AIR POWER

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AIR POWER

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EDITOR'S NOTE

As this edition of the *Journal* goes to the publishers, two issues take centre-stage. The first is that the National Democratic Alliance (NDA) government completed one year in office amidst loud claims of major progress made by the government, and equally strident accusations by the opposition of a wasted year. That was to be expected in a flourishing democracy. However, conventional wisdom suggests that much work has, indeed, been done and we are on the cusp of much higher growth and development. It is claimed that the groundwork has been done, the time is ripe and the stars propitious. In defence matters also, progress has been made and inertia overcome. Again, much needs to be done and the "make in India" or "manufacture in India" slogans must be translated into actual planning, research, development and production in a time-bound manner, with clear accountability stipulated. Is that too tall an order? One hopes not. We will review what transpires in the coming year at the same time next year.

The second issue of import is the continuing and growing assertiveness and brinksmanship on display by China, particularly in the East China Sea and, even more importantly, in the South China Sea. It started with the unilateral announcement of an enlarged Air Defence Identification Zone (ADIZ), followed by interception of Japanese and US aircraft over international waters and vociferous pronouncements of the increasing extent of Chinese sovereignty over the seas. The Chinese moves were not seriously challenged by the littoral states given the economic and military clout of China. A seemingly war-weary America also was apparently subdued in its comments. With this, further escalation was on the cards and soon the Chinese buttressed their claims in the South China Sea by reclaiming land over some rocks and shoals. Much worse, militarisation of the reclaimed areas also started. The unilateral declaration of sovereignty was being given

teeth. Interestingly, all this is taking place in spite of the American "pivot to Asia". Some checks and balances have to be introduced. It was, therefore, encouraging to hear US Secretary of Defence Ashton Carter, emphatically state at the recent Shangri-La dialogue in Singapore that there must be "an immediate and lasting halt to land reclamation" in the South China Sea. "We also oppose the further militarisation of disputed features," he added. He also spoke of the growing bilateral, trilateral and multilateral relationships with other powers in the region. More pertinent for us, he also said that the US will "find ways to complement India's 'Act East' policy". The message sent suggested that America will, indeed, challenge Chinese claims and activities. What actually transpires is anyone's guess.

The situation in the East China Sea also merits discussion. The dispute over the Senkaku Islands continues and there is little love lost between China and Japan. In fact, bilateral trade is decreasing and Japan is moving some of its industry out of China. The growing tension is a matter of concern as the two countries are major powers and Japan has started to seriously improve its defence preparedness. The role of the US is again important and it has to be actively involved. The rivalry between China and Japan shows no sign of abating. Two articles in this issue address the problem. **Dr Amarjit Singh,** in a scholarly work, discusses the history of the dispute and the chances of reconciliation. **Prerna Gandhi** argues that the undying conflict has forced both countries to strive to improve their war-fighting potential and that Japan's technological superiority could soon result in an effective military capability.

Our reliance on the internet can only increase and **Ashish Gupta** introduces the term "Internet of Things". The object is to effect better data management for greater operational effect. Its impact will be felt in a myriad different ways. In fact, the impact will be near omnipresent. The article is well worth more than a mere reading as it is representative of how operations can and should be conducted. The twist in the tail is that Information Technology (IT) does not represent a panacea as security issues loom large.

Dilipraj E, in another well researched and logically presented article presents the covert cyber capabilities of the US. Undoubtedly, the US is well ahead of all others in this field and is intent to retain the superior status.

He cogently argues that "internet functioning is primarily dependent on the laws, policies, infrastructures and security agencies of the US". He delves deep into US capabilities and shows how the US is not only a major player in the cyber domain but is also the leader by far in the field of cyber warfare. The article is a timely reminder of what we can expect in the not too distant future.

In discussing the role of aerospace power in the Indian context, **KK Nair** makes the classic statement that aerospace power alone can satisfy the needs of flexibility, rapid action, reaction and "reach". Whilst explaining the role of aerospace power, Nair also recommends that there should be a national body created to oversee aerospace activities. Helpfully, he also presents an organisation chart.

Our area is prone to natural calamities and they seem to occur with punishing regularity. In a very readable article on disaster management, **Nishant Gupta** helps us understand disasters, and what can and should be done to mitigate the resultant suffering, including the interface between the civil authorities and the military. The need for international cooperation is also stressed. This is a text-book article and the recommendations made are worthy of understanding and translation into policy.

A solar powered aircraft landed at night at Ahmedabad on March 10, 2015. The aircraft is on a around the world trip that will cover 35,000 km in 500 hours of flying in five months. The aircraft represents much more than mere adventure. **RK Narang** examines the significance of the experiment and suggests what we can expect in the times to come.

Finally, their is an article by **RA Maslekar** on India's aerospace footprint over the Indian Ocean. The importance of the Indian Ocean to India in particular and the world at large can never be overestimated. The author examines the present capabilities and future needs.

Happy reading.

AEROSPACE POWER IN THE INDIAN CONTEXT OF NATION BUILDING

K K NAIR

The aim of this paper is to undertake a brief overview of the prevailing and future applications of aerospace power in providing solutions to national security objectives in the larger process of nation building. In the contemporary dynamic environment, it is essential to have a clear understanding of the attributes, limitations and potential of air power so as to enable its optimum exploitation in furthering national objectives.

ROLE OF AEROSPACE POWER IN INDIA'S NATIONAL DEVELOPMENT

AEROSPACE POWER AND NATION BUILDING

India's general environment is a complex amalgam of its history, geography, culture, politics, etc and, consequently, its security environment is equally complex. The security challenges facing India are varied, complex and dynamic. At the same time, the country no longer views national security in isolation, but as an essential adjunct of overall national growth and development. The new millennium has been witness to sweeping changes, with India emerging as a fast growing economy having major stakes and influence on the global arena. As the nation marches ahead on the path of socio-economic growth and seeks to fulfill the legitimate aspirations of its

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India ranks amongst the top five countries in the "number of conflict years experienced"; it is second in the list of countries involved in "most wars of all types"; and tops the list of countries that "have experienced the greatest number of intra-state wars".

citizens, it can ill afford to be complacent about the existing and future security challenges. Seeking optimal solutions to these challenges would be imperative to our uninterrupted growth and development.

As we move ahead, it would be essential to bear in mind the fact that India ranks amongst the top five countries in the "number of conflict years experienced"; it is second in the list of countries involved in "most wars of all types"; and tops the list of countries that "have experienced the greatest number of intra-state wars"[1]. Evidently, India's security challenges are unique in more ways than one—they are prolonged, diverse and span the entire spectrum of conflict. Consequently, there are a myriad issues that have the potential to profoundly affect the economic, social, and political institutions of our nation. The ability to prevail despite the challenges and continue on the path of development is a paramount need.

At the same time, the requirement to maintain a restrained, measured and balanced response to these challenges has always been a primary one. The response to security challenges needs to be mulled upon as a subset of the overall scheme of uninterrupted growth and national development, and not in isolation. This is so for a variety of reasons apart from the main fact that India's national security objectives have evolved against a backdrop of its core values, namely, democracy, secularism, peaceful coexistence and the national goal of social and economic development.[2] As a nation with no extra-territorial ambitions, it would be essential to possess a potent instrument of national power capable of deterring conflict, maintaining

1. Ref Human Security Report 2009/10, "The Causes of Peace and The Shrinking Costs of War", Part-III at http://www.hsrgroup.org/human-security-reports/20092010/overview.aspx
2. Core values, as stated by Ministry of Defence. Refer site of India's Ministry of Defence for details on India's national security objectives at http://mod.nic.in/aforces/body.htm. Accessed on February 28, 2011.

peace and performing the wide variety of complex tasks that a growing power demands.

This is especially so in view of our growth trajectory that is on the ascent and would continue to be so for quite some time in the future. Economic growth is one of the foremost indices of development and numerous international reports ranging from McKinsey to Global Policy predict a shift of the world's economic centre of gravity to Asia, particularly India and China, by around 2025.[3]

They would also greatly impact the national economy, the diplomatic apparatus, administrative apparatus and, most importantly, the common man.

As the economic matrix shifts, the dynamics of geo-politics and aerospace power would also shift since all three factors are intrinsically linked and impact each other in many ways. For instance, a vibrant economy in the global context automatically implies an increased geo-political role for India in the comity of nations. An increased role implies an increased area of influence that demands support by instruments of national power that are equally far-reaching, rapidly responsive and flexible. These characteristics are intrinsic to the nature of aerospace power. Elements in air and space are sought precisely for these capabilities. As India rises, its sphere of influence across the globe would rise and the dynamics of geo-politics would demand a variety of tasks ranging from humanitarian ones like disaster relief, casualty evacuation to military power projection across the world. Our national instruments of power, both military and otherwise, would need to be supported by aerospace capabilities that are equally far-reaching, responsive and flexible. These capabilities would seminally impact all three military Services and the other security forces. They would also greatly impact the national economy, the diplomatic apparatus, administrative apparatus and, most importantly, the common man. Aerospace capabilities need to be viewed in the wider context of overall national development and growth; they are the perfect glue enabling jointness not only amongst

3. See Mckinsey Global Institute, "The Bird of Gold: The Rise of India's Consumer Market" *McKinsey Report,* May 2007; and Charles A Kupchan, "Getting Ready for a World Transformed", Council on Foreign Relations, November 2012 available at http://www.cfr.org/politics-and-strategy/getting-ready-world-transformed/p29392. Accessed on February 7, 2015.

the Services but across the nation. As in the case of national air power that includes both civil and military aviation, aerospace power today is a matrix of total national capability and when viewed through the national prism, it represents an extraordinarily potent force that impacts across the geo-politics, geo-economic and security spectrum. Consequently, aerospace power needs to be employed in pursuance of national objectives with great wisdom, acumen and clarity of purpose. The endeavour is complex and it would be essential to comprehend the complexities, challenges and options in our particular context for national advancement.

THE COMPLEXITIES IN WIELDING AEROSPACE POWER

Aerospace power is extraordinarily potent and, as in the case of most potent instruments, is correspondingly complex. It is capable of being put to multifarious uses, it can adapt to various roles, hence, demands employment with consummate skill and acumen. The varied roles fulfilled by aerospace power have been demonstratively apparent in the recent past. Using the aerospace medium, nations vastly removed in distance and time have exercised their power and influence across continents with astonishing rapidity. On the other hand, as evident during 9/11, non-state actors have also exploited gaps in air defence to ram civilian passenger aircraft onto buildings.

The opportunities and challenges in aerospace are manifold. Only a clear understanding of the aerospace doctrine will allow nations to leverage and exploit its tremendous potential. Air power doctrine in the past, and now, aerospace doctrine, is primarily a derivative of the fundamental principles that guide the application of air and space power and innovative ideas on optimum exploitation of the medium. Its fundamental principles draw on operational experiences and are time-honoured as the optimum way to succeed. They comprise guidelines that have worked in the past. Conversely, innovative ideas look to the future and are limited only by one's imagination and technology. The overall interaction of these two constituents, therefore, makes air power doctrine a particularly dynamic doctrine bounded by the limits of experience, imagination and technology.

Unless the unique attributes and limitations of air power are understood, the perils of sub-optimal utilisation would continue to prevail. History is replete with such instances primarily because of the fact that air power is the youngest form of military power to have evolved. Its relevance and application are yet to completely sink into the minds of military strategists and practitioners of operational art.

This is particularly so in our unique context since we are witness to the historical fact that civilisations waxed and waned depending on the might of their armies. For instance, the survival of the various empires of the Mauryas, the Guptas, and later, the Mughals, etc through thousands of years, was entirely dependent on their armies until the British introduced the concept of maritime power by the 18th century. Armies have been, visible manifestations of sovereign might for thousands of years. The British displayed to the world the impact of maritime power in the recent centuries. Thus, a generic comprehension of the utility of armies and, to a certain extent, maritime power is inherent in the national psyche.

Air power, by contrast, arrived in the past few decades and, hence, its relevance, potential, and applicability are yet to sink in fully into our nation's consciousness. The use of air power as a powerful flexible tool for national security, statecraft and overall development is yet to be comprehended in full measure, leading to continued instances of its sub-optimal utilisation. The full-scale utilisation of the Indian Air Force (IAF) during conventional wars like the 1965 and 1971 India-Pakistan Wars, its non-utilisation during the 1962 Indo-China War and restricted use during the 1999 Kargil conflict serve to illustrate the point.

EXAMINING THE ROLE OF AEROSPACE POWER IN THE INDIAN CONTEXT

Air power, in its classic sense, is understood as the total ability of a nation to assert its will through the medium of air.[4] It includes both civil and military aviation, existing and potential. The traditional interpretation

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4. This classic definition is attributed to the Russian air power theorist Alexander Procofieff Seversky.

evolved further as technology evolved to allow a variety of platforms to operate at a variety of heights in the atmosphere and beyond. For instance, Common Aerospace Vehicles (CAVs) are today a reality with platforms like the X-37 B launching into space to perform space operations and then gliding back to earth. Other nations have likewise begun their programmes to both harness the opportunities presented by the opening up of space, and to prepare against the challenges of defending against threats from air and space.[5] Apart from platforms, space capabilities are used in conjunction with air capabilities to fulfill a variety of tasks ranging from observation to communication, navigation, etc. No longer is high-level aerial imagery used in isolation—it is used in combination with space-based observation. Similarly, for navigation, a combination of inertial navigation and satellite navigation is in vogue. Quite clearly, in the modern sense, air power has evolved to aerospace power that is a product of aerospace capability and aerospace doctrine. Within this broad premise, national air forces are unique in the sense that they are the only national military institution exclusively devoted to military operations in the aerospace continuum. Little wonder then, that across the world, the transformation of air power to aerospace power is spearheaded by national air forces.

Air power is the strength of an air force as opposed to an attendant capability. The strength of India's air power lies in the IAF with the capabilities of the air arms of the other Services reinforcing that strength. Other aviation related research and development as also industrial capabilities provide a force multiplier effect. The strength of air power includes the ability to harness the opportunities in the operating medium and also to secure the nation against threats from the operating medium. With the altitude now having been pushed beyond the atmosphere into space, it is imperative that space capabilities are integrated to provide aerospace power to the nation. With the largest constellation of civilian

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5. For a more exhaustive treatment of the evolution, see Wg Cdr KK Nair, "The X-37B Space Plane: Space Militarisation, Weaponisation or Plain Experimentation", *Infocus Journal*, October 17, 2014, available at capsindia.org/files/documents/CAPS_Infocus_KKN-1.pdf

remote sensing and communication satellites, India's space capabilities are formidable. With cryogenic technology being mastered, our launch capabilities are amongst the cheapest and best in the world. However, the fact that the Indian military boasts of nothing more than one dedicated military satellite clearly indicates a large gap in the integration of space capabilities. Apart from the opportunities, the threats also need to be taken cognisance of. As of now, the ability for situational awareness over our sovereign territory is confined to the lower reaches of

The Preamble of the Indian Constitution summarises our aims and objectives as a nation. From our national aims and values enshrined in the Constitution flow our national interests, which, in turn, determine our national security objectives.

the atmosphere where most aircraft fly. The upper atmosphere, used by high altitude drones, observation balloons, missiles, common aerospace vehicles and spacecraft, remains unobserved. An attendant and available strength in the form of space capabilities is neither harnessed nor secured against. The dictates of modern warfare demand pitting strength against an attendant vulnerability. Our adversaries can be expected to do likewise, hence, it would be essential to harness our civilian strengths in space so as to pit strength against strength and prevail when the challenges of modern warfare present themselves. Our strength as a nation now lies in our cumulative aerospace capabilities and it is essential to adapt and evolve accordingly.

THE ROLE OF THE IAF IN THE NATIONAL SECURITY MATRIX

The IAF has played a pivotal role in the country's security ever since its inception over 75 years ago. Contrary to conventional wisdom, the IAF was established as an independent force on October 8, 1932 making it one of the oldest, continuously functioning independent air forces of the world. The past years have witnessed the IAF grow from a fledgling companion of the Royal Air Force (RAF) in India to an independent professional fighting force that has always endeavoured to be in the forefront of national service.

Hence, land and naval forces had little option apart from fighting their way in to decisively influence the outcome, even if it meant having to accept significant attrition. The arrival of air power changed all that.

They are also witness to its gradual evolution to a credible aerospace power.

The dominant role of air power in modern warfare, the high costs of aircraft and allied equipment, and a host of other factors demand closer attention to their potential and role in securing national interests. The case of the IAF can be no different, since the strength of our nation's air power is rooted in it. It would, hence, be essential to understand the place of the IAF in the national security matrix.

The Preamble of the Indian Constitution summarises our aims and objectives as a nation. From our national aims and values enshrined in the Constitution flow our national interests, which, in turn, determine our national security objectives. This, in turn, dictates the military strategy which is the process of coordinating the development, deployment and employment of military forces to achieve national security objectives. Military strategy essentially is a combination of land, maritime and air strategies. Since land, sea and air have their distinct characteristics, advantages and limitations, the strategic options enabled by land, maritime and air power are equally distinct.

Success in conventional conflict has historically hinged on the destruction of an enemy's fielded forces, followed by capture or termination of the enemy's leadership. Hence, land and naval forces had little option apart from fighting their way in to decisively influence the outcome, even if it meant having to accept significant attrition. The arrival of air power changed all that. Air power could circumvent the enemy's land, naval forces and directly attack the enemy's leadership, its command and control centres and other areas of critical vulnerabilities which would lead to early capitulation of the enemy. This was illustrated in ample measure during the 1971 Indo-Pak War when, following a bombing of the Governor's House in Dacca by the IAF, Pakistan agreed to a ceasefire with most of its military forces in the western sector relatively intact.

Apart from the ability to circumvent is the ability of air power to decisively interfere in the enemy's land and sea operations without the reverse being true. Take, for instance, the battle for Longewala, wherein Pakistani armour was decimated by the IAF with no reciprocal damage. The IAF dominated the skies and, hence, it could interfere as it pleased.

The ability of the IAF to rapidly project military force and influence statecraft have become increasing evident post-independence. The speedy aerial reinforcement of Srinagar during the 1947-48 conflict with Pakistan demonstrated the first visible exploitation of air power by India to further national strategy. Similarly, the aerial evacuation of King Tribhuvan of Nepal in 1950 during a crisis and his subsequent reinstation to the throne paved the way for the Indo-Nepalese Treaty of Friendship. Air power's coercive capability (without any offensive action) was demonstrated in 1987 when the IAF conducted a humanitarian air-drop to provide succour to the Tamil civil population in Jaffna. This finally led to the Indo-Sri Lanka Accord of 1987. The role of the IAF in launching a swift air-landed operation during Operation Cactus in 1989 to drop Indian forces at Male was crucial in the rescue of the besieged Republic of Maldives and subsequent restoration of the Maldives government.

In keeping with its mandate of enabling national development, the IAF also plays a significant role in aid of civil population during disasters, crises, etc. Notwithstanding the size of the country and the varied terrain, it deploys swiftly and frequently across the country for disaster mitigation, control, etc. The IAF frequently deploys for supply drops as also aerial evacuation during natural disasters like earthquakes, cyclones, landslides, floods, etc both within the country and even beyond. For instance, during the 2004 tsunami, the IAF conducted airlift and relief operations in the Andaman and Nicobar Islands as also in Maldives and Sri Lanka. Its transcontinental reach was apparent when, during Hurricane Katrina, the IAF rapidly responded and delivered aid and supplies in Arkansas, USA. Numerous such operations have been conducted and the statistics are mind-boggling. For instance, the IAF evacuated 40,000 people during snowstorms in Jammu and Kashmir in 2005. It evacuated over 1,13,700 Indians during the 1990

Iraqi invasion of Kuwait, making it the biggest airlift ever, at almost double the figures of the famous Berlin airlift.

It also serves the ends of democracy by periodically transporting paramilitary and civilian personnel for election duties in violence prone areas.

The role of the IAF in defending the skies on a daily basis is carried out by fully armed aircraft on live Operational Readiness Platforms (ORPs) or Combat Air Patrols (CAPs). These are capable of responding within minutes to signal the resolve of the Government of India in deterring any aerial misadventure. All the above examples are demonstrative of the fact that air power enables force projection, both benign and otherwise, in support of national security objectives in a myriad ways.

AIR POWER AND JOINTNESS

At the same time, there always has to be cognisance of the fact that air power delivers best when used in synergy with the other components of military power. The conflicts and developments of the past three decades indicate a growing role for air forces. In fact, certain air campaigns conducted by the Western air forces, particularly the US and its allied forces, have led to a school of thought that believes wars can be won entirely by air forces. The thought is extremely enticing. However, one needs to be cautious in subscribing to these views since these perceptions draw on the experiences of air forces pitted against markedly inferior militaries, with little or no air power capabilities. The context is entirely different, and the conclusions and inferences of these operations have to be applied with caution in our Indian context.

In our case, the experiences of the past indicate that air power cannot win a war by itself, and, at the same time, no modern war can be won without it. Our records indicate that in almost every war fought since independence, the IAF has played a significant, and, at times, pivotal role. It also indicates that air power can be exploited best not only when it is in synergy with the other two components of the military, but also with the diplomatic efforts and other national civil processes. The spectrum of modern conflicts

is significantly different, and modern wars, whether conventional, sub-conventional or unconventional (with or without a nuclear overhang), cannot be won singly by any one of the three primary components of military power. Modern conflicts can be decisively influenced only by each component of military power operating in synergy with each other and optimally exploiting the unique attributes of its medium of operation (air, land and sea) to achieve national objectives. Since the objective is common, joining forces and operating jointly would be the most logical recourse of arriving at solutions to national challenges. Integrated and joint operations comprise the cornerstone of modern military operations, and aerospace power must be seen as the binding factor. This is primarily so since land and naval forces historically operated independent of each other until the advent of air power. Air power enables land and naval forces to undertake sustained operations beyond their physical operating mediums of land and sea, leading to the increasingly accepted perspective of air power being the lynchpin of joint operations.

EXPANDING JOINTNESS BEYOND THE SERVICES

AIR POWER AND NATIONAL DEVELOPMENT IN THE WIDER CONTEXT OF ECONOMIC GROWTH

Apart from national air forces which enable military power projection, it also needs to be borne in mind that national civil aviation and the industry and infrastructure supporting aviation comprise one of the most powerful drivers of national economies. Growth in national aviation is a catalyst to economic growth and vice-versa. The above is particularly relevant in view of the fact that our national economy grew at a rate of 9.1 percent during the first half of 2006-07, Gross Domestic Product (GDP) growth rate spiked to 9.7 in 2008, and spiked again to 9.4 in 2011. The GDP rates have fallen since, but the fall is not expected to last[6] in view of

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6. See "Economy, Market on High Octane", *The Times of India*, January 13, 2007, and World Bank GDP growth rate data at http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG and India GDP Annual Growth rate at http://www.tradingeconomics.com/india/gdp-growth-annual.

the fact that India has been the 9th fastest growing economy since 1980 and is expected to sustain this growth till at least 2020. The sustained growth is expected to lead to an unprecedented rise in the demands on civil aviation. Aircraft orders to meet the growing demand are expected to continue rising till 2020. Secondly, India's burgeoning middle class, which drives the booming economy, is increasingly choosing air over rail travel. The above has led to an increased demand for civil aviation. For example, during the Paris Air Show in 2005, India's order for 400 aircraft was the largest in the world. The boom in demand may not be consistent, but it certainly would increase in the future. To put matters in perspective, passenger traffic is expected to increase by more than 50 percent. The forecast of growth of passenger traffic at 7.7 percent in India is well above the global average of 4.8 percent and even above China's 7.2 percent[7]. India is currently the 9th largest aviation market handling 121 million domestic and 41 million international passengers.[8] Overall, air transport (including air freight) in India attracted Foreign Direct Investment (FDI) worth US$ 456.84 million from April 2000 to July 2013, as per the data released by the Department of Industrial Policy and Promotion (DIPP)[9]. All of the above is considering that the domestic regional aviation market is yet to open up. The potential, at present, is only unfolding and as time progresses and the economy stabilises, the demands on civil aviation can only be expected to increase.

It is, hence, not surprising that while most of the globe post September11 experienced a drawdown in civil aviation, India registered a reverse trend. At the same time, the present global recession complicates future projections. The future is always fraught with uncertainty. The Indian economy would not be immune to the global meltdown and the impact would certainly be felt. However, since the aviation market and industry are characteristically capital-intensive and cyclical, with long lags between investment decisions

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7. As revealed by Airbus's global market forecast in Press Trust of India Report, "India to Face $105 Bn Demand for Aircraft", *The Financial Times*, December 7, 2006.
8. See Indian Brand Equity Foundation Report, dated September 13, 2013, at http://www.ibef.org/industry/indian-aviation.aspx
9. Ibid.

and project completions, the impact of a short-term recession would be cushioned.

With regards to the military component of national air power, India's military aviation sector is also amongst the fastest growing in the world. Around 500 aircraft and acquisitions worth billions are expected within the next few years[10]. The IAF, as part of its modernisation drive, is expected to procure air assets worth over $ 38 billion by 2020.[11]

The point being made is that the scale of economies herein is massive. The economic clout presently being wielded by Indian air power is the most powerful in the world. Its ripple effect on the economies of other nations would be tremendous. The factors driving our decisions, hence, would need to take into account both the narrow operational and tactical requirements as also the larger national strategic issues. The standard dictum of concentration of force and effort makes enormous sense in this case. We would need to leverage our advantages as a singular cohesive entity to obtain maximum returns keeping the breadth and depth of our national goals in mind. The depth demands we look beyond the conventional to the advantages now accruing beyond the atmosphere also. We need to look upwards onto space, not for divine intervention, but to harness the earthly advantages accruing due to the Indian revolution in outer space.

HARNESSING THE INDIAN SPACE REVOLUTION

With regards to space, its impact on revolutionising national development and commerce is apparent to the entire nation. India ranks among the top six space-faring nations of the world in terms of budgets and technological capabilities. In 2009, the Indian Space Research Organisation's (ISRO's) budgetary allocation was Rs.41.67 billion (US$ 0.91 billion), in 2010-11 it rose to Rs.57.78 billion (US$ 1.26 billion), accounting for about 0.14 percent of the GDP, and continues rising[12]. The commercial aerospace industry plays a progressively larger role in the space missions and taps

10. Refer Rajat Pandit, "Aviation Majors Eye Indian Defence Market", *The Times of India*, December 21, 2006.
11. Refer FICCI Report, "Indian Aviation: Spreading its Wings," February 2013.
12. Refer Deloitte Report, "Overview of Indian Space Sector-2010," August 2010.

The total acquisition of civil and military aircraft up to the year 2025 is expected to number over 1,600 and monetarily worth hundreds of billions of dollars. On the other hand, our space assets presently earn for the nation revenues of around $ 90 million.

the outsourcing work offered by ISRO. From the successful launch of the GSLV D-5 in January 2013, it is demonstrably evident that India's cryogenic technologies have matured. This augurs well for all the three prime components of national power. It serves the needs of knowledge and information, the economy, as also the military. Apart from launches, India's national space programme is focussed primarily on space-based telecommunications and observation which form the backbone of modern information systems. The Indian Navy has obtained its dedicated military satellite for communications[13]. With the successful launch of the GSLV D-5, the other Services would soon receive their much sought communication capabilities. A complement of observation satellites serves for certain military and civil purposes, navigation satellites are on the anvil, and overall the major components enabling air and space-based 'informationalisation' are in place. Purposeful and efficient utilisation would demand integration of these components.

PUTTING THE ACT TOGETHER

In view of the foregoing, it is conclusively apparent that there exists an emergent need to treat the entire vertical dimension as a single entity and harness the cumulative potential of air and space systems: civil and military, existing and potential. The individual competencies of all these diverse components of aerospace power would need to be assimilated, employed and wielded as a single composite entity for commercial, military and political gains to the nation. For example, the total acquisition of civil and military aircraft up to the year 2025 is expected to number over 1,600

13. Refer PTI News Report, "India's First Defence Satellite GSAT-7 Launched Successfully", *The Times of India*, August 30, 2013; and D.S. Madhumati, "Navy's First Satellite GSAt-7 Now in Space", *The Hindu*, August 30, 2013.

and monetarily worth hundreds of billions of dollars. On the other hand, our space assets presently earn for the nation revenues of around $ 90 million, which is expected to increase. The political, economic and military clout such acquisitions and sales would accrue would be immense. Such clout wielded in concert would have a more gainful impact on the national power indices rather than the prevailing disjointed efforts.

Such mammoth transactions also arrive with a variety of attendant opportunities and chaos. Left directionless, the opportunities in air and space might go untapped, significant gains may be frittered away piecemeal, and large scale chaos and rivalry would prevail. The above is in sharp contrast with global trends wherein overall national air power efforts are getting increasingly integrated. Integration of military and civil production of aircraft and allied systems is on the rise. In the case of space, military and civil programmes are deeply intertwined, and at times, almost indistinguishable, as in the case of China. The integration extends beyond the platforms and allied systems onto the support infrastructure also. In our unique case, such integration is largely absent at present. The anticipated expansion in capabilities would need to be sustained by an equally efficacious support infrastructure. For example, maintenance support would be essential for sustaining the expansion, yet, the same is in a state of serious neglect. National Maintenance, Repair and Overhaul (MRO) opportunities are aplenty, but this vital sector is presently characterised by neglect and chaos. Most heavy maintenance of civil aircraft is carried out abroad, whereas the military does the same locally and with a much more diverse set of aircraft. The IAF's large reservoir of trained aviation technicians goes untapped, in spite of the fact that hundreds superannuate annually and join the ranks of the jobless. Apart from services, manufacture is characterised by overzealousness to import technology. India's globally renowned

Such mammoth transactions also arrive with a variety of attendant opportunities and chaos. Left directionless, the opportunities in air and space might go untapped, significant gains may be frittered away.

innovative acumen and spirit of entrepreneurship goes unnoticed. The immense potential of local industry to contribute and gain goes untapped.

On the other hand, India's civilian DoS (Department of Space) boasts of the largest constellation of remote sensing satellites in the world and provides services and products across the globe. Yet, its military is unable to tap into it, and scouts across the world, finally ending up with imagery from commercial international firms like Space Imaging, Israel's Offeq, etc. Evidently, while individual competencies are significant, the cumulative potential of air and space systems is yet to be realised or tapped.

Secondly, with regards to employability, the inherent flexibility of air and space systems enables a wide variety of common options for civil and military applications. Apart from aircraft and satellites which could be put to both military and civil uses, other platforms like Unmanned Aerial Vehicles (UAVs), etc could also be utilised for a variety of applications ranging from policing jobs to disaster mitigation, etc. Similarly, surveillance, communication, navigation as well as search and rescue assets, both military and civil, airborne and spaceborne, would need to be integrated to afford optimal utilisation of assets and coordinate efforts. A case in point is the envisaged networking of civil and military radars for a composite air picture. The same would need to be integrated and extended vertically further into space by utilising the civilian space assets. The threat to platforms is no longer limited to the atmosphere—it extends into space, and situational awareness of the realm above the atmosphere would, hence, be imperative in the present times as also in the future. The foreseen crowding of the national air space and the challenges of air space management in the near future would also demand greater coordination of air and space assets. It would be even more imperative in view of the anticipated test flight of India's "multi-purpose aerospace vehicle" which would transcend the realms of both air and space[14].

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14. For details on the multi-purpose aerospace vehicle, see speech of President of India, Dr. APJ Abdul Kalam, "Vision for Aeronautics Missions", JRD Tata Memorial Lecture, Bangalore, August 20, 2005. Available at home site of President of India, http://presidentofindia.nic.in/scripts/sllatest1.jsp?id=579 -->

INSTITUTIONALISING THE NATIONAL AEROSPACE EFFORT WITH AN AEROSPACE BODY

Air and space assets, nonetheless, would be scarce and costly. Hence, there would be a need for a central body to arrest duplication and coordinate national efforts for common gain as well as coherent direction during crises and contingencies. It would be imperative to streamline the acquisition, development, management and employment of these potent elements as a single entity for comprehensive national gain.

An Aerospace Commission to Synergise Air and Space Power: Paradoxically, in an era of magnificent machines, it is the man and management modes which would ultimately be decisive. Therefore, it would be essential to have a singular national body constituted with suitable men and management modes tasked with streamlining the foreseen surge in national aerospace capabilities into potent national indices of power. The body could be instituted with the task of consolidating national requirements and guiding the acquisition, management and development of national air and space capabilities and competencies. At the same time, individual competencies and tasks would be left untouched. The guiding principle would be centralised direction, decentralised control and execution. The aim would be to centralise direction while leaving organisational control and execution of committed tasks untouched. The point is not to add an additional layer of bureaucratic control, but to have a single potent body which enables cross-exchange of resources and judicious sharing of potent capabilities in tune with the larger needs of building Comprehensive National Power (CNP). Thus, the prevailing Space Commission would continue guiding the drive for national space competencies, the IAF's operational tasks would be left untouched, the Directorate General for Civil Aviation (DGCA) would continue regulating civil aviation, etc. At the same time, the means of consolidating competencies for mutual benefit (without affecting individual competencies) could be explored, scarce resources in terms of personnel, equipment and services could be traded internally, mutually damaging rivalries could be resolved, etc. In view of national interest and the greater common good of all, a roadmap and the means to

tread on it could be decided and acted upon. In sum and substance, hence, the conceptual framework of the institution dedicated to the development and exercise of national air and space power (and by extension, national power) would be of a non-intrusive yet effective paternal character. It would herd the diverse components onto the path of nation building, enable the means to tread the path with optimum efficiency, and leave the actual tread to the prescribed organisations. In keeping with the immense unpredictable pace of technology, a system to monitor and enable mid-course corrections would also need to be included. The body would need to be inherently dynamic and adaptable for harnessing newer and more potent opportunities and options.

Broadly, the following institutional structure could be envisaged as given in Fig 1 below.

Fig 1

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                    ┌──────────────┐
                    │   National   │
                    │  Leadership  │
                    │    (PMO)     │
                    └──────┬───────┘
                    ┌──────┴───────┐
                    │  Aerospace   │
                    │  Commission  │
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┌──┴──────┐ ┌───┴────┐ ┌───┴────┐ ┌───┴────┐ ┌───┴─────┐ ┌───┴────┐
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│Private  │ │DRDO    │ │DOs     │ │IAF     │ │DGCA     │ │HAL     │
│Industry │ │        │ │        │ │        │ │         │ │        │
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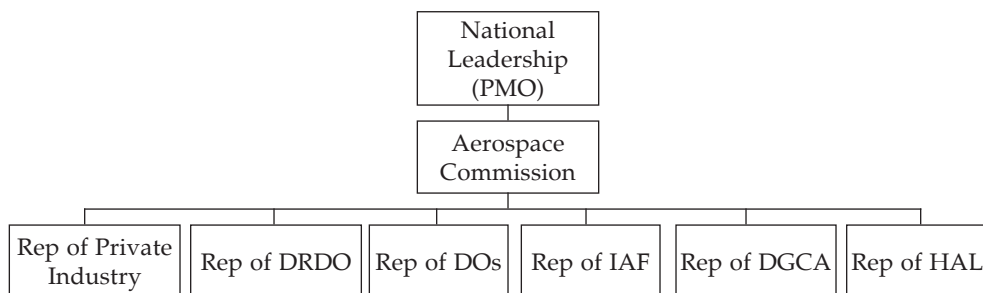
The envisaged commission would:

- Obtain inputs from all the components and adopt a dynamic national aerospace vision as well as roadmap to guide development of national aerospace capabilities and competencies.
- Exercise its authority to enable the means of fulfilling the vision and treading the roadmap.
- Formulate a national aerospace policy for developing, sustaining and employing aerospace power in pursuit of national interest.
- Perodically review measures aimed at efficacious development and exploitation of aerospace power and recommend the options and opportunities laterally and vertically.

- Provide an authoritative interaction among the military, civil and commercial bodies as well as international bodies. Overall, it would harness and network the strengths and individual competencies of the aforestated Instruments of Power (IoP) for common gain within the aegis of national interest.

