICBMs have also been modernised with better technology. New solid fuelled ICBMs like the DF-31, JL-2 (SLBM), and the in development DF-41, are strengthening China's nuclear deterrence with more survivable road mobile capability. The DF-31 has a range of 8,000 km and accuracy of 100-300 m CEP,¹² and can reach targets in Europe, Asia, parts of Canada and northwestern USA. China has about 12 of these missiles in its inventory and another 24 of the improved model, the DF-31A. In the recent Victory Parade, the ICBMs on display were the DF-31A and DF-5B. The DF-31A is an improved version of the DF-31 with an increased range of 10,000 to 14,000 km and can be nuclear armed with 3-4 Multiple Independently Targetable Vehicle (MIRV) warheads with selectable explosive yields of 20, 90 or 150 kilotons (KT) each. The DF-31A is capable of targeting the entire USA.¹³

The other ICBM displayed was the new liquid fuelled DF-5B, which is reported to be capable of hitting any target on earth with a range of 13,000 to 15,000 km.¹⁴ The renewed interest in deploying a new liquid fuelled missile is perhaps because of its longer range and increased payload carrying capacity. The DF-5B has an improved engine and better accuracy compared to the DF-5A. It has also been reported that the DF-5B is China's first MIRV capable ICBM and is probably capable of carrying five nuclear warheads.¹⁵ It is likely

11. *IHS Jane's Weapons: Strategic 2013-2014*, p. 6.

12. *Ibid.*, p.16.

13. *Ibid.*

14. Staff Reporter, "PLA's new DF-5B Liquid-Fuel ICBM 'Can Hit any Target on Earth,'" *Want ChinaTimes*, August 16, 2015, <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20150816000155&cid=1101>. Accessed on September 14, 2015.

15. Wendell Minnick, "China's Parade Puts US Navy on Notice", *Defense News*, September 3, 2015, <http://www.defensenews.com/story/defense/naval/2015/09/03/chinas-parade-puts-us-navy-notice/71632918/>. Accessed on September 14, 2015.

that the DF-5B has been deployed for an interim period till the time the road mobile DF-41, with a range of 12,000 to 15,000 km becomes operational.

China's ICBM force is small with just 50-75 ICBMs but this number is likely to increase to 100 ICBMs in the next 15 years.¹⁶ One hundred ICBMs, with many of them having MIRV payloads, will pose quite a serious threat to the USA.

Intermediate Range Ballistic Missiles (IRBMs): Another missile which was displayed for the first time in the parade was the **DF-26** IRBM which has a range of about 3,000 to 4,000 km.¹⁷ The Chinese have announced that the DF-26 is an Anti-Ship Ballistic Missile (ASBM) and can strike at large and medium ships. This means that from China's east coast, the DF-26 is capable of threatening US Navy ships in the Western Pacific Ocean right up to Guam, and from Kunming, it can cover Southeast Asia, India and the Bay of Bengal. The long nose of the DF-26 clearly indicates that the design caters for a manoeuvrable warhead in the terminal phase. The DF-26 is a derivative of the DF-21D ASBM (range 1,550 km¹⁸) which was labelled as an "aircraft carrier killer" for possible use against American aircraft carriers if they were to intervene in a Taiwan contingency. For a ballistic missile to manoeuvre in the terminal stage and home onto a moving ship requires real time Intelligence, Surveillance, Reconnaissance (ISR) data from satellites, unmanned reconnaissance platforms or surveillance ships in that area. This is a challenging task, firstly, to acquire the data and, secondly, to feed it into the missile in the very short terminal phase. It is not clear whether China really has these capabilities or they are still in the development phase. There are no reports of the Chinese having carried out any trials of the DF-26 or the DF-21D on a moving target at sea. The United States has been aware of the existence of the DF-26 since 2007¹⁹ and the US Department of Defence (DoD) annual report of 2015 on China's military capabilities does mention the development of a "new advanced IRBM with the capability to strike targets at ranges up to 4,000 km but the number of these missiles in the Chinese inventory has not been given."²⁰

16 National Air and Space Intelligence Centre, *Ballistic and Cruise Missile Threat* (Wright-Patterson Air Force Base, Ohio, 2013).

17 Tegler, n. 3.

18. Range figures from n. 11.

19. Tegler, n. 3.

20. U.S. DoD. "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015" http://www.defense.gov/pubs/pdfs/2012_cmpr_final.pdf. Accessed on September 14, 2015.

The United States has been aware of the existence of the DF-26 since 2007 and the US Department of Defence (DoD) annual report of 2015 on China's military capabilities does mention the development of a "new advanced IRBM with the capability to strike targets at ranges up to 4,000 km but the number of these missiles in the Chinese inventory has not been given."

Therefore, the US may have surely found ways to counter the missile.

In addition to the DF-26, China has a small number of about six missiles of the DF-3A²¹ class of IRBMs with a range of 3,000 km. The DF-3A is an improved version of the older liquid fuelled DF-3 missiles. The DF-3A is a solid fuelled missile and is likely to be replaced with the DF-21 Medium Range Ballistic Missiles (MRBMs). China has nuclear armed the DF-3A for nuclear deterrence against regional countries.

Medium Range Ballistic Missiles (MRBMs): China's MRBM force consists of about 75-100 missiles of the DF-21 class.

According to one report, the DF-21 is deployed in Delingha which is about 1,500 km from the Indian border.²² From Delingha, these missiles, with a range of about 1,750 to 2,150 km, can cover parts of northern, central and eastern India. China has also deployed the conventionally armed DF-21C for long range precision strikes on military targets, airfields and ports. As has been mentioned earlier, the DF-21D ASBM was displayed in the parade. The showcasing of two ASBMs – DF-21D and DF-26 – at the parade indicates perhaps to the US Navy and other regional navies to beware of Chinese capabilities. But, as mentioned earlier, these missiles need to be tested against ships at sea. Another point to note is that these missiles are available only in small numbers and depending upon accuracy and other factors, more than just one missile will be required against one target. These missiles are road mobile, and in any future war, China's opponents will have to plan for real time persistent ISR to locate and target these missile sites.

21. n. 10.

22. Hans M. Kristensen "DF-21C Missile Deploys to Central China", September 28, 2010, <http://fas.org/blogs/security/2010/09/df21c/>. Accessed on September 4, 2014.

Short Range Ballistic Missiles (SRBMs): In the SRBM category, China displayed the DF-15B and DF-16 missiles at the parade. The 800 km range²³ DF-15B SRBM is a more accurate version of the DF-15A with a CEP of 5-10 m compared to 30-45 m CEP of the DF-15A. It has also been reported that the DF-15 has a more advanced terminal guidance system with active radar seeker and laser range finder. The reentry vehicle of the missile has four control fins for guidance control in the terminal phase. The first flight of the DF-15 was conducted in June 1988 and it entered service in 1990. The DF-15A was inducted in service in 1996 and the DF-15B entered service in 2006.²⁴ While the DF-15 was displayed at the parade in Beijing in 2009, the DF-16 is a new SRBM [North Atlantic Treaty Organisation (NATO) code name CSS-11 Mod1] which was paraded for the first time in the September 3, Victory Parade. The DF-16 is a solid fuelled, road mobile missile with an improved range of 800–1,000 km.²⁵

Since the turn of the century, China has increased and improved its conventional ballistic missile capabilities. In 2000, the PLA Rocket Force had only one brigade of conventional SRBM missiles. By the year 2010, the number of conventionally armed SRBM brigades increased to seven. China has deployed a very large inventory of modern solid fuelled mobile SRBMs opposite Taiwan in the mainland. These SRBMs can be nuclear armed or with conventional warheads. China today has the largest and most devastating short range ballistic missile force in the world.²⁶ As Table 1 above shows, China has about 1,000 – 1,200 SRBMs. These are mostly deployed against Taiwan but all of them are solid fuelled road mobile systems and can easily be moved opposite India. According to the US DoD, China's SRBM force has now stabilised at a strength of about 1,000-1,200 missiles.²⁷ While the number seems to have stabilised, China continues to induct new advanced variants with better accuracy to replace older models. There could be several reasons for the missile numbers to have happened. One of them probably is

23. n. 11.

24. Ibid.

25. Ibid.

26. "2014 Report to Congress of the US-China Economic Review Commission", http://library.uoregon.edu/ec/e-asia/reada/annual_report_full_10.pdf. Accessed on September 14, 2015.

27. US DoD "Annual Report to Congress, Military and Security Developments Involving the People's Republic of China, 2011".

that cross-strait relations with Taiwan have improved since 2008 when the Kuomintang Party came to power in Taiwan and the Chinese don't feel any urgency to further increase their SRBM inventory. Another reason possibly is that induction of the new DF-10 Land Attack Cruise Missiles (LACMs), MRBMs and longer range more accurate variants of the SRBMs has made it unnecessary to add more to PLA Rocket Force's inventory.²⁸

Cruise Missiles: Apart from ballistic missiles, the second artillery also has land attack Ground-Launched Cruise Missiles (GLCMs) in its inventory. The main GLCM in the second artillery's inventory is the DF-10. This missile was earlier called Dong Hai-10/DH-10 – Dong Hai in Chinese means East Sea. It was also referred to as Chang Jian-10/CJ-10, which means Long Sword in Chinese. It seems that the name has now been officially changed to DF-10 with markings in English on the missiles in the Victory Parade. The DF-10 has a range of 1,500 km+ and the missile uses the inertial navigation system with GPS (Global Positioning System) updates and TERCOM (Terrain Contour Matching)/DSMAC (Digital Scene Matching Area Correlation) for terminal guidance. With this type of navigation facility, the missile probably has a CEP of 10 m.²⁹ There has been speculation in the foreign press that the DF-10 may have derived its technology from the Russian Kh-55 Air Launched Cruise Missile (ALCM) which China purchased from Ukraine in the 1990s.³⁰

Another cruise missile in China's fleet is the subsonic YJ-63 land attack ALCM (the KD-88 is a derivative of the YJ-63). This missile has been fitted in modified H-6K bombers. The PLAAF's long range bomber fleet consists of H-6 variants which are a Chinese copy of the Soviet era TU-16 aircraft. The H-6 fleet has been upgraded with new avionics and better engines. The most important improvement is in the H-6K which carries the YJ-63 ALCM with a range of 200km, accuracy of 10-15 m and a payload of 500 kg.³¹ The YJ-63

28. Michael S. Chase and Andrew Erickson, "The Conventional Missile Capabilities of China's Second Artillery Force: Cornerstone of Deterrence and Warfighting," *Asian Security*, 8:2 (Routledge 2012), pp. 115-137.

29. Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, *A Low-Visibility Force Multiplier* (Washington, D.C.: NDU Press, 2014), p. 30

30. Indian Defence Research Wing, "PLA to Display DF Series Missiles at V-J Parade: Report," August 25, 2015. Accessed on September 14, 2015.

31. Gormley, et al., n. 29, p. xix.

guidance system comprises inertial navigation and an electro-optical television for the terminal phase. With the electro-optical system, the YJ-63 can be guided onto the target with the man in the loop by getting target images via the data link between the missile and launch aircraft. In the Victory Parade, China also displayed its new supersonic anti-ship ALCM, the YJ-12. The H-6K that carries six ALCMs (YJ-63/YJ-12), has been fitted with new turbofan engines to extend its range. The YJ-12 has a maximum speed of Mach 4, maximum range

of 400 km, and has a warhead of 400-500 kg.³² At present, the YJ-12 is air-launched but the Chinese have plans to develop variants for launch from ships and submarines. Modifying the H-6K to carry cruise missiles has given the PLAAF the capability to carry out long range standoff precision strikes.

China has developed its cruise missiles with heavy dependence on Russian arms and technical skills. The Chinese also received help from Israel, Ukraine and Belarus. In 1989, after the Tiananmen Square incident, the West imposed sanctions and stopped arms sales to China. The collapse of the Soviet Union in the early 1990s led to Russia looking for new buyers for its arms and the Chinese found an opportunity to procure advanced Russian arms technology. In 1993, the Chinese signed a five-year agreement with Russia for military technology and skilled technical specialists. The Chinese also asked the Russians to send at least one team of cruise missile scientists. The Chinese recruited about 1,500 to 2,000 surplus Russian engineers and technical specialists and moved them to a factory in Shanghai where they started work with Chinese technicians to develop a land attack cruise missile.

China is also developing two new ALCMs with a range of 1,500 km and accuracy of 10 m.³³ These are probably the KD-20 air-launched version of the

The PLA Navy also has its own anti-ship cruise missiles fitted on ship platforms and submarines.

While China has the capability to arm cruise missiles with nuclear warheads, there is no evidence to suggest that this has been done.

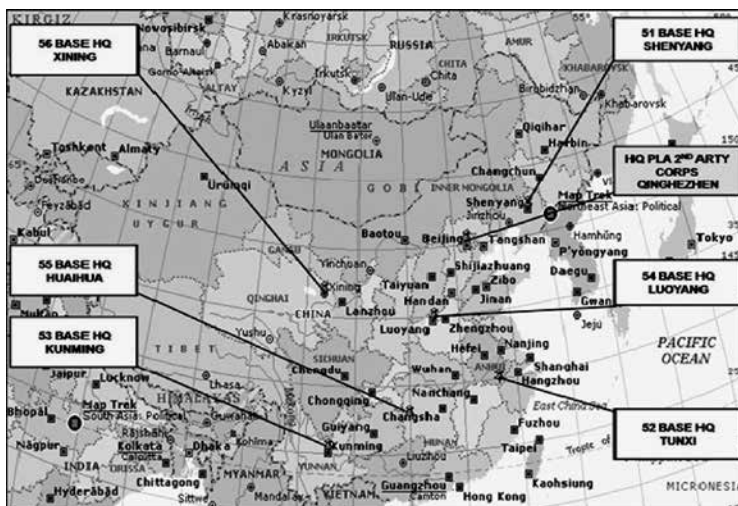
32 China Military Online, "China's Anti-Ship Missiles YJ-12 and YJ-100 Revealed," February 4, 2015, http://english.chinamil.com.cn/news-channels/china-military-news/2015-02/04/content_6340222.htm. Accessed on September 14, 2015.

33. Gormley, et al., n.29, p. 56.

DF-10, which are carried by the H-6K.³⁴ The PLA Navy also has its own anti-ship cruise missiles fitted on ship platforms and submarines. While China has the capability to arm cruise missiles with nuclear warheads, there is no evidence to suggest that this has been done.³⁵ Therefore, China's cruise missiles are likely to be armed with conventional warheads only.

MISSILE BASES

Map 1: PLA Rocket Force Missile Bases³⁶



The PLA Rocket Force is organised in six operational missile bases and one central storage complex. Storage of nuclear warheads is done centrally in Taibai county, deep inside underground facilities in the Qinling mountains of Shaanxi province.³⁷

34. Jeffrey Ling and P.W. Singer, "China Shows off its Deadly New Cruise Missiles," *Popular Science*, March 10, 2015, <http://www.popsci.com/china-shows-its-deadly-new-cruise-missiles>. Accessed on September 14, 2015.
35. Gormley, et al., n.29, pp. 74-75.
36. Missile base locations adapted from Mark Stokes and L.C. Russell Hsiao, "Spotlight on New Second Artillery ICBM Base Leadership," *Asia Eye*, the official blog of the Project 2049 Institute. (August 2, 2011), <http://blog.project2049.net/2011/08/spotlight-on-new-second-artillery-icbm.html>. Accessed on September 14, 2015.
37. Mark A. Stokes, "The Second Artillery Force and the Future of Long Range Precision Strike", in Ashley J. Tellis and Travis Tanner, eds. *Strategic Asia 2012-2013 China's Military Challenge*, (Seattle and Washington, D.C. NBR 2012).

The operational missile bases are roughly of the status of a division and are commanded by an officer of major general rank and each base has three or more launch brigades under it. Each brigade consists of six launch battalions and two companies.³⁸ The number of launchers in each company depends on the type of missiles held in the battalion. The location of the missile bases is given in Map 1.

The forces deployed with each of the six missile bases are given below:

Base 51: This base has its Headquarters (HQ) in Shenyang, Liaoning province, in northeastern China. The base has more than four brigades under it: 806, 810, 816, and 822 Brigades. These brigades are located in the provinces of Liaoning, Shaanxi, Jilin and Shandong. 51 Base has one DF-21 brigade with conventional capabilities and one ICBM brigade with DF-31/DF31A missiles. The other brigades include the DF-3A, DF-15 and probably one more DF-21 brigade.³⁹

Base 52: This Base HQ is located at Tunxi in Anshui province, in southeastern China. The base has 7-9 brigades under it and these are located in the provinces of Anhui, Jiangxi, Fujian, Zhejiang, and Guangdong. The base is equipped with conventional missiles of two or more DF-21 brigades, two or more DF-15/ DF-16 brigades and two DF-11 brigades. In addition, there are two nuclear armed DF-21 brigades. This is the largest and most powerful missile base deployed opposite Taiwan.

Base 53: This Base HQ is at Kunming, Yunan province, in south China. The base has 4-5 brigades located in the provinces of Yunan, Guizhou, Guangxi and Guangdong. This base is equipped with diverse types of equipment like LACMs and different types of ballistic missiles. The conventional brigades under this base include one DF-10 LACM, one brigade probably with the DF-21D ASBM and one more conventional brigade, probably of the DF-21. In addition, Base 53 has two nuclear brigades. One of these brigades is equipped with the DF-21 and one is equipped with the DF-31. This base covers Southeast Asia and India.

Base 54: This base is in eastern China with its HQ at Luoyang in Henan province. This base has three ICBM brigades, with one of them equipped with DF-5 silo-based nuclear missiles and the other two probably equipped with DF-31 nuclear missiles.

38. Ibid.

39. Kristensen, n. 22, and Sean O' Connor in *Air Power Australia*, December 2007.

Base 55: This base has its HQ in Huaihua in Hunan province and is located in southern China. The base consists of two ICBM brigades, with one of them equipped with the DF-5/5A and one with DF-31 nuclear missiles. In addition, it has one brigade probably of conventional armed LACMs.

Base 56: Base 56 has its HQ at Xining in north-central China. The base consists of three brigades located at Gansu, Qinghai, and Xinjiang provinces. This is the main base which caters for any conventional contingency against India. This base probably has one or two brigades equipped with conventionally armed DF-21C missiles and, in addition, has one ICBM brigade equipped with DF-31A nuclear missiles. A small number of old DF-4 missiles are also deployed at this base but they are likely to be replaced with the DF-31. The location of the brigades for a contingency against India is likely to be near Korla in Xinjiang province.⁴⁰

ANALYSIS

The PLA Rocket Force, in its more than four decades history, has grown from being a mainly strategic nuclear force to a strategic nuclear and conventional missiles force with the capability to carry out long range precision ballistic and cruise missile strikes. China's nuclear missiles can not only threaten the USA, Russia and Europe but also regional countries, including India. China has modernised its missile force with advanced technology. The major emphasis has been on improved accuracy, use of solid fuelled rockets and increased survivability, with road mobile capability. This has made it into a potent force for nuclear deterrence and regional coercion. While the PLA Rocket Force has been modernising its nuclear missiles to provide a credible minimum deterrent against the USA and Russia, its conventional strike capability is the one which will come to the fore in regional conflicts. Since the 1990s, China has been developing its conventional missile capabilities and has been able to improve their accuracy with advances in information technology.

China's Missile Base 53 at Kunming, and Missile Base 56 at Xining are the ones which are of concern to India due to their location and capability of striking at India. Indian targets in the north, east and central India are within reach of China's DF-21 ballistic missiles and DF-10 land attack cruise

40. Kristensen, n. 22.

missiles. The DF-26, with its 3,000-4,000 km range, can cover all of India. No missile brigade has been observed to be permanently located in Tibet but MRBMs, SRBMs and cruise missiles are mobile systems and can be moved to Tibet if required. The missile brigades at Delingha and Da Qaidam near Golmud are connected to Tibet by the Qinghai-Tibet Railway (QTR) line and the road network to Lhasa. They can easily be moved up to Tibet to enhance their reach into India.

The missiles which will carry out the role for conventional long range attacks will be the MRBMs DF-26 and DF-21; SRBMs DF-16, DF-15 and DF-11; the DF-10 (earlier it was called the DH-10/CJ-10) and YJ-63 cruise missiles. The PLAAF is also developing two new air launched LACMs (Land Attack Cruise Missiles) with 1,500 km range and 10 m accuracy.⁴¹ The Chinese armed forces are in the process of some organisational changes. Under the reorganisation taking place, the PLA Army is in the process of receiving conventional SRBMs. All SRBMs of less than 300 km range are being transferred to the PLA Army for direct firepower support of the land battle. The PLA Rocket Force will retain all SRBMs above 300 km range.

In any future conflict against India, the PLA Rocket Force will use its conventional missiles in preemptive strikes, as part of the PLA's "anti-access strategy", in an attempt to degrade Indian Air Force (IAF) forward airfields, military bases and vital targets. China's ballistic and cruise missiles will be a major threat to the IAF. To counter this threat, the IAF needs to upgrade its terminal air defences. Long range Surface-to-Air Missiles (SAMs) (as and when they are inducted), will provide some ABM (Anti-Ballistic Missile) capability against China's ballistic missiles. Cruise missiles fly at low levels and to counter them, the first requirement is detection. The IAF needs to consider development of low cost aerostat radars to pick up cruise missiles. To destroy cruise missiles, deployment of CIWS (Close in Weapon Systems) of the Phalanx class needs to be considered. These CIWS guns coupled with modern SAMs and interceptor

China's Missile Base 53 at Kunming, and Missile Base 56 at Xining are the ones which are of concern to India due to their location and capability of striking at India.

41. n. 11.

The PLA Rocket Force suggests a security challenge for India. This is a challenge which India must accept, and build up its capabilities appropriately to withstand attempts at coercion by China, either on its own or in collusion with its "iron brother" Pakistan.

aircraft having "look down shoot down" capability will strengthen air defences against cruise missiles. The IAF also needs to use passive methods to absorb damage by any missiles which get through the defences. The IAF needs an adequate number of Hardened Aircraft Shelters (HAS) to park fighter aircraft. Another passive method which needs to be explored is deployment of modern means of runway repair material which can keep the runway down time to minutes instead of hours. The IAF also has the advantage of a large number of airfields in the east and west, so even if some airfields are down,

operations can continue from other locations. The adversary cannot take out all our airfields. The best defensive strategy against China's missiles is to deter them by developing similar capabilities so that India can strike targets in China. India needs to step up its plans to develop the hypersonic Brahmos-2 cruise missile and subsonic 1,000 km range Nirbhay cruise missile. Apart from targets in Tibet, other targets are deep inside China, which may be beyond the range of our strike aircraft. Therefore, India needs to consider developing conventional ballistic missiles – the Agni class – and cruise missiles with sufficient range to strike at Chinese counter-force targets deep in China. India needs to develop these missiles in adequate numbers to retaliate forcefully against China, if required. India also needs to have persistent ISR capability to locate Chinese missile movements against India. Satellite reconnaissance has its limits in terms of swathe and revisit time. We need to increase the number of our satellites for ISR and also consider procurement of High Altitude Long Endurance (HALE) UAVs to carry out persistent ISR over Chinese targets.

The PLA Rocket Force suggests a security challenge for India. This is a challenge which India must accept, and build up its capabilities appropriately to withstand attempts at coercion by China, either on its own or in collusion with its "iron brother" Pakistan.

CHINA'S ADIZ: ENFORCEMENT IN EAST CHINA SEA AND PROSPECTS FOR SOUTH CHINA SEA

TANMAY SHARMA

INTRODUCTION

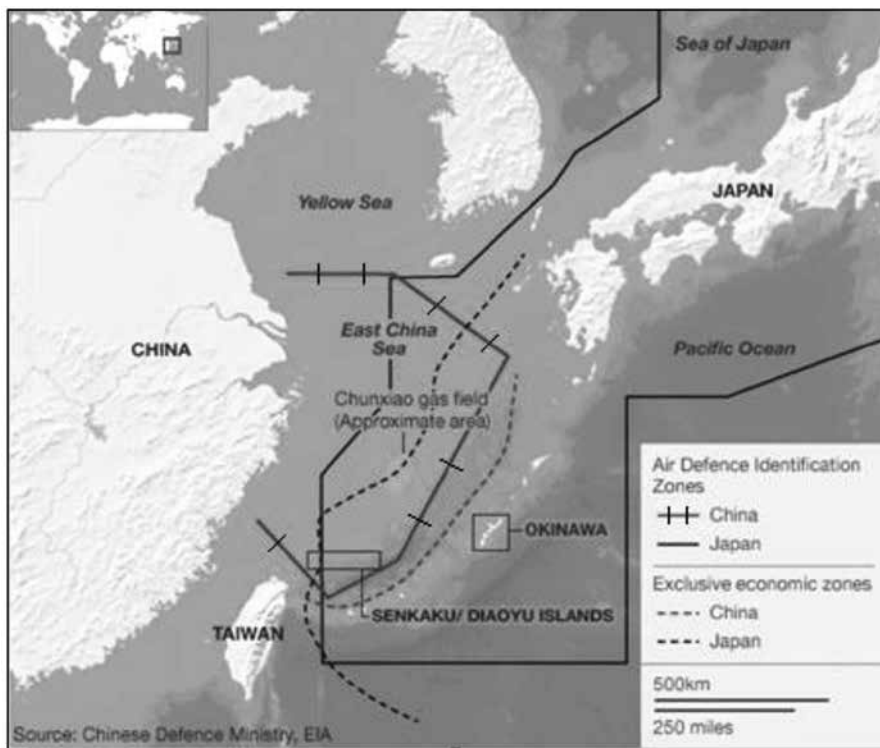
While the world wonders whether the People's Republic of China (PRC) is taking incremental steps towards establishing an Air Defence Identification Zone (ADIZ) in the South China Sea, there is a need to carry out a detailed analysis of Beijing's already established ADIZ in the East China Sea to decipher China's true intent behind such whimsical and one-sided declarations.

On November 23, 2013, China established an ADIZ in the East China Sea (Fig. 1). China's ADIZ overlaps the one from Japan and encompasses the Senkaku Islands, which Japan administers, but over which both countries claim sovereignty. As per US Secretary of State John Kerry, China's ADIZ "constitutes an attempt to change the status quo in the East China Sea." Within days, military aircraft from the United States, Japan, and South Korea flew through China's ADIZ without complying with China's ADIZ regulations. Over the last few years, international tensions over China's ADIZ have diminished, but the prospect of a new Chinese ADIZ in the South China Sea covering its much debated 'nine-dash line' has sparked many a debate and warrants further study of China's

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operations in its East China Sea ADIZ to date. A report has been issued by the US–China Economic and Security Review Commission on this issue. This report has assessed the extent to which China has enforced its ADIZ in the East China Sea, and studied the potential conditions and implications of a Chinese ADIZ in the South China Sea.

Fig 1: China's ADIZ and Claimed EEZ in the East China Sea



BACKGROUND

Air Defence Identification Zone

An ADIZ is a publicly declared area, established in international air space adjacent to a state's national/sovereign air space, in which the state requires

that civil aircraft provide their identifiers and location¹. Its purpose is to allow a state the time and space to identify the nature of approaching aircraft prior to their entering the national air space and prepare defensive measures, if necessary². The first ADIZ was established by the United States in 1950 when it created a joint North American ADIZ with Canada, citing the legal right of a nation to establish reasonable conditions of entry into its territory. The US does not apply its ADIZ procedures to foreign aircraft not intending to enter US air space and, similarly, does not recognise the right of a coastal nation to apply its ADIZ procedures to foreign aircraft not intending to enter its national air space³.

South Korea's ADIZ was established in 1951 during the Korean War by the United States Air Force. It currently does not cover Socotra Rock, known to the Koreans as Ieodo. Korean Defence Minister Kim Kwan-jin had said that South Korea would consider extending its ADIZ in the light of the extent of the Chinese ADIZ but an announcement of a change was postponed after a meeting with the United States' ambassador.

Japan's ADIZ, which was established in 1969, covers most of its Exclusive Economic Zone (EEZ). Japan makes no demands on aircraft flying through, unless they are landing in Japan. The ADIZ was revised in 1972, the same year that the US-Japan Okinawa Reversion Treaty provided for the return of the Ryukyu Islands and Daitō Islands to Japan. Its ADIZ was created by the United States armed forces during the post-World War II Allied occupation, with the western border at 123° degrees east. This resulted in only the eastern half of Yonaguni Island being part of Japan's ADIZ and the western half being part of Taiwan's ADIZ. On June 25, 2010, Japan extended its ADIZ around Yonaguni 22 km westwards⁴. This led to an overlapping with sections

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1. Ruwantissa Abeyratne, . "In Search of Theoretical Justification for Air Defence Identification Zones" (PDF), *Journal of Transportation Security*, March 2012 (Springer US).
 2. Jeremy Page,"The A to Z on China's Air Defense Identification Zone", *The Wall Street Journal*, November 27, 2013. Retrieved on November 29, 2013.
 3. "Entering, Exiting and Flying in United States Airspace", Federal Aviation Administration, June 14, 2013.
 4. "The Ministry of Defense Extends the Air Defense Identification Zone, 26km West above Yonaguni Island," *The Ryukyu Shimpo*, June 25, 2010.

China's ADIZ regulations deviate from international norms by seeking to exert control over both civil and military aircraft, deliberately creating an overlapping area with other countries' ADIZs and disputed territory, and threatening to use "defense emergency measures" against all non-compliant aircraft.

of Taiwan's ADIZ⁵. However, Taiwanese foreign affairs officials said that it does not make any difference, as an understanding has been reached between the two parties on how to handle it. According to the China Network Television on November 24, 2013, China and Russia do not recognise Japan's ADIZ.

The People's Republic of China announced the establishment of the East China Sea ADIZ on November 23, 2013, defining it as a zone that allowed a coastal state to "identify, monitor, control and react to aircraft entering this zone with potential air threats"⁶. China's ADIZ regulations deviate from international norms by seeking to exert control over both civil and military aircraft, deliberately creating an overlapping area with other countries' ADIZs and disputed territory, and threatening to use "defense emergency measures" against all non-compliant aircraft.

IDENTIFICATION RULES

According to the Chinese Ministry of National Defence, foreign aircraft in the zone will be expected to abide by the following⁷

- **Identification of Flight Plan:** Any aircraft in the zone must report its flight plan to China's Ministry of Foreign Affairs or Civil Aviation Administration.

5. "Japan Extends ADIZ into Taiwan Space", *taipeitimes.com Taipei Times*, June 26, 2013. Retrieved on November 24, 2013.

6. "Statement by the Government of the People's Republic of China on Establishing the East China Sea Air Defense Identification Zone", <http://news.xinhuanet.com/>, Xinhua, November 23, 2013. Retrieved on November 23, 2013. "Defence Spokesman Yang Yujun's Response to Questions on the Establishment of The East China Sea Air Defense Identification Zone, Ministry of National Defence of the People's Republic of China," November 23, 2013

7. "Announcement of the Aircraft Identification Rules for the East China Sea Air Defense Identification Zone of the P.R.C", Ministry of National Defence of the People's Republic of China, November 23, 2013. Retrieved on November 25, 2013.

- **Radio Identification:** Aircraft in the zone must maintain two-way radio communication and respond in a timely and accurate manner to inquiries.
- **Responder Identification:** Any aircraft with an Air Traffic Control Radar Beacon System transponder must keep it on during the aircraft's time in the zone.
- **Sign Identification:** Any aircraft in the zone must display insignia indicating its nationality and registration clearly, in accordance with international treaties.
- **Aircraft in the Zone Should Follow Instructions:** The Chinese military will adopt "emergency defensive measures" in response to aircraft that refuse to follow the instructions.

However, the primary difference in this ADIZ from those of other countries is that an aircraft which is passing through the other ADIZs without entering the sovereign air space of the respective country does not have to notify the authorities, but here all aircraft passing through have to abide by the rules or face the consequences.

Chinese media claimed that while "freedom of flight" would be respected for "normal" flights, the principle would not apply to "provocative flyover" and "surveillance activities"⁸. However, the primary difference in this ADIZ from those of other countries is that an aircraft which is passing through the other ADIZs without entering the sovereign air space of the respective country does not have to notify the authorities, but here all aircraft passing through have to abide by the rules or face the consequences⁹. A major incident occurred on July 25, 2015, when Lao Airlines flight QV 916 was turned back by the Chinese. The Chinese Ministry of Defence (MoD) later said that the aircraft was prevented from entering Chinese territory due to an inadequate flight plan, and that the incident had nothing to do with the ADIZ¹⁰.

8. "Air Defence ID Zone to Deter Those with Designs on China's Territory," *People's Daily*, November 26, 2013.

9. Foreign Ministry Spokesperson Qin Gang's Regular Press Conference, Ministry of Foreign Affairs of the People's Republic of China, November 29, 2013.

10. *Ibid.*

GEOPOLITICAL AND ECONOMIC SIGNIFICANCE OF SOUTH CHINA SEA

It may be worth speculating as to why China is so keen to assert its control over the South China Sea region, right from the Strait of Malacca in the south to the Taiwan Strait in the north. Why would it really want to establish an ADIZ in a region where it has territorial disputes with four major regional players, i.e. Taiwan, Malaysia, Philippines and Vietnam? All these countries have their EEZs claims overlapping with the Chinese (Fig 2) and, hence, an ADIZ in this region would be a cause for major turmoil and conflict. If we analyse the significance of this region, the motive of Beijing would become quite clear.

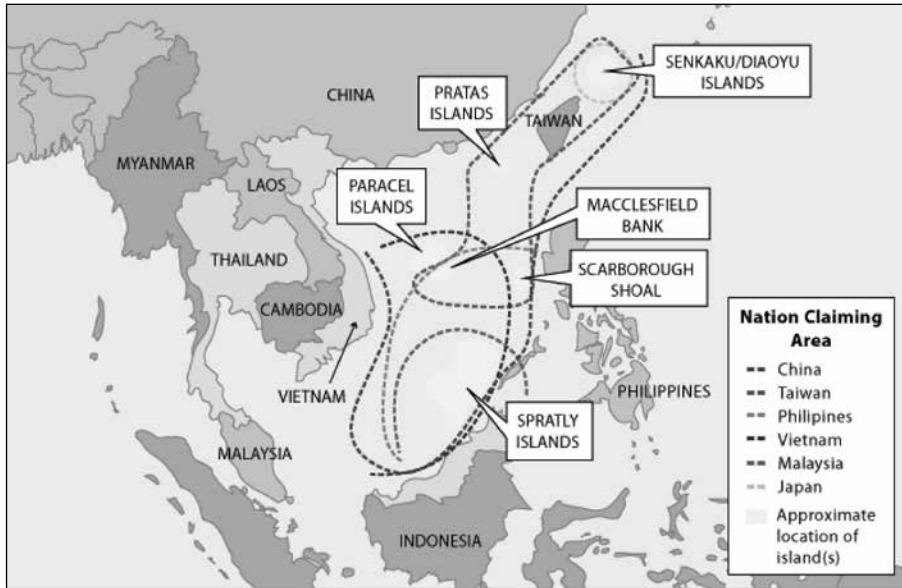
The South China Sea is an extremely significant body of water in a geopolitical sense. It is the second most used sea lane in the world: 50 percent of the world's annual merchant fleet tonnage passes through the Straits of Malacca, Sunda , and Lombok . Over 1.6 million m³ (10 million barrels) of crude oil a day are shipped through the Strait of Malacca. The region has proven oil reserves of around 1.2 km³ (7.7 billion barrels), with an estimate of 4.5 km³ (28 billion barrels) in total. Natural gas reserves are estimated to total around 7,500 km³ (266 trillion cubic feet). A 2013 report by the US Energy Information Administration (EIA) raised the total estimated oil reserves to 11 billion barrels¹¹. In 2014, China began to drill for oil in waters disputed with Vietnam¹².

According to studies made by the Department of Environment and Natural Resources of the Philippines, this body of water holds one-third of the entire world's marine biodiversity, thereby making it a very important area for the ecosystem as well as a major economic resource.¹³

11. "US Report Details Rich Resources in South China Sea," archived from the original on 2013-02-133.

