177-195

ACHIEVING CIVIL MILITARY FUSION IN SPACE

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"Space technology is an example of what security will mean for any strong nation in the future. Various challenges in this area have been reviewed and identified by the three services. We have to work fast to solve them."

Indian Prime Minister Shri Narendra Modi

Introduction

Civil-Military integration (CMI) may be defined in various ways but the underlying principle remains the integration of national military and civilian capabilities to meet the nation's needs, both civil and military. The concept is not new and has been pursued by many developed countries for decades now, although the terminology has gained more visibility in recent years. This has been caused by another recent phenomenon – the democratisation of technology that has ensured that advancing technology and path breaking innovation is no longer the prerogative of governmental agencies. The contemporary world thus has evolved from just spin-offs (application to and conversion of military technologies in civil fields) to include "spin-on" (developments for civil purposes or for commercial applications having relevance for national security or military purposes).[1] Many of these emerging technologies are dual-use, having both civil and military applications, and this is of particular importance for capability and capacity enhancement in the technological and capital-intensive domain of outer space. Analysts are comparing this to the

evolution in the aviation sector and the spread of the internet, both of which started as military centric technologies but saw rapid expansion through private participation and commercial applicability.

More recently, emergence of disruptive technologies and trends and a shift of global focus on economic outcomes has resulted in emergence and proliferation of smaller establishments and start-ups who are capable enough to make significant contributions. With an acceptance of these entities into the domain, there is a need to evolve further to Military-Civil Fusion (MCF) – strategizing the integration of these commercial entities for incorporating the latest technological capabilities available globally and investing in emerging and disruptive technologies towards dual-purposes. CMI in the domain of space has been pursued differently by various governments, defined by their respective interests, budgets and human resources.

In India, the civil-military interaction in the domain of space has been a complex one. The sole organisation entrusted with space activities is Indian Space Research Organisation (ISRO), which has tried to stay closely aligned to its civilian mandate, focussing preferably on science rather than the business potential or the optimum exploitation by the armed forces of downstream applications. Lately however, there is a greater cognisance at the apex level of the economic and military aspects of the domain, resulting in a spate of initiatives since 2020, when the government of India (GoI) decided to open up the Space sector. While this has resulted in some important transformations in the sector, there is a need to more comprehensive study, understanding, implementation and evolution of reforms to achieve effective CMF in the sector.

Evolution

At the beginning of the space age, the quest for access to the domain was for strategic purposes that resulted in both the Cold War rivals investing heavily into achieving the technological edge. Space had limited usage for operational or tactical level military operations and offered few civilian applications. There were very few commercial services on offer, which in the absence of technology diffusion catered to a limited and geographically dispersed customer base. Space exploration efforts thus remained confined to national agencies funded by governments.

The first Gulf War demonstrated the utility of space-based systems for force enhancement functions, introducing it to the operational and even tactical levels and inciting interest among the militaries across the world. In the U.S., many civilian applications also emerged, either as an offshoot or through some dedicated programmes by National Aeronautics and Space Administration (NASA). In the Soviet Union, a similar, but limited role was played by State Owned Enterprises (SoE).

In the past couple of decades, the digital revolution, rapid pace of technological advancements, miniaturisation of components and the receding geopolitical tensions that led to the emergence of globalisation have all significantly lowered the cost curve of access to technology. Concomitantly, access to the hitherto 'distant' space has been democratised. With greater technologic proliferation and awareness, there are ever more set of use cases emerging, providing opportunities for established private entities as well as budding entrepreneurs to invest in this sector for scientific, as well as economic reasons. Nations or organisations no longer have to invest in owning satellites or have launch capabilities to exploit the space domain, as commercial enterprises would be able to provide these at highly economical rates. In 2022, the number of global space launches leapt to 186, with 182 successful. Of these, 82 were carried out by governments; 21 by commercial companies under contract to their host governments, and 83 by commercial companies for commercial customers, including foreign governments. [2]

Private Participation

Some of the innovative ideas in recent years that have revolutionised the domain have gained maturity through majorly private initiatives, even as government agencies and large aerospace companies largely focussed on incremental improvement of existing systems. The most prominent example of this has been SpaceX, whose use of technological innovations to drive down the launch costs and the concept of reusable rockets have been revolutionary successes. Even the concept of smaller satellites that are cheaper to design, develop and produce in much shorter timelines and modular concepts in satellite production that together enable mass production through assembly line processes, have mainly been private sector initiatives.