The above list is by no means exhaustive and is only illustrative of the wide variety of tasks it would be called upon to perform once it is instituted. In sum and substance, the framework of the commission would need to be dynamic and adaptable to withstand the rigours of ever-changing technology and national interests. We need to adapt and prevail in a changing world.

INDIA'S AEROSPACE FOOTPRINT IN THE IOR

R A MASLEKAR

SUMMARY

The Indian Ocean Region (IOR), while being a major source for energy security and trade, is also a cauldron of instability due to conflicts, piracy and terrorism. The major powers consider the IOR to be of great strategic significance. China, too, is steadily enhancing its footprint in the IOR. India's geographical location gives it a natural influential position over the major sea lines of communication and choke points in the Indian Ocean. Its aerospace capabilities are vital elements of national power for securing its interests in the region. Hence, these capabilities need to be developed and acquired to match the imperatives of the time.

Fig 1: Indian Ocean Region

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The IOR also has the unique distinction of hosting the major powers of the world, far away from their mainland, either through island territories or leased bases on the territories of the IOR countries.

INTRODUCTION

Long before the larger Atlantic and Pacific Oceans had been well explored, the Indian Ocean was a bustling region of travel and trade. There is evidence that the Egyptians explored the Indian Ocean as early as about 2300 BC, when they sent maritime expeditions to the "land of Punt," which was somewhere on the Somali coast.[1] More than 2,000 years ago, traders sailed the ocean to exchange goods between India and Africa and Arabia.[2] The Indian Ocean, the world's third largest ocean, covers 73.556 million sq. km. of area and includes a number of seas, bays, gulfs, straits and channels[3]. The major choke points include Bab-el-Mandeb, Strait of Hormuz, Lombok Strait, Strait of Malacca and Palk Strait. Through these waters, nearly 70 percent of the world's energy trade and half of its container traffic transits each year. The Indian Ocean has become the primary passage for the 21st century economic balance shift from the West to the East.

The Indian Ocean Region (IOR), with 35 states (29 littoral and six island states), is one of the most complex regions in the world, spread over three continents and having a wide variety of races, cultures and religions, as well as being well endowed with natural resources. In percentage terms, the region has the largest population in the world. The people coexist at different levels of economic development, with different types of governments of varying levels of political stability and quality of governance, demographic pressures, ethnic and sectarian tensions.[4] The region is a cauldron of instability due to persistent conflict situations and the spread of terrorism. The IOR also has the unique distinction of hosting the major powers of

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1. Retrieved at http://www.britannica.com/EBchecked/topic/285876/Indian-Ocean
2. Retrieved at http://kids.britannica.com/elementary/article-346145/Indian-Ocean?#9346145.toc
3. Retrieved at http://en.wikipedia.org/wiki/Indian_Ocean
4. Leighton G Luke, Ciara O'Loughlin, *Indian Ocean: A Sea of Uncertainty* (West Perth, Australia: Future Directions International, 2012).

the world, far away from their mainland, either through island territories or leased bases on the territories of the IOR countries. All the major powers have a considerable military presence in the IOR. This ocean is expected to play a critical role in the US' Asia pivot strategy. India has a prominent and unique geographical position in the IOR, halfway between Africa and Australasia. The Indian peninsula juts into the Indian Ocean, giving the country an inherent influential presence in the region. Its island territories of Lakshadweep and the Andaman and Nicobar group enhance its reach further into the ocean. India, if it continues its focussed growth in the economic and military

Aerospace power has enabled nations to exercise their power and influence across vast distances in a rapid response to a dynamic strategic environment. Aerospace power can be defined as the total ability of a nation to assert its will through the medium of air and space.

dimensions, will be sought by the major powers to play a role of immense strategic significance in the region. The Indian Ocean will play an important role in India's progress towards being in the same league as the world powers. India would need to balance its focus between the Himalayas and the Indian Ocean to secure its national interests.

It is, therefore, essential for the nation to possess a potent instrument of national power capable of deterring conflict and maintaining peace. Aerospace power has enabled nations to exercise their power and influence across vast distances in a rapid response to a dynamic strategic environment. Aerospace power can be defined as the total ability of a nation to assert its will through the medium of air and space. It includes both civil and military capabilities. Aerospace power enables surface forces to undertake operations beyond their physical operating mediums.[5]

This paper aims to assess the present scope of India's aerospace power footprint in the Indian Ocean Region in securing its national interests. It will discuss only the aerospace capabilities of the country to first detect, and then counter, the threats to national interests in the IOR. However, it is

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5. *Basic Doctrine of the Indian Air Force* (New Delhi: Air Headquarters Vayu Bhawan, 2012).

The International Seabed Authority had allotted India and China a large area in the central Indian Ocean for seabed exploration. After surrendering some of the blocks due to inaction, India has once again put forward a claim for additional allotment of seabed blocks as a response to the Chinese efforts.

an acknowledged fact that any counter-action would necessarily be a joint operation and, thus, need an all round capability, without overdependence on a single arm or Service of the defence forces.

INDIAN INTERESTS IN THE IOR

Writing in the 1940s, K. M. Pannikar had argued that "while to other countries, the Indian Ocean is only one of the important oceanic areas, to India, it is a vital sea. Her lifelines are concentrated in that area, her freedom is dependent on the freedom of that water surface. No industrial development, no commercial growth, no stable political structure is possible for her unless her shores are protected."[6] Indian interests in the IOR may be broadly classified as economic, diplomatic and military.

Economic

India has a coastline of more than 7,500 km, 1,197 island territories and an Exclusive Economic Zone (EEZ) of more than 2.3 million sq km. It sits astride vital Sea Lanes of Communication (SLOCs) which provide it with the shortest and most economical means of overseas trade. Ninety percent of the country's trade by volume and 77 percent by value is seaborne. India's need for energy for its economic growth is dependent on an assured supply of coal, crude oil and natural gas. These energy resources are mostly imported as indigenous production is limited. The country's major oil and gas fields are located offshore. As overland natural resources are getting depleted, the focus is now shifting to deep seabed mining. Inter-state competition over seabed minerals is emerging as a major strategic issue, given the region's vast mineral deposits containing valuable metals such as

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6. Retrieved at http://www.foreignaffairs.com/articles/111008/k-m-panikkar/india-and-the-indian-ocean

silver, gold, copper, manganese, cobalt, and zinc. [7] The International Seabed Authority had allotted India and China a large area in the central Indian Ocean for seabed exploration. After surrendering some of the blocks due to inaction, India has once again put forward a claim for additional allotment of seabed blocks as a response to the Chinese efforts. Certain rare earth minerals are also found in near-shore sand bodies in India's coast. One such mineral is 'thorium' found in the sands of the Kerala coast which is also a source for nuclear energy. India's exports of marine products not only contribute to its economic growth, the seas are also a source of livelihood for a large part of its populace.

Diplomatic

The Indian diplomatic footprint in the IOR is fairly strong even though the overall strength of its diplomatic corps is limited as compared to even smaller nations. This reflects its focus on the countries of this region due to the following factors which are of considerable importance to India's national interests:

- Energy security.
- Natural resources.
- Markets for Indian manufactured goods and services.
- Indian diaspora.
- Indian immigrants repatriating large amount of remittances.

India does not have the money power or the military prowess to spearhead its diplomacy. Hence, it has chosen its 'soft power' capabilities to build friendly relationships with other countries. India had undertaken good initiatives like the Indian Technical and Economic Cooperation (ITEC) programme way back in 1964 to assist developing nations in training select individuals in various fields, including defence. Most of the IOR countries have benefited through this programme. The pan-African E-Network project initiated by India to e-connect 48 African nations to provide

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7. Retrieved at http://chellaney.net/2013/11/29/bridge-between-europe-and-asia-strategic-challenges-in-the-Indian-Ocean

tele-education and tele-medicine has many IOR littoral African states as members.[8] Such initiatives have helped India garner diplomatic support at various fora and would also be needed in the future if India aspires for permanent membership of the United Nations Security Council (UNSC). India's attempt to raise the level of diplomatic relations with the Islamic states of the IOR is to cater to the social and economic needs of its Muslim population as also to counter Pakistan's efforts against Indian interests.

Military

India's military diplomacy in the IOR, though limited in scope, has led to considerable goodwill and helped enhance bilateral relations. India's security relations in the region are anchored by its close relationships with many countries on the eastern seaboard of Africa, the island nations in the IOR, and those of the Persian Gulf. These countries have received military equipment from India as also training for security personnel. Also, the Indian defence forces have, in the past, assisted various state governments against possible coups, in peace-keeping operations under the UN flag, in disaster relief, and maritime security during regional and world conclaves, e.g., naval ships patrolled off the coast of Mozambique during the African Union Summit in 2003 and World Economic Forum Meet in 2004. In reciprocation, India has been allowed to set up communication monitoring facilities, and its military aircraft—even fighter aircraft—have been permitted to stage through on long distance transit, with logistics support and berthing facilities for naval ships. While India is averse to creating offshore military bases and has been voicing its concern against other countries' attempts in this regard, it needs to create and sustain a friendly environment which could facilitate its future military operations, if needed, and, as far as possible, negate the efforts of those inimical to Indian interests to gain any foothold.

ASSESSMENT OF THREATS

The late Prime Minister Jawaharlal Nehru summed up India's concerns regarding threats from the maritime front when he stated, "History has

8.   Retrieved at http://www.mea.gov.in/Portal/ForeignRelation

shown that whatever power controls the Indian Ocean has, in the first instance, India's seaborne trade at her mercy and, in the second, India's very independence itself."[9] Successive governments in Delhi have recognised the fact that the Indian Ocean has security implications in all its dimensions for the country. India's new 'maritime doctrine' is quite explicit on the central status of the Indian Ocean in Indian strategic thought and on India's determination to constitute the most important influence in the region as a whole. The key security considerations include:

- Accessibility of the Indian Ocean to the naval fleets of the world's most powerful states. Steady rise in the Chinese naval footprint in the IOR.
- Proliferation of conventional military power and nuclear weapons among the region's states.
- The large Islamic populations on the shores of the ocean and in its hinterland which have come under the influence of the radical and extremist leadership.
- Illegal immigrants and human trafficking.
- India being made a conduit for illegal trade in arms and narcotics.
- The oil wealth of the Persian Gulf. Critical dependency for energy security by many developed and developing countries.
- Importance of key straits for world trade and their possible effect as choke points.

As the third largest economy in the world and one largely dependent on foreign oil, India's primary strategic concern in the foreseeable future will be energy security. India will not only have to protect its offshore oil and gas assets but also the extensive investments of both its public and private sector oil companies in oil concessions in foreign countries, many of them in the IOR. These investments are perceived to need military protection as the criticality of the resource rises or instability spreads in the region.

Piracy, originating in Somalia in the early 1990s, has become an industry earning millions of dollars in ransom money for the perpetrators of the crime. Initially only affecting the coastal waters, the pirates' success has

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9.   Brahma Chellany *Asian Juggernaut* (Noida, India: Harper Collins Publishers, 2006).

The pirates' reach has now extended much closer to the Indian coast, leading to higher security concerns. In the broad expanses of the Indian Ocean, the distances involved are simply too vast to be monitored comprehensively.

meant that, with better weaponry and "mother ship" vessels, their operations were able to move progressively further out from the coast and were able to accost substantially larger ships, even super-tankers. Pirates have even attacked patrolling foreign naval vessels. The pirates' reach has now extended much closer to the Indian coast, leading to higher security concerns.[10] In the broad expanses of the Indian Ocean, the distances involved are simply too vast to be monitored comprehensively. Although in recent years, there has been considerable decrease in piracy incidents due to the combined effort by many nations, and laudable actions by the Indian Navy too, the situation can easily deteriorate with new players entering this business.

Maritime terrorism is likely to gain primacy in the future. The distinct advantage of using the seas as a supply chain link for terror attacks on land was made quite evident by the Mumbai attacks of 2008. An important adjunct to maritime terrorism is drug trafficking and gun-running. The increasing container transport by sea and lax security checks at ports have facilitated the carriage of human terrorist cargo, arms and ammunition, and narcotic drugs. India, by virtue of geography, lies at the pivot of the Golden Triangle and Golden Crescent, the two infamous drug-producing areas.[11] The large number of fishing ports and beaches along its coast, coupled with an utterly deficient coastal security apparatus, make India a most suitable location for all kinds of activities detrimental to national security and interests.

The Indian Ocean is potentially an arena for geo-strategic rivalry among the great powers, resulting in "Indian-Oceanic arc of militarisation" stretching from Egypt to Indonesia and further to Australia". Almost half of the Indian Ocean states have armed forces in excess of 100,000 and /

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10. Probal Ghosh, "Security Challenges from Non-State Actors in the Indian Ocean", *Strategic Trends, South Asia Series*, vol 1, issue 3, December 2011 (New Delhi: Observer Research Foundation).

11. Ibid.

or military expenditure in excess of 3 percent of Gross Domestic Product (GDP). Most of the West Asian portion of the IOR has been characterised as "the global zone of percolating violence" and "is likely to be a major battlefield, both for wars among nation-states and, more likely, for protracted ethnic and religious violence"[12] There is, moreover, "an increasing tendency of extra-regional powers of military intervention in IO littoral

Maritime terrorism is likely to gain primacy in the future. The distinct advantage of using the seas as a supply chain link for terror attacks on land was made quite evident by the Mumbai attacks of 2008.

countries to contain what they see as a conflict situation." Such actions add to the prevalent political instability in the region.

Chinese sea-faring interest in the IOR for trade dates back to the early 15th century when Adm Zeng He led large fleets of the Ming dynasty on several voyages through the Indian Ocean to the coastal countries of East Africa.[13] In the later half of the 20th century, China steadily increased its military footprint in the IOR, ostensibly to secure its national interests. Chinese assistance to the countries of South Asia to develop their maritime infrastructure, with an eye for future basing facilities for its navy, is perceived by India as a potential threat. This is of critical significance considering the fast pace of modernisation of, and large scale accretion to, the Chinese blue water naval capabilities

PRESENT AEROSPACE FOOTPRINT

Supplementing its diplomatic and political initiatives, India is shaping its growing military capability for envisaged threats emanating from and in the IOR. These forces should be able, should the need arise, to undertake the following tasks:

- Prevent militaries, especially the air forces and navies of hostile nations to have freedom of operation in the Indian Ocean.

12. Z Brzezinski, *The Grand Chessboard: American Primacy and its Geostrategic Imperatives* (New York: Basic Books 1997).
13. Edward L Dreyer, *Zheng He: China and the Oceans in the Early Ming Dynasty, 1405-1433* (New York: Pearson Longman, 2007).

- Operate in distant waters with impunity to safeguard Indian maritime and economic interests. If need be, project power over the mainland of hostile nations.
- Have all round surveillance, interception and interdiction capability over key choke points, on vital islands, around the littoral, and along key sea routes.

Effective accomplishment of these tasks would need all round capability development of the three components of the security set-up: the army, the navy and the air force. However, this paper will discuss only the aerospace capabilities of the country.

Indian Air Force

The Indian Air Force (IAF) has steadily developed its capabilities from being a small tactical air force to a credible strategic force. Its asset acquisition programme has focussed on multi-role, long range modern technology platforms, with adequate scope for indigenous development. A critical capability combination of the Air Superiority Fighter (ASF) Airborne Warning and Control System (AWACS) and Air-to-Air Refuelling (AAR) aircraft has been operationalised, enabling extension of the nation's offensive air capability from the eastern coast of Africa to western Australia. Enhancing of infrastructure in peninsular India, as also on the island territories, has further contributed to extension of air power influence over larger areas. However, fighter operations deep into the oceans and seas need dedicated and continuous training. The crews have to be physically fit and psychologically attuned for long flights over alien environments. The co-development with Russia of the Brahmos supersonic cruise missile for India's air and naval forces introduces a highly lethal capability that is most likely to be used as a conventional counter-force weapon. The limited strategic airlift capability acquired through the IL-76 aircraft procured in the early 1980s was put to good use in 1988 when a para battalion was airlifted at short notice from Agra to Male, the capital of the island nation of Maldives.[14] India's quick

14. Retrieved at http://indianairforce.nic.in

response had saved the legitimate government from being overthrown in a coup attempt. The recent acquisition of the C-17 Globemaster and C-130J Super Hercules has incrementally enhanced this capability. While the IAF has a large fleet of medium lift helicopters, these are not suitable for operations from naval ships. However, these could be airlifted in the C-17 aircraft in disassembled form for any "out of area" contingency.

While the IAF has a large fleet of medium lift helicopters, these are not suitable for operations from naval ships. However, these could be airlifted in the C-17 aircraft in disassembled form for any "out of area" contingency.

The IAF has been actively associated with military diplomacy undertaken by the country. It has been participating in multi-nation air exercises regularly, both within and outside India. This has enabled its air crew to be aware of international procedures and learn operational practices from modern air forces. They have also gained experience in long distance flights with multiple mid-air refuelling. The IAF has participated in disaster relief operations in many parts of the world, including the IOR, and was involved in 'coercive diplomacy' adopted by India against Sri Lanka when it undertook air-drops of aid material for humanitarian reasons over Jaffna in 1987.

Indian Naval Air Arm

India's naval fighter aircraft, operating from the INS *Vikrant,* had, for the first time in independent India, projected a potent and lethal capability during the 1971 Indo-Pak War on the eastern seaboard. During the same war, the country's political and military leadership had come under tremendous pressure following reports of the US carrier task force, led by the aircraft carrier USS *Enterprise,* heading towards the Bay of Bengal.[15] Other maritime operations the world over, involving use of aircraft, have reinforced the point of a robust naval air arm being a necessity and not a mere luxury, to the national leadership. Hence, the focus on a two-aircraft carrier-based navy, supplemented by land-based long-range maritime aircraft. The induction of

15. Retrieved at http://en.wikipedia.org/wiki/USS_Enterprise_(CVN-65)

the aircraft carrier INS *Vikramaditya* with its MiG 29K fighter aircraft has enhanced the offensive reach as well as the sea control capability of the Indian Navy. Procurement of one Landing Platform Dock (LPD), the INS *Jal Ashwa*, and plans for constructing more such units will give a fillip to heliborne capability from the seas. Recently, the navy has inducted the Boeing P-8I aircraft, which is a long-range, anti-submarine warfare, anti-surface warfare, intelligence, surveillance and reconnaissance aircraft, capable of broad-area, maritime and littoral operations. The older TU-142M long-range anti-submarine aircraft is still in operation, as is the IL-38 maritime patrol aircraft. These would need replacement in the near future. The navy has a limited number of various types of helicopters optimised for different roles ranging from early warning, anti-submarine, air assault and search and rescue. These helicopters have been procured from different countries. Onboard helicopters were effectively used by Indian naval ships in the anti-piracy role in the Gulf of Aden. Some Unmanned Aerial Vehicles (UAVs) have also been procured. These add to the surveillance capability of the navy.

Indian Coast Guard Air Arm

The Indian Coast Guard (ICG) is a maritime armed force operating under the Ministry of Defence. The force was constituted in August 1978 under the Coast Guard Act, 1978, and is mandated to protect the maritime and other national interests of India in the maritime zones of India. Its ships, air cushion vehicles and aircraft constantly patrol the Indian EEZ. The air arm is equipped with Dornier DO-228 aircraft for reconnaissance missions while the fleet of Chetaks and Dhruv Advanced Light Helicopters (ALHs) carries out search and rescue, tracking suspect vessels in anti-poaching and anti-smuggling tasks. The air arm is also tasked for monitoring oil spills. These assets are limited in number as well as capability considering the expanse of India's coastline and EEZ, and the likely threats. The aircraft are not weaponised, but the helicopters can carry armed personnel.

Indian Satellites

The Indian Space Research Organisation (ISRO) is the premier organisation

responsible for ensuring that the country's space-based assets capabilities match the growing demand for economic growth, and the security of national interests. It has been able to develop such capabilities with international assistance as well as indigenous technological prowess. ISRO has established two major systems, the Indian National Satellite (INSAT) series of geo-stationary satellites for communication, television broadcasting and meteorological services, and the Indian Remote Sensing (IRS) satellites which are the Earth Observation (EO) satellites for resource monitoring and management. IRS is the largest civilian remote sensing satellite constellation in the world, providing imageries in a variety of spatial resolutions, spectral bands and swaths. The Radar Satellite-1 (RISAT-1) is a state-of-the-art microwave remote sensing satellite carrying a Synthetic Aperture Radar (SAR) payload with resolution of one metre which enables imaging of the surface features during both day and night under all weather conditions. The RISAT will be used extensively for purposes like mapping, managing natural disasters and surveying the seas. It can also see through camouflage or foliage used to conceal camps or vehicles and even track ships at sea. The RISAT has reduced India's dependence on foreign agencies for satellite imagery.[16] India has taken steps to develop an independent regional navigation satellite system. It is designed to provide an accurate position information service to users in India as well as the region extending up to 1,500 km from its boundary, which is its primary service area. The Indian Regional Navigation Satellite System (IRNSS) will provide two types of service, namely, Standard Positioning Service (SPS) and Restricted Service (RS) and is expected to provide a position accuracy of better than 20 m in the primary service

India has taken steps to develop an independent regional navigation satellite system. It is designed to provide an accurate position information service to users in India as well as the region extending up to 1,500 km from its boundary, which is its primary service area.

16. Retrieved at http://ibnlive.in.com/news/india-launches-spy-satellite-risat2

India may need to develop its "over the horizon" look capability to complement its air and space-based assets to monitor and track foreign aircraft and ships, both civil and military, at further ranges than normally detectable through other types of radars.

area.[17] Even with such concerted effort to build space-based capabilities, India does not have continuous surveillance, tracking and mapping coverage over the IOR. The glaring deficiency in all round surveillance and tracking got highlighted when the MT *Pavit*, a ship which was drifting after being abandoned by its crew near Oman, ran aground at one of the beaches of Mumbai in 2011.[18] Such an incident is a wake-up call for the nation still trying to shore up its security post 2008 Mumbai attacks by the terrorists.

NEED FOR FUTURE ACCRETIONS

The Indian efforts to keep as much area of the Indian Ocean under its watch as is possible are being incrementally enhanced by the acquisition of wide-ranging capabilities. These capabilities are spread over offensive and non-offensive assets. However, some distinctive capabilities could be added to make the country's response more time-sensitive and effective. Such capabilities are described in the subsequent paragraphs.

Amphibious Aircraft: India, with more than 1,100 island territories many of them uninhabited and quite distant from the mainland, needs capability to ensure their security. Such capability has to be quick to respond, with minimal operating constraints. The main advantage of the amphibious aircraft is its versatility to operate from land as well as water. These aircraft are generally built for long range and extended endurance to operate over a vast expanse of seas and also be capable of carrying passengers and evacuating stretcher casualties. Their Short Take-off and Landing (STOL) capability enables these aircraft to operate from restricted space on land and over water. These may be equipped with a plethora of

17. Retrieved at http://www.isro.org/satellites/navigationsatellites.aspx
18. Retrieved at http://www.thehindu.com/news/national

electronic equipment for reconnaissance and surveillance, and are capable of day and night operations. While they may not be able to hover over a designated spot like a helicopter, their operational capabilities far exceed those of shipborne or land-based helicopters. Large amphibious aircraft like the Shimaywa US-2 can also operate in deteriorating sea conditions which would normally ground any other aircraft or helicopter.[19] The incident of January 2011 when a Somali pirate mother ship the *Prantalay 14*, was detected by an Indian Coast Guard Dornier aircraft about 200 miles from Kochi, leading to its interception by navy and coast guard ships after about seven hours of tracking, emphasises the need for large amphibious aircraft for a quicker response.[20] Such incidents have been occurring with alarming regularity.

Over the Horizon Radar: India may need to develop its "over the horizon" look capability to complement its air and space-based assets to monitor and track foreign aircraft and ships, both civil and military, at further ranges than normally detectable through other types of radars. The extended ranges would give adequate response time.

Amphibious Assault Ship / Landing Platform Helicopter (LPH): The Indian Navy has embarked on capability enhancement based on the concept of a carrier task force. It also has plans to build more Landing Platform Docks (LPDs) like the INS *Jal Ashwa* which has the capacity of accomodating six helicopters. Most of the naval ships are capable of accommodating at least two light utility helicopters. However, what is required is a ship that is able to embark a large number of heavy and medium lift helicopters for conducting vertical envelopment operations from the seas. And, if the need arises, attack helicopters could also be carried on board. A modern-day example of such an operation was the one by the HMS *Ocean* during the Libyan crisis of 2011.[21] During the April 2015 emergency evacuation of more than 5,000 Indians and foreign nationals from Yemen by Indian ships and aircraft, an LPD/LPH type of ship with a large component of heavy or

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19. Retrieved at http://www.shinmaywa.co.jp/aircraft/english/us2
20. Retrieved at http://www.thehindu.com/news/national/kerala/navy-destroys-pirate-mother-ship arrest -pirates/article1137420.ece
21. Retrieved at http://www.royalnavy.mod.uk/

The interests of outside powers in the IOR may grow to such a level as to be in direct confrontation with those of India. It would then depend upon the wisdom and diplomatic acumen of the national leadership whether India stands firm or acquiesces to the adversary.

medium lift helicopters may have facilitated the operation in a more effective manner. In the future too, India is likely to be involved in such evacuations from the IOR littorals as a large number of its citizens are working in these countries.

CONCLUSION

India seems to be playing a catch up game in terms of its capacity building to counter likely threats to its interests in the IOR. It has to be very clearly understood by the policy-makers that the strategic scenario may not unfold as envisaged and, hence, the nation needs to be prepared for the unexpected. The interests of outside powers in the IOR may grow to such a level as to be in direct confrontation with those of India. It would then depend upon the wisdom and diplomatic acumen of the national leadership whether India stands firm or acquiesces to the adversary. However, it is quite apparent that there is no escape from building adequate deterrence, and a credible and effective military response. Air and space assets would, firstly, be an effective diplomatic tool to avoid escalation through the display of resolve and, secondly, enforce the will of the nation to defend its interests by offensive action, if the situation so demands. Hence, if India sees the IOR as a primary area to pursue its national interests, it is essential to acquire adequate capacities of aerospace power to cover the whole region.

"INTERNET OF THINGS": A NEW PARADIGM FOR MILITARY OPERATIONS

ASHISH GUPTA

Modem warfare has reached a strategic inflection point in the wake of different geo-political challenges, global terrorism menace, different economic challenges, violence emanating from religious radicalisation and internal security challenges. Warfare is no longer the sum total of capabilities, of putting more personnel, capital and technology on the battlefield, but of better situational awareness, contextual knowledge, discerning disposition and homogenised actions. Technological breakthroughs have profoundly altered and shaped the doctrinal, organisational and strategic contours of warfare. History is replete with examples in which adoption and assimilation of enabling technologies and corresponding shifts in doctrine, organisation and strategy have endowed the innovator with the capability to avoid attrition and pursue a form of "decisive" warfare.

Based on the outcome of the Persian Gulf War, which witnessed the use of an impressive array of high-technology weapons that allowed the coalition forces to overwhelm the world's fourth largest army in a remarkably short time, many strategists viewed these developments as revolutionary, spurred through technological breakthroughs rather than part of ordinary evolutionary innovations. At the same time, it is also

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The phrase "Internet of Things (IoT)" has evolved to collectively identify the growing number of smart, connected products, with exponentially expanding opportunities.

important to understand that a revolution is not simply a demonstration of new technological capabilities. The revolutionary process is much more than a technology demonstrator—it is an all encompassing process that requires effective adaptation of such technologies for successful exploitation, corresponding doctrinal and organisational modifications, and willingness to digress from the established ways of doing things.

Information technology has revolutionised the way the warfare is conducted. Once comprising solely mechanical and electrical parts, military hardware has evolved into complex systems by a myriad combinations of various components and functionalities of sensors, microchips, microprocessors, hardware, software, data storage and connectivity. These "smart, connected products", bolstered by advancements and improvements in processing power, device miniaturisation and ubiquitous wireless connectivity, have put warfare on the cusp of an epochal shift, from the conventional to an information-based virtual age. These smart, connected products offer limitless possibilities and opportunities for new functionality, far greater reliability, higher and multifarious product utilisation, and capabilities that cut across, and transcend, the traditional domains of warfare. The changing nature of military hardware is also forcing a rethink of strategic doctrines, a reevaluation of concept of operations and a reassessment of doing things.

Smart, connected military products raise a new set of strategic challenges. The challenges of utilisation of a prodigious amount of new and sensitive data, insertion of new technology into legacy systems, redefining warfare outside the traditional military mindset, and the role of the military leadership in the backdrop of this new paradigm need to be tackled with due diligence. The phrase "Internet of Things (IoT)" has evolved to collectively identify the growing number of smart, connected products, with exponentially expanding opportunities. For exchange of information between people or

things, a virtual or physical connectivity is a prerequisite. The connectivity *per se* is only a conduit and it is the changing nature of the "things" with expanding capabilities and data generation that is ushering in a new era of warfare.

Over the past 50 years, the information revolution radically reshaped military thinking, concept of operations and strategy. The world is now going to witness another transformation. Before the advent of modern Information Technology (IT), military hardware was predominantly mechanical, and activities in the conduct of warfare such as planning, resource allocation, exchange of instructions and orders were performed using manual modelling, verbal communication and paper processes. Riding of the IT wave, the adoption of IT enabled services in the realm of warfare saw a dramatic increase in the productivity of these activities, in part due to the enhanced ability to capture and analyse a huge amount of data associated with each activity. With increased connectivity and the rise of the internet, an IT-driven renaissance enables better coordination and integration across individual activities. These developments have made the administration, supervision, operation and coordination of military affairs much more productive, result oriented and temporally relevant.

Embedded sensors, intelligent processors, sophisticated software and seamless connectivity in these products, coupled with data analysis and algorithmically induced decision-making capabilities, are driving unfathomable improvements in product functionality and performance.

Now, IT has become an indispensible appendage to all military activities. Proliferation of IT in military related products is remarkably variegated and prolific. Embedded sensors, intelligent processors, sophisticated software and seamless connectivity in these products, coupled with data analysis and algorithmically induced decision-making capabilities, are driving unfathomable improvements in product functionality and performance. This wave of IT-driven transformation has the potential to be bigger than its predecessors, triggering even more innovation, operational enhancements

The alloying of intelligence and connectivity gives rise to an entirely new set of product functionality and capabilities in four core areas: monitoring, control, optimisation and autonomy. and tactical utilisation. Smart, connected products offer a whole new set of technological solutions to some of the challenges in modern warfare.

Smart, connected products are made by an amalgam of three core elements: physical components, "smart" components, and connectivity components. Smart components focus on value addition and capability enhancement of the physical components, while connectivity amplifies the capabilities of the smart components. The end result is the evolution of a dynamic process of value addition and improvement. The product's mechanical and electrical parts are termed as physical components while *smart* components are fabricated by using sensors, microprocessors, data storage, controls, software, embedded operating systems and enhanced user interface. In many products, software is increasingly used to emulate the functionalities of some hardware components or for enabling a single physical device to undertake multi-tasking at various levels. *Connectivity is achieved by using* components capable of interfacing/ interacting with the environment, medium or other devices by using ports, antennae, and protocols enabling wired or wireless connections.

MODERN WARFARE AND INTERNET OF THINGS

The alloying of intelligence and connectivity gives rise to an entirely new set of product functionality and capabilities in four core areas: monitoring, control, optimisation and autonomy. A capability developed in one area is in itself an enabler and energiser, and functions as a stepping stone for the next level, ultimately leading to the desired goal. For example, monitoring capabilities are the bedrock for successful command and control operations, optimisation and autonomy.

- **Monitoring:** Smart, connected products facilitate comprehensive monitoring of the pace and magnitude of operations and even subtle

changes in the external environment are recorded through sensors and external data sources. By analysing and synthesising data, the user is alerted to change/ modify circumstances or performance. Monitoring also gives an insight into the product's operating characteristics, its history and its utilisation. Intelligence, Surveillance and Reconnaissance (ISR) operations have always been the mainstay of military operations. ISR operations provide valuable inputs and data which support planning, decision-making and mission accomplishment.

In some cases, such as in air defence operations, monitoring is the core element of mission accomplishment. Air defence systems are made up of a set of sensors and a set of kill vehicles, collectively called a weapon system. While sensors are used to detect incoming targets, kill vehicles are assigned to destroy targets. Air defence weapon systems designed with smart products will be capable of controlling themselves in a coordinated manner. Based on a pre-evaluated threat threshold, the smart components monitor the evolving air situation and alert operators in advance if the threat reaches a pre-defined threshold. The sensors continuously monitor the assigned area, exchange information laterally with other sensors and allocate weapons to targets based on vicinity and kill probability.

- **Control:** Smart, connected products can be controlled through remote commands or algorithms that are built into the device or reside in the product cloud. Algorithms are rules that direct the product to respond to specified changes in its condition or environment. Control through software embedded in the product allows the customisation of product performance to a degree that previously was not effective or often even possible. The same technology also enables users to control and optimise their interaction with the product in many new ways.[1]

- **Optimisation:** The monitoring data garnered from smart, connected products and capacity to control product functionality allows optimisation of product performance in unthinkable ways—a capability

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1. Michael E. Poter and James E. Heppelmann, "How Smart, Connected Products Are Transforming Completion," *Harvard Business Review*, November 2014, p.64.

acquisition not possible with earlier technology. Smart products, using algorithmic architecture and data analytics of in-use or historical data, offer improved efficiency and utilisation. In radar, for instance, a local microcontroller can adjust polarisation on every revolution during the rains. The radiated power can be adjusted to not only improve radar performance but minimise its impact on the efficiency of power generating components.

Real-time monitoring of data on equipment condition and its operational capability enables operators to optimise its utilisation by performing preventive maintenance and accomplishing repairs remotely, thereby reducing product down time and need for onsite repair teams. Even when onsite repair requirement is indispensible, advance information about failed components and instructions to accomplish the repairs reduces costs, reduces down time and improves spare management.

- **Autonomy:** *By smart* monitoring adaptive control and functionality optimisation capabilities, the smart, connected products can achieve a previously unattainable level of autonomy. Products equipped with sophisticated components and processes are capable of interacting with their environment, self-diagnosing their own service needs, optimising their output and adapting to operators' preferences. Autonomy not only reduces the continual presence of operators but improves operational safety in dangerous environments and facilitates operations in remote locations. Autonomous products can also self-synchronise and coordinate with other products and systems, producing results far exceeding the sum total of individual capabilities. The value of these capabilities can grow exponentially as more and more products become connected.

A whole gamut of technologies is driving the Internet of Things (IoT) evolution. IoT is no longer confined to the traditional range of physical devices. The amalgam of traditional devices, human operators and smart devices in varying temporal and spatial domains, greatly expands the scope of application of IoT. IoT takes the outside physical information as a sensing

foundation to realise identification of things, carry out dynamic sensing of environmental information, connect with other devices, and then builds a network by using various wired and wireless network communication technologies to achieve information transmission. After sensing, a connection needs to be realised for distributed data sharing by integrating sensing subnets with existing networks. IoT uses high-performance computing technology to achieve intelligent data management and decision-making. Based on the results from the decision-making process, the control of things and the environment is realised.

The data collection process of IoT is mainly through the control of various sensing devices to collect information on the surrounding environment and transfer the data through the corresponding network protocols.

- **Identification Technology:** For application of IoT, the basic requirement is recognition of things by assigning to each device, a globally unique value for its unambiguous identification. There are many coding rules, such as the Electronic Product Code (EPC) which uses Radio Frequency Indentification (RFID) technology, IP version 4 (IPv4) and IP version 6 (IPv6) which are based on the Transmission Control Protocol/Internet Protocol (TCP/IP). For the realisation of the full potential of IoT and seamless connectivity, mapping and compatibility issues between different coding methodologies need to be resolved. RFID is a non-contact identification technology for automatic identification of targets and collection of data through its radio frequency signals. TCP / IP based IPv4 and IPv6 technology is capable of meeting the requirement of a vast number of devices in IoT.