12. Keith Johnson, "How Do You Say 'Drill, Baby, Drill' in Chinese?," *www.foreignpolicy.com* (AFP - Getty), May 5, 2014. Retrieved on May 6, 2014.

13. Daniel Schearf, "S. China Sea Dispute Blamed Partly on Depleted Fish Stocks," *VOA*, May 16, 2012.

Fig 2: Territorial Disputes in South China Sea

Hence, it is quite clear why China has such great interest in this region; it has several territorial disputes with other countries over sharing of the island territories and it is trying to build major military infrastructure to claim and maintain a strong hold over the entire South China Sea.

UPDATE ON CHINA’S ENFORCEMENT OF ITS EAST CHINA SEA ADIZ

China’s unilateral action of declaring this ADIZ sparked an intense global debate as to the logic of such a move, but also amplified larger concerns over Chinese intentions throughout the Asia-Pacific and wider Indo-Pacific regions. A Bloomberg report from October 2015 suggested that China “has quietly stopped seeking to actively enforce its ADIZ”¹⁴. This may be attributable to political calculations by the Chinese authorities. The Chinese leaders may not have intended to enforce the ADIZ fully, or even

14. Ting Shi, “Quiet Air Zone Shows China’s Struggle to Control Contested Seas,” Bloomberg, October 28, 2015, <http://www.bloomberg.com/news/articles/2015-10-28/quiet-air-zone-shows-china-s-struggle-to-control-contested-seas>.

China may be seeking to advance its position in the East China Sea over the long term after a short spike in tension, leaving a new status quo with the East China Sea ADIZ in place.

to enforce it at all, but rather may have calculated that the establishment of an ADIZ would bolster China's position vis-à-vis Japan. According to a January 2015 Congressional Research Service report, China may be seeking to advance its position in the East China Sea over the long term after a short spike in tension, leaving a new status quo with the East China Sea ADIZ in place. It would acquire strategic advantage by asserting a maximalist position, then seeming to back down, while preserving some incremental gain, akin to a ratchet effect. According to this theory, it would project a calm image and justify this ADIZ as a 'reasonable' step to which foreign nations should not object. If there is an accident, crisis, or loss of life, Beijing could then blame Tokyo, Seoul, Taipei, or Washington¹⁵. This explanation of China's intentions aligns with the view, widely held among foreign observers, that China often seeks to assert its interests in territorial disputes by 'salami slicing', or, according to Robert Haddick, an independent contractor at the US Special Operations Command, the slow accumulation of small changes, none of which in isolation amounts to a *casus belli*, but which add up over time to a substantial change in the strategic picture¹⁶.

Many observers have attributed an assessed lack of ADIZ enforcement to inadequate Chinese military capabilities. Possible shortcomings in China's military capabilities, as well as China's efforts to improve its capabilities in these areas are:

- **Command Structure:** China is moving toward greater jointness in the administration of its ADIZ. It has established a Joint Operations Command Centre (JOCC) in the area.¹⁷ A May 2015 report from the *Kanwa Defense*

15. Ian E. Rinehart and Bart Elias, "China's Air Defense Identification Zone," Congressional Research Service, January 30, 2015,

16. Robert Haddick, "America Has No Answer to China's Salami-Slicing," *War on the Rocks*, February 6, 2014, <http://warontherocks.com/2014/02/america-has-no-answer-to-chinas-salami-slicing/>

17. Official in the Japan Maritime Self Defense Force, briefing to Commission, Washington, DC, December 7, 2015.

Review suggests that this JOCC aims to integrate the People's Liberation Army (PLA), PLA Air Force (PLAAF), PLA Navy (PLAN) aviation and army aviation forces. Administering the ADIZ through a JOCC would facilitate the integration of radar data and coordination of interceptors¹⁸.

- **Radar Infrastructure:** China's network of land-based radar systems is probably barely capable of tracking aircraft in its ADIZ, although some analysts suggest its effectiveness may suffer from a gap in coverage resulting from a division of radar assets between the PLAAF and PLAN.¹⁹ In

addition to its land-based radar systems, China has more than a dozen Airborne Early Warning and Control (AEW&C) aircraft that could increase the PLA's monitoring capabilities²⁰. It is unclear as to what extent AEW&C aircraft are integrated into China's ADIZ enforcement operations. A *PLA Daily* report from January 2014 indicated that China planned to keep at least one AEW&C aircraft available at all times to support the ADIZ²¹. However, how much a single such aircraft would be able to achieve in support of an active and aggressive ADIZ in the area is another matter worth a debate.

It is unclear as to what extent AEW&C aircraft are integrated into China's ADIZ enforcement operations. A *PLA Daily* report from January 2014 indicated that China planned to keep at least one AEW&C aircraft available at all times to support the ADIZ.

18. Open Source Centre, "Kanwa: 'PLA Studies on Redefining China's Military Commands,'" May 1, 2015. ID: CHR2015051932229003.

19. Mark Stokes, "China's ADIZ System: Goals and Challenges," *Thinking Taiwan*, April 24, 2014, <http://thinking-taiwan.com/chinas-adiz/>; Ian Easton, "China's Evolving Reconnaissance Strike Capabilities: Implications for the U.S.-Japan Alliance," Project 2049 Institute, February 2014. http://www.project2049.net/documents/Chinas_Evolving_Reconnaissance_Strike_Capabilities_Easton.pdf; U.S.-China Economic and Security Review Commission, Hearing on China's Military Modernisation and its Implications for the United States, written testimony of Mark Stokes, January 30, 2014; and Open Source Centre, "China: Media Suggest Effort to Portray Air Force as Capable of Enforcing ADIZ," November 29, 2013. ID: CHO2013112985082237.

20. Wendell Minnick, "China's Achilles' Heel: Air Defense Gap," *Defense News*, May 10, 2014.

21. Open Source Centre, "PLA Daily: Airborne Early Warning Aircraft to Serve over East China Sea," January 28, 2014, ID: CHR 2014012835717559.

ENFORCEMENT OF THE ADIZ

Against Military Aircraft

China has never sought to fully enforce its ADIZ and public reports suggest that only a handful of foreign military flights have been intercepted till date²². China did not intercept several non-compliant foreign military flights in its ADIZ in the several days following its establishment. Only a few Japanese military aircraft were intercepted in mid-2014 and further authoritative public reports of any other intercepts have not appeared²³. However, determining the extent to which China has enforced its ADIZ since late 2013 is not possible using open sources, as China does not publish comprehensive data on the extent or frequency of its ADIZ enforcement actions, and foreign militaries do not publicise the extent or frequency of their operations in China's East China Sea ADIZ and do not regularly comment on China's operations in the area. Analysts using open sources generally must rely on media reports for information on China's ADIZ activities, but these reports are not necessarily comprehensive.

Against Commercial Aircraft

China's ADIZ apparently has not disrupted commercial air traffic in the East China Sea. Although the Japanese government has instructed Japanese commercial airlines not to comply with China's ADIZ regulations,²⁴ there have been no reports of the Chinese authorities attempting to apply ADIZ regulations to the activities of any planes operated by these carriers. Many airlines, such as Cathay Pacific and Singapore Airlines, have been reported to cooperate with China's ADIZ

22. Shi, n. 14; Rinehart and Elias, n. 15, p. 11.

23. Martin Fackler, "Japan Protests Chinese Flybys over East China Sea," *New York Times*, June 11, 2014, <http://www.nytimes.com/2014/06/12/world/asia/japan-protests-chinese-flybys-over-east-china-sea.html>; Martin Fackler, "Chinese Flybys Alarm Japan as Tensions Escalate," *New York Times*, May 25, 2014, <http://www.nytimes.com/2014/05/26/world/asia/japan-east-china-sea.html>

24. Hiroyuki Kachi and Yoshio Takahashi, "Japan Asks Airlines to Ignore China Flight-Plan Rule," *Wall Street Journal*, November 26, 2013", <http://www.wsj.com/articles/SB10001424052702304281004579221681641322204>.

regulations.²⁵ The US government has also directed its carriers to comply with China's ADIZ regulations while operating in the region,²⁶ although a Department of State spokesperson said this guidance to US carriers "does not indicate US government acceptance of China's requirements for operating in the newly declared ADIZ."²⁷

Nonetheless, an incident in July 2015 brought some attention to China's treatment of commercial flights in the area, where Chinese air traffic controllers turned back Lao Airlines flight QV916 en-route from South Korea to Laos as it approached the Chinese mainland over the East China Sea.²⁸ The flight reportedly was turned back just after it entered China's East China Sea ADIZ (Fig 3). Some media reports suggested that the flight was turned back for failing to comply with China's ADIZ regulations, which would make this the only commercial flight known to have been turned back by the Chinese authorities for this reason²⁹. However, a Chinese Ministry of National Defence spokesman said the incident was unrelated to China's ADIZ, and claimed that this was done due to an improper flight plan passed by the airline.³⁰

25. Demetri Sevastopulo, Jennifer Thompson, and Simon Mundy, "US Urges Airlines to Comply with China Air Rules," *Financial Times*, November 30, 2013, <http://www.ft.com/intl/cms/s/0/41e02002-58e7-11e3-a7cb-00144feabdc0.html#axzz3wHqQIICT>.

26. Rinehart and Elias, n. 15; U.S. Department of State, "China's Declared ADIZ - Guidance for U.S. Air Carriers," November 29, 2013. <http://www.state.gov/r/pa/prs/ps/2013/11/218139.htm>.

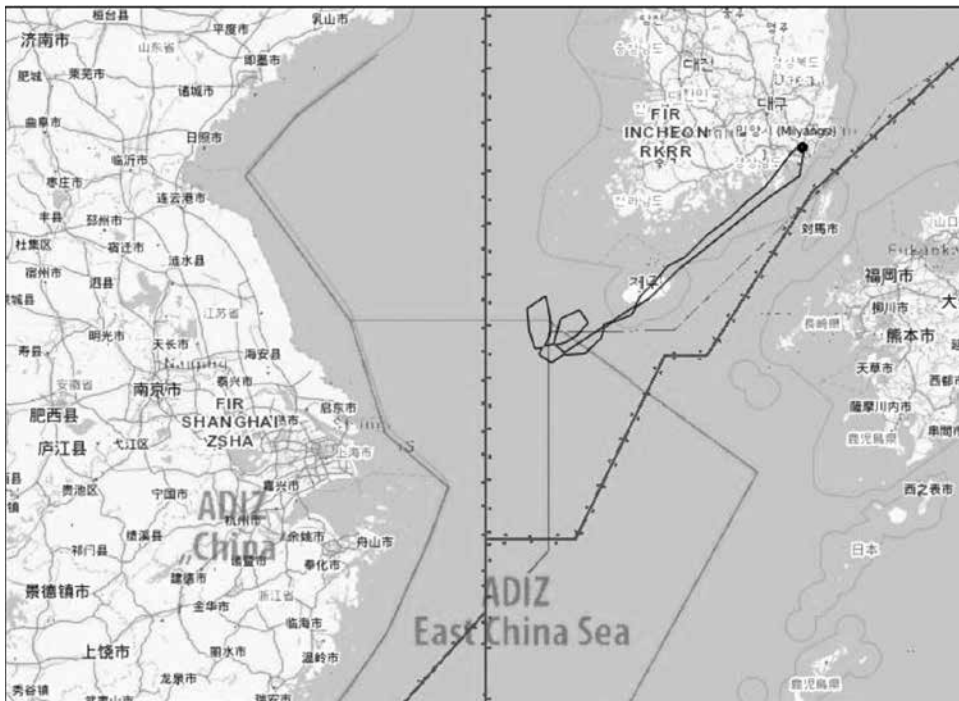
27. Ibid.

28. Xinhua (English edition), "Laos Plane Refused Entry to China Has No Link with ADIZ," July 30, 2015, http://news.xinhuanet.com/english/2015-07/30/c_134464654.htm; Jeremy Torr, "China Turns Back Lao Airlines Flight for Failing to Comply with ADIZ Rules," *Air Transport World*, July 27, 2015, <http://atwonline.com/open-skies/china-turns-back-lao-airlines-flight-failing-comply-adiz-rules>.

29. Ankit Panda, "A First: China Turns Back Commercial Flight For Violating East China Sea ADIZ Rules," *Diplomat* (Japan), July 30, 2015, <http://thediplomat.com/2015/07/a-first-china-turns-back-commercial-flight-for-violating-east-china-sea-adiz-rules/>; Jeremy Torr, "China Turns Back Lao Airlines Flight for Failing to Comply with ADIZ Rules," *Air Transport World*, July 27, 2015, <http://atwonline.com/open-skies/china-turns-back-lao-airlines-flight-failing-comply-adiz-rules>.

30. Xinhua (English edition), "Laos Plane Refused Entry to China Has No Link with ADIZ," July 30, 2015. http://news.xinhuanet.com/english/2015-07/30/c_134464654.htm.

Fig 3: Path of Flight QV916 on July 25, 2015



OTHER CHINESE ACTIVITIES IN EAST CHINA SEA AIR SPACE

China has greatly increased its military presence over the East China Sea in recent years. These activities often are not explicitly connected to China's ADIZ, but they demonstrate China's claim to authority over air space in the area, as well as China's claim to sovereignty over the Senkaku Islands. According to Japan's Ministry of Defence, the number of Japanese jet fighter scrambles against Chinese aircraft rose from about 150 in Japan's fiscal year 2011 to about 450 in fiscal year 2014³¹ which is a rough indicator of the Chinese military activity in the air space above the East China Sea. Notably, the beginning of the recent spike in Japanese intercepts coincided with the Japanese government's purchase of the Senkaku Islands in 2012. Other incidents in the East China Sea air space, such as a December 2012 transit by

31. Ministry of Defence (Japan), "China's Activities Surrounding Japan's Airspace", http://www.mod.go.jp/e/d_act/tyouku/.

a Chinese government surveillance aircraft in the territorial air space of the Senkaku Islands³² and a January 2013 incident in which Japan and China each scrambled jet fighters also indicate that air space tensions began to rise soon after the Japanese government's purchase of the Senkaku Islands,³³ more than a year before the ADIZ was established. Increased Chinese military activity in the region has also included several exercises in the East China Sea and the Western Pacific, including the first known flights by PLA Air Force planes into the Western Pacific through the Miyako Strait in 2015.³⁴

Increased Chinese military activity in the region has also included several exercises in the East China Sea and the Western Pacific, including the first known flights by PLA Air Force planes into the Western Pacific through the Miyako Strait in 2015.

A Possible ADIZ in the South China Sea ?

Many observers believe China is expanding its military capabilities in the South China Sea to support a future South China Sea ADIZ. Moreover, several statements by Chinese government officials suggest that China is considering establishing a South China Sea ADIZ.³⁵ In December 2013, after China declared its East China Sea ADIZ, China's then ambassador to the Philippines responded to questions about whether China might declare an ADIZ in the South China Sea, by saying China was entitled to decide "where and when to set up the new air identification zone."³⁶ In January 2016, a Chinese Ministry of Foreign Affairs spokesperson claimed that the

32. Ibid.

33. J. Michael Cole, "Japan, China Scramble Military Jets in East China Sea," *Diplomat* (Japan), January 12, 2013, <http://thediplomat.com/2013/01/japan-china-scramble-military-jets-in-east-china-sea/>.

34. Open Source Centre, "Xinhua: Air Force Spokesman: PRC Planes Train in Pacific Beyond 1st Island Chain, Patrol East China Sea ADIZ," November 27, 2015, ID: CHR2015112740202821.

35. Li Bao and Si Yang, "Experts Worry China May Soon Establish South China Sea ADIZ," *Voice of America*, July 29, 2015, <http://www.voanews.com/content/experts-concerned-china-may-soon-establish-southern-adiz/2882795.html>; Andrew S. Erickson, "Lengthening Chinese Airstrips May Pave Way for South China Sea ADIZ," *National Interest*, April 27, 2015, <http://nationalinterest.org/blog/the-buzz/lengthening-chinese-airstrips-may-pave-way-south-china-sea-12736>.

36. Jim Gomez, "Envoy Says China Has Right to Set Another Air Zone," *Associated Press*, December 2, 2013.

decision of setting up an ADIZ in the South China Sea will be made based on a full assessment of the security situation and after making joint efforts with all relevant parties to safeguard peace and stability of the South China Sea. Also, China expects that relevant countries would not flex military muscles by sending aircraft and vessels and instead take concrete actions to uphold peace and stability in the South China Sea together with China.³⁷ This statement and similar statements by senior Chinese officials in recent years suggest that China is positioning itself to defend the announcement of a South China Sea ADIZ as a defensive reaction to the actions of other countries.

Antonio Carpio, a senior associate justice of the Supreme Court of the Philippines, said at a lecture at the Centre for Strategic and International Studies that China was already effectively enforcing a quasi-ADIZ in the South China Sea³⁸. Any Philippine plane that flies over the Spratlys receives a stern warning from China via radio to “stay away from the area.” The quasi-ADIZ was part of China’s grand design to control the South China Sea and the resources therein. Beijing’s behaviour over the past few years, ranging from the harassment of the fishing vessels from other claimant states to the building of artificial islands clearly illustrates that it wants all the fisheries, oil, gas and mineral resources within the nine-dash line (Fig 4) and intends to use the features it controls as strategic outposts for military advantage. Carpio stressed on the importance of the Philippines’ current legal case against China to declare its notorious nine-dash line invalid, emphasising the need for the international community to pressurise Beijing to abide by it.

Timing for this ADIZ

Whether and when China will establish an ADIZ in the South China Sea depends on its motivations and enforcement capabilities. Should China seek to use the establishment of a South China Sea ADIZ for purely geopolitical purposes rather than for the practical purposes usually associated with

37. Open Source Centre, “PRC MOFA: Foreign Ministry Spokesperson Hua Chunying’s Regular Press Conference on January 4, 2016,” January 4, 2016, ID: CHR2016010524954940.

38. <http://thediplomat.com/2015/10/china-enforcing-quasi-adiz-in-south-china-sea-philippine-justice/>

ADIZs, the timing will likely depend on the Chinese leaders' cost-benefit analysis of the geostrategic advantages of exerting control over disputed areas against the reputational, diplomatic, and other potential costs it will almost certainly incur due to widespread negative reactions from regional countries and the United States.³⁹ A range of regional events, such as the pending decision by the Permanent Court of Arbitration on the territorial dispute between China and the Philippines, could influence this cost-benefit analysis.

However, if China seeks to enforce an ADIZ, it might calculate that the development of its military capabilities to fully enforce it should precede the declaration of an ADIZ. In this scenario, the timing for the declaration of an ADIZ depends on China's ability to maintain aircraft and Intelligence, Surveillance, and Reconnaissance (ISR) presence in the South China Sea. Observers should look for the completion of runways and support infrastructure on the Spratly Islands land features, and eventually the deployment of advanced military aircraft and radar systems to these land features, as signs that China is approaching the capability to enforce an ADIZ. Given that China's aircraft presence and other military capabilities are greater in the Paracel Islands than in the Spratly Islands, it is plausible that China could declare an ADIZ over the Paracel Islands and their surrounding waters that do not include the Spratly Islands and the southern reaches of the South China Sea. In this case, it could later expand this ADIZ to cover the Spratly Islands and their surrounding waters as its military capabilities improve there, or establish a second ADIZ in the area.

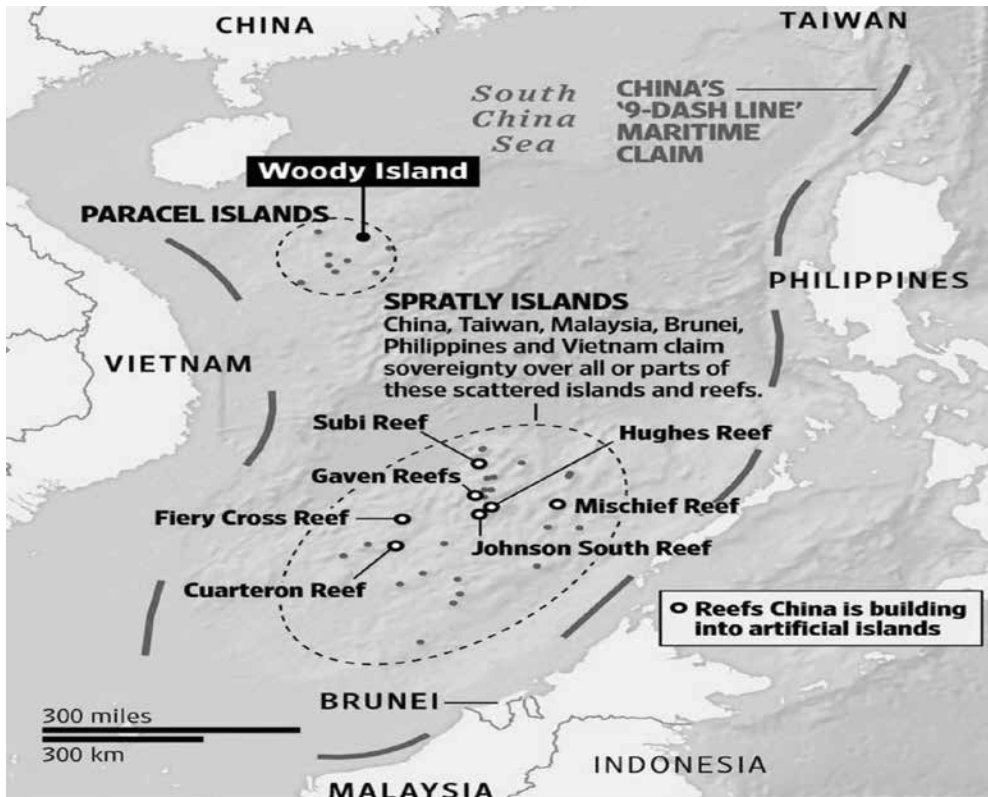
Likely Shape

The geographic limits of a notional Chinese ADIZ in the South China Sea could have implications for China's claims there. China's "nine-dash line," its expansive and vague demarcation of its claims in the South China Sea, do not clearly define the limits of these claims (Fig 4). An ADIZ, by contrast, almost certainly would have absolute geographic limits. If China draws its

39. US-China Economic and Security Review Commission, January 14, 2014, <http://www.uscc.gov/sites/default/files/Research/China%20ADIZ%20Staff%20Report.pdf>; Xinhua (English edition),

ADIZ to roughly conform to its maritime claims, as it did in the East China Sea (Fig 1), China might implicitly clarify the boundaries of its claims.⁴⁰

Fig 4: China's "Nine-Dash Line" and Occupied Land Features in the South China Sea



CHALLENGES TO A SOUTH CHINA SEA ADIZ

China would face geographical, environmental, logistical, and operational challenges in seeking to enforce an ADIZ in the South China Sea. China has made significant investments that could address many of these challenges.

40. Andrew S. Erickson and Austin Strange, "Pandora's Sandbox: China's Island-Building Strategy in the South China Sea," *Foreign Affairs*, July 13, 2014, <https://www.foreignaffairs.com/articles/china/2014-07-13/pandoras-sandbox>.

These efforts, which include the creation and expansion of artificial land features in the Spratly Islands and the construction of runways and support infrastructure on these land features are rapidly increasing China's ability to enforce an ADIZ in the area. Important challenges to a possible Chinese South China Sea ADIZ include the following:

- **Few Airfields:** Because of the long distances between the Chinese mainland and much of the South China Sea, China most likely would need to use several airfields throughout the South China Sea to host the aircraft necessary to enforce a South China Sea ADIZ⁴¹. China's East China Sea ADIZ, by contrast, is close enough to mainland China and Chinese aircraft can deploy from there. China has already constructed runways on Woody Island in the Paracel Islands and Fiery Cross Reef in the Spratly Islands. Both these runways are long enough to host the fighter aircraft China would use to patrol its ADIZ.⁴² Media reports suggest that China stationed J-11 jet fighters at Woody Island in late 2015, and in February 2016, deployed J-11s and JH-7 strike aircraft there⁴³. China has also reportedly nearly completed the construction of runways at Subi Reef and Mischief Reef in the Spratly Islands. Satellite imagery suggests that these runways will be long enough to host fighter aircraft.⁴⁴
- **Limited Radar Infrastructure:** Establishing consistent radar coverage of the entire area of a potential South China Sea ADIZ would be crucial to

41. Ben Dolven et al., "Chinese Land Reclamation in the South China Sea: Implications and Policy Options," Congressional Research Service, June 18, 2015, 11; U.S.-China Economic and Security Review Commission, Hearing on China's Relations with Southeast Asia, written testimony of Bonnie S. Glaser, May 13, 2015.

42. James Hardy, "China Completes Runway on Fiery Cross Reef," *IHS Jane's Defense Weekly*, September 24, 2015, <http://www.janes.com/article/54814/china-completes-runway-on-fiery-cross-reef>.

Centre for Strategic and International Studies, "Airpower in the South China Sea," 2015, <http://amti.csis.org/airstrips-scs/>

43. Richard D. Fisher, Jr., "China Again Uses Woody Island for Military Posturing," *IHS Jane's Defense Weekly*, February 24, 2016, <http://www.janes.com/article/58307/china-again-uses-woody-island-for-military-posturing>; Franz-Stefan Gady, "China Stations Combat Aircraft on South China Sea Island," *Diplomat* (Japan), November 10, 2015, <http://thediplomat.com/2015/11/china-stations-combat-aircraft-on-south-china-sea-island/>; Wendell Minnick, "China Expands Presence with Fighters on Woody Island," *Defense News*, November 8, 2015, <http://www.defensenews.com/story/defense/air-space/strike/2015/11/08/china-expands-presence-fighters-woody-island/75147522/>.

44. Hardy, n. 42.

In a predominately marine environment with exposure to sea water and salt air, moisture-laden air is considerably more detrimental to an aircraft than it would be if all operations were conducted in a dry climate.

China's ability to monitor the ADIZ. A February 2016 Centre for Strategic and International Studies (CSIS) report suggested that China appears to have installed a high frequency radar system at Cuarteron Reef which would significantly bolster its ability to monitor surface and air traffic across the southern portion of the South China Sea⁴⁵. China has already established radar facilities on Woody Island, and it almost certainly will install radar systems at Subi Reef and Mischief Reef to further expand its monitoring capabilities in the South China

Sea. It may have built further radar facilities at Cuarteron Reef, Gaven Reef, Hughes Reef, and Johnson South Reef. In addition, AEW&C aircraft could supplement China's land-based radar systems. China's runways at Woody Island and Fiery Cross Reef are long enough to host AEW&C aircraft, and China's runways at Subi Reef and Mischief Reef almost certainly will be long enough to host these aircraft.

- **Harsh Maritime Environment:** Salt water corrosion would degrade aircraft stationed in the South China Sea. According to the Federal Aviation Administration (FAA), "In a predominately marine environment with exposure to sea water and salt air, moisture-laden air is considerably more detrimental to an aircraft than it would be if all operations were conducted in a dry climate." Moreover, "the speed of an electrochemical attack is increased in a hot, moist climate," such as the climate of the South

45. Hardy, n. 42; Richard D. Fisher, Jr., "China Deploys HQ-9 Surface-to-Air Missiles to Woody Island," *IHS Jane's Defense Weekly*, February 17, 2016. <http://www.janes.com/article/58071/china-deploys-hq-9-surface-to-air-missiles-to-woody-island>; n. 42. Centre for Strategic and International Studies, "Another Piece of the Puzzle." <http://amti.csis.org/another-piece-of-the-puzzle/>; Centre for Strategic and International Studies, "Cuarteron Reef Tracker," <http://amti.csis.org/cuarteron-reef-tracker/>; Centre for Strategic and International Studies, "Hughes Reef Tracker," <http://amti.csis.org/hughes-reef-tracker/>; Centre for Strategic and International Studies, "Johnson Reef Tracker," <http://amti.csis.org/johnson-reef-tracker/>; and Xiaodon Liang, "High Tensions over Low-Tide Elevations in the South China Sea," *National Bureau of Asian Research*, January 13, 2016, <http://www.nbr.org/research/activity.aspx?id=644#.VpjLEj3LCcd.twitter>. Centre for Strategic and International Studies, "Airstrips Near Completion," January 14, 2016, <http://amti.csis.org/airstrips-near-completion/>

China Sea. The effects of salt water corrosion could require China to shorten aircraft deployment times in the area and keep a larger number of aircraft in rotation. Many of China's indigenously produced planes, such as the J-11, may already have very short operational periods between maintenance, even in dry conditions. China could mitigate the effects of salt water corrosion by regularly cleaning aircraft and sheltering them in hangars.⁴⁶

Creating fuel storage facilities at its completed and emerging airfields would be an important step toward allowing China to station military aircraft there.

- **Rough Weather:** Coastal erosion could present a continuous challenge to China's ability to preserve its artificially expanded land features, although to prevent erosion, China has constructed sea walls at Subi Reef and Mischief Reef, and may have completed its sea wall at Fiery Cross Reef⁴⁷. In addition, seasonal typhoons could periodically impede China's ability to operate ships and aircraft in the South China Sea.
- **Inadequate Fuel Storage and Transportation:** Creating fuel storage facilities at its completed and emerging airfields would be an important step toward allowing China to station military aircraft there. A December 2015 report from China's local government authority in the Parcel

46. US Federal Aviation Administration, "Aircraft Cleaning and Corrosion Control," http://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_handbook/media/faa-8083-30_ch06.pdf. U.S. Federal Aviation Administration, Aviation Maintenance Technician Handbook – General, 2008, http://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_handbook/media/faa-8083-30_ch06.pdf. Wendell Minnick, "China Expands Presence with Fighters on Woody Island," *Defense News*, November 8, 2015, <http://www.defensenews.com/story/defense/air-space/strike/2015/11/08/china-expands-presence-fighters-woody-island/75147522/>; Gady, n. 43; Andrew S. Erickson, "Lengthening Chinese Airstrips May Pave Way for South China Sea ADIZ," *National Interest*, April 27, 2015, <http://nationalinterest.org/blog/the-buzz/lengthening-chinese-airstrips-may-pave-way-south-china-sea-12736>.

47. Eric Niiler, "As China Builds Artificial Islands, Reefs, Fish at Risk," *Discovery*, May 29, 2015. <http://news.discovery.com/earth/oceans/as-china-builds-artificial-islands-reef-fish-at-risk-150529.htm>. Centre for Strategic and International Studies, "Spratly Airstrip Update: Is Mischief Reef Next?," <http://amti.csis.org/new-imagery-release/>; James Hardy and Sean O'Connor, "China Completes Runway on Fiery Cross Reef," *IHS Jane's Defense Weekly*, September 24, 2015, <http://www.janes.com/article/54814/china-completes-runway-on-fiery-cross-reef>.

Islands suggests that China is building fuel storage facilities on Woody Island in partnership with the state-owned oil company Sinopec, making it possible to hold fuel for facilities and vehicles that would support aircraft. Open source reporting so far has not indicated fuel storage facilities at Subi Reef, Mischief Reef, or Fiery Cross Reef. Moreover, it is unclear whether China has the ability to transport sufficient quantities of fuel to the Spratly Islands to support aircraft operations there. However, a *PLA Air Force Daily* report in August 2015 indicated China had, for the first time, used a liquids transport ship to move aviation fuel during a 17-day voyage “through island and reef areas.” These ships could allow China to transport fuel to South China Sea land features. Fiery Cross Reef has a harbour, deep enough to receive these ships.

- **Limited Aircraft Support Infrastructure:** China would need to create a variety of support structures, such as aircraft shelters and maintenance facilities on the Spratly Islands land features it occupies for aircraft deployed there. Satellite imagery of China’s Spratly Islands land features does not clearly indicate whether China has constructed the support structures necessary to host large numbers of aircraft. Reports from CSIS suggest that China has constructed concrete or cement plants on Subi Reef, Mischief Reef, and Fiery Cross Reef. These plants could facilitate the construction of aircraft support infrastructure, among other structures.
- **Limited Personnel Support Infrastructure:** If China deploys a regiment of fighter aircraft to any of its current or future Spratly Islands airfields, it most likely will also need to deploy hundreds of logistics, maintenance, and ground crew personnel who typically support PLA air regiments. China currently may have a limited capability to house such large numbers of personnel on its Spratly Islands land features, but its continued construction at these land features may soon overcome this issue. According to a CNN report from May 2015, China has built “military barracks” on Fiery Cross Reef, and a CSIS report from January 2016 said China has constructed housing facilities at Mischief Reef. The same report featured a satellite image of a freighter carrying “temporary housing units” into Subi Reef’s lagoon. In addition, CSIS has suggested

that Subi Reef's older facilities, which pre-date the recent land reclamation campaign, could be capable of hosting up to 200 troops.

- **Underdeveloped Joint Command Structure:** To integrate an array of systems and platforms to enforce an ADIZ, China probably will establish a JOCC in the South China Sea. This centre would be responsible for integrating radar data to monitor air traffic and for directing Chinese aircraft to respond to ADIZ violations. One Chinese media report suggests that China is creating a joint command structure for coordinating "coastal defense," "information sharing," and "maritime law enforcement" among China's military and civilian government entities in the Paracel Islands.⁴⁸ This structure could be the framework for a larger command that eventually administers a South China Sea ADIZ.

Chinese Actions in South China Sea Air Space: A De Facto ADIZ?

Although China has not declared an ADIZ in the South China Sea, some reports suggest that China is attempting to exert control over air traffic in some parts of the South China Sea. Some observers have said China is enforcing a "de facto ADIZ" in the South China Sea.⁴⁹ However, there is no public evidence that China has attempted to exert control over aircraft more than 20 nautical miles (nm) from the shores of any Chinese-controlled land feature. This suggests that China is most likely asserting a perceived right to control air traffic in and around the claimed territorial air space of the land features it controls, rather than asserting the broader authority (i.e., the authority that an ADIZ with regulations resembling those of its East China Sea ADIZ would give it) to control air traffic over non-territorial air space. Several foreign military and civilian flights are known to have received warnings from the Chinese authorities not to approach the Chinese-occupied South China Sea land features; the incidents involved a US surveillance

48. Open Source Centre, "Hainan Wang (China): PRC Sansha Mayor Strengthens Joint Military-Police-Civilian Defense, Explores New Methods," September 30, 2015. ID: CHR2015101554794892.

49. Greg Torode and Michael Martina, "South China Sea Tensions Surge as China Lands Plane on Artificial Island," Reuters, January 5, 2016, <http://uk.reuters.com/article/uk-southchinasea-china-idUKKBN0UI20820160105>; Prashanth Parameswaran, "China Enforcing Quasi-ADIZ in South China Sea: Philippine Justice," *Diplomat* (Japan), October 13, 2015. <http://thediplomat.com/2015/10/china-enforcing-quasi-adiz-in-south-china-sea-philippine-justice/>.

Political calculations about the utility of an ADIZ for China's larger goal of asserting sovereignty over disputed territory might lead China not to fully enforce a declared South China Sea ADIZ.

plane in May 2015, two US B-52 bombers in November 2015, an Australian surveillance plane and a private aircraft carrying a BBC reporter in December 2015, and a Philippines government aircraft in January 2016.⁵⁰

Implications of a Potential South China Sea ADIZ

China's operation of its East China Sea ADIZ has the following implications for how a potential Chinese South China Sea ADIZ could

operate:

- China probably would not seek to use the ADIZ to disrupt commercial air traffic in the South China Sea. Despite directions from the Japanese government to its national carriers not to comply with China's East China Sea ADIZ regulations, no enforcement actions by Chinese air traffic control authorities against Japanese commercial aircraft have been reported. Moreover, China would already be facing a hostile international political climate in the wake of the announcement of a South China Sea ADIZ, and probably would seek to avoid the international criticism it would receive for disrupting commercial air traffic.
- Political calculations about the utility of an ADIZ for China's larger goal of asserting sovereignty over disputed territory might lead China not to fully enforce a declared South China Sea ADIZ. Beijing could perceive that the declaration of an ADIZ would change the status quo with respect to the South China Sea maritime disputes, even if China does not fully enforce the ADIZ.