More recently, private companies are investing in more niche capabilities such as SAR and hyperspectral sensing. Pixxel, an Indian company, has already launched three of its inhouse developed hyperspectral satellites on its way to a complete constellation to 24. Mass production has enabled constellations for low latency communications from LEO and swarms of satellites to be developed, tested and deployed. Other private initiatives include optical communication, use of additive manufacturing for aerospace systems, enhancing space situational awareness (SSA), automatic identification system for maritime traffic monitoring and automatic dependent surveillance sensors for aviation activities, among many others.

While some of these are far from reaching the desired level of sophistication, rapid technological advancement and proliferation is ensuring that progress towards achieving technological maturity or achieving near parity with extant systems is relatively much faster. Success stories like SpaceX and Blue Origin have inspired hundreds of space start-ups and companies and attracted funding, contributing to the speed and diversity of innovation. Economic competition has also spurred innovations, encouraged shortening of product development cycles and in rapid evolution of product lines. New age private establishments have been seen to be less risk averse while investing in developing and testing novel technological applications and more agile and responsive to innovative ideas that could have a potential end use. The lower access cost has also allowed greater diversity and proliferation of the space industrial base, invigorated the ecosystem and allowed for more democratisation of the supply chains.

A major hindrance to the linear development of space enabled services has been the disconnect between the space technologists and the potential consumers. The experts have tended to focus on the science even as the potential end user has remained largely unaware of the technological capabilities, potential and limitations. This has been especially evident in India, where the government departments, including the armed forces, and the private sector have severely lagged behind in drawing use cases from its successful space program. Private companies, looking at commercialising their products, are more adept at understanding the demand-supply dynamics and the needs and agendas

of potential customers, be those businesses or nations. As compared to governmental behemoths, they display greater interest in proactive customer engagement and education. Their interest in commercial viability makes them better focus on end user requirements. This is largely different from the conventional approach of supplying raw data through complex pipelines. Private companies can acquire technology and expand reach through mergers and acquisitions. SatSure, an Indian deep tech start-up working at the intersection of spacetech, Artificial Intelligence (AI), and Software as a Service (SaaS) to drive decision intelligence, has acquired a U.S.-based Geospatial services company called Old City Innovations.[3] Working for commercial interests, private entities also better collaborate on technology development and testing and more smoothly reach agreements on use of each other's products. Indian companies Skyroot and Bellatrix signed a memorandum of understanding (MoU) in February 2021, under which Bellatrix's orbital transfer vehicle is supposed to launch on a rocket that Skyroot is developing.[4]

CMI in Space

Spin-off and spin-on cooperation in the space industry have become common and solid practices with the intent to lessen product and technology development costs, expand the utilisation of dual-use resources and expedite the introduction of advanced commercial products to the defence sector.[5]

- **Intelligence, Surveillance and Reconnaissance (ISR).** A number of private satellite companies have been launched to cater to varying requirements of the satellite imagery and analysis market. Hi-resolution imagery up to 30-cm native spatial resolution is now available through privately owned satellites and they are persistently working at enhancing their capabilities. Use of data from privately owned satellites to the Ukraine military is the most fitting and recent example of CMI. Following this, the U.S. National Reconnaissance Office (NRO) has announced contracts worth billions of dollars over the next decade to a trio of satellite-imagery companies: Maxar, Planet and BlackSky.[6] The NRO has noted that the increasing availability of commercial companies' imagery "increases our resilience and enables an integrated approach" to national security.[7]

- **Communications.** Satellite communication has been the backbone of the commercial space industry. The successful resilient employment of SpaceX's Starlink constellation by Ukraine armed forces, when the legacy ViaSat system succumbed to cyber-attacks has been noticed by militaries across the world. In an effort to expand their revenue streams, private companies are investing in innovations towards expanding broadband connectivity, extending 5G connectivity to air, sea, and other remote areas, providing high speed internet on commercial airlines and on satellite-to-mobile device connectivity. All these have applicability to enhancing military communication networks and would be enablers for the futuristic Internet of Military Things (IoMT).

- **Constellations.** The advent of satellite applications based on constellations comprising hundreds, and envisioned thousands, of satellites offer unique capabilities, capacities and applications. For ISR, they offer increased temporal resolution with an option to diversify the spatial and spectral resolutions. Communication and networking abilities from LEO based mega-constellations enable more ubiquitous, persistent coverage to even remote and inaccessible areas, at lower latency. Together, these enable more expansive and persistent C4ISR coverage and shortening of the OODA loop. Large constellations of satellites would offer resilience to the national security and military users, making it near impossible to neutralise or meaningfully degrade the functionality of a system by targeting individual satellites through kinetic or non-kinetic ASATs.

- **Operationally Responsive Systems (ORS).** Mass production capability could contribute to an ORS by providing a stockpile of easily replaceable satellites, increasing the speed at which a satellite constellation can be reconstituted or improved. Smaller launch vehicles being developed could be utilised for quick responsive launch to enhance capacities and inject replacements in the event of a conflict.

- **Anti-Satellite (ASAT).** Small satellites also have ASAT potential (on-orbit rendezvous and proximity operations), which the militaries would need to factor in for their offensive as well as defensive operations.

Militaries have the option of procuring or coordinating services from commercial systems for their various planning and execution requirements. This would allow rationalisation of effort related to developing and operating organic capacities. The more regular, less-demanding requirements could be offloaded to commercial entities to enable national agencies to concentrate on more intensive research, designing and development. Concurrently, the armed forces could continue to explore the newest technologies and emerging trends and applications in the civil domain for military-specific opportunities. Many governments are already incentivising private investments in further development and deployment of these capabilities that would benefit national security users.

CMI - United States

The U.S. has been at the forefront of civil military integration in Space, encouraging private investment in the domain, initially to enhance capacities and subsequently to build advanced capabilities. As seen from the example of SpaceX, the ecosystem has prospered from the enabling policies and governmental support through funding and business opportunities. In return, these private companies have provided services to the country's space programme, as well as to the military and helped contribute to the nation's economy. More recently, it allowed the U.S. government to support operations in Ukraine, while providing it the benefit of plausible deniability of its active participation.

The U.S. Space Development Agency, created in 2019, has put forth an ambitious plan involving small satellites, as part of its National Defense Space Architecture to quickly deliver needed space-based capabilities to the joint warfighter to support terrestrial missions. The SDA aims to harness commercial development to lower costs and achieve a proliferated architecture and enhanced resilience and employ spiral development methods, adding capabilities to future generations as the threat evolves.[8] U.S. Army's Project Convergence, aimed at building the Army of 2030, where the service will reorganize and develop innovative technologies to outpace near-peer adversaries in future battles, has been experimenting with leveraging both national assets as well as commercial constellations for imaging and communications. Combining

this with novel capabilities in data fusion and artificial intelligence, it reported cutting down the sensor to shooter timeline from 20 minutes to 20 seconds.[9]

China

China's "military-civil fusion" (MCF) aims to eliminate barriers between China's civilian research and commercial sectors, and its military and defence industrial sectors. These are being pursued through reorganisation and interactive efforts between government institutions and private industry.[10] In terms of space capabilities, the Chinese government issued Document 60 (Guiding Opinions of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment) in 2014. It was followed by other policy documents that encouraged private and international investment in space, a previously protected sector. Civil–military integration (CMI) was uplifted as a national-level strategy in 2015 and Outer Space was one of the sectors included in its military White Paper issued in 2015 and the 'Made in China 2025' (MIC2025).[11] The commercial participation has seen a steady increase and of the 182 total satellites launched by China in 2022, 100 (55 percent) were of commercial class.[12] Towards CMI, thirteen technical experts from private companies had been appointed to the PLA Rocket Force's National Defence Science and Technology Expert's Panel upon its founding.[13]

Even as it tries to adopt private participation and a market-oriented approach against the entrenched traditional state-led approach, these initiatives are planned to be directed at economic development and technological advancement rather than on military modernisation.[14] State-owned enterprises (SOEs) and their subsidiaries (most major commercial space companies are either subsidiaries of SOEs or are spin offs from government or other government organizations or SOEs) continue to dominate its space sector.[15] Purely private initiatives are at relatively lower levels of technological accomplishments and are heavily dependent on government's support with very little autonomy in operations. The government has allowed commercial space companies to leverage the government's supply chains and other capabilities, such as the use of government launch sites and the facilities of space SOEs. China could possibly utilise these efforts for the export potential of their

low-cost products and services and to reduce China's reliance on space-related systems and technologies from other countries.

Challenges

There are challenges to expansion of the use of the domain by private entities that could impact their utilisation for military purposes.

- **Regulating.** The existing global space regimes are inadequate to address the issues emerging from growing private sector participation – the crowding of orbital space, the dual-use potential and liability issues when dealing with multinational operations. Parochial interests in maintaining the technological edge and preferred access to the domain have precluded consensus on any new initiatives aimed at regulating the environment. The use of commercial space assets in support of Ukraine's military in the Russian-Ukrainian conflict have highlighted the complications related to the legitimacy of such action. The ambiguity of purpose of a system also complicates application of existing legal mechanisms related to application of force on it being targeted by an adversary during a conflict. This was evident in the targeting of the ViaSat network through cyber hacking by Russia, as it was the primary system being employed by the Ukraine military, but which also resulted in collateral damage to civilian services across Europe. While SpaceX stepped in with their Starlink system to resume wartime services, it was evident that there was no clarity on legal or military options to respond to the attack or options for the civilian customers for resumption of services or to claim for the losses suffered.

- **Domestic Regulation.** Being a technologically intensive and strategically sensitive sector, space has unsurprisingly been drawn into the tussle related to geopolitics and technology in a highly polarised global environment. Governments are already showing reluctance to give unbridled access to private companies, especially when dealing with niche technologies and sharing of sensitive data. The greater political oversight and control could impede technological advancement through collaborations and sharing, as also disincentivise investments.

- **Geoeconomics.** Commercial space enterprises are also becoming part of the economic competition between states with governments vying to garner a greater share of the burgeoning space market. In the U.S., there are demands for policies and incentives to keep U.S. companies competitive internationally.[16] The European nations have also boosted their spending on space by 17% over coming years to address the intensifying global competition.[17] Nations are looking at diversifying their sources to avoid being denied capabilities for strategic reasons. China seeks to utilise the potential of its Belt and Road Initiative (BRI), signing 23 pacts with 11 countries along the BRI route for space-related cooperative activities, displacing the U.S. commercial services. These measures could either spur innovation, or act against a more efficient collaborative approach to innovation.

- **Commercial Rationalisation.** As seen with the dot-com sector, experts expect the next few years in the sector to be tumultuous as expectations, capabilities and commercial realities pan out,[18] An example is that of the U.S.' Defence Innovation Unit (DIU), an organisation focussed exclusively on fielding and scaling commercial technology across the U.S. military, whose success rate has been around 23 percent – projects that ended up in actual applications.[19] Stringent government control could delay important projects, allowing alternatives to displace space enabled initiatives as has been seen by terrestrial communications and unmanned aerial RS. Uncertainty in the sector would reduce funding and stall important projects that have implications for dual-purpose employment.

- **Survivability**. Growing commercial interest is adding onto the orbital traffic, increasing the vulnerability of deployed assets. This would require investments in enhancing domain awareness and measures towards resilience.

- **Protection of Civil Assets.** In the recent Russian-Ukrainian conflict, as the U.S. continues to leverage more commercial satellites for providing intelligence and communications services to Ukraine, Russia has issued a warning that this "quasi-civilian infrastructure may become a legitimate target for retaliation." A recent Chinese paper titled "2022 Challenges to Security in Space", from its People's Liberation Army (PLA) Xian-based research institute, considers

Elon Musk's Starlink satellite system a threat, to be targeted and neutralised, primarily through electronic warfare.[20] This brings forth the question of the state's responsibility in devising technological and non-technological means to deter and protect not only government controlled but also commercial space assets being employed for military purposes against physical, jamming and cyber-attacks.[21] The question is important as commercial systems are not designed and engineered as sturdily or secured against attacks as military ones. As these assets provide plausible deniability to governments, it becomes difficult to profess or define overt sureties to their operations.

- **Technology Awareness and Adoption.** An important aspect of space enabled technologies is the awareness at various levels of military hierarchy about the capabilities and potential and the ability among the military practitioners to adopt them. History is replete with examples that profess that technology in itself is not a battle winner, unless supported by effective doctrines and training.

CMI in Space – India

While Indian space program has been a success, it has suffered from a lack of vision on developing futuristic capabilities like LEO based constellations, spaceplanes and reusable launch systems and lack of coordination among various agencies. A case in point is the lack of coordination among various agencies on the IRNSS system that has precluded wide-spread adoption by the potential end-users, both military and civil. A scientific, rather than an application-based approach, has also affected the return on investments. Despite India's advanced space capabilities, its share in the global commercial space sector is only 2 percent, [22] owing to lack of capacities as well as business acumen. The GoI has now set a projected target of commercial space industry contributing 1 percent to the country's $5-trillion economy target by 2024 and to expectedly increase India's global share in the space market to around 10 percent by 2030. This is to be achieved through enhanced private participation and harnessing the huge untapped potential that exists in the country in terms of human resources, technical acumen and capabilities established in the industries in space sector.[23]

Actions by the GoI have been demonstrative of the its resolve. NewSpace India Limited (NSIL) was set up in March 2019 as a PSU under the administrative control of the DOS to function as the commercial arm of ISRO. Indian National Space Promotion and Authorisation Centre (IN-SPACe) was established in June 2022 as an autonomous agency in Department of Space (DOS) to act as a single-window, independent, nodal agency for promotion & regulation of all space sector activities of private entities. All technology transfer is to take place through NSIL, while authorisation and regulation would be done through INSpace. Already, these two entities have facilitated some important collaborations with the private sector for space-based applications and services and monetised ISRO's potential and services. These organisations also facilitate bringing together the industry stakeholders for their suggestions on the new space policy, spectrum allocation and licensing framework to make the regulatory environment conducive to private sector participation, towards creating a level playing field. The Prime Minister has clearly enunciated that he did not want to see the industry only as vendors, but as leaders in space development. ISRO has been made a facilitator to offer technological assistance and sharing of existing space infrastructure towards faster technology maturation and cost saving. The companies also stand to benefit by leveraging the aerospace grid vendor ecosystem comprising more than 400 private entities specialising in domain specific technology development, manufacturing and supply of components.

Some of the significant events, among many, have been:

- Award of contract for the commercial development of next five polar satellite launch vehicles (PSLVs) to space conglomerate formed by Larsen & Toubro (L&T) and Hindustan Aeronautics Limited (HAL)
- Signing of MoU between ISRO and Skyroot Aerospace in 2021, which led to the successful maiden launch of India's first privately built rocket for suborbital flight, the Vikram-S, in November 2022.
- Dhruva Space, pursuing a communications constellation, successfully validated its satellite orbital deployer during the PSLV C53 mission and subsequently launched two nanosatellites for amateur communications onboard PSLV-C54 in November 2022.

- Signing of MoU between IN-SPACe and QNu Labs in December 2022 to develop Indigenous Quantum Tech Satellite QKD, with the support of ISRO.[24]

- Global private initiatives are also vying for the Indian market through tie-ups with local companies to deliver satellite broadband services. Significant ones are UK's OneWeb with Bharti Airtel, Luxembourg-based SES with Reliance Jio and Canada's Telesat with Tata's Nelco.

More space-linked private entities have mushroomed to avail the opportunities being offered and in November 2022, Chairperson of ISRO S Somanath said that 100 start-ups had already registered with the space agency, of which at least 10 are working on upstream applications (developing satellites and rockets).[25] Besides the initiatives already covered, Agnikul Cosmos and Space Fields have been developing launch vehicles for smaller payloads, Digantara is on line to developing and deploying technologies for contributing to Space Situational Awareness (SSA) and Tathya Earth is looking at downstream applications based on remote sensing. The growing interest and positive policy initiatives have helped these companies raise a cumulative funding of more than $245.35 million in 2022, with expectations of over $300 million in investment in 2023.[26] Indian investment however, has remained low owing to the lack of investors with sufficient risk appetite to venture into an emerging domain, as also lack of clarity in relation to defined space policy. More demonstrable successes would beget more investment, preferably from domestic investors, to avoid commercial exploitation by foreign players, lesser foreign exposure in a sensitive domain and ease of CMI.

The CMI/MCF implementation would require a national strategy or plan that defines a mechanism that facilitates the interaction of a top-down centralised governance structure and bottom-up commercial-led development. [27] Towards this the GoI has established Defence Space Research Agency (DSRA) in 2019 as a civilian scientific organisation responsible for developing space-warfare systems and technologies for Defence Space Agency (DSA), a tri-services institution mandated to aggregate the demands of the armed forces.[28] DSRA is in its formative years and is providing limited assistance to the armed forces. On the other hand, while most initiatives being pursued by these New Age space companies have dual-use potential, there is lack of clarity on

structures and processes for their interaction and coordination with the armed forces.

A relatively clearer initiative has been Mission DefSpace, launched by the Prime Minister during DefExpo in October 2022 with 75 Defence Space Challenges relevant to the end users. These challenges have been categorised into existing DDP initiatives of iDEX, Make-I and Make-2. Private Industries, including Start-ups, MSMEs and Individual Innovators, are eligible to apply. The challenges have been classified into five buckets viz. Launch System, Satellite System, Communication & Payload System, Ground System and Software System to provide a holistic 3600 overview of space.[29]

Path Ahead

A committed governmental approach has often produced spectacular results through a national coordinated effort. The U.S. moon landing program was one such example. In India, success of the Unified Payments Interface (UPI) story has been achieved through public private partnership. Today, almost 40 percent of the world's UPI business happens in India, confirming that India could innovate and implement through a national approach and need not always look at use cases across the world to adapt. India's opening up of the space sector to private participation and efforts at adoption and implementation of CMI in the domain have more similarities with the Chinese model than the western one. The need is to develop and evolve its own model adapting the best of both, for optimising MCF in Space.

The fundamental aspect of MCF would be a comprehensive and systematic legal and regulatory framework that is enabling for the private sector participation and provides for institutionalised coordination among all agencies that could contribute to national security. Towards this, the approval by the cabinet of the new India Space Policy (draft was released in 2020), followed by the approval by the parliament of the Space Activity Act are much awaited. These are expected to provide clear and transparent policy guidelines and regulations, procedures and opportunities. Along with more enabling well-defined import and export control norms, these would help private sector entities expand the business in the sector, boosting the space economy, attract foreign

investment and give a boost to the local manufacturing. The country enjoys a clear advantage in terms of possessing a vibrant, technologically advanced and cost-efficient space sector, lower input costs and strength of its proven software prowess that could be leveraged judiciously, to propel growth in the commercial space sector.

India remains a resource constrained country and it would best achieve its objectives through optimum utilisation of the capabilities and capacities available. Presently, the efforts by private entities lack the desired sophistication and establishment of a vibrant commercial space sector manufacturing industry in the country is a distant goal. The government is thus focussed on providing technological support and access to infrastructure to facilitate the development of commercial space rather than funding technological innovation and has decided not to include the space sector into the Performance Linked Initiative (PLI) scheme.[30] However, the interactive and collaborative mechanisms to promote the sustainable development of the space industry need a focussed and evolving approach. At a later date, these should be able to utilise and incorporate technological innovation benefits from the civil and private enterprises. The entrenched bureaucratic and technocratic mindset that is distrustful of all commercial activity and sceptical of private entities competence should give way to increased interdependence in capability development and innovation. Owing to the sensitivity of the sector, indigenisation is the key to access to technology and achieving scales and to overcome challenges related to export and IPR restrictions.

After years of dithering, the military use of space for its impact on all terrestrial operations has now been openly accepted by India. The increasing requirement of space enabled capabilities for the armed forces in terms of expansion and diversification is challenging the extant structures and capacities. There is a requirement for a formalised MCF strategy that could better define the space doctrines, roles and roadmaps for the defence forces and the way to capability and capacity building. Air Chief Marshal VR Chaudhari, as the Vice Chief of Air Staff in September 2021, had highlighted the lack of robust “military-civil fusion”-like framework that was preventing the nation from innovating and manufacturing next-generation space technologies on a large scale.[31] A pertinent example of military role and requirements is that of SSA,

which he had also referred to as critical for the armed forces to protect and defend its assets in space as also for enabling an effective ASAT capability.[32] Civil specific SSA capabilities would not be sufficient for the defined tasks of the DSA that would require to be extended to tactical, predictive and intelligence driven SSA that comes under an integrated C4ISR architecture.[33] These would require dedicated sensors as also networking with the civilian capabilities towards a more comprehensive network and would necessitate a 'whole of nation' approach.

A further enabler would be a National Security Strategy that would encourage coming together of military and civil components (government, industry, academia) of the nation to contