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About the Author

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Different Strategic Intent

The unprecedented rise of two Asian giants since the 1990s has become a major subject of academic discourse in contemporary international relations. China and India both launched economic reforms, the former in the late 1970s and the latter in the early 1990s; both witnessed high growth rates of 8-10 percent and 6-8 percent respectively. While both countries have registered high GDP growth, China maintains an edge over India in foreign trade, investment, foreign currency reserves, manufacturing, and aerospace and defence industry, while India has a sizeable advantage in the services sector.

The emergence of China and India as major regional powers raises hope that the two could help shape the future international system and contribute differently towards Asia's development and harmony. This is in contrast to balance of power politics, which has dominated the discourse in the last few decades. While great opportunities exist in many areas for both Beijing and New Delhi to seek and strengthen bilateral cooperation given shared interest and priorities, competition and great power ambitions burdened by historical legacies rooted in territorial disputes largely offset hope for peace and tranquillity. The lack of trust and mutual suspicion amidst a tense strategic landscape defined by America's 'pivot' to Asia is further driving both countries apart, at the cost of peaceful development.

There have been many positive developments in Sino-Indian relations over the past decade. Both nations have witnessed summit-level meetings, held joint military exercises and seen a significant increase in the volume of trade. Sino-India trade in 1987 was worth a mere $117 million, but an improved political environment and positive interactions have resulted in exponential growth of bilateral trade which could touch $100 billion by 2015. The current year has seen China emerge as India's largest trade partner. The two countries have been communicating through strategic dialogues and both refer to their relationship as a 'strategic and cooperative partnership for peace and prosperity,' founded on the basis of the enigmatic concept of 'Asian harmony.' The relationship could be further strengthened by reducing the prevailing trust and trade deficit, institutionalising mechanisms and confidence building measures through goodwill and by carrying forward the momentum generated by high-level visits from both sides. Placing trade and economic development as top priorities in their engagement with each other could help resolve existing complexities and pave the way for a mutually beneficial relationship in the future. However, issues revolving around China's arms transfers to Pakistan, the largest importer of Chinese weapons systems, and the recent border incursions by China like in Depsang and Burtse areas are becoming reasons for intractability, with Beijing shifting the focus of the discourse from *vikas vaad* (peaceful development) to creating unsustainable complications in Sino-Indian relations.

Trends in China's Aerospace and Defence Sector

The emergence of capitalism and the creation of markets in China is an example of institutional evolution shaped simultaneously by the central government, local government and enterprises. It is these organisational

changes and increased synergy between central and local authorities on the one hand and private entities on the other that have largely been responsible for transforming China's capabilities. While the private sector in China spearheaded the global supply chain network, logistics and the financial supply chain were powered by the state-owned enterprises, and the entire gamut supported by the institutional mechanisms of the government's supply chains at both the local and central level.[1]

The other reason that provided momentum to China's elevation to one of the top five exporters of conventional arms in the world was its readiness to adapt to the changing international business environment. The institution of the General Armament Department (GAD) in the People's Liberation Army (PLA) as a 'super agency' shifted the model of technology development from technology-push to demand-pull. The Commission of Science Technology Industry for National Defence was replaced by the State Administration for Science Technology Industry for National Defence to function as a regulator and a link between GAD and industry. The formulation of the Medium to Long Term Plan for Development of Science and Technology (MLP) and the focus in the 11th and 12th five year plans on the aviation industry, guided by Beijing's strict leadership, also helped China become one of the top arms exporters in the world.

China's vibrant and high-technology aviation sector is thriving as a mainstay strategic industry by embracing knowledge-intensive activity, innovation and skills despite being owned by the state. The world is witnessing a gradual but seamless transition of the Aviation Industry Corporation of China (AVIC) from a fundamentally low value-added technology industry to a high-valued innovation-fuelled industry in the

21st century. Changes in the organisational structure, accompanied by improved infrastructure and capabilities, have helped turn around a fledgling state-owned enterprise into a viable business model.

China's aviation industry has followed a dual approach to strategise and align itself with high-end technology. The short-term focus of AVIC has been to acquire foreign technology to address contemporary needs, while the long-term objective is to step up capabilities through indigenous research and development (R&D) and expand production capacity to enhance and diversify its existing export product line. The development of the J-31 jet fighter at Shenyang Aircraft Works, also referred to as Project 310, is an example of Beijing's efforts to diversify AVIC's existing export product line. The Chinese refer to this aircraft as 'Advanced Fighter Concept', similar to the US Joint Strike Fighter (JSF), being developed solely for the export programme and not intended to augment the PLA Air Force's force structure.[2] The intent of AVIC is to build capabilities and promote its existing export product line and, in the coming decade, to secure its position to develop a low-bypass engine. Until then, China will not hesitate to use the Chinese variants of Russian AL-31F, RD 93, Saturn 117S (engine that powers Su-35 and T-50) and D-30-KP2 aero engines even in their export product line.[3]

The Defence Industry – A Catalyst for Capacity Building

The purpose of this paper is not to uncover China's strategies for acquiring advanced military technology but to evaluate China's efficacy in adapting and absorbing technology, which could be further optimised and upgraded. China, over many decades, has excelled in the art of acquiring foreign technology in the short and medium term and upgrading the technology through internal R&D, infrastructure

development and manufacturing capabilities over the long run—a strategy not only founded around import substitution but also aimed at building a comparative advantage in the future. China has effectively capitalised on building alliances: both sanctioned ones, like with the Russians, and unsanctioned ones have proven to be sources of advanced technology. Beijing has made major inroads in upgrading its indigenous production capacity, which has become the cornerstone of China's modernisation strategy.