- **Sensing Technology:** Data acquisition in the form of generation, access, transmission, processing and application is an important component of IoT. In IoT, depending upon the type of sensing devices (RFID, infrared devices, TCP/IP-based devices, global positioning system devices), real-time data in various forms are acquired. The data collection process of IoT is mainly through the control of various sensing devices to collect

information on the surrounding environment and transfer the data through the corresponding network protocols.

- **Communication and Network Integration Technology:** The transmission of sensing data in IoT mainly relies on network and communication technology The network level of IoT is not limited to the traditional and single network structure but is spread over different types of networks, such as the internet, 2G/3G mobile communications networks, and broadcasting and television networks. It involves wired, wireless, mobile and other means of access, unification of heterogeneous network addresses, conversion, packet format, routing options and other issues.
- **Intelligent Information Processing Technology:** The key technology in IoT is how to transform physical sensing data into logic data. Intelligent information processing technology integrates intelligent computation, data mining, optimised algorithm and machine learning, and after processing and analyses of the data, the results are delivered to the intended user.

IoT-centric operations, like network-centric warfare, will enable a shift from attrition-centric warfare to a war-fighting style characterised by expeditious decision-making, versatile networked command and control, and self-synchronisation. IoT will accelerate the process of attainment of information superiority, better awareness and understanding of the battle space rather than simply more raw data. With the emergence of new challenges to national security, the changing nature of global terrorism and an ever-growing reliance on network-centric operations, the intelligence agencies have to trawl through vast amounts of data to identify subtle and specific signatures to determine the magnitude and timing of conditioned responses**.** In modern warfare, the key to successful operations is an immediate and appropriate response to fleeting signatures, and a detour from the time-consuming routine monitoring processes. The consequences of not dealing effectively with these challenges are potentially profound. IoT enabled forces, acting with speed, precision, and reach, achieve the massing of effects versus the massing of forces. The results that follow are the rapid

foreclosure of enemy courses of action and the shock of closely coupled events. [2] One of the potential strengths of IoT-centric warfare will be to offset a disadvantage in numbers, technology, or position.

BATTLEFIELD AWARENESS AND IOT

Carl von Clausewitz had stated, "The great uncertainty of all data in war is a peculiar difficulty, because all action must, to a certain extent, be planned in a mere twilight, which in addition, not infrequently—like the effect of fog or moonshine—gives to things exaggerated dimensions and unnatural appearance."[3] Situational Awareness (SA) encompasses a wide range of activities on the battlefield to gain information about the enemy's intent, his capability and actual position. Throughout military history, seeking of higher ground for an insightful perception of the battlefield has been the holy grail of warfare. Over recent years, aerial and space reconnaissance assets are being increasingly used to gain SA and thereby penetrate the fog of war. The main determinant of effectiveness in these operations is the speed of delivery of the relevant information. IoT can play a vital role in raising situational awareness by collecting, analysing and delivering the synthesised information in real-time for expeditious decision-making for appropriate military action. Defining SA in the realm of IoT requires understanding of SA from the perspective of the fact that SA is highly dependent on the following three factors:

- The perception of the elements in the environment within a volume of time and space.

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2. Neil Couch and Bill Robins, "Big Data for Defence and Security," Royal United Services Institute for Defence and Security Studies, Occasional Paper, September 2013, p.1.
3. Clausewitz, *On War* (Project Gutenberg), Chapter II Section 24. Available online at http://www.gutenberg.org/ ebooks/1946?msg=welcome_stranger. Accessed on April 16, 2015.

- The comprehension of their meaning and/or comprehension of the current situation.
- The projection of their status in the near future.

Perception is the key to all SA because operators perceive the environment differently. Perception, in turn, impacts how each individual comprehends, and acts upon information. Comprehension is the ability to take disjointed elements from the perception phase and understand what their meaning and significance are to the greater whole. Projection is the ability to predict future actions, at least, in the near term; this is achieved from the knowledge that is obtained from perception and comprehension. IoT enabled devices can enhance the level of perception by adding an objective functionality to a complex and abstruse set of data. The chaotic war-time environmental signatures and stimuli are organised to fit in the human cognitive process for comprehension.

Today, *Battlefield Situational Awareness (BSA) can be enhanced* by leveraging real-time and untethered interactions among combatants, decision-makers and machines. Unification of Command, Control, Communications, Computers, Information, Surveillance, Reconnaissance (C4ISR) systems, sensors, video, voice, data collaboration and secure mobile computing is delivering transformative and emancipator battlefield capabilities. IoT technologies can conjure up an integrated battlefield awareness system for monitoring, planning and reacting to threats as they emerge. An IoT enabled wearable device will transform a war-fighter in the field into a communications node, capable of gathering and transmitting data back to analytics and command centres. The lateral and vertical exchange of information of the battlefield between aerial and space-based sensors, Unmanned Aerial Vehicles (UAVs), monitoring and communication devices, radars and wearable devices will provide real-time assessment of evolving operational requirements that help a military commander use assets effectively in deterring, and responding to, threats.

INTELLIGENCE AND OPERATIONS

For many intelligence experts, automated analysis technology is the top Intelligence, Surveillance and Reconnaissance (ISR) priority. In the military realm, data comes from a number of sources and platforms. It is varied and increasingly 'unstructured', with large quantities of imagery and video generated every day. It has been commented that data in military operations, "has reached an inflection point in data deluge. We are now in danger of data asphyxiation and decision paralysis."[4] The collected data need to be sieved through the mesh of perceived objectives and goals to perform real analysis rather than exhaustive culling of raw data. IoT enabled devices can be used as predictive tools capable of providing coherent and actionable sets of data. IoT devices are capable of performing semantic and pragmatic data analysis to which experts can then apply their experience, intuition and human judgment.

IoT will usher in a new era of efficiency, visibility and availability of military equipment in the right hands at the right time. It will be a huge enabler of creating efficiencies and unprecedented end-to-end visibility in every logistics activity and transaction.

APPLICATION OF INTERNET OF THINGS IN MILITARY EQUIPMENT LOGISTICS

The proliferation of data generated from connected devices and sensors will have an enormous impact on military equipment logistics processes and the way logistics oriented decisions are made. IoT will usher in a new era of efficiency, visibility and availability of military equipment in the right hands at the right time. It will be a huge enabler of creating efficiencies and unprecedented end-to-end visibility in every logistics activity and transaction. Gen Dennis J Reimer, chief of the staff of the army, famously said, "There will not be a revolution in military affairs unless there is a revolution in military logistics." A loose consensus is slowly developing to recognise the Revolution in Military Logistics (RML) as a necessary precondition of the Revolution in Military Affairs (RMA). For RML, the focus needs to be on:

4. Couch and Robins, n.2, p.10.

- **More Accurate and Timely Visibility of Demands:** IoT will further serve this demand by exploiting real-time information connectivity and auto communication by products of their status, health and requirements.
- **Quicker, More Responsive Processes:** Timely, integrated and predictive support even in unforeseeable conditions, as the products will accurately provide the information in real-time.
- **Increased Support From Afar:** During split-based operations conditions, by sustaining the force from dispersed geographical locations, as with IoT products, blow by blow performance evaluation would be possible.
- **Reduced Footprint:** By limiting the extent and magnitude of logistics support forces from the active theatre, attrition would be reduced.

Every smart equipment in the logistics chain, from intelligent storage to transportation to fitment and, finally, being declared operationally suitable, will give off streams of useful real-time data. By leveraging IoT in the logistics process, it will be possible to:
- Collect data coherently across the whole spectrum of military equipment to predict future demand accurately.
- Create efficient shipments and optimisation.
- Prioritise the components' availability.
- Initiate procurement processes by studying the consumption pattern and inventory held.

IOT AND CASUALTY MITIGATION

The care of war casualties, both during their service and as veterans, is the lynchpin of military ideology. Changes in battlefield medical technologies, evacuation of the seriously wounded from the battlefield and assisting those in need of physical and mental succour have profoundly changed the treatment of wounded and injured soldiers. Without proper care of the wounded, the morale of the troops would suffer. IoT is capable of fuelling tremendous growth and improvement in the provision of health care services to military personnel by improved monitoring, driving better outcomes, consistency of care, and enhancing the domain knowledge of

medical experts. IoT can combine human intelligence and diligence with technology advancements to deliver enhanced results. The personalised medical devices and mobile health care applications that make up IoT, have been increasingly making forays in the defence health care programmes. IoT can be further exploited to holistically improve all aspects of health care by not only managing health, but by disease prevention and fitness promotion. To bolster health care for defence personnel, leveraging the potential of IoT and adoption of IoT driven systems and processes, along with patient participation and subsequent data analysis, will change the way health services are delivered. IoT will continue to evolve fast, leading to impactful and positive changes in the realm of military forces.

The combination of IoT sensors will allow significantly improved measurement and monitoring methods of vital functions (temperature, blood pressure, heart rate, cholesterol levels, blood glucose, etc). Implantable wireless identifiable devices could be used to store health records that could save a patient's life in emergency situations. Edible, biodegradable chips could be introduced into the body and used for guided action. Things are more and more integrated within the human body. It is expected that body area networks can be formed and that they will communicate with treating physicians and emergency services.

IOT AND DEPLOYMENT/ MOBILISATION

Real-time route optimisation of all types of forces, equipped with IoT enabled devices, can be done by studying the steady stream of data generated during movements. The enabling automated capability to support rapid deployment of forces and to furnish accurate and timely data to manage the deployment conundrum has a bearing on operational efficiency and efficacy. The automated planning, organising, coordinating, and controlling of deployment activities will provide optimum, cost-effective and need-based solutions to the movement/deployment of both equipment and personnel, from origin to destination. For example, a system with IoT enabled devices will be able to plan and execute air movement as well as design and analyse force packages by real-time estimation of airlift requirements for a given

Modern aviation equipment with high technology integration requires managing and monitoring each component throughout the entire life-cycle process from its design, prototype fabrication, mass production, integration with other components, and maintenance.

deployment list, maintenance of pre-planned contingency packages, and by automated generation of individual aircraft load plans.

EQUIPMENT MAINTENANCE AND IOT

The core of military operations comprises resources—the combined human and physical assets necessary to perform at peak levels. In today's military Services, keeping military equipment major end items in mission capable condition has been a tremendous challenge in theatres of operation. The harsh conditions, extended deployments and stretching of the limits of their capabilities have put extensive wear and tear on equipment. The perennial operational readiness requirement of equipment throughout all the branches of the military Services is stretching the existing maintenance resources and practices to the limit. Many diverse and complex factors affect equipment maintenance, such as the battlefield environment, equipment condition, maintenance resources, technical level of personnel, etc. Therefore, it is of great significance to use advanced IoT technology for advanced equipment maintenance and management.

By using IoT, visualisation techniques and automatic identification technology, with a combination of computer platforms, databases, supervision of the maintenance personnel and material in important links, the nodes and parts of the maintenance process, can be effectively implemented. The safety management system with intelligent decision-making and automatic monitoring based on IoT will be capable of combining, optimising and appropriately allocating various resources and processes such as manpower, material, financial resources, information, technology, management level and equipment maintenance objects. For example, modern aviation equipment with high technology integration requires managing and monitoring each component throughout the entire

life-cycle process from its design, prototype fabrication, mass production, integration with other components, and maintenance.

IoT achieves automatic and intelligent information collection, transmission, processing and connections between objects through a variety of sensing equipment.[5] The management and process monitoring systems, based on IoT technology, can effectively improve the management efficiency of the equipment maintenance materials. The traceability of management behaviour and spare management information can be achieved by means of convenient, fast and accurate acquisition of raw materials.

IOT IN AEROSPACE AND AVIATION

IoT can help to improve the safety and security of products and services by protecting them from counterfeiting. Aviation maintenance, for example, is marred by the problem of Suspected Unapproved Parts (SUPs). A SUP is an aircraft part that is not guaranteed to meet the requirements of an approved aircraft part (e.g. the part does not conform to the strict quality requirements). Thus, SUPs pose a great risk of undermining the capability of a mission critical aircraft to meet its objective. SUPs can seriously violate the maintenance and security standards, leading to accidents or incidents. This problem can be solved by introducing electronic pedigrees for certain categories of aircraft parts, which document their origin and safety-critical events during their life-cycle (e.g., modifications). By storing these pedigrees within a decentralised database as well as on RFID tags, which are securely attached to aircraft parts, an authentication (verification of digital signatures, comparison of the pedigree on RFID tags and within the database) of these parts can be performed, for example, prior to installing them within an aircraft. Thus, the safety and security of an aircraft can be significantly improved. The 'on-condition' wireless monitoring of the aircraft by the use of intelligent devices with sensing capabilities available within the cabin or outside and connected to the aircraft monitoring systems is another emerging application area that forms the basis for ubiquitous

5. H. Sundmaeker, et al., "Vision and Challenges for Realizing the Internet of Things," IoT European Research Cluster (European Union, 2010).

The transformation of actionable and reliable knowledge and creation of perceptions from the large amount of data generated by the physical devices and human sensors requires further research and standardisation.

sensor networks. The nodes in such a network will be used for detecting various conditions such as pressure, vibrations, temperature, etc. The data collected gives access to customised usage trends, facilitates maintenance planning, allows condition-based maintenance, reduces maintenance and waste, and can be used as an input for evaluating and reducing energy consumption during aircraft operations.[6]

CHALLENGES OF IOT

It has been succinctly commented that "IoT describes a splendiferous future: a dynamic and universal network where billions of identifiable 'things' (e.g., devices, people, applications, services, etc.) are communicating with one another anytime and anywhere; things become context-aware, are able to configure themselves and exchange information, and show 'intelligent/cognitive' behaviour when exposed to a new environment and unforeseen circumstances; intelligent decision-making algorithms will enable appropriate rapid responses, revolutionizing the ways business values are generated." [7]

However, the present is not without challenges and tribulations, and the current research and developments, though promising, are still far from realisation of the envisaged vision. The diverse, heterogeneous and time dependent data generated by IoT enabled devices and resources is a major hurdle for the aggandisation of IoT. The transformation of actionable and reliable knowledge and creation of perceptions from the large amount of data generated by the physical devices and human sensors requires further research and standardisation. IoT requires efficient mechanisms and methods that can handle a large amount of data and respond to the identified phenomena and events arising from the environment in a timely fashion. Furthermore, security and privacy issues and the trust and reliability of the

6. Ibid.
7. Ibid.

data are also important for IoT-based applications and services, especially those in the military domain. Some of the major challenges are given below:

- **Inherent Dynamism and Complexity of IoT:** In the military realm, most of the data generated is transient in nature, with high spatiotemporal dependencies. While analysis of data for meaningful inferences is possible, the pervasiveness and volatility of the environments require continuous monitoring and updates. This inherent dynamicity becomes a challenging issue when scalability, diversity and network/resource constraints are taken into consideration. The challenge in the future will be further exacerbated in the wake of the mobility and ubiquity of IoT enabled military hardware providing real-time data streaming. The issues of dynamicity and complexity will have a significant impact on many aspects of military operations such as data and resource access services, and maintenance, data analysis, aggregation and mining.[8] Further research, refinement and consolidation for coherent data processing mechanisms are required to address these issues.

- **Scalability of IoT Resources:** Creating domain knowledge models from data garnered from a large number of IoT entities, devices and their related data is critical for data engineering and knowledge harvesting. The data generated during military operations is an expected outcome of different processes, so meaningful interpretation needs to be associated with domain knowledge of resources and entities. Many military specific applications have been developed to maintain own domain knowledge, but interoperability with cognitive layouts of human operators and algorithmic understanding of other IoT devices is an issue. The granularity of the data is another important issue; the completeness and unambiguity of the data will result in expansion of the domain knowledge realm. The data handling in the military environment is more challenging and fraught with technical difficulties due to the magnitude of data generated by corresponding resources, the continuous changes in the state of the resources and data, and the

8. Payam Barnaghi, Wei Wang, Cory Henson and Kerry Taylor, "Semantics for the Internet of Things: Early Progress and Back to the Future," p.16. Available online at http://knoesis.org/library/download/IJSWIS_SemIoT.pdf. Accessed on April 17, 2015.

The trustworthiness of these resources is another key issue which involves the capability of sensors to produce accurate and reliable data and its functioning in a changing environmental condition.

volatility of the environments.[9] A more efficient mechanism on information search and retrieval, indexing query and information access will be required to address these issues.

• **Quality, Trust, and Reliability of Data:** The data, after observation and measurement, is provided by different sensory devices designed to perform a myriad operations. However, the quality of observations and measurements can change over time, for example, changes in the environment, faults in devices, or errors in device settings. As with any sensor, IoT enabled military sensors are not entirely impervious to inaccurate and erroneous measurements, thereby affecting the quality, viability and veracity of data generated. Detection of anomalies, filtering out erroneous measurements and accepting data within the acceptable threshold can help in detecting errors and processing of data conforming to various operational requirements. The trustworthiness of these resources is another key issue which involves the capability of sensors to produce accurate and reliable data and its functioning in a changing environmental condition. Design adoptable sensors, with high reliability attributes, environment independent functionality, fitted with robust feedback and verification mechanisms can bridge the trust deficit.

• **Interpretation and Perception of Data:** The data received from various sensors is a key enabler for developing situation-aware applications that can intelligently respond to corresponding changes in operational conditions. Perception is the key to human intelligence and experience. Providing interpretation capabilities and analytics methods to sensors to process and elucidate changes in the battlefield will provide the military commanders with comprehension capabilities to take disjointed elements from the perception phase and understand their broader meaning and significance. However, sensor perception has additional

9.   Ibid.

challenges such as integration and fusion of data from different sources, description of the events for cognitive understanding, risk threshold calculation, real-time processing of the data, and quality and dynamicity of the outputs. The research is this field needs to develop solutions that can efficiently query and access data from various sensors, geographically distributed, with different assigned roles. The requirement of situation recognition, anomalies detection and pattern association with existing knowledge to create higher-level abstractions or new knowledge are some of the challenges which need to be tackled.[10]

The research is this field needs to develop solutions that can efficiently query and access data from various sensors, geographically distributed, with different assigned roles.

- **Security and Privacy:** In the battlefield, the IoT enabled sensors will be used to describe the operational environment, the status of weapons, the location of mission critical assets, combatant deployment and other activities. This calls for mechanisms to provide and guarantee the security and privacy of data. While sharing and communicating the IoT data, encryption and verification measures for meeting the desired security levels and privacy requirements are a must. As data is shared over the communication networks and can be shared among myriad users and devices, it is paramount to regulate access control through authentication and authorisation. Security and privacy imperatives in the IoT domain are central to the development and consolidation of reliable and efficient solutions in support of military operations.

CONCLUSION

Smart, connected military products will have a transformative effect on the quality, efficiency and effectiveness of military operations. Increased situational awareness, better understanding of equipment performance, improved maintenance practices, and better heath care support to combatants will create opportunities for mission accomplishment, reduced

10. Ibid.

What distinguishes the victors is their grasp of information—not only from the mundane standpoint of knowing how to find the enemy while keeping him in the dark, but also in doctrinal and organisational terms.

attrition and casualty containment. The contours of the future conflicts will be shaped in part by how these technological advances are assessed and adopted. Yet, in the context of warfare, technology is an enabler but does not govern it. It is not technology *per se*, but rather the organisation of technology that is important. What distinguishes the victors is their grasp of information—not only from the mundane standpoint of knowing how to find the enemy while keeping him in the dark, but also in doctrinal and organisational terms.[11] History demonstrates that changes of this magnitude do not occur without being accompanied by a fundamental change in the way war is conducted.[12] The forays made by IoT in the warfare realm are a culmination of the advances in computerised information and telecommunications technologies. These advances, when married to related innovations in management and organisational theory, will inevitably have a profound impact on the means and ends of armed conflict.

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11. Peter L. Hays, Brenda J. Vallance and Alan R. Van Tassell, *American Defense Policy* (London: John Hopkins University Press, 1997), p.567.
12. Norman C. Davis, *In Athena's Camp: Preparing for Conflict in the Information Age* (Rand National Defence Research Institute, 1997), p.79.

COVERT CYBER CAPABILITIES
OF THE US

DILIPRAJ E

INTRODUCTION

Though declared as the global common by the world, it is an undeniable fact that internet technology was conceived, developed, and nurtured in the US during the second half of the 20th century. In other words, the US was the cradle for cyber technology, especially the internet, which is currently the backbone of the global communication network. In fact, the internet is still indirectly governed by US laws which are secretly amended at times to be in tune with its national interests. Therefore, by default, the US has an edge over rest of the world in the cyber field, with advanced technological skills, institutional mechanisms, policy initiatives, skilled workforce and advanced implementation strategies. Such vital factors play an important role in making the US a leading, vibrant player in the complex domain of cyber space.

However, being widely acclaimed as the superpower of the world, the US has more responsibilities and accountabilities than any other country in securing and streamlining the conduct of activities in cyber space. Moreover, being the global hub for internet traffic because of the location of a larger cyber infrastructure, the responsibility increases manifold. The fact that there are more Internet Service Providers (IPSs) in the US than

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While many countries of the world have some overt cyber capabilities, these by themselves do not pose any threat to others as these capabilities are to be employed only during a time of conflict.

in any other country and with the presence of the Internet Corporation for Assigned Names and Numbers (ICANN), the privately owned internet regulatory organisation, guided by the laws of the US, the bar of responsibility is raised further. In short, it can be said that in the present chaotic scenario of governance in the cyber world, internet functioning is primarily dependent on the laws, policies, infrastructure and security agencies of the US.

In this context, it is imperative for the US to have a robust security mechanism in order to safeguard cyber space from various threats across the domain. The defensive and offensive capabilities of the US should be efficient enough to not only protect its own national interest in cyber space but also be able to defend the global communication network. The defensive capabilities of the US are claimed to be the best in the world, but it remains an unproven fact as the country has not faced an actual threat of all out cyber warfare yet. Nevertheless, the effectiveness of US offensive capabilities in the cyber realm has been tested in various instances in the recent past and its abilities are growing day by day. A study of the US offensive capabilities in cyber space will reveal a few startling facts, not about its overt cyber capabilities but regarding its covert cyber capabilities.

While many countries of the world have some overt cyber capabilities, these by themselves do not pose any threat to others as these capabilities are to be employed only during a time of conflict. On the other hand, the very concept of covert cyber capabilities itself poses a serious threat to other players of the world, as these comprise an invisible weapon which can deflate the target's abilities without warning. Therefore, the revelations on the US' covert cyber capabilities through various sources since mid-2013 have created serious turbulence in the global cyber world which has led to a tectonic shift on all aspects from governance, regulations, ownership, legality, safety and security. It is this shift that will determine the fate of

the internet and the future of cyber space.

However, while the US is trying its best to remain a superpower of the world in a multipolar environment, its covert cyber capabilities play an important role by virtually penetrating inaccessible corners of the world, which otherwise would not be possible through the traditional means in the real world, to keep the authorities posted/informed about issues pertaining to their national interest.

This paper deals with a study of the various covert cyber capabilities of the US which has taken aback the cyber community of the world. However, the paper will not cover the infamous National Security Agency's (NSA's) PRISM programme as it has gained enough limelight from the media—instead, the paper will concentrate on other covert cyber operations of the US which have more precise targeting capabilities and serious impacts.

The US is trying its best to remain a superpower of the world in a multipolar environment, its covert cyber capabilities play an important role by virtually penetrating inaccessible corners of the world, which otherwise would not be possible through the traditional means in the real world, to keep the authorities posted/informed about issues pertaining to their national interest.

US COVERT CYBER CAPABILITIES

X-Keyscore

According to the NSA of the US, X-Keyscore is a part of the agency's lawful foreign signals intelligence collection system. The NSA also claims that only a limited number of personnel in the agency can get access to X-Keyscore in order to complete their assigned tasks. Moreover, there are multiple technical, manual and supervisory checks and balances within the system in X-Keyscore to prevent deliberate misuse by anybody, along with a full audit on every search made by an NSA analyst to ensure that it is proper and within the law. The agency argues that such programmes allow it to collect the information that enables it to perform its missions

successfully – to defend the nation and to protect US and allied troops abroad.[1]

While that seems to be a legitimate claim by the NSA, the real purpose of X-Keyscore was revealed when Edward Snowden exposed it through the *Sydney Morning Herald* and *O Globo* newspapers in July 2013. The exposed documents included 32 slides of a power point presentation meant for explaining the functions of the X-Keyscore programme to its trainees. This exposed classified power point document which was supposed to be declassified on August 1, 2032, reveals a number of shocking facts about the programme. An entry in the Special Source Operations (SSO) Directorate inside the NSA dated September 21, 2012, announced that X-Keyscore is operational.[2] It was also revealed that a large portion of the NSA's information collection in the internet comes from its allies across the globe. Based on the exposed slides and documents, it can be assumed that countries like Australia, Canada, Great Britain and New Zealand have an active role to play in this programme as contributors and partners of information sharing. Also, according to Edward Snowden, Germany also has access to X-Keyscore which he revealed in a TV interview.

X-Keyscore Location and Function

According to the exposed slides, X-Keyscore is a software tool which acts as a Digital Network Intelligence (DNI) exploitation system/ analytical framework that performs strong (e.g. e-mail) and soft (e.g. content) selection of data and metadata and provides real-time target activity surveillance. The programme stores all the data in the collection site indexed by metadata and can even provide a series of viewers for common data types. This programme has a very small but focussed team which works closely with the analysts and the support staff is integrated with the developers. The whole team's actions

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1. "X-Keyscore: NSA Tool Collects 'Nearly Everything a User Does on the Internet'", *The Guardian*, July 31, 2013, in http://www.theguardian.com/world/2013/jul/31/nsa-top-secret-program-online-data. Accessed on April 4, 2014.
2. "How the NSA is Still Harvesting Your Online Data", *The Guardian*", June 27, 2014, in http://www.theguardian.com/world/2013/jun/27/nsa-online-metadata-collection. Accessed on April 4, 2014.

in the programme are based on mission requirements. The programme is based on more than 700 servers situated in approximately 150 sites around the world and the network is a massively distributed Linux cluster.[3]

Fig 1: Location of X-Keyscore Sites

Source: NSA X-Keyscore exposed slides.

Virtually anything can be stored in this programme by indexing the data with a metadata. The programme has the capability to analyse data at two levels – shallow and deep. While the shallow method would help to look into more data for identification of possible intelligence, the deep method, with a strong selection pointer, is used to gather intelligence. Extraction of information from X-Keyscore is based on a "strong selection" pointer. When there are strong selection pointers, the results are precise and if not, a huge volume of data would be extracted which has to be browsed repeatedly in order to get the required information. This shows that the analysts have to be smart and innovative in order to extract the required information from the humongous volumes of collected data.

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3. "NSA X-Keyscore", exposed document in http://www.documentcloud.org/documents/743244-xkeyscore-slidedeck.html. Accessed on August 4, 2013.

The data for analysis is pooled in from all sources, including allied countries, data collected through other surveillance programmes, other departments of the NSA, and also data acquired through aerial surveillance using drones.

During a TV interview, when asked about the usefulness of X-Keyscore to its users, Snowden's reply was:

You could read anyone's email in the world. Anybody you've got email address for, any website, you can watch traffic to and from it, any computer that an individual sits at, you can watch it, any laptop that you're tracking, you can follow it as it moves from place to place throughout the world. It's a one stop shop for access to the NSA's information. And what's more, you can tag individuals using 'X-Keyscore'. Let's say I saw you once and I thought what you were doing was interesting or you just have access that's interesting to me, let's say you work at a major German corporation and I want access to that network, I can track your username on a website on a form somewhere, I can track your real name, I can track associations with your friends and I can build what's called a fingerprint which is network activity unique to you which means anywhere you go in the world, anywhere you try to sort of hide your online presence, hide your identity, the NSA can find you and anyone who's allowed to use this or who the NSA shares their software with can do the same thing…"[4]

This statement of Snowden clearly reveals that anybody can become a target of the NSA and the NSA can track that person anywhere in the world with the help of X-Keyscore and an intelligent and innovative analyst, without moving from their location. The data for analysis is pooled in from all sources, including allied countries, data collected through other surveillance programmes, other departments of the NSA, and also data acquired through aerial surveillance using drones.

In short, X-Keyscore is the processing and analysis phase of intelligence in the NSA, using which the agency claims to have captured over 300

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4. Edward Snowden, personal interview to *Norddeutscher Rundfunk*, January 26, 2014.

terrorists. But a few reports denote that X-Keyscore brands any user of the TOR network as an 'extremist' and the user is listed in the NSA's target list.[5] This raises questions regarding the terrorists arrested by using X-Keyscore as to whether they are really involved in terrorist organisations or are just frequent visitors of TOR networks and other encrypted methods in cyber space; and regarding their activities in the physical world that have branded them as terrorists. Although answers to such questions will never be given, the fact which can be understood is that X-Keyscore is the first step in digital intelligence in the internet world and more such software is to follow in cyber space as this domain is the Pandora's Box of intelligence, according to intelligence agencies around the world.

> **The TAO Department in the NSA is responsible for developing and employing technologies for endpoint operations. Endpoint operations involve the process of actively subverting systems that create, store or manage information like computers, peripherals and telephone switches, in order to directly retrieve data of intelligence value or achieve other operational ends.**

TAILORED ACCESS OPERATIONS (TAO)

The TAO Department in the NSA is responsible for developing and employing technologies for endpoint operations. Endpoint operations involve the process of actively subverting systems that create, store or manage information like computers, peripherals and telephone switches, in order to directly retrieve data of intelligence value or achieve other operational ends. According to another revealed document titled "Expanding Endpoint Operations", which was written by an unknown colonel of the US Army as early as September 17, 2004, the TAO Department was increasing endpoint operations in terms of numbers and diversity of targets, and building a more scalable and robust endpoint operations infrastructure. The expansion

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5. "X-Keyscore Exposed: How NSA Tracks all German TOR Users as 'Extremists'", *RT,* July 3, 2013, in http://rt.com/news/170208-nsa-spies-tor-users/. Accessed on April 5, 2014.

process included the acquisition of a new endpoint access Remote Operations Centre (ROC) which would enable dramatic expansion of the operations of the TAO Department to be available for both its internal and external customers. While the internal customers are the NSA, Central Intelligence Agency (CIA) and Joint Special Operations Command (JSOC), the list of external customers include various intelligence agencies of countries like Australia, Canada, Great Britain and New Zealand.[6]

One part of the TAO Department of the NSA is believed to be operating from a base in Texas, which was earlier a Sony Chip Company and was later converted into the NSA's operative location in 2005.

Fig 2: The Location of NSA's TAO Department

Source: Google Earth.

According to revealed documents[7] from the Texas Cryptologic Centre, as of March 11, 2008, the break-up of employees of the TAO Department housed in the Texas-based centre is as follows:

6. "Expanding Endpoint Operations", *SIDtoday*, NSANet, September 17, 2004.
7. "Secret Documents: The Special Department TAO NSA Introduces Itself", *Der Spiegel*, December 30, 2013, in http://www.spiegel.de/fotostrecke/nsa-dokumente-die-abteilung-tao-der-nsa-fotostrecke-105355-3.html. Accessed on April 6, 2014.

Table 1: Sector-Wise Employees' Break-up of TAO based in Texas

Sector	Numbers	Breakdown
Civilians	30	Includes 1 AIA, 1 Intern
Military	30	US Air Force- 10 US Army - 8 US Navy - 10 US Marine Corp - 2
Total	**60**	
Civilian	Unknown	7 Selectees 9 Nominees Unknown No. of External Hires which include 3 CJO'd, 7 preliminary
Military	Unknown	Unknown No. Chiefs, etc 5 x USA Great Skills Billets 2 (additional) FIOCers not included (R&T)
Contractor	1	TAO/ ANT Contract

Source: "Sectret Documents: The Special Department TAO NSA Introduces Itself", *Der Spiegel*, December 30, 2013, in http://www.spiegel.de/fotostrecke/nsa-dokumente-die-abteilung-tao-der-nsa-fotostrecke-105355-3.html. Accessed on April 6, 2014.

Until 2008, TAO operations were conducted on targets in countries including Cuba, Venezuela, Iraq, Afghanistan, Mexico and Colombia. There were many kinds of operations conducted by the TAO Department involving different malwares/spywares and using different tactics for network penetration and installation of these spywares into the target's system. This includes spyware operations like Olympus Tickets, SHARPFOCUS (SF2), PARCHDUSK (PD and FOXACID messages. Initially e-mails were used to spam the target with FOXACID messages; later, the NSA QUANTUM method was started and became the method used to insert the FOXACID malware.[8] The operations of TAO are based on its motto "*Your data is our data, your equipment is our equipment – any time, any place, by any legal means*".[9] This statement exhibits the overall intent of these clandestine organisations and covert cyber missions of the US, and their arrogance due to their possession of this supreme technology.

8. Ibid.
9. "The ROC: NSA's Epicentre for Computer Network Operations", *SIDtoday*, NSANet, September 6, 2006.

NSA QUANTUM

QUANTUM is one of the covert programmes of the NSA's TAO Department, targeting individuals' computers to implant specially built Trojans which enable surveillance on web-based accounts of the user in various platforms. Details about the QUANTUM programme were revealed in the German weekly *Der Spiegel* on December 30, 2013. This programme works on a concept called "man-on-the-side capability". The QUANTUM method of implant into a target is possible if the chosen target has a selector that is vulnerable to the QUANTUM technique and has been active for the last 14 days, and if detected by the single-sign on site which has QUANTUM capabilities. When a target qualifies with all these conditions, it is possible to detect the communication between the target's computer and the server in real-time and send the Trojan piggy-backing the requested content, and implant the host.[10]

The revealed documents on QUANTUM disclose the involvement of one of America's largest management consulting firms, Booz Allen Hamilton, in the programme along with the NSA's TAO Department. Going by the way the company's name appears in the document, alongside the TAO Department, it can be inferred that QUANTUM was developed by a team comprising personnel from both the NSA's TAO Department and Booz Allen Hamilton Company. The documents further reveal that apart from the US, QUANTUM also benefits the interests of Australia, Canada, Great Britain and New Zealand. In fact, it can be understood from the documents that if a partnering agreement form is set up with the General Communication Headquarters (GCHQ) of the UK, then the research and technology analysts of the TAO Department can utilise GCHQ resources in include additional capabilities to their QUANTUMTHEORY.[11]
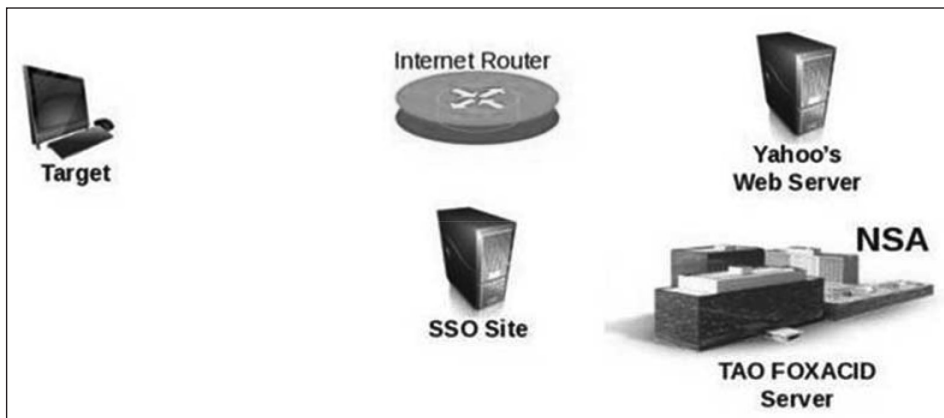
Functioning

The QUANTUM programme involves several nodes for its functioning. They are the target, internet router, Web application server, SSO site and the NSA's TAO FOXACID server.

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10. "(TS) NSA Quantum Tasking Techniques for the R & T Analyst", *Der Spiegel*, December 30, 2013.
11. Ibid.