50. Jim Gomez, "Philippine Plane Warned by 'Chinese Navy' in Disputed Sea," Associated Press, January 18, 2016; BBC, "Australia Conducting 'Freedom of Navigation' Flights in South China Sea," December 15, 2015, <http://www.bbc.com/news/world-australia-35099445>; BBC, "Flying Close to Beijing's New South China Sea Islands," December 14, 2015, <http://www.bbc.com/news/magazine-35031313>; Yeganeh Torbati and David Alexander, "U.S. Bombers Flew Near China-Built Islands in South China Sea: Pentagon," Reuters, November 13, 2015, <http://www.reuters.com/article/us-southchinasea-usa-idUSKCN0T12G720151113>; and Jim Sciutto, "China Warns U.S. Surveillance Plane," CNN, May 21, 2015, <http://www.cnn.com/2015/05/20/politics/south-china-sea-navy-flight/>.

Implications for US Security Interests

Setting up an ADIZ in the South China Sea could have some security implications for the United States⁵¹. These are:

- A Chinese ADIZ in the South China Sea could lead to tense mid-air encounters between US and Chinese aircraft, especially as China has previously demonstrated a willingness to challenge US military aircraft in contested maritime areas, and as senior US Department of Defence officials have indicated a willingness to conduct military flights near Chinese-occupied land features. China has expressed its opposition to US surveillance flights near Chinese-claimed land features in the South China Sea, such as the May 2015 transit of a US P-8A Poseidon aircraft near Subi Reef, Mischief Reef, and Fiery Cross Reef. China most likely lacks the ability to intercept US military flights over much of the South China Sea, but an improved ISR network and functional airfields hosting fighter aircraft on the Spratly Islands land features could give China this ability.
- A Chinese ADIZ in the South China Sea could complicate the operation of state and commercial aircraft in the South China Sea. A potential Chinese ADIZ would overlap with First Information Reports (FIRs) in the South China Sea administered by regional countries as delegated by the International Civil Aviation Organisation. An attempt by multiple authorities to exert control over air traffic could create uncertainty for pilots in the region. The establishment of a Chinese ADIZ in the South China Sea could also prompt other claimants to South China Sea territory to declare their own ADIZs over the South China Sea air space. This could further complicate the operation of aircraft in the South China Sea by increasing the number of authorities regulating the air space.

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51. As per http://origin.www.uscc.gov/sites/default/files/Research/ADIZ%20Update_0.pdf

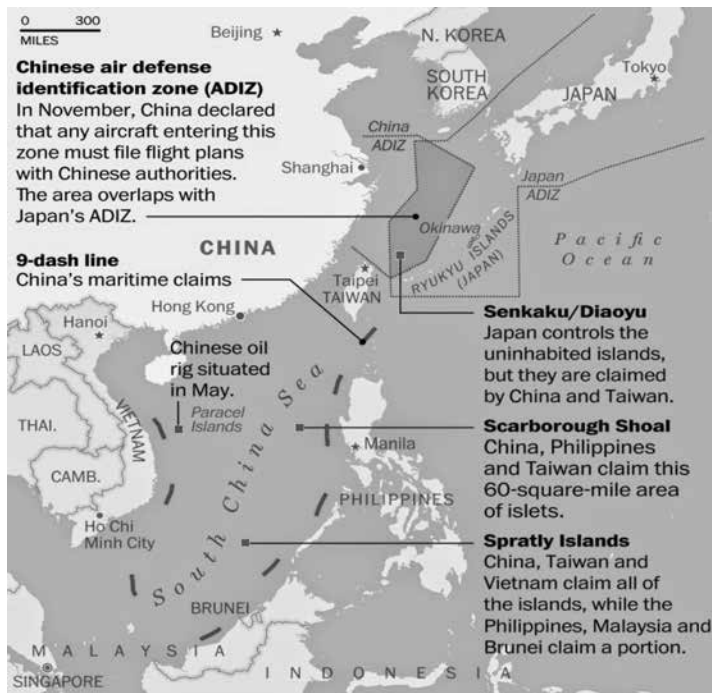
- China's development of the capabilities to enforce a South China Sea ADIZ, and its actual establishment of a South China Sea ADIZ, could change the political status quo in the South China Sea. According to Harry Harris, commander of the US Pacific Command, a fully developed array of Chinese military facilities in the region "creates a mechanism in which China would have de-facto control over the South China Sea in any scenario short of war." This shift could cause an escalation in regional tensions and a negative reaction from China's neighbours, including the Philippines, which has a mutual defence treaty with the United States. This would put pressure on the United States to reassure its allies and partners in the region of the US commitment to ensuring stability in the region.
- Some of the infrastructure and platforms useful for the enforcement of an ADIZ could have military applications in a South China Sea contingency. If China continues to build these capabilities, it could increasingly complicate the operational planning of US forces passing through the South China Sea or carrying out exercises in the close proximity of this area. There may be severe restrictions on maritime exercises carried out by any of the regional players in this sea.
- As China's radar infrastructure in the South China Sea grows, so too does its ability to collect intelligence on US forces in the region and to monitor the military and commercial activities of other countries. This would pose a major threat to any nation carrying out air-naval operations/exercises in the vicinity of this region. Chinese ADIZ control is likely to regularly infringe into any such operations.

CONCLUSION

While the world wonders whether the People's Republic of China (PRC) is taking incremental steps towards establishing an ADIZ in the South China Sea, detailed analysis of Beijing's already established ADIZ in the East China Sea seems to point to an interesting conclusion: China may not actively enforce the zone, and it could be part of a sophisticated "bargaining" strategy. Though Beijing is in the process of building

infrastructure and capabilities in the South China Sea, mainly in the Paracel Islands and parts of reclaimed areas in the Spratly Islands, the overall larger plan may be to justify or maintain a stronger hold over the various territories (Fig 5) in the region that it has disputes in (with various countries).

Fig 5: Disputed Territories in South China Sea



As it did in the East China Sea, China may be seeking to advance its position in the South China Sea over the long term after a short spike in tension, leaving a new status quo with a new ADIZ in place. It would acquire strategic advantage by asserting a maximalist position, then seeming to back down, while preserving some incremental gain, akin to a ratchet effect. According to this theory, it would project a calm image and justify this ADIZ as a 'reasonable' step to which foreign nations should not object over a prolonged period of time. In the process, China would achieve what it wants, i.e. to increase its stronghold in the region and also have the capability

to monitor and react to aerial traffic (both commercial and military) in this strategic zone. Another major achievement perceived is that it would gain a notch over the US in this area in terms of strategic advantage.

Though the South China Sea is well outside the area of operation of the Indian Navy, and India does not really have any direct interests here, nevertheless, a major part of the Indian trade to Southeast Asia and Japan does pass through the region. Also, as the Indian Navy stands poised to grow from a Brown Water navy to a Blue Water one, a stronghold of China in the South and East China Seas would surely pose a threat to its undeterred operations there. There would be several restrictions in carrying out international exercises with naval forces of other countries beyond the Strait of Malacca.

Hence, for the sake of peace and stability in the region, it would be prudent to hope that China does not impose or announce an ADIZ in the South China Sea, and even if it does, the same should be a quasi-ADIZ like the one in the East China Sea. Also, the same should ideally be in consultation and cooperation with the other regional players like Taiwan, Vietnam, Japan, Brunei, Malaysia and the Philippines.

ON CHINA'S SOFT POWER

TEMJENMEREN AO

This paper is an attempt to define what exactly constitutes China's soft power. This becomes essential as the nation continues to grow and, hence, the question emerges on whether China would receive the same level of global acceptability, as, to some extent, that of the United States of America, through its soft power. The fundamental rationale of the paper is based on the presumption that the unrivalled economic success that China's economy has been able to achieve over the last three decades has enabled it [China] to gain massive appeal at home and abroad. However, it could be argued that as China's economic growth flattens, the idea of an alternative economic growth—which Beijing has been selling globally—arouses scepticism not only about its model of growth but also its systemic weaknesses, thus, hurting the soft power gains that China has been able to achieve so far, and also impairing its rise.

DEFINING THE CONCEPT

According to Joseph S Nye, who coined the term “soft power”, a country derives its soft power primarily from three sources: its culture (in places that find it appealing), its political values (when it lives up to them at home and abroad) and its foreign policies (when they are seen as legitimate and having moral authority)¹. According to Nye, hard power can rest on inducements (carrots) or threats (sticks). But sometimes “...*you can get the outcomes you*

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1 Joseph S Nye, “The Limits of Chinese Soft Power”, Belfer Centre for Science and International Affairs, July 10, 2015, http://belfercenter.ksg.harvard.edu/publication/25543/limits_of_chinese_soft_power.html. Accessed on June 12, 2016.

When a country's culture includes universal values and its policies promote values and interests that others share, it increases the probability of obtaining its desired outcomes because of the relationships of attraction it creates.

want without tangible threats or payoffs.... The indirect way to get what you want has sometimes been called the second face of power...." A country may obtain the outcomes it wants in world politics because other countries – admiring its values, emulating its example, aspiring to its level of prosperity and openness – want to follow it. This soft power of getting others to want the outcomes that you want coopts people rather than coerces them. Further, soft power rests on the ability to shape the preferences of others. It must be realised that

soft power is not merely the same as influence; after all, influence can also rest on the hard power of threats and payments. Thus, soft power is more than just persuasion or the ability to move people by argument; it is the ability to attract, and attraction, according to Nye, is what often leads to acquiescence. Simply put, in behavioural terms, soft power is attractive power and in terms of resources, soft power resources are the assets that produce such attraction.²

Joseph Nye also elaborates on the sources of soft power that include, apart from many other things, culture and government policies at home and abroad. Culture, according to him, is a set of values and practices that create meaning for a society. When a country's culture includes universal values and its policies promote values and interests that others share, it increases the probability of obtaining its desired outcomes because of the relationships of attraction it creates. Government policies are another potential source of soft power since they reinforce a country's soft power. Domestic or foreign policies that appear to be hypercritical, arrogant, indifferent to the opinion of others, or based on a narrow approach to national interests can undermine soft power. The values a government champions in its behaviour at home, for example, democracy in international institutions (working with others)

2. Joseph S Nye, *Soft Power: The Means to Success in World Politics* (New Delhi: KW Publishers Pvt Ltd, 2012), pp. 5-7.

and in foreign policy (promoting peace and human rights) strongly affect the preferences of others.³

Others, such as Joshua Kurlantzick, define soft power as a kind of attractiveness to a nation's brand, and it can be conveyed through various means, including a country's popular and elite culture, its public diplomacy⁴ (government-funded programmes intended to influence public opinion abroad), the action of its businesses abroad, the international perception of its government's policies and the gravitational pull of its economic strength, among other factors. The author further adds that in the context of China, soft power has a broader idea as it means anything outside of the military and security realms, including not only popular culture and public diplomacy but also more coercive economic and diplomatic levers such as aid and investment, and participation in multilateral organisations.⁵

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EVOLUTION OF CHINA'S SOFT POWER

In the 1950s, as the Chinese government saw the world being divided into the socialist and capitalist camps. China, adopting the Marxist and Leninist theories which equated capitalism with imperialism and war, realised that

3. Ibid., pp. 11-14.

4. Public diplomacy is defined as the process by which direct relations with people in a country are pursued to advance the interests and extend the values of those being represented. This new definition of public diplomacy goes beyond the more traditional interpretations that describe public diplomacy as a state-centred process of communication with a foreign audience. This new public is part of the view that in the world of post-modern transnational relations, the roles and responsibilities of actors in international relations are no longer clearly delineated and most actors are not nearly as much in control as they would like to be. For details, see Ingrid D'Hooghe, "The Expansion of China's Public Diplomacy System", in Jian Wang, ed., *Soft Power in China: Public Diplomacy through Communication* (New York: Palgrave Macmillan, 2011), p. 20.

5. Joshua Kurlantzick, *Charm Offensive: How China's Soft Power Is Transforming the World* (New Haven: Yale University Press, 2007), pp. 5-6.

world peace could be achieved through the triumph of socialism over capitalism and the curtailment of any kind of colonialism. The Chinese government laid out the five principles for relations amongst countries with different political systems that included respect for territorial integrity and sovereignty, non-aggression, non-interference, equality and peaceful coexistence. From the 1960s to the late 1970s, Mao's "three worlds" theory guided China's world view. The First World constituted the two superpowers, the US and the Soviet Union; the Second World comprised the other developed countries and socialist regimes in Europe; and the developing countries constituted the Third World.⁶

After Mao's death, Deng Xiaoping realised how Maoism had alienated China's neighbours, created instability on China's borders, and impoverished China itself. He realised that in order to overcome these issues and for China to become a strong nation, there was a need for a massive inflow of foreign investments and technology, along with a peaceful external environment. Acknowledging that China was not strong enough, Deng propagated that China should keep a low profile and not expose itself by trying to take a lead on global issues. By initiating economic reforms, 25 years of unparalleled economic growth followed, which changed China enormously. These drastic changes in China itself set the stage for the country to exert soft power around the world.⁷

The economic reform which started in the late 1970s led to growing economic dynamism within China, thereby bringing about a change in the perception of the world about the Chinese leadership. China realised the importance of the various international regimes as mechanisms to promote its interests. Therefore, during the 1980s, China began engaging with, and also integrating into, the various multilateral regimes. Through this, China abandoned its revolutionary rhetoric and increasingly spoke about the virtues of a peaceful international environment. Thereafter, China's foreign policy discourse focussed on peace and development and military alliances. It also continued to favour the principles of greater equality amongst nations,

6. Hongying Wang, "China's Image Projection and its Impact", in Wang, ed., n. 4, p. 40.

7. Kurlantzick, n.5, p. 15.

national independence, a new international economic order, and the Non-Aligned Movement (NAM).⁸

Since the end of the Cold War, Chinese-style soft power has been a key component of its foreign policy. The need for positive recognition as an international actor became particularly acute after the Tiananmen incident in 1989. In line with Deng Xiaoping's "low profile" policy, the Chinese leadership opted to focus on domestic development while pursuing a generally conservative, non-confrontational approach abroad. Ever since the beginning of the new century, the People's Republic of China (PRC) has more consciously pursued soft power. The various refrains in its diplomatic language throughout the past 20-odd years, by engaging in various multilateral regimes, invariably reflect a softer, gentler foreign policy approach to facilitate the overall Chinese goal of joining the global mainstream, to pave its own path abroad, and to define responsibilities on its own terms.⁹

A new dimension in China's foreign policy has evolved over the last decade with the Chinese government becoming more vocal in criticising certain aspects of the existing international system and suggesting various reforms and an alternative vision of the world order called, "harmonious world". The phrase "harmonious world" first officially appeared in a joint declaration issued by China and Russia in October 2004. During his speech at the United Nations' sixtieth anniversary celebrated in September 2005, President Hu Jintao emphasised that China would "strive to establish a harmonious world of lasting peace and common prosperity". This was later reiterated and elaborated in a Chinese government White Paper on China's Passage of Peaceful Development¹⁰, issued in December 2005.¹¹

Chinese leaders today are vigorously pursuing the country's soft power, which they believe should match its growing hard power, by developing and promoting its cultural soft power. This was reiterated by President Hu Jintao in 2007 at the Seventeenth National Congress of the Chinese Communist

8. Wang, n.6, pp. 40-41.

9. Yong Deng, "The New Hard Realities: Soft Power and China in Transition", in Mingjiang Li, ed., *Soft Power: China's Emerging Strategy in International Politics* (Maryland: Lexington Books, 2009), pp. 68-69.

10. For details see, Wang, n. 6, pp. 41-42.

11. *Ibid.*, p. 41.

Party (CCP), while delivering his work report to the Congress. He stated, *"...enhancing cultural soft power is a basic requirement for realising scientific development and social harmony. It is necessary for satisfying rising demands for spiritual culture and national development strategy...."*¹² According to President Hu Jintao, since the Chinese usage of soft power is applied to international relations as well as to domestic policies, the need arises for unifying domestic and international considerations into an organic whole. Internationally, the overall goals, as outlined by Hu, were to make the country more influential politically, more competitive economically, more appealing in its image, and more inspiring morally. At the practical level, President Hu Jintao emphasised on the "go abroad" approach in order to promote Chinese arts, culture, media and entertainment.¹³

President Xi Jinping, like his predecessor Hu Jintao in 2014, repeated the same message on the need to increase China's soft power. The Chinese leaders are aware that for a country like China, with growing economic and military power, there is a risk of scaring its neighbours into forming counter-balancing coalitions, hence, a smarter strategy would include an effort to appear less frightening to them. According to David Shambaugh, it could be estimated that China spends roughly US \$ 10 billion a year in "external propaganda"; in comparison, the US spent only US \$ 666 million on public diplomacy in 2014.¹⁴

CHINA'S SOFT POWER PUSH

China is very concerned about its global image because today the entire world has its eyes on China as it rises in global prominence. China's developmental strategy is to promote "security and shape a secure, economic, and political environment". To achieve this, China has to overcome two pressing and interrelated challenges of maintaining both internal and external stability in the international order to ensure its continued growth. There remains a consensus within China that even though it has been able to achieve

12. Wang, n.4, pp. 8-9.

13. Ibid.

14. Nye, n.1.

impressive economic growth over the last few decades, which has enhanced its hard power, it lacks the kind of soft power that will support and sustain its development strategy. Thus, in an effort to enhance its soft power, China has ramped up its “external communication” and public diplomacy in order to create a more desirable international opinion environment for its policies and actions.¹⁵

The last three decades have witnessed a steady rise of China’s soft power, especially amongst the developing countries. China, in fact made conscious efforts in this direction by providing these countries cash grants, aid projects, low-interest loans, economic collaboration agreements, direct investments, and through cultural exchanges. The Chinese government’s push to open government-funded cultural centres in schools and universities abroad has been intended to boost China’s soft power; for instance, the Confucius programme established in universities and schools is for the promotion of the Chinese language.¹⁶

On the diplomatic front, China has proposed a value free concept of a “world of harmony” — the peaceful coexistence of diverse countries. China has attempted to put forward the idea of the concept of peaceful development to build a harmonious society. These ideas are very inspiring to the international community as they help in mellowing doubts and fears about China’s rapid growth. This concept talks about respect and tolerance for different ideologies and social systems. It also emphasises consultation amongst all the countries involved, and not through unilateralism. In the light of the concept of a world of harmony, China has advocated non-intervention in the affairs of other countries and is careful not to make its

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15. Wang, n. 4, p. 2.

16. Soft Power Confucius Says”, *The Economist*, September 13, 2014, <http://www.economist.com/news/china/21616988-decade-ago-china-began-opening-centres-abroad-promote-its-culture-some-people-are-pushing>. Accessed on June 12, 2016.

China's foreign policy has attempted to reassure other countries of its non-threatening intent in order to enhance its acceptability in the international community, and attain a favourable image.

trade investment and other aspects of its foreign relations conditional on how well its counterparts live up to political, environmental, or labour standards. In an interview, Joseph Nye also acknowledged China's increasing attractiveness to other countries when he said, "...I think it is a wise policy for China to increase its soft power. China's successful economy makes it attractive, and Chinese traditional culture is attractive. And China has pursued a series of policies which have been attractive to other countries...."¹⁷

While the American liberal model of development has had admirers in many Third World countries, China's rapid economic growth has made it an alternative model of development for many developing countries. Furthermore, China has been especially successful in cultivating soft power in the developing countries that the West has failed to penetrate, such as Iran, Zimbabwe and Venezuela. China's diplomacy has also been successful in the Asia-Pacific region, especially after it abandoned its fixation with the Communist ideology as the guide to its interactions, and developed friendly relations with neighbouring countries regardless of their ideological tendencies and political systems. China adopts the principle of "non-interference" in the internal matters of other countries and insists on letting them make their decisions on their internal affairs. This non-interference principle stands in sharp contrast to the practices of Western countries, which often bundle economic aid with political demands. This makes China's approach more acceptable to these nations.¹⁸

China's foreign policy has attempted to reassure other countries of its non-threatening intent in order to enhance its acceptability in the international community, and attain a favourable image. It is with these goals in mind that the instruments of soft power have been conceived

17. Suisheng Zhao, "The Prospect of China's Soft Power: How Sustainable?", in Li, ed., n.9., p. 249-250.

18. Lu Tang and Hongmei Li, "Chinese Corporate Diplomacy: Huawei's CSR Discourse in Africa", in Wang, ed., n.4, pp. 96-97.

and are being pursued. Despite the internal debate over its foreign policy since the end of the Cold War, China has largely stuck to the line of “peace and development”. This has paid off in its diplomacy, not least in terms of ensuring decades of stable growth on the domestic front. As the economy grows, its trade, investment, and aid have cemented ties with the rest of the world while strengthening its leverage in foreign relations. In practice, China’s foreign policy has been geared toward adapting to the imperatives of deepening economic globalisation, cultivating acceptance abroad, and bringing about change in the regional and international status quo in order to ensure that the ways and means by which China conducts its domestic and international affairs are not being judged by the global community. Therefore, it can be said that the most remarkable change in China’s foreign policy has been the country’s embrace of multilateral diplomacy. China’s accession to various multilateral regimes since the 1980s and its entry into the World Trade Organisation (WTO) at the onset of the 21st century represented landmark events in its path to joining the global world economy and the global order as a responsible nation.¹⁹

The major steps taken by China towards furthering its soft power could be summarised as follows:

- Promoting its traditional culture to the world through various programmes.
- Selling its model of economic growth as a better alternative to the Western liberal models.
- Promoting its idea of a benign nation which seeks global development through peace and harmony through its diplomatic channel and public diplomacy.
- Playing a more active and responsible role in international affairs by showing commitment towards development through its economic engagements based on the principle of non-interference and non-imposition of any obligations.

19. Yong Deng, “The New Hard Realities: Soft Power and China in Transition”, in Li, ed., n.9, p. 71.

BEIJING CONSENSUS: CHINA'S SOFT POWER

One of the major enablers for China's growing soft power has been its unprecedented economic growth since the late 1970s. In order to study China's soft power, it is crucial to discuss its economic development since it has been a major driving force in China, and the resultant meteoric economic transformation that has awed the world. The story of Chinese economic achievements in itself is an important source of its soft power, with the developing countries being inspired by its economic development and wanting to learn about the Chinese experience and its development model.²⁰

This upward trajectory helped increase China's external image and, thus, its soft power image took a leap as many of the developing countries began to get attracted to the Chinese alternative means of economic growth, with a high percentage of the public worldwide starting to believe that economic power has shifted from the United States to China. In line with China's economic success, the attention of both foreigners and Chinese began to propagate the so-called China model of development – termed as the Beijing Consensus.²¹

The Beijing Consensus is used to describe the model of development that has allowed China to achieve a high level of economic growth without undermining the authority of the Communist Party. The term was coined by a former *Time* foreign editor, Joshua Cooper Ramo. According to Ramo, in the Beijing Consensus, growth comes from the state, directing development to some degree, thus, avoiding the kind of chaos that comes from rapid economic opening, thereby allowing a nation to build its economic strength. This model stands in direct contrast to democratic liberalism, the economic and political model emphasising individual rights and civil liberties that has underpinned the societies of the West, and of its democratic allies in Asia. China has been openly advertising the benefits of China's socio-economic model, as it has enjoyed striking success of decades of economic growth and poverty reduction.²²

20. Zhongying Pang, "China's Soft Power Dilemma: The Beijing Consensus Revisited", in Li, ed., n.9, p. 125.

21. Hongyi Lai, "The Soft Power Concept and a Rising China" in Hongyi Lai and Yiyi Lu, eds., *China's Soft Power and International Relations* (New York: Routledge, 2012), pp. 12-13.

22. Kurlantzick, n.5, pp. 56-57.

The emergence of the Beijing Consensus as a better alternative could also be attributed to a decline in the attractiveness for the Washington Consensus²³ since the mid-1990s. In an era when it was found that the American interventionists have become more influential in US foreign policy-making—both American liberal moralists who argue for humanitarian intervention and the neo-conservatives who support the act of intervention to preemptively halt threats to American national security – China, unlike the US which used sanctions as a weapon to derive outcomes, reiterated its policy of non-intervention. This enabled China to not only fuel, but also advance its soft power globally.²⁴

Furthermore, the good reputation that China harvested from its economic rise was also in sharp contrast to the reduced influence of the Washington Consensus, which is based on the Western liberal political economy. This idea has received a setback in the past few years from many of the developing nations. While a growing number of developing countries simply want to learn about the Chinese experience, they also believe that the Chinese model of economic development may be an alternative to the Western prescription.²⁵

Since the Washington Consensus calls for rapid market reforms, it also needs a push towards rapid political liberalisation, which many of the emerging nations aren't able to undertake — especially the developing nations that have authoritarian or semi-authoritarian regimes. Thus, the Chinese model proved to be a better alternative since the regimes had time to coopt the new business people and other elites they needed to keep on their side to remain in power.²⁶ These impressive economic changes and rapidly growing economic powers enabled China to have an expanding and large amount of resources at its disposal, to develop and expand its soft power through various programmes and initiatives. Culture and diplomacy, for instance, are some of the tools utilised by China for furthering its soft power. China's

23 The Washington Consensus demands a free market system going hand-in-hand with liberal democratic reforms.

24. Kurlantzick, n.5, pp. 44-45.

25. Pang, n. 20, p. 127.

26. Kurlantzick, n. 5, p. 58.

cultural promotion is part of a broader effort at public diplomacy, cultivated by the government to mould public opinion abroad in order to effectively pursue its national interests. China's growing economic might allowed Beijing to deploy these tools, since it cost money to hold events such as cultural summits or even sending language teachers to other nations.²⁷

LIMITS OF CHINA'S SOFT POWER

Despite the gains made by China in terms of its global acceptability, there remain serious questions on its efficacy to truly become a great power. This doubt arises from the fact that China today finds itself engulfed in numerous conflicts within and outside its homeland. This raises concerns amongst the global community that tends to see beyond China's economic growth and its humanitarian outreach. According to Joseph S Nye, China's soft power is limited by the legitimacy of the rule of the Communist Party that is based not only on a high rate of economic growth, but also on appeals of nationalism. The other limit is China's reluctance to show more tolerance towards greater freedom in its civil society. The Chinese Communist Party has not opened itself to the idea that soft power comes from the civil society; rather, it has remained fixated on the idea that the state is the source of all soft power. The US, by contrast, derives much of its soft power not from the government, but from civil society. According to Nye, China's aid programmes are successful and constructive, its economy is strong, and its traditional culture is widely admired. But if the country is to realise its enormous soft power potential, it will have to rethink its policies both at home and abroad, limiting its claims upon its neighbours and learning to accept criticism in order to unleash the full talents of its civil society. Thus, according to Nye, as long as China fans the flames of nationalism and holds tight the reins of Party control, its soft power will always remain limited.²⁸

In spite of its initial success, China's exercise of its soft power in the current form is seriously flawed. One study points to the absence of Chinese

27. *Ibid.*, p. 61.

28. Nye, n.1, http://belfercenter.ksg.harvard.edu/publication/25543/limits_of_chinese_soft_power.html.

Non-Governmental Organisations (NGOs) on the international stage, which deprives China of a crucial soft power tool, hampers its public diplomacy, weakens the credibility of the message it seeks to send out, and reduces the amount of feedback. Another study suggests that two major factors have constrained Beijing's ability to project its soft power. One is the gap between its engaging foreign policy whilst there continues to exist a closed and rigid domestic political system. The other is the constant tension between its multiple foreign policy objectives and the still nascent soft power resources.²⁹

But China's international vision is in itself somewhat contradictory. While, on the one hand, China continues to champion world peace, advocating a comprehensive nuclear test ban and the destruction of all nuclear weapons, on the other hand, the Chinese government shying away from addressing the ethnic genocides occurring in various nations, pulls down its image globally.³⁰ Despite China's growing national power, the Chinese leadership perceives an imbalance between its hard power and soft power. The consensus seems to be that China may have acquired greater economic and military strength since the reforms began in the late 1970s, but has remained weak in its symbolic power. This lack of "soft power" is a result of the apprehension that prevails amongst the global community towards China. While it could be argued that there is a genuine lack of understanding on China amongst the foreign public, it could also be argued that China has so far failed to do an effective job in describing and explaining itself to the outside world. Others point to the more fundamental structural and systemic problems of domestic control of information and the lack of transparency by the Chinese bureaucrats as the root cause of China's poor performance in external communication.³¹

China's soft power gets further constrained due to the very growth that in the past helped it to become a more globally integrated and acceptable nation. Unfortunately, today, as China has been able to reach a level of prominence in the various international organisations, a sense of unease has also set in amongst the global community. This unease amongst the various

293 Suisheng Zhao, "The Prospect of China's Soft Power: How Sustainable?", in Li, ed., n.9, pp. 251-252.

30. Wang, n. 6, p. 40.

31. Jian Wang, "China's Search of Soft Power", in *Ibid.*, pp. 5-7.

Its ongoing and non-legitimate claims over the disputed reefs in the East and South China Seas, along with its military build-up in the region, have generated discomfort amongst the Southeast Asian nations adjacent to the South China Sea.

states is somewhat justified as China, with its emergence has become more assertive with its neighbours, not forgetting very fact that it continues to have an authoritarian regime that pays little attention towards providing universal human freedom. There was hope in the West that as China became economically stronger and continued to get integrated into the various multilateral regimes, there would emerge a more liberal China which was not only acceptable globally but more predictable in its behaviour. However, this has not happened, as today, we find a China using its economic gains to build

a military which would service its interest beyond its continental landmass, causing unease amongst its neighbours and the globe at large. Its ongoing and non-legitimate claims over the disputed reefs in the East and South China Seas, along with its military build-up in the region, have generated discomfort amongst the Southeast Asian nations adjacent to the South China Sea. There was also an almost war-like situation with Japan in 2013 when China declared the establishment of an Air Defence Identification Zone over the Senkaku/Diaoyu Islands in the East China Sea. These actions, along with the internal systemic structure that prevails in China, in some way or the other, undermine China's soft power, thereby limiting its global acceptability.

BEIJING CONSENSUS RUNNING OUT OF STEAM? : FROM A MODEL TO A PHASE

While China's values of non-interference, respect for other nation's internal affairs, economic gradualism directed by the state can, however, enjoy some appeal, they do not have universal appeal and are restricted only to specific groups and nations such as Venezuela or Iran. These nations share a strong resentment towards the American model as they see it as being interventionist. Despite this, China cannot offer average people a comprehensive, inspiring vision of how to build a free, rights-oriented

political system and economy, a vision that remains popular in many parts of the world. The global apprehension against China remains as it continues to exploit its labour and environment along with its persisting authoritarian system of governance which alienates the average people in Asia, Latin America, and Africa. Further, China's support for autocratic rulers in countries like Zimbabwe and Sudan also angers the international civil society as they expect a more responsible emerging global power. The non-interventionist policy of China has led to Beijing turning a deaf ear to the various ongoing atrocities, i.e. the genocides in Africa; making one question the very basis of China's claims for a peaceful and a harmonious society. This is coupled with the authoritarian regime that continues in China and which, in recent times, has somehow become less tolerant towards freedom of domestic civil society compared to the time of Jiang Zemin.³²

The Beijing Consensus is a new developmental model that described the effect of China's experience on the developing countries in Africa, Asia and Latin America.

Just as China's economic and military power is far from matching that of the United States, China's soft power is still not equal to that of the United States, particularly in terms of political values and moral appeal. The current Beijing Consensus is only a transitional model of development. It may go from a "value-free" to a "value-added" model involving the sequencing of economic growth, legal reforms, democratisation, and constitutionalism, with different aspects of development being emphasised at different times. This has been demonstrated by the evolution of several East Asian newly industrialised economies such as South Korea, Taiwan, Singapore and Hong Kong, which, after achieving high levels of economic growth, eventually implemented the rule of law and eventually democratised in order to protect the full range of human rights by initiating some form of constitutionalism.³³

The Beijing Consensus is a new developmental model that described the effect of China's experience on the developing countries in Africa,

32. Kurlantzick, n.5, pp. 216 and 229.

33. Deng, n. 19, pp. 261-261.

Asia and Latin America. This model meant a market economy/ capitalism combined with political authoritarianism and repression. However, just as China's economy today is running out of steam, the very concept of the Beijing Consensus is also undergoing a revision, with many beginning to call it a "Chinese Experience" rather than the "Beijing Consensus". This subtle distinction is meant to convey that China has still not successfully produced a new developmental model; rather, it has just provided many lessons of both success and failure. China has failed to realise that soft power cannot be ascribed by following Deng's developmental doctrine which stated that; "...development is the most important means to solve China's problems...." Soft power in its truism is achieved through a nation's internal as well as external behaviour that makes it attractive to outsiders. Therefore, despite the major harm caused to China in the aftermath of the 1989 Tiananmen incident, throughout the 1990s, China continued to focus on its "economic development". The Party and its state tried to solve China's social problems and overcome political challenges by focussing on economic development rather than seeking further reform of the system, with the Party reiterating to its countrymen that all the country's problems could be easily solved as long as there was more development.³⁴

According to Joseph Nye, the Beijing Consensus is attractive to authoritarian and semi-authoritarian developing countries; it undercuts China's soft power in the West because China suffers from corruption, inequality and a lack of democracy, human rights and the rule of law. In addition to its authoritarian nature, the Beijing Consensus has not been effective in dealing with many important dimensions of human development at home and abroad. The Chinese economic growth, while undeniably impressive, is widely associated in the West with pollution, cheap labour and a threat to domestic jobs.³⁵

China's economy is also showing signs of fatigue, especially after the 2008 global financial crisis, as a result of not only the external factors but on account of various internal policy lapses as well. This economic slowdown is also

34. Pang, no. 20, p. 126.

35. Deng, n.33, p. 260.

leading to a more serious concern, that of the rise in China's bad debt which has risen from 150 percent to 260 percent of China's total debt-to-GDP ratio in less than a decade. This may well cause another financial crisis, as the debt continues to mount every fiscal; all as a result of China's economic slowdown that has led to loans being taken to pay off interest rather than being used for productive activities. Therefore, the current emerging economic trend, along with the added incapacity to address the various impending social and political issues, renders the entire concept of the Beijing Consensus obsolete, thereby qualifying it as a phase rather than a model.

CONCLUSION

China's rise has included both building its tangible economic-military power and intangible political-cultural influence. The Chinese government has become aware of the distinction between the two components of power and the need to develop soft power to increase its legitimacy as an emerging great power.³⁶ China may never achieve global acceptability and become a soft power in its true sense; on the contrary, the same could also be said for the US. However, if we make a comparison, there lies a great distinction between the two and that comes from the universal values of freedom, justice, and equality, which, unfortunately, comprise China's biggest shortcoming. The Tiananmen incident showed the prevalence of a high level of state intolerance towards the principle of freedom, and the grave state of China's human rights continues to impact its soft power image. There is also the issue of crony capitalism arising out of its authoritative capitalistic regime being imposed on the people and causing a lot of resentment against the authority along with the growing intolerance of the state on the civil society's basic freedom.

Over the past decade, we also find a more assertive China, especially when we consider its activities in the South and East China Seas. The ruling of an international tribunal at The Hague in July 2016 disqualified China's historical claim on the South China Sea based on its nine-dash line, due to

36. *Ibid.*, p. 260.

lack of hard evidence. China, by boycotting the ruling and stating that it is non-binding, does not paint a good picture for itself, especially for a rising global power with global aspirations. This reaction of China to the ruling of the arbitration not only sets a bad precedence on the legality of future judgements but also affects China's global credibility. This is a major cause of concern as it hampers China's soft power image that it has been trying to build and which has remained one of China's major agendas since the last three decades.

And, finally, the economy of China, which, over the last few years, has somehow seemed to have flattened, would also play a spoiler towards its soft power push. There is hope amongst Chinese policy-makers that the new model of economic growth termed as the "new normal" will somehow push the economy into the double digit growth that it once achieved; this, however, seems to be too optimistic given the current state of affairs of the global economy and the West tending towards protectionism. Through its grand economic corridor initiative defined as 'One Belt One Road', China seeks to integrate its road and sea links in order to ensure not that only its manufacturing sector gets quick access to its resources in Central Asia and reduces the transit time of its exports to Europe, but it also seeks to attain new markets in South Asia. However, this Chinese initiative is also causing a great deal of apprehension amongst various states since they are not comfortable with the idea of an expanding China getting close to their backyard. These attributes, along with China's own inaction internally and its aggression militarily, put its entire soft power push in jeopardy.