Events of the 1990s redefined China's stature in world politics. Despite three decades of hostility, Russia emerged as the principal supplier of advanced weapons to China mainly because of the eagerness of Rosoboronexport to revive Russia's cash-starved arms industry. The breakup of the Soviet Union, the end of the Cold War, and China's realignment with Russia as well as with erstwhile states of the Soviet Union—whose economy depended solely on the arms industry—characterised the emergence of China in the post-Cold War era. Beijing's entry into the World Trade Organisation was another game changer, resulting in China's integration with the world economy and access to dual-use technology. As a consequence, China's aviation industry started to roll back trade barriers by adopting a development strategy rooted in liberalisation, competition and cooperation. There was also a marked shift in focus from the earlier obsession over quantity to quality, and a swing from being imitators to innovators.[4]

The international threat environment in the 1990s forced Beijing to review its defence industrial strategy, with the leadership willing to walk the extra mile to guarantee China's security irrespective of cost. The Gulf War altered the country's outlook and China substantially increased defence allocation which started to register a year-on-year increase of 12

percent. In 1993, China's defence expenditure amounted to a meagre $6 billion, which in real terms was less than its allocation in 1979. However, in the post-Cold War era, China substantially increased defence expenditure to $15 billion (2000's figure), which further escalated to a whopping $132 billion in 2014[5]—the highest in Asia, second only to the US and amounting to almost six percent of the world's planned defence expenditure.[6] It has become apparent that China is aggressively trying to close existing gaps with developed economies by not only viewing defence as a means to guarantee security and ensuring sovereignty, but is also using the aviation industry as a catalyst for capacity building. Its defence economy has been propelled by a forward-thinking leadership which understands the relevance of science and technology (S&T) towards building a modern and innovative nation based on technological autarky.

In the course of developing its defence industrial capacity, China observed that the existing technology gap with developed nations was largely due to the lack of qualified human resources and limited capacity to absorb technology.[7] China's S&T vision document drafted a roadmap to enhance the quality of human resources by investing in research institutes and higher education facilities. China started diverting large amounts of public and private funds for defence R&D, employing over 400,000 personnel in R&D and 120,000 personnel in aviation-related R&D. Furthermore, increased allocation for education has resulted in an increase of natural-science engineers and PhD holders.

The business sector also played a key role in China's emergence as an innovation-oriented nation. China followed the dual-use technology route in order to develop S&T through various programmes like 863, 973, Xinghuo (integrating S&T and agriculture) and Huoju (high-tech

industrial development park), which resulted in spin-ins of major technology. It has also helped in rejuvenating the scientific culture, and China today appears to be on the cusp of a transformational change from a low value-added manufacturing economy into a high value-added innovation-driven economy.

The MLP for development of S&T 2006 has resulted in a surge of R&D institutes; S&T laboratories and defence enterprises have started developing partnerships with universities and foreign high-tech firms to establish technology incubators and undertake high-end R&D. China allocates one-third of its total defence outlay for procurements and R&D. Aggregate expenditure on defence R&D has increased to 13 percent of its defence outlay and 16 percent of global defence R&D.[8] An increase in the defence budget has helped the PLA expand acquisition of modern military equipment, and a boost in the R&D capabilities has facilitated development of indigenous programmes. China's allocation on R&D has increased to two percent of GDP and is further expected to rise to 2.5 percent by 2015. As a result, China has been able to develop a plethora of modern fourth-generation aircrafts, frigates, destroyers and a wide range of nuclear and conventionally powered submarines.

China has aggressively pursued an R&D strategy centred on streamlining leading business divisions within AVIC and Commercial Aircraft Corporation of China, Ltd. Beijing objectively restructured the industry to leverage advantage through competition at the lower tier in the component and sub-assembly supplier segment. These units, similar to strategic business units, are involved in design and development, such as manufacturing of guidance and control systems and development of propulsion systems—major areas which were previously starved of technology in China. The lower tier suppliers are becoming a source of

developing efficient technology business incubators by raising private capital to cover R&D costs. Some of these units operating under AVIC have made a mark in the fields of:[9]

- Telemetry
- Micro-electronics
- High performance digital signal processors
- Field programmable gate arrays required for high speed long range precision strike
- Propulsion system

The other reason China increased its range of capabilities was because it was able to create a pool of experts from the industry, academia and civil universities under the aegis of GAD's S&T committee. The group was responsible for designing a blueprint to achieve technological breakthroughs that could then be applied in force modernisation programmes. Through this institutional set-up, technology push was replaced by demand-pull and the armed forces could now decide the technology they wanted for capability-building rather than the industry thrusting technology upon the armed forces. The roadmap for building capabilities was conveyed directly by the GAD to the industry. The expert group broadly advised GAD in the following programmes:[10]

- General Missile Technology
- Precision Guidance Technology
- Computer Software Technology
- Satellite Technology
- Radar Sensor Technology
- Simulation Technology
- Stealth Technology
- Opto-Electronics Technology
- Aircraft Technology