Fig 3: Various Nodes Involved in the Functioning of QUANTUM

Source: "(TS) NSA Quantum Tasking Techniques for the R&T Analyst," *Der Spiegel*, December 30, 2013.

The FOXACID server is an exploit server that is operated by the NSA's TAO Department for the QUANTUM programme to install the Trojans into the targets. The functioning of QUANTUM is clearly mentioned in the exposed documents and this revelation delineates the sophistication of the technology and the amount of effort that is required for this covert method of bugging. It is also mentioned that QUANTUM has been effective and successful against Yahoo, Facebook and other static Internet Protocol (IP) addresses. The functioning of QUANTUM as mentioned in the documents is as follows:

• Target logs into his/ her Yahoo account.
• SSO site connected with the internet router sees the QUANTUM tasked Yahoo selector's packet and forwards it to the TAO's FOXACID server.
• FOXACID server injects a FOXACID URL into the packet and sends it back to the target's computer.
• Simultaneously, the Yahoo server receives the packet from the target's computer through the internet router requesting e-mail content.
• Before the Yahoo packet reaches the target's computer, the FOXACID packet intervenes and beats it back to the endpoint.
• Though the target's Yahoo page is loaded, in the background, the FOXACID URL also loads which redirects to the FOXACID exploit server in the NSA's TAO.

- Now based on the exploitability of the browser, the FOXACID server deploys a stage 1 implant back to the target, thus, implanting the target with a Trojan.

It is claimed in the documents that QUANTUM is capable of targeting a wide range of realms like IPv4_public, alibabaForumUser, doubleclickID, emailAddr, rocketmail, hi5Uid, hotmailCID, linkedin, mail, mailruMrcu, msnMailToken64, qq, facebook, simbarUuid, twitter, yahoo, yahooBcookie, ymail, youtube and watcherID.

Also, the QUANTUM tasking can be done in two different ways. The Research and Technology (R&T) analysts can submit the QUANTUMTHEORY tasking upon which a stage 1 implant called VALIDATOR would be implanted on the target. Secondly, TOPI analysts can submit QUANTUMNATION tasking upon which a stage 0 implant called SEASONEDMOTH (SMOTH) is implanted on the target. A SMOTH dies within 30 days time of deployment unless there is a request to extend its life. The VALIDATOR is a small Trojan implant used as a backdoor access service against personal computers of targets of national interest, including, but not limited to, terrorist targets.[12]

Therefore, it is clear from the NSA's QUANTUM that anybody in this world can become a target for VALIDATOR or any other espionage and surveillance tool of the NSA if the person is perceived to be of some importance to the national interest of the US. Moreover, the NSA has the technological expertise to single out its target in this crowded virtual space and it can also pursue its covert methods of espionage by camouflaging its virtual communications within the trusted communications between the user and the web applications server. Another inference that can be arrived at is that the US has a free hand in tapping the internet router and is able to intervene in the communications between the user and the web applications servers because of the fact that most of the cyber infrastructure is available well within its legal and technical control jurisdictions. A feasible solution can be achieved on this front only with an effective internet governance model which involves participation from a truly global community.

12. Ibid.

NSA ANT Catalogue

In December 2013, *Der Spiegel,* the German weekly newsmagazine revealed another of the NSA's sophisticated programmes, consisting of a digital toolbox called the "NSA ANT Catalogue". This article was co-authored by Jacob Appelbaum, Judith Horchert and Christian Stöcker. Unlike the PRISM programme which was exposed by Edward Snowden to the *Washington Post* and *The Guardian*, the exposure/whistleblower of this project is unknown. But the exposed catalogue reveals the magnitude and variety of digital weapons being used by the US intelligence agency to spy on its targets. The operations of the Advanced/Access Network Technology (ANT) division in the NSA's TAO Department range from penetrating networks, monitoring mobile phones and computers, to diverting, modifying and even deleting data. The network web created by the implants of these sophisticated tools is so big that it has succeeded in establishing a covert network for the NSA that operates parallel to the internet.

The leaked NSA ANT Catalogue is a 50-page document created in 2008. Its list is like a mail-order catalogue of digital tools, from which the employees of the NSA can order technologies from the ANT division for use against its targets. The ANT division is part of the NSA's TAO Department and they are specialised in covert data-mining and data-skimming operations, especially on specific difficult targets. ANT tools are like elite forces which are moved in only when the TAO's other hacking and data-skimming methods are not sufficient to gather the required information from their target systems.[13] While the ANT division develops both hardware and software required for these digital tools, the catalogue of these tools not only defines the operations of the tools but also gives the cost for every tool which ranges from free to $250,000.[14]

Every tool that has been developed by ANT has its own special purpose and the operating devices include almost all areas of the digital world from monitors, cables, USBs, routers, servers, mobile phones and

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13. Jacob Appelbaum, et al. , "Die Klempner aus San Antonio", *Der Spiegel,* January 2014.
14. "Inside TAO: Documents Reveal Top NSA Hacking Unit", *Spiegel Online International,* December 29, 2013, at http://www.spiegel.de/international/world/the-nsa-uses-powerful-toolbox-in-effort-to-spy-on-global-networks-a-940969.html. Accessed on April 6, 2014.

chips, at both hardware and software levels. Most of the NSA ANT tools that have been exposed belong to a family of clandestine tools called "ANGRYNEIGHBOR".

Analysis of NSA ANT Catalogue

A study on understanding the functions and operational capabilities of 50 NSA ANT tools helped to arrive at the following inferences:

- These tools are meant for special operations which are highly covert in nature for the purpose of information gathering, sabotage, espionage and surveillance.
- The functionality of the tools can be mainly associated with military operations, but not necessarily confined to the military only, as a few tools like COTTONMOUTH (USB-based) can also be used for non-military operations.
- A few tools belong to a family of tools called ANGRYNEIGHBOR, which denotes that there are more families of tools either under operation or development.
- All the disclosed documents related to the NSA ANT catalogue are dated in the year 2007. Therefore, there are high chances that these tools have become obsolete, and new versions and models would have replaced them by now.
- There are passing references to many new technologies whose functionalities do not appear in any of the exposed documents. This means that there are many more undisclosed tools developed by the ANT Department whose capabilities are unknown.
- Revelation of these tools would create a compulsion for the agency to either abandon them on the whole or switch to more covert methods of espionage and surveillance.
- In the case of abandoning, the agency would have to abandon many units of these tools which were operational in the field somewhere across the globe. If any other country's agencies were to lay their hands on these tools, identifying and investigating them could reveal more precise capabilities about them.

- Both hardware and software are implanted on devices manufactured by most widely used brands like Samsung, Cisco, Juniper, etc. Therefore, this results in distrust about US brands which, in turn, creates more hassles for any country's procurement body in terms of rigorous audit during procurement of any such devices from the US, especially for national security purposes.

- It is also revealed from the documents that the NSA implants a few of its tools by a method called interdiction, in which the agency would intervene during the supply chain process and place its implant on the devices before they get delivered to their intended recipient. This emphasises the need for enhancing the safety for any supply chain process, especially for defence equipment, irrespective of its size or function.

- The fact that many implants can be installed, controlled, operated and executed remotely emphasises the need for enhanced network security and also acts as a point of realisation for disintegrating and isolating a few sensitive networks from other national grids.

Since the cyber world is a trove of information, with the ability to virtually connect anything and everybody, this medium is utilised ably by all players for their covert operations in order to achieve their desired supremacy. Hence, the cyber domain has become the battleground of the future.

WHAT LIES AHEAD?

A futuristic look into cyber space, beyond capabilities and vulnerabilities, and by mapping the scattered dots, reveals the bigger picture of a game played by many players to achieve 'supremacy'. The US refers to this supremacy in the cyber domain as "global network supremacy".[15] As we live in the age of information, the ability to control and manipulate any given information gives a player the upper hand in this game. Since the cyber world is a trove of information, with the ability to virtually

15. n. 9.

The use of covert capabilities helps the players to unveil the hidden plans of others by silently intruding into their networks, which helps them not only to orchestrate their immediate move but also to frame long-term policies and strategies.

connect anything and everybody, this medium is utilised ably by all players for their covert operations in order to achieve their desired supremacy. Hence, the cyber domain has become the battleground of the future. The various players are none other than entities that operate in the cyber world ranging from individuals to countries. Since the cyber world is slow in penetrating the real world, there is lot more to be virtualised. Till this is achieved and even after, the covert cyber capabilities will act as sabotaging tools to stop another player, in most cases, a country, from enhancing its capabilities in both the virtual and real worlds, and to keep them engaged in tackling the threats of sabotage. Also, at present, the use of covert capabilities helps the players to unveil the hidden plans of others by silently intruding into their networks, which helps them not only to orchestrate their immediate move but also to frame long-term policies and strategies.

A suitable example to understand the extent of danger a successful covert cyber operation can cause would be the series of events which unfolded in Iran in the recent past that changed the fate of the country's ambitious nuclear programme. Iran had started its nuclear programme with aid from the US in the 1950s under the then "Atoms for Peace" policy of the US. As the years passed and due to regime change in Iran, the country which was once an ally of the US, became a foe, and ended up facing economic sanctions from the US. The drift between the two countries also affected Iran's nuclear programme which the country struggled to continue with for long, until recently. However, with help from Russia, some other countries, and the nuclear black market, Iran sustained and enhanced its nuclear programme. Later, in 2005, when Ahmedinijad, became the president of Iran, the nuclear programme gained momentum and Iran began work towards enrichment of weapons

grade uranium. Due to the failure in talks between the US and Iran, in December 2006, sanctions were imposed on Iran by the United Nations, initiated by the US, to curb its nuclear programme. However, these sanctions did not succeed in giving the desired results and Iran managed to move forward in its nuclear programme.[16]

In 2008, the centrifuges in the Natanz nuclear facility in Iran began to face unprecedented crashes. These breakdowns which seemed to be like small random accidents, continued till spring 2010 and the engineers in the facility were clueless about the reason for those crashes. In spring 2010, the situation in the Natanz facility began to deteriorate further when the centrifuges started functioning in a haphazard manner followed by more frequent and high intensity breakdowns, thus, affecting the entire nuclear programme of Iran. During this period, the engineers struggled to decipher the reasons behind the disruptions in the Natanz nuclear facility; later, it was discovered by Symantec, a cyber security products manufacturing company, that a highly sophisticated computer worm had affected the controller systems or Supervisory Control and Data Acquisition (SCADA) systems in the facility. This computer worm was named STUXNET, thus, becoming the first computer programme to be used as a cyber weapon. Additionally, technical papers started coming out related to its functioning.[17]

Later, Stuxnet started getting media attention and slowly media reports emerged about the origin of this computer worm. It was generally reported across all media that Stuxnet was the result of a joint effort by the US and Israeli intelligence agencies, the NSA and Unit 8200 respectively. It was reported that way back in 2006, after the negotiations between Iran and the West floundered, the US, during the Bush Administration, started a covert cyber programme codenamed

16. "Timeline on Iran's Nuclear Programme", *New York Times*, November 24, 2014, in http://www.nytimes.com/interactive/2014/11/20/world/middleeast/Iran-nuclear-timeline.html?_r=2#/#time243_7215. Accessed on December 10, 2014.
17. "How a Secret Cyber War Program Worked", *New York Times*, June 1, 2012, in http://www.nytimes.com/interactive/2012/06/01/world/middleeast/how-a-secret-cyberwar-program-worked.html?ref=middleeast. Accessed on December 11, 2014.

Olympic Games in order to sabotage Iran's nuclear programme. The engineers at the NSA and Israeli Unit 8600 initially wrote a 'beacon' programme that could map the functioning of the Natanz facility and introduced it into the facility, possibly with the aid of an unsuspecting insider. The 'beacon' programme collected and transmitted information related to the facility's computer configurations and other such sensitive information to the agencies. Using the collected data, the engineers again wrote another complex 'worm' programme with the ability to disrupt the facility and, thus, introduced this programme into the computers of the facility through various unknown methods. The worm programme took control of many centrifuges in the facility which made them run either too fast or too slow and, at times, the centrifuges even exploded, whereby the worm succeeded in disrupting the nuclear programme of Iran. Surprisingly, in summer 2010, due to some programming error, the worm programme copied itself into the laptop of an Iranian scientist who worked in the facility. When the scientist connected his laptop to the internet, the worm spread to other parts of the world through the internet and that was when the malicious programme came to the notice of the world community. It was later revealed by the cyber research community that the Stuxnet programme that had spread through the internet was only one version of the various programmes written under the Olympic Games project, and many such variants were utilised on the Iranian facility in order to disrupt and sabotage the nuclear programme. Stuxnet had ably used some 'Zero-day' vulnerability in the Siemans Step 7 software which was widely used in the facility, to cause disruption. It was also reported that when Obama became US president in 2009, his predecessor President Bush successfully persuaded him to continue with the Olympic Games project by highlighting its importance.[18]

In 2013, Symantec came up with a research paper exclusively on Stuxnet, describing its evolution and different variants. This report ascertained that Stuxnet 0.5 was the oldest known Stuxnet version which was in the process of development as early as 2005 and it was in the wild since November 2007.

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18. Ibid.

Stuxnet 0.5 was less aggressive than its later versions, especially Stuxnet 1.x.[19] Some highlighting dates and the relevance of different versions of Stuxnet are mentioned in Table 2.

Table 2: Evolution of Stuxnet Versions

Version	Date	Description
0.500	November 3, 2005	C&C server registration
0.500	November 15, 2007	Submit date to a public scanning service
0.500	July 4, 2009	Infection stop date
1.001	June 22, 2009	Main binary compile timestamp
1.100	March 1, 2010	Main binary compile timestamp
1.101	April 14, 2010	Main binary compile timestamp
1.x	June 24, 2012	Infection stop date

Source: Geoff Mcdonald, Liam O Murchu, Stephen Doherty & Eric Chien. "Stuxnet 0.5 – The Missing Link", Symantec, version 1.0, February 26, 2013.

Fig 4 below shows the uranium enrichment production at Natanz with reference to key milestones of Stuxnet's development. Interestingly the highlighting dates in Stuxnet's life-cycle coincide with the dips in feed or production amounts and lower levels of production given the same or greater feed amounts (shown as gaps between the two lines).

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19. Geoff Mcdonald, Liam O Murchu, Stephen Doherty & Eric Chien. "Stuxnet 0.5 – The Missing Link", Symantec, version 1.0, February 26, 2013.

Fig 4: Low Enriched Uranium Production and Milestones in Stuxnet Coincidences
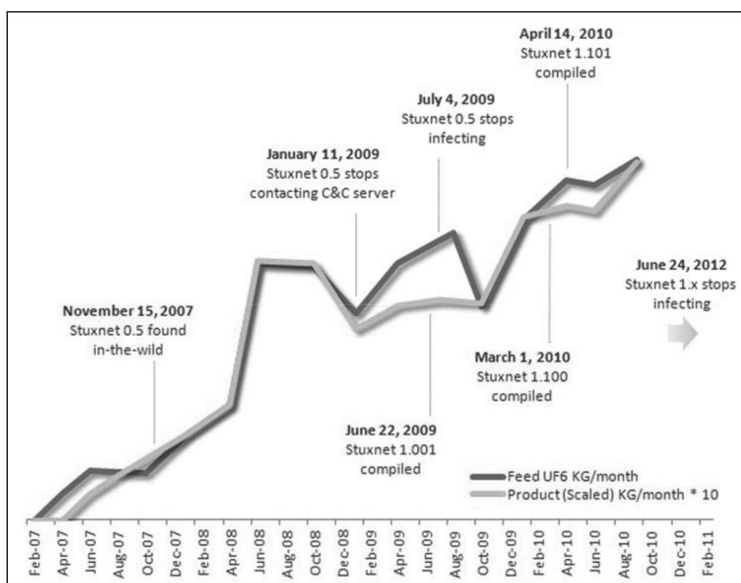
Source: Geoff Mcdonald, Liam O Murchu, Stephen Doherty & Eric Chien. "Stuxnet 0.5 – The Missing Link", Symantec, version 1.0, February 26, 2013.

Although the operational success of different variants of the Stuxnet worm remains unclear, it has succeeded in achieving various other aspects/goals. These are:

One, this computer programme has succeeded in making the cyber weapon a reality.

Two, different variants of Stuxnet together succeeded in delaying Iran's nuclear programme by one and a half to two years time.

Three, the whole Stuxnet episode that disrupted Iran's nuclear programme has instilled fear about the prospective danger of cyber weapons in the mindset/ psyche of the world community.

Four, and most important, the Stuxnet episode may have been one of the main reasons for the Iranian political circle to have a rethink and return to the diplomatic table to discuss the nuclear programme with the West.

The Iranian nuclear episode is a clear example of what covert cyber operations are capable of: disturbing and disrupting a state's national security and even leading to a change of balance in international politics.

As mentioned earlier, where global cyber security is concerned, these covert cyber capabilities pose a serious threat, due to their nature being "covertness". While it is claimed by the US and other countries that these covert cyber capabilities are used to conduct network operations like tracking, detecting and identifying prospective terrorists and their activities in the cyber world, the possibility of these invisible and 'capability-disabling' weapons targeting an individual or a particular group of people or even a state, cannot be denied. Such capability poses a grave danger to cyber freedom and virtual existence for any individual in the domain as well a serious threat to the national security of any targeted nation. This fear is a compelling factor for the common users to lean towards more secretive and clandestine means of operations in the cyber domain, like using TOR networks for everyday browsing in order to hide their location and identity, fearing the consequence of being targeted. Also, many states desire to acquire such covert cyber capabilities so as to be able to participate in the ongoing game of 'supremacy' and have the ability to take revenge, if need be, on another state. If this situation continues, the deep web would go deeper and the cyber 'under' world would expand more rapidly which would only increase the complexities that already exist in this highly technical realm. This complexity in the virtual world will not only have a spillover effect into the physical world but also have its own negative repercussions on the political, economic, social and other activities of the real world.

DECONSTRUCTING DISASTER MANAGEMENT: WITH SPECIAL REFERENCE TO CIVIL-MILITARY LINKAGES

NISHANT GUPTA

INTRODUCTION

Jammu and Kashmir (J&K) was once again in the news for devastation and intense trauma associated with hundreds of unnatural deaths. This time, the cause was not the commonly known beast of terrorism and/or cross-border attacks, rather the damage was caused by nature's fury in the form of unprecedented floods and inundation. The scale and intensity of extreme weather incidences like the J&K floods repeatedly bring out the inadequacies in the country's disaster response capabilities. Many international agencies, including the Department for International Development (DFID) and the Disasters Emergency Committee of the UK have also observed that there is urgent and serious need for substantial disaster preparedness measures in India. At the same time, shortfalls in disaster management capacity are not unique to India. The resources of the developed nations, including the US, have also been found wanting in appropriately responding to natural disasters. Due to limited resources and increasing disaster management

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Due to limited resources and increasing disaster management demands/ requirements, a developing and aspiring nation needs to explore all possible means of strengthening the national, regional and international disaster relief mechanisms.

demands/requirements, a developing and aspiring nation needs to explore all possible means of strengthening the national, regional and international disaster relief mechanisms. This calls for appropriate understanding of natural disasters and in-depth analysis of the existing disaster relief mechanisms.

This research paper is broadly divided into three sections. The first section focusses upon understanding disasters. The second section delves into the role of the military in the disaster relief framework and the effectiveness of foreign military assistance. This section also brings out the dynamics of civil-military relations in disaster relief. The third section brings the spotlight on South Asia and the disaster relief mechanism in India with special reference to the role of the military. Finally, some recommendations have been made towards meeting the challenges of disaster response.

UNDERSTANDING NATURAL DISASTERS AND DISASTER RESPONSE

Before defining a disaster *per se*, understanding hazards is essential as natural disasters are the disasters that follow natural hazards. A hazard, as defined by the UN International Strategy for Disaster Reduction (ISDR), is "a potentially damaging physical event, phenomenon or human activity that may cause loss of life or injury, property damage, social and economic disruption or environmental degradation". Natural hazards are broadly classified into three categories: hydrometeorological, geological and biological. ISDR defines a disaster as "a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources". Man-made disasters have been kept out of the scope of this study.

Disasters can be classified in many ways. According to the speed of their onset, disasters are typically of two types, viz. slow and rapid. Rapid-onset disasters take place suddenly. There may be no (or very little) warning of the hazard that causes them. Flash floods, tsunamis, earthquakes, windstorms, volcanic eruptions, landslides, avalanches and meteor strikes are common examples of rapid-onset natural disasters.

Natural hazards are broadly classified into three categories: hydrometeorological, geological and biological.

In the past two decades, there has been a considerable rise in the recorded number of natural disasters and the number of reported large-scale disasters—disasters wherein 10,000-99,999 people are killed or affected—has also increased substantially.[1] The large increase in reported disasters may be partly attributed to better reporting by the media, governments and humanitarian agencies. But the actual increase in the number of disasters is undeniable. Floods, windstorms and earthquakes are among the most common types of rapid-onset natural hazards. Most of the increase in the number of disasters has been accounted for by hydrometeorological hazards, primarily floods and windstorms. A flood is considered the most common type of natural hazard occurring in recent years. Floods typically affect large numbers of people but cause a relatively low number of deaths as compared to other disasters, including earthquakes. Floods generally require extended responses, especially if renewed rains occur. That means that humanitarian actors are required to maintain their field presence for a longer duration and are possibly required to respond to several disasters within a disaster.

In the 21st century, India has been witnessing increased frequency and magnitude of natural disasters, bringing its significantly high vulnerability to the fore. Analyses of major disaster response operations (be it the 1998 super cyclone in Orissa, the 2000 floods in Assam, the massive earthquake in Gujarat in 2001, the tsunami in 2004, the floods and earthquake in 2005,

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1. Sharon Wiharta et al, *The Effectiveness of Foreign Military Assets in Natural Disaster Response: A Report by the Stockholm International Peace Research Institute* (Sweden: SIPRI, 2008).

In the past two decades, there has been a considerable rise in the recorded number of natural disasters and the number of reported large-scale disasters— disasters wherein 10,000-99,999 people are killed or affected— has also increased substantially. the 2013 cloudburst in Uttarakhand or the most recent floods in J&K) highlight a need to enhance disaster relief preparedness in India. In a relief operation, the emergency phase aims at providing immediate life-saving assistance in terms of evacuation and provisioning of shelter, water, food and basic health care. Subsequent needs include reconstruction and rehabilitation. These needs may continue for several years, particularly in the case of refugees and victims of socio-economic collapse. Alongside, a sense of humanity and a sign that someone cares is also crucial.

Disasters are becoming more complex with increasingly long-term consequences. Even the economically developed nations do not have adequate adaptation and mitigation resources/strategies to adequately respond to major disasters. More importantly, disasters disproportionately affect the poor. In countries with economic problems or political instability, disasters weaken already fragile public institutions; and essential services such as health, water and sanitation get severely hampered. As per some reports, over 90 per cent of the total disaster-related deaths occur in the developing countries, where the economic losses they cause hit far harder than in the industrialised/developed nations, and can virtually wipe out years of economic development.[2]

It is well proven that the amount of money spent on prevention pays richly and saves a lot in relief. The total quantum of aid provided for emergency assistance has been increasing but the funding that is available for assistance to individual relief efforts may have decreased, given the rise in the frequency, number and extent of disasters. Competition over resources is, therefore, intensifying the debate about cost-effectiveness in disaster relief. Hence, it is more important for the developing nations to

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2. The Indian Red Cross Society official website. Accessed at http://www.indianredcross.org/ program.htm on August 21, 2014.

adapt to and mitigate, disasters. India, an aspiring nation, also needs to appreciate the international disaster relief mechanisms, and find ways and means to strengthen and exploit the same at national and regional levels.

INTERNATIONAL DISASTER RELIEF ASSISTANCE

The primary concern for any government in the face of a major disaster is to save lives, alleviate suffering and maintain the general welfare of the people affected by it. The term 'disaster response' signifies the provision of assistance or intervention during or immediately before/after a disaster for life preservation and meeting the basic subsistence needs of the affected people. Disaster response preparedness is also largely related to disaster response as it includes pre-disaster activities that are undertaken to minimise loss of life, injury and property damage in an impending disaster, and preparation regarding rescue, relief, rehabilitation and other services that can be provided following the disaster.

In any emergency, the first responders are the disaster-affected people and their governments. The International Disaster Relief Assistance (IDRA) comes into play when an affected nation perceives that the disaster response requirements exceed its capabilities and requests the international community for help. There could also be a scenario wherein an affected country is offered assistance even before it seeks, or contemplates seeking, it. The key objective of international humanitarian action is to support national efforts in protecting the lives, livelihoods and dignity of people in need. IDRA comprises material, personnel and services provided by the international community to an affected state and to meet the needs of the government/people affected by a disaster.

When a natural disaster strikes, a multitude of factors influence an affected country's decision to request for, or to accept offers of, international assistance, including:
- The scale of the disaster and the humanitarian needs it creates.
- The level of preparedness for such a disaster at the national and sub-national levels.
- The urgency of particular capabilities needed.

Many militaries have special units for disaster relief operations. The Swiss military is one such military known for its contribution in disaster management. With specialised units, its rescue corps is the main pillar of military disaster relief.

• The international relations policy of the affected nation and the prevailing geo-political situation

Foreign military assets comprise the personnel, equipment and services of a military nature provided by foreign governments with the consent of the affected state for IDRA. Regional multilateral frameworks and other methods of coordinating the deployment and use of military assets in international disaster relief assistance are largely in place. In the period 1997-2006, as reported by the Stockholm Peace Research Insititute (SIPRI), the military assets that contributed most commonly to international disaster relief operations by the responding countries were:

- Air transport, including aeroplanes used for the transport of relief items and personnel.
- Medical assistance (field hospitals and personnel).
- Expert personnel (in civil-military coordination and liaison, needs assessment and logistics).[3]

Mention of air transport as the primary military asset employed in disaster relief operations underscores the importance of air power. The roles that air power can play in disaster management/relief can be categorised under the following verticals:

- Reconnaissance of disaster area.
- Air transportation of personnel, medical teams, materials, supplies and disaster equipment.
- Air dropping of food, water and medicines, etc.
- Air evacuation of casualties/marooned people.
- Air transportation of VVIPs/VIPs, air force, army, civilian officials and Non-Governmental Organisations (NGOs).

3. Wiharta et al, n. 1, Executive Summary, p. x.

Many militaries have special units for disaster relief operations. The Swiss military is one such military known for its contribution in disaster management. With specialised units, its rescue corps is the main pillar of military disaster relief. The rescue corps comprises two verticals: the disaster relief standby company which can intervene within hours, and the disaster relief battalions which can be called up and deployed within days to ensure sustainability, concentration of forces and reinforcement. The specialised units of the rescue corps are also augmented with elements from other Service branches, including the air force, engineers, logistics and medical forces, military security and Nuclear, Biological, Chemical (NBC) defence forces.

The USA, having unmatched financial and military resources and a large network of overseas military bases, has an explicit policy of making its forces available for international humanitarian work. The European countries also deploy military assets for natural disaster responses in Africa, Central America, the Middle East and Asia, but rarely in Europe. Outside Europe, Australia, Canada, India, Japan and South Africa respond more readily to natural disasters in neighbouring countries than to those outside their region, unless they already have military assets in the affected region. The ASEAN Regional Forum (ARF) also promotes a greater role of military assets in regional disaster management. It believes that the more experience the militaries of the region have in dealing with disaster management, the better they will be in delivering in major disaster events. On the contrary, some countries have policies limiting the use of their military assets in international disaster response.

Many factors influence a government's decisions regarding offering/seeking/accepting military assistance. The considerations of the assisting country are somewhat more than those of the affected country, and the primary ones are:[4]

- The scale of the disaster and the humanitarian needs it creates.
- The assisting country's policies regarding the deployment of its military assets for international disaster relief.

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4. Ibid.

In 1994, the Guidelines on the Use of Military and Civil Defence Assets in Disaster Relief (Oslo Guidelines) were issued to formulate an international normative and practical framework for the use of military and civil defence assets in natural disaster response.

- Whether the affected country has requested for foreign military assistance or not.
- The availability of military assets that are not engaged in higher priority tasks, and how quickly and easily those assets can reach the disaster site.
- National interests.
- Diplomatic and historical relations with the affected country.
- Media coverage of the disaster and the public pressure it generates.

The 2008 SIPRI report entitled "The Effectiveness of Foreign Military Assets in Natural Disaster Response" underscores India's readiness in responding to natural disasters, especially in its neighbourhood, whereas some countries have policies limiting the employment of their military assets in international disaster response.[5]

OSLO GUIDELINES ON THE USE OF FOREIGN MILITARY AND CIVIL DEFENCE ASSETS IN DISASTER RELIEF

In 1994, the Guidelines on the Use of Military and Civil Defence Assets in Disaster Relief (Oslo Guidelines) were issued to formulate an international normative and practical framework for the use of military and civil defence assets in natural disaster response. These guidelines address the use of foreign Military and Civil-Defence Assets (MCDA) in international disaster relief operations. MCDA are uniformed assets and services contributed by foreign military and civil-defence organisations for humanitarian assistance. They include relief personnel, equipment (e.g. air, ground and sea transport, communication equipment), and supplies and services (e.g. medical support, security services). MCDA are generally provided at no cost to the affected state and/or to the United Nations (UN), unless otherwise regulated

5. Ibid.

by an international agreement. MCDA, when deployed through a central request to support UN agencies is called UN MCDA. MCDA and UN MCDA are governed by individual Status of Forces Agreements between two countries and/or by the Oslo Guidelines on the Use of Foreign Military and Civil Defence Assets in Disaster Relief.[6]

The Oslo Guidelines highlight the principle that use of foreign military and civil-defence assets should be requested for only where there is no comparable civilian alternative.

The essential principles followed in extending military assistance in disaster relief are:

- Military assistance is generally not extended unless the civil administration asks for it though there are a few exceptions to this rule.
- The military is expected to be in a supporting role and not in charge.
- The military should strive to leave at the earliest, as soon as the civil administration is capable enough to manage the region. So local authorities should not be made dependent on the military.
- The military leadership should follow the laws governing military disaster response.

The Oslo Guidelines highlight the principle that use of foreign military and civil-defence assets should be requested for only where there is no comparable civilian alternative. They also provide principles and procedures for requesting for, and coordinating, military and civil-defence assets when these resources are deemed necessary and appropriate for humanitarian response. A Consultative Group on the Use of Military and Civil Defence Assets manages the Oslo Guidelines.[7]

However, application of the guidelines at the national level varies. Most notably, the articulation calling for foreign military assets to be used only as a 'last resort' has been interpreted and applied in different ways by

6. "Disaster Response in Asia and the Pacific: A Guide to International Tools and Services", a publication of the OCHA-ROAP Regional Office for Asia and the Pacific. Accessed at www.unocha.org/roap on August 16, 2014.
7. Guidelines on the Use of Foreign Military and Civil Defence Assets in Disaster Relief – "Oslo Guidelines." Accessed on August 20, 2014 at http://reliefweb.int/sites/reliefweb.int/files/resources/8706B7B69BD77E00C1257233004F0570-OCHA-Nov2006.pdf.

different actors. Essentially integral to the concept of 'last resort' is whether the military asset can offer unique capabilities and availability. There are some areas, including transport, logistics and the ability to deploy rapidly, wherein militaries unquestionably possess unique capabilities.

As per the Oslo Guidelines on the Use of Foreign Military and Civil Defence Assets [8] in Disaster Relief,[9]

> Military and civil defence assets should be seen as a tool complementing existing relief mechanisms in order to provide specific support to specific requirements, in response to the acknowledged "humanitarian gap" between the disaster needs that the relief community is being asked to satisfy and the resources available to meet them. Therefore, foreign military and civil defence assets should be requested only where there is no comparable civilian alternative and only the use of military or civil defence assets can meet a critical humanitarian need. The military or civil defence asset must, therefore, be unique in capability and availability.

At the same time, the Oslo Guidelines do not prevent foreign civil protection assets, civilian in nature and respecting humanitarian principles that can provide important direct and indirect contributions to humanitarian actions based on assessments of humanitarian needs and their possible advantages in terms of speed, specialisation, efficiency and effectiveness, especially in the early phase of relief response. The use of civil protection assets should be needs driven, complementary to, and coherent with, humanitarian aid operations, respecting the overall coordinating role of the UN. Thus, the Oslo Guidelines propagate different criteria for foreign military and civil Humanitarian Assistance and Disaster Relief (HADR) assets.

However, once it has been established that international assistance is needed, whether that assistance is provided by soldiers or civilians should

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8. "Military Disaster Relief Swiss Armed Forces and Civil Affairs Support." Accessed at http://www.vtg.admin.ch/internet/vtg/en/home/themen/katahi.print.html on August 12, 2014.
9. The "Oslo Guidelines" were originally prepared over a period of two years and were released in May 1994. Thereafter, these guidelines were relaunched in 2006. The primary changes in this Revision 1.1 concern the addition of the word "foreign" in the title, as well as additions for clarification to paragraph 5 related to "last resort".

be of secondary importance. More significant is that the aid arrival is not delayed. However, this may not be the case in countries that are experiencing conflict or political instability, as the government institutions in these states are weak and the geo-political situation is much more complex. And in such circumstances, the arrival of foreign military aid may have different connotations and may also complicate the environment further.

EFFECTIVENESS OF FOREIGN MILITARY ASSETS
The capability of the military extending foreign military assistance is not the only criterion to judge its effectiveness. The effectiveness of foreign military assistance depends upon many other elements as well. The efficiency of operations largely depends on how well the military capabilities have been used within the larger operations and how well the operations have been coordinated by others, generally civilian actors. For harnessing the best results from foreign military assistance, the following need to be looked into:

- Generally, timeliness is the primary reason for deploying foreign military assets, especially in the initial days and weeks of the operation, as militaries have the necessary equipment that can expeditiously supply large quantities of relief products to the disaster areas and can also undertake search and rescue. Military aircraft in particular can transport large quantities of relief supplies and other assets, and military helicopters can support search and rescue operations. But timelines in HADR operations can often be affected by bureaucratic delays (at times, inescapable) such as the Status of Forces Agreement.
- The deployed military assets must be appropriate, determined by how well the capabilities meet the requirements. To ensure that appropriate resources are provided, it is necessary to link need assessments to the overall coordination framework.
- The effectiveness of such operations is also affected by the absorbing capacity of the affected country. While the ability to coordinate and use assets during the relief operations heavily relies on the institutional capability of the distressed country, militaries tend to be relatively

self-sufficient. Nevertheless, the arrival of large numbers of foreign militaries from different countries, with overlapping capabilities, can lead to serious absorption problems.

- Coordination between the civilian humanitarian actors and the military is indeed critical to disaster relief. As per the UN Under-Secretary General for Humanitarian Affairs and Emergency Relief Coordinator John Holmes: "Coordination between civilian and military actors is essential during an emergency response. The increasing numbers and scale of humanitarian emergencies, in both natural disaster and conflict settings, had led to more situations where military forces and civilian relief agencies are operating in the same environment." Differences in cultures, priorities and operating modes between the military and civilian staff can have critical impacts on information management, which is essential for the success or failure of relief operations.

- Cost is another critical issue of deploying armed forces, which is generally considered to be higher for military equipment than for civilian assets. There are concerns that foreign military assets place a disproportionate burden on humanitarian funds. However, in several countries, Defence Ministries cover some or all of the costs for overseas disaster relief, reducing their impact on humanitarian aid budgets.