DISASTER MANAGEMENT: THEORY, PLANNING AND PREPAREDNESS

RAJESH ISSER

ABSTRACT

*Disaster management is truly a complex subject that is impacted by all disciplines of science and social science since both humans and the natural world interact, involving all facets. A fundamental premise must be that while most **hazards** may not be controllable, **vulnerabilities** can be analysed and mitigated. Planners tend to be stuck in the past and have subjective perceptions of the future, which is why there is a need to objectively anticipate likely problems and options to evoke appropriate responses. The focus should be on coordination with true vertical and horizontal integration of the entire community and all organisations incorporated in the process. There is a difference between **planning** for disasters and actually managing them which could be due to poor planning processes, faulty templates, exclusivity, ignoring community dynamics, etc. Most aspects of preparedness are applicable in all contingencies, hazards and situations. These are **multi-dimensional** and span across organisational boundaries. Therefore, some general **principles of preparedness** can be enunciated. In case operations are dispersed and far-flung, there is a need to follow **distributed leadership** models with clear mission-command type orders from the higher leadership. Moving from a framework*

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Disaster management is affected by numerous issues from diverse subjects, some of which are: convergence; emergence; integration; collaboration; situation awareness; common operating picture; capacity and resilience building; flexibility and adaptability; and, planning and preparedness.

*of relief and rehabilitation to an institutional framework that holistically encompasses all aspects of disaster management is a Herculean effort undertaken successfully by India. The key to resilience in disaster is **capacity-building of local communities**, which has to be contextualised to local hazard mapping and vulnerabilities.*

DISASTER THEORY

Theory in any field or subject serves many purposes. It may be an idealistic template by academicians that they want promoted in society or it could represent the complete knowledge available on the issue. Theories

strive for accurate definitions to allow meaningful research and debate, formulate concepts around which learning can take place and elucidate ethical standards in a profession. Models, classification and typology in theories help in defining and linking variables to give meaning to academic constructs. Theories can generate paradigms that evolve and explain causal relationships between variables, which allows identification and solutions to problems in a logical manner.

While a single theory around a phenomenon can unify diverse views and ideas in order to give semblance and direction for applications, it must not constrain inclusivity of diverse and out-of-the-box ideas and explanations. For example, the Theory of Comprehensive Emergency Management had traditionally constrained work around disasters with a focus on reaction, till newer ideas such as emergence, chaos theory and theories based on community resilience gave newer and more meaningful insights. Models such as incident command systems are being challenged with ones based more on collaboration rather than control. Disaster management is affected by numerous issues from diverse subjects, some of which are: convergence; emergence; integration; collaboration; situation awareness; common operating

picture; capacity and resilience building; flexibility and adaptability; and, planning and preparedness.

Historically, disaster theories were overly influenced and funded by military approaches to issues of war and conflict, especially nuclear scenarios. The focus shifted in the 1960s-70s to technological or man-made disasters such as the Bhopal tragedy, and then on to natural hazards

like earthquakes and floods. Concepts also shifted from emergency management, which signified a reactive and false belief in the ability to control, to disaster management encompassing the four recognised phases, focus on communities, etc. The debate on what is a disaster still goes on, with variance on issues such as area affected, affected population, coping capacity, significant losses of lives and property, and displacement of communities.

Over the decades, the focus has also shifted from hazards, since all should not, or may not, lead to disasters, to vulnerability which accounts for hazards, capacities and a possibility to avert disasters by foresight and planning. It also has the ability to localise context and focus on practical issues. Complexity in linking numerous variables involved in this field, some in the control of man and others only of nature, also made it clear over the years that there was no silver bullet or one solution. It also became clear that while the four phases of disaster management were good for clarity and understanding, there were complex overlaps and each affected the efficacy of others in the short and long runs. Today, the focus has firmly shifted from response and preparedness to a more holistic disaster risk reduction strategy. Also, while government oversight is important, it is not possible to get the best results without actively involving all sectors and actors, i.e. Non-Governmental Organisations (NGOs), community participation, private sector, specialised fields (medical), etc. This blurring of sectors and functions will intensify further in the future towards a more integrated approach.

This is truly a complex subject that is impacted by all disciplines of science and social science where both humans and the natural world interact, involving all facets. A fundamental premise must be that while most hazards

Today, the focus has firmly shifted from response and preparedness to a more holistic disaster risk reduction strategy.

may not be controllable, vulnerabilities can be analysed and mitigated¹. The first responders and most affected are the communities, and that is where the focus must lie. Integrating all this into sustainable development plans that holistically look at humans and their environment is the current focus of this field. There are major political and organisational ramifications which need to be addressed by the leaders. One thing is for sure: disasters will continue to surprise the best laid-out plans. Adaptability and improvisation must never be lost sight of in responding effectively.

AN INTEGRATED APPROACH TO VULNERABILITY

Is there a concept that can holistically guide the disaster management policy and action? From a historical focus on the hazard itself, theorists have moved to sustainable models of mitigation, yet even they have focussed on natural hazards only. Also, this tends to ignore the response and preparedness phases which makes it less comprehensive. It assumes no surprises by nature, with development following sustainable lines. The change of spotlight onto social, economic and political factors started in the 1980s. It was realised that vulnerability was the root cause of disasters, but what constituted vulnerability was a debatable issue. Many factors contribute to vulnerability such as poor land-use, faulty construction, damage to the environment, cultural practices and beliefs, failures of early warning, ineffective communication, etc. These may be vulnerabilities due to displacement and demographic pressures, settlements dictated by economic and social discrimination, etc. Therefore, any holistic view will factor many diverse fields and look at it from two angles: the external manifestations of risks, impact and stress on people; and, the internal capacity to cope and bounce back. Some social scientists have classified it as “event and consequences vulnerability”.

There are mainly four schools of thought on the issue of reducing vulnerability. The Physical Science School analyses location and exposure to hazards and commits to early warning, planned development with avoidance

1. David McEntire, “The Status of Emergency Management Theory”, Paper presented at FEMA Higher Education Conference, Emmitsburg, MD, USA. FEMA website.

of hazard prone areas, relocation of entire populations, etc. It ignores the socio-economic reasons for such settlements and the impracticality of relocating entire populations. The Engineering School believes that nothing is insurmountable by architecture, building materials and design, and other such technological advances. It tends to ignore the cost factor, especially for the impoverished sections of society. The Structural School recognises the susceptibility caused by socio-economic and demographic factors such as race, ethnicity, gender, age, poverty – in other words, vulnerability caused by social structures. The last is the Organisational School that focusses on resilience which is a mix of good response and recovery actions, preparedness, leadership and management of these processes, and adaptable action in general. It assumes that disasters can never be completely eliminated. A vulnerability model² holistically incorporates risk and susceptibility as liabilities, while resistance and resilience fit into capabilities. With the help of statistics, computer-based analysis and mathematical modelling, scientists can quite accurately map out vulnerability. This allows comprehensive management of disasters and the model can be applied to all hazards, i.e. natural, chemical, industrial, biological, technological, etc.

PLANNING PRINCIPLES

While planning and preparedness go hand in hand, subtle differences between activities is important for objective evaluation of states of readiness. The nuances of the two in terms of general principles behind activities are to be clearly understood. It is testimony to their sound and logical foundations that these have hardly changed over decades of evolution of theory and practice with great advances in technology. The latter part of this article traces the evolution of these issues in India and suggests some measures ahead.

Planners must recognise that disasters are crucially different from minor emergencies; there are major qualitative and behavioural differences³. Some

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2. David McEntire, Colleen Crocker, and Ekong Peters, "Addressing Vulnerability Through an Integrated Approach," *International Journal of Disasters Resilience in the Built Environment*, vol I, no 1, 2010, pp. 50-64. www.emeraldinsight.com.
 3. EL Quarentelli, "Ten Criteria for Evaluating the Management of Community Disasters", *Disasters* 21, 1997, pp. 39-56.

examples are: forced interaction between unfamiliar groups on a large scale, curtailing of autonomy, performance quality of organisations, and public-private coordination. Plans must be generic rather than agent-specific; the issues are more to do with time spans, intensity, predictability, speed, early warning, etc. rather than agent-specific focus. This allows capability building with cost-benefits, efficiency, and effectiveness across the entire span, and involves all potential actors. Focussing on general principles and not specific details is important since being too specific may not fit the actual conditions that would inevitably be unique. Simple points need to be developed to encourage adaptability, which allows emergence of ad hoc networks that are essential for flexible responses.

The focus must be on planning processes rather than a written document, and on holding meetings to share information, drills and rehearsals, techniques for training and knowledge transfer, mutual aid and understanding, public education, establishing linkages, community-based plans and revisiting for revalidation⁴. Plans should be based on what is likely to happen because while the past has lessons to be learnt, study of hazards and vulnerabilities indicates the possibilities ahead. Planners tend to be stuck in the past and have subjective perceptions of the future which is why there is a need to objectively anticipate likely problems and options to evoke appropriate responses. Uncertainties are permanent features, and the aim is to reduce them to a manageable level. There is a clear link between cognition and action in disaster management that allows managers at all levels to innovate, adapt and align to the larger objectives. Planning must aim to reduce impulsive actions and encourage logical but timely decisions⁵. This is only possible with a truthful and objective after-action analysis of events of the past.

A 'command and control' structure that is premised on the total breakdown of social structures and community capacities of natural and spontaneous behaviour is a fundamental mistake of planners. The focus instead should

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4. "National Disaster Management Guidelines- Incident Response System," NDMA Publication, NDMA Bhawan, Government of India, July 2010. ISBN-978-93-80440-03-3.
 5. Louise K. Comfort, "Crises Management in Hindsight: Cognition, Communication, Coordination and Control", *Public Administration Review*, December 2007, Special Issue. www.researchgate.net/publication/227604591.

be on coordination with true vertical and horizontal integration. Unless the entire community and all organisations are incorporated in the planning process, an effective blueprint may not be possible. Education, at all levels, is a key theme of preparedness, with regular review and updating catering for changes in the status of resources and people. Time-tested social science knowledge must govern thought and action. For example, the wrong premise of social breakdown, mass panic, over-hyped role of outside agencies, etc. must be replaced by an understanding of community-based resilience and capacities⁶.

Criteria: As per EL Quarentelli, the following criteria of managing disasters are fundamental. There is a difference between planning for disasters and actually managing them. Management brings in problems of command and control, communication channels and processes, and coordination mechanisms. Actual events that have been studied over the years indicate a sizeable gap between planning and actions to manage disasters. In the first place, this could be due to poor planning processes, faulty templates, exclusivity, ignoring community dynamics, etc. Thus, the first step to effective disaster response is distinguishing between the two.

Communication is the backbone of any disaster response, and the real issues are of what is communicated rather than how. Case studies show that some mode of communication continues to exist and actors adapt well to ensure its flow. The problem is distortion and volume that affect disaster management. Four broad types of communication channels or flows are critical in a disaster: inter-organisation, intra-organisation, public information and feedback from a community. Each flow will face difficulties of information overload, distortion, delay, restructuring to meet demands, emergent networks and informal channels, among many other issues.

The response to a disaster leads to additional demands which are different from those created by response-needs. Convergence of 'many' on the disaster scene needs management of mobilisation, delegation, division of labour, coordination, communication channels and decision-making structures.

6. "Uttarakhand Disaster 2013: Lessons Learnt", Report on National Workshop by the NIDM, August 2013. www.nidm.gov.in

Information must flow freely and accurately, and networks have to incorporate vertical and horizontal freedom, and flexibility to support emergence.

Personnel and resources must be mobilised in an effective and efficient manner, including management of the volunteers and aid flowing in. The criteria are early identification of needs, assessment of capacities and timely deployment in appropriate measure. Division of labour and delegation of tasks among all the agencies may also require consideration of emergent groups and networks. Importantly, changes in tasks, load, responsibilities partnerships, etc have to be accepted in a dynamic environment. Therefore, tasks, and the groups undertaking them, would vary from the routine, and planned for emerging new needs and solutions.

Generic needs exist in all disasters – only the scope and span vary — e.g. housing, shelter, warnings, evacuation, medical needs, search and rescue and property protection are common themes. Good assessments must lead to adequacy of response for each case. Real needs must be met in an efficient and timely manner. Information must flow freely and accurately, and networks have to incorporate vertical and horizontal freedom, and flexibility to support emergence. Proper decision-making can only be possible if problems of fatigued leaders due to overwork, conflicts over responsibilities, overlapping organisation domains, acceptance of emergent groups and jurisdictional issues are resolved at the earliest. Emergent phenomena are a reality in terms of groups, behaviours and networking, which allows flexibility of response and creative solutions. Incorporation of emergence with other activities on the basis of shared values and norms can be attempted.

Coordination must not be confused with control⁷. This issue can lead to lack of cooperation between agencies. Similarly, the differences in the perspectives of the private and public sectors have to be well understood to manage coordination. The time to develop a leisurely understanding is not available. The way forward is to de-emphasise organisational leadership

7. Norbert Steignberger, "Organising for the Big One", Proceedings of ISCRAM 2015, Conference at Kristiansand, May 24-27, 2015. steignberger@wiso.uni-koeln.de.

with abundant use of tact, sensitivity and quick trust-building acts. The media must be used proactively and positively to affect, educate, update and warn about public perceptions in a disaster; and the revolution in information technology must be fully taken advantage of to carry out these functions. An Emergency Operations Centre (EOC) is a function, a place and a structure around which disaster management is coordinated among various groups, agencies and communities⁸. It must finally be a social system based on a functional approach to problem solving and information sharing.

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DISASTER PREPAREDNESS

Attributes and Activities: Disaster preparedness straddles the areas of mitigation, response and recovery; i.e. it encompasses action to respond to life-threatening situations, ability to take action to protect life and property, as well as action in post-disaster recovery facilitation. Theoretically, mitigation action is undertaken well before the impact point of a disaster, with structural activities such as strengthening buildings, elevating housing, and non-structural such as policy-making, land-use planning, etc. Response preparedness involves short-term recovery. Some activities such as early warning, public awareness and communications span both mitigation and preparedness. The Federal Emergency Management Agency (FEMA) objectives list out the attributes of preparedness and expected specific activities against each⁹. Some of these are as follows:

- **Hazard Knowledge, Management and Coordination:** This includes various assessments, estimation of potential impacts using latest technology and computer simulations, and disseminating these to all

8. Paul Salmon, Jenkins Stanton and Walker, "Coordination during Multi-Agency Emergency Response: Issues and Solutions", *Disaster Prevention and Management*, vol 20, no 2, 2011. www.emeraldinsight.com/0965-3562.htm.

9. "CERT 1: Disaster and Preparedness", *Participant Manual*, FEMA, USA. www.fema.gov

the stakeholders. Community-based disaster scenarios are good tools to evaluate preparedness. Lines of authority and responsibility, control and distribution of resources and decision-making chains have to be identified. In many cases, management groups and incident management systems may need to be established. Prior to impact, training, drills and exercises to clarify roles and responsibilities are must-do activities. An important aspect is policy formulation that sets the objectives and clearly assigns responsibilities and accountability.

- **Plans and Agreements:** Plans will be formal and informal, covering Memorandums of Understanding (MoUs), mutual aid schemes and informal agreements. Common objectives and vision are set that allow division of work and tasks. The coverage needs to be broad, incorporating community-based organisations, volunteers, NGOs, and societies such as the Red Cross. In conjunction with planning, there is a core requirement to identify needs, acquire resources and effectively distribute them in the pre and post-phases as well as during the active response one. Every activity, e.g. protection, search and rescue, debris management and medical help is resource hungry and this needs to be factored in. Among various resources are the key ones of skilled manpower and communication set-up. Also, redundancy needs to be built in by identifying alternatives. Even the post-response phase of recovery needs to be planned. Some of the initiatives and early action will be taken in the response phase to set the framework for restoration activity.
- **Life Safety:** The response must factor in life-saving issues such as first-aid supplies, evacuation plans, routes and means, networking of hospitals, etc. Leaders must be able to immediately chalk out incident stabilisation, damage assessments and earmarking of resources and responsibilities. Most activities in terms of protection of property are pre-impact except early warning and communication which span the entire time-line. Building codes and standards enforcement, retrofitting and reinforcing, removal of hazards (if possible) and preservation of critical assets are some of the large number of mitigation activities.

- **Flexibility in Response:** Plans bring structures to think and act by a group but they cannot be rigid since every disaster will throw up surprises and unexpected situations. The need to improvise, innovate, adapt and in general do creative problem-solving is a characteristic of all major disasters. This needs to be encouraged and practised in exercises, scenario-building, table-tops and discussions. Restoration of critical services to allow response activities is an area that must be well thought out together by all the stakeholders.

General Principles of Preparedness: Most aspects of preparedness are applicable in all contingencies, hazards and situations. These are multi-dimensional and span across organisational boundaries. Therefore, some general principles of preparedness can be enunciated.

- Formal written plans are just the first step and must be followed up by training, practice, updating and regular revision. Lesson-learning from recent disasters, best practices of others and seeking information to update and upgrade are equally important activities.
- Plans are just documents unless backed by resources, practise by stakeholders and active ownership by all.
- To think of plans as a panacea is a myth waiting to be proved wrong. Rather than a product, plans are a process to develop confidence, trust, credibility, knowledge and efficiency among partners. They also allow gaps to be identified for rectification.
- Assumptions in planning have to be realistic and based on the facts of the community and environment. For example, the strengths and resilience of the people need to be factored in and not the assumption that they will panic and be unruly.
- Collaborative themes are dominant in the diversity of actors; therefore, only a top-down approach may not be effective. Challenges also include turf battles, jurisdictional problems, weak structural arrangements and poor leadership¹⁰. This is also of great relevance when engaging the community as a whole.

10. Alexander Kouzmin, Man Jarman and Uriel Rosenthal, "Inter-Organisational Policy Processes in Disaster Management," *Disaster Prevention and Management*, 4, 1995, pp. 20-37.

- While specialists and experts will play important roles, plans must involve the community and participants who will actually take part – it is the key to effective planning. Strategies for preparedness must be as broad-based as possible, incorporating all the stakeholders.
- Paucity of time and resources may put preparedness for disasters at a lower priority. Active and vigorous education of leaders and the community can put it back on track. Advocacy of the subject is important to avoid the higher and fatal costs of ignoring it.
- An all-hazard focus and built-in flexibility to adapt, innovate and be creative will allow far better plans for preparedness.

Planning and Flexibility: Despite the best efforts spent in planning and exercising, disasters do unfold in unexpected ways and overwhelm capacities and bring in the need for flexibility of the thought process, for improvisation, quick innovation and creative problem-solving. So, how do planning and flexibility go together? Firstly, experience shows an inverse relationship between planning and improvisation — lack of planning will demand the highest need to improvise. Planners provide a framework of responsibilities, relationships, clarity on who does what, etc. At the same time, continuous assessments of the situations allow flexibility around this framework to adapt and improvise, thereby retaining coherence and avoiding chaos. Therefore, planning and flexibility do complement each other; rigidity of thought and other cognitive processes is the last thing that planners advocate or aim for.

SOCIAL CAPITAL IN DISASTER MANAGEMENT

What is social capital and its role in disaster management? It is an innate resource of the social framework that greatly facilitates action by individuals of the family, group or community. Just as physical capital is created by changing materials to make tools, and human capital by changing knowledge and skills for providing capabilities, social capital aims at changing relationships among people to assist action. It is not very tangible in terms of measurable scales, but is evident to keen observers. Social interaction generates obligation, expectations and reciprocity that

are essentially predicated on trust and factual interdependence among people. These are greatly influenced by factors such as economic status, culture, local practices and community bonding. Not only are members of the community the first-responders, they are active, and perhaps, the most effective participants in the entire gamut of disaster management activities. Most volunteering is a result of obligations and a sense of community duty rather than a failure of the administration capabilities of state authorities.

Dissemination of knowledge and information has credibility when mixed with local cultural preferences and methods rather than just relying on media or technology. For example, successful evacuations are possible only when belief in the message by the authorities is passed and confirmed among the community. Therefore, planners must design early warning and other messaging around this context and complement existing communications networks. Evolved social structures have the resilience and methods to deal with unexpected circumstances. These are based on beliefs of altruism and division of labour founded on trust within the group. It is rare for a community as a whole to panic and fall apart, as many outside helpers would like to believe and assume. The accepted and defined hierarchy and authority structure in families and communities are not laid down in black and white, and yet work very well even under pressure.

An accepted version of organisational authority as a social capital is the Disaster Research Centre (US)¹¹ typology which frames changes in an organisation on the references of structure and tasks. An established (Type I) authority framework comprises the pre-existing and well-rehearsed everyday structures such as the fire service or police. Type II has a similar authority structure but gets expanded by volunteers who have earlier worked in the same set up, e.g. retired fire service personnel. Type III extends along the task line by the addition of new but existing organisations such as religious groups which join in the task. The group structure is maintained while they adapt to the new task. Type IV is an extension along both task and structure axes, and

11. DA McEntire, "Searching for a Holistic Paradigm and Policy Guide: A Proposal for the Future of Emergency Management," *International Journal of Emergency Management*, vol I, no 3, 2003, pp. 298-308.

Social coherence and viability in disasters is well documented in contrast to the myth of social collapse. Emergent social action cannot be wished away by command and control fixated authorities. It is a mainframe around which supplementary planned action needs to be organised before, during and after a disaster.

is an emergent organisation wherein an ad hoc task-oriented relationship divides labour on acceptable functional lines.

Over the decades, disaster management and emergency response have been incorporated into governance, especially at the local level. Municipal duties now include professional and trained capacities to meet these obligations. Public administrators are formally trained in the discipline and undergo refresher courses in their careers. There are university courses at all levels and research into localised contexts is picking up all over.

The USA has provided leadership in these aspects, and FEMA has been somewhat replicated in most developed and developing countries. Certification and standardisation of all this effort is critical in ensuring professionalism and accountability across the board. If it is accepted that hazards are physical aspects in control of nature, and disasters are primarily social constructs, then the way to deal with vulnerabilities is through strengthening the social capital. Social coherence and viability in disasters is well documented in contrast to the myth of social collapse. Emergent social action cannot be wished away by command and control fixated authorities. It is a mainframe around which supplementary planned action needs to be organised before, during and after a disaster. Some specific suggestions by Dynes¹² are as follows:

- Use existing social networks to spread awareness of disaster responsibilities, duties and self-help ethos.
- Involve local groups and communities in the planning and training. Local capacities of resources and skills need to be mapped by them, with help from the authorities.

12. R Russel Dynes, "The Importance of Social Capital in Disaster Response", *Preliminary Paper #327*, 2002, Disasters Research Centre, University of Delaware.

- Patterns of social habits, cultural preferences and routines must form the basis of plans.
- It is better to build on existing social platforms rather than thrust new structures that may not be accepted. This is applicable as much to the authority structure existent. It needs to be supported in a crisis, and not usurped.
- A key focus is normalisation of essential services to at least a base level to allow communities to display their resilience in recovery.
- A focus on social capital allows strengthening of capacities against vulnerabilities.
- External aid is a double-edged weapon since it can jeopardise and destroy the age-old social capital. This has to be deeply thought out by the higher authorities and agencies.

Legal and policy frameworks can seriously impinge quick decision-making and leaders need flexibility and adaptability to deal with rule-bending requirements.

LEADERSHIP IN DISASTER RESPONSE

What is Leadership?: Leadership is the ability to motivate and guide groups and communities to achieve goals by providing focus, inspiration and direction. The response phase in a disaster is critical since life and death situations exist and it has elements of search and rescue, medical triage, stabilisation and care to victims, and evacuations. There are myriad challenges of logistics, coordination, information dissemination, prioritisation of resources and capacities, and taking key decisions, with large consequences. Legal and policy frameworks can seriously impinge quick decision-making and leaders need flexibility and adaptability to deal with rule-bending requirements. Leadership competencies vary in all phases of disaster management, however, awareness and knowledge of these will allow leaders to facilitate laying the bedrock for subsequent phases. The pace of decision-making, risks of failures and consequences, information and analysis voids and constant public glare make the response phase the most demanding in terms of the leadership competencies required — especially those related to adapting to dynamic changes — situational awareness and risk-taking abilities.

Leadership Theories: Early leadership concepts were based on heredity and heroism, with emphasis on innate qualities and skills such as personality, charisma, intelligence, integrity, determination, sociability. Contextual issues led to refinement to a trait-based approach — or the Traits Theory. Some of these skills such as confidence and judgement are still relevant today. In the early 1950s, the focus changed to skills and traits that could be learned. However, both these did not explain interaction with others, especially followers. The Behavioural Theory explored what leaders actually did, including their interaction with followers and team members. Distinct styles such as autocratic, democratic and *laissez faire* were identified. The Situational Theory was a follow-up, with leaders changing behaviours to fit the situation. This also emphasised on the motivational needs of team-members and a trust- and inspiration-based relationship, which led to the Transactional Theory between 1960 and 1980. Being on the same page and having a shared vision are some of the nuances involved. Leadership is now evolving into terms such as integrative, where the leader, the follower and the situation all determine its effectiveness and success, and shared and distributive forms where there is little emphasis on single or individual-based theories. For example, the right leader for the right job may involve multiple leaders at varying phases from different organisations. In a disaster, normal people may need to be inspired to do extraordinary things while a mitigation phase may need educated reasoning to convince them of the radical life-affecting changes to be made.

What are the Skills Required?: What are the essential skills that a leader must possess to effectively manage the response phase in disaster management? The first skill is of the cognitive domain, encompassing a rich and profound understanding of the complexities and challenges ahead. A leader must have a clear insight into problems, vulnerabilities, resources and capacities to allow quick and creative problem-solving. The second skill is of being decisive in an environment characterised by confusion, information gaps and acute need for prioritisation of decisions. In case operations are dispersed and far-flung, there is a need to follow distributed leadership models with clear mission-command type orders from the higher leadership. Another facet of decisiveness is flexibility to modify orders as demanded by the situation.

The third skill is communicating with not only own team members, but also all stakeholders and the affected community. Breakdown or overload of communication is a top area to be looked at. What is communicated is critical in terms of credibility, appropriateness and de-confliction of ambiguity. Understanding of the technology in hand can truly empower leaders to communicate effectively. The fourth skill related to communication is laying a network to connect to all the stakeholders. This is where personal charisma, vigour, personality and understanding of other organisations play an important role. The fundamental tenets of effective networking in disasters are trust and mutual respect. Another skill that distinguishes good disaster response leaders is accountability by being transparent in all dealings, aiming for high levels of integrity in resource utilisation and relying on true and verifiable feedback. Adherence to high moral values and legalities allows credibility to grow. The final skill is having an open-mind that has a high learning curve. This allows true assimilation of experiences, lessons learnt and new knowledge from others. This is critical to leaders who bring change in an organisation in order to adapt to newer requirements.

DISASTER MANAGEMENT: INSTITUTIONAL MECHANISMS IN INDIA

Moving from a framework of relief and rehabilitation to an institutional framework that holistically encompasses all aspects of disaster management is a Herculean effort that has been undertaken successfully by India. The legacy of knee-jerk reactive actions under the Ministry of Agriculture has been replaced by an organisational effort down to the district levels in the framework under the National Disaster Management Agency (NDMA) in 2005. The International Decade for Natural Disaster Reduction (IDNDR) between 1990 and 2000 brought out a vision, a legal and constitutional framework, and other such issues. A high powered committee under the chairmanship of JC Pant holistically reviewed Disaster Management (DM) in India and put forth major structural recommendations. A comprehensive framework was established after the DM Act 2005 with a clear hierarchy and linkage right down to the

village levels. An interesting issue being debated is a suggestion for a rights-based approach, e.g. "Right to Safety"¹³.

Policy formulation leads to realistic planning, and the process has been kick-started with professional approaches and centre-staging risk management. Awareness and the involvement of the local government and communities is a key to effective policies and plans. Integration of stakeholders, traditional coping mechanisms, political commitment, a standard operating procedure for risk reduction are some of the ideas being propounded and experimented with. Vulnerabilities faced by India in terms of global warming and its impact on climate change, earthquakes, floods, epidemics, cyclones, etc. point to the imperatives of disaster risk reduction. For every rupee invested in disaster reduction, at least three are saved in terms of post-disaster costs. A national plan mandated by the DM Act has to incorporate measures for the prevention of disasters, integration of mitigation measures into development schemes, capacity building and delineation of roles and responsibilities. Plans are being formulated and revised regularly down to the village level. The work done by the NDMA, National Institute of Disaster Management (NIDM) and the states are illustrative of the change in emphasis. The Third Report of the Second Administrative Reforms Commission on Crisis Management 2006 has mainstreamed early warning concepts and practices, level of training of first responders, training of search and rescue teams, community practices and involvement of all stakeholders in table-tops, mock exercises, etc. Importantly, genuine feedback and a lessons-learnt approach are advocated as critical issues in preparedness.

Issues in Disaster Response: An important component in the disaster field is high-end technology. Along with this, and complementing it, is expertise based on scientific and social knowledge. Both will lead to capabilities in responding to the changing nature of disasters in terms of uniqueness, newer challenges, impact, scope and complexities. The Uttarakhand forest fire in May 2016 has shown some glaring gaps in capacities at the national,

13. OS Dagur, "Armed Forces in Disaster Management: A Perspective on Functional Aspects of Role, Training and Equipment", *Manekshaw Paper No 4*, Centre for Land Warfare Studies (New Delhi: KW Publishers Pvt Ltd).

state and community levels. A focus on disaster risk reduction and capacity building will address response problems. The National Disaster Response Force (NDRF) was set up as a national capacity to handle large disasters and to augment state-level capacities when gaps were noticed. It has evolved into a highly specialised and multi-skilled body that has been deployed across the country for quick response to natural or man-made disasters, including Chemical, Biological, Radiological, Nuclear (CBRN) disasters. The under-six-hour quick deployment in Nepal has not only shown maturing capacities, but also high levels of political will. The National Disaster Response Force (NDRF) has to focus on the following in the future:

- **Management Practices:** A collaborative model to facilitate the numerous actors in a disaster scene needs to be adopted and skills honed in this area. The leadership needs to be familiar with the inter-agency work and the nuances of coordinating multiple actors.
- **Technology:** There is a need to propagate the science of micro-zoning across all states through the various centres. There also is a need to absorb hi-tech communication equipment, especially that relevant to remote and dispersed location operations.
- **Systems Development:** There is a need to standardise disaster language across the nation, as also be aware of its compatibility with what is followed internationally. Emergency Operations Centres (EOC) are a critical need in all states, and, especially, in vulnerable districts. The concept of mobile EOCs is also relevant for geographical remote actions.

After the passage of the NDMA Act 2005, the three-tier structure advocates setting up of assessment, analysis and response mechanisms at each level. A State Disaster Response Force (SDRF) is one of the key mechanisms suggested in the Act. While 22 states have notified the setting up SDRFs, only 10 have effectively managed to do so. It is notable that most have done so in reaction to calamitous events, e.g. Orissa (1999 cyclone), Bihar (2009 Kosi floods), Gujarat (2001 earthquake) and Uttarakhand (Himalayan tsunami 2013). The SDRFs have some obvious advantages such as familiarity with the local language, culture and sensitivities, awareness of local resources

The key to resilience in a disaster is capacity-building of local communities. This has to be contextualised to local hazard mapping and vulnerabilities.

and capacities, and being directly involved with local capacity building and networking. There are also some key challenges for SDRFs. First, the manpower is on deputation from the state police forces and is temporary, affecting continuity issues, specialisation and experience. There is a need to look at other agencies from which skilled manpower can be absorbed. Second, training suffers because of lack of infrastructure and skilled trainers, especially for long durations. Third is the paucity of funds at the state level and the low prioritisation of this sector. For example, two additional battalions of the NDRF were cleared quickly only in the aftermath of the Nepal earthquake. Fourth, good practices in setting up a robust communications network, with redundancy, comprise a priority, but need funds and clarity of vision. Lastly, working for community capacity-building requires commitment which is difficult to find in reluctant deputationists.

THE WAY AHEAD

The key to resilience in a disaster is capacity-building of local communities. This has to be contextualised to local hazard mapping and vulnerabilities. The effort must be to raise awareness levels, motivate communities for involvement in activities, and focussed capacity building in terms of leader training, trauma care, first-responder skills, etc. A focus on the youth in schools and colleges would be a correct long-term investment. Equally important is the motivation of the civil authorities and government officials towards this work. Disaster risk reduction has to be effectively integrated with economic development agendas at all levels of the government. Synergy of efforts by the government and NGOs towards this needs to be facilitated and encouraged in a structured manner. There is a paradigm shift in this field from response and relief in the post-disaster period to mitigation and preparedness in the pre-disaster period. However, hazards will continue to create surprises in the form of disasters and this will demand charting

out a flow of activities envisaged. A disaster protocol to handle different agencies, NGOs, volunteers and multiple capacities needs to be in place and managed in an adaptive manner in the aftermath. Vulnerability and resource mapping will give the NDMAs an ability to respond quickly and effectively. Trained and identified personnel from the National Social Service (NSS), civil defence and trained communities will allow a first-rate initial response to be supplemented by subsequent specialised efforts in the form of the SDRF and NDRF.

Local constraints will dictate the specifics of the response, e.g. narrow by-lanes may require motorcycle-borne fire-fighting elements. Innovative strategies in processes and problem-solving will best emerge in the context of local knowledge in a crisis.

It is important that community leaders be involved in the planning process since templates for all conditions are not possible. Local constraints will dictate the specifics of the response, e.g. narrow by-lanes may require motorcycle-borne fire-fighting elements. Innovative strategies in processes and problem-solving will best emerge in the context of local knowledge in a crisis. Another example is the training in first aid and trauma care of capable community members which can help save lives in the golden hour of the disaster. Resource mapping will include rosters of medicos, hospitals, paramedics, etc, and networking and legal structures to ensure transfers, triage and other life-saving measures. While surprises will continue in disasters, nothing should stop the responding communities and agencies from preparing for uncertainties and unpredictabilities. Every disaster response must be critically studied to learn the right lessons. The key is adaptability to changing demands, urgencies and priorities.

TECHNOLOGICAL AND REGULATORY CHALLENGES IN INTEGRATION OF UAVS IN NON-SEGREGATED AIR SPACE

RK NARANG

INTRODUCTION

Unmanned Aerial Vehicles (UAVs) were initially developed for military missions. The rising capability of surveillance and armed UAVs and their successful employment in recent wars has stimulated the development of Unmanned Combat Aerial Vehicles (UCAVs) to undertake dull, dirty and dangerous combat missions in hostile territory. The global UAV market 2015-2025 report published by Strategic Defence Intelligence, a market research company, had predicted that the UCAVs segment, with a share of 34 percent, is likely to dominate the UAV market.¹ Some technology demonstrator prototypes of UCAVs have already demonstrated their ability to undertake missions which were meant exclusively for manned combat aircraft. The unique capabilities of UAVs have also made them favoured platforms for civil applications. They are ideally suited for tasks requiring long duration surveillance or operations over inaccessible areas. The industrial applications of UAVs have created business opportunities with huge economic potential.

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1. The Global UAV Market 2015-2025, January 2015, <http://www.reportsnreports.com/reports/327969-the-global-uav-market-2015-2025.html>. Accessed on June 6, 2016.

Proliferation and easy availability of small UAVs and the potential for their exploitation by terrorists for subversive activities have raised concerns among the security agencies.