- Target Characteristics and Signal control
- Inertial Technology
- Next-generation military capabilities such as hypersonic flight vehicles transiting upper atmosphere rather than adopting a traditional ballistic trajectory[11]

This institutional mechanism has helped PLA achieve a defence R&D system which is more capable of satisfying PLA's operational requirements rather than PLA merely adapting to the industry's requirements. The industry has been more than willing to make changes to oblige the GAD. Flexibility and adaptability coupled with the enthusiasm of private enterprises comprising of joint ventures, strategic alliances and foreign enterprises have spearheaded China's defence economy. The institutional structure defined by the collaborative mechanism has become the cornerstone driving the modernisation of China's aerospace and defence industry. Alterations have been carried out in the management and financial systems governing AVIC. China's civil and military leadership have also made significant efforts to align and adapt with the changing international business environment.

China's defence economy has started venturing into capital markets, critical to drive growth. While capital markets have funded wars in the past, PLA is now looking at stock markets to propel expansion plans of its defence industry. China's defence economy is expected to raise $1.4 billion through private placement to buy production facility and equipment to make warships.[12] By 2003, AVIC started generating revenues which rose to $28 billion, with profits surging to $1.5 billion. AVIC's market capitalisation increased to $33 billion and is further expected to rise to $164 billion by 2017. Apart from Asia, where Pakistan is the major importer of conventional Chinese weapons, China also

exports arms to 16 African countries, and between 2007 and 2012, China signed deals worth $11 billion worldwide.[13]

China, a technology-deficient nation, adopted a unique leapfrogging strategy: it first acquired technology already developed elsewhere either through alliances or by subterfuge, and then bridged the gap through internal R&D on those parts of the technology spectrum not available through either means. Thus, China optimised its resources by smartly investing in R&D on that technology which was part of the denial regime rather than trying to reinvent the wheel by investing in the entire spectrum of technology. Quite a few of China's military capabilities were developed as a result of a well-crafted 'adaptation strategy,' which discretely embraced foreign technology and then through internal R&D transformed it into indigenous capability with distinct Chinese characteristics.[14]

Indeed, there are innumerable examples of China using this strategy to perfection; one such instance which comes to the fore was the development of China's KJ-2000, an indigenous Airborne Warning and Control System developed in the aftermath of an aborted deal with Israel and Russia. The Russian Bereiv A-50 was to be outfitted with Israel's Phalcon Airborne Early Warning Radar, but China later successfully installed its indigenously developed airborne radar on four A-50 and IL-76 platforms through internal R&D.

China believed that independent innovation was critical for its rise as a global power. Like any other technology-deficient nation, China relied heavily on foreign technology to build robust national infrastructure centred on upgrading human capital, knowledge-intensive activities, pool of natural science engineers and technology incubators, all powered by

an aggressive internal R&D mechanism to build future capabilities around comparative advantage. It also believed that a nation without manufacturing capabilities could not acquire great power status. Immediately after the Cold War, China was able to take advantage of the cash-strapped defence industries in the West eager to participate in arms trade irrespective of the earlier frigid relationship. China was therefore able to incisively upgrade its manufacturing capability through this engagement. China was also able to benefit from Russia, from which it continued to buy a vast assortment of weapons and technology. Today, China's major source of aircraft design and engine technology originates from Russia.

Rosboronexport's fervour to trade in conventional arms with China resulted in Russia losing significant ground in the arms market in favour of supplying China with low-cost weapon systems. Acquisition of Russian platforms like Su-27, Su-30MKK and Su-30 MK2 helped Beijing step up its military capabilities through indigenous R&D. The expected sale of Su-35, which Russia and China have been negotiating since 2010, could become yet another Russian guinea pig. The Su-35 is expected to be outfitted with the 400-km range IRBIS-E X-band radar, which has the capability to detect and track 30 targets and attack eight targets simultaneously.[15] If the deal is successfully negotiated, IRBIS-E will most likely also be dissected by the Chinese to develop capabilities in the area of Passive Electronically Scanned Array radar systems—one capability yet to be cracked and developed by China's Electronic Technology Group.[16]

The other deals in the making include revival of negotiations to buy IL-76 platforms from Russia and the sale of IL-78, which would augment China's existing capability in air-to-air refuelling based on the antiquated

H-6 platforms (derivative of the Tu-16). In addition to outright stripping acquired airborne platforms, China has no qualms of using imported components on its indigenously developed platforms. For example, the J-10 is powered by the Russian AL-31F turbofan aero engine. While China has an ongoing programme for the development of aero engines under the aegis of AVIC aero engines and AVIC commercial aero engines with market capitalisation in excess of $1 billion, none of its home-grown fighter aircrafts are yet powered by the indigenously developed engines due to reliability issues.[17] China is searching to acquire advanced aero engine technology by taking baby steps through acquisition of Continental Piston engine manufacturers in the US for $200 million—all directed towards future development of a home-grown aero engine.