DISASTER MANAGEMENT IN SOUTH ASIA

The Himalaya-Hindukush is the youngest, the largest and seismically, the most active mountain system of the world. This mountain system also has the largest non-polar glacial deposits which are increasingly melting due to the effects of global warming. Heavy rainfall and high silt load on water bodies cause recurrent floods over large areas. At the same time, South Asia also has a large area facing droughts due to scanty rainfall and depleting ground water level. A long coastline and many islands are threatened by cyclones, storm surge and sea level rise. It is estimated that the South Asian countries lose between 2 to 12 percent of the Gross Domestic Product (GDP)

annually on account of natural disasters.[10] Two-thirds of the disasters the region experiences are climate related and there has been a phenomenal increase in their frequency, severity and unpredictability in the recent times.[11]

Table 1: Disasters in South Asia[12] (1970-2009)

Countries	Total		% Share	
	Events	Deaths	Events	Deaths
Bangladesh	254	5,28,503	22.44	60.82
Bhutan	7	287	0.62	0.03
India	462	1,79,459	40.81	20.65
Maldives	5	325	0.44	0.04
Nepal	78	11,390	6.89	1.31
Pakistan	137	91,886	12.10	10.57
Sri Lanka	63	37,362	5.57	4.30
Afghanistan	126	19,794	11.13	2.28
Total	**1,132**	**8,69,006**	**100**	**100**

MODELS OF REGIONAL RESPONSE

There are various types of regional responses which are generally grouped into three primary clusters[13]:

• **Coordination Response Model:** Assistance from member countries is pooled by the regional organisation which coordinates the response. Example: Euro-Atlantic Disaster Response Coordination Centre (EADRCC).

• **Assured Response Model:** Assurance of assistance is arranged by the regional organisation through prior negotiations and commitments which

10. PG Dhar Chakrabarti, director, SAARC Disaster Management Centre, and executive director, National Institute of Disaster Management, *Regional Cooperation for Disaster Management in South Asia: Challenges and Opportunities for Regional Early Warning System for Natural Disasters*. Accessed at www.dmb.gov.bd
11. SAARC Workshop on Climate Change and Disasters: Emerging Trends and Future Strategies Kathmandu, Nepal, August 21-22, 2008, *Regional Cooperation on Climate Change Adaptation and Disaster Risk Reduction in South Asia: Road Map*. Accessed at http://saarc-sadkn.org/downloads/road_map%20CCA&DRR.pdf on October 4, 2014.
12. Chakrabarti, n. 10.
13. Ibid.

The 2004 Indian Ocean tsunami was a historic event that triggered a change in the region's outlook towards disaster management.

become binding on the member countries. Example: Regional Response Mechanism of Caribbean Disaster Emergency Response Agency (CDERA).

• **Voluntary Response Model:** Each member country, on a voluntary basis, earmarks assets and capacities for regional standby arrangements for response and relief. Asia is largely following this model. The Association of Southeast Asian Nations (ASEAN) and South Asian Association for Regional Cooperation (SAARC) have created frameworks for voluntary response following the principles of national sovereignty and democracy.[14]

SAARC AND DISASTER MANAGEMENT

The 2004 Indian Ocean tsunami was a historic event that triggered a change in the region's outlook towards disaster management. On June 25, 2005, a Special Session of the SAARC Environment Ministers was held at Male to deliberate on the issue of disaster management. In 2006, the Comprehensive Framework on Disaster Management in South Asia was developed in Dhaka aligned with the implementation of the Hyogo Framework of Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters.[15] Subsequently, the SAARC Council of Ministers, on July 30, 2006, and the Fourteenth SAARC Summit, held in New Delhi in April 2007, approved the framework. The framework

14. "ASIA: Natural Disasters Spur Regional Cooperation" in *IRIN: Humanitarian News and Analysis.* Accessed at http://www.irinnews.org/printreport.aspx?reportid=79491 on September 13, 2014. The ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA) is a noteworthy initiative and the Association of Southeast Asian Nations (ASEAN) Regional Forum (ARF) has been taking many initiatives towards enhancing regional cooperation in disaster management. In 2008, ARF had announced its first region-wide disaster relief exercise and contemplated deployment of military assets as part of plans to deepen cooperation on disaster management. ARF also calls for greater civil-military cooperation and coordination in major disaster responses.

15. The Hyogo Framework for Action (HFA) 2005-15, a 10-year plan for building the resilience of nations and communities to disasters, endorsed by the UN General Assembly in the Resolution A/RES/60/195 following the 2005 World Disaster Reduction Conference, is the guiding principle being followed towards creating Regional Frameworks on Disaster Management.

provides a platform for the South Asian countries to[16]:

- Establish and strengthen the regional disaster management system to reduce risks and to improve response and recovery management at all levels.
- Identify and elaborate country and regional priorities for action.
- Share best practices and lessons learnt from disaster risk reduction efforts at national levels.
- Establish a regional system to develop and implement regional programmes and projects for early warning.
- Establish a regional system of exchanging information on prevention, preparedness and management of natural disasters.
- Create a regional response mechanism dedicated to disaster preparedness, emergency relief and rehabilitation to ensure immediate response.
- Create a regional mechanism to facilitate monitoring and evaluation of achievements towards goals and strategies.

In 2006, the SAARC Disaster Management Centre (SDMC) was established at the premises of the National Institute of Disaster Management (NIDM)in New Delhi with a mandate to serve the SAARC nations by providing policy advice and facilitating capacity building services, including strategic learning, research, training, system development and exchange of information for effective disaster risk reduction and management.

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16. South Asian Disaster Knowledge Network official website http://www.saarc-sadkn.org. Accessed on September 25, 2014.

Disaster Division, Hydrometeorological Disaster Division, Policy Planning Division and Biological and other Man-Made Disasters where professionals from the member states work to assess and analyse the risks of various disasters, identify the critical gaps, develop regional projects as outlined in the roadmaps, and implement and monitor the projects as per resources allocated for the same.

National Focal Points of the SAARC Disaster Management Centre, as nominated by the member countries, are as follows:

Table 2: National Focal Points of SAARC Member States

Afghanistan	Afghan National Disaster Management Authority
Bangladesh	Department of Disaster Management
Bhutan	Ministry of Home and Cultural Affairs
India	Ministry of Home Affairs
Maldives	National Disaster Management Centre
Nepal	Ministry of Home Affairs
Pakistan	National Disaster Management Authority
Sri Lanka	Ministry of Disaster Management and Human Rights

In India, the Ministry of Home Affairs, the national focal point, has a Disaster Management Division which is responsible for response, relief and preparedness for natural calamities and man-made disasters (except droughts and epidemics). This division is also responsible for legislation, policy, capacity building, prevention, mitigation and long-term rehabilitation.

As and when a member country needs assistance in the event of a disaster, it may request for such assistance directly from any other member country or through the SDMC (SAARC Disaster Management Centre). The requesting country specifies the scope and type of assistance while the assisting country notifies, directly or through the SDMC, the scope and terms of such assistance. The requesting country provides, to the extent possible, local facilities and services for the proper and effective administration of the assistance. The requesting country exercises overall direction, control and supervision of assistance within its territory.

SDMC has developed the South Asian Disaster Knowledge Network (SADKN), a gateway to knowledge and information on disaster risk management in South Asia. The SADKN web portal is a common platform for sharing knowledge and information among the multiple stakeholders of the member countries of SAARC on the multi-disciplinary and

SDMC has developed the South Asian Disaster Knowledge Network (SADKN), a gateway to knowledge and information on disaster risk management in South Asia.

multi-sectoral issues of disaster risk assessment, risk prevention, mitigation and preparedness, and disaster response, relief, recovery and reconstruction.

The SADKN is a network of networks, with eight national portals and one regional portal, that would involve the national, provincial and local governments, international organisations, scientific, technical and academic institutions, non-governmental organisations, media and corporate sectors, communities and individuals in South Asia in sharing knowledge and good practices on disaster management. The SADKN portal is an endeavour to provide ready access to clear, understandable and user-friendly information about real-time, impending and historical disasters, details of hazards, vulnerabilities and risks of disasters, and knowledge of resources, references, images and videos on virtually every aspect of disaster management in a user-friendly manner. It is creating an environment that encourages people to create, learn, organise, share, use and reuse knowledge on disaster management. Its vision is to provide a one-stop unified point of access to disaster management knowledge and services and thereby accelerate and improve the quality of disaster mitigation and response in the region.[17]

The SAARC Disaster Management Centre develops roadmaps on different aspects of disaster risk reduction and management through a consultative process involving all the member states, various technical and scientific organisations, other stakeholders and resource persons in the

17. Official website of SADKN. Accessed at http://www.saarc-sadkn.org/about.aspx on September 21, 2014.

Resource constraints have been a major limiting factor in implementation of the agreed framework and roadmaps. Additionally, SAARC has been very conservative in receiving assistance from external sources.

region. Based on these roadmaps, programmes and activities are initiated at the national and regional levels for implementation of the roadmaps, and priorities have been fixed in the short, medium and long terms. Some of the prominent roadmaps that have been developed are:

• Application of Science and Technology for Disaster Risk Reduction and Management.
• Coastal and Marine Risk Mitigation Plan.
• Climate Change and Disasters: Emerging Trends and Future Strategies.

• Community-Based Disaster Risk Management in South Asia.
• Mainstreaming Disaster Risk Reduction in Development.
• Earthquake Risk Management.

Member countries usually agree to implement projects derived from these roadmaps and embodied in the Regional Framework of Disaster Management developed by the SAARC Disaster Management Centre. Despite institutional commitments, achievements with regards to these pursuits are still far from being comprehensive or substantial. The SAARC Comprehensive Framework on Disaster Management and the SAARC roadmaps on disaster risk reduction are not legally binding instruments although these have been unanimously adopted by the member states. Non-legal bindings have limitations on the implementation and enforcement of the framework and the roadmaps. Resource constraints have been a major limiting factor in implementation of the agreed framework and roadmaps. Additionally, SAARC has been very conservative in receiving assistance from external sources. Almost all the SAARC initiatives have been funded by contributions from the member states, as per the sharing formula worked out on the basis of the size and population of the member states. Due to resource constraints, there is always reluctance on the part of the member states to enhance their contributions, which constrains the

implementation of regional projects. At the same time, the SDMC has successfully implemented several projects on disaster management of regional scale with partial financial support from outside agencies like the United Nations Office for Disaster Risk Reduction (UNISDR), Asian Disaster Reduction Centre (ADRC) and World Bank.

Despite having established elaborate disaster response mechanisms, the prevailing structures are still far from having any semblance of a symbiotic relationship. Among other matters, the member states do not appear to be forthcoming in sharing critical data and information on trans-border hazards and vulnerabilities, particularly on issues like discharge and withdrawal of waters from rivers and reservoirs, rainfall in upper catchment areas, etc which are necessary for developing regional flood early warning systems, etc.[18] Such disjointed approaches highlight the mistrust prevailing among the SAARC nations. There is a pressing need to somehow strengthen mutual dependencies and thereby enhance the effectiveness of the existing SAARC disaster response mechanisms.

DISASTER RESPONSE MECHANISM IN INDIA

India is highly vulnerable to natural disasters: 58.6 per cent of its landmass is prone to earthquakes of moderate to very high intensity; over 40 million hectares (12 per cent of land) is prone to floods and river erosion; of its 7,516-km-long coastline, close to 5,700 km is prone to cyclones and tsunamis; 68 per cent of the cultivable area is vulnerable to droughts and hilly areas are at risk from landslides and avalanches. There is vulnerability to disasters/emergencies of Chemical, Biological, Radiological and Nuclear (CBRN) origin. These heightened vulnerabilities to disaster risks can be related to many factors including expanding population, urbanisation and industrialisation, development within high-risk zones, environmental degradation and climate change.[19]

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18. *SAARC: Regional Progress Report on the Implementation of the Hyogo Framework for Action (2011-2013)*, A Regional HFA Monitor update published by Prevention Web accessed at http://www.preventionweb.net/english/hyogo/progress/reports/. Accessed on October 4, 2014.
19. *National Policy on Disaster Management 2009* (New Delhi: National Disaster Management Authority, 2009), p. 1.

Post 2004 tsunami, with the enactment of the Disaster Management Act of 2005 there has been a paradigm shift from response and relief to mitigation and preparedness. Now the endeavour is to make disaster management a holistic, multi-dimensional, and multi-disciplinary approach involving diverse scientific, engineering, social, and financial processes.

In India, the approach of disaster response within a policy framework is of recent origin. In the past, when disasters struck, the Department of Relief and Rehabilitation under the Union Ministry of Agriculture was given the charge of providing relief material. Its approach was primarily post-disaster management-centric. However, post 2004 tsunami, with the enactment of the Disaster Management Act of 2005 there has been a paradigm shift from response and relief to mitigation and preparedness.[20] Now the endeavour is to make disaster management a holistic, multi-dimensional, and multi-disciplinary approach involving diverse scientific, engineering, social, and financial processes. The National Policy on Disaster Management (NPDM) 2009 envisages a paradigm shift, from the erstwhile relief-centric response to a proactive prevention, mitigation and preparedness-driven approach for conserving developmental gains and to minimise loss of life, livelihood and property.

Essentially, states are entrusted with the administrative responsibility for disaster preparedness and management as well as the task of responding to any kind of disaster. The Centre is mandated to intervene when the magnitude of the disaster escalates beyond the state authorities' capability. In such an eventuality, the extent of the Centre's intervention is dictated by the gravity of the disaster, the required scale of relief operations, and the central assistance required for augmenting the financial resources at the disposal of the affected state government.

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20. Government of India (GOI), Ministry of Home Affairs (MHA), National Disaster Management Division, *Disaster Management in India - A Status Report, August 2004.* Accessed at http://www.ndmindia.nic.in/GoIUNDP/ReportPub/DM-Statu-%20Report.pdf on October 19, 2014.

But, on the ground, the states generally find themselves ill-equipped to respond to disasters of high magnitude and the central agencies play a major role in disaster response. A Supreme Court appointed committee on the recent catastrophic floods in J&K (September 2014), also flagged the state government's deficient response and praised the valiant response of the defence forces, National Disaster Response Force (NDRF) and local volunteers.[21]

The National Disaster Management Authority (NDMA), the apex disaster management body under the chairmanship of the prime minister, is mandated to lay down the policies, plans and guidelines for disaster management to ensure a timely and effective response to disasters. Primarily, there are three central organisations to deal with the subject of disaster management: the Ministry of Home Affairs (Disaster Management Division), NDRF and NIDM. NDMA is mandated to encourage identification of disaster situations that would affect more than one state and to promote better coordination among the states, central ministries and departments and other agencies concerned through the establishment of mechanisms on the lines of the Mutual Aid Agreement.

Further, for execution of various polices, the Central Relief Commissioner (CRC) is designated as the nodal officer for coordination of relief operation. The office of the CRC receives all the information related to forecasts and warnings from the Indian Meteorological Department and issues directions for an action plan to respond to the emerging situation.[22]

Various ministries are assigned the responsibility for hazard identification and risk assessment, and to respond to disasters related to their field of expertise.

21. Krishandas Rajagopal, "As Floods Struck, Omar Government Went Missing, says SC Panel", *The Hindu* (Delhi), October 12, 2014.
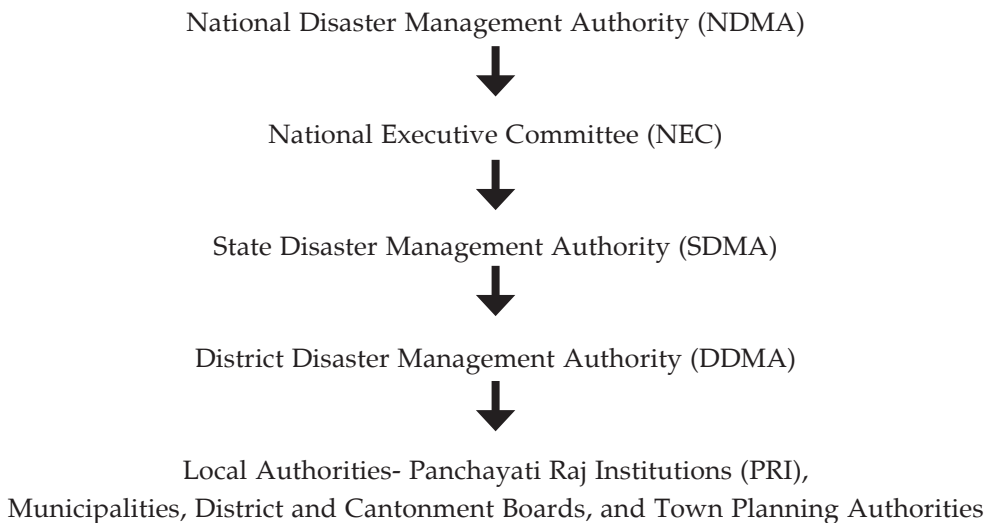22. H. Shivananda and P.K. Gautam, "Reassessing India's Disaster Management Preparedness and the Role of the Indian Armed Forces", *Journal of Defence Studies,* vol. 6 no. 1, January 2012, pp. 102-113.

Table 3: Responsibility of the Various Ministries in the Wake of Disasters[23]

Disasters	Nodal Ministry
Earthquakes and Tsunamis	MHA/Ministry of Earth Sciences/Indian Meteorological Department (IMD)
Floods	MHA/Ministry of Water Resources/ Central Water Commission (CWC)
Cyclones	MHA/Ministry of Earth Sciences/IMD
Droughts	Ministry of Agriculture /IMD
Biological Disasters	Ministry of Health and Family Welfare
Chemical Disasters	Ministry of Environment and Forests
Nuclear Disasters	Ministry of Atomic Energy
Air Accidents	Ministry of Civil Aviation
Railway Accidents	Ministry of Railways

Source: National Disaster Management Authority, Government of India, 2011.

Fig 1: Institutional Framework under the Disaster Management Act, 2005

National Disaster Management Authority (NDMA)

⬇

National Executive Committee (NEC)

⬇

State Disaster Management Authority (SDMA)

⬇

District Disaster Management Authority (DDMA)

⬇

Local Authorities- Panchayati Raj Institutions (PRI),
Municipalities, District and Cantonment Boards, and Town Planning Authorities

In spite of thoughtful conception and establishment of elaborate national disaster management structures under the National Disaster

23. Ibid., p. 106.

Management Authority (NDMA) placed directly under the prime minister, inadequacy of resources continues to be a sore point. The State Disaster Management Authorities (SDMAs) are yet to be established in some of the states. In some states, the establishment of SDMAs remains symbolic as they are nothing more than the changed name of the department of relief and rehabilitation, home guards and emergency fire services manned with ad hoc personnel.

The NDMA is mandated to deal with all types of disasters, but major crises having serious or national ramifications are handled by the National Crisis Management Committee (NCMC), headed by the Cabinet secretary. NCMC is supported by the Crisis Management Groups (CMGs) of the central nodal ministries and assisted by the National Executive Council (NEC) on a requirement basis.[24]

The NDRF (National Disaster Relief Force), the force responsible to respond to disasters, has very limited capabilities primarily because of its very small size. Reportedly, the NDRF comprises 10 battalions, three each from the Border Security Force (BSF) and Central Reserve Police Force (CRPF) and two each from the Central Industrial Security Force (CISF) and Indo-Tibetan Border Police (ITBP). Each battalion consists of 1,149 personnel and has 18 specialised search and rescue teams of 45 personnel.[25] There are reports that two more battalions have been approved. But these numbers are virtually insignificant in the response to a disaster of high magnitude.

As the civil administration remains ill equipped for quickly initiating a tangible response to major disasters, the armed forces continue to be the only credible option available to the nation to handle these disasters. Though the responsibility of coordinating disaster response and relief operations lies with the Home Ministry, the armed forces under the Ministry of Defence, are routinely called out to assist, act upon, and manage, the situation. For instance, when the tsunami hit the Indian coast on December 26, 2004, the Indian armed forces, coordinated by the Integrated Defence Staff (IDS), efficiently handled relief, rescue and evacuation work. Whether it was the

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24. n.19, pp.12-13.
25. "NDRF to Add Two More Battalions," *The Times of India* (New Delhi), September 10, 2014.

On account of their vast potential to meet any adverse challenge, speed of operational response and the resources and capabilities at their disposal, the armed forces have historically played a major role in emergency support functions. These include communication, search and rescue operations, health and medical facilities and transportation, especially in the immediate aftermath of a disaster.

Kashmir earthquake of 2005, the tropical cyclone in Bangladesh in 2007, the flash floods in Ladakh's capital Leh in 2010, the Sikkim earthquake of September 2011, the 2013 flash floods in Uttarakhand or the 2014 floods in Jammu and Kashmir, the armed forces have been the flag bearers of disaster management.

Aid to civil authorities during calamities is indeed one of the primary mandates of the defence forces, but this mandate is meant to work on the principle of being the 'last to enter and the first to leave'. However, in most post-disaster operations, the armed forces have been seen as 'the first to enter and the last to leave', assuming functional control of the disaster management activities.

The National Disaster Management Policy, approved by the Union Cabinet in October 2009, acknowledges the role of the armed forces in disaster management and appreciatingly states,

> Conceptually, the Armed Forces are called upon to assist the civil administration only when the situation is beyond their coping capability. In practice, however, the Armed Forces form an important part of the Government's response capacity and are *immediate responders in all serious disaster situations*. On account of their vast potential to meet any adverse challenge, speed of operational response and the resources and capabilities at their disposal, the Armed Forces have historically played a major role in emergency support functions. These include communication, search and rescue operations, health and medical facilities and transportation, especially in the immediate aftermath of a disaster. Airlift, heli-lift and movement of assistance to neighbouring

countries primarily fall within the expertise and domain of the Armed Forces.[26] [Emphasis added]

This recognition is essentially because of innumerable examples of sterling performance by the Indian military in HADR operations, against all odds. To mention a few, in the 2001 Bhuj earthquake, despite 95 dead and hundreds wounded in the Air Force Station Bhuj, this station exhibited a high degree of professionalism by assuming the task of being the primary base to receive aid for the complete area. Similarly, during the 2004 tsunami that struck the Andamans Islands and the eastern coast, the devastation at Air Force Station Car Nicobar resulted in the loss of life of 116 personnel, including women and children. Notwithstanding this loss, the surviving air warriors dedicated themselves to the disaster response operations and the station, being the only connection to the outside world, became the nodal relief centre. The destruction was so widespread that 30 transport aircraft and 16 helicopters flew round the clock to help the island territories. Additionally, two IL-78 aerial refuelling tankers were stripped of their fuselage fuel tanks overnight to carry relief material, and no international assistance was sought. [27] The Indian Air Force (IAF) had also extended assistance to neighbouring nations. Air-bridges were established for the Andaman and Nicobar Islands (Operation Sea Wave), Sri Lanka (Operation Rainbow) and the Maldives (Operation Castor); helicopters, including the IL-76, An-32, Do-228—almost all available fixed-wing and rotary-wing effort—were employed. In Sri Lanka, within the first two days, the IAF positioned six medium lift helicopters and undertook 445 missions, flying about 315 hours and airlifting about 330 tonnes of material and 882 passengers till the helicopters returned after almost a month. Two long range AVROs modified for para-drop were sent to the Maldives to undertake inter-island operations on its short field runways. The effort involved 155 sorties airlifting about 170 tonnes of load and 885 passengers. Similarly, during the Uttarakhand flash floods of 2013, under Operation Rahat, the IAF flew 3,544

26. Ibid., p. 13.
27. Manmohan Bahadur, "Disaster Relief is Good Diplomacy", in *Mail Today* (New Delhi), June 14, 2014.

Appointing a former military leader, Gen NC Vij, former chief of the army staff, as the founder vice chairman of NDMA is also recognition of the fact that military leaders are expected to be well-versed with the nuances of disaster management essentially because of their routine exposure to the same.

missions and transported 24,000 passengers and 800 tonnes of load.[28] In J&K this year, 84 military aircraft were deployed for rescue and relief operations. About one lakh people were rescued by the joint efforts of the armed forces and the NDRF.[29]

In recognition of the Indian military's contributions in disaster management, and to exploit this unparalleled national potential, the chief of the Integrated Defence Staff of the Chiefs of Staff Committee has been appointed a member of the NEC, the executive committee of the NDMA mandated to assist the NDMA in the discharge of its functions and also to ensure compliance of the directions issued by the central government.[30] Appointing a former military leader, Gen NC Vij, former chief of the army staff, as the founder vice chairman of NDMA is also recognition of the fact that military leaders are expected to be well-versed with the nuances of disaster management essentially because of their routine exposure to the same.

Gen Vij, having first-hand knowledge of disaster management policies and operations, has brought out the inadequacy of the prevailing disaster management infrastructure,

There is no gainsaying that we are much behind the world in our levels of preparedness to meet the challenges of grave disasters, especially in the case of earthquakes. While the enactment of the Disaster Management Act 2005 was a much laudable pioneering step by the Government; to be result oriented, the follow-up needs to be far more vigorous. We now know the

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28. Nishant Gupta, *The Indian Air Force in India's National Defence:2032* (New Delhi: KW Publishers, 2014), pp. 65- 66.
29. Group Captain Ashok K Chordia, "IAF in Noncombat Operations," *Geopolitics*, vol. 5, issue 5, October 2014, pp 8-14.
30. n. 19.

path which must be traversed and the strategy stands evolved, but we need to shift to top gear to attend to preparedness deficits on crash priority to save lives. Business as usual attitude of the officialdom and non-availability of the dedicated disaster management staff at all levels (generally an addendum to revenue departments in the states) pose insurmountable problems."[31]

THE WAY FORWARD

Generally, it is felt that prevailing civil-military coordination mechanisms are not adequate for a seamlessly smooth disaster response mechanism. For organising an effective response to disasters, the military and the civilian authorities, such as the police, fire services and first aid providers, need to better appreciate each other's procedures as well as capabilities and limitations. Even the developed countries are experiencing this inadequacy and for overcoming coordination issues, simulations and training on a regular basis are considered necessary.

The differences in the culture, priorities and operating modes of military personnel and those of civilian actors have a direct impact on relations between the civilian and military spheres. Coordination between military assets and civilian humanitarian actors has been one of the greatest challenges, that has been further enhanced by the increasing deployment of foreign military assets. Information management is crucial to the success or failure of any relief operation.

The aforementioned 2008 SIPRI report also recommends improving the capacity of military commanders and forces in potential contributing countries so that they can take part in natural disaster relief alongside humanitarian actors. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA), can play a significant role in addressing this issue. Ensuring that military doctrines, standard operating procedures, field manuals and training practices adequately include the humanitarian principles and elements of the Oslo Guidelines would also be helpful. Humanitarian actors may also be involved in the designing of the military

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31. Gen NC Vij, "The Earthquake and Tsunami in Japan of 11th March 2011: A Wake up Call for India." Accessed at http://www.vifindia.org/print/684 on September 22, 2014.

A comprehensive disaster management approach has to look beyond the traditional vulnerabilities and the region should be prepared to face any eventuality, expected as well as unexpected.

training framework on humanitarian assistance and disaster response.

Disaster management holds critical significance for South Asia. The region being highly vulnerable to natural disasters, with a limited response capability, has no option but to explore futuristic solutions. As climate change is leading to occurrence of unprecedented disasters and an increase in the frequency of extreme weather incidences, an effective policy has to be evolved, catering for the five 'Rs': Risk assessment, Risk prevention and mitigation, Relief, Recovery and Reconstruction.

A comprehensive disaster management approach has to look beyond the traditional vulnerabilities and the region should be prepared to face any eventuality, expected as well as unexpected. Unprecedented floods in J&K highlight the need to be prepared for the unexpected. The floods in J&K in 2014 were the worst in 100 years, whereas as per the National Policy on Disaster Management (NPDM) of 2009, on flood zones, Kashmir is not an area that is vulnerable to floods.

NPDM 2009 acknowledges the fact that disasters do not recognise geographical boundaries and major disasters may often simultaneously affect several countries. Therefore, it will be the national endeavour to develop close cooperation and coordination at the international level in all spheres of disaster management. It also lays emphasis on building strategic partnerships at various levels. [32] Hence, regional capacities should be developed to respond to disasters, and relevant institutional relationships should be strengthened, particularly between existing regional organisations like SAARC and the UN regional offices. This would also improve the effectiveness of foreign military assets in disaster relief and coordination with other actors. As per the NPDM 2009, the central government is to facilitate coordination with the UN agencies, international organisations and governments of foreign countries in the

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32. n. 19, p. 14.

field of disaster management. The Ministry of External Affairs (MEA) in coordination with the Ministry of Home Affairs (MHA), is to facilitate external coordination/cooperation.[33]

In addition to the MEA and MHA, in the pursuit of international cooperation, it is essential to involve the Ministry of Defence (MoD) as well essentially because of two main reasons. First, there is a high likelihood of overseas help coming in the form of foreign military assistance. And military-military coordination is generally better than civil-military action. Secondly, in case India has to extend assistance in disaster relief, experience suggests that the Indian military would be the likely instrument of choice. No other government machinery is more capable and experienced in disaster management, at both domestic and international levels.

In India, the involvement of the military in HADR operations is a vital dimension of civil-military relations. There have been repeated recommendations towards using the expertise of the armed forces for bolstering the capacity of the civil authorities, including the disaster response forces. This would enable the latter to achieve self-reliance and, thus, reduce their dependence on the armed forces. But the moot question is, in the present socio-economic limitations, would India be able to afford duplication of resources?

Many civil and military leaders are of the opinion that in the given circumstances, rather that expecting the NDMA to be adequately prepared to respond to major disasters as the first line of response, it would be more appropriate to take measures to strengthen the Indian military in such a manner that it is better prepared, trained and equipped to handle this national requirement. A former additional secretary of the Cabinet Secretariat has recommended that the government must set up a centre for excellence in disaster management for the Indian armed forces. To ensure that in the field formations the military equipment meant for war is not used for secondary tasks in the disaster-prone areas, field formations are recommended to be given brick formations (logistics)

33. Ibid., p. 12.

specifically for disaster response at the earliest.[34]

The military is also required to be involved in needs assessment activities. Involving military representatives in assessment activities would facilitate identification of the most useful role that military assets can play in complementing civilian capabilities. It would also strengthen civil-military coordination.

The decision to deploy military assets as part of international disaster relief assistance should be based primarily on the humanitarian needs and interests of the relief effort and the affected country and communities. In particular, the burden of coordination and the real and opportunity costs of accommodating and operating the assets for the affected government must be taken into account.

National disaster management plans in countries which are particularly prone to natural disasters, including India, should include provisions on how to assess the need for foreign military assets, how to request for them, how to manage offers of military assets from foreign countries and how to manage the assets when they arrive. It should always be kept in mind that the mandates and competencies of humanitarian and military organisations are different—this fact should never be lost sight of.

The implications of natural disasters on international relations are quite subjective and difficult to predict. But there is also a high potential of spurring regional/international cooperation. Natural disasters can also be instrumental in improving bilateral relations. The J&K floods in 2014 comprise a case in point. Just before the floods, Indo-Pak relations were appearing to be highly strained. Foreign secretary level bilateral talks scheduled in August 2014, could not be conducted because the countries had differences of opinion on certain issues and India was disturbed by Pakistan's approach. But soon after, the floods in Pakistan, Pakistan Occupied Kashmir (POK) and J&K made the Indo-Pak leadership overlook immediate as well as traditional differences and they immediately extended courtesies and offered disaster management help to each other.

34. Mohan Das Menon, "We Must Define the Role of Armed Forces in Disaster Management" *The New Indian Express,* June 30, 2013. The author is a former additional secretary, Cabinet Secretariat.

In responding to a disaster, besides the limitation of response capabilities, another critical challenge is to reconcile the two contradictory needs i.e. the need for speed, to move quickly in response to a disaster to save lives, provide food and housing, and establish order and security; and the need to take the time to accurately assess and understand the situation in all its complexity, to grasp the needs and desires of the affected community, and to involve the community in the short and long-term recovery efforts. This paradoxical challenge of needing to 'go slow' in order 'to go fast' needs to be addressed with maturity.

Responsiveness, reach and flexibility make air power the first choice of the civil authorities in disaster relief and humanitarian assistance operations. As India is acquiring new air power assets, including the C-17 Globemaster, C-130 Super Hercules, 100+ new Mi-17 V-5s and 15 Chinook heavy lift helicopters, its disaster relief potential would be of a very high order, equalled by very few nations.[35] India should exploit this capability in fostering regional cooperation by consciously reassuring and reemphasising that it believes in the philosophy of peaceful coexistence and defensive defence. The region should be made to understand that these assets would be better utilised for disaster response and preparedness in the region, rather than employing them in offensive military action against each other. And this is feasible only if we strengthen mutual cooperation and promote an environment of trust, avoiding doubts, suspicion and scepticism.

The most critical dimension in any kind of collaboration at any level, be it the community, national, regional or international, is the degree of trust achieved between the collaborating individuals, groups, institutions or nations. The interacting identities working towards a common goal have no option but to strive for a working environment based on mutual trust.

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35. Bahadur, n. 27.

THE SENKAKU ISLANDS DISPUTE AND ITS IMPLICATIONS FOR THE PACIFIC ISLAND CHAINS

AMARJIT SINGH

After a strange water cannon duel in September 2012 between Taiwanese and Japanese patrol boats, the dispute over a group of islets called the Senkakus in Japan (Diaoyus in China, and Tiaoyutas in Taiwan) seemed to simmer down for a few weeks. However, a month later, China sent fishing and patrol boats to the vicinity of the disputed islands. The spat continued through 2013, with China regularly sending fishing vessels, surveillance and patrol aircraft, and coast guard ships. Japan responded by sending patrol boats of its own. On December 13, 2012, Japan scrambled eight F-15 jets after a Chinese surveillance aircraft entered the Senkaku air space[1]. This was obviously a test by China to gauge the Japanese response, which helped the Chinese plan for the next event. On January 11, 2013, China again sent in a Y-8 transport aircraft a little outside Japanese air space, but inside the Air Defence Identification Zone (ADIZ) that triggers an automatic Japanese air patrol. Thus, as expected, the Japanese sent off F-15 aircraft to monitor the surveillance aircraft, but to their surprise, they found Chinese J-10 aircraft on

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1. "Japan Protests About Chinese Airspace 'Intrusion' Over Disputed Islands," *The Guardian*, www.guardian.co.uk, December 13, 2012.

In September 2012, the Japanese national government entered into an agreement to outright buy the Senkaku Islands from the Kurihara family, the legitimate Japanese owners of the islands since 1970.

their tail.[2] The Chinese had clearly planned this surprise for the Japanese. Other reports claimed that ten J-7s and J-10s had entered the ADIZ; in response, Japan dispatched its F-15s, but it is not clear if that was perhaps a separate event on January 11, 2013, media miscommunication, or Chinese misinformation.[3] Consequently, the cat-and-mouse game between China and Japan lasted through the year and spilled into 2014 as national sentiments come to the fore on both sides.

In 2013, the two sides continued to send fighter planes into the area. A Chinese frigate locked weapons-targeting radar onto a Japanese destroyer. In October 2013, China declared that if Japan shot down any Chinese drones sent to the Senkakus, this would be considered an "act of war". And in November 2013, China declared the Senkakus within its ADIZ. In February 2014, US intelligence reported the detection of road-mobile ballistic missiles close to the Senkakus. And in May 2014, the Chinese conducted naval exercises in the Western Pacific Ocean, partly to simulate a retake of the Senkakus, having telegraphed their intentions to do so in January 2013[4]. (Other military incidents have taken place as well, and this list is not comprehensive nor intended to be.)