UAVs, unlike manned aircraft, are flown either by a remote pilot or in autonomous mode and are susceptible to breaking of command and control signals, hacking of data links for feeding spurious information and clandestine exploitation of own UAVs by adversaries and/ or terrorists. Also, there are apprehensions that UAV operations in the non-segregated air space could endanger the safety of manned aircraft. UAVs have higher accident rates than manned aircraft, which adds to concerns about safety of manned aircraft and people on the ground. In addition, UAVs would also have to operate with manned military aircraft in a dynamic air environment during war. Proliferation and easy availability of small UAVs and the potential for their exploitation by terrorists for subversive activities have raised concerns among the security agencies. Military UAVs so far have been operating in the segregated air space in which they are either kept well clear of manned aircraft or made to operate in separate sectors specifically earmarked for them, which does not ensure optimum utilisation of congested air space. The military and civil UAVs now have the ability to fly at higher speeds, operate at high altitudes, have greater endurance and would be required to operate in the non-segregated air space, which is the biggest challenge.²

Efforts have been made by the International Civil Aviation Organisation (ICAO), European Union (EU), the United States (US) and some other countries to develop enabling technologies and formulate a favourable regulatory framework to integrate UAVs in the non-segregated air space in a step-by-step manner. Some countries have allowed small UAV operations with certain restrictions. However, they have not been able to fully integrate them in the non-segregated air space due to the uncertainty about crucial technologies. This paper, therefore, attempts to find answers to the following questions:

2. UAV operations in the non-segregated air space mean that both manned and unmanned aircraft would operate in the same air space, with a similar set of safety rules with suitable modifications for UAVs.

- What are the challenges for integration of UAVs in the non-segregated air space?
 - What are the initiatives undertaken to facilitate integration?
 - Why may full integration continue to be a challenge?
 - What is the status of UAV integration in India?
- The challenges being faced in integration of UAVs are of two types, i.e. firstly, the technological challenges, which can be overcome by developing enabling technologies; and, secondly, the regulatory challenges.**

Various stakeholders have been using different terms to indicate Unmanned Aircraft (UA) and systems, i.e. UAV, Unmanned Combat Aerial Vehicle (UCAV), Unmanned Aircraft System (UAS) and Remotely Piloted Aircraft System (RPAS)³, and these terms have been used interchangeably during the deliberations. This paper is a descriptive analysis of the challenges faced and the initiatives being taken to facilitate the integration of UAVs in the non-segregated air space. It discusses the technological and regulatory issues related to the integration of UAVs in the non-segregated air space and the initiatives taken by the ICAO, US, EU and India toward this. The paper does not address issues related to air space management in the non-segregated air space.

CHALLENGES FOR INTEGRATION

UAVs, while flying in the non-segregated air space, are likely to encounter two types of airborne traffic, i.e. cooperative and non-cooperative traffic. Cooperative traffic is capable of broadcasting its position through a transponder or by any other means, while non-cooperative traffic does

3. The term Remotely Piloted Aircraft System (RPAS) is being used by the ICAO and EU and it comprises Remotely Piloted Aircraft (RPA), Remotely Piloted System/s (RPS/s or Ground Control Station/s), Command and Control (C2) link and any other component as specified in the type design. For details, refer <http://www.wyvernlimited.com/wp-content/uploads/2015/05/ICAO-10019-RPAS.pdf>. Accessed on June 12, 2016.

not broadcast its position.⁴ UAVs, while flying through air space with dense air traffic, would have to be equipped with suitable sensing and safety equipment in order to identify non-cooperative traffic, maintain separation, and take suitable evasive measures if the traffic is found closing in dangerously. Also, regulatory provisions for licensing, certification and operations are needed to integrate UAVs with manned aircraft. Therefore, the challenges being faced in integration of UAVs are of two types, i.e. firstly, the technological challenges, which can be overcome by developing enabling technologies; and, secondly, the regulatory challenges, which can be dealt with by amending the existing rules and regulations as well as formulating new ones to facilitate operations of UAVs in the non-segregated air space.

TECHNOLOGICAL CHALLENGES

The challenges being faced in the integration of UAVs in the non-segregated air space and the technologies needed for this are discussed in the succeeding paragraphs.

Collision and Traffic Avoidance Systems

Airborne and ground-based surveillance sensors and equipment are needed to enable UAVs to take actions autonomously for de-confliction of traffic and collision avoidance. The details of the “sense and avoid” and “traffic avoidance” systems being developed are discussed below.

Sense and Avoid Systems: Sense and avoid systems are needed to provide traffic avoidance and collision avoidance capability in congested air space. The time available for identification of potential hazards from other manned, unmanned aircraft, and obstacles on the ground is very little. Human beings have the unique ability to appreciate these risks and take necessary corrective actions to ensure the safety of the aircraft. However, this task would have to be performed by on-board sensors/ equipment in UAVs.

4. Roland E. Weibel and R. John Hansman, “Safety Considerations for Operation of Unmanned Aerial Vehicles in the National Airspace System,” March 2005, <http://dSPACE.mit.edu/bitstream/handle/1721.1/34912/Weibel%20-%20ICAT%20Report%20-%20UAV%20Safety.pdf?sequence=1>. Accessed on June 3, 2016.

Therefore, these sensors/ equipment should be able to detect other manned and unmanned aircraft flying in the near vicinity, identify the threat from them as well as from obstacles on the ground and take corrective actions autonomously.⁵ However, existing sensors do not seem to have this capability. The development of reliable and robust sense and avoid equipment continues to be a big challenge.

Traffic Avoidance System: The Traffic Collision Avoidance System (TCAS) is an airborne system which was designed for manned aircraft and gives warning in terms of time to go for collision by comparing velocity and direction. However, it was not meant to have high lateral fidelity for unmanned aircraft and, hence, may have to be modified for unmanned aircraft to identify collision threats and take actions autonomously.⁶ Similarly, UAVs would need light weight Infra-Red (IR) sensors, optical sensors and Laser Radars (LIDAR) for detecting non-cooperative traffic.

DATA LINKS

A UAV needs secure data and voice communication links for the following:

- To provide a command and control link between the UAV and its operator/pilot located in the ground control station for controlling the operation of the UAV.
- For sharing of videos and other sensors' data of the UAV with the ground control station as well as with other aircraft.
- To provide radio telephony (voice) contact between the UAV operator and air traffic control for management and de-confliction of air traffic.⁷

UAVs normally have two independent data uplink nodes for controlling the UAV and one downlink node for downloading of the payload and/or telemetry data. Two nodes are provided for the uplink to ensure that the

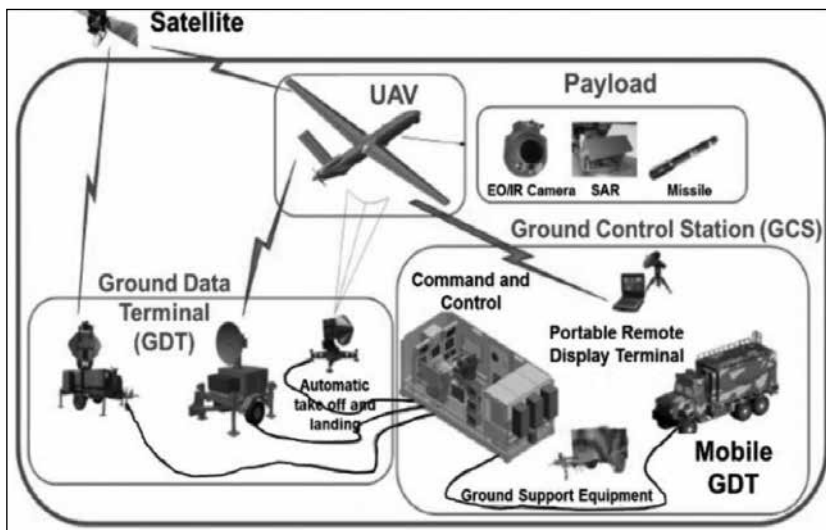
5. "FAA Faces Significant Barriers to Safely Integrate Unmanned Aircraft Systems into National Airspace System", <https://www.oig.dot.gov/sites/default/files/FAA%20Oversight%20of%20Unmanned%20Aircraft%20Systems%5E6-26-14.pdf>. Accessed on May 27, 2016.

6. n.3.

7. "Civil Air Space Invaders – The Integration of Drones in Commercial Aviation", May 2014, <http://www.nortonrosefulbright.com/knowledge/publications/115638/civil-air-space-invaders-the-integration-of-drones-in-commercial-aviation>. Accessed on May 25, 2016.

stand-by uplink is available to control the UAV in case of unserviceability of the main link, while only one link is provided for downloading of data since it does not impact the controllability and safety of UAVs.

Fig. 1: A Typical Data Link⁸



The data links with the UAV are either direct Line of Sight (LOS) or Beyond Line of Sight (BLOS) through satellites. The direct LOS data links normally provide command, control and data link connectivity with UAVs up to a range of 200-250 km, whereas in BLOS, the data link connectivity is maintained through satellites and it provides far greater ranges than the LOS data links.⁹

Lost Link: The command and control link between the remote pilot and the UAV could witness interruptions lasting from a few seconds to a few minutes due to unreliability of the command and control link and/ or fading of signals. This poses a serious security hazard to manned air traffic. The US Department of Transport's audit report on "Barriers to UAS Integration"

8. İsmet Çuhadar and Mahir Dursun, "Unmanned Air Vehicle System's Data Links", June 2016, <http://www.joace.org/uploadfile/2015/1015/20151015021322106.pdf>. Accessed on June 7, 2016.

9. Ibid.

dated June 26, 2014, had cited a few examples of data link failures, which included a UAS helicopter flying into restricted area around Washington DC in 2010 and another UAS descending from the authorised 20,000 ft to 19,000 ft without approval.¹⁰ Therefore, apart from strengthening and improving the security of the command and control links, the need is felt for providing the auto recovery mode as a mandatory requirement for operations in the non-segregated air space.

Vulnerability of Data Links: The safety of data links is a major concern especially for UCAVs that are likely to operate in hostile enemy territory. The possibility of jamming, interference or hacking is a crucial vulnerability, which could be exploited by the adversary in a variety of ways. The adversary could carry out an electronic attack silently to disrupt downloading of sensors' data or replace original data with fake data. The adversary could also take over control of the UCAV and make it either crash or land in enemy territory or utilise it for operations against own targets. Iran's engineers had surprised the world by hacking into the control system of the highly advanced RQ-170 Sentinel Stealth UAV of the US Central Intelligence Agency (CIA) and making it land in Iran in 2011.¹¹ In 2012, students of the University of Texas took control of a US military UAV by hacking into its communication system in response to a challenge by the US Department of Homeland Security.¹² The possibility of a similar takeover of UAVs by terrorists cannot be ruled out and this is one of the major concerns for security agencies and air space regulators.

LEVEL OF AUTONOMY

UAVs, as of now, are not capable of fully autonomous operations, in which they could adapt to unplanned situations and take appropriate actions autonomously without the intervention/ supervision of human beings. UAVs do not yet have the capability to respond to Air Traffic Control (ATC)

10. n.5.

11. "How Iran Hacked Super-Secret CIA Stealth Drone", December 16, 2011, <https://www.rt.com/usa/iran-drone-hack-stealth-943/>. Accessed on June 7, 2016.

12. "Civil Air Space Invaders – The Integration of Drones in Commercial Aviation", May 2014, <http://www.nortonrosefulbright.com/knowledge/publications/115638/civil-air-space-invaders-the-integration-of-drones-in-commercial-aviation>. Accessed on May 25, 2016.

In future, UAVs would also be required to exchange data with other aircraft for the non-segregated operations, which would also require a certain bandwidth.

instructions autonomously, and, on the other hand, air traffic control also does not have the means to ensure that its commands are actioned by UAVs autonomously. There is a need to increase the level of autonomy of UAVs for making their operations safer in the non-segregated air space. Image processing for collision avoidance sensing, voice recognition for control and trajectory optimisation are some of the crucial technologies needed for achieving autonomy.

BANDWIDTH LIMITATION

The frequency spectrum is needed for carrying out voice communication between the UAV pilot and ATC, control of the UAV and for downloading of videos and other data from on-board sensors. In future, UAVs would also be required to exchange data with other aircraft for the non-segregated operations, which would also require a certain bandwidth. The frequency bands commonly being used for UAV operations include Ku band (12-18 GHz for high speed links), K band (18-26.5 GHz for conveying large amounts of data), S band and L band (2-4 GHz and 1-2 GHz respectively), C-band (4-8 GHz) and X band (8-12 GHz is normally earmarked for the military).¹³ The frequency bandwidth required for operations of a UAV and its sensors is very high. If multiple UAVs are required to operate in the same area, the numbers that can operate would be limited due to the non-availability of the bandwidth.

ACCIDENTS/ INCIDENTS

Technology and Reliability

The high accident/incident rate of UAVs has been a cause of concern for air space regulators. The causes of UAV accidents/ incidents are

13. <http://www.joace.org/uploadfile/2015/1015/20151015021322106.pdf>. Accessed on June 7, 2016.

poor reliability, non-availability of separation maintenance and collision avoidance equipment, vulnerability and unreliability of the command and control link and inadequate automation in the absence of a pilot and human factors. Research is being carried out to develop/ improve essential technologies to reduce the accident/incident rate.

Human Factors

The accident rate for UAVs is much higher than for manned aircraft and a significant percentage is attributed to Human Factors

(HFs) which continue to be an essential element of UAV operations despite the fact that UAVs were developed to overcome the limitations of manned aircraft. UAVs are different from manned aircraft in many ways and they have posed new challenges for the designers and regulators. The operation of UAVs is carried out from a ground control station, which had given hope that UAV operators would not be subjected to fatigue like pilots of manned aircraft. However, UAVs are being employed for missions of much longer duration than their manned counterparts, which require continuous attention under a high stress environment. The difficult working conditions have made UAV pilots susceptible to errors/ omissions, thereby adversely impacting the safety of UAVs and other aircraft. A study in 2010 observed that HFs comprised one of the major contributors in UAV accidents and accounted for 32 percent of the accidents in a sample of 56 UAV accidents.¹⁴ The US Congressional Research Service Report (CRS) on UAS of 2012 observed that the US Air Force (USAF) alone had lost 79 UAVs due to

The accident rate for UAVs is much higher than for manned aircraft and a significant percentage is attributed to Human Factors (HFs) which continue to be an essential element of UAV operations despite the fact that UAVs were developed to overcome the limitations of manned aircraft.

14. Muhammad Asim, Dr Nadeem Ehsan and Khalid Rafique, *Probable Causal Factors In UAV Accidents Based On Human Factor Analysis and Classification System*, http://www.icas.org/ICAS_ARCHIVE/ICAS2010/PAPERS/492.PDF. Accessed on June 3, 2016.

accidents, with human error being the major contributor.¹⁵ The human factor elements like hypo vigilance and ergonomics that contribute to accidents in UAVs are discussed below.

Hypo Vigilance: Hypo vigilance is a Post-Traumatic Stress Disorder (PSTD) in which the patient is in a hyperarousal state with constant tension and always 'on guard' symptoms causing exhaustion.¹⁶ A study in 2014 indicated that hypo vigilance is also a significant contributor in HF accidents in UAVs since UAV operators have long working hours and their attention levels vary, depending upon the level of activity, type of mission and duty hours, which could lead to errors/omissions, thus, resulting in accidents/incidents.¹⁷ It is one of the human factor elements which is associated with reduction in the attention level of people and is considered to be a major contributor in car accidents.

Ergonomics: The Cambridge Dictionary defines ergonomics as the "scientific study of people and their working conditions, especially done in order to improve effectiveness."¹⁸ The pilot has been shifted from the cockpit of a manned aircraft to the Ground Control Station (GCS) in a UAV. Ergonomically poor design of the ground control station of the UAVs could have serious flight safety implications and there are some examples in which poor ergonomics has led to UAV accidents. In one such incident, a UAV operator had erroneously put off the ignition switch (which was placed in close proximity to the landing gear switch) during landing, resulting in its crash in 2006. In another poor ergonomics related accident, strong glare on the screen had prevented the UAV operator from reading the alert while he was switching off the UAV engine erroneously.¹⁹

15. <http://www.afsec.af.mil/shared/media/document/AFD-150116-044.pdf>. Accessed on May 31, 2016.

16. "What is Hypervigilance and What is the Treatment," <http://www.epainassist.com/mental-health/hypervigilance>. Accessed on September 7, 2016.

17. Yerim Choi, Namyoon Kwon, Sungjun Lee, Yongwook Shin, Chuh Yeop Ryo, Jonghun Park and Dongmin Shin, "Hypovigilance Detection for UCAV Operators Based on a Hidden Markov Model," May 20, 2014, <http://www.hindawi.com/journals/cmmm/2014/567645/>. Accessed on June 2, 2016.

18. <http://dictionary.cambridge.org/dictionary/english/ergonomics>. Accessed on June 5, 2016.

19. Sean Gallagher, "Pushing the Wrong Button: Bad Button Placement Leads to Drone Crashes," March 1, 2013, <http://arstechnica.com/information-technology/2013/03/pushing-the-wrong-button-bad-button-placement-leads-to-drone-crashes/>. Accessed on June 5, 2016.

Fig. 2: Crashed US Drone in Iraq in 2006²⁰



Mode Confusion: The high performance UAVs can be programmed for take-off, climb, en-route, approach and landing mode during flying. If an operator forgets or gets confused about the mode in which the UAV is currently flying, due to fatigue or lack of situational awareness, the controller could perceive the behaviour of the UAV as unusual or unexpected, which may result in accidents. UAVs have been reported to have taken-off autonomously due to confusion of the mode.²¹

REGULATORY CHALLENGES

The successful employment of armed UAVs for anti-terror strikes has generated tremendous interest in UAVs. According to a 2011 survey, the number of UAVs being developed had increased from 195 in 2005 to 680 in 2011. The leading aerospace powers are laying special emphasis on developing more capable armed UAVs and UCAVs. Also, UAVs are being increasingly employed for industrial and agricultural applications. As a

20. Ibid.

21. "Human Factors Implications of RPA Flight in Non-Segregated Airspace," March 2014, <http://reports.nlr.nl:8080/xmlui/bitstream/handle/10921/962/TP-2013-345.pdf?sequence=1>. Accessed on June 27, 2016.

result, there is an increasing demand for formulating an enabling regulatory framework to facilitate their integration in the non-segregated air space.

Operations: An unmanned aircraft can fly either by Visual Flight Rules (VFR) or Instrument Flight Rules (IFR) to operate in civil air space. The IFR manned flight is flown entirely with the help of on-board instruments; however, additional sensors/ instruments would be needed for safe operations of UAVs in the IFR. The operation of UAVs in uncontrolled, non-segregated air space, where no radar cover is available, is likely to be a bigger challenge. The separation from other traffic in the VFR in the manned aircraft is maintained by the pilot visually. The flight of a UAV in the VFR, in uncontrolled air space, necessitates that it has the required instrumentation to replicate the ability of the pilot to detect and take evasive actions autonomously to maintain separation from manned/ other unmanned aircraft. It may be relatively easier for a UAV to maintain separation from cooperative traffic but the bigger challenge lies in maintaining separation and in detecting and taking collision avoidance actions from non-cooperative traffic.

Licensing and Certification: The air space regulators, on their part, have to ensure that there is no danger to manned aircraft and people on the ground. They also have to formulate/amend regulations/guidelines, etc. for licensing of operating crew, certification of UAVs and security of data links to safely integrate UAVs in the non-segregated air space.

Distributed Control: A UAV or RPA can be controlled from different locations by simply handing over of the radio control frequency to another controller situated hundreds of miles away. The distance between the controller and UAV could vary from Line of Sight (LOS) to Beyond Line of Sight (BLOS) operations for satellite controlled UAVs. This is a new development in aviation, which has raised new challenges for attribution of responsibility for control of the UAVs and would have to be factored in the regulations for the UAVs.

CERTIFICATION OF MILITARY UAVS

Euro Control, an organisation of the EU for safety of air navigation, came up with specifications for the use of military RPAs as operational air traffic

outside the segregated air space in February 2012.²² The laying down of specifications for military aircraft will help in aligning the flight safety requirements to certify them and, thus, facilitate in their integration with, civil traffic in the non-segregated air space.

INITIATIVES FOR INTEGRATION

The US, EU and ICAO have taken a lead in the formulation of regulatory mechanisms to facilitate integration of UAVs, especially in the non-segregated air space. It is being ably supported by research in developing critical technologies to facilitate safe operations of UAVs along with manned aircraft. Some of the technological, regulatory and other initiatives, which have contributed, or are likely to contribute, in integration in the non-segregated air space, are covered in the succeeding paragraphs.

Technological Initiatives

The non-availability of essential technologies is a major hurdle in integration of UAVs in the non-segregated air space. The details of some of the initiatives being undertaken to develop technologies essential for the integration of UAVs are discussed in the succeeding paragraphs.

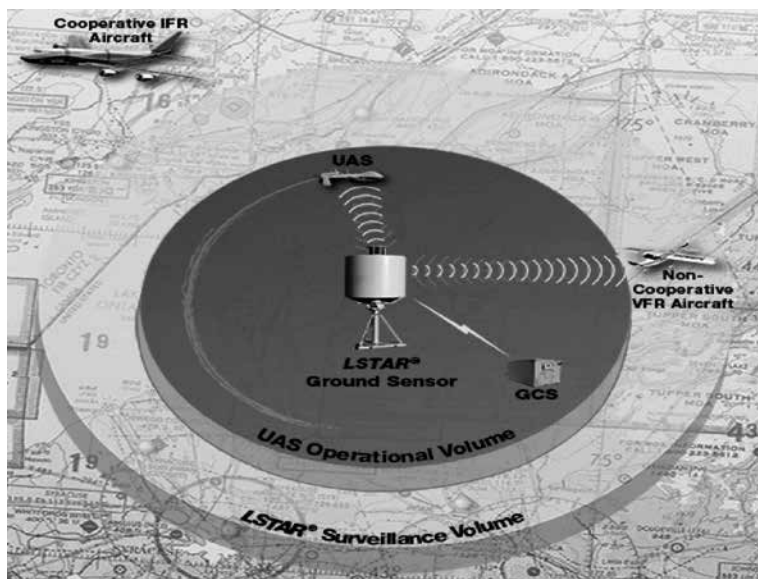
Ground-Based Sense and Avoid (GBSAA) System

Fig. 3: GBSAA System Based on LSTAR Radars²³



22. <https://www.eurocontrol.int/sites/default/files/content/documents/single-sky/cm/civil-mil-coordination/cmac-rpa-specifications-v-2-0-20120201.pdf>. Accessed on June 22, 2016.

23. <http://www.srcinc.com/what-we-do/radar-and-sensors/lstar-air-surveillance-radar.html>. Accessed on June 21, 2016.

Fig. 4: LSTAR Detection Range for Control of UAS

The US Army has developed a GBSAA system for providing separation between UAV and other traffic. It is based on a light weight, low cost 3-D, 360 degree surveillance radar system capable of detecting and tracking all types of aircraft, including small and slow moving drones and helicopters. The radars send their detection and track information to a central fusion processor and the data is correlated with existing traffic information to build a complete picture.²⁴ The GBSAA operator also monitors the UAV's deviation from the position, heading and altitude by using algorithms, and alerts the UAV operator if the separation between the UAV and other airborne aircraft reduces or poses a threat to other airborne objects. The initial system was installed at El Mirage, California, and first tested on April 27, 2011. The GBSAA operator is normally an ATC controller who is in contact with the ATC and UAS but has no contact with other aircraft. This system is also being tested by the US Navy and US Marines.²⁵

24. <http://www.srcinc.com/what-we-do/radar-and-sensors/lstar-air-surveillance-radar.html>. Accessed on June 21, 2016.

25. Thomas P. Priesterbach, Kelly A. Bruns, Lauren I. Baron, and Jason E. Sohlke, "Unmanned Aircraft System Airspace Integration in the National Airspace Using a Ground-Based Sense and Avoid System," http://www.jhuapl.edu/techdigest/TD/td3203/32_03-spriesterbach.pdf. Accessed on May 29, 2016.

The safety and reliability of communication and data links among the GBSAA controller, UAV operator and ATC would become crucial for ensuring safe separation and collision avoidance. The induction of such a system would add to the workload of ATC controllers and could increase their stress levels.

The non-availability of essential technologies is a major hurdle in integration of UAVs in the non-segregated air space.

Airborne Radar

The National Aeronautics Space Administration (NASA) had carried out trials of the on-board radar of a UAV in 2003 to check the detection distance of non-cooperative traffic and the UAV's ability to take evasive manoeuvres. However, the radar could pick up the target only at 4 miles, which was not adequate to take evasive measures and avoid a collision.²⁶ The results of the trials were not satisfactory.

Sense and Avoid System

The US Defence Advanced Research Projects Agency (DARPA) tested an integrated Sense and Avoid (SAA) system comprising an optical camera and passive ranging sensors, which identify incoming or crossing aircraft and determine the best avoidance strategy compliant with air rules as part of the Aircrew Labour In-Cockpit Automation System (ALIAS) programme. The trials of the SAA system were successful, in which a Cessna 172G aircraft was used as the target aircraft in May 2016.²⁷

ADS-B

The Automatic Dependent Surveillance Broadcast (ADS-B) system will be capable of broadcasting the aircraft location in real-time in terms of altitude and velocity as well as be able to receive information about other aircraft, weather and terrain.²⁸ The initial reports of the system as a traffic avoidance system are encouraging. ADS-B has been included as essential

26. n.3.

27. "1st Success Seen in System Designed to Help Aircraft Automatically Avoid Mid-Air Collisions," May 04, 2016, <http://www.darpa.mil/news-events/2016-04-05a>. Accessed on June 15, 2016.

28. n.12.

equipment in the ICAO manual for RPAS operations. ADS-B Out, a mode of ADS-B, broadcasts Global Positioning System (GPS) information like the aircraft's location, air speed and other data to a network of ground stations, which, in turn, relay the data to air traffic control displays and to nearby aircraft equipped to receive the data via ADS-B In mode. The US has made it mandatory for all aircraft to be equipped with ADS-B equipment for operations in its controlled air space from January 1, 2020 onwards.²⁹

MIDCAS

Five EU countries (Sweden, France, Germany, Italy and Spain) are funding the project to develop the Mid-Air Collision Avoidance System (MIDCAS), which integrates ADS-B with Electro-Optical (EO) and Infra-Red (IR) cameras to identify other aircraft.³⁰ The project was launched in 2009 and a consortium of 11 companies, led by SAAB of Sweden, is involved in the development process.

Fig. 5: MIDCAS Development Partners³¹



MIDCAS is expected to undertake the following functions:

- Improve situational awareness for the RPAS pilot.
- Help maintain separation from other traffic (or self-separation).
- Collision avoidance by anticipating traffic on collision course and taking evasive measures.³²

29. <https://www.faa.gov/nextgen/equipadsb/>. Accessed on July 14, 2016.

30. n.3.

31. "MIDCAS is the European Detect and Avoid Project," <http://www.midcas.org/>. Accessed on August 30, 2016.

32. Ibid.

The bandwidth required for command and control of UAVs, transmission of intelligence data and video imagery is huge. The capabilities of UAVs are constrained due to the limited availability of bandwidth.

which envisages using airborne Internet Protocol (IP)-based architecture³⁵ for sending communication signals through multiple stops for maintaining end-to-end security.³⁶ The Airborne Internet Protocol (AIP) was first proposed in the NASA Langley Research Centre's Small Aircraft Transportation System (SATS) planning conference in 1999. The AIP is used for providing inflight connectivity by forming a peer-to-peer (air-to-air) wireless communication network among the aircraft, thereby overcoming the limitations of satellite communication.³⁷ Gary Clayton, head of R&T for Cassidian UK, which is responsible for ASTRAEA's communications architecture, in an interview in 2013, had intimated that they are developing air, sea or land-based mobile IP nodes, which can create a secure territorial network between multiple air platforms.³⁸ AIP systems could help overcome bandwidth limitations. However, dependence on such systems without suitable back-up systems could also make them vulnerable. Any failure or disabling of a such system due to enemy actions could jeopardise the entire operation and would need to be factored in operational plans or alternative means of providing similar communication, and data transfer capability would have to be found.

Wavelet Compression

The bandwidth required for command and control of UAVs, transmission of intelligence data and video imagery is huge. The capabilities of UAVs are constrained due to the limited availability of bandwidth. Increasing the bandwidth, therefore, is not an option. A study was carried out in the

35. Steven V. Pizzi, "A Routing Architecture for the Airborne Network," May 21, 2007, https://www.mitre.org/sites/default/files/pdf/07_0746.pdf. Accessed on June 15, 2016.

36. n.12.

37. "The Airborne Internet," <http://cdn.intechweb.org/pdfs/20441.pdf>. Accessed on July 12, 2016.

38. <https://www.theengineer.co.uk/issues/june-2013-online/your-questions-answered-astraea-autonomous-planes/>. Accessed on July 8, 2016.

University of California in 2013 to find a solution to overcome the limitation of data transmission capabilities in UAVs by improving the bandwidth utilisation through wavelet compression. The study observed that reduction in size of the transmission of images by 93 percent and corresponding decrease in bandwidth demand is feasible through Enhanced Compression Wavelet (ECW) technology.³⁹

ACCIDENTS/ INCIDENTS

Technological initiatives are being taken to improve the reliability of the UAV platform, develop traffic avoidance and collision avoidance systems, and improve command and control systems to curb the rate of accidents/incidents, which are discussed separately. The initiatives being taken to reduce accidents/ incidents due to HFs are discussed below.

EEG for Hypo Vigilance Detection

The National Research Foundation (NRF) of Korea, in collaboration with the Korean government, in a study titled "Hypo Vigilance Detection for UCAV Operators Based on a Hidden Markov Model" in 2014 proposed use of Electroencephalography (EEG) signals on UAV operators for building a databank for study, and utilising these for reducing their hypo vigilance cycles.⁴⁰ The aviation medicine specialists need to analyse this study and, if found suitable, consider incorporating appropriate provisions in the annual medical schedules and/ or for the treatment of operating crew of unmanned aircraft.

Improving Ergonomics

A report by ARS Technology on the contribution of human error (ergonomics) in UAV accidents in 2013 observed that there was 98 percent overlap between inputs and output devices used by ground control workstations of UAVs and those used by general purpose computers. It observed that American National

39. Mary Elizabeth Parker, "Data Overload In Unmanned Aircraft Systems: Improving Bandwidth Utilization Through Wavelet Compression," May 2013, <http://spatial.usc.edu/wp-content/uploads/2014/04/ParkerMaryThesis.pdf>. Accessed on June 15, 2016.

40. n.17.

Standards Institute and Human Factors and Ergonomics Society ANSI/HFES-100-2007 standards for computing workstations could form the basis for formulating ergonomic standards of UAVs' ground control workstations.⁴¹

RESEARCH

The US Government Accountability Office report to the Congressional Committee on UAS dated July 2015, highlighted the technological challenges being faced in UCAV development. NASA is collaborating with the Department of Defence (DoD) to generate operations and safety data. It is also collaborating with academia to undertake research on UAS operations.⁴² The Federal Aviation Administration (FAA) has collaborated with universities and DoD and had allocated a budget of \$4.2 million in 2013 and \$8.6 million in 2014 to undertake research in areas and technologies associated with the integration of UAVs in the National Air Space.⁴³

Regulatory Initiatives

The employment of UAVs in conflicts and their increasing business potential has compelled the air space regulators to formulate an enabling regulatory framework. The International Civil Aviation Organisation (ICAO), Federal Aviation Administration (FAA) of the US and European Aviation Safety Agency (EASA) of the European Union have been at the forefront in formulating regulatory frameworks which are duly supported by technological innovations to ensure safe integration of UAVs with manned aircraft. The initiatives taken by the air space regulators are discussed in the succeeding paragraphs.

INTERNATIONAL CIVIL AVIATION ORGANISATION (ICAO)

ICAO is a specialised agency of the UN which is responsible for providing the international regulatory framework for RPAS integration into the non-

41. n.19.

42. "US GAO Report on UAS," July 2015, <http://gao.gov/assets/680/671469.pdf>. Accessed on May 26, 2016.

43. n.5.

segregated air space in consultation with member states. It had set up the Unmanned Aircraft Systems Study Group (UASSG) in 2007 which was the focal point for UAS related issues. This was superseded by the Remotely Piloted Aircraft System Panel (RPASP) in 2014 which aims to amend 18 out of 19 annexures (excluding Annex 5) to accommodate RPAS.⁴⁴ ICAO had published Circular 328 on UAS in the year 2011 and has so far amended Annexures 2, 7 and 13 to the Chicago Convention to accommodate RPAS for use by international civil aviation.⁴⁵

ICAO came up with its first edition of the Manual on Remotely Piloted Aircraft Systems (RPAS) (Doc 10019-AN/507) in 2015.⁴⁶ The goal of ICAO is to develop Standards and Recommended Practices (SARPs) with supporting Procedures for Air Navigation Services (PANS) and guidelines to facilitate safe, secure and efficient integration of RPAS into the non-segregated air space and aerodromes.⁴⁷

USA

Integration of UAVs in the US national air space was envisaged in the "Vision 100-Century of Aviation Reauthorisation Act" passed by the US Congress on December 12, 2003.⁴⁸ The US Department of Transportation's FAA has been actively pursuing rule making for UAS. The "FAA Modernisation and Reform Act of 2012" was a step in developing the next generation air transportation system and air traffic control modernisation by the US. Section 322 of the Act proposes a framework for integration of UAS into the US NAS.⁴⁹ The Act directed the US government to develop an integration plan by the end of Financial Year (FY) 2015 with a five-year

44. <http://www.icao.int/MID/Documents/2016/RASG-MID5/PPT3%20-%20RPAS%20Elie.pdf>. Accessed on June 9, 2016.

45. "Unmanned Aircraft Systems (UAS) and Remotely Piloted Aircraft Systems (RPAS)," <https://www.easa.europa.eu/unmanned-aircraft-systems-uas-and-remotely-piloted-aircraft-systems-rpas>. Accessed on June 10, 2016.

46. Publications:2718, February 20, 2015, <http://www.icao.int/isbn/Lists/Publications/DispForm.aspx?ID=2733>. Accessed on June 12, 2016.

47. <http://www.icao.int/safety/RPAS/Pages/default.aspx>. Accessed on June 9, 2016.

48. "Vision 100-Century of Aviation Reauthorisation Act," December 12, 2003, <https://www.gpo.gov/fdsys/pkg/PLAW-108publ176/pdf/PLAW-108publ176.pdf>. Accessed on August 31, 2016.

49. "FAA Modernisation and Reform Act of 2012," February 1, 2012, <https://www.gpo.gov/fdsys/pkg/CRPT-112hrpt381/pdf/CRPT-112hrpt381.pdf>. Accessed on May 25, 2016.

roadmap for full integration. The US government has formulated a policy for integration of small UAS; however, a comprehensive integration plan as mandated by the Act is still awaited.⁵⁰

UAS in Arctic: The FAA released the Arctic Implementation Plan on November 1, 2012. Section 332 (d) of the UAV Modernisation and Reform Act of 2012 directs the US government to establish permanent operational areas and corridor routes in the Arctic for operations of small UAS on a 24-hour basis for research and commercial purposes within six months of the Act coming into force. Two UAS companies have been granted permission to undertake operations in the Arctic, i.e. ConcoPhillips' Insitu's Scan Eagle UAV for marine mammals and ice surveys in September 2013 and BP's AeroVironment's Puma AE UAV to survey pipelines, roads, and equipment at Prudhoe Bay in Alaska in June 2014.⁵¹

Centre of Excellence: The FAA selected the Mississippi State University's team as the FAA's Centre of Excellence for Unmanned Aircraft Systems (COE UAS) in May 2015 after going through a rigorous competition. Mississippi State University will be supported by 22 of the world's leading research institutes to carry out cutting edge research in areas related to UAS integration in the non-segregated air space, and an initial amount of \$5 million was allotted for a five-year agreement.⁵²

50. https://www.faa.gov/uas/media/Sec_331_336_UAS.pdf. Accessed on June 14, 2016.

51. *Ibid.*

52. Press Release, "FAA Selects Mississippi State University Team as Center of Excellence for Unmanned Aircraft Systems," May 08, 2015, https://www.faa.gov/news/press_releases/news_story.cfm?newsId=18794, June 14, 2016.