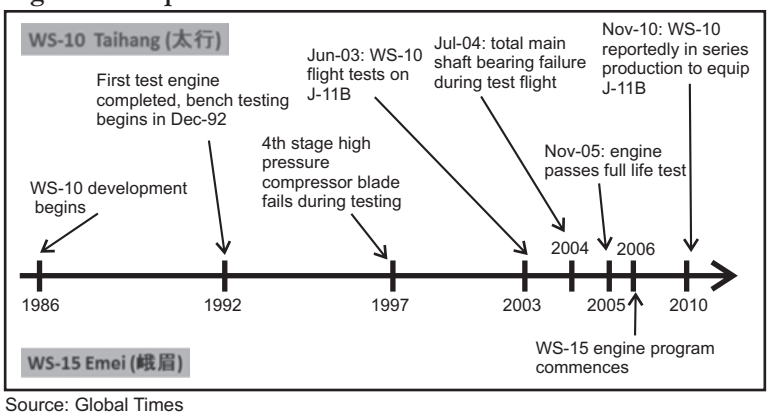
Russia has exported more than a thousand AL-31FN aero engines as part of a multi-billion dollar contract signed between the two countries. Russia has also exported RD-93 low bypass turbo fan manufactured at NPO Klimov in St. Petersburg and D-30 KP2 engines to China. Further, it is no secret that China is investing large amounts of resources to reverse engineer many of the Russian engines to develop indigenous capabilities and possibly produce its own aero engine. Some of the variants of probable home-grown aero engines are WP-14 (for J-8II); WS-10 (for J-10 & J-11); WS-13 (derivative of AL-222K-25F aero engine from Ukraine); and WS-18 (derivative of D-30 KP2). Aero engine technology remains China's Achilles heel from a design and manufacturing standpoint. However, until China is able to develop its own jet engine, its fighter programme will continue to be propelled by Russian Salyut and Klimov aero engine enterprises. China's long-term goal will not only be to promote the existing export product line but also develop a next-generation combat aircraft to compete with the American JSF.[18]

China's long-term priority to develop a high-performance power plant

for variants of J-10, J-11, JF-17, J-20 and J-31 appears a distant dream today but could well become a reality in the near future. In the interim, they are utilising resources to design and develop engines for ARJ 21 and C919 single aisle passenger aircraft with an aim to spin-in capabilities into the military aircraft segment. The demand for engines for ARJ 21 and C919 is expected to rise and could be worth $100 billion spread over the next two decades. Furthermore, Beijing is contemplating increasing investments on research to $50 billion for the underfunded low-bypass turbo fan engines.[19] Eventually, an increase in allocation of funds for R&D and a tacit flow of knowledge from China's expanding range of commercial aviation joint ventures (such as the memorandum of understanding to create a facility for assembly and engine testing of the CFM engines) will boost the development of the aero engine programme.

The development programme for WS-10 that commenced in 1986 has significantly benefitted from increased investment in R&D, and when completed, should be capable of replacing the Russian AL-31F. The timeline for China's WS-10 and WS-15 (likely aero engine for J-20) is shown in Figure 1.

Fig. 1: Development and Production Timeline of WS-10 & WS-15



Source: Global Times

The HQ-9, a derivative of the Russian S-300 and produced by China Precision Machinery Import Export Company was selected by Turkey, a NATO member, in a $3.44 billion contract for Turkey's missile shield programme (T-LORAMIDS). China's competitors in the bid were the US Patriot, Russian S-400 and French-Italian consortium Eurosam SAMP/T, but China was able to successfully outbid the Russians—who were the source of technology for the HQ-9 air defence missile. Under the T-LORAMIDS programme, Type 120 low altitude search radar will provide improved anti-stealth capability. The Type 305A AESA search radar will upgrade the anti-ballistic missile capability and the YLC-20 passive sensor will augment counter-stealth capability. The system will finally become integrated with the NATO system.[20]

The commercialisation and expanding trade of low-cost conventional arms is helping China not only narrow the existing qualitative gap but also augment capability for future capacity development. The J-31 and future derivatives could become potential competitors to the JSF; in being accepted for the T-LORAMIDS programme, the HQ-9 has already proven that low-cost and improved quality can become a game changer in expanding China's exports of conventional arms. China's strengthening military capability has created ripples beyond Chinese territory, which are being felt not only across the region but also across the globe. The country is not only the second richest nation but also lays claim to the second most powerful military in the world. China has effectively leveraged access to civil technology to spin-in technology into its military aviation industry. There are innumerable examples of such joint ventures emerging in China, eventually resulting in the tacit flow of knowledge trickling into China's military aviation industry.

Civil Aviation as Means to an End

China's ability to effectively leverage and exercise its influence in Europe is abundantly evident. The European Union recently had to reverse a law on regulating international aviation emissions to accommodate Chinese airlines flying into Europe and in return, China eased its boycott of Airbus orders worth $11 billion, which helped Airbus save 2000 jobs.[21] Airbus SAS (formerly EADS) was also able to grab a $4.2 billion contract from two Chinese start-ups amidst China's deregulation of the civil aviation sector. Qindao Airlines ordered 23 A320s while Zhejiang Loong Airlines ordered 20 A320 aircrafts.[22] China is developing an edge, and its influence in Europe is unquestionable. Moreover, the intensity of lobbying on the part of European nations to obtain access into China throws light on Europe's eagerness to engage with China.