In September 2012, the Japanese national government entered into an agreement to outright buy the Senkaku Islands from the Kurihara family, the legitimate Japanese owners of the islands since 1970.[5] Reportedly, behind this move, was the hawkish Governor of Tokyo, Shintaro Ishihara, who with his

2. "Unchartered Waters: Japan and China Scramble Fighter Jets in Island Dispute," RT Question More, http://rt.com/news/china-japan-diaoyu-senkaku-822/, January 12, 2013.
3. "Japanese F-15s Scrambled to Intercept PLA Jets in East China Sea," *China Times*, http://www.wantchinatimes.com/news, January 11, 2013.
4. "China to go Ahead With Naval Exercise Amid East China Sea Island Dispute with Japan," http://www.cbsnews.com/news/china-to-go-ahead-with-naval-exercise-amid-east-china-sea-island-dispute-with-japan/, *CBS News*, January 31, 2013.
5. "Japan Agrees to Buy Disputed Senkaku Islands", http://www.telegraph.co.uk/news/worldnews/asia/japan/9521793/Japan-agrees-to-buy-disputed-Senkaku-islands.html, *The Telegraph*, September 5, 2012.

anti-China leanings, did not hesitate to announce that he was inviting a confrontation with China.[6] This was open provocation as it stirred Chinese sentiments, and suddenly, an enraged China came out of its shell to claim jurisdiction over the Senkaku Islands. That China had not done so for one hundred years is noteworthy, since statutory time limitations are universal in any dispute over property. Moreover, it is intriguing why China should respond to what was basically an internal transfer of property within Japan, giving the impression that there is more to this war of words and show of force than a legally solid claim by China.

A negotiated settlement of the status of these islands is unlikely, as neither side will relinquish its claim for the simple reason of geo-political power.

Having taken a stand on territorial matters, at first, it appeared that it was going to be exceptionally difficult for China to disavow or change its stand, especially after the Communist Party had stoked national sentiments to a boil. The issue is unlikely to be forgotten for the foreseeable future. A negotiated settlement of the status of these islands is unlikely, as neither side will relinquish its claim for the simple reason of geo-political power.[7]

However, since January 2014, China has decreased the number of the military excursions, adventures, and tests. This coincided with the coming to power of Xi Jinping, first as party general secretary and chairman of the Central Military Commission (CMC) in January 2014, and later as president in May 2014. Evidently, China has completed its preliminary "testing of the waters" and show of strength, and felt satisfied at the result. However, the fervent remilitarisation of Japan under Prime Minister Shinzo Abe is probably something that China did not account for. China had stirred a hornet's nest, and was staring down a barrel of enormous economic and military consequences. Japan is not an "India" that is wary of using military

6. "Tokyo Governor Risks Chinese Outrage with Disputed Island Construction Plan," http://www.telegraph.co.uk/news/worldnews/asia/japan/9588601/Tokyo-governor-risks-Chinese-outrage-with-disputed-island-construction-plan.html, *The Telegraph*, May 2012.

7. Ken Dilanian, "U.S. Defies China, Sends Bombers into Disputed East China Sea Zone," *Los Angeles Times*, April 20, 2015; interesting information on the topic is also available at "Senkaku Islands Dispute," http://en.wikipedia.org/wiki/Senkaku_Islands_dispute, Wikipedia. Accessed by author on March 2015.

In November 2013, the US Senate recognised Japanese administration of the Senkakus and opposed the use of force. This was crafted as a direct statement to China to not use force against Japan.

power to counter an aggressive China. Though India feels its military power is restricted, being less than that of China, Japan's military power is also less, but it seems to be ready to face the challenges head-on.

A war between the world's largest and third largest economies will impact the world as much as it will adversely affect the economic status of China and Japan.[8] The USA shall probably be the most affected for the $104 billion a year it exports to China and $66 billion a year to Japan. Moreover, notwithstanding China's overseas media campaigns that have been savvier than Japan's, the sympathies of the powerful Western world are projected to side with Japan rather than China. In November 2013, the US Senate recognised Japanese administration of the Senkakus and opposed the use of force.[9] This was crafted as a direct statement to China to not use force against Japan. If the West could impose sanctions on Russia, a superpower, it may not be hesitant to impose sanctions on China if it were to embark on an ill-conceived venture. Further, an adverse impact on China's economy may be just as well for China's enemies.

In a survey conducted by Gerron NPO and *China Daily* in August 2013, it was discovered that 92.8 percent of the Chinese people had a negative (unfavourable) impression of Japan, while 90.1 percent of all Japanese thought likewise about China.[10] These numbers simply reveal that the two populations are heavily polarised and distrust each other. The implication is that the two groups are entrenched in their positions, so a negotiated peace will be hard to come by, if at all. In September 2012, riots in China had led to the closure of Japanese plants. Chinese public sentiments had been

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8. "The Economic Impact of a War Between Japan & China", http://www.silverdoctors.com/the-economic-impact-of-a-war-between-japan-china/, Silver Doctors, February 20, 2013.
9. Ibid.
10. The Genron NPO, "The 9th Japan-China Public Opinion Poll," http://www.genronnpo.net/english/index.php?option=com_content&view=article&id=59:the-9th-japan-china-public-opinion-poll&catid=2:research&Itemid=4, August 13, 2013; quoted in Saturo Nagao, "Japan-India Military Partnership: India is the New Hope for Asia," *CLAWS Journal*, Winter 2013.

so aroused that Chinese shop owners were rude, and refused to sell goods to Japanese tourists.[11] As a result, Japan is already slowly moving its plants and machinery to Indonesia and Philippines, which will see Japanese economic losses in the situation considerably mitigated while adversely affecting Chinese exports.[12] The gain of those countries will be China's loss, while Japan is likely to come out even.

The downside to Japan's industrial power is that Japan must get its minerals from overseas, while China is more self-reliant. Under a Chinese naval blockade, Japan's industrial power stands to be squeezed.

China's comprehensive military power is more than that of Japan's,[13] but Japan's industrial and technological power is formidable. What Japan doesn't have by way of population – as China does – Japan has by way of technology and its well-known national culture of quality and product excellence. The downside to Japan's industrial power is that Japan must get its minerals from overseas, while China is more self-reliant. Under a Chinese naval blockade, Japan's industrial power stands to be squeezed.[14] But this assumes that the United States will stand by idly. While analysts have opined that the USA will stand by if China invades Taiwan, Japan is not in the same basket, as it is vitally important for US security, maintaining the American military presence in East Asia. Moreover, the American policy-makers prefer to support Japanese-style democracy on moral principles than they do Chinese Communism that doesn't guarantee freedom of speech or religion.

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11. The author heard of this first hand from a small Chinese roadside shop owner during a visit to Dalian when China's first aircraft carrier was being launched.
12. Cathy Rose Garcia, "More Japanese Firms Seen Moving from China to PH," http://www.abs-cbnnews.com/business/10/08/13/more-japanese-firms-seen-moving-china-ph, September 10, 2013.
13. Nation Ranking, https://nationranking.wordpress.com/category/national-power-index/, 2011.
14. Japan was aware of this even before World War II, which is why it built a powerful naval fleet. That Japan lost the battle in the Pacific to USA was a matter of touch-and-go. At the bombing of Pearl Harbour, Japan failed to unleash its third wave of airplanes for bombing, which was planned to attack stores, repair facilities, and oil tanks. Had it succeeded with that third wave, the setback to the USA would have been significant. As a consequence of that, the Battle of Midway would have been different, if it would have taken place, and the outcome also different. That could have changed the history of the Pacific War.

LEGAL HISTORY OF THE SENKAKUS

Japan occupied the Senkakus in 1895 after a Japanese government survey indicated the islands were uninhabited. There were no records that the islands had ever belonged to China, and Japan erected a marker in January 1895 to formally incorporate the islands into the territory of Japan. Moreover, these islands were not part of any territory ceded to Japan by the Chinese Qing dynasty in May 1895 that may have recognised the Daioyus as formerly belonging to China. Thus, the Senkakus did not appear on the list of occupied territories that Japan had to renounce after its surrender in World War II, and China did not bring up at that time the claim that the Daioyus belonged to China. However, according to the San Francisco Peace Treaty of 1951 between the allied powers and Japan, the Senkakus were among those given over to the US Administration,[15] which were subsequently reverted to Japan per the 1971 agreement between Japan and the USA that recognised the Senkakus as Japanese territory.

Though 49 countries signed the 1951 treaty, including countries such as Iraq and Iran that had seen action during World War II, India, for instance, refused to sign, though invited to do so. India asserted that the treaty limited Japanese sovereignty and national independence. Thus, India was taking a stand in favour of the fallen nation against what it considered to be white racist dominance and supremacy. China and Taiwan were not invited owing to the civil war raging between the countries, and the USSR raised numerous objections on the nature and premise of the treaty.[16]

The People's Republic of China (PRC) published statements in August and September 1951 denouncing the Treaty of San Francisco as illegal and urging nations not to recognise it. As a major victim of Japanese aggression, it was upset at Japan's general exclusion from the negotiation process, not realising that the rest of the world was having difficulty understanding which was the legitimate government of China – the Nationalists or

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15. "San Francisco, Peace Treaty of 1951," http://encyclopedia2.thefreedictionary.com/San+Fra ncisco,+Peace+Treaty+of+1951. Accessed on March 2015.
16. Ibid. Also available at "Treaty of San Francisco," http://en.wikipedia.org/wiki/Treaty_of_ San_Francisco. Accessed on March 2015.

Communists.[17] Nevertheless, the PRC claimed that the Paracel Islands, Spratly Islands and Pratas Islands were actually part of China.[18] However, the treaty did not even address the Paracel and Spratly Islands, while the Pratas Islands were given over to the United Nations. Hence, the PRC's statements were obviously meaningless and construed as out of context to the 1951 Treaty. The PRC did not as much as raise the issue of the Senkakus, though the USSR vaguely alluded to the treaty as violating the rights of China to Taiwan and "other" islands. Notwithstanding the objections by the PRC, the PRC actually benefited from this treaty by repossessing Japanese occupied assets in Manchuria and Inner Mongolia, even though the Chinese outwardly denounced it. The very fact that they accepted the terms of the treaty to repossess assets in Manchuria and Inner Mongolia implies in common law that their actions were construed as acceptance of the treaty. In 1974, China occupied the Paracel Islands when the USA was on its way out from Vietnam.

Taiwan signed its own peace treaty with Japan in 1956, known as the Treaty of Taipei.[19] This treaty gave special recognition to the people of Pescadores Islands as nationals of Taiwan because these islands, between Taiwan and China, were specifically ceded to Japan by the Qing dynasty in 1895. Once again, while acknowledging the Treaty of San Francisco, there was no mention or argument over the status of the Senkakus. The claim by Taiwan over the Senkakus did not come until the early 1970s, when Chiang Kai Shek was made to believe there may be oil in the region. Subsequently, as the claims heated up, and China claimed everything over Japan that Taiwan claimed, both the PRC and Taiwan began to claim that the Treaty of San Francisco did not determine the ultimate sovereignty of the Senkakus

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17. Refer to Seokwoo Lee, "The 1951 San Francisco Peace Treaty with Japan and The Territorial Disputes in East Asia," *Pacific Rim Law & Policy Journal Association*, https://digital. law.washington.edu/dspace-law/bitstream/handle/1773.1/748/11PacRimLPolyJ063. pdf?sequence=1. Accessed on March 2015.

18. "China's Maritime Disputes", Council of Foreign Relations, 2013, http://www.cfr.org/ asia-and-pacific/chinas-maritime-disputes/p31345#!/?cid=otr-marketing_use-china_sea_ InfoGuide; useful information can also be obtained at "South China Sea Islands," http:// en.wikipedia.org/wiki/South_China_Sea_Islands.

19. Treaty of Peace Between the Republic of China and Japan, full text available at http://www. taiwandocuments.org/taipei01.htm. Accessed on March 2015.

The Senkakus have always been considered a part of the known region of Okinawa, also known as the Ryukyu Island chain. This is important in the current context because Okinawa is a central US military base.

by virtue of its omission from the San Francisco Treaty, nor did the signing of the Treaty of Taipei with Japan imply that Taiwan was giving up its claim on the Senkakus (a claim that did not exist before the early 1970s).[20]

While China has apparently pointed to historical maps revealing that the Daioyus belong to China, the validity of those maps is under question, partly since no one else has those maps. There has been no excavation or archaeological discovery in the Daioyus to support the Chinese claim, but there is evidence to the contrary that those islands were never inhabited, exploited, or harvested by China.[21]

Moreover, there is some history of the Okinawan Islands and other nearby islands in relation to China. The Senkakus have always been considered a part of the known region of Okinawa, also known as the Ryukyu Island chain. This is important in the current context because Okinawa is a central US military base. According to legend, in 221 BC, people from a Chinese mission first settled in Okinawa. For several centuries up to 1590, Okinawa was for all practical purposes an independent kingdom. Its people were fishermen and traders, exchanging goods and trade with all eastern nations, coming all the way to the Kingdom of Bengal. Over the 15th century, Okinawa had very strong trade ties with China, including paying tribute to Chinese overlords in Fujian province. As a result, and because of the peaceful nature of the Okinawans, the Chinese emperors came to think of the Okinawans as "loyal subjects." The early part of the 16th century saw the Portuguese lay waste to Malacca, after which the Okinawans retreated from their trade activities in Southeast Asia and

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20. "The World and Japan Database Project, Database of Japanese Politics and International Relations", Institute of Oriental Culture, University of Tokyo, http://www.ioc.u-tokyo.ac.jp/~worldjpn/documents/texts/docs/19520428.T1E.html. Accessed on March 2015.
21. Refer Shannon Tiezi, "Japan and China Spar Online Over Senkaku/Diaoyu Islands," *The Diplomat*, January 8, 2015.

relied upon China for support and protection against the invading Europeans.[22]

But, in 1590, the Japanese Shogunate, with an aim at controlling Asia, demanded that Okinawa stop paying a tribute to China and pay a heavier tribute to Japan instead. The Okinawans relented, but trade with China was allowed to continue, especially because it brought a good tribute to Japan. However, Okinawa played both China and Japan and continued to pay tribute to China. When Cmde Matthew Perry of the US Navy briefly occupied Okinawa in 1853, a scared Okinawa sought help from a weak China. Even the King of Hawaii, Kameameha III, pleaded Okinawa's case to the Chinese. This arose from the influence of tens of thousands of Okinawan migrant labourers who had settled in Hawaii to work on the sugar fields there. But soon after Perry left, Japan annexed Okinawa in 1879 in punishment for its turning to China. Since then, Okinawa, except for several post-war years under the American Administration, has been a part of Japan.[23,24] Therefore, as far as the agreements and legal language of modern nations go, Okinawa and the Senkakus are part of Japan, even though Okinawa once paid tribute to China. In many respects, China seeks to claim territories that once paid tribute, or possibly belonged, to China, without accepting the changing realities in the millennia and centuries in between.[25] If the International Court of Justice had to rule on a trade dispute between Japan and China concerning either the Ryukyu or Senkaku Islands, it would likely base

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22. "Narrative of an Empty Space," *The Economist*, December 22, 2012.
23. George Kerr, "Ryukyu Kingdom and Province Before 1945," National Academy of Sciences, National Research Council, Washington, D.C., 1953; it is also generally interesting to read "History of the Ryukyu Isles," http://en.wikipedia.org/wiki/History_of_the_Ryukyu_Islands.
24. Refer Reiko Teshiba, "Suspended in Time: Okinawa's Continuing Struggle," Swarthmore College, http://www.swarthmore.edu/writing/suspended-time-okinawas-continuing-struggle, 2002. Accessed on March 2015.
25. If China were to let other nations employ the same arguments as applied by China, Mongolia would have the right to claim half of all of China. Hence, there is some illogic in China's claims.

its decision on the Ryukyus and Senkakus belonging to Japan, part and parcel.[26]

MILITARY PICTURE

Though the dispute gained centre-stage after the possibility in the 1970s that there may be petroleum deposits around the Senkakus, the reality today is different. The military and geo-political picture is clearly more important than the legal and economic angles. National greed and power projection invariably appear to carry more weight than any other issue. The legal and historical angles to the dispute are merely a ruse, a means for China to assert itself.[27] The reason is simply one of naval power projection that China finds fundamental to its self-identity: its emergence as a nation that will never be bullied again. The scars of the humiliation by the West in the 19th century forcing its population into opium addiction, and the rape and humiliation by the Japanese in the early part of the 20th century, have not faded.

The modernisation of China's navy began in the early 1980s under the leadership of Premier Deng Xiaoping and China's navy chief, Lu Huaqing, who envisioned three stages to its development.[28] The modernisation was both aggressive and massive. The first stage was to modernise so as to prevent attacks on its littoral coastline, which required developing a brown-water navy; the second was to build up defensive capabilities up to the first island chain, which required the development of an effective green-water navy; and the third is to create offensive control over the second island chain, which will place China's navy quite firmly in the blue-water category. These island chains are discussed in the following sections.

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26. Reinhard Drifte, "The Japan-China Confrontation over the Senkaku/Diaoyu Islands – Between "shelving" and "dispute escalation," http://www.globalresearch.ca/the-japan-china-confrontation-over-the-senkakudiaoyu-islands-between-shelving-and-dispute-escalation/5393760, Global Research, July 28, 2014.

27. A car shuttle driver in the Philippines, and engineers in Vietnam have communicated with the author that China is displaying expansionist tendencies, not to mention hundreds of articles and commentaries in media around the world.

28. Refer Nikolaos Diakides, "An Assessment of China's Defense Strategy in the Post-Cold War Era – What Role for Bilateral Defense Cooperation with Russia, Piraeus, , http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1638214, December 2009.

FIRST ISLAND CHAIN

The first island chain contains all the islands southwest and northeast of Japan that are under Japanese protection; this first chain encompasses the Sakhalin and Kurile Islands held by Russia, and the Spratly Islands claimed by the Philippines and other nations. More precisely, the first island chain consists of the Kurile Islands, the Japanese Archipelago, Bonin Islands, Ryukyu Islands (which include Okinawa and the Amami, Miyako

The first island chain is necessary for China to prevent US aircraft carriers and carrier groups from coming too close to the Chinese coast to launch effective operations.

and Yaeyama Island groups), and Taiwan—all the way to the Malay Peninsula and Vietnam, the northern Philippines, and Borneo (Fig. 1). It is a vast territory included within the chain that China logically thinks is important for its power projection; the economic factor of ocean resources within the first island chain is only secondary to China's wish to exercise control in its vicinity – to have breathing space and strategic depth. However, the military perspective of these islands is vital for Japan and the United States as well, and this places those powers in direct confrontation. For instance, the USA has major military bases in Okinawa that it is unwilling to relinquish; losing its base in Okinawa will make its base in Guam in the second island chain more vulnerable to Chinese invasion. Thus, the US cannot afford to lose Guam under any circumstances, so pivotal is the first island chain for US force projection in North and East Asia.

But the first island chain is necessary for China to prevent US aircraft carriers and carrier groups from coming too close to the Chinese coast to launch effective operations. The farther away US aircraft carriers are from the Chinese coast, the less effective US aircraft are against attacks on mainland China. China apparently learned a lesson when US President Clinton sent two aircraft carrier battle groups to Taiwan during the Sino-Taiwan dispute in 1998. The Chinese realised they had little by way of surface-to-ship missiles to stop the US show of power, and they also realised that the US could easily threaten all the coastal cities of China by their aircraft carrier force. Hence, keeping the USA at a distance from

the first island chain can greatly help China in the event of a war with Taiwan.

Thus, naval power is of primary importance to China in its quest to emerge as a nation without rivals. In terms of a military strategy, this is a well-thought out and well-reasoned Chinese plan. Conversely, it makes perfect sense for Japan to hold on to the chain of islands to its southwest, since any concession to, or encroachment by, China will only escalate as the years go by, eventually threatening the Japanese mainland.

Within a few days of the Senkaku incident on September 23, 2012, the USA and Japan conducted a joint exercise for the defence of islands in the southwest chain.[29] Though this exercise was planned many months earlier, it sent a clear signal to China: the USA will intervene militarily in the defence of those islands that were once administered by the USA and are now under Japanese governance. The US takes seriously any change to the status quo in North Asia – especially because it threatens to overturn its own 60-year dominance of the Pacific all the way to the East China Sea. US military doctrine is predicated upon keeping wars away from its own shores – that is why it never gave up its options in Europe and the Western Pacific after World War II. The Western Pacific is currently ably supplied by the USA through the fortresses of Okinawa, Guam, and Hawaii, and through the alliances with the Philippines, Japan, Indonesia, and Australia; further, the United Kingdom, Australia, and New Zealand guarantee the sovereignty and integrity of Malaysia and Brunei.

After China and Japan began their dispute over the Senkakus, Taiwan sending its own fleet of fishing and coast guard vessels to assert its claim actually served to quieten the situation for a while by convoluting things. Who would now fight whom in this triangular competition where each has two opponents? Neither party wishes to fight two opponents in a triangular conflict, and China certainly did not imagine that Taiwan would enter the fray at that juncture. However, Taiwan will not rake up a military conflict with China (which China knows), and this has

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29. "U.S., Japan Train for Island Defense", *The Wall Street Journal*, Japanhttp://online.wsj.com/article/SB10000872396390444083304578013692399658834.html, September 24, 2012.

emboldened China to take the lead in aircraft incursions into the Senkaku air space and ADIZ.

SECOND ISLAND CHAIN

The second chain of islands covers the Northern Mariana Islands, Guam, the Philippines, and from Palau down to Irian Jaya—a stone's throw from Australia (Fig. 1). By obtaining naval power up to the second island chain, China would be able to have full sway over the Western Pacific. This dream of China is one that Japan implemented in World War II, giving Imperial Japan access to vast natural resources in Southeast Asia to run its military machine. China, in turn, apparently wishes to be recognised as the unrivalled power in its eastern "backyard" – and indeed, the entire East China Sea, South China Sea, and Philippines Sea are considered by China as its "backyard," —as if they do not comprise its neighbours' backyards as well.[30]

The importance of Guam as the US centrepiece of the second island chain is one reason why the US will not wish to see China encroach on any island of the first island chain, because any island in the first island claim is a stepping stone to the second one. If China were to take control of the Senkakus, the fear among the Japanese and Americans is that it would probably install various anti-ship and ballistic missiles there, which would more easily threaten the USA's primary base in the region – Guam.

Of course, Chinese missiles in the Senkakus will also more easily threaten Taiwan, and more specifically, Taipei, which is at the northern end of Taiwan[31]. Thus, China could aim to lob missiles at Taiwan from two directions. A Chinese presence at Senkaku will make it easier for China to attack and take remote Okinawan islands, such as Yonaguni and Inomote, which are presently difficult for Japan to defend at such enormous distances from its mainland and air bases.

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30. "Is the South China Sea China's Backyard?," http://www.212s.com/?p=2672, *Anything New York*. Accessed April 2015.
31. With missiles in the Senkakus, China can launch rockets at Taipei from two directions – one from the Chinese mainland, and the other from the northeast. Hence, this will thin the defences of Taiwan.

The capture of islands in the third island, chain requires not only a blue water navy, but a superior blue water navy. China appears to be slowly but surely grinding along on its long march to superiority.

Again, when a nation gives an inch, it should be afraid it could lose a yard or a mile. Thus, the loss of the Senkakus would threaten Japan with the fear of losing Okinawa next. This is a battle where China's hatred for Japan, and China's eagerness for dominance in the East China Sea, can allow no inch of Japanese territory to be left undefended. At this moment, history and revenge must be cast aside – realism and survival are important – and Japan is not going to roll over for China.

THIRD ISLAND CHAIN

The third island chain arguably runs in an arc from Wake Islands to Midway, then on to the Hawaiian Islands, Kiribati, Western Samoa, Tonga, Fiji, New Caledonia, Vanuatu, and Solomon Islands. This is the arc captured by the Japanese during World War II (except for Hawaii), and from which they were beaten back, island by island. Anybody owning these islands owns the Pacific, so to speak. The capture of islands in the third island, chain requires not only a blue water navy, but a superior blue water navy. China appears to be slowly but surely grinding along on its long march to superiority.

While the focus of China and the world presently remains on the first island chain, which carries a direct threat on to the second island chain, the long-term implications for the might of the USA extend to the third island chain that includes Hawaii[32]. The Pacific might of the USA is centred in Hawaii, and the Pacific Command of the USA, headquartered in Hawaii, alone has the largest navy and air force of the world. During World War II, Adm Yamamoto realised this and, therefore, superbly planned the Pearl Harbour attack, which probably failed because the Japanese admiral in charge of the invasion did not launch the third wave of aircraft from his aircraft carriers, thereby scuttling the mission and escaping, before US

32. Saurav Jha, "China's 'Third Island' Strategy," *MPR: World Politics Review*, http://www. worldpoliticsreview.com/articles/4893/chinas-third-island-strategy, January 6, 2010.

submarines could locate the fleet. History has proved that cowards who run away get caught in their own fear in the end, as eventually happened to the Japanese fleet off Midway Island.

Hawaii is much too important for the USA from its military perspective. Inasmuch as the first island chain corresponds to China's green water navy and the second island chain to its blue water navy, the third island chain corresponds to China's supremacy in the world. Like Iran's claim to process uranium as an international right, China claims it has

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a right to have a blue-water navy. That is fine so long as no one else feels threatened[33]. At present, every nation in the East Pacific and Southeast Asia, not to mention India and Australia, and then Canada and the USA, feels threatened by the Chinese show of arms and rapid military production, which is becoming more sophisticated and modernised by the day. The USA and its allies in East Asia are unnerved by the numerous territorial claims made by China.[34]

China has already made inroads into the third island chain. It has invested heavily in Western Samoa, and has a submarine base in Fiji. A very large amount of infrastructure expansion in underdeveloped Western Samoa has been fully funded by the Chinese. In fact, Western Samoa has

33. For instance, Iran has to date not retracted the statement of former President Mahmoud Ahmadinejad in 2006, wherein he said, "This regime occupying Jerusalem must vanish from the page of time" (Refer Robert Mackay, "Israeli Minister Agrees Ahmadinejad Never Said "Israel Must be Wiped off the Map," *The New York Times*, http://thelede.blogs.nytimes.com/2012/04/17/israeli-minister-agrees-ahmadinejad-never-said-israel-must-be-wiped-off-the-map/?_r=0, April 7, 2012). In fact, as recently as April 18, 2015, in spite of the prospect of a nuclear deal and the lifting of sanctions against it, Iran marked its Army Day parade with a float displaying a banner proclaiming "Death to Israel, US," instead of disavowing the threats made by their former president (Refer to "Iran marks Army Day with cries of 'Death to Israel, US',"http://www.timesofisrael.com/iran-marks-army-day-with-cries-of-death-to-israel-us/, *Times of Israel*, April 18, 2015).
34. Mark Landler, "With Russia, as With China, Unnerved U.S. Allies Seek Reassurances," *New York Times*, http://www.nytimes.com/2014/03/20/world/europe/another-set-of-wary-allies-seeks-us-reassurance.html?_r=0, March 19, 2014.

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been enjoying an economic boom of late owing to Chinese investment. China has also made gifts to Western Samoa and Tonga that both have happily accepted. It can be asked, what does China want from making so many gifts? The difference between the USA and Japan providing gifts to countries and China offering gifts is in their posturing. And, both Japan and the USA have democratic governments, while China's is veiled in secrecy, which frightens many. In the case of Fiji, with which many Indians would like to have good relations because of the large Indian population, China has made more inroads than India. The military government of Fiji has placed systemic restrictions on the rights of Indians, thus, putting pressure on Indian-origin settlers to emigrate to New Zealand, Australia, Malaysia, and the USA. Thus, it was in consideration of the strategic drift of Fiji, and an effort to ease the political onslaught on the Indian settlers, that Narendra Modi made a stopover there during the G-20 meeting in Australia in 2014.

China is already in a power game with the USA and all its neighbours. This is further evidenced by President Barack Obama's initiative to strategically and militarily engage the Southeast Asian nations with an aim to check the concerns about China's claims over territorial waters.[35]

POLITICAL PERSPECTIVE

Thanks in part to the Chinese nationalism and the North Korean ballistic missile tests, a nationalistic government under Shinzo Abe came to power in Japan in elections of December 2012 and December 2014. Mr. Abe's victory was in part owing to his promise to take a hardline stance against China and North Korea. This means that Japan will probably choose to rearm itself as

35. Gwenn Robinson, "Obama to Spearhead Southeast Asia Push," *Asia-Pacific*, http://www.ft.com/cms/s/0/7c7daa92-2fb5-11e2-ae7d-00144feabdc0.html#axzz2JxLTY6D9, November 16, 2012.

a nation. Japan has already been quietly building up a formidable navy and a credible defence air force. Now, it will only augment its efforts because its national honour is at stake.[36]

Abe now seeks to develop close economic and defence strategic partnerships with Indonesia, Thailand, and Vietnam to contain an aggressive China.[37] Consequently, Japanese naval collaboration with India has seen an increase in the recent years. Moreover, Japan was the first country outside the subcontinent that the new Indian Prime Minister, Narendra Modi, visited after being elected last April. This was a show of unity with, and preference for, Japan over China, in addition to the desire to attract Japanese investment. After years of letting the USA take the lead in its military matters, Japan now realises that, while it can rely on the USA to some extent in defence matters, in the end, it must fend for itself.

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Unwittingly or otherwise, China has raised the spectre of a situation that it actually fears most – a militarily-resurgent Japan. Now that China has "tested the waters" of what Japan will do in the event of a battle or war, would China go to war against a Japan that is prepared to take on the Chinese challenge?

In the end, every nation's future depends on the will of its leaders. If Japan stays nationalistic for a long period, China's hopes to dominate Japan will be minimised. In fact, it is likely that China will anger and exasperate Japan to the point where Japanese politics will shift towards the nationalistic right. The number one and number three economies of the world going to war is a big event in world affairs, but is not an unknown one. If war is thrust on them due to internal or external processes, neither country is likely to recoil into its shell. China will press on to avenge its past

36. Martin Fackler and David E. Sanger, "Japan Announces a Military Shift to Thwart China," http://www.nytimes.com/2014/07/02/world/asia/japan-moves-to-permit-greater-use-of-its-military.html?_r=0, *The New York Times,* July 1, 2014.
37. "Shinzo Abe Snubs China on First Trip Abroad," *The American Interest*, http://blogs.the-american-interest.com/wrm/2013/01/15/shinzo-abe-snubs-china-on-first-trip-abroad/, January 15, 2013.

The Senkakus are a stepping stone to Okinawa, which has major US bases. In turn, Okinawa is a stepping stone to mainland Japan, the thought of which shakes the nerves of the Japanese.

humiliations and redeem itself in its own eyes, while Japan will press on to maintain its national honour. For the present, it appears that the dispute over the Senkakus will remain simmering. Over this period, China may draw up plans to take the Senkakus while conducting more naval exercises for the same, but Japan will use this period to enhance its military power.

SUMMARY

China and Japan are locked in a geo-political gambit that will draw in the USA. But a clash between these major economic powers is sure to upset the world economy, much more than the hostilities of the West with Russia over Crimea and Ukraine. China's ambitions to build a superior blue water navy that spans the Pacific is a direct punch in the face of the USA's control of the Pacific. This may or may not be a welcome move for the future of the world, but it surely sets up for great power rivalry. Moreover, the East Asian countries are already wary and suspicious of China's moves to claim vast swathes of ocean spaces and islands, including the major island of Taiwan.

The Senkakus are a stepping stone to Okinawa, which has major US bases. In turn, Okinawa is a stepping stone to mainland Japan, the thought of which shakes the nerves of the Japanese. The Senkaku Islands also enable China to install missiles that can threaten Taiwan, not to mention that China will be closer to capturing the southernmost Japanese islands of Yonaguni and Inomote where Japan has little projection of military power. And yet, this is only Step 2 of the plan, where the first island chain represents a green water navy.

The second island chain represents China's blue water navy, but here it comes head to head with the USA's formidable base in Guam that the USA can ill-afford to lose due to its own strategic perspective, and doctrines of preservation. If this fortress falls, the USA would be on the back foot, from where Hawaii would be threatened. Finally, power over the third island

chain represents China's superior blue water navy and total dominance of the Pacific.

In the end, if China fails to accept the sound legal judgment of the international community that allots the Senkakus to Japan in the legal system of modern nation states, which would be inevitable from all legal projections of international law,[38] the possibility of a war between Japan and China depends entirely on the will of the leaders of those two nations. Of late, however, China's provocative actions have decreased from the level of 2012 and 2013. Yet Japan cannot afford to back down, because every inch yielded to China will embolden China for a yard. Nevertheless, China may wish to surge forward for its ever-expanding resource needs and to avenge the bruises to its ego by the Japanese and the West in the past century and a half. For China, to kill two birds with one stone is an attractive proposition – for which Japan needs to be on eternal guard. The reality of the situation hovering around the Senkakus, which affects the second and third island chains, is much too profound to let the first bastion fall. Hence, Japan will lock horns with China in the foreseeable future on the matter of the Senkakus, and the USA will aim to continue attending to its guard in the Pacific, creating increasing inter-power rivalry and gamesmanship in the East China Sea and the Pacific.

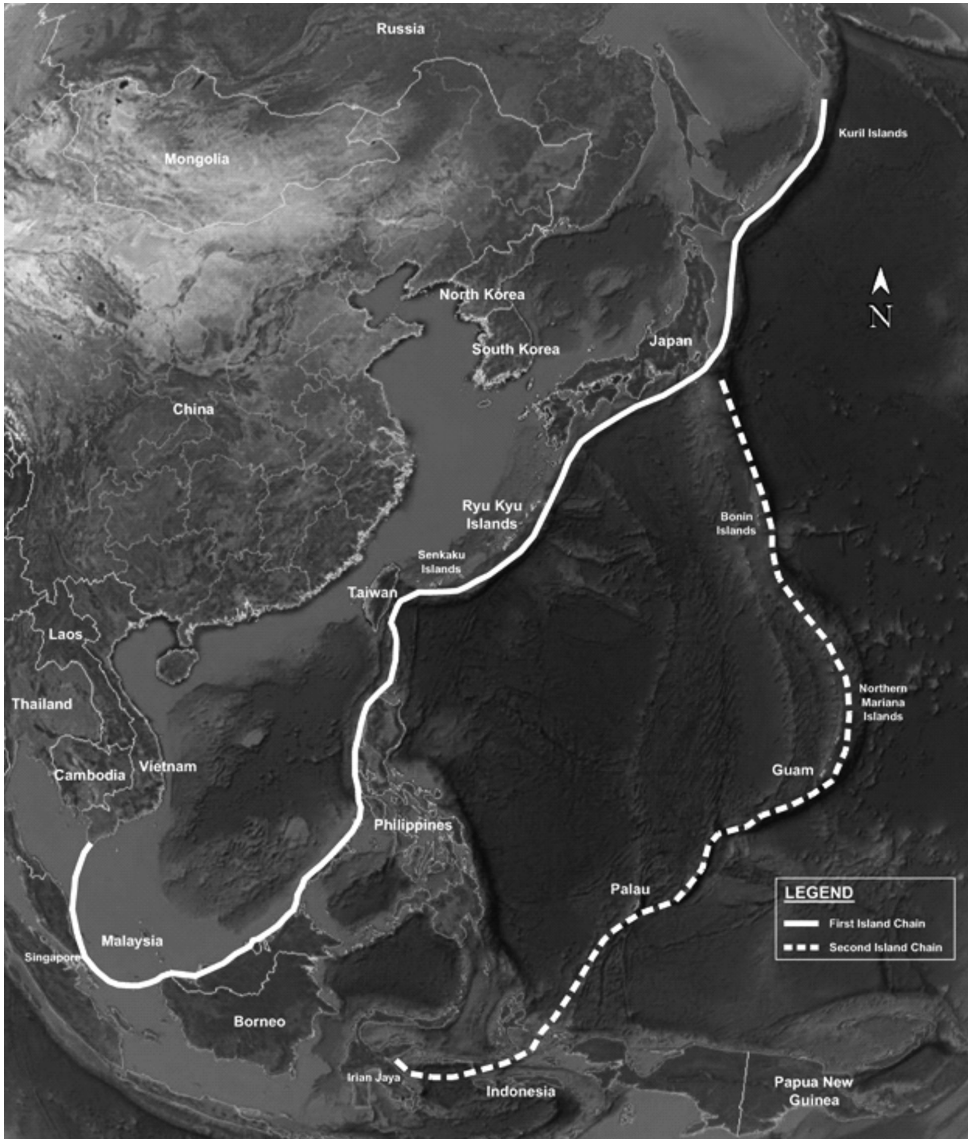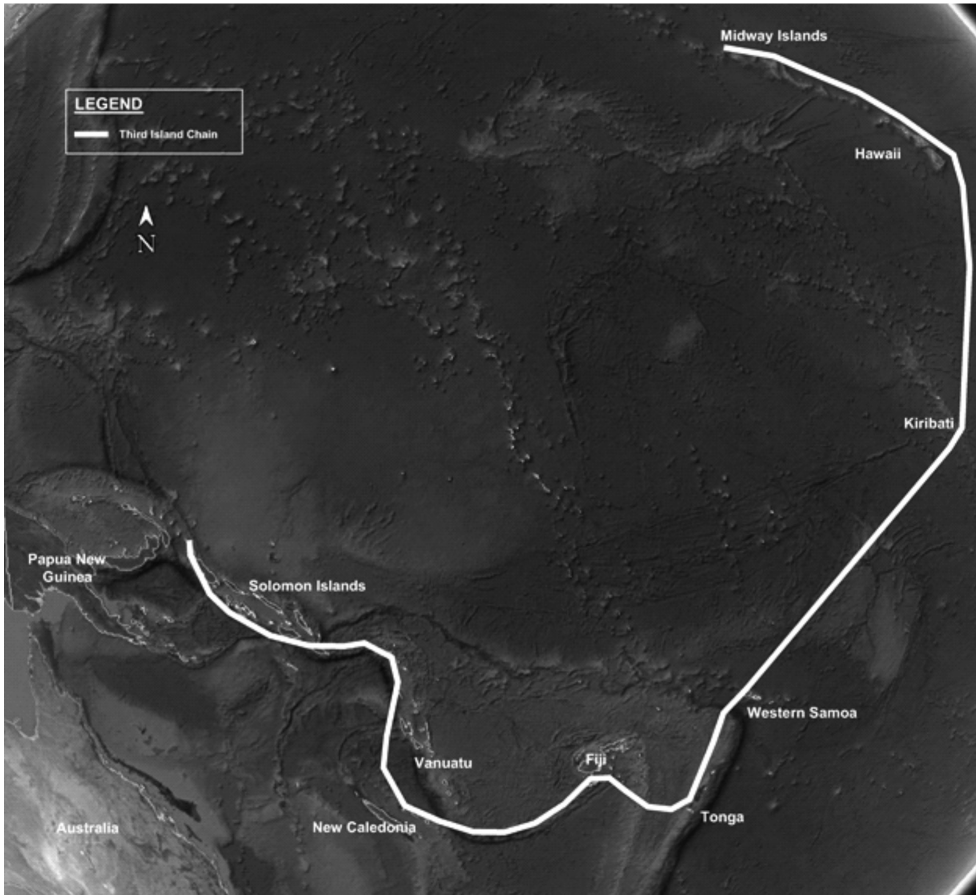
38. Drifte, n. 26.