Fig. 7: FAA's Centre of Excellence for UAS Research⁵³



These 22 research institutes, along with more than a hundred leading industry and government agencies, formed an Alliance for System Safety of UAS through Research Excellence (ASSURE). The process of integration of UAVs is complex and ASSURE members have the expertise as well as access to infrastructure, laboratories and testing facilities. They are the core of three FAA UAS test sites, lead four FAA research centres, have seven airfields and a 340-UAS fleet. The alliance partners would undertake research in various fields related to integration of UAVs, which include air traffic control interoperability, UAS airport ground operations, control and communications, detect and avoid, human factors, UAS noise reduction, UAS wake signatures, unmanned aircraft pilot training and certification, low altitude operations safety, spectrum management and UAS traffic management.⁵⁴

Small UAS Integration: The US had formulated a policy on July 30, 2013,⁵⁵ which allowed the FAA to grant exemption under Section 333 of the Act to deviate from certain rules if it finds that small UAV operations can be performed safely, and authorise them to operate in the NAS. The US had

53. "Alliance for System Safety of UAS through Research Excellence (ASSURE)," <http://www.assureuas.org/about.php#>. Accessed on August 30, 2016.

54. Ibid.

55. "Unmanned Aircraft Systems (UAS) Operational Approval," July 30, 2013, http://www.faa.gov/documentlibrary/media/notice/n_8900.227.pdf. Accessed on July 9, 2016.

published a notice of proposed rule-making for operations of small UAS in April 2015, which was followed up by the notice for registration of small UAS in December 2015.⁵⁶ A total of 5,309 civil operators were authorised under Section 333 to operate small UAS for commercial applications from July 2013 to May 2016.⁵⁷ The final operational rules for routine commercial use of small UAS were issued under Part 107 of the regulations on June 21, 2016.⁵⁸ The small UAS Rule (Part 107) came into force with effect from August 29, 2016.⁵⁹

Drone Advisory Committee (DAC): FAA Administrator Michael Huerta, speaking at the Association for Unmanned Vehicle System International (AUVSI) annual conference-2016 in New Orleans, had announced the setting up of a DAC consisting of a cross-section of stakeholders from the field of UAS operations, business and other related issues, which would provide inputs to the FAA and decision-makers for resolution of issues affecting the efficiency and safe integration of UAS into the NAS.⁶⁰

Test Sites: The US had designated six test sites under the NASA to undertake research and testing of aspects related to UAS integration in civil air space in 2013.⁶¹ The FAA had followed a rigorous selection process to select six test sites out of 25 proposals from 24 states, taking into consideration geography, climate and location of ground infrastructure, research needs, air space use, safety, aviation experience and risk.⁶² These sites are at the University of Alaska Fairbanks, North Dakota Department of Commerce, State of Nevada, Griffiss International Airport, Texas A&M University, Corpus Christi, Virginia Polytechnic Institute and State University (“Virginia Tech”).⁶³

56. https://www.faa.gov/news/press_releases/news_story.cfm?newsId=19856. Accessed on June 14, 2016.

57. https://www.faa.gov/uas/legislative_programs/section_333/333_authorizations/. Accessed on June 14, 2016.

58. http://www.faa.gov/uas/media/RIN_2120-AJ60_Clean_Signed.pdf. Accessed on July 8, 2016.

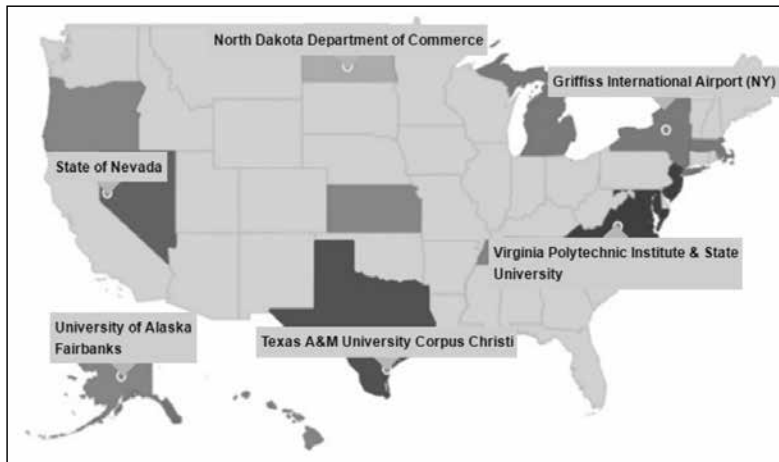
59. “Becoming a Pilot,” https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/. Accessed on September 7, 2016.

60. https://www.faa.gov/uas/legislative_programs/. Accessed on June 14, 2016.

61. “US GAO Report on UAS,” July 2015, <http://gao.gov/assets/680/671469.pdf>. Accessed on May 26, 2016.

62. https://www.faa.gov/uas/legislative_programs/. Accessed on June 14, 2016.

63. “UAS Test Sites Contacts,” https://www.faa.gov/uas/legislative_programs/test_sites/contacts/. Accessed on June 14, 2016.

Fig. 8: Six UAS Test Sites in the US⁶⁴

Focus Area Pathfinders Initiative: The FAA announced the UAS Focus Area Pathfinders Initiative in collaboration with three companies of the industry to explore UAS operations beyond the type of operations proposed in the small UAS operations. These include CNN to look at UAS operations over populated areas for news gathering, Precision Hawk to explore UAS flights outside the pilot's direct vision for crop monitoring and BNSF Railway to explore command and control challenges of using UAS to inspect the rail system infrastructure.⁶⁵

JOINT AUTHORITIES FOR RULE-MAKING ON UNMANNED SYSTEMS (JARUS)

JARUS is a voluntary group comprising experts from the National Aviation Authorities and regional aviation safety organisations. It has 46 countries/organisations as its members, including India. It aims to recommend technical, safety and operational requirements for the certification and safe integration of UAVs into the air space and at aerodromes, which could be used as a guideline while formulating regulations by countries/organisations and avoid duplication of effort.⁶⁶ It has published 10 documents related to

64. http://www.faa.gov/uas/programs_partnerships/coe_test_sites/

65. "Focus Area Pathfinders," https://www.faa.gov/uas/legislative_programs/pathfinders/. Accessed on June 14, 2016.

66. <http://jarus-rpas.org/>. Accessed on June 12, 2016.

UAV operations and has held various conferences on issues related to UAV integration. The European Aviation Safety Agency (EASA) is working in close coordination with JARUS to formulate UAV integration regulations.⁶⁷

EUROPEAN UNION (EU)

The EU has been formulating regulations for the integration of RPAs into the European air space. The EU Regulation (EC) No 216/2008 mandates regulation of civil unmanned aircraft with an operating mass of 150 kg or more.⁶⁸ The EU came up with a roadmap for integration of civil RPAs into the European aviation system in June 2013. The roadmap proposes a three-pronged approach involving a regulatory approach, a strategic research plan and a study on the societal impact. It envisages:

- Allowing operations of light RPAs between 2014 and 2018,
- Extending RPA operations to all the air spaces under IFR conditions and initiation of VFR operations between 2019 and 2023.
- Full integration between 2024 and 2028.⁶⁹

The European Union came up with “Riga Declaration” on March 6, 2015, which committed to allow businesses to provide drone services in all Europe from 2016 onwards.⁷⁰ EASA published a “Technical Opinion” in December 2015 for integration of UAVs in the segregated/non-segregated air space, which is based on the degree of risks involved and does not discriminate between UAVs of different Maximum Take-off Weight (MTOW). The paper proposes a regulatory framework for performance and risk-based UAV operations in the following three categories:

- “Open Category” (low risk) permits UAV operations subject to meeting the minimum requirements.

67. “Regulations,” <http://jarus-rpas.org/regulations>. Accessed on June 12, 2016.

68. Regulation (Ec) No 216/2008 of the European Parliament and of the Council dated February 20, 2008, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02008R0216-20130129>. Accessed on June 10, 2016.

69. http://www.sesarju.eu/sites/default/files/documents/news/European-RPAS-Roadmap_130620.pdf?issuusi=ignore. Accessed on June 10, 2016.

70. “Riga Declaration on Remotely Piloted Aircraft (Drones) Framing the Future of Aviation,” on March 6, 2015, <http://ec.europa.eu/transport/modes/air/news/doc/2015-03-06-drones/2015-03-06-riga-declaration-drones.pdf>. Accessed on June 10, 2016.

- “Specific Category” (medium risk) allows operations subject to authorisation by the National Aviation Authority (NAA).
- “Certified Category” (higher risk) UAV operations are subject to approvals by NAA and EASA.⁷¹

EASA aims to come up with new rules or amend existing rules during 2016 and 2017 in order to move forward towards integration of the UAVs in the European air space.⁷² The EU has come up with Innovative Operational UAS Integration (INOUI) under the Single European Sky programme to facilitate UAS integration in the future air traffic management environment.⁷³

INDIA

The Director General of Civil Aviation (DGCA) is India’s civil aviation body which is responsible for formulation of regulations for integration of UAVs in the Indian air space. DGCA had banned launching of UAVs in the Indian air space by non-government agencies and individuals in October 2014 due to security threats and lack of regulations.⁷⁴ It subsequently came up with a draft circular titled “Guidelines for Obtaining Unique Identification Number (UIN) and Operation of Civil Unmanned Aircraft Systems (UAS)” in April 2016 for comments from the public. The final circular is awaited and the implications are discussed subsequently in the paper.⁷⁵

WHY FULL INTEGRATION MAY TAKE LONGER

Full integration of UAVs in the non-segregated air space is the ultimate goal of UAV designers and air space regulators. In order to do that, the UAV would need to have, firstly, the capability to fly accurately and safely in IFR

71. “Introduction of a Regulatory Framework for the Operation of Unmanned Aircraft,” <https://www.easa.europa.eu/document-library/opinions/opinion-technical-nature>. Accessed on June 10, 2016.

72. “Civil Drones (Unmanned Aircraft),” <https://www.easa.europa.eu/easa-and-you/civil-drones-rpas>. Accessed on June 10, 2016.

73. http://ec.europa.eu/transport/modes/air/studies/doc/ses/2010_inoui.pdf. Accessed on June 10, 2016.

74. http://dgca.nic.in/public_notice/PN_UAS.pdf. Accessed on June 12, 2016.

75. [http://www.dgca.nic.in/misc/draft%20circular/AT_Circular%20-%20Civil_UAS\(Draft%20April%202016\).pdf](http://www.dgca.nic.in/misc/draft%20circular/AT_Circular%20-%20Civil_UAS(Draft%20April%202016).pdf). Accessed on June 12, 2016.

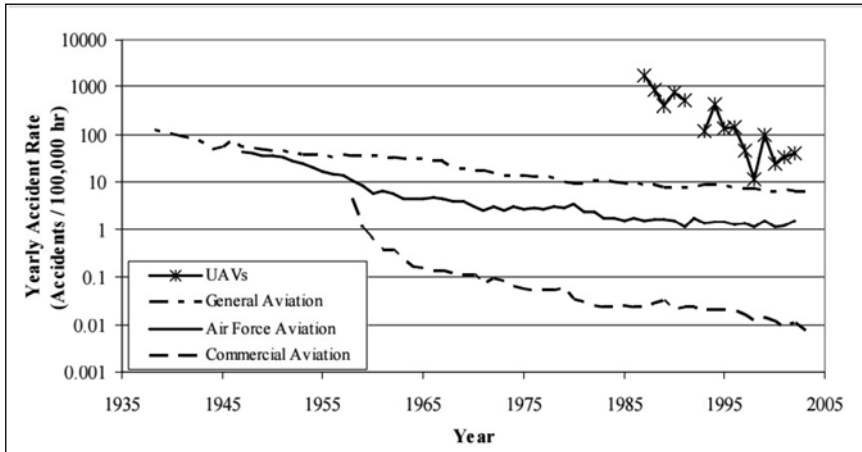
and VFR conditions in the non-segregated air space; secondly, capability to identify conflicting traffic using EO, IR sensors, radars or any other means, and take evasive measures autonomously; thirdly, to safely operate in hazardous weather or meteorological conditions; and fourthly, to protect itself from obstacles during flying. The integration of UAVs in the non-segregated civil air space is likely to be subjected to tougher certification and regulatory norms as civil regulatory bodies are extremely sensitive to accident rates, dangers of collision and possible exploitation of UAVs and sensors by hacking of data links. Therefore, it would be prudent to analyse the extent of progress made in developing the essential technologies and in regulation formulation to understand the level of integration achieved, and estimate the future of integration of UAVs.

ACCIDENT RATE: CONCERNS AND HOPE

The reliability of an airborne platform can be judged from its accident rate. The CRS report for the US Congress on “US Unmanned Aerial Vehicles” dated January 3, 2012, indicated a declining accident rate among both manned and unmanned aircraft with maturing of technology, improving reliability and better regulatory mechanisms.⁷⁶The comparative accident rate for both manned aircraft (general aviation, air force aviation and commercial aviation) and UAVs for the time period from 1935 to 2005 is as follows:

76. Jeremiah Gertler, “US Unmanned Aerial Systems,” January 3, 2012, <http://www.fas.org/sgp/crs/natsec/R42136.pdf>. Accessed on May 30, 2016.

Fig. 9: Comparison of Accident Rate⁷⁷



The accident rate (per 100,000 hours) of class A mishaps of some of the unmanned and manned aircraft of the US is given below:

Fig. 10: Accident Rates of Manned and Unmanned Aircraft

Class A Accident Rate*	Unmanned					Manned	
	Predator	Hunter	Global Hawk	Pioneer	Shadow	U-2	F-16
As of 2005	20	47	88	281	191	6.8	4.1

Class A Accident Rate*	Unmanned	
	Predator	Reaper
As of 2009	7.5	16.4
As of 2014 ⁷⁸	4.79	3.17

*The USAF defines a Class A mishap as a mishap which results in losses totalling \$2,000,000 or more, or fatality/ permanent disability or destruction of aircraft.⁷⁹

77. Roland E. Weibel and R. John Hansman, "Safety Considerations for Operation of Unmanned Aerial Vehicles in the National Airspace System," March 2005, <http://dspace.mit.edu/bitstream/handle/1721.1/34912/Weibel%20-%20ICAT%20Report%20-%20UAV%20Safety.pdf?sequence=1>. Accessed on June 3, 2016.

78. Craig Whitlock, "When Drones Fall from the Sky," June 20, 2014, <http://www.washingtonpost.com/sf/investigative/2014/06/20/when-drones-fall-from-the-sky/>. Accessed on June 20, 2016.

79. <http://www.afsec.afmil/shared/media/document/AFD-150116-044.pdf>. Accessed on May 31, 2016.

The level of automation, bandwidth limitation and security of data links are the other key areas where technology would play a key role to overcome these limitations/ challenges.

The accident rate variation of manned aircraft with time has some parallels with the UAVs. The above study indicates that the accident rate in manned aircraft was very high during the period 1935 to 1955. It dropped to below 1/1,00,000 hours in 1960. Thereafter, the accident rate continued to drop further to very low level (1 for air force aviation and 0.01 for commercial aviation) in the following five decades.

The accident rate of UAVs was also high during the initial phase and it has seen a decline with the passage of time. It reduced from over 1,000 in 1985 to about 70 in 2004. The accident rate of the Predator UAVs of the US had dropped from 20 in 2005 to 7.5 in 2009, while the accident rate of its latest UAV Reaper was 16.9 in 2009. The *Washington Post* had reported on June 20, 2014, that the accident rate of the Predator and Reaper UAVs had further reduced to 4.79 and 3.17 respectively.⁸⁰ The accident rate of UAVs is still higher than that of manned aircraft, which is a major concern. However, the silver lining lies in the fact that accident rate of UAVs is coming closer to that of manned aircraft due to improvements in designs, enhanced survivability in adverse weather and increased reliability. The reduction in the accident rate of UAVs is a good sign; however, it would have to be brought down further to facilitate smooth integration of UAVs.

TECHNOLOGY: STILL A CHALLENGE

DARPA had successfully tested the ALIAS sense and avoid equipment (which is a light weight plug and play system with single camera and passive ranging features) in May 2016, as it is considered essential to facilitate the integration of UAVs. However, this system could prove ineffective in identifying other flying objects during clouding, poor visibility, or at night. Therefore, follow-on research would be needed to develop a system which is capable of detecting aircraft below the horizon and in poor light

80. n.78.

conditions.⁸¹ The effectiveness of the ADS-B system in the present form could be limited since its pilot cannot physically see and identify the approaching threat. The EU is developing the MIDCAS to overcome the limitations of the ADS-B by adding EO and IR sensors.

The GBSAA appears to be having relatively short range and could be used for detecting aircraft flying at low to medium altitudes since it consists of light weight portable radar/s. It would provide an alternative to meet the sense and avoid capability requirement by providing traffic information to the UAV operator for maintaining separation from other manned and unmanned aircraft. However, the GBSAA operator does not have contact with manned aircraft, which would increase the complexity of the air traffic control system. Also, there is a need to ascertain the effectiveness and reliability of the radar, data fusion and radio communication (voice) link among the GBSAA operator, UAV pilot and ATC controller.

The level of automation, bandwidth limitation and security of data links are the other key areas where technology would play a key role to overcome these limitations/ challenges. The level of automation is still low and trials are being conducted to test the efficacy and reliability of collision avoidance systems. The security of data links is still a concern and the technology being developed is not yet fool-proof. The bandwidth limits the number of UAVs that can fly in a given area of operation or data that can be exchanged and this continues to be a challenge for researchers. Efforts are on to increase encryption as well as to find hardware solutions to protect data links.

The US is making endeavours to overcome the technological challenges hampering the integration of UAVs into the NAS. The FAA's collaboration with Mississippi State University to set up a Centre of Excellence for UAVs with NASA for setting up of six test sites, and with industry for the Focus Area Pathfinder Initiative, are the best examples of collaboration among the US government, R&D agencies, industry and academia to undertake core research in developing futuristic UAV related technologies and retaining lead in the technological arena. The earmarking of test sites would facilitate in testing of critical technologies and using the experience gained and test

81. n.27.

data generated as the basis for formulation of regulations to facilitate UAV integration.

REGULATIONS: A CAUTIOUS AND SLOW INTEGRATION

ICAO has made slow progress in formulating regulations since the setting up of the Unmanned Aircraft Systems Study Group (UASSG) in 2007 and Remotely Piloted Aircraft Systems Panel (RPASP) in 2014. Publication of Circular 328 in 2011, Manual of RPAS in 2015 and amendment of three out of 18 Annexures indicates the slow pace of formulation of the regulatory framework. The setting up of working groups to address issues related to airworthiness, telecommunication for command and control and air traffic control, Detect And Avoid (DAA), personnel licensing, RPAS operations and air traffic management indicate unresolved critical areas needing further research and deliberations.⁸² ICAO's plan to complete only two SARPs for air traffic management and "detect and avoid" requirements for unmanned aircraft by 2020 indicates the difficulties being faced in the finalisation of regulations.⁸³ All the SARPs have to be completed to facilitate integration of RPAS into the non-segregated air space.

The US was proactive in allowing limited UAV operations despite technological limitations. The FAA came up with a notice for registration of small UAS in December 2015 which was followed by the publishing of rules to allow routine civil operations of small UAS in the NAS, vide Rule 107 to Title 14 Code of Federal Regulations (14 CFR) dated June 21, 2016.⁸⁴ In the meantime, the FAA had issued a certification of waiver to over 5,300 applicants for operation of UAS in the NAS by June 2016, which indicates the willingness of the US government to allow civil UAS operations on a case by case basis. The deployment of UAS in the Arctic by the US on a 24-hour basis appears to be aimed at utilising the unique capabilities of UAS for furtherance of strategic, scientific and business interests in a common

82. <http://www.icao.int/MID/Documents/2016/RASG-MID5/PPT3%20-%20RPAS%20Elie.pdf>. Accessed on June 9, 2016.

83. <http://www.eurocontrol.int/news/icao%E2%80%99s-rpas-manual-issued>. Accessed on June 9, 2016.

84. "Operation and Certification of Small Unmanned Aircraft Systems," June 21, 2016, http://www.faa.gov/uas/media/RIN_2120-AJ60_Clean_Signed.pdf. Accessed on July 8, 2016.

international region (a global common). The abundant resources, unique climate and geographical location of the Arctic offer enormous opportunities for scientific research. The US is likely to benefit economically from the abundance of natural resources available in the Arctic. However, the US government, despite being proactive in allowing small UAS operations, was unable to make a five-year roadmap for full integration of UAS in the NAS by end 2015, which was proposed in the FAA Modernisation and Reform Act, 2012. The FAA is cautious in its approach in integrating medium and heavy UAVs in the NAS as some of the critical technologies are yet to be developed/ matured.

The EU roadmap for civil RPAS integration envisages an incremental approach with full integration of RPAS to be achieved during the time period 2024-28. The Riga Declaration on RPAS indicates efforts by the EU countries to harness the tremendous business opportunities presented by this futuristic technology. The publication of the technical opinion instead of the draft regulation and proposing risk-based operations by the RPAS is an indicator of the limitations of the existing technologies and urgency among the EU countries to facilitate integration of RPAS in the civil air space.

INTEGRATION OF UAVs IN THE INDIAN AIR SPACE

Regulations

The Director General of Civil Aviation of India publishing a draft circular titled “Guidelines for Obtaining Unique Identification Number (UIN) & Operation of Civil Unmanned Aircraft System (UAS)” on April 21, 2016, shows the willingness of the Indian government to allow UAV operations in the Indian air space. The circular had guidelines for obtaining a Unique Identification Number (UIN) for UAVs, the procedure for allotment of UA permits to UA pilots meant for operations above 200 ft above ground level (a.g.l.) and guidelines and restrictions for the operation of UAVs. The draft circular does not include guidelines for certification and operation of UAVs since SARPs in Annexure 6 (Operations) and Annexure 8 (Airworthiness) on UAS are not available.

The draft circular is likely to undergo an internal review to incorporate suggestions/ comments received from the public before DGCA comes up with a circular for the operation of civil UAVs. The requirement of safety of manned aircraft and people on the ground while facilitating the operations of UAVs is a contradictory requirement for air space regulators. The regulations should be neither too restrictive to hamper exploitation of UAVs nor too loose to become a safety and security hazard. Therefore, it would be prudent to take a closer look at the provisions of the draft circular before they become a rule. There may be a need to review some of the clauses of the draft circular or include some aspects for harnessing the unique capabilities of UAVs.

AIR SPACE MANAGEMENT

At present, the operations of UAVs belonging to the military, paramilitary, disaster management and other government agencies are allowed in the segregated air space in India. The operation of civil UAVs remains banned since October 2014. However, special permissions are granted for operation of UAVs by the respective state or government agencies for specified tasks within a specified area for a given period of time. Draft regulations for the operations of UAVs were placed in the public domain in April 2016 for comments/views. The final rules, when published by the DGCA, would, in all likelihood, make it mandatory to register small UAVs, and their operations could be permitted in segregated areas having less air traffic density, with enhanced separation from manned aircraft. The UAVs would be required to obtain air defence and security clearance from the nearest airfield and local administration respectively.

Increased reach of the civil manned aircraft and helicopters has already reduced the availability of the military air space in India. With flexible use of air space, civil aircraft are being permitted use of military air space in certain block timings or height bands. The proliferation of UAVs in the already constrained air space of India is likely to pose new challenges for air space management. The added security concerns related to ensuring physical security of military and civil UAVs' ground stations, preventing exploitation of civil UAVs by anti-national elements, monitoring the movement of small

civil UAVs, preventing collision, and maintaining separation from other manned/ unmanned aircraft would further complicate the air space and security scenario in the years to come.

CIVIL-MILITARY INTEGRATION

Research and development is an essential aspect of capability development. The civil aviation authorities of the leading countries have research programmes.⁸⁵ India's research programmes are generally dedicated towards developing military aviation platforms and associated systems. The Indian civil aviation sector, which includes civil aircraft and civil air traffic management systems like air traffic surveillance and approach radars, runway aids, etc., has not been viewed as a strategic sector for 'Make in India' or for indigenisation. There is no known programme to design and develop enabling systems like ground-based collision avoidance and traffic separation systems/ ground-based radars to facilitate integration of UAVs in the non-segregated air space in India. Also, key stakeholders in civil aviation, i.e. Ministry of Civil Aviation (MoCA) and Director General of Civil Aviation (DGCA) have traditionally not been undertaking research and development of traffic separation and air traffic management systems required for the integration of UAVs in the Indian air space as research and development is not included in the functions of the Civil Aviation Ministry.⁸⁶ Also, the Research and Development Directorate of the Civil Aviation Department was renamed as Aircraft Engineering Directorate on November 3, 2009.⁸⁷

There is a need to initiate measures, which would encourage research to support indigenous design, development and testing of UAVs and associated systems for both military and civil users in the final DGCA circular.⁸⁸ The Technology Development Board of the Ministry of Science and Technology

85. <https://www.faa.gov/nextgen/equipadsb/research/>. Accessed on July 14, 2016

86. "Functions Alloted to the Civil Aviation Ministry," June 23, 2014, http://civilaviation.gov.in/sites/default/files/6_0.pdf. Accessed on September 7, 2016.

87. <http://dgca.nic.in/dgca/publicnotice%20R&D0-AED.pdf>. Accessed on September 7, 2016.

88. "Guidelines for Obtaining Unique Identification Number (UIN) and Operation of Civil Unmanned Aircraft System (UAS)," April 21, 2016, [http://www.dgca.nic.in/misc/draft%20circular/AT_Circular%20-%20Civil_UAS\(Draft%20April%202016\).pdf](http://www.dgca.nic.in/misc/draft%20circular/AT_Circular%20-%20Civil_UAS(Draft%20April%202016).pdf). Accessed on June 22, 2016.

(S&T) supports technology initiatives, including the ones for the defence and civil aviation and air transportation sectors. Bharat Electronics Limited (BEL) has developed Coastal Surveillance Radars, C-Band and S-Band Polarimetric doppler weather radars for civil uses and a wide variety of radars for the Indian armed forces. There is need to utilise the expertise of BEL in developing radars for use in civil airports.⁸⁹ The laboratories of the Ministry of S&T and BEL, in collaboration with MoCA, could consider developing air traffic surveillance and approach radars for providing traffic separation and collision avoidance to UAV traffic. The armed forces are the largest users of UAVs and have vast experience of operating UAVs in varied terrains. They could contribute significantly in the design and development of UAVs, associated airborne and ground control technologies and in the formulation of regulations. The potential of academia and industry could be exploited to undertake studies/ research and development of technologies necessary for the integration of UAVs. India's DRDO carries out research to develop military UAVs/UCAVs and associated technologies such as automation, airborne EO/IR sensors and for improving the security of data links. It could consider developing technologies like LIDAR, equipment similar to ADS-B/MIDCAS, airborne radar for collision avoidance, airborne internet protocol/peer-to-peer communication systems to facilitate integration of UAVs. The integration of UAVs in the Indian air space also needs to be included in the Civil Aviation Ministry's strategic plan.⁹⁰ The MoCA, Ministry of S&T, MoD, DGCA, HAL, DRDO, industry and academia could play important roles in the development of technologies associated with the integration of UAVs in the non-segregated air space.⁹¹

CONCLUSION

Unmanned Aerial Vehicles (UAVs) have enormous potential for military and civil industrial applications; however, their integration in the non-

89. "Civilian Radars," <http://www.bel-india.com/Products.aspx?MIId=14&LIId=1&link=83>. Accessed on September 7, 2016.

90. "Strategic Plan, Ministry of Civil Aviation 2010-2015," http://www.civilaviation.gov.in/sites/default/files/mocaplan_0.pdf. Accessed on July 9, 2016.

91. "Technology Development Board," <http://tdb.gov.in/our-objective/#>. Accessed on July 9, 2016.

segregated air space is a challenge. The push for formulating a regulatory framework for integration of UAVs in the non-segregated air space has been driven by two major factors: one, the increasing economic potential of UAVs in the civil industry as is evident from the Riga Declaration by the EU; two, enhanced capability and disproportionate advantage of UAVs/UCAVs in certain combat/non-combat roles. However, the integration of UAVs is dependent on the development of certain enabling technologies. The safety of manned aircraft, people on the ground, and the possibility of take-over of UAVs by terrorists/ adversaries by hacking into the UAVs' data links are concerns for air space regulators and security agencies. There is a need to improve the reliability of unmanned platforms, develop airborne 'sense and avoid'/collision avoidance systems, traffic separation systems and enhance the security of data link systems.

ICAO, USA and EU have led the development of UAVs and associated technologies. The USA has published rules for operations of small civil UAVs in June 2016. It had issued over 5,300 licences to civil UAV operators during the period July 2013 to May 2016. ICAO came up with its first edition of the Manual on Remotely Piloted Aircraft Systems (RPAS) (Doc 10019-AN/507) in 2015, and the EU too is moving in the same direction. Similarly, many other countries – including China – have allowed operations of small civil UAVs in their national air space with certain safety restrictions. The operation of bigger UAVs in the non-segregated air space is essential to achieve full integration, which would depend on improving the reliability of UAVs and developing enabling technologies.

The US and EU have addressed the issue of full integration of UAVs at two levels: firstly, by undertaking research to develop critical enabling technologies like airborne and ground-based sense and avoid systems, security of data links, increasing automation, etc. to overcome technological challenges; and, secondly, by formulation of a regulatory framework for the integration of UAVs. The significant aspect of their technology development and regulation formulation has been collaboration among the government, Department/ Ministry of Defence, industry, academia and civil aviation regulatory authority. In the case of the EU, many countries have come together

The issue of a draft circular by the DGCA is a welcome initiative; however, development of certain technologies – and regulatory support thereof for developing UAV capability indigenously – and integration of UAVs in the non-segregated air space would need urgent attention for optimum exploitation of the potential of these unique flying machines.

to develop critical technologies and propose regulatory frameworks which are considered essential for the integration of the UAVs in the non-segregated air space.

The issue of a draft circular by the DGCA is a welcome initiative; however, development of certain technologies – and regulatory support thereof for developing UAV capability indigenously – and integration of UAVs in the non-segregated air space would need urgent attention for optimum exploitation of the potential of these unique flying machines. The Ministry of Civil Aviation needs to consider revival of the Directorate of Research and Development and pursue

development of enabling technologies to facilitate integration of UAVs in the non-segregated air space. The collaboration among various stakeholders, i.e. MoCA, MoD, Ministry of S&T, Ministry of Home Affairs (MHA), DGCA, DRDO, armed forces, HAL, industry and academia is essential to address the technological and regulatory challenges being faced in the integration of UAVs in the non-segregated air space.

Some breakthroughs have been achieved in developing critical technologies; however, they are at a nascent stage and would have to mature before they can be employed for operational use. These technologies need to undergo rigorous testing, and trials and data related to their operational use would have to be generated over a period of time for verification and further improvements. The success of some of these technologies is essential for the integration of UAVs in the non-segregated air space.

The progress in the formulation of a regulatory framework has been gradual and only small civil UAVs have been granted clearance to operate on a case-by-case basis by some countries. UAVs are currently operating in the segregated air space. Some of the SARPs – including the ones for certification

and operations of UAVs – have not been finalised. Therefore, full integration of UAVs in the non-segregated air space is not likely to take place in the near future till the essential enabling technologies mature. However, partial integration of UAVs in the non-segregated air space should be feasible as soon as there is reasonable confidence in at least some of the enabling technologies supported by improvements in the reliability of the UAV platform and security of command and control links. During this phase UAV flights could be allowed to operate with manned aircraft by providing greater separation between UAVs and other manned traffic and by keeping UAV traffic under positive radar surveillance and ATC control.

Full integration of UAVs in the non-segregated air space is not likely to take place in the near future till the essential enabling technologies mature.

EVOLUTION OF IAF HELICOPTERS – I: *INCEPTION TO 1971 OPERATIONS*

BS NIJJAR

BIRD, AEROPLANE AUTOGYRO HELICOPTER

Humankind's obsession with flying is well documented with it being mentioned in ancient Indian (*Pushpak Vimana*¹) as well as Greek mythological (flight of the Icarus and the legend of Pegasus²) texts. However, the earliest documented flight by any human was in November 1783, in a balloon.³ The human endeavour was not satisfied with the flight in a balloon and, thus, efforts to overcome the limitations of the balloon continued which ultimately resulted in the first flight by the Wright Brothers in the year 1903.

Indians were no different from people in the rest of the world in their understanding of the limitless opportunities of flying. Their dreams of flying like a bird came closer to being fulfilled with the arrival of the first aeroplane in a crate to Karachi harbour in December 1910.⁴ The arrival of this aircraft, followed by displays all over India, motivated many Indians, mainly the rich, to fulfill their dreams of flying in a *vimana* or an aeroplane, and many went ahead and did just that.

Thus, the airplane arrived on the Indian shores in 1910 and by the beginning of World War I, there were many Indians who had set their eyes

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1. Hindu Wisdom, "Vimanas", www.hinduwisdom.info/Vimanas.htm. Accessed on April 12, 2016.
2. ICAO, "Aviation History: The Desire to Fly in Mythology", www.icao.int/secretariat/PostalHistory/aviation_history_the_mythology.htm. Accessed on April 12, 2016.
3. Aeragon.com, "Balloons", www.aeragon.com/air/bal/index.html. Accessed on April 12, 2016.
4. Somnath Sapru, *Combat Lore: Indian Air Force 1930-45* (New Delhi: KW Publishers, 2015), p.3.

The earliest surviving sketch of a helicopter is attributed to Leonardo da Vinci, who, in 1463, converted the scientific work done by Archimedes and applied it to the medium of air.

on becoming pilots. This resulted in many of them being commissioned as pilots in the Royal Flying Corps (RFC), as it was called then. The demand of the Indians to be allowed to serve as officers in the RFC as early as 1911, just seven years after the invention of the aeroplane by the Wright Brothers in the year 1903, was fulfilled during World War I.

However, the flight so achieved by the aircraft invariably necessitated attaining a certain speed on the ground before getting airborne. Hence, the human obsession was not satiated as it was still not possible to do what birds could. Man wanted to soar in the sky, fly in all directions at will and land, but most importantly, wanted to take off and land vertically. Many of them may have recognised this to be a safer option also, as they would have seen most of the accidents that occurred on the fixed-wing aircraft during the landing or take-off phases when the aircraft was moving in contact with the ground. Therefore, efforts continued to achieve a true form of flying which would enable man to fly in any desired direction at will.

It was complicated and the earliest work on the principle of rotary thrust was done by Archimedes, as early as the second century BC when he had used it to transfer water from a lower to a higher elevation. The earliest surviving sketch of a helicopter is attributed to Leonardo da Vinci, who, in 1463, converted the scientific work done by Archimedes and applied it to the medium of air. Subsequent efforts failed mainly on account of lack of a suitable power plant.⁵ The effort took a back seat after the invention of the aeroplane, but for some, the dream and efforts continued. Much later, on January 9, 1923, it was the autogyro, which came closest to being called a helicopter, was first flown. The autogyro was characterised by an extremely short take-off and landing run owing to a freely rotating rotor which was able to share the aerodynamic load of its wings.

5. Mark Lloyd, *The Guinness Book of Helicopter Facts & Feats* (UK: Guinness Publishing, 1993), p.8.

However, it was in Nazi Germany that the world's first helicopter, the Focke Achgelis Fa-61 took off for its first flight in 1936.⁶ By 1941, its subsequent models, the Fa 223 Darche (dragon) and the smaller Flettner Fl 282, were being used by the Germans to transport senior officers, carry equipment between ships and perform reconnaissance and artillery spotting duties.⁷

Thus, the age of the helicopter began some thirty years after the first fixed-wing flight in 1903 and is indicative of the complex nature of the machine for which a lot of solutions were to

be found. Post World War II, however, saw the Fa-61 team shifting base to France where they continued their work. Once the initial hurdles were overcome, further developments were at a rapid pace and their potential was soon realised by the American military also which found ways to utilise the unique abilities of the platform. It was not long before the helicopters arrived in India and the Indian Air Force (IAF) personnel were exposed to both the American way of working, as well as the helicopters being operated by the American commandos in their special operations.

Thus, the age of the helicopter began some thirty years after the first fixed-wing flight in 1903 and is indicative of the complex nature of the machine for which a lot of solutions were to be found.

HELICOPTERS IN THE INDIAN SKY: THE FIRST HELICOPTER COMBAT RESCUE

One of the significant events shaping the outcome of the Burma Campaign against the Japanese came with the involvement of the Americans in the form of the American First Air Commando Group (1st ACG) initiated by Gen Henry 'Hap' Arnold, commanding officer of the United States Army Air Force (USAAF) after his interaction with Col Orde Wingate of the "Chindits" fame in 1943. The general was appalled by the stories of wounded troops being left behind on the first Chindit operation. The 1st

6. Ibid., p.14

7. Robin Cross, *History of War: 50 Events you Really Need to Know* (London: Quercus Editions Ltd., 2012), p.176.

ACG was, thus, formed with the purpose of supporting Wingate with a wide mix of aircraft specifically chosen for the task. The aircraft, in addition to 25 transports (C-47 and C-46), 225 gliders, 100 light aircraft, Mustangs and 12 Mitchell medium bombers, included four YR-4B helicopters.⁸ One of these was also used for the first ever combat rescue. It was used to rescue three British soldiers on board an L-1B aircraft, which had come down 100 miles behind enemy lines in Burma after being hit by ground fire on April 21, 1944. The helicopter was ferried from its base at Lalaghat to a forward base at Taro and onto Aberdeen (a temporary airstrip created in Burma) along a circuitous route of over 500 miles by Lt. Harman, with multiple refuelling stops. He reached the crash site on April 25, 1944, to pick up the first of the wounded, and ferried casualties one by one to the nearest fixed-wing landing site. This was also the first time Indian IAF aviators operating in the region interacted with their “easy going” American counterparts. By this time, they had sufficient combat experience and knew the perils of baling out over jungle terrain.

Having seen such a rescue effected by the 1st ACG, they also understood the significant increase in the chances of survivability accorded by airborne rescue specialists and the significance of having own airborne transport assets. This gets reflected in the procurement plans in the post independence defence organisation when these were being prioritised in the aftermath of the post partition division of military assets.

POST-INDEPENDENCE: HELICOPTERS AND RIAF

Post independence, Royal Indian Air Force (RIAF) assets were divided between India and Pakistan. Subsequently, the discussions and evaluations of military requirements continued and many of these requirements were discussed by the army, navy and air force chiefs at the Chiefs of Staff Committee (COSC) meetings.

During one such discussion during the COSC meeting held on April 5, 1949, it was generally accepted that helicopters could be adopted to great

8. Peter Preston-Hough, *Commanding Far Eastern Skies: A Critical Analysis of RAF Air Superiority Campaign in India, Burma & Malaya* (England: Helion & Company Ltd., 2015), p.28.

advantage by the defence Services. The term 'generally' indicates a consensus among the three Services and is also indicative of the fact that the Services were aware of the developments taking place the world over in the field of helicopters. Therefore, in order to formalise the proposal, a Joint Planning Sub-Committee was tasked to study the proposal.

The Joint Planning Sub-Committee composed of Brig (later Field Mshl) SHFJ Manekshaw of the Indian Army, Lt Cdr N Krishnan of the Indian Navy and Wg Cdr M.S Chaturvedi of the RIAF was formed with a specific purpose to examine the proposal for establishing such a flight and to ascertain the approximate cost of the formation of a helicopter flight. The sub-committee evaluated the requirements and submitted a report on July 4, 1949, which was considered at the COSC meeting on July 7, 1949. The recommendations which appear to have been accepted by the COSC were:

- The formation of the flight to be postponed till marked improvements in the design and maintenance of helicopters are made by the manufacturing countries.
- In view of the limited financial resources available to the defence Services at the time, the question of formation of a helicopter flight to be considered in relation to the allocation of the priorities for the expansion programme of the Services as a whole.

Hence, the proposal which included acquisition of a total of four helicopters, including one reserve, was put on hold mainly due to resource constraints and the setting of priorities.

Further, in 1949, Air Headquarters (Air HQ) had recommended an expansion of the RIAF to a 20 squadron strength. This was in response to the threats against which the government had instructed the Air HQ to plan, and be prepared for. This proposal mainly concerned fighter aircraft and one transport squadron.

Post January 26, 1950, when India had become a republic and the 'Royal' epitaph was removed from the RIAF, the Defence Committee of the Cabinet (DCC), on September 14, 1951, approved the raising of a second transport squadron, bringing the sanctioned strength of IAF squadrons to 11. The

helicopter was still relatively low on the priority list, probably owing to the prevailing political and security environment.

In May 1950, as the relations between India and Pakistan became strained, as a part of an emergency measure codenamed “Operational Plan Shikar”, approval was given to raise the strength of the squadrons to 15. It was emphasised that it was only an emergency measure. This was maintained at around 14.5 squadron strength till December 1952, when the proposal for a permanent expansion with a timeline commencing in Financial Year (FY) 1953/54 to FY 1957/58 was proposed by the IAF and in which the helicopters did find a mention.

For the first time, this plan included the raising of one helicopter flight of Sikorsky S.55 helicopters. The proposal was to purchase three helicopters against the requirement of five. Despite objections by the Finance Ministry, the DCC, on December 27, 1953, approved the planned expansion with the revised target date of the operation squadrons reaching their full strength as March 31, 1957, instead of the proposed March 31, 1958.⁹

Hence, it took close to four years for the original proposal to be reinitiated and approved. The original proposal had acknowledged that the helicopter might be particularly useful in view of the poor state of communications and the difficult terrain over which the forces may be called upon to operate. Between 1949 and 1952, there were major geopolitical changes which had taken place. The Americans who had assisted the Chinese during World War II were having a major faceoff with them in the Korean peninsula. India, on its part, was also affected by the events within its neighbourhood.

INDIA AND THE KOREAN WAR

In 1950, there were major changes occurring in the geopolitical situation the world over with the major one being the confrontation between the United States of America (USA) and the Chinese, known as the Korean War. India refused to be drawn into the war despite the efforts of the USA and stuck to the “non-aligned” principle. India, however, played the role of a sort of

9. History Cell, Ministry of Defence, GoI, “Experience of Air Force and Air Force Matters”, File No. 601/14513/H

go-between, between the Americans and the Chinese and sent a contingent of the 60 Para field medical regiment to help the American forces.

During this war, the Americans had improved upon the lessons learnt in utilising the helicopters post World War II and perfected the helicopter utilisation for what is now known as Combat Search and Rescue (CSAR). In many cases, the time between the ejection and picking up of a casualty was reduced to minutes. It was also an operational necessity as the water temperatures were dangerously low.

The American forces also utilised helicopters for Casualty Evacuation (Casevac) duties, the reports of which were available to the Indian military planners due to the presence of its own personnel who would have been a part of many such Casevac missions.

Hence, it was the effective use of the helicopter during the Korean War which was a factor governing the decision for induction of the helicopter into the Indian armed forces. However, by this time, some of the spirited aviation enthusiasts in India had already introduced helicopters in the civil sector.

CIVIL AVIATION: HELICOPTER FLYING

The civil sector had already taken a lead and imported its first helicopter, the Hiller UH12B. The first Commercial Helicopter Pilot Licence (CHPL) was awarded to Capt Rustom C Captain in 1953. He even flew the then Prime Minister Jawaharlal Nehru and the home minister of Bombay state from Nariman Point to Vaitrana dam in late 1953. Thus, the Indian political leadership of the time was introduced to this versatile machine and the requirement of helicopters by the IAF was deemed to be inescapable and it was decided to induct a passenger helicopter which could be used in multiple roles and also meet the civil aviation certification criteria.

THE FIRST HELICOPTER PIONEERS¹⁰

As per the plan formulated and approved by the DCC on December 27,

10. History Cell, Ministry of Defence, GoI, "104th Helicopter Unit", File No. Air/HU/254/H Period September 1954-December 1960, Form-1500s.

The first Sikorsky S.55 helicopter, with the tail number IZ-648, arrived in India on March 19, 1954. This was followed by inductions of the IZ-649 and IZ-650 on September 21, 1954, and December 24, 1954, respectively.

1953, the first helicopter flight christened No.104 Helicopter Flight (HF) was formed on March 10, 1954, at 3 Wing (Wg) Palam with Flt Lt A N Todd (3364) GD (P) as the first Commanding Officer (CO). Orders for the Sikorsky S.55 helicopters were, however, placed in early 1954.¹¹ One of possible factors governing the decision to induct the S.55 helicopter being that it was the first transport helicopter to receive type certification by the Civil Aviation Authority on March 25, 1952.¹²

The first Sikorsky S.55 helicopter, with the tail number IZ-648, arrived in India on March 19, 1954. This was followed by inductions of the IZ-649 and IZ-650 on September 21, 1954, and December 24, 1954, respectively.

One of the first tasks for which the helicopter was utilised was the Prime Minister's (PM's) visit to Tilpat on March 28, 1954 for a Fire Power Demonstration (FPD). This was followed by the PM's tour of Uttar Pradesh (UP) on July 8, 1954. Subsequently, the unit was also involved in undertaking the first rescues of Flying Officer (Fg Offr) Sher Karan Singh and Fg Offr Bawa on July 20, 1954 and August 14, 1954, respectively. This was followed by a radiation survey undertaken by Mr D Wadia, adviser to the Government of India (GOI) for atomic research, on September 23, 1954.

One of the earliest examples of the participation by helicopters towards providing Humanitarian Assistance and Disaster Relief (HADR) operations occurred on September 28, 1954, with the rescue of 15 villagers marooned in the Yamuna river. This was followed by a fly-past with the national flags of India and Yugoslavia during the visit of the President of the People's Republic of Yugoslavia Mshl Tito, on December 21, 1954.

Hence, by the time the third helicopter was inducted on December 24, 1954, helicopters had already been utilised for communication, casualty evacuation, radiation surveys, SAR, HADR and air display duties. Their area

11. Chris Smith, *India's Adhoc Arsenal* (UK: SIPRI, Oxford, 1994), p. 235.

12. Sikorsky Archives, "Sikorsky Product History", www.sikorskyarchives.com/S-55.php. Accessed on March 25, 2016.

of operations had also continuously expanded from Delhi, Rajasthan, UP to include Assam and Orissa.

As helicopters were increasingly being utilised for more roles and with the building up of experience, the peculiarities of maintaining a machine which inherently had so many moving parts, came to the fore. Thus, maintaining the machine proved to be different as well as more difficult from the practices being followed for fixed-wing aircraft.

By April 1955, that is within a year of the helicopters' induction, the serviceability of the flight was down to 46.6 percent with two of the three helicopters being Aircraft on the Ground (AOG). This reduction in serviceability started affecting the conversion/continuity training of the pilots, even though only four pilots were held on strength. At the same time, however, the operational demands and tasking on the flight kept on increasing.

On May 11, 1955, the lone serviceable helicopter proceeded to Jorhat for communication duties to assist the civil population of Assam in natural calamities. The operational control was vested with the Assam government, with accompanying instructions that it was not to be utilised for any air force task. Restrictions were imposed in order to ensure effective utilisation of the only serviceable helicopter.

By the end of 1955, helicopters had been extensively utilised for flood relief work in the Assam, Orissa and Punjab sectors and their serviceability further deteriorated. Hence, one of the pilots was posted out to 11 Squadron in February 1956.

This reduction in serviceability was worrisome for the authorities and the maintenance intensive nature of helicopter operations was once again highlighted. The IAF and the maintenance branch were made aware of the pitfalls associated with operating helicopters which required a constant supply of components and adequate logistic support. Subsequently, two helicopters were also involved in accidents in June 1956. The accidents were reported on consecutive days – June 26 and 27, 1956. One of the accidents on the IZ-648 was categorised as Category-Bee (Provisional). The accidents were probably attributable to a combination of factors of inadequate experience

A comprehensive audit of helicopter operations would have highlighted the need to have a training pattern similar to that of the fixed-wing aircraft in which the *ab-initio* training was invariably carried out on an aircraft specifically designed to fulfill training needs, and conserving the flying hours available on a larger helicopter.

as well as maintenance related issues and, thus, investigations into the reasons behind the accidents resulted in the unit temporarily moving from Air Force Station Palam to Air Force Station Kanpur by the end of September 1956. No.1 Base Repair Depot (BRD) was located at Kanpur and better maintenance support was expected.

This decision of involving the BRD proved to be correct and the serviceability improved; the helicopter was utilised extensively in the VIP role by the PM and the minister of defence. However, the same could be sustained only till December 1956 when the serviceability once again was adversely affected and dropped to zero. Flt Lt Todd was also posted back to 11 Squadron and the only engineering officer, Fg Offr Appalawamy, was posted to 3 Wg. With the posting out of the only other pilot to No1 BRD, with effect from February 1957, only Flt Lt SK Majumdar was available in the unit.

A comprehensive audit of helicopter operations would have highlighted the need to have a training pattern similar to that of the fixed-wing aircraft in which the *ab-initio* training was invariably carried out on an aircraft specifically designed to fulfill training needs, and conserving the flying hours available on a larger helicopter. Hence, a survey of the available helicopters to meet the *ab-initio* and conversion training needs resulted in the selection of the Bell 47G, and in 1956, orders for four Bell 47Gs were placed.¹³

Simultaneously, the IAF also invoked the standby option for the additional helicopter, as per the original statement of the case. Accordingly, the fourth aircraft, the IZ-1589, was taken over by the flight on September 18, 1957, and flown to Kanpur by Mr Graham, the test pilot of the Original Equipment Manufacturer (OEM), Sikorsky. In addition, two more Sikorsky helicopters were erected by 104 Helicopter Flight personnel and flown to

13. Smith, n.11, p. 235.

Kanpur in September 1957. These two in all probability were used to build up the unserviceable helicopters to undertake the tasks placed on the unit. Graham also carried out tropical trials for the aircraft, and high altitude trials in Nainital area. This is reflective of the thought process prevailing in the IAF establishment for utilising the helicopter in areas other than the plains and for additional procurements and/or manufacturing. The limitations of the S.55 would have been evident when they were tried for operations at higher altitudes and, consequently, a test pilot was sent by the manufacturer to validate the graphs and other operational parameters for using the S.55 at a higher altitude.

The purchase of the Bell 47Gs was through M/s Pillman Aircraft Company of Bombay. The then Commandant General of the Home Guards of Bombay state, Shri MJB Maneckji, who had a stake in the aircraft company, went to the Bell manufacturing plant in Fort Worth Texas, USA, for the procurement. In addition to taking over the aircraft, he also received training on the type. Incidentally, the Home Guards, which was purely a voluntary body with Maneckji at the helm since May 1949, had their own air wing to motivate the younger generation to take up flying.¹⁴

The Bell 47Gs arrived in India by the end of 1957. Two of the Bell 47Gs on which Flt Lt Majumdar had received some training in Bombay in October 1957, were taken over by the unit on December 26, 1957. One of the first tasks undertaken by these two helicopters was of flood relief in a foreign country. On December 27, 1957, they were taken directly to Ceylon (Sri Lanka) for flood relief operations in a Packet aircraft. These were flown by Flt Lt Majumdar and Mr Maneckji himself for close to a month in Ceylon and the effort was well appreciated in the media. Hence, this was also the first overseas mission flown by IAF helicopters. By this time, India's foreign as well as defence policy was being shaped by the geopolitics of the region and this had an effect on future helicopter procurements.

14. The Directorate of Publicity, Government of Bombay, "Bombay Marches on – A Review of the Work and Activities of the Government of Bombay During the Quinquennium 1946-1951", p. 32, www.dspace.gipe.ac.in/xmlui/bitstream/handle/109373/33592/GIPE-030185.pdf?sequence=2&isAllowed=n. Accessed on April 12, 2016

GEOPOLITICS: INDO-US VS INDO-PAK RELATIONSHIP

In the intervening period of 1949-55, the Indo-US and US-Pak relationships underwent a major change. In 1948, inputs by an outside expert in the form of a famous British physicist PMS Blackett were sought to formulate India's defence policy and to balance the defence expenditure against the planned nation building programme. "The Blackett Report"¹⁵ had a major impact on the state of readiness of the Indian defence forces. Much later, during a press conference to celebrate the silver jubilee of the Defence Research and Development Organisation (DRDO) on January 12, 1984, the Chief Scientific Adviser to the Ministry of Defence (MoD), Dr VS Arunachalam criticised the report as a "ruse" to retard the development of India's indigenous defence capability.¹⁶ Hence, despite the advice of the chiefs of staff, described as "wild" by Mr Blackett, a narrow and circumspect defence policy was adopted by the Cabinet in 1949. This policy, coupled with that of non-alignment, along with initial efforts towards demobilisation of the defence forces and a passive participation in the Korean War, had a major impact on the Indo-US relationship.

The relationship is highlighted by remarks made by US Secretary of State Dulles in 1954, describing the Indian policy of non-alignment to be "an immoral conception". This, coupled with Pakistan fitting into the general scheme of things for containment/encirclement of Russia, resulted in Pakistan signing an agreement with the USA in 1954, which paved the way for military aid to Pakistan. The aid was with a rider that Pakistan cooperate in a regional defence network directed at the USSR. Pakistan readily accepted this and by the end of 1955, it had joined both the Central Treaty Organisation (CENTO) and Southeast Asia Treaty Organisation (SEATO).¹⁷ With military aid now flowing freely to Pakistan in the form of advanced weapon systems and aircraft, a reappraisal of defence procurements by India was initiated as early as 1954.¹⁸ In this, of the three Services, the Indian Navy was able to put forth its case more effectively.

15. Smith, n. 11, p. 48.

16. Ibid., p. 53.

17. Ibid., p. 14.

18. Bharat Kumar, *Unknown and Unsung: Indian Air Force in Sino-Indian War of 1962* (New Delhi: KW Publishers, 2013), p. 83.

The Indian Navy's proposal for two light fleet carriers with a mix of different types of aircraft totalling 117 was approved by the Defence Minister's Committee (Navy) on October 26, 1949, and passed by the Standing Committee of the Parliament on November 13, 1950. The carriers were proposed to be acquired in 1956 and 1959.¹⁹ The Defence Committee of the Cabinet (DCC) finally approved the proposal on April 30, 1956. Accordingly, a refit process, beginning in 1957 with the acquisition of the keel of the "Hercules", resulted in the commissioning of the *Vikrant* into the Indian Navy on March 4, 1961, in Belfast, England. However, these carriers required availability of on-board rescue helicopters for conduct of carrier operations by fixed-wing aircraft.

Hence, en route to India, two Alouettes were loaned to the ship by the French Navy for Search And Rescue (SAR) duties at sea and for carrying out 'plane guard' tasks. These Alouettes, which were on loan, were operated by Indian Navy pilots from May 23, 1961, till October 6, 1961. The experience gained by the naval pilots in closely observing the performance of helicopters being operated by the British and French governed their selection of the Alouette. Further experience gained on the Alouettes on loan from the French Navy greatly influenced the acquisition of a "common helicopter" for the three Services.

The experience gained by the naval pilots in closely observing the performance of helicopters being operated by the British and French governed their selection of the Alouette. Further experience gained on the Alouettes on loan from the French Navy greatly influenced the acquisition of a "common helicopter" for the three Services.

COMMON HELICOPTER?

By 1957, helicopters had carved out a niche for themselves and it was firmly established that the tasks undertaken by a helicopter were an inescapable necessity and this versatile platform was required by all the

19. Satyindra Singh, "Blueprint to Bluewater", <http://indiannavy.nic.in/sites/default/themes/indiannavy/images/pdf/chapter4.pdf>. Accessed on April 6, 2016.

Jointness in the highest decision-making was highlighted when the army chief was said to have spoken to the air chief and thereafter handed over the telephone to the naval representative Cdr Douglas, who then spoke to the air chief and conveyed his views.

three Services. The search, therefore, began for a common helicopter which would meet the requirements of the army, navy and air force. The then Defence Minister Mr Krishna Menon, through the naval chief, deputed Cdr (later Cmde) George Douglas to recommend a helicopter common to all, after liaising with the army and air force.

On approaching the Air Chief, Air Mshl Subroto Mukherjee, he was informed that as far as the air force was concerned, the army requirement would be paramount.²⁰

This was significant when contextualised in relation to a decision taken on the Joint Planning Committee Paper No 28(49) in response to the Army Headquarters' proposal for having an inter-communication flight of its own for carriage of VIPs, air ambulance work and signal use (carriage of despatches and signals, reconnaissance of land lines, cable laying). The decision, as taken on November 15, 1949, stated that the RIAF should continue to provide the army with aircraft on "as is required basis".²¹ Hence, here, once again, the IAF considered the helicopter to be used primarily for army tasks.

Army Chief Gen KS Thimayya, on his part, projected the requirement as "a helicopter capable of lifting fifteen fully armed soldiers to an area of seven to twelve thousand feet altitude". Cdr Douglas recommended that the Alouette II would be able to meet the requirements and stated that the French had a successor helicopter in the form of the Alouette III which should be recommended for the final purchase.

Jointness in the highest decision-making was highlighted when the army chief was said to have spoken to the air chief and thereafter handed over the telephone to the naval representative Cdr Douglas, who then spoke to the air chief and conveyed his views.

20. Ibid., Ch 4, p. 33.

21. n. 9.

Displaying great foresight, Cdr Douglas made an additional recommendation that the Alouette III be assembled initially at Hindustan Aeronautics Limited (HAL), Bangalore, before gradually giving way to an Indian manufactured one (licensed version). This telephonic conversation between the air chief and Cdr Douglas in the army chief's office resulted in the recommendation by the air chief to commence the bidding/procurement process and for evaluating various helicopters in India under operational conditions in Assam, Kashmir and in sea level monsoon situations.²² Hence, the quest for expanding the existing helicopter fleet, while meeting the requirements for the three Services, began in this "joint" manner.

The raising of units at Jorhat and Srinagar with a detachment at Leh was undertaken primarily for communication duties in difficult terrain whose diversity ranged from the high altitude barren mountains in the north to the predominantly hilly jungle terrain in the east.

PLANNING FOR EXPANSION

By early 1958, the plans for expansion of the helicopter fleet commenced with the posting in of additional pilots to 104 HF. The consolidation phase and conversion training of the pilots continued throughout 1958, and by April 1959, the conversion training of one navy pilot, Lt Cdr PKK Menon,²³ was also progressed and completed by May 1959. Hence, training of fixed-wing as well as helicopter pilots of the navy was being undertaken by the IAF.

On November 23, 1959, a second helicopter unit designated 105 Helicopter Unit (HU) was raised at Jorhat and equipped with Bell 47G helicopters.²⁴ This was followed by the raising of 107 HU at Srinagar on January 1, 1960, and equipped with S-55s and Bell 47 G IIIs. 107 HU used to maintain a detachment at Leh also and moved permanently to Leh on May 13, 1961.

22. Singh, n.19, Ch. 4, p.33.

23. Ibid., Ch. 4, p.13.

24 Rajesh Isser, *The Purple Legacy* (New Delhi: Pentagon Press, 2012) , p.1

A major factor affecting future helicopter acquisitions and having a direct bearing on the operations by the IAF helicopter fleet was the onset of the era of the Soviet-made Mil Mi-4.

The raising of units at Jorhat and Srinagar with a detachment at Leh was undertaken primarily for communication duties in difficult terrain whose diversity ranged from the high altitude barren mountains in the north to the predominantly hilly jungle terrain in the east. The requirement of a more capable helicopter which could operate in the diverse terrain, as envisioned by Gen Thimayya, was also felt, and as a logical consequence, Sikorsky was approached for meeting this requirement and it was also at this time that the USSR offered the

Mi-4 for evaluation.

Hence, in 1960, the acquisition process for helicopters was accelerated with two Sikorsky S-62A²⁵ helicopters being acquired for evaluation trials. These were also deployed initially for VIP duties with 104 HU – one of them was lost in the Ladakh region.²⁶ During extensive trials, these were compared with the Russian Mi-4 helicopter in July 1960. The Mi-4 which looked similar to the S-55, outclassed the S-62 in almost all aspects and was, thus, selected for induction. The Mi-4 used during the evaluation was thereafter placed with 104 HU which at one time was operating all the three helicopter types: S-55, Bell 47 and Mil Mi-4 . By this time, 104 Helicopter Flight had become a unit and the total number of helicopter units were set to further expand from three units and necessitated the setting up of a dedicated conversion training establishment.

HELICOPTER CONVERSION AND TRAINING

To meet the training needs of the planned expansion of the helicopter fleet, an acute need was felt for a separate flying training establishment. This helicopter training unit was formed on April 2, 1962, at Palam.²⁷ It was equipped with

25. Smith, n.11, p. 235.

26. Kumar, n. 18, p.131.

27. Isser, n.24, p.2.

some of the 12²⁸ additional Bell 47Gs acquired in 1962. On December 1, 1962, it was renamed as the Logistics Support Training Unit (LSTU) and shifted to Allahabad, and later to Jodhpur, on May 22, 1967. Much later, it moved to Hakimpet, on October 15, 1973, and was renamed the Helicopter Training School (HTS). However, a major factor affecting future helicopter acquisitions and having a direct bearing on the operations by the IAF helicopter fleet was the onset of the era of the Soviet-made Mil Mi-4.

THE Mi-4 ERA

With the placing of an order for 10 Mi-4s in October 1960 and the subsequent disposing of the second S-62 to Thailand, the era of Soviet manufactured helicopters was ushered in. These were procured from the Border Roads Organisation (BRO) funds for transporting BRO equipment in difficult terrain and at high altitudes. The initial order for 10 helicopters was thereafter followed up with an additional order of 16 in 1962.²⁹

The training course for the conversion of the pilots and the technicians onto the Mi-4 was conducted between April and June 1962 in Russia. The helicopters were erected at Bombay and flown to the respective units via circuitous routes involving many halts.

Some of the new Mi-4s were handed over to 107 HU and with the rest, 109 HU was raised at Chandigarh on August 26, 1961. 109 HU maintained a permanent detachment at Tezpur and this detachment converted into 110 HU with the induction of the Mi-4 helicopters in September 1962. The unit had six helicopters ready and serviceable by September 1962, just in time for the 1962 War.³⁰ This expansion, which in addition to the Mi-4, included An-12s, necessitated dedicated maintenance support. The distinct shift of sourcing military equipment from the West to Russia also necessitated a reorientation of maintenance practices and, hence, Chandigarh was chosen to be the overhaul complex for the Soviet origin aircraft and a repair depot was established.

28. Smith, n.11, p. 235.

29. Kumar, n.18, p.131.

30. Melville C Rego, Bharat-Rakshak, "In the Line of Fire-No 110 Helicopter unit, IAF," Bharat-Rakshak.com, May 23,2011, <http://www.bharat-rakshak.com/IAF/History/1962war>. Accessed on April 6, 2016.

NO.3 BASE REPAIR DEPOT (3 BRD)

No 3 BRD was established in February 1962 to meet the maintenance and overhaul needs of Soviet origin aircraft at Chandigarh. By 1967, the existing facilities were expanded significantly for overhaul and repair of Mil Mi-4 engines, sub-assemblies and components. Meanwhile, the procurement process initiated in the late 1950s for a common helicopter for all the three Services culminated in the selection of the Alouette III. What was even more significant was the selection of Hindustan Aeronautics Limited (HAL) for the task of licensed production of the helicopters.

HAL AND ALOUETTE III

The Alouette III was selected as the “common” helicopter meeting the requirements of the three Services. In all, 20 helicopters were to be procured in fly-away condition, and for the rest, bilateral agreements were signed for their licensed production in India.

The signing of agreements between HAL and M/S SNIAS of France in June 1962 paved the way for the licensed production of the Alouette III, christened “Chetak” at Bangalore. An agreement with Turbomeca of France was also executed for the manufacture of the Artouste engine. Subsequently, another licence agreement with SNIAS in September 1970 permitted production of the Lama (Cheetah) helicopter, utilising the same engine, rotor and transmission systems. Over 400 Chetak and Cheetah helicopters were produced between 1965 and 1983. This figure reached close to 600 produced by the year 2000.³¹ With this, the aspiration of indigenised production of helicopters received a major boost and laid the foundation for major expansion of the technological skills required for helicopter production. But the challenges faced by the Indian armed forces during the 1962 conflict with China also had a significant impact on the modernisation efforts by the Indian armed forces.

31 Hindustan Aeronautics Limited, “Helicopter Division Bangalore: Brief History”, www.hal-india.com/Helicopter%20Division%20Bangalore/M_124. Accessed on April 12, 2016.

1962 OPERATIONS

The literal “baptism by fire” for both the air crew and the recently acquired helicopters during the 1962 War in undertaking active operations resulted in the testing and redefining of the limits to which the helicopter could be subjected.

During the build-up phase itself, one Mi-4 was lost due to faulty construction of the helipad. The mission involved airlifting a part of a dismantled gun to a newly constructed helipad. On landing, the aircraft sank in the loose top surface, resulting in extensive damage being sustained by the helicopter.

In the North-Eastern Frontier Agency (NEFA), three Bell 47s were lost. Two of these were lost at Tsangdhar, as a result of direct enemy action, and the third unserviceable helicopter had to be left at Tawang when the Chinese overran the post.³² The helicopter fleet also suffered the first battle casualty during active operations in the form of Squadron Leader (Sqn Ldr) Vinod Sehgal who was commanding 104 HU (Palam) and operating a detachment at Tezpur. The loss of the first of the Bell-47GII, which were operating in a single pilot configuration in direct support of the army for reconnaissance, communication and Casevac duties, was followed by the loss of a second helicopter flown by Sqn Ldr AS Williams who was fired upon when he went to investigate what had happened to the first helicopter. He was fortunate to survive the crash.

Meanwhile, in the Ladakh sector, operations by the Mi-4s of 107 HU were of similar nature, involving air maintenance of forward posts, Casevac and subsequent airlifting of the withdrawing personnel. The differences from the NEFA operations lay in the difficulties posed by the higher altitude of the operations.

It was during these operations that the unique abilities of the helicopters were utilised to the fullest extent by the pilots and technicians even with their limited experience. The operating limits of 4,000 to 5,000 ft altitude were exceeded routinely, with landing at altitudes as high as 7,000 ft.³³ Evacuations were undertaken under hostile fire and trying conditions. The operational experience so gained proved to be a boon for the IAF and shaped the

32. Kumar, n. 18, p.199.

33. Ibid., p. 230.

During the 1962 operations, the Chinese had unhesitatingly fired upon helicopters, even on those on which huge red crosses were painted while being used as air ambulances.

formulation of Standard Operating Procedures (SoPs) and training programmes.

The air crew, thus, tested the machines to their limits by transporting troops in the initial phases to evacuating casualties and providing food to the retreating troops. Some of the Service personnel were even rescued at night. This was significant as the helicopters were not cleared for night operations and night landing 'facilities' were improvised, often without previous coordination, by army personnel manning the helipads.³⁴

Besides the direct effects on the outcome of individual battles, the availability of the versatile platform also had a morale boosting effect on the troops.

The 1962 War, thus, moulded and transformed the entire philosophy of helicopter deployment and utilisation. The close coordination with the army entailed establishment of procedures and proved to be the start of an everlasting relationship between the IAF helicopters and the army. Proving of the machine in varied conditions paved the way for further expansion of the fleet in the form of an additional order for 76 Mi-4 helicopters.³⁵ This also necessitated logical establishment of additional units and this 'baptism by fire,' so to speak, resulted in the helicopter being utilised in a slightly different role during the large scale 'infiltration' bid by Pakistan in 1965.

THE 1965 WAR

While processing the case for procurement of helicopters, the planners did not envisage the utilisation of helicopters in an offensive role. This, along with the fiscal prudence being exercised by the Government of India, resulted in the decision of not opting for the armed version of the Mi-4 helicopter.³⁶

34. Ibid., p. 202.

35. Smith, n.11, p. 235.

36. Premananda Goswami, "Helicopter Operations in J&K-111HU," October 1, 2015, <http://www.bharat-rakshak.com/IAF/history/1965war/1338-premananda-goswami.html>. Accessed on February 24, 2016.

Originally, the Mi-4 was designed to operate a 12.7 mm machine gun from a gondola mounted under the belly, along with air-to-surface rocket pods and bomb racks.³⁷ This was a part of the Soviet policy of deploying the helicopter in an assault configuration.

During the 1962 operations, the Chinese had unhesitatingly fired upon helicopters, even on those on which huge red crosses were painted while being used as air ambulances. Lacking the means for a suitable counter, it was natural for the air crew to feel helpless, and they must have desperately wanted to retaliate.³⁸ Not having the means for retaliation stimulated the thinking in the IAF of equipping the Mi-4 with some means of retaliation, and arming them. Therefore, local modification work was undertaken in the intervening period of 1962 to 1965, with multiple trials in various configurations of mounting guns as well as bomb racks, sourced from fixed-wing aircraft.

This was finally accomplished at No 1 BRD Kanpur by using a .5mm Browning gun of a Liberator and fixing it on a gondola under the belly of an Mi-4. The gunner would thereafter sit astride and fire at the targets straight ahead, as instructed by the pilot. Modification to drop 25-pounder (lb) bombs were also made by attaching a chute with three vertical channels from which nine bombs could be released by the gunner, on indication by the pilot. These chutes would thereafter be manually reloaded.³⁹ This innovative approach led to helicopters of the IAF undertaking another role in which they had appeared to be deficient. That is, in addition to the conventional roles undertaken by helicopters, of communication, logistic support, Casevac and reconnaissance, an offensive role in the form of bombing and strafing was also added.

In addition to the conventional roles undertaken by helicopters, of communication, logistic support, Casevac and reconnaissance, an offensive role in the form of bombing and strafing was also added.

37. Lloyd, n. 5, p. 44.

38. Rego, n. 30.

39. Isser, n.24, p. 55.

With local modification, the Mi-4s were now ready to undertake “offensive” operations against infiltrators entering from Pakistan on August 5, 1965. In order to once again assist the army, the IAF formed a task force with helicopters drawn from 107,109 and 111 HUs. This task force was positioned at Chandigarh, Jammu and Srinagar and placed so as to undertake operations in direct support of the army.

The unique use of the Mi-4s entailed getting airborne with a logistic load for a particular destination, bombing and strafing enemy positions before landing at the destination, delivering the load and picking up casualties on the return leg. This task force carried out 79 offensive sorties from August 20, 1965, onwards, till the cessation of the war. The use of the helicopter in this manner is estimated to have had a great demoralising effect on the infiltrators.⁴⁰

The lessons learnt from this war highlighted the capabilities of helicopters in the entire spectrum of air operations as an effective platform in support of ground operations. The main beneficiary of helicopter support remained the army but valuable lessons were also learnt by the IAF which firmed up procedures and built up the required skill set for future operations. It was not long before helicopters were tasked to take part in counter-insurgency operations.

HELICOPTERS IN COUNTER-INSURGENCY (COIN) OPERATIONS

A myriad factors had caused the rise of insurgency in the northeastern region of India. Insurgency in Nagaland as a political movement commenced as early as 1929, with the Nagas petitioning the Simon Commission. However, the army was called in to help the Assam Rifles only in 1955-56, when the first act of violence occurred, in June 1954. The army thereafter commenced its operations by February 1956.⁴¹ Operating in the difficult hilly jungle terrain of NEFA justified the demands of the army for air support.

40. Harbaksh Singh, *War Despatches: Indo-Pak Conflict 1965* (New Delhi: Lancer International, 2011), p. 227.

41. Gautam Das, *Insurgencies in North-East India* (New Delhi: Pentagon Press, 2013), p. 100.

In Mizoram (then Lushai Hills), armed insurgency reared its head on March 1, 1966, when Mizo rebels, numbering about 8,000, attacked 30 towns and military posts in all the districts. The insurgency was led by a retired havildar of the Indian Army, Lal Denga (later the chief minister of Mizoram) and had its origins in the famine of 1959. The movement was facilitated by the then East Pakistan government, when many Mizos crossed over to receive arms training there.⁴² Both the army and IAF were involved in launching COIN operations in support of the Assam Rifles.

The initial close air support operations in Nagaland began in August 1960 when the Naga insurgents surrounded an Assam Rifles post and the Dakotas were 'air maintaining' the post by carrying out low level drops. During one such mission, a Dakota was hit and had to force land. Thereafter, four Ouragans and four Vampires fired T10 rockets and used 20mm cannons to repulse the attack.⁴³ This was probably the first time that fighters were deployed to repel an insurgent attack and sustain the post.

The response was slightly different during the Mizoram insurgent attack of 1966 with the availability of Mi-4s. When the Government of India directed the army and air force to put down the insurgency, emergency troops, totalling a battalion strength, were inducted by Mi-4 helicopters into Aizawl under cover provided by Toofanis firing T.10 rockets. This was probably the first and only time when helicopters were used to transport troops with Close Air Support (CAS) to retake an 'occupied' territory within the Indian boundary, and the operation was completed within hours.⁴⁴ The operation which took place in March 1966, gave tremendous credence to the use of helicopters in direct support of the army, the success of which totally depended on the successful insertion of troops into the hostile area by helicopters.

Subsequent analysis and assessment of employment of available air assets in such a manner, along with the lessons learnt during the 1965 War, ushered in major organisational changes in the existing defence organisational

42. Anil Athale, *Counterinsurgency and Quest for Peace* (New Delhi: Vij Books, 2012), p. 40.

43. Pushpinder Singh, *History of the Indian Air Force: Volume II* (New Delhi: The Society for Aerospace Studies, 2007), p.109.

44. Ibid.

structure. It was, therefore, decided to put in place a support structure to ensure coordinated actions between the armed forces, especially the IAF and army.

In 1969, to ensure close cooperation between the army and air force, Advance HQ of the Western Air Command (WAC) and Eastern Air Command (EAC) were established, alongside the respective Army Commands. Further Tactical Air Centres (TACs) were established at each Core HQ.⁴⁵ In this manner, a structure was in place for effective utilisation of available assets by military planners and to ensure close cooperation between the two Services. The positive results of such reorganisation were soon evident in the 1971 operations for the liberation of Bangladesh. This reorganisation was supplemented by the experienced and dedicated skill set which was now available among the helicopter air crew as well as in the supporting ground crew largely due to the experience gained during the 1962, 1965 and COIN operations.

1971 OPERATIONS

During the early part of 1971, the IAF was busy planning for a war that Pakistan was likely to start in order to divert the attention of its people and, indeed, of the world at large, from the crisis in East Pakistan. These plans depended on the existing politico-military situation which was changing continuously. By this time, the IAF had also built up its capabilities in accordance with the Tata Committee report of 1963, envisaging expansion to a 45 Squadron force. The priorities, as specified by the IAF were:

- Defence of the home base.
- Support to the army in the field, and in order to do this, to gain and maintain a favourable air situation over the tactical battle area. This was to be achieved by carrying out counter-air operations, reconnaissance, interdiction and other operations having a direct bearing on the outcome of the land battle.
- Provide transport and maritime support to the army and navy.

45. Ibid., p.156.

The order of battle for helicopters in December 1971 included a mix of units flying the Mi-4s and HAL Chetak. No(s) 105 HU, 107 HU, 109 HU, 110 HU and 111 HU were flying the Mi-4s, and No(s) 104 HU, 112 HU, 115 HU, 116 HU and 117 HU operated the Chetaks.⁴⁶ The initial batch of Mi-8s, which had been acquired from the Soviets, had arrived, but were not used during the 1971 operations. The total strength of helicopters under the Eastern Air Command (EAC) amounted to 82. Of these, 60 were Mi-4s and the rest were a mix of Bell 47GIII and Chetaks. Another positive aspect of the build-up was the synergy existing between the army and the air force commanders which percolated down to the local TAC commanders as well as the helicopter air crew.

During the preparatory phase itself it was evident that the operations were to be in support of liberating Bangladesh for which local support was a mandatory requirement. This support was available in the form of the Mukti Bahini. In addition, material help was also extended in the form of training their pilots to fly an armed Chetak helicopter which was specially modified by the BRD with a twin-barrel machine gun and rocket pods fitted on either side. The rocket pods could fire seven rockets in pair or salvo modes. When the operations commenced, this helicopter was used initially for undertaking operational tasks by night and acted as a self-contained mobile hitting unit. It was used to attack ammunition trucks, boats and barges ferrying troops by night on the Meghna river and other targets of opportunity such as enemy troop concentrations. Subsequently, it was also used to give cover to the troops being inducted by the Mi-4s.⁴⁷ The successful translation of an operational thought by the IAF, no doubt, borrowed from the French who had pioneered the use of the helicopter as an offensive platform in French Indo-China, laid the foundation for this additional role for the helicopters. By this time, the modifications on the Mi-4s, as used during the 1965 operations, were abandoned, and the Mi-4s were used mainly for the communication, troop transport, logistics and Casevac roles.

As the war progressed, besides undertaking crucial reconnaissance and communication tasks, including conveying the commander-in-chief

46. Ibid., p.158.

47. Isser, n.24, p.70.

The synergistic use of heli-power, thus, made a significant contribution to the overall war effort in achieving the overall objective for the liberation of Bangladesh.

and chief of staff of Bangladesh, helicopters were utilised for a series of Special Heliborne Operations (SHBO) tasks mainly in the eastern theatre. The first was the heli-lift of over 584 troops and field artillery weighing 12.5 tons to a Drop Zone (DZ) south of Sylhet by night. The use of the helicopters in this manner outmanoeuvred the enemy, in addition to overcoming the natural obstacles and essentially compressing the planned timeframes. The second one being the Meghna river crossing in which ten Mi-4s heli-lifted 656 troops and 8,000 kg of equipment. The third and the largest one was the heli-lift of 2,563 troops and 79,370 kg of equipment in the Narsingdi and Baidyabazaar area. These operations were undertaken under hostile conditions and most of the helicopters were hit by small arms fire but did not sustain significant damage. To the credit of the ground crew, the battle-damaged helicopters were flown out after undertaking field repairs.

Meanwhile, in the western theatre, besides undertaking crucial roles of reconnaissance, logistic supply and Casevac, helicopters were also used to support long range, deep penetration actions by the para commandos. Aably assisted by helicopters, troops of 10 Para Commando captured the District HQ of Chhachro, around 45 km inside Pakistan, south of the Gadra road. This post thereafter continued to be air-maintained by ferrying in of supplies, reinforcements, and ferrying out of casualties. During one such Casevac during the battle of Naya Chor, an Mi-4 was engaged by two Sabres and two F-6s. The crew and the aircraft even survived the strafing and bombing (the 500 lb bomb dropped on it).⁴⁸ The other significant Casevac missions included those in the Uri and Kargil sectors, sometimes under constant shelling by the enemy, in which over 89 battle casualties were evacuated.⁴⁹

The net effect of the helicopter operations on the outcome of the battle and, more importantly, on the morale of the troops during the operations

48. Singh, n. 43, p.193.

49. *Siachin Pioneers, 114 Helicopter Unit, IAF* (Hyderabad: Vamsi Art Printers Pvt Ltd, 2005), p.7.

in both the eastern and western theatres, can well be imagined.

The synergistic use of heli-power, thus, made a significant contribution to the overall war effort in achieving the overall objective for the liberation of Bangladesh. The helicopter losses in the eastern theatre amounted to two Mi-4s. Total IAF losses included two Chetaks, of which one was attributed to direct enemy action.

The following table summarises the helicopter effort in the eastern theatre excluding that of the armed Chetaks:⁵⁰

The army, thus, started viewing helicopters as a platform essential to fighting a land battle to achieve these aims and even instituted the commemorative Sylhet Trophy with a model helicopter acknowledging the significant contribution made by the helicopters during the 1971 operations.

Table 1

Aircraft Type	Sorties	Hours Flown	Load Carried (Tons)	Passengers	Casualties
Mi-4	1,397	922:05	111.1	4,065	866
Chetak	894	726:35		809	282
Bell 47G	113	84			31
Total	2,404	1,802:40		4,874	1,179

The successful conduct of the 1971 operations significantly turned the attention of the then military commanders to the significance of involving air power in terms of both fighters and transport aircraft (comprising both fixed-wing and rotary-wing assets, as defined by the air force) as an integral element of the four fundamental principles of war, as defined by the army. These are manoeuvre, mass, surprise, and economy of force.⁵¹ The army, thus, started viewing helicopters as a platform essential to fighting a land battle to achieve these aims and even instituted the commemorative Sylhet Trophy with a model helicopter acknowledging the significant contribution

50. Isser, n.24, p. 63.

51. Vijay Oberoi, *Indian Army Aviation-2025* (New Delhi: KW Publishers, 2007), p. 10.

made by the helicopters during the 1971 operations. This idea also shaped the future modernisation plans of IAF helicopters as well as the organisational structure of the armed forces, especially that of the army.

CONCLUSION

The above narrative attempts to answer certain fundamental questions regarding IAF helicopters. The circumstances leading to their induction, and the factors affecting the expansion of the fleet have been examined. The events shaping the induction of helicopters and their evolution from primarily passenger transports to platforms utilised in the offensive role and their role in support of land operations have been discussed, including in the last major war fought by the Indian armed forces.

In the forthcoming part of this continuum, certain additional factors governing the further expansion of the helicopter fleet, along with enhancement of their roles and development of indigenous capabilities post 1971 operations, would be examined. And this would pave the way for understanding some of the contemporary issues affecting IAF helicopters.

A PARADOX OF SHIFTING SANDS: INDIA'S REALTIONSHIP WITH THE NPT

JAI RAINA

INTRODUCTION

The nuclear Non-Proliferation Treaty (NPT) was formulated when the world was in the throes of the Cold War, in an atmosphere wrought with the paranoia of a nuclear holocaust. The NPT did much to assuage this. It was opened for signature in 1970, and currently, only nine countries in the world possess nuclear weapons. Some countries like South Africa, Argentina, Brazil and Ukraine have given up their nuclear weapons programmes. Many other technically advanced powers, despite having the technology, have desisted from pursuing one at all. While one cannot attribute all of these achievements to the NPT, it has played a significant role in such developments. The extent of its universality is impressive: 190 nations have signed and ratified it, making it one of the most widely ratified treaties in the world. As of June 2016, only five countries (including India) remain outside the NPT.

India has had a complex relationship with the NPT. This paper has likened it to a paradox of shifting sands – a common phenomenon in the desert that precludes travellers from charting a course using only the topography as a

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The NPT in a sense represents the dominant view on non-proliferation, and India is one of its most unique outliers.

guide. Since the genesis of the relationship, neither India nor the NPT could find a clear path to each other. The sands of global events have been shifting faster in the past decade and will shift even faster in the times to come. This paper seeks to examine where India and the NPT have diverged, and, more interestingly how India, despite this divergence, nevertheless sees convergence of principles with

the NPT.

The NPT in a sense represents the dominant view on non-proliferation, and India is one of its most unique outliers. However, despite this, India has been a consistent part of the discourse on nuclear issues. To understand India's current stand in the contemporary non-proliferation regime, an awareness of the historical context is necessary.

HISTORICAL BACKGROUND

In the early years of independent India, its position could be summed up thus: nuclear technology for "constructive purposes" was seen as desirable and even necessary for the young country, but even though the Indian leadership was aware of the great potential that ownership of nuclear weapons had, the development of nuclear weapons was not seen as a pressing priority at this point, though the leaders were well aware of their potential.

India benefitted greatly from foreign assistance in the early years of its civilian nuclear programme. Thousands of Indian scientists gained technical knowhow by participating in US nuclear energy projects, and one of India's earliest plutonium processing plants at Trombay utilised the American Plutonium-Uranium Extraction Process (PLUREX)¹. Furthermore, the United States supplied India with heavy water for its CIRUS reactor which had been built with Canadian support and was one of India's first reactors.

However, by the 1960s, this atmosphere of cooperation and free flowing information had somewhat subdued. Soviet and American

1. <http://www.nti.org/learn/facilities/858/>. Last accessed on June 11, 2016.

nuclear testing had continued almost unabated. Both countries also boasted of large and growing nuclear arsenals which were a source of constant tension. Further, additional countries like the UK, France and China had also conducted nuclear tests by 1964. In such an atmosphere, the concerns that had been long expressed by more than a few countries, finally found utterance. In 1961, the UN had passed a long pending resolution calling for restraint in acquisition of nuclear weapons and a reduction in nuclear armaments. The deliberations in the UN sparked much debate as they came in the way of the vested interests of nuclear weapon states, as well as the development goals of non-nuclear weapon states. Stemming from the 1961 resolution, the United Nations further passed Resolution 1722 (XVI) that called for the Eighteen-Nation Committee on Disarmament (ENDC) to be constituted to deal with disarmament, test controls, and confidence-building measures.

India's major bone of contention with the treaty was that it would only recognise those states that had tested a nuclear device prior to 1967 as Nuclear Weapon States (NWS).

Amidst these developments, India took a firm anti-proliferation stand. It joined the ENDC, and even becoming a signatory to the Partial Test Ban Treaty (PTBT) in 1963, Article I of which ambitiously stated that parties to the treaty would strive, *"to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control"*²

In 1965, the ENDC commenced negotiations on what would go on to become the nuclear Non-Proliferation Treaty (NPT). India's major bone of contention with the treaty was that it would only recognise those states that had tested a nuclear device prior to 1967 as Nuclear Weapon States (NWS). Thus, only their nuclear arsenals would be granted the exclusive sanction of law. All other states could join the treaty only as Non-Nuclear Weapon States (NNWS). Article II of the NPT states:

2. <http://www.state.gov/t/isn/4797.htm#treaty>. Last accessed on June 11, 2016.

Each non-nuclear weapon State Party to the Treaty undertakes not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly; not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices; and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices.³

Essentially, this provision expressly forbids the NNWS from receiving or manufacturing any nuclear weapon device of their own. Meanwhile, in a manner of balancing this demand upon the NNWS, Article VI of the treaty went on to say:

Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

Of particular note is how no fixed time period was set for this provision. A further advisory by the International Court of Justice (ICJ) in 1996 went only as far as to say that while this Article can be interpreted as specifically calling for nuclear disarmament, the negotiations on the issue of disarmament were to be undertaken "in good faith".⁴ The court did not lay down under what parameters good faith fell. This has given the NWS states incredible flexibility within the NPT with regard to the question of disarmament. It may even be seen as granting the NWS *carte blanche* to continue as they had been prior to the treaty.

The treaty was, however, not without benefits for the NNWS. Article IV of the NPT enabled them to carry on Research and Development (R&D) in nuclear energy for peaceful purposes. Despite these apparent benefits, India

3. <https://www.iaea.org/sites/default/files/publications/documents/infcircs/1970/infcirc140.pdf>. Last accessed on June 11, 2016.

4. <http://www.icj-cij.org/docket/files/95/7497.pdf>

continued to view the NPT as an inequitable settlement, one that cemented the position of those states that already possessed nuclear weapons while placing severe restrictions on those that didn't. Dr. Bhabha was quick to point out during the 1965 negotiations on non-proliferation, that there was a distinction between "horizontal proliferation" i.e. new countries acquiring nuclear weapons and "vertical proliferation" i.e. the five NWS acquiring nuclear weapons.⁵ Clearly, the treaty was more amenable towards preventing horizontal proliferation. India's representative at the ENDC compared it to a nuclear apartheid.⁶ India stated that such a treaty would divide the world into the nuclear haves and have nots. Thus, it came as little surprise that when the treaty opened for signature in 1968, and despite exhaustively taking part in the negotiations, India was not amongst its signatories.

Nevertheless, despite being a non-signatory to the NPT, arrangements negotiated prior to the NPT continued to bear fruit for India. Canada assisted India by way of personnel who helped to set up two reactors in India. The United States too continued to provide India with material such as enriched uranium as per (or at least stemming from) previously negotiated agreements.

This is not to say that it was business as usual for the Indian state. By staying out of the NPT, India ceased to enjoy the level of international assistance that it had received in the initial years of its nuclear programme. A more significant shutting out of India from the global regime would be observed after its maiden nuclear test at Pokhran in 1974.

India's official stand after the test was that it had conducted a Peaceful Nuclear Explosion (PNE) and not tested a weapon. PNEs are difficult to distinguish from actual nuclear weapon tests—the USSR and USA had conducted a great many themselves during this period. PNEs and their potential applications were a much explored area of study not only for the Indian scientific establishment, but worldwide as well. Article V of the NPT even talks about PNEs, permitting states to share "...potential benefits from any

5. https://www.iaea.org/sites/default/files/publications/magazines/bulletin/bull22-3/223_403587380.pdf. Last accessed on June 11, 2016.

6. https://books.google.co.in/books?id=eR7liM63oh8C&pg=PA166&lpg=PA166&dq=vc+trivedi+nuclear+apartheid&source=bl&ots=VU4Ft7NGO9&sig=su_Y_PuPuwgr9BqGE3ieQAryj24&hl=en&sa=X&ved=0ahUKEwizmlv27tbNAhUKnJQKHeE4Di0Q6AEIIDA#v=onepage&q=vc%20trivedi%20nuclear%20apartheid&f=false. Last accessed on June 11, 2016.

peaceful applications of nuclear explosions will be made available to non-nuclear-weapon States Party to the Treaty on a non-discriminatory basis and that the charge to such Parties for the explosive devices used will be as low as possible and exclude any charge for research and development..."⁷ Regardless of whether the motivation of the test was purely scientific or otherwise, it did have the effect of showing the world that the Indian nuclear capability was more than theoretical.

India faced significant global condemnation after the test. Canada recalled its personnel working on nuclear power plants in India. American shipments of uranium too continued only on the basis that they were negotiated and agreed upon earlier. The response of the White House to the 1974 test was somewhat tempered by the fact that it was embroiled in the Watergate scandal (though non-proliferation issues were not high on Nixon's agenda to begin with). Both Houses of Congress in the United States, however, took a much harsher stance towards the test.

From 1975 onwards, the voices demanding tightened restrictions on nuclear exports grew louder in Congress. Three years later, they succeeded in passing the Nuclear Non-Proliferation Act of 1978 (NNPA). The NNPA called for, amongst other things, amendments to the Atomic Energy Act with regards to exports and nuclear assistance to other countries. Section 123 of the Atomic Energy Act all but expressly forbade nuclear trade with India. This aspect of the NNPA was particularly detrimental to India as the amended Act stated that the United States could only engage in nuclear exchanges with those countries that had a particular set of safeguards. Since the Indian position, from the inception of its nuclear programme, had been to stave off any kind of foreign influence/ interference with the programme, it had not implemented any of the stipulated safeguards. Thus, in a single stroke, India found itself effectively unqualified for any kind of nuclear exchange with the United States.

Further, the test of 1974 was also a significant factor in the formation of the Nuclear Suppliers Group (NSG). This accentuated India's segregation from the non-proliferation regime. In essence, the NSG controls the export of technology and material used to manufacture nuclear weapons. The NSG

7. <https://www.iaea.org/sites/default/files/publications/documents/infcircs/1970/infcirc140.pdf>. Last accessed on June 11, 2016.

placed heavy restrictions on the supply of nuclear material and technology to India in the aftermath of the test. Though the very fact that the NSG had to come into being demonstrates that the NPT had not been not completely comprehensive in itself.

The result of these developments for the Indian nuclear programme was fairly detrimental. India's nuclear programme had been heavily reliant on outside support. Heavy water that was needed to run most of its reactors, came from abroad, as did the equally important factors of technology and technical assistance.

It would be tempting to dismiss the period post the test as one of stagnation or glacial change in India's nuclear progress, but this claim is not wholly true. It is true that without foreign assistance and a lack of indigenous systems to complement its nuclear infrastructure, the progress was slow. India did, however, manage to achieve significant strides in its nuclear weapons delivery systems. Work on the Agni and Prithvi series of missiles (both of which were designed to carry nuclear warheads) began during the 1980s. Furthermore, the Agni and Prithvi projects provided Indian scientists with a wealth of information and experience for subsequent work on more sophisticated missiles.

RK Sinha (former chairman of the Atomic Energy Commission and secretary in the Department of Energy) has pointed out in a speech that, despite the embargoes, there has been substantial development of indigenous technology. He gives the example of India's increasing use of locally available thorium over uranium, work on the manufacture of heavy water, and work on a prototype plutonium-thorium-uranium-233 fuelled Advanced Heavy Water Reactor (AHWR) to gain experience with the thorium and uranium-233 fuel cycle. Sinha has also emphasised that India's long-term goals in the healthcare, agricultural, power, and other sectors have benefitted from the indigenous nature of its nuclear programme. It is interesting to note that his speech was delivered while inaugurating a medical facility in the northeast, which utilises indigenous technology for cancer treatment. India's progress in the civilian application of nuclear technology also allowed it to keep its weapons option open as well.

What is noteworthy is that by 2001, almost all of these sanctions had been lifted. It is interesting to see that India, compelled with similar factors after its previous test (volatile regional relations, domestic political considerations, and even scientific considerations) did not receive wholly similar responses.

Progress on civilian uses of nuclear energy was matched by developments that allowed India to keep its weapons options open. Ultimately, India would go ahead and conduct a full nuclear weapons test despite all the sanctions imposed on it. On May 11, 1998, India simultaneously tested three nuclear devices, and another two on May 13. Predictably, in the aftermath of the tests, sanctions followed: the United States withheld in excess of \$100 million in aid and an even greater amount by postponing loans. Germany put a halt to any new developmental aid to India, while Australia recalled its ambassador, and Japan too put a stop to its

annual grant to India. What is noteworthy is that by 2001, almost all of these sanctions had been lifted. It is interesting to see that India, compelled with similar factors after its previous test (volatile regional relations, domestic political considerations, and even scientific considerations) did not receive wholly similar responses.

POST 1998

By the time India conducted its nuclear tests, the world had undergone substantial changes. The Cold War was over and the War on Terror was coming to the fore. From the late 1990s onwards, the growing Taliban activity in Afghanistan as well as the spate of terrorist attacks on American interests abroad, brought greater American interest in South Asia. A rising China also challenged the United States to rethink some of its policies in the region. India's place in the global market too was far different from it had been in 1974. The overtures it had made towards opening its economy and joining the global market were well received. In such an atmosphere, India and the United States began to grow closer together. In 2000, just two years after being at the receiving end of global denunciation and, particularly,

American criticism, President Clinton made a state visit to India. It was the first visit by a sitting president in more than 20 years. The visit held great symbolic value and signalled the beginning of a fostering of closer ties between India and the USA.

Improved ties with the US would enable the Americans to aid in integrating India's position in the larger non-proliferation regime. Further, one cannot discount the fact that India itself made efforts to project itself as a responsible nuclear power. Despite being a non-signatory to the NPT, India had not carried out a single test from 1974 to 1998, nor did it engage in the proliferation of its nuclear material/expertise, and it continued to contribute to the discourse on non-proliferation and disarmament on the world stage. This aspect is important to note, as Articles I and II both emphatically call for both the NWS and NNWS to strive for these objectives. Regardless of which metric one would wish to apply to India, it certainly did conform to this aspect of the treaty. Also of particular note is how the Indian state has shown restraint in the development of its nuclear arms, following a doctrine of credible minimum deterrence. As a result, while India may not have subscribed to the NPT, it certainly has subscribed to the larger thrust of it. This has been further elaborated on in the subsequent section where the NPT is examined section by section.

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Shortly after his coming to office, the attacks of 9/11 pushed the War on Terror to the top of President Bush's agenda. No doubt, realising that India and Pakistan would have key roles to play in the growing War on Terror, President Bush authorised a rolling back of sanctions placed on both countries in the aftermath of their nuclear tests. Further, it has been noted that President Bush had something of an affinity towards India. This, combined with the growing voices in the Bush Administration for stronger ties with India (for numerous practical reasons: as a counter-balance to China, India

as a potential market, nuclear and otherwise, etc., etc.), allowed for a further cultivation of Indo-US relations.

The nuclear issue had been a historical stumbling block in Indo-US relations. For more than three decades, it had coloured relations between the two countries. If the two countries could resolve the issue, it would usher in a paradigm shift in Indo-US relations.

The US moved quickly to remove the decades-long obstacles in India's nuclear advancement that it had placed and/or supported. This shift in policy, though hinted at a few years prior, was formally announced in a joint statement between President George W. Bush and Prime Minister Manmohan Singh in July 2005. The tone of the statement is as telling as its contents:

President Bush conveyed his appreciation to the Prime Minister over India's strong commitment to preventing WMD proliferation and stated that as a responsible state with advanced nuclear technology, India should acquire the same benefits and advantages as other such states. The President told the Prime Minister that he will work to achieve full civil nuclear energy cooperation with India as it realizes its goals of promoting nuclear power and achieving energy security. The President would also seek agreement from Congress to adjust US laws and policies, and the United States will work with friends and allies to adjust international regimes to enable full civil nuclear energy cooperation and trade with India...⁸

In the July statement, the Indian prime minister added that India would be sure to *"assume the same responsibilities and practices...as other leading countries with advanced nuclear technology...."*⁹

A year after the July 2005 statement, significant legislative changes took place in the US in pursuance of the newly stated position. The Henry J Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006, was passed in the House of Representatives, reshaping the dreaded Section 123

8. <http://georgewbush-whitehouse.archives.gov/news/releases/2005/07/20050718-6.html>. Last accessed on June 11, 2016.

9. Ibid.

of the Atomic Energy Act. The Senate, in turn, passed the “United States-India Peaceful Atomic Energy Cooperation and US Additional Protocol Implementation Act” to “*exempt from certain requirements of the Atomic Energy Act of 1954 United States exports of nuclear materials, equipment, and technology to India.*”¹⁰ By 2007, what would popularly be come to be known as the 123 Agreement was ready for release. By late 2008, after some wrangling in both countries’ legislatures, it was passed and came into force.

However, it was not only American law that had to be amended—significant changes in aspects of the global non-proliferation regime were also required for Indo-US nuclear cooperation to produce any tangible results. India and the United States undertook significant lobbying efforts to bring about these changes. The International Atomic Energy Agency (IAEA) accepted an India-specific safeguards agreement for nuclear reactors in India. After some deft manoeuvring, the NSG also accepted an India-specific exemption. In the years that followed, India has enjoyed a growing stake in the global nuclear marketplace and been able to engage in significant nuclear exchanges (which will be touched upon subsequently).

In looking at the historical background of India’s relationship with the NPT, one tends to focus on Articles I, II, and VI. Indeed, the lion’s share of attention they receive in academic and other circles is well deserved to an extent. After all, the nature of their content (non-proliferation and disarmament respectively) is such. However, the NPT is much more than the aforementioned Articles. It is like any treaty, the sum of its parts. To better understand the uniqueness of India’s position with regards the NPT, a fuller analysis of all substantive Articles of the treaty is required.

TREATY ANALYSIS

Articles I-VII may be seen to be the substantive Articles of the treaty in which one can find the principles of the treaty enshrined. Articles VIII-XI contain more procedural aspects of the treaty. For the purposes of our analysis, we will examine the first seven Articles to demonstrate India’s

10. https://www.bis.doc.gov/index.php/forms-documents/doc_view/198-report-109-721. Last accessed on June 11, 2016.

convergence with the philosophy of the NPT while not repeating those Articles that have already been discussed.

Article III of the NPT calls on member states to accept IAEA safeguards “... on all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere.”¹¹ As a non-member to the NPT, India was under no obligation to place its largely indigenous civilian nuclear reactors under any kind of international safeguards. However, a significant shift was observed in this position in the integration of India in the global nuclear community in the 2000s. India agreed to systematically separate its civilian and military nuclear programmes and further agreed to broad and extensive safeguarding of its civilian nuclear programme.¹²

In 2008, India agreed to place 35 of its nuclear facilities under irrevocable and comprehensive safeguards. India went as far as to accept the IAEA Board as the ultimate arbiter on any compliance issues. India even opened itself up to “special inspections” of its civilian facilities in addition to the routine inspections the IAEA carries out. Such inspections are more comprehensive and allow for greater scrutiny of aspects of a country’s facilities.

Not only has India consented to rigorous safeguarding but also consented to pay a portion of the significant inspection costs. In addition to the aforementioned, India went ahead and signed the Additional Protocol, a supplementary document to the existing IAEA safeguards agreement. The Additional Protocol “grants the IAEA complementary legal authority to verify a State’s safeguards obligations”.¹³ Signing the Additional Protocol, a purely voluntary document (though a widely signed one, with 147 signatories)¹⁴, can be seen as a significant step by India towards the cause of non-proliferation. Put together, the India specific safeguards agreement illustrates that India

11. <https://www.iaea.org/sites/default/files/publications/documents/infcircs/1970/infcirc140.pdf>. Last accessed on June 11, 2016.

12. <https://chellaney.net/2008/07/12/india-iaea-safeguards-agreement-fact-sheet/>. Last accessed on June 11, 2016.

13. <https://www.iaea.org/safeguards/safeguards-legal-framework/additional-protocol>. Last accessed on June 11, 2016.

14. <https://www.iaea.org/safeguards/safeguards-legal-framework/additional-protocol/status-of-additional-protocol>. Last accessed on June 11, 2016.

has displayed a marked enthusiasm and commitment to bringing its civilian nuclear programme well within the fold of the IAEA regime.

Article IV of the treaty, amongst other things, asks that parties "... cooperate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes...". India has benefitted from consequential nuclear transactions with a whole host of countries, including Russia, Canada, Korea, Australia, and the United Kingdom in the years following 2010. India has not only received nuclear fuel but also benefitted by way of cooperation in R&D, training, safety, etc. India has also contributed in collaboration with international organisations, as well as directly providing assistance to other countries. For the present year, 2016, the Nuclear Security Summit lists India's contributions in its country-wise progress report:

...establishment of a national-level Counter-Nuclear Smuggling Team for effective and coordinated response to threats involving the acquisition of nuclear and radioactive materials for malicious purposes; is equipping all major sea and air ports with radiation portals and detection equipment; continued regional and international activities through the Global Centre for Nuclear Energy Partnership; contributed to the upgrade of the IAEA's Seibersdorf Laboratory in 2015 and plans for a contribution in 2016 of US \$1 million to the IAEA Nuclear Security Fund; pledged commitment to INFCIRC 869.¹⁵

India has long contributed personnel and expertise to research facilities, projects and international organisations, but its collaboration in the ITER (International Thermonuclear Experimental Reactor) is a particularly good example. The ambitious ITER project seeks to build the world's largest magnetic fusion device. Doing so would allow the human race to create energy in much the same way that the sun and the stars produce their fuel. Ultimately, the project aims at demonstrating the feasibility of fusion as alternative energy and paving the way for fusion energy power plants in

15. <http://www.nss2016.org/news/2016/4/5/highlights-from-national-progress-reports-nuclear-security-summit>. Last accessed on June 11, 2016.

India did time and time again show consistent support for the principle of disarmament. The 1988 “Action Plan for a Nuclear Weapon Free and Non-Violent World Order” presented by Prime Minister Rajiv Gandhi in 1988 to a special session of the United Nations General Assembly on disarmament, is a particularly good example.

the future. The project had begun in 2007 and India, as well as China, the European Union (EU), the US, Japan, Korea, and Russia are all combining their resources, and are collaborating together to work on this potentially revolutionary 25-year project.¹⁶

Coming now to assistance provided to other countries, India signed a nuclear cooperation agreement with Sri-Lanka¹⁷ that was aimed at “*cooperation in the transfer and exchange of knowledge and expertise, sharing of resources, capacity building and training of personnel in peaceful*

application of nuclear energy—including the use of radioisotopes— nuclear safety, radiation safety and nuclear security”.¹⁸

While we have covered Article VI earlier, we have not touched upon India's strong stance on nuclear disarmament that it advocated till as recently as the 1980s. Of course, the strength of this view must be tempered by the fact that India has itself rather recently pursued a nuclear weapons programme motivated by security considerations. That being said, India did time and time again show consistent support for the principle of disarmament. The 1988 “Action Plan for a Nuclear Weapon Free and Non-Violent World Order” presented by Prime Minister Rajiv Gandhi in 1988 to a special session of the United Nations General Assembly on disarmament, is a particularly good example. The plan was rooted in the principles of disarmament and non-alignment that India since its inception had repeatedly advocated on the world stage, and could be seen to be in line with Article VI of the NPT. The plan called for:

16. <https://www.iter.org/proj/inafewlines>. Last accessed on June 11, 2016.

17. http://www.dae.nic.in/writereaddata/ncpw/IGA_srilanka_2015.pdf

18. <http://www.world-nuclear-news.org/NP-India-Sri-Lanka-agree-to-nuclear-cooperation-1602154.html>. Last accessed on June 11, 2016.

First[ly], there should be a binding commitment by all nations to eliminating nuclear weapons, in stages, by the year 2010 at the latest. Secondly, all nuclear-weapon States must participate in the process of nuclear disarmament. All other countries must also be part of the process. Thirdly, to demonstrate good faith and build the required confidence, there must be tangible progress at each stage towards the common goal. Fourthly, changes are required in doctrines, policies and institutions to sustain a world free of nuclear weapons.¹⁹

While India's complex security considerations do not allow it to enter into any treaties that ensure the total *absence* of nuclear weapons in its immediate surroundings, it has entered into regional treaties that go a long way in promoting regional nuclear security.

The plan went on to elaborate in great detail how its objectives could be met. Though little came of the plan, it can be seen as reflective of those voices within the Indian state that stayed firm on the more traditional views of non-proliferation that India had held. In more recent times, India has continued to lend support for steps that may push the world free of nuclear weapons.

Article VII permits member countries to enter into regional treaties to ensure the "total absence of nuclear weapons in the region." While India's complex security considerations do not allow it to enter into any treaties that ensure the total *absence* of nuclear weapons in its immediate surroundings, it has entered into regional treaties that go a long way in promoting regional nuclear security. One can look at the "India-Pakistan Non-Nuclear Aggression Agreement" and the "Agreement on Reducing the Risk from Accidents Relating to Nuclear Weapons" both of which are Indo-Pakistani agreements. While their respective nuclear arsenals have been a source of great strife for each other (and a matter of global concern), these agreements do mitigate the concerns somewhat and are indicative of a degree of regional responsibility.

The Non-Nuclear Aggression Agreement came into force in 1991 and is a confidence-building measure that prohibits parties from conducting or supporting a surprise attack on the nuclear installations of others. From 1992

19. <http://fissilematerials.org/library/gan98.pdf>. Last accessed on June 11, 2016.

onwards, both India and Pakistan have shared lists of their civilian nuclear facilities as part of larger confidence-building measures that the treaty calls for so as to diffuse the apprehension of an attack.²⁰

The Indo-Pakistani "Agreement on Reducing the Risk from Accidents Relating to Nuclear Weapons" is a more recent development, having come into force in 2007, and extended for another five years in 2012.²¹ As per the treaty, both parties are to inform each other in case of a nuclear accident, undertake efforts to curtail its radiological impact, and, perhaps, most importantly, take steps to ensure that an accident is not mistaken for a hostile action.

CONCLUSION

What can one infer from India's history with the non-proliferation regime? Certainly, the NPT has stood resolute against the test of time, as has India in its position. So how does one account for the changes that have occurred? The changes that are visible today are a result of changes and shifts in perception towards both the treaty and India. India has made impressive attempts to shift its image of a state with nuclear ambitions – from an international pariah to a stakeholder in the community of nations. Where India's efforts have been (largely) recognised, it is observed that India has reciprocated by increasing the level of its compliance to the principles of the NPT. The Indian case has been one that has been unseen in the past.

If an analysis of history has shown us anything, it is that the shifting sands between India and the NPT continue to obscure a clear path forward. Nevertheless, India's clean record is its biggest asset in any kind of potential inclusion in the treaty, and cannot be ignored. Also, this truly is a feature that is unique to India amongst all the nations that currently lie outside the treaty. This paper has demonstrated some of India's distinctive actions and characteristics that make it an outlier to the NPT that has steadfastly lived by its principles of non-proliferation and pursuit of nuclear disarmament.

20. <http://www.ir-ia.com/India-Pakistan-Non-Nuclear-Aggression-Agreement.html>.

Last accessed on June 11, 2016.

21. <http://www.stimson.org/agreement-on-reducing-the-risk-from-accidents-relating-to-nuclear-weap> .Last accessed on June 11, 2016.