In 2007, Airbus agreed in principle to allocate the manufacturing of five percent of the A350 XWB airframe in China. Harbin Hafei Airbus Composite Manufacturing Centre (HMC)—a joint venture between Airbus China (20 percent) and a group of Chinese partners comprising of Harbin Aircraft Industry Group Corporation Limited (HAIG, 50 percent), Hafei Aviation Industry Company Limited (HAI, ten percent), AviChina Industry & Technology Company Limited (AVICHINA, ten percent) and Harbin Development Zone Infrastructure Development Company Limited (10 percent)—would deliver elevators for A350XWB.[23] HMC and Spain-based Aernnova Aerospace (ANN) also signed a contract in 2010 to manufacture and assemble a set of carbon fibre elevators. Production commenced in 2012 to deliver elevators to ANN, major suppliers of aero structures of Airbus aircrafts. The carbon fibre elevators manufactured at HMC will eventually be integrated with the A350 XWB horizontal tail plane at the Airbus plant in Getafe, Spain.[24]

China is encouraging local investments by deregulating the airline sector and as a result, competition is expected to grow with new airlines surfacing in China—akin to Coase's theory of emergence of capitalism and creation of markets. Emergence of China as a 'breakout nation' will boost domestic consumption and increase passenger traffic in the airline sector. In future, only efficient airlines in China will be able to sustain their presence in the new emerging market economy. A case in point: Honeywell signed an agreement with Air China to provide services to optimise safety, efficiency and performance of the airline's growing fleet of wide-body aircrafts. As part of the agreement, Honeywell will provide customised service and maintenance, referred to as predictive trend monitoring and diagnostic (PTMD) solutions, to reduce down-time costs by expediting maintenance and turnaround time and thus increase efficiency.[25]

The aerospace industry in China has witnessed spectacular growth since the turn of the century and its revenues are expected to skyrocket to a whopping one trillion Yuan by 2017 at a conservative Compounded Annual Growth Rate of 19 percent.[26] It is indeed a commendable achievement in the midst of the tough competition China's aviation industry faces in its export product line from Russia, once a mentor and major source of technology in China. China's leadership, coupled with increasing demand of commercial jets because of increasing passenger traffic, a growing economy and strong government support, are instrumental factors driving forward China's civil aviation industry, which is likely to spin-in technology into the military aviation industry in the foreseeable future. China's civil commercial sector is expected to be the top revenue producer this decade, with development and production of major aircraft programmes like C-919, ARJ-21 and MA-700 in the pipeline expected to fuel additional market growth.[27]

The global aerospace supply chain in China is being driven by progressive policy interventions and is further expected to be strengthened through joint ventures, foreign investments and strategic alliances. Boeing, Airbus and Eurocopter are all lobbying in China for manufacturing space in systems and subsystems. China apparently looks at these alliances as a vehicle to execute its aerospace strategy to leapfrog and compete with the major primes. China's aviation industry is also aided by S&T. The document 'Science & Technology in China: Roadmap to 2050' presents a panoramic scenario for China's modernisation drive to 2050. As for India, the defence and aerospace industry is not part of the rubric in the country's 'Science, Technology and Innovation Policy (STI) 2013.'

Decoding India's Aerospace and Defence Industry

India's opening of its economy in 1991 coincided with the end of the Cold War and fragmentation of the erstwhile Soviet Union. Despite historic alignment with the Soviet Union, India was unable to effectively leverage benefit from the disintegrating USSR and correct its policy to energise its aviation industry which appeared adrift. The historic opportunity in the 1990s was left unutilised, which could have shifted the self-reliance paradigm to a new construct founded in joint ventures, alliances and investments from foreign enterprises to revive a fledgling aviation industry. Late Air Commodore Jasjit Singh had written that India missed a unique opportunity when America was ready to transfer the upgraded Northrop TF-5 lead-in fighter trainer in the late 1980s to upgrade its aviation industry. However, there also exists a contrary view that the deal fell apart because the aircraft did not meet the service qualitative requirements.[28] Whatever may have been the case, while many countries like South Korea were building capabilities, the concept to benefit from the offset mechanism was missing from India's strategy

formulation. This could possibly be explained by New Delhi's lack of understanding of the concept of offsets, as iterated by the Kelkar Committee in 2005.

Offsets are industrial compensation practices prevalent as a pre-condition for purchase of defence equipment either through government to government or commercial sales. Offsets help the buyer country obtain access to technology, joint ventures, alliances and foreign investments provided the receiving country is able to effectively benefit from the defence imports—something India has unfortunately not been able to substantially leverage.[29] The Comptroller and Auditor General, the Indian auditor, also commented on the inefficacy of the acquisition council to implement offset contracts. It criticised the defence ministry on the methods adopted for implementing these contracts, which it said were not aligned with the provisions prescribed in the Defence Procurement Procedure. It further emphasised that lucidity in interpreting and implementing offset provisions was the need of the hour for establishing a strong defence industrial base. It also elaborated that out of a total of 16 offset contracts worth INR 18,445 crores ($3billion) concluded between 2007 and 2011, five offset contracts worth INR 3,400 crores ($545 million) did not provide significant value addition to the Indian Offset Partners.[30] A majority of these contracts consisted of selling of ready-made equipment rather than being vehicles for transfer of technology, joint ventures, alliances, investments and a tacit flow of knowledge—a strategy recommended by the Kelkar Committee in 2005 and also followed by many other countries, including South Korea and China, to expand their defence industrial bases.

Short-term goals overriding long-term plans dominated the aviation industry post-1960. The concept of design and development took a

backseat and was virtually erased from the consciousness of Indian strategists and manufacturers of defence equipment. The mindset was entrenched in acquisition rather than indigenisation, and all acquisitions were centred on license production. While aviation technology experienced exponential growth in avionics, material and platforms, India's own design capabilities eroded and as a result, it exterminated the potential of its own design and development capabilities. India continued to lag behind while other nations made progress and China's strategy to leapfrog and catch up with the West paid dividends. India's aviation industry therefore witnessed a gap of twenty five years in designing a combat aircraft between HF-24 (Marut) in 1957 and Tejas, the Light Combat Aircraft, in mid-1980s largely because of inadequate will and a lack of leadership and strategy to boost capabilities in this domain.[31]

It took a 'Kargil' for New Delhi to understand that India required a new procurement management structure and recommendations from Kelkar Committee to clarify that India should effectively leverage its buying power and offset arrangements to expand its domestic industrial base through foreign investment and technology transfer. While India agreed to open its arms industry by creating new structures like Defence Acquisition Council, Defence Procurement Board and Defence Offset Management Wing to bring synergy between all stakeholders, a superficial reorganisation was responsible for India not being able to reap desired benefits and thus yet again failing to upgrade its antiquated aviation industry because of myopic vision and lack of will.

As a result, India continues even today to rely on acquisitions. Despite being an aspiring emerging power, India's Self Reliance Index is well below the targeted 70 percent that is essential to meet authentic requirements for security. India's defence production capability must

undergo a paradigm shift by being strengthened through collaborative partnerships between public sector undertakings (PSUs), private sector, joint ventures, alliances and foreign investment, the only method to energise a struggling aerospace and defence industry.

Grounded Industry

India's aviation strategy somewhere went adrift by not acknowledging the role of firms (both private and PSUs), financial institutions or the state in shaping markets which could have become the tipping point for the industry in the new millennium. Lack of infrastructure development, paucity of human and capital resources, limited institutional evolution and minimal convergence in the organisation continue to plague India's aerospace and defence industry. India wasted the 20th century by insulating the defence public sector undertakings (DPSUs); the 21st century is no different despite India opening the arms sector to the private industry in 2001. While on the one hand, China is building capabilities through a well-structured vertically and horizontally integrated aerospace and defence industry that is driven by a strong leadership and a clear objective to produce platforms matching capabilities of JSF and an aero engine to power their fighters, India, on the other hand, continues to run a fledgling industry where its stakeholders appear to be functioning in independent silos.

The perception is that India continues to adopt a protectionist policy towards the DPSUs by not providing a level playing field for all its stakeholders. From a purely nationalistic perspective, the arms industry must operate in a free market economy driven by competition where the best firms are utilised for defence capacity building. The Kelkar Committee also proposed the involvement of India's best firms in

capability building and pursuing an offset policy to absorb technology and investments. The committee suggested exploring possibilities to synergise capacity by including private sector, DPSUs, Ordnance Factories and Defence Research and Development Organisation (DRDO) to promote high-technology capabilities and create an environment to allow for a quantum jump in export of defence equipment. The Kelkar Committee's recommendations include:[32]

- Formulating a 15-year Long Term Integrated Perspective Plan (LTIPP) for acquisition;
- Sharing technology requirements of armed forces with the industry;
- Identifying entry points for the private sector in the acquisition process;
- Promoting participation of small and medium enterprises in defence production;
- Setting a new organisation for defence acquisition in Ministry of Defence (MoD);
- Boosting R&D mechanisms by both DRDO and the industry;
- Optimising utilisation of existing capacity;
- Including mandatory offset clause for all contracts valued in excess of INR 300 crores; and
- Examining negative list for exports and forming an export marketing organisation.

Many recommendations made by the committee are gathering dust and progress in developing indigenous capabilities is rather sluggish with no sense of urgency. The underlying message of the Kelkar Committee was to build indigenous capability in the defence sector? a mandatory requirement to arm a nation aspiring to become a military power. India

established an acquisition council under the aegis of MoD, but the lack of adequate institutional mechanisms and the inability to bring all potential stakeholders on board has made it less effective. As a result, India today continues to arm its arsenal through acquisitions from abroad, with the model for capability-building and technology development being guided by technology-push. An LTIPP reflects capabilities to be evolved over a period of 15 years as a means to guarantee security for the nation; regardless of the fact that the capabilities are being developed through multi-billion dollar acquisitions, neither the Service Headquarters (SHQ) nor the MoD has made any effort to build a pool of acquisition experts.

R&D continues to remain an Achilles heel responsible for India's dwindling aviation industry. India spends a measly 0.9 percent of GDP on R&D. 70 percent of this amount is spent by the government while the rest comes from the private sector. If the latter wants a share of the pie, then the private sector too will have to increase allocation on R&D. Private sectors in most developed countries contribute a larger amount towards R&D compared to governments. Unfortunately, despite India's potential to develop high-end technological capabilities, it continues to function under restrained conditions due to inadequate policy interventions. Consequently, the industry is weakened and unable to take advantage of the surging demand in India's aerospace sector. A protectionist approach adopted towards the DPSUs is waning India's progress in developing a high-quality aviation industry because of the inability to effectively optimise available capacity.

India ranks amongst the top ten defence spenders and is the largest importer of conventional weapon systems and platforms. India spends 45 percent of the total defence outlay on capital acquisitions. India's import dependence is 70 percent; the rest of its needs are met through

poor quality and obsolete product lines from the ordinance factories and DPSUs. India has not been able to exploit capabilities of the entire spectrum of stakeholders, and as a result, only part of the capabilities indigenously developed can be categorised as state-of-the-art while the rest are obsolete and do not deserve to be a part of India's force structure. India's six DPSUs and 39 ordinance factories have produced T-72 tanks, frigates and integrated MiGs, Sukhoi and Jaguar aircraft platforms. However there have not been any path-breaking innovations originating from these gigantic institutions created immediately after Independence.

India's manufacturing capabilities are contracting[33] and the sector contributes much less to the GDP as compared to China's manufacturing sector. Furthermore, India's experience of building manufacturing capabilities and bridging the gap in design and critical technology through license production by the DPSUs has been limited. While the DPSUs have supported the armed forces in the past, they have not been able to significantly contribute towards capability building and are therefore gradually becoming less relevant. A competitive route to acquire contracts from all stakeholders rather than merely nominating DPSUs will need to be the future roadmap to develop an efficient and a capability-driven industry. A measured step in this direction would not only help build a globally competitive indigenous defence capability but also become another medium to guarantee national security.

In a major policy initiative in January 2011, the defence ministry issued guidelines permitting Navaratnas[34] and Miniratnas[35] Public Sector Enterprises (PSEs) to enter into technology joint ventures and strategic alliances with private and foreign partners. The aim of the guideline was to draw out a roadmap to synergise and enhance national competence in producing state-of-the-art globally competitive defence equipment

within the framework of a globally competitive price line.[36] It also suggested exploring all viable approaches, such as formation of consortia, joint ventures and public-private partnerships, to step up capabilities, particularly in the aftermath of the much peddled joint venture between Mazagon Dock Limited and Pipavav shipyard. However, Department of Public Enterprises and Department of Industrial Policy and Promotion (DIPP) restricted investments of DPSUs to 15 percent of their total net worth in joint ventures, a figure further restricted to INR 1,000 crores for Navratnas and INR 500 crores for Miniratnas, thus further slowing down the process of technology absorption.

The skewed and piecemeal initiatives by the government have restricted the FDI inflow into defence from 2000 until June 2014 to a paltry $4.94 million, where defence was ranked 61 out of a total 64 items (as per the fact sheets on FDI from April 2000-July 2014 posted on DIPP website). During the same period, the total equity inflows, reinvested earning and other capital amounted to $335 billion.[37]

S. Gopalakrishnan of Infosys has reiterated the need for India to attract more FDI. Referring to the World Investment Report of the United Nations Conference on Trade and Development, Gopalakrishnan believes that steps must be initiated by the government to double the FDI inflow currently pegged at a meagre 4.3 percent of gross fixed capital formation.[38] Policy initiatives are needed to attract more FDI not only to expand defence capabilities but also to bridge the burgeoning current account deficit which is currently at a staggering $88 billion (4.8 percent of GDP) and needs to be brought down to $70 billion (3.7 percent of GDP). Raghuram Rajan, the governor of RBI, acknowledged the need to raise the FDI cap in defence to attract investments, which should be

examined objectively to push growth and stimulate the defence sector.[39] The composite FDI cap has, however, now been revised to 49 percent and notified by DIPP through its Press Note number 7 (series 2014).[40]

The order books reveal DPSUs holding large outstanding orders far beyond their existing capacity, while a large potential is lying untapped in the private sector for current and future engagement to build India's comprehensive national power and energise its defence economy. The Indian Air Force (IAF) is poised at a threshold towards a steep growth trajectory and its modernisation will need to be shored up through effective and dynamic engagement of the private sector and industry friendly policies. The orders are plenty, valued at INR 2,00,000 crores ($33 billion) in the next decade and include aircraft manufacturing, radars and weapon systems: the private sector will now need to display leadership and initiative to take advantage of the surging demand in the aerospace industry. The INR 12,000 crore ($2 billion) Avro replacements for 56 aircrafts, opportunities in surface-to-air weapons and radars, and the much anticipated indigenous fighter programme under 'Make' category will be path-breaking for the Indian private sector.

The Indian private industry is enthusiastic to participate in building capabilities for India's defence sector; at the same time, the industry is wary and looking for effective policy interventions from the government through tax breaks, offset mechanisms and protection against foreign exchange risk variations (ERV)—benefits currently only enjoyed by the DPSUs. Today, 'Buy' (Indian), 'Buy and Make' (Indian) and 'Make (Indian)' categories, all contain a large proportion of imported components and sub-systems, and depreciation of the rupee has severely impacted profitability for the private company. Moreover, since the gestation period for a project can be anything between five and ten years,

fluctuations in the currency markets adversely affect the viability of the private sector to compete with their PSU counterparts which are protected from ERV. Private companies in India also have to compete with foreign vendors and DPSUs for contracts, both protected from ERV, giving them an advantage, while the private companies have to weather the variations in foreign exchange. Therefore, the future roadmap will have to be defined by fair and practical policy interventions for building capabilities through partnerships and consortiums towards developing a robust aerospace and defence ecosystem.

India's private sector must position itself as a reliable and dependable brand in India's emerging aerospace and defence sector based on a collaborative and a non-zero sum framework. Despite the industry being complex and burdened with risk, the private sector is taking initiatives and displaying leadership to address the funding issues through joint ventures and consortiums. For instance, Bharat Forge under the Kalyani group recently sold stakes in its defence venture to Elbit Systems Land and C4I Ltd, an Israeli company, to set up a BF Elbit Advanced Systems in a bid to bring in technology. The subsidiary of Bharat Forge is expected to develop and assemble artillery guns, mortar gun system and ammunition customised for Indian conditions.[41] The Kalyani group has also signed a strategic alliance with Saab, a defence and security company which develops and supplies high-technology and radar systems, to partner and address requirements of key Indian Army air defence projects like VSHORADS and SRSAM.[42]

Then there is Dynamatic Technologies, which develops high-end technology products for aeronautics and has facilities located at Bangalore and also in Europe. It has become a leading R&D organisation with several inventions and patents to its credit. Not so recently, it handed

over the flap track beams for A320 aircraft to Spirit Aero Systems (Europe). In India, Dynamatics has partnered with HAL and other defence establishments on key projects. Tata Advanced Systems Limited, in a joint venture with Lockheed Martin, plans to develop empennages and centre wing box for C-130J and cabins for Sikorsky S-92. Mahindra is entering the small aircraft segment and is developing GA-8 (eight seat) and GA-10 (ten seat turbo prop) at Gipps Aero, an Australian company acquired by Mahindra.

Currently classified as a Tier-2 supplier, the company is hoping to elevate its status to a Tier-1 supplier of component and aero structures to original equipment manufacturers like ANN in Spain. ANN holds 24 percent stake in Mahindra Aerospace, which will help the Indian company enhance its capabilities through the partnership.[43]

The point to make is that such Indian ventures are clearly competent to enter the high-tech defence space, and will subsequently become part of the larger global supply chain, contribute to India's defence economy through tacit flow of knowledge and ultimately help resurrect and energise India's defence Industry.

Prescriptions to Energise India's Aviation Industry

India has for long relied only on DPSUs to arm its arsenal; however, indigenisation of defence production and increasing the level of self-reliance in components and sub-assembly manufacturing has to be spearheaded by both DPSUs and the private sector consisting of Tier-1 and Micro, Small and Medium Enterprises (MSMEs). A policy initiative, which promotes synergy between all players and provides space for potential competitors to become collaborators, is what is required at

present to guide India's defence economy. Firms, financial institutions and the state will have to play a role in upgrading and modernising India's defence capability. Like the private sector in 1990s resurrected India's constrained economy, the private sector in the 21st century will once again have to power India's grounded aviation industry. The government, through its various policy initiatives, will have to recognise and embrace India's extremely dynamic private sector waiting to contribute towards indigenisation of India's defence production—provided problems related to taxation, formation of joint ventures and exports are addressed in a framework which offers equal opportunities to all its stakeholders.[44]

The private sector, on the other hand, will need to take risks in R&D projects by strategising with the government and foreign enterprises so as to take advantage of surging demand in India's aerospace and defence sector through technological advancements and quality engagement. India is blessed with high-quality manpower, manufacturing capability and availability of high-precision tools. Institutional evolution and organisational restructuring, as witnessed in China, will help energise India's defence economy. Policies supporting growth, driven by structural changes synergising capabilities of MoD, SHQ, DPSUs and the private sector, will have to lead this transition. The motivating factor driving the change should be a transition steered by a process where SHQs are enabled to dictate technology to the production agencies, i.e., demand-pull strategy.

Despite the inadequacies in processes and systems, change appears inevitable provided it is backed by the topmost leadership. An objective and sustainable vision for the aerospace and defence sector must lead the change where all stakeholders are able to function in a collaborative framework under a network rather than under a hierarchical

organisational structure. The MSMEs possess capabilities to develop and upgrade systems and become cradles for innovation in component and sub-assembly systems. Collaborative mechanisms steered by policy initiatives displaying trust and confidence in the capabilities of the private sector will have to become the future drivers in expanding India's defence production capacity.

The MoD has provision to fund private companies in the 'Make' category to develop and deliver component and sub-assembly systems. However restricted initiatives and time-consuming procedures have resulted in limited success. There are only a few projects with the army and none with the air force under the 'Make' category, and there exists a larger perception that while the government is willing to take risks with foreign partners in upgrading and integrating systems and sub-systems, it is unwilling to trust and partner with its own industry.

There is always an ongoing debate between 'change' and 'continuity'. Any change without continuity results in chaos, while continuity without change results in status quo. India's aerospace and defence industry requires both change and continuity. While it may not be prudent to change entirely by replicating the growth model of China's aerospace and defence sector, it can always serve as a benchmark. New Delhi could at the very least replicate China's deep belief that for a technology-deficient country, R&D will have to remain the mainstay in any science, technology and innovation policy to contribute towards future development and build a robust defence industrial complex.

Reforming India's defence and security policymaking process underpinned in a collaborative mechanism involving the country's premier R&D organisation, DRDO, and proactively supporting both the

Indian private sector and public sector undertakings to execute projects driven by requirements from the SHQs for capacity building, can become a workable model to expand India's weak defence industrial base.

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