Fig. 1: First and Second Island Chains

Fig. 2: Third Island Chain

SOLAR POWERED AVIATION:
A NEW REVOLUTION?

R K NARANG

INTRODUCTION

The Solar Impulse-2 (SI-2), a solar powered aircraft, made by the Swiss duo Bertrand Piccard and Andre Borschberg, landed at the Sardar Vallabhai International Airport, Ahmedabad, on the night of March 10, 2015.[1] This aircraft thereafter left Ahmedabad and landed at Mandalay (Myanmar) via Varanasi on March 19, 2015.[2] The single seat aircraft is made up of carbon fibre, with a large wing span of 72 m and it flies at a maximum speed of 49 knots at sea level.[3] It houses 17,000 solar cells which charge lithium batteries during the day and can store up to 340kWh (kilowatt-hour) of energy per day and give it day and night flying capability. The lithium batteries power four 17.5 HP (17.5 CV) electric motors, which drive the propellers. The development of the solar powered SI-2 aircraft is the result of a joint effort by a team of experts from aviation and industry.

The SI-2 team is aiming to make it the first solar powered aircraft to go around the world. The landing in India is part of its journey across the

1. http://info.solarimpulse.com/en/our-adventure/solar-impulse-2//. Accessed on March 12, 2015.
2. "Solar Impulse's Round the World Solar Plane Lands in Myanmar to Demonstrate The Potential of Clean Technologies", http://info.solarimpulse.com/en/our-story/pilots/#.VQ-GzPmUdDA. Accessed on March 23, 2015.
3. "Challenge1-Energy to Cross Oceans and Continents", http://info.solarimpulse.com/en/our-adventure/building-a-solar-airplane/#.VQ-Fj_mUdDA. Accessed on March 22, 2015.

SI-2 is aiming to become the first aircraft to fly across continents and demonstrate the viability of solar powered aircraft.

world. The aircraft would be flying during both day and night to demonstrate its capability. The around the world trip across continents would strengthen its case as a viable alternative to aircraft flying on conventional sources of energy. The partners involved in the development of this aircraft are exploring the commercial viability of their inventions/innovations by creating new products for automotive, engineering and other industries. This aircraft could prove to be a game changer in the aviation, space and industrial sectors. This paper will deliberate on the pioneering role played by the private sector entrepreneurs in the development of Solar Impulse-2 (SI-2), the Research and Development (R&D) challenges, the dual use technologies, the future of solar power in industry and aviation, the challenges to R&D in India, and a way ahead for India.

PIONEERING SPIRIT OF PRIVATE ENTERPRISE

The ingenuity, collaborative effort and pragmatism of the private sector were on display when the SI-2 landed at Ahmedabad on March 10, 2015, with the names of the main partners displayed on the aircraft and the pilots' and crew's uniforms. Solar Impulse is a privately financed solar powered aircraft project, which was envisioned and initiated by Swiss psychiatrist Bertrand Piccard. Andre Borschberg, a pilot, Chief Executive Officer (CEO) and co-founder, soon joined him.[4] Bertrand Piccard was earlier involved in an around the globe expedition in a hot air balloon in 1999. The first prototype SI-I was test flown in December 2009. The Solar Impulse's flying expeditions include the European Tour (May 2011 to July 2011), Switzerland to Morocco and back (May 25, 2012, to July 24, 2012), and the Across America trip (West to East from May 3, 2013 to July 6, 2013). The cost of developing the SI-2 was about $150 million over a period of 13 years, which is considered to be much

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4. Neha Singh, "Solar Impulse-2: Watch Swiss Solar Plane's LIVE Landing and Takeoff from Ahmedabad to Varanasi", http://www.ibtimes.co.in/solar-impulse-2-watch-swiss-solar-planes-live-landing-takeoff-ahmedabad-varanasi-photos-625787. Accessed on March 12, 2015.

less vis-à-vis corresponding aviation projects.[5] The development of the SI-2 and its around the world trip across continents, demonstrates the pioneering spirit, pragmatic approach and enormous potential of the private entrepreneurs.

VENTURING INTO AN UNKNOWN AREA

The field of R&D involves venturing into new areas, not explored before, and has the inherent danger of failure. Such endeavours require conviction and perseverance; however, their success can have favourable and disproportionate

The SI-2 and its around the world trip across continents, demonstrates the pioneering spirit, pragmatic approach and enormous potential of the private entrepreneurs.

benefits. Bertrand Piccard envisaged development of a solar powered aircraft immediately after his return from a trip around the world in a hot air balloon in 1999. Andre Borshberg, an engineer and professional pilot of Ecole Polytechnique de Lausanne (EPFL) joined him in 2003. These two pioneers, during their journey to build a dream aircraft, were initially snubbed by the aviation majors for aiming to design a huge but extremely lightweight solar powered aircraft, which did not have the necessary strength of a conventional aircraft. Though the SI-2 does not meet all the standards of a conventional aircraft, it indicates a good beginning, and has given hope of developing into a viable clean energy alternative to conventional aircraft flying on aviation fuel.

The development of the SI-2 had its share of setbacks when its first wing spar, which was delivered in 2012, broke during testing. However, it is said that success has many fathers, which proved right even in the case of the SI-2. The Solar Impulse team did not find it easy to get partners initially. However, as they moved forward, they kept finding partners with every milestone/success. The partners who joined these pioneers during their journey include Solvey, Altran, Semper between 2004-06 followed by

5. "Solar Impulse-2: Technology of Aircraft has Huge Potential, "March 12, 2015 http:// www.business-standard.com/article/current-affairs/technology-of-aircraft-has-huge-potential-115031200043_1.html. Accessed on March 12, 2015.

Omega and Deutsche during the period 2007-09. The SI-2 team has now enlarged with four main and 80 smaller partners. The four main partners, who supported the SI-2 project are Solvay, a chemical industry group, Omega, a watch brand, Schindler, an elevator and escalator provider, and ABB, a company dealing with renewable energy and transportation. While the partners involved in the development of the SI-2, with the exception of ABB, were not related to the aviation field, they played an important part in the realisation of such an ambitious aviation project. The development of the first prototype of the Solar Impulse took 10 years from formulation of the concept in 1999 to the actual flight of its first prototype in December 2009. It comprises a magnificent feat by a private entrepreneur considering that many aviation and government R&D agencies the world over are yet to achieve such a milestone. It is a perfect example of the private sector venturing into an unknown area and succeeding despite the odds.

CHALLENGES AND INNOVATIONS FOR AROUND THE WORLD TRIP
The world trip of the SI-2 is planned from Abu Dhabi to Abu Dhabi with enroute halts across the continents, which include Muscat (Oman), Ahmedabad and Varanasi (India), Mandalay (Myanmar), Chongqing and Nanjing (China), Hawaii, Phoenix and New York (USA), a location in Midwest US, cross-Atlantic, Southern Europe/North Africa before returning to Abu Dhabi. The world trip is spread over five months from March to August 2015, involving 500 hours of flying which would cover a distance of about 35,000 km.

The around the world trip had posed enormous technical and human challenges. The SI-2 aircraft was subjected to intensive testing. The pilots were given rigorous training and equipped to stay in the 3.8 m^3 cockpit continuously for five days and five nights in order to cross the Atlantic and Pacific Oceans. The SI-2, despite having a maximum operating altitude of 27,000 ft, is protected by thermal insulation only. It does not have a heating or air-conditioning system, thereby subjecting the pilots to extreme temperatures varying from +40 C to -40 C. The associated challenges include carrying suitable food and water, provision of toilet facilities, resting and

flying without endangering the safety of the flight. A lot of thought and innovative solutions were required to meet these challenges. The team has planned for every contingency with precision and perfection. The innovatively designed reclinable seat allows the pilot to do exercises, take rest, carries a parachute and dingy for bail out in case of an emergency, and has a provision for a toilet. The pilots flew a 72-hours-long training sortie in a simulator to prepare for the world trip. They were trained to take short naps of 20 minutes every two hours during which the aircraft would be flying on autopilot. The cockpit has been equipped with visual and audio alarms to wake up the pilot in case of an emergency.

DUAL USE TECHNOLOGY AND INCENTIVE FOR PRIVATE SECTOR

The advanced technological innovations associated with the development of the SI-2, have applications in civil, automotive, engineering and other industries. Solar energy has been in use for the last few years, but it has not been able to replace the conventional sources of energy due to the high initial cost of installation and lower efficiency. The solar panels used on the SI-2 have an efficiency of 22.7 percent.[6] According to the National Aeronautics and Space Agency (NASA) scientists, the efficiency of the solar panels in the last decade was about 8 percent and is likely to increase to 50 percent in the near future[7]. The creation of the solar powered aircraft is a result of improvements in the efficiency of solar energy panels and is the first step in finding clean energy solutions. The electric engine of the SI-2 operates with 97 percent efficiency.[8] The SI-2 electric motors will lose only 3 percent of energy (with 97 percent efficiency) compared to 70 percent of energy lost in the form of heat by a normal engine. The associated inventions/ developments resulted in improving the quality and efficiency

6. "Construction of HB-SIB", http://info.solarimpulse.com/timeline/view/6544#.VQ-FWvm UdDA. Accessed on March 23, 2015.
7. Joe Frost, "Interview with Nasa's Albion Bowers (Full Transcript)", March 11, 2015, http://www.techly.com.au/2015/03/11/interview-nasas-albion-bowers-full-transcript/. Accessed on March 12, 2015.
8. Marco D'Souza "Solar Impulse-2: The Aircraft and Visionaries Behind the Promise of Sustainable Energy", March 15, 2015, http://www.dnaindia.com/scitech/report-solar-impulse-2-aircraft-visionaries-sustainable-energy-solar-plane-circumnavigate-globe-2069035. Accessed on March 17, 2015.

of low powered LEDs, insulation of batteries and lightweight structures, which could also reduce the weight of the aircraft, vehicles and machines alike. The improved efficiency of electric appliances would reduce electricity consumption. The companies associated with the development of the SI-2 project are using their experience/expertise to create new products, which can be sold in the market. Bayer Material Science AG, a partner in the SI-2 project has applied for 12 patents. It has developed polycarbonate sheets for the cabin windows of aircraft, which has the potential to replace conventional glass windshields in cars and reduce their weight by about 30 percent.

The improved efficiency of the solar panels and electric appliances could reduce dependence on oil, which is one of the major contributors to environmental pollution, and preserve this perishable source of energy. The next challenge for the engineers/designers would be to make solar energy affordable, simple to manufacture, and easier to adopt in other fields. The countries/regions having maximum sunshine would benefit most from this innovation. This acceptance of solar energy would increase if it can be made a cheaper substitute for conventional sources of energy. There is need to explore the use of solar and other sources of energy to run/ operate automobiles and electric appliances like cars, cooking/electric appliances, air conditioning systems, etc. The inventors of the SI-2 aim to capitalise on the success of the world tour and make it a mega event in the Conference on Climate Change of the United Nations, which is scheduled to be held at Paris in December 2015.[9] The strategy of the team appears to be focussed on reaping benefits from the publicity they receive from the world tour and establish business links across the world.

WILL THE SOLAR AIRPLANE REPLACE CONVENTIONAL AIRCRAFT?

The Solar Impulse-2 aircraft reportedly experienced control difficulty in turbulent conditions prior to landing at Ahmedabad airport on March 10, 2015. A thunderstorm and cloudy conditions delayed the departure of the

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9. Aaron Mamiit, "Solar Impulse Plane Begins Pioneering Around-The-World Solar Flight", March 9, 2015,http://www.techtimes.com/articles/38283/20150309/solar-impulse-plane-begins-pioneering-around-the-world-solar-flight.htmj. Accessed on March 16, 2015.

SI-2 from Ahmedabad to March 18, 2015.[10] India, as a goodwill gesture, waived off landing and parking charges to the Solar Impulse team for their extended stay at Ahmedabad due to bad weather.[11] The SI-2, with its 72 m wingspan has a larger wingspan than a Boeing 747 but weighs only about 2 tonnes compared to 447 tonnes of the Boeing 747.[12] In fact, the SI-2 is lighter in weight than a generic sedan car. The significant feature of its design is that one-fourth of the weight of the SI-2 results from housing the lithium batteries that weigh 633 kg. The large and delicate design would restrict flying in strong and turbulent winds. The requirement of large parking spaces and wing clearance would further restrict its utilisation due to the lack of the same at already congested airports. The need for sunny conditions would restrict its employability in countries/regions having shorter periods of sunlight and for lesser duration of the year. Selection of the United Arab Emirates (UAE) as the starting and ending point for the Solar Impulse-2's around the world trip appears to have been done in view of the favourable weather, its future employability and business interests.

Conventional commercial aircraft have the capacity to carry up to 500 people across the continents at transonic speeds. The solar powered aircraft is a promising and futuristic concept, however, the design and development of a commercially viable solar powered aircraft still has a long way to go. Such aircraft are not likely to replace conventional aircraft in the near future. However, the writing is certainly on the wall. Once the concept is proven, scaling it up for commercial applications will be just a question of engineering.

FUTURE OF SOLAR POWERED AIRCRAFT

The Solar Impulse-I had demonstrated in 2010 that it was possible to fly by day and night without fuel when it flew non-stop for 26 hours from San

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10. "Solar Impulse-2 Aircraft Extends Stopover in Ahmedabad Once Again", http://zeenews. india.com/news/sci-tech/solar-impulse-2-aircraft-extends-stopover-in-ahmedabad-once-again_1562749.html

11. "After Many Hurdles, Solar Plane Finally On Way to Varanasi", March 18, 2015, http://www.ndtv. com/india-news/after-many-hurdles-solar-plane-finally-on-way-to-varanasi-747682. Accessed on March 20, 2015.

12. http://www.boeing.com/boeing/commercial/747family/pf/pf_400er_prod.page. Accessed on March 24, 2014

The development of the solar powered aircraft by China indicates its approach to becoming a leader in the development of new technologies.

Francisco to New York[13]. The SI-2 is expected to fly continuously for five days/ 120 hours non-stop to enable it to cross the Atlantic or Pacific Ocean. The around the world trip by the SI-2 demonstrates its long endurance and high altitude operations capability. Many countries in the world are developing solar powered aircraft. A Chinese website published an undated photograph of China's solar powered aircraft on March 12, 2015, which coincided with the arrival of the SI-2 in India. The aircraft has a 40 m wingspan, six propeller engines and has been designed by the China Academy of Aerospace Aerodynamics.[14] The release of the picture of their indigenous solar powered aircraft highlights the importance the Chinese have given to development of new technologies. The development of the solar powered aircraft by China indicates a drastic change in its approach from producing existing advanced technologies by following the reverse engineering route to becoming a leader in the development of new technologies.

The ability of the SI-2 to fly for days together coupled with the autopilot and slow speed poses human limitations in flying these planes on a regular basis and necessitates development of an unmanned version. According to Bertrand Piccard, the company aims to develop an unmanned version of this aircraft by 2016, which would be able to fly 20 km above the ground continuously for six months and carry out tasks which were till now meant only for satellites.. There have been similar experiments by the USA, Britain and other countries. NASA's Helios remotely piloted solar powered flying wing[15] and the Zephyr solar powered Unmanned Aerial Vehicle (UAV) of

13. "Solar Impulse Arrives at Starting Gate", January 6, 2015, http://www.swissinfo.ch/eng/ solar-impulse-arrives-at-starting-gate/41201440?ns_mchannel=ps&ns_campaign=DSA&ns_ source=adw&ns_linkname= _cat:swissinfo.ch&gclid=CL30w9j_q8QCFRcOjgodAoIAmw. Accessed on March 16, 2015
14. Yao Lan, "China's Solar Powered UAV Soars High into the Sky", March 12, 2015, http:// www.ecns.cn/visual/hd/ 2015/03-12/60937.shtml. Accessed on March 12, 2015.
15. http://www.nasa.gov/centers/armstrong/news/FactSheets/FS-068-DFRC.html#. VRDcBfmUdDA. Accessed on March 24, 2015.

the UK[16] have already been test flown. Facebook is aiming to provide the internet by developing and deploying solar powered drones all over the globe — it is planning to test the drone some time in 2015.[17] These solar powered manned/ unmanned aerial vehicle projects were making slow progress till now and no urgency was being shown in the development of these technologies. However, the success of the SI-2 is likely to act as a catalyst in expediting the development of military and commercial solar powered UAVs.

The success of the SI-2 is likely to act as a catalyst in expediting the development of military and commercial solar powered UAVs.

These lightweight solar powered UAVs could be employed in law enforcement, disaster relief, Intelligence, Surveillance, and Reconnaissance (ISR) and communication roles and would complement conventional unmanned aerial vehicles. The enhanced endurance and autonomous operation would enable them to provide round the clock data and communication relay coverage and could have applications in both civil and military fields. The envisaged development of the solar powered UAV could bring in a revolution in aviation, space and industry.[18] It could prove to be a game changer in future battles.

INDIA'S GAINS AND NEAR MISSES

The landing of the Solar Impulse-2 at Ahmedabad was coupled with some of its partner companies negotiating with Indian industry/clients. Indian industry too capitalised on the SI-2's visit, with the Aditya Birla Group becoming their host partner in India.[19] ABB India, a partner of the SI-2, had been in negotiations with Indian car companies like Tata Motors,

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16. "Zephyr Solar-Powered HALE UAV, United Kingdom", http://www.airforce-technology.com/projects/ zephyr/. Accessed on March 24, 2015.
17. http://www.gizmag.com/facebook-testing-drone-enabled-internet/33964/. Accessed on March 24, 2015.
18. Chetan Kumar, "Next: Solar Impulse 3.0, A Drone That can Fly Non-stop for 6 Months", March 12, 2015, Chethan Kumar, http://timesofindia.indiatimes.com/india/Next-Solar-Impulse-3-0-a-drone-that-can-fly-non-stop-for-6-months/articleshow/46535411.cms. Accessed on March 20, 2015.
19. "Aditya Birla Group to Host Solar Impulse-2 In India", http://info.solarimpulse.com/timeline/view 7826#.VQ-FR_mUdDA. Accessed on March 23, 2015.

Ashok Leyland, Mahindra, Honda, etc. for replacing glass windows with polycarbonate windows, especially in their premium vehicles like the Jaguar, etc. It has also been supplying the products to many mining companies in India. The production and supply of solar pumps for farmers was also being explored. Schneider, a key partner of the Solar Impulse-2 project, and an elevator and escalator company, too announced testing of a solar powered escalator in Pune. India is looking to generate 100 Gigawatt of solar energy capacity up from the existing 3 Gigawatt, by 2022.[20] The Government of India has launched its ambitious Green Energy Corridor to encourage states to explore sources of renewable energy to meet their electricity/energy needs. Many state governments have started exploring exploitation of clean energy sources to meet their energy demands. In a pioneering move, the Rajasthan and Bihar governments have called for bids to supply solar energy to state electricity boards in a reverse bidding process[21] and are likely to benefit from these developments..

During its stay, the SI-2 was open to public viewing at Ahmedabad. Its team had visited India four years earlier when it met then Gujarat Chief Minister and present Prime Minister of India Shri Narendra Modi, and discussed the use of clean energy.[22] The present Gujarat government was equally enthusiastic about the visit of the SI-2 to Ahmedabad. It was a golden opportunity for scientists, business leaders, students/academicians of Indian Institutes of Technology (IITs), engineering colleges, as well as children to interact with the pioneers of the SI-2. People had come from different parts of Gujarat to see this flying machine. Our scientists/researchers could have used this opportunity to interact with the SI-2 team and exchange views on the nuances of the development of new technologies, and collaborate, if required. However, there has been no news of any interaction of the scientists/scholars with the SI-2 team and it is not certain whether they

20. Anindya Upadhyay, "How Narendra Modi Envisioned a Successful Solar Impulse 2 When Everyone Else was Sceptical", March 11, 2015, http://articles.economictimes.indiatimes. com/2015-03-11/news/60008722_1_solar-impulse-solar-airplane-andre-borschberg. Accessed on March 17, 2015.
21. "Bihar Bats for Solar Power for Aquaculture", March 16, 2015, http://www.renewableelectron. com/. Accessed on March 17, 2015
22. Upadhyay, n. 20.

benefited much from its stopover. The lack of enthusiasm among the academic institutions/ scientific community indicates a lack of Research and Development (R&D) culture in India and could be termed as a missed opportunity.

CHALLENGES OF R&D IN INDIA

India is dependent on foreign suppliers for aviation and military equipment and a large amount of money is spent on its procurement and maintenance. In the past, India had the disadvantage of being a late starter as it was under colonial rule when aviation was born and started prospering. Metallurgy and engine technology were other challenges to the development of indigenous aviation and defence equipment. The understanding of the research and design process, acceptance of failures, adequate funding, support of the government/users and persistence are key to the success of any R&D project. The media, in its enthusiasm for sensational news and/ or lack of understanding of the R&D process, sometimes misses the point, and inadvertently harms the strategic interests of the country. The public too sometimes gets swayed by the perception management campaign of big companies to discredit the indigenous R&D efforts, and blow their failures out of proportion. The rigid approach of the R&D agencies to review projects, and their reluctance to accept failures too is responsible for such perceptions. The lack of support from the government and future users further complicates matters and goes against indigenous R&D efforts, which is often exploited by foreign vendors/ suppliers.

India, with an investment of $ 40 billion is R&D, which amounts to 0.9 percent of the GDP is well short of the 2 percent target set by the Indian government in 2010.[23] The lack of adequate investment in the R&D sector is a key challenge in India, which is hampering indigenisation. China's investment of $ 16 billion for development related to design and manufacturing of jet engines for aircraft indicates its efforts in indigenising

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23. Vikram Doshi and Vijay Gilde, "Budget 2014: Govt Should Extend Incentive to Boost R&D Activity in India", June 23, 2014, http://businesstoday.intoday.in/story/budget-2014-incentive-needed-to-boost-randd-activity-in-india/1/207478.html. Accessed March 25, 2015.

India's investment of 0.9 percent of GDP in R&D is much less compared to 1.76 percent of GDP by China.

critical defence technologies.[24] The Chinese spending on R&D had increased to 21.7 percent in 2010, raising the investment in R&D from 0.06 percent to 1.76 percent of the GDP, with an aim to further increase to 2.5 percent by 2020.[25] The Chinese had also increased spending on science and technological development to 4.58 percent of the fiscal expenditure. They have been investing heavily in the development of advance defence technologies, which include aircraft, UAVs, armed UAVs, Unmanned Combat Aerial Vehicles (UCAVs), aircraft carriers, Intercontinental Ballistic Missiles (ICBMs), etc. Their success in some of them, has placed China in the league of the US, UK and other leaders in the development of new technologies, that spend up to 3 percent of their GDP on R&D.[26]

However, despite these disadvantages, India has had its share of successes in the field of R&D and production of military hardware. India has developed the Marut, Ajeet, target drones, missiles, tanks, ships, etc in the past. The Marut was considered to be the best aerodynamic design at that time, though it failed to achieve its design performance due to lack of a suitable engine. There were plans to make a version powered by afterburning engines also, but India could not procure suitable engines and the efforts to produce an engine for this aircraft did not succeed. India is now making slow but steady progress in producing military hardware indigenously. The current military/ aviation projects include the Advanced Light Helicopter (ALH), Light Combat Aircraft (LCA), Light Combat Helicopter (LCH), Intermediate Jet Trainer (IJT-36), Rustom UAV, Akash Surface-to-Air Missile (SAM), Astra Air-to-Air Missile (AAM) and Kaveri engine. The LCA has joined the IAF fleet and the ALH is slowly becoming the backbone of the helicopter fleet of the three Services and paramilitary forces. The existing

24. "China Plans USD 16 billion R&D Project for New Jet Engines". March 1, 2013, http://www.deccanherald.com/content/315769/china-plans-usd-16-billion.html. Accessed on March 25, 2015.
25. "China Spending on R&D Rises 21.7%.", September 29, 2011, http://www.deccanherald.com/ content/315769/china-plans-usd-16-billion.html. Accessed on March 25, 2015.
26. Doshi and Gilde, n. 23.

pace of R&D in military hardware has not been able to meet the needs of the armed forces and there is need to expedite R&D and production in this sector.

Countries like India are often dissuaded from developing the same/similar technologies by the countries that have them, in order to be able to sell their own products. Some of the futuristic military projects in the past were shelved due to replacements offered by foreign vendors. It has often been seen that the technology which was initially refused by them was offered subsequently, when the country had already made progress in developing similar technology indigenously. The high procurement and maintenance costs of foreign military hardware also limit the numbers a country can procure, which creates deficiency. The participation of the private sector in the past was minimal due to restrictions on its participation and in allowing industrial use of by-products. However, there has been a rethink in the government circles on such an approach due to its economic unviability. The participation of the private sector is being encouraged now, which would be critical in developing state-of-the-art defence equipment.

Countries like India are often dissuaded from developing the same/similar technologies by the countries that have them. Some of the futuristic military projects in the past were shelved due to replacements offered by foreign vendors.

WAY AHEAD FOR INDIA
The development of the SI-2 is a result of 12 years of intensive research and testing, and is likely to prove a game changer in the aviation industry. With this innovation, countries across the globe are likely to reorientate their aviation development programmes. This machine is ahead of its time and offers a unique way ahead, hence, others will endeavour to catch up. The timelines of the SI-2 indicate that a large time period and persistence are required for the development of advanced technologies. The way the SI team went about carrying out research and development, planning, training and involving experts from the respective fields

of expertise is an excellent example of vision, investment in R&D, entrepreneurship of private players and utilisation of the knowledge base. It also shows that enormous potential and opportunities exist for the private sector due to their applicability in other industries, and their commercial viability.

One of the key lessons India and Indian industry can learn from the SI-2 is that invention is a result of vision, planning, preparation, collaboration, perseverance and well thought out execution. The SI-2 partners commercially using aviation innovations in other industries is a valuable takeaway for the Indian R&D agencies and private sector. Solar powered airplanes/UAVs comprise an emerging field and provide India an equal opportunity or a fair chance to develop them before other countries establish their monopoly. The development of solar powered aircraft/UAVs needs to be included in the overall development plan by the Indian R&D agencies/industry. Research and development is a time consuming process and needs the support of own people. India needs to have a proactive policy, set up long-term goals, enhance investment in R&D, involve the private sector and provide the necessary support to develop such technologies. The accountability and financial viability of the projects would be the key to the success of future R&D projects. India's private sector could play a key role in the success of such projects.

India has all the elements for encouraging innovation, including engineers, academicians, a strong industrial base and a sense of innovation. With its skilled manpower and competitive industry, India is capable of providing low cost innovative solutions. The Indian industry could play a key role in making India a manufacturing hub byindigenising and/or transfer of technology from foreign companies in the field of clean energy. The huge market in India is a big incentive for business, which could be leveraged to make India a manufacturing hub, thereby proving to be a win-win situation for both parties.

CONCLUSION

The journey of the development of the solar powered electric aircraft project, the SI-2, from its inception in 1999 to its around the world trip has a fascinating story behind it. The way the partners of the SI-2 team have looked at expanding their trade relationships with automobile, engineering and other industries shows the way to private industries for entering the high technology sector and yet making it viable. The pragmatic approach of the team of the SI-2 in utilising their by-products in other industries is a perfect example of making such programmes financially viable. The SI-2 team collaborated with, and/or hired, experts from different fields. The professionalism displayed in equipping, training and preparing for the world tour is worth emulating.

Solar power has the scope of expanding into the power and other industries to provide clean energy solutions. The key impediments in the proliferation of solar energy were the high initial costs and low efficiency. The improved efficiency of electric appliances and solar cells would enhance their utilisation in generating power and reduce electricity consumption. India would benefit immensely from the revolution in solar power and could provide electricity in far off places. The availability of solar power would reduce power deficits in the peak summer time and, thus, improve productivity. Researchers and engineers should endeavour to make solar energy a cheaper and viable replacement for conventional sources of energy.

While it may take some time to build commercially viable solar powered aircraft, a solar powered UAV is not a distant goal. The arrival of the SI-2 is likely to result in aviation manufacturers reviewing their plans for development and induction of future aircraft and UAVs. The development of the solar powered aircraft, UAVs and envisaged employment of the solar powered UAVs in roles meant for satellites may force countries to review their procurement plans, doctrines and R&D efforts.

The success of the SI-2 indicates that there is enormous potential for the private sector to venture into the unknown area of R&D and succeed. The Indian government and private sector R&D organisations could take a clue

or two from the SI-2 team. They should keep in mind the key issues when they invest is such niche technologies. Solar powered aircraft and UAVs comprise an emerging field and India should include the development of solar powered UAVs in the overall development plan of UAVs.. The R&D sector in India needs to be nurtured and investment in the R&D sector needs to be enhanced to 2 percent of the GDP. R&D culture can be improved in India by involving universities and the private sector as well as by improving the functioning, transparency and accountability of the R&D organisations of the government. The government should provide the right environment and incentives to encourage innovations/ inventions.

THE EMERGENCE OF THE ASIAN DEFENCE INDUSTRY: ARE CHINA AND JAPAN GOING TO FACE A WAR IN THE 'BUSINESS OF WAR'

PRERNA GANDHI

INTRODUCTION

East Asia is a region of contradictions. While it contributes an equal share to world Gross Domestic Product (GDP) as North America, it is also home to four flashpoints: the Taiwan Straits, Korean Peninsula, East China Sea and South China Sea. Countries in the region are bound to each other by economic linkages through trade and production networks, which have led the region to have a joint stake in its shared prosperity. However, increasing economic interdependence, while being a deterrent for conflict, falls short of becoming a cause for peace. Inability to resolve the historical legacies and boundary disputes, the competition for resources, the rise of China, the US pivot to Asia, the unstable regime of North Korea and the changing Japanese security identity are some of the multifarious security problems for the region. This constant clash of strategic aspirations to dominate the region ensures that military instruments will play a critical role in Asia.

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The East China Sea conflict has become an excuse for both countries to pursue military growth as China and Japan emphasise the other as a viable threat to their security.

Increasing national assets brought forth with increasing economic activity, have led countries in the region to seek to protect their assets and resources by increasing their military capabilities. This has led to higher military expenditures which are spent largely on military modernisation.

The long standing conflict between Japan and China over islands in the East China Sea known as the Senkaku Islands in Japan and Diaoyu Islands in China, has been deteriorating since the 2010s. Massive anti-Japanese protests in China threaten to undermine the mutually-beneficial Sino-Japanese economic interdependencies that have built up with time. China's temporary embargo on rare earth minerals in 2010 that formed vital Japanese imports made it evident to Tokyo that Beijing would not hesitate to use economic sanctions to attain its political objectives. Further, large scale military escalation in the East China Sea has led to scrambling of fighter jets, locking of radars and an undue display of Chinese and Japanese naval warships which only precipitated the existing suspicions rather than calming the tensions. Historical legacies that were negotiated in the 1980s and early 1990s to pursue economic development are now viewed as irreconcilable factors in the bilateral relations. The East China Sea conflict has become an excuse for both countries to pursue military growth as China and Japan emphasise the other as a viable threat to their security. In this paper, we will aim to examine whether China, which is rapidly becoming a major arms exporter, and Japan, that seeks to relax the ban on arms exports and enter the global defence market, will face a war in this global industry of the 'business of war".

MILITARY MODERNISATION AND NEED FOR INDIGENOUS DEFENCE INDUSTRY

Military modernisation is defined as the relevant upgrade or improvement of existing military capabilities through the acquisition of new imported or indigenously developed weapon systems and

supporting assets, the incorporation of new doctrines, the creation of new organisational structures, and the institutionalisation of new manpower management and combat training programmes.[1] However, procurement of weapons and equipment occupies a central share in military modernisation and, consequently, the defence budgets of most countries. Defence acquisitions involve both domestic and foreign firms capable of meeting the necessary military requirements. While purchases from foreign companies are seen as a means of bringing in higher-end technology, they are also a drain on a country's hard-earned foreign exchange reserves. Large-scale foreign purchases also raise issues of safeguarding of national assets and security secrets. However, one of the most critical questions concerns security of supply. Without a ready source of domestic supply, countries have no reliable source of arms to defend themselves in a scenario of conflict and the most secure source is usually a domestic one. Consequently, achieving a certain degree of self-reliance in arms procurement becomes a key strategic goal. Adding to this aspiration for self-reliant defence is the fear that depending too heavily on imported weaponry risks exposing a country to arms embargoes, cut-offs and other types of supplier restraint, thus, weakening a nation's military capabilities and undermining its national security[2].

While purchases from foreign companies are seen as a means of bringing in higher-end technology, they are also a drain on a country's hard-earned foreign exchange reserves.

Therefore, reducing one's reliance on foreign sources of arms is a crucial military objective as well as a means of securing the sovereignty and legitimacy of one's political institutions. Another strategic rationale driving defence industrialisation, especially among developing nations, is the more intangible aspiration of national pride and prestige. Possessing an

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1. Ashley J. Tellis and Michael Wills, eds., *Strategic Asia 2005-06: Military Modernization in an Era of Uncertainty* (Canada: National Bureau of Asian Research, 2005), p. 15.
2. Richard A. Bitzinger, "Revisiting Armaments Production in **Southeast** Asia: New Dreams, Same Challenges", *Contemporary Southeast Asia: A Journal of International & Strategic Affairs,* vol. 35, issue 3, December 2013, pp. 369-394.

independent defence industrial capability feeds directly into many states' concepts of national power — not only by creating military power but also by demonstrating its industrial and technological prowess, and thereby confirming its status as a nation to be reckoned with. "Techno-nationalism" or the idea of acquiring technology forming the basis of nationalism has also become one of the means of achieving self-reliance in arms procurement. A robust indigenous defence industry such as in the case of Singapore is also seen as an important compensation by a smaller country to hedge its size and vulnerability with regard to its larger neighbours[3]. If strategic concerns are paramount to achieving self-reliance in defence procurement, economics is generally the other concern. Development in a country's defence industry can spur development in other industries, as the experience of the developed nations has shown.

Firstly, defence industrialisation promotes backward linkages spurring the development, expansion, and modernisation of other manufacturing sectors in the national economy such as steel, machine tools, and shipbuilding, as well as building up general skills and know-how of the human capital. All this industrial development, in turn, provides lead-in support, equipment and personnel for the production of armaments. The construction of warships, for example, can stimulate the establishment of indigenous shipbuilding industries, while production of military vehicles requires steel mills and automotive factories to provide critical parts and components such as armour plating, chassis, and engines, as well as skilled labour to assemble these vehicles. Domestic production of armaments at times also serves as a "technology locomotive," spurring the growth of new industries and new technologies, particularly in the higher-technology arenas such as aerospace, electronics and information technology sectors. Creation of these new strategic industries raises the country's level of technical expertise, manpower skills and industrial infrastructure. Military aerospace programmes, for example, often constitute the basis for civil aircraft production. Indigenous arms production also helps to create jobs

3. Ibid.

by generating much needed employment opportunities required by all countries.[4]

The recent rise in military expenditures in the East Asian region has permitted an increase in weapon acquisitions and, by extension, enabled the potential growth of local defence manufacturing. A major factor to note is the increasing emphasis on offset requirements in arms purchases as a means of gaining new technologies and human capital skills to support more advanced armaments production. Offsets are mutually beneficial arrangements whereby the supplier, as an incentive to the buyer, offers to transfer to it certain industrial or technological goods. From the early 1970s when 15 countries had offset requirements, presently around 120-130 countries demand offset clauses.[5] Offsets usually include the local licensed production of the weapon systems being acquired, training and other types of skills-building, technology transfers, sub-contracts, or Foreign Direct Investment (FDI) into the purchasing country's defence industry. In recent, years, the developing countries, to leapfrog and gain access to higher-rung technologies, have been increasingly demanding more (and larger) offsets in arms deals, and using those offsets to modernise and reinvigorate their defence sectors. The end aim for these countries, after satisfying the domestic need, is to enable the defence industry to become a major source of exports and, consequently, a strong earner of foreign exchange reserves.

WORLD DEFENCE MARKET OUTLOOK

There are five main factors that appear to be affecting the global defence industry today: the hierarchical nature of the global process of armaments production, the impact of military spending upon the defence industry, the effects of the international arms trade, the process of defence-industrial globalisation, and the emerging information technologies-based Revolution

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4. Ibid.
5. Laxman Kumar Behera, "Arms Trade Offset: Global Trend and 'Best Practices", in Vinod Misra, ed., *Core Concerns in Indian Defence and the Imperatives for Reforms* (Pune: Pentagon Press, 2015), p. 289.

To deal with cyber threats, countries are now putting new command structures in place and promulgating policies on allowing the military Services to operate in cyber space.

in Military Affairs (RMA).[6] The growing international discourse on arms controls and export regulations along with restrictions on international collaboration on defence projects [barring major programmes such as the F-35 Joint Strike Fighter (JSF)] to keep technologies in-house, reduce access to both funds and technology for any path-breaking defence projects. Countries now emphasise newer approaches to security and aim for networked force structures that are both multi-usage and mobile. For example, counter-terrorism forces now look to police-based and intelligence-based approaches to remain a step ahead of the various terrorist groups. To deal with cyber threats, countries are now putting new command structures in place and promulgating policies on allowing the military Services to operate in cyber space. The rise of 'non-state' actors has created a flourishing black market for arms and other weapons.

In *Defence Outlook 2015: A Global Survey of Defence-Industry Executives* (published by McKinsey & Company), there is a general consensus that the global defence industry will see a decline of about 5-20 percent. On the question of new players emerging, industry executives from the West have stated that the expectation of a new competitive global player emerging is minimal. With regard to companies in emerging markets, the executives have stated that many of these defence firms would continue to function as low-cost manufacturers or suppliers. In the three-tier hierarchy of defence suppliers, as put forth by Keith Krauss—critical innovators; adaptors and modifiers and copiers and reproducers—mostly newly emerging firms are expected to remain at the third tier.[7] However, most Western executives agree that if any of these companies manage to emerge as global players, it

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6. Richard A. Bitzinger, "Introduction: Challenges Facing the Global Arms Industry in the 21st Century", in Richard A. Bitzinger, ed., *The Modern Defense Industry: Political, Economic and Technological Challenges* (Santa Barbara: Praeger Security International, 2009), p. 1.
7. Ibid., p. 2.

would have significant ramifications for the global defence industry.[8]

The McKinsey Report also states that the four sectors for most potential growth for defence companies are commercial aerospace, services, unmanned systems and cyber security. Further, of the 10 most lucrative defence markets, the **BRIC** (Brazil, Russia, India, China) countries rule the roost, with **India** at number one position, **Brazil** at number two, **Russia** at number six and **China** at number eight. All the four countries, despite being

From a macro-perspective, the top 50 nations spend 92 percent of global defence budgets, amounting to $1,636 billion of the world's total spending, on national defence.

large economies, face hostile security environments. India especially faces the threat of a two-front war scenario owing to the "all-weather friendship" between China and Pakistan. Other important countries listed are South Korea at number five and Pakistan at number nine. While Japan does not make it to the top 10, it comes in strong at number 13. From a macro-perspective, the top 50 nations spend 92 percent of global defence budgets, amounting to $1,636 billion of the world's total spending, on national defence. The top 50 produce more than 90 percent of global economic output, influence most of the world's defence activity, and shape the global security environment. Six of these nations generate 60 percent of global defence spending (the US, China, Russia, Saudi Arabia, Japan and France); 29 of the top 50 nations increased defence spending in real terms, while 21 of the top 50 reduced their defence outlays.[9]

Deloitte, to examine the top 50 countries from a macroeconomic perspective, segments countries by their respective levels of per capita and percentage of GDP allocated to defence. Each country is characterised as higher income or lower income based on whether its GDP per capita is above or below US $ 30,000. Each country is then further classified as "spender" or "economiser" based on whether its level of defence spending exceeds 3 percent. Of the four BRIC countries, barring Russia, which is a

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8.   http://www.mckinsey.com/insights/manufacturing/defense_outlook_2015.
9.   Ibid.

low-income spender, the other three are low income economisers. So while changing levels of economic growth allow lower income nations to increase defence investment, higher level income countries retrench.

Fig 1
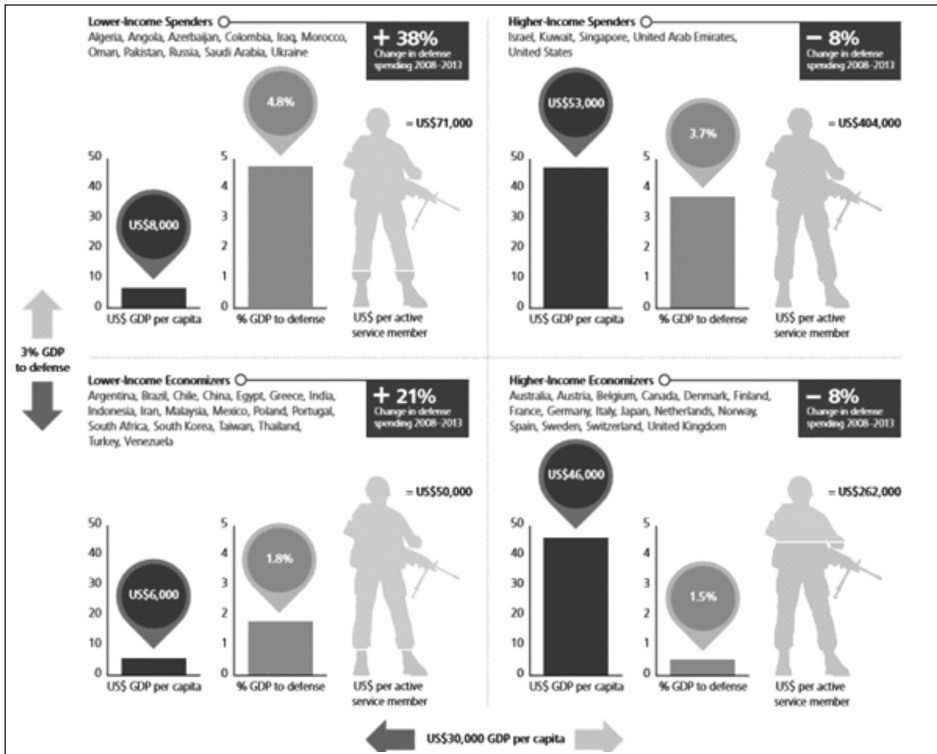
Source: Deloitte 2014 Global Defence Outlook

Of the 25 top 50 nations with the highest per capita income, all but four (Australia, Singapore, Kuwait and Japan) have signalled that defence spending will decline or remain flat over the next two to five years. But the 25 lowest income members of the top 50 are all increasing defence spending in the same period. Further, between 2006 and 2012, the number of global terrorist incidents per year tripled but declined substantially in the high income countries. And with the impending end of Operation Enduring Freedom (OEF) and subsequent withdrawal of forces, it is expected that

the defence expenditure of the Western countries—that form a major block of the higher income countries—would fall further. Also, cyber threats prompt a different approach to security, for, while the main targets of cyber attacks in low income countries are government targets, in the high income countries, they are industrial targets However, with the instability in Ukraine, defence acquisitions in the North Atlantic Treaty Organisation (NATO) countries have received an impetus. By 2015, China's defence budget is expected to exceed the total of France, Germany and the UK, and total defence spending of Russia and China is expected to exceed all of the European Union countries combined[10].

CHINESE DEFENCE INDUSTRY

Influencing Factors

With its increasing international political and economic profile, China has laid great emphasis on improving its military capabilities to secure its national interests. China has two main options to ensure its military modernisation: domestically produce all of the weapons needed to equip the country's military or purchase weapon systems and related components and technologies from the major military equipment producers of the world. However, China has combined these two approaches by attempting to improve design and manufacturing processes so as to produce better-quality weapons domestically while importing key systems to fill short-term needs. After largely pursuing the first path for much of the 1960s, 1970s, and part of the 1980s, China has, since the 1990s, been following the combined path— improving domestic production while purchasing advanced weapon systems from abroad, mostly from Russia and Israel. However, the large volume of Russian imports during the 1990s indicates that China's military was decidedly dissatisfied with the quality of products from its own defence industry. Therefore, developing a strong domestic base has become imperative since the late 1990s to develop real

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10. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Public-Sector/gx-ps-global-defense-outlook-2014.pdf

military options, especially in view of the changing balance of power in Asia[11].

China's military modernisation programme is shaped by two main drivers: *contextual* and *direct*. Contextual drivers include a range of external factors in China's national security that shape China's threat perceptions, strategic outlook, and contingency planning. Direct drivers include a range of financial, political, and technological factors more internal to China. Preventing Taiwan's independence (and concomitantly bringing about its "reunification" with the mainland) is one of China's main priorities and a strong contextual driver for the People's Liberation Army's (PLA's) defence procurements, deployments and training. The second contextual driver is China's desire to become a global power. But with the exception of possessing Inter-Continental Ballistic Missiles (ICBMs), China has no global military capabilities. A third contextual driver of PLA modernisation is the regional security environment that China faces. The strong US presence in almost all China's regional systems has had a major impact on China's security calculus. Another factor that impinges on China's military modernisation programme is its increased demand for energy for which it is the Chinese military that has to shoulder the responsibility to ensure a regular supply of energy imports into China. Further, potential instabilities around China's periphery strongly influence the PLA's thinking and, subsequently, the military's modernisation programme.[12]

While contingencies, particularly regarding Taiwan and the United States, do drive budgets, deployments, and allocation of resources, they are more in the realm of what the PLA requires rather than what it gets. What the PLA gets is influenced by more direct drivers such as sanctioned funds, technology available, political climate and military doctrine. In all modern militaries, training regimens, financial allocations, weapons procurement decisions and a broad range of other considerations are determined by the operational doctrine. In the case of the PLA, the contemporary doctrine is designed to prepare the military force to

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11. "A New Direction for China's Defense Industry", RAND Corporation, 2005.
12. Tellis and Wills, eds., n.1, p.84.

fight and win what China terms a "limited war under high technology and information conditions." Since its inception, the PLA doctrine has evolved through five principal stages: People's War (1935-79), People's War under Modern Conditions (1979-85), Limited War (1985-91), Limited War under High Technology Conditions (1991-2004), and Limited War under High-Technology and Information Conditions (2005-). Since the mid-2000s, China has speeded up "informationalization" of its military forces and has thereby accelerated the modernisation of weaponry and equipment.[13]

China's defence industry faced tumultuous times from the late 1970s till the recent times when Deng Xiaoping initiated reform of China's planned economy. Government procurement of military goods declined dramatically following the adoption of Deng's "Four Modernizations" policy—agriculture, industry, science and technology and national defence—which placed the military as the last priority. This led to most defence enterprises diversifying into production of non-military/civilian goods (defence conversion or *junzhuanmin*) which was a largely troubled process for most Chinese firms. Weapon producers found it difficult to shift to producing goods that could be profitably sold on emerging domestic markets. Military goods producers were also hampered by legal constraints and difficulties in attracting foreign partners who could provide new capital, know-how, and technologies. Firms also lacked the managerial flexibility to replicate the successes of the new Chinese companies that emerged during the reform period. These problems were further exacerbated by the general weaknesses of China's state-owned enterprises in absorbing new technologies and management practices, and in developing the technical skills of the labour force.[14]

The Chinese government's commitment to self-reliance in military equipment production also hindered the ability of these enterprises to successfully sell to non-defence markets, because factories had to remain capable of producing a full range of components and equipment for military

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13. Ibid.
14. n. 11.

production, forestalling specialisation, and quality and technological sophistication. Chinese arms sales peaked in 1987 at over $1 billion. Chinese exporters, however, lost large export markets after the very poor performance of Chinese weapons in Iraq's hands during the 1991 Gulf War. This was followed by a period of heavy influx of technologically superior and relatively inexpensive Russian weapons. In the early 1990s, Chinese officials began inviting foreign investment in the defence-industrial sector. In 2001, the Chinese government adopted the "going out" strategy that encouraged offshore investment by Chinese firms. The Chinese efforts to extensively engage with offshore high-technology industry demonstrated the importance attached to high-technology industry. However, globalisation was still a one-way process, as evident from the 2007 "shareholding reforms" announced by the Commission of Science, Technology and Industry for National Defence (COSTIND) that permitted direct investment only under certain conditions.

While the Chinese authorities were prepared to accept foreign assistance in the form of technological inputs, they were extremely wary of arrangements that had the potential to place China in a dependent relationship. China completely eschewed long-term defence-industrial relationships after the Sino-Soviet split, in favour of reverse engineering and other forms of illicit technology transfer such as espionage of foreign designs. China began with producing Soviet systems under licence; it later shifted to reverse engineering before producing derivatives of foreign designs and ultimately advanced indigenous designs such as the J-10. However, the need for defence-industrial autonomy discouraged ambitious Research and Development (R&D) and production programmes, and led China to set a technological bar lower than in the Soviet Union. The subordination of economic to strategic considerations was further demonstrated by the extent to which China was prepared to go to preserve its defence-industrial capabilities in the event of a conflict. The "Third Front" initiative which was pursued from the late 1960s through to the late 1970s, saw the geographical dispersal of defence-related production

and R&D facilities to remote areas of central China at great cost, for reducing their vulnerability to attack.[15]

Structure and Sales

China's numerous military industries are all owned primarily by 10 large state owned companies. These top 10 defence groups, with estimated combined assets of Yuan 2 trillion ($315 billion) have listed more than 70 subsidiaries, including over 40 with defence related businesses. These companies cover all segments and conduct most of the defence research and development. These companies are listed below.[16]

- China Aviation Industry Corporation (AVIC)—makes aircraft for civilian and military uses, including bombers and fighter jets.
- China Aerospace Science and Technology Corp (CASTC)—the major contractor for China's space programme.
- China Aerospace Science and Industry Corporation (CASIC)—mainly engaged in the research and development of missiles.
- China North Industries Group Corp (NORINCO)—focusses on research and development of weapons and equipment for the land forces.
- China South Industries Group Corp (CSIGC)—makes weapons and equipment for the land forces, as well as civilian products ranging from motorcycles to special steel.
- China Electronics Technology Group Corp (CETGC)—specialises in research, development and production of large-scale electronic systems and software.
- China Shipbuilding Industry Corporation (CSIC)—manufactures civilian and military ships and offshore equipment, including submarines and missile destroyers in the northern China shipyards.
- China State Shipbuilding Corporation (CSSC)—manufactures civilian and military ships and offshore equipment, including submarines and

15. J.D. Kenneth Boutin, "Arms and Autonomy: The Limits of China's Defense Industrial Transformation" in Bitzinger, ed., n. 6.
16. http://www.sify.com/finance/china-s-top-10-defence-companies-imagegallery-1-others-mjrsA7fjahfsi.html

China's military spending more than quadrupled in real terms between 2000 and 2012, and the country has engaged in major efforts to develop its domestic arms industry.

missile destroyers in the eastern and southern China shipyards.

• China National Nuclear Corporation (CNNC)—China's major nuclear power investor and producer; also involved in research of nuclear weapon technology.

• China Nuclear Engineering Group Corp (CNEGC)—China's main construction contractor for its civilian and military nuclear projects.

Chinese companies are not covered by the Stockholm International Peace Research Institute (SIPRI) top 100 due to lack of data on which to make a reasonable estimate of arms sales for most companies. However, according to the information provided by their financial reports, the 10 large Chinese companies had total sales of around Yuan 1,477 billion ($233 billion) in 2011. These companies, each comprising hundreds of individual enterprises, produce a wide range of products, of which military products represent a minority of total sales. The military share is not generally known on a company-by-company level, although for the whole industry, it was estimated as 26 percent in 2006 and 25 percent in 2007. Based on the overall industry picture and on limited information on individual companies, it is nonetheless possible to state that at least 9 of these 10 companies would almost certainly be in the SIPRI top 100 if figures for arms sales were available. Of these, 4-6 would probably be in the top 20, and one company, the aviation company AVIC, may rank in the top 10.

China's military spending more than quadrupled in real terms between 2000 and 2012, and the country has engaged in major efforts to develop its domestic arms industry. As a result, China has, since the late 2000s, been decreasing its arms imports in favour of procurement from the Chinese industry. In addition, China's arms exports have grown substantially in the past decade, to the extent that the country was the fourth largest arms

exporter in 2009-13.[17] The top level decision-making body for the Chinese military industry comprises the State Council and Central Military Commission (CMC). The State Council is the highest "executive organ" of state administration. The CMC exercises direct unified command of the PLA. All decisions to launch major projects as well as directives on rules and regulations for the defence industry are issued jointly by the State Council and CMC. Any large arms export contract also requires the approval of both the State Council and the CMC.

While substantial growth has been made by China's defence companies with the reorganisation and streamlining launched in the 1990s, inherent deficiencies remain.

The State Council is also responsible for organisations involved in the economic and technical aspects of China's military industry policies.

These organisations include the state owned Assets Supervision and Administration Commission (SASAC) and the State Administration for Science and Technology and Industry for National Defence (SASTIND). The CMC controls the PLA's General Armaments Department (GAD) which projects the requirements for new weapons, specifies operational requirements, and tests the armaments produced. In 2007, Beijing issued guidelines aimed at encouraging private investment in a sector traditionally sheltered from competition and public scrutiny. Beijing has made repeated calls to speed up listings of all but the most sensitive military businesses. About 25 per cent of the assets of the top 10 are now held in the listed companies, according to market analysts.[18] While substantial growth has been made by China's defence companies with the reorganisation and streamlining launched in the 1990s, inherent deficiencies remain. Also, one has to take into consideration the fact that China has yet to make great forays in the global defence market as more than 50 percent of the sales of jet fighters, warships and tanks go to its ally, Pakistan.

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17. *SIPRI Yearbook 2014: Armaments, Disarmament and International Security.*
18. http://www.reuters.com/article/2012/09/16/us-china-defence-idUSBRE88F0GM20120916

JAPANESE DEFENCE INDUSTRY

Influencing Factors

In its *Diplomatic Bluebook 2014*, Japan describes its surrounding security environment as becoming "increasingly severe" due to a significant change taking place in the balance of power among nations. With the relative decline of US influence in recent times, Japan has been in a dilemma on how to reinvigorate and support the US' extended deterrence in the region. In recent years, the range of activities of the Japanese Self-Defence Forces (SDF) has been constantly expanding. From participation in international peace-keeping activities, to their active role in disaster relief post-2011 Tohoku earthquake, the late 2000s saw an increasing public acceptance for the presence of the SDF. Shinzo Abe, the first post-war born prime minister in Japan, with his strong nationalist leanings, had been a major influencer in enlarging the mandate of the SDF. After his resounding victory in the 2012 and again in the 2014 elections, Abe has provided a thrust for bolstering the Japanese SDF with numerous legislations.

Due to constitutional restrictions, Japan cannot maintain offensive war material. Yet, it currently maintains the Japan Ground Self-Defence Force (JGSDF) that numbers approximately 160,000 troops with a large number of technically superior tanks, personnel carriers, mechanised artillery hardware, avionics and missiles most which are supplied by the United States. The Japan Maritime Self-Defence Force (JMSDF) numbers some 45,000 members and controls advanced submarines, warships, combat aircraft and armed helicopters, and a variety of smaller combat or support vessels. The Japan Air Self-Defence Force (JASDF) features a force of some 47,000 personnel.[19] They control approximately 12 fighter squadrons and utilise about 400 combat aircraft in addition to roughly 300 interceptors.[20] The Japanese defence industry has an important role to play in the entire lifecycle of the SDF defence equipment, from its manufacture to maintenance. Since

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19. Brahmand World Defence Update 2015 (Pentagon Press).
20. Michael A. Panton, "Politics, Practice and Pacifism: Revising Article 9 of the Japanese Constitution," *Asian-Pacific Law & Policy Journal*, vol. 11, no. 2, p. 178.

Japan's defence budget is minimal compared to those of its neighbours, especially China, the austerity has forced the Japanese defence industry to become more efficient to survive, as military Services cannot bear the cost premium required to subsidise inefficient domestic production.

However, despite constitutional restrictions, Japan's inherent technological capabilities have always enhanced its deterrent capabilities and diplomatic negotiating power to inhibit aggressive action by other countries, ensuring national sovereignty without dependence on other countries. With a more capable indigenous defence technology base, Japan has the potential to reduce its reliance on imports of defence products as indigenously developed technologies can be tailored to Japan's specific needs. This has the added benefit of increasing economic activity at higher levels of the value chain, including design and R&D. Since defence technology can often be applied to the electronics, computing, or commercial aerospace industries, Japan's edge in robotics can be multiplied by leveraging technology and processes developed in the defence industry. Despite progress and optimism, there are limitations and obstacles that may hinder growth and reform in Japan's aerospace and defence industry. The nation has several economic priorities which may compete with the indigenous defence industry, such as social welfare and health care spending for the elderly population, priorities on other areas of growth stimulus as well as payments on outstanding debt.

In the years following World War II, Japan's military industries were totally shut down during a period of internationally rapid development, particularly in the case of the aircraft industry. Japan's defence industry was kept in quasi-isolation by its own government, with a ban on arms exports in keeping with the "Three Principles" formulated at the 1967 Diet session. The Three Principles prohibited exports to Communist bloc countries, countries subject to "arms" exports embargo under the United Nations Security Council's resolutions, and countries involved, or likely to be involved, in international conflicts. In February 1976, the Government of Japan announced the collateral policy guidelines at the Diet session that "arms" exports to other areas not included in the Three Principles would also

be restrained in conformity with Japan's position as a peace-loving nation.[21] However, despite the isolation, the domestic defence industry transformed into a dominant player in design and manufacture of defence components. Japan began as a supplier of defence components and later began to build and produce various indigenous aircraft ranging from the C-1 and PS-1 to the more recent P-1 and F-2. Though Japanese industry went on to make great progress, building components for the most advanced civilian aircraft such as Boeing 767s/777s/787s and co-producing advanced military aircraft such as the Lockheed P3Cs and F-15s, it has been handicapped by restrictions placed on exports of military technology or products.

On December 27, 2011, the Japanese government officially announced easing of the ban, allowing Japanese defence contractors to take part in the joint development of weapons with other countries (and not only the US) and to supply military equipment for humanitarian purposes. Although Japan is the world's sixth biggest military spender, it often pays more than double what other nations pay for the same equipment because local export restricted manufacturers can only fill small orders at a high cost. Given the fiscal restraints, Tokyo is, therefore, keen to make its defence programme more efficient to maintain its military capability in the face of China's rise and growing uncertainties in the region. A 2012 report entitled, "Towards Formulation of a Strategy for Survival" released by the Ministry of Defence' Defence Production and Technology Base Research Committee, after a six months study, noted that Japan is suffering from what is often labelled as the **Galapagos syndrome of isolation**[22] from global markets after half a century of ban on weapons exports.[23] However, inability to resolve its historical legacies has led Japan to constantly reiterate its pacifist stand by prohibiting manufacture and export of complete weapon systems.

21. "Japan's Policies on the Control of Arms Exports", Ministry of Foreign Affairs, at http://www.mofa.go.jp/policy/un/disarmament/policy/.
22. Galápagos syndrome is a term of Japanese origin, which refers to an isolated development branch of a globally available product. The term is a reference to similar phenomena Charles Darwin encountered in the Galápagos Islands, with its isolated flora and fauna, which were key observations in the development of the Evolutionary Theory.
23. "Japan Strives to Overcome Industrial Base Crisis", *Defense News*, June 24, 2012 at http://www.defensenews.com/article/20120624/DEFREG03/306240003/Japan-Strives-Overcome-DefenseIndustrial-Base-8216-Crisis-8217 .

The issue of urgency is that Japan, with its numerous legislative constraints, must ensure that the domestic defence industry remains dynamic as its collapse in the face of international competition may lead the country to lose much-needed autonomy in defence production or at least breakout capability for autonomy and, thus, strategic leverage on the US and any independence left in the destiny of its own security policy. On April 1, 2014, the Government of Japan, in accordance with the National Security Strategy adopted on December 17, 2013, set out the "Three Principles of Transfer of Defence Equipment and Technology" as a set of new principles on overseas transfer of defence equipment and technology, which replaced the "Three Principles on Arms Exports and Their Related Policy Guidelines". According to the new principles, an appropriate overseas transfer of defence equipment and technology contributes to "active promotion of the maintenance of international peace and security through timely and effective implementation of contribution to peace and international cooperation…. to strengthening security and defence cooperation with the United States as well as other countries[24]." The new principles lay out that the Japanese government will make a comprehensive judgment in the light of the existing guidelines of the international export control regime and, based on the information available, will analyse the extent to which the overseas transfer of such equipment and technology will raise concerns for Japan's security.

As acknowledged by Japan's aerospace trade association, "When compared with the automobile, home electric, computer and other industries in Japan, the aerospace industry is relatively small. Much is expected of Japanese producers over the coming years".[25] Like Europe, Japan faces a dilemma where aerospace is concerned. The status of possessing a key, high-technology industry – and one with military applications – pushes states to cultivate sector-specific policies in the hope that domestic firms can reap the rewards. Yet the cost and

24. "Three Principles on Transfer of Defence Equipment and Technology", http://www.mofa.go.jp/files/000034953.pdf .
25. Steven McGuire, "The United States, Japan and the Aerospace Industry: From Capture to Competitor?" *Pacific Review*, vol. 20, issue 3, September 2007, pp. 329-350.

complexity of modern aircraft push the industry in the direction of global production structures where components are bought from around the world with a network of partner firms. Europe and Japan have struggled to develop policies that advance national ambitions for aerospace without antagonising the key American market – and its government. Japan, unlike Europe, has chosen to cooperate closely, being a primary contractor/ supplier to both American and European firms.

Structure and Sales

The Japanese defence industry is primarily a consortium of privately-owned group of companies, with defence and aerospace occupying a significant portion of the business. Japan accounts for 17 percent of the Asia-Pacific aerospace and defence sector value. Mitsubishi Heavy Industries (MHI) is the leading player in the Japanese aerospace and defence sector, generating a 22.8 percent share of the sector's value. Some of the other defence companies in Japan are Fuji Heavy Industries (FHI), Kawasaki Heavy Industries (KHI), Sumitomo Heavy Industries (SHI), NEC, ShinMaywa, and IHI, with defence leading to as much as 20 percent of total revenue of the group's business. Boeing has counted on Japanese manufacturers to produce parts for its aircraft, with Japanese companies making 35 percent of the 787 Dreamliner and 21 percent of the 777's wide body jets. For the Boeing 777, MHI, KHI, FHI, ShinMaywa and Nippi Corp. will hold a 21 percent work share to include fuselage sections, passenger entry doors, landing gear wheel wells and cargo doors, and their total work share will comprise 21 percent of the 777's structures. MHI, FHI and ShinMaywa are also involved in Airbus' A380 programme. Japanese engine manufacturers such as IHI are partners in the programmes of GE's GE90 and Rolls-Royce's Trent, while KHI is involved in Rolls-Royce's Trent and Pratt & Whitney's (P&W's) PW400, and MHI is also involved in partnership with P&W concerning the PW 400.

To stay within constitutional restrictions, Japanese firms have promoted a new trend towards disaggregation of product or platform technologies into more discrete components that can be applied to both commercial and

defence-oriented purposes. Following the Japanese philosophy of "spin on" with increased levels of R&D spending by industry, even Western companies are now actively looking for opportunities to apply commercially developed technology to military systems, rather than the other way round. Emphasis has begun to be placed on systems integration: the ability to integrate many different technologies (of commercial and/or defence origin) into a new, more advanced defence system. Further, with increasing globalisation and massive advancement of the Information Technology (IT) sector, the giant, autonomous firms that once contained the entire vertical production chain are now being transformed into horizontally integrated and modular enterprises that focus on one or selected parts of the production chain. In this sense, the technology itself is dual-use, regardless of a user's intent.

The Japanese aerospace and defence industry has undergone a revival from virtual stagnation in 2010 to double digit growth in 2013. The market is predicted to stabilise and post strong growth towards 2018. The Japanese aerospace and defence market had total revenues of $45.3 billion in 2013, representing a Compound Annual Growth Rate (CAGR) of 4.9 percent between 2009 and 2013. In comparison, the Chinese and Indian markets grew with CAGRs of 9.2 percent and 9.8 percent respectively, over the same period, to reach the respective values of $127.7 billion and $24.3 billion in 2013. The defence segment was the market's most lucrative in 2013, with total revenues of $26.3 billion, equivalent to 58 percent of the market's overall value. The civil aerospace segment contributed revenues of $19 billion in 2013, equating to 42 percent of the market's aggregate value. The performance of the market is forecast to accelerate, with an anticipated CAGR of 7.7 percent for the five-year period 2013-18, which is expected to drive the market to a value of $65.5 billion by the end of 2018.[26]

COMPETITION, OR NOT?

Barack Obama's shifting the American military and diplomatic pivot to the Asia-Pacific puts the two regional neighbours, China and Japan, more sharply into the international spotlight. The fact that after World

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26. Market Line Industry Profile, "Aerospace & Defense in Japan", April 2014.

War II, Japan was engaged in a security alliance with the United States diminished Beijing's fears that, at least in the short to intermediate term, Japan might reassert its World War II era disposition toward militarism. However, Beijing now views the same alliance (and efforts to upgrade it) as the US' and Japan's joint efforts to counter China's military power. Historical legacies that were negotiated in the 1980s and early 1990s to pursue economic development are now viewed as irreconcilable factors in the bilateral relations. The East China Sea conflict has become an excuse for both countries to pursue military growth as China and Japan emphasise the other as viable threats to their security. Though in the **guns versus butter** debate, **butter** (utilising available resources for the production of civilian goods) will retain a strong priority for both countries, as in East Asia, governments primarily derive legitimacy from economic growth rates. However, to enhance their military capabilities in view of their rising threat perceptions, both countries will devote a relatively larger share to **guns** (utilising available resources for the production of military goods) to develop a robust indigenous defence base.

If one looks at the case of the developed nations, they developed sophisticated weapons and other equipment from the capability of their indigenous defence base. Be it the US or erstwhile USSR/ present day Russian Federation, their existing military capabilities can be traced to the strength of their domestic defence companies. And it this strength that, consequently, deters enemies from any aggressive course of action. While export of strategic technologies is kept under restrictions by national governments, it is the irony of the defence industry that to sustain itself and be constantly innovating, it has to be export-oriented. While technology denied is technology gained, exports create the requisite orders (in addition to demand by the national military) that make production of expensive weapons financially viable. Exports also result in valuable feedback from the purchasing countries as to how to improve the existing weapon systems to better achieve their purpose. **It is, hence, a causal nexus that while defence companies play a very important contribution in the national security of a country, they are commercial ventures.**

And unless they are commercially viable, the national security of that country will always be fragile.

China has been an older player than Japan on the global defence market. Japan, on the other hand, despite being a very late entrant, has potential technological capabilities such as its edge in ICT (Information and Communications Technology) that can translate into competitive defence products. This does pose a very credible threat to China. Aerospace is considered the most profitable segment of the defence market and involves leading edge technologies. Both countries seek to become strong aerospace players. Maritime power is seen as the deciding factor in a country's transition to global power status; however, recently, aerospace power with its ability to affect immediate strategic results and lower casualty rates has begun to receive greater prominence in militaries around the world. While China still relies on Russian technologies for development of domestic aircraft, Japanese aircraft manufacturers are taking part in sub-assembly and/ or manufacture of components of various models of US and European aircraft mainframes, including Boeing and Airbus, as contractors.

In the present day, exchange of defence technologies forms a critical component of bilateral or multilateral strategic relations. Exporting defence technologies to another country is seen as a signalling and reiteration of the receiving country's strategic value to the exporting country. Further, exports of weapons and other defence equipment also lead to uniformity in procedures and systems between partner countries and alliance coalitions. However, the high prices of Japanese technologies and goods being manufactured by Japan, and the suspicions of its neighbours about its re-militarisation—as also its constitutional restrictions—prevent Japan from manufacturing offensive military hardware. Instead, Japanese defence companies now focus their export efforts on parts, including sensors and advanced building materials.[27] Exporting under the category of dual-use technologies allows Japan dual benefits of remaining within its

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27. http://www.wsj.com/articles/japans-military-contractors-make-push-in-weapons-exports-1405879822

constitutional limitations and being a credible partner to its allies. China, on the other hand, has products in all ranges and categories on the global defence market. With its lower prices, China exports to 35 mainly low- and middle-income countries, with Pakistan accounting for more than 55 percent of its defence sales.

There is an inherent dichotomy in supply-demand relations in the defence industry. On the supply side, the companies want to manufacture systems with the highest possible performance that, in turn, leads to spiralling costs and interminable deadlines. On the demand side, countries that are the main buyers, want affordable systems and prefer to purchase from the lowest bidder. In this kind of challenging scenario, more than what the Chinese and Japanese defence companies will manufacture, it is how they place themselves and their products in the global defence market that will make the difference. On the whole, while the countries do not find themselves in direct competition, the dynamics of power rivalry, coupled with historical animosities, lend an edge of uncertainty to the question of whether China and Japan will face a war in the 'business of war.'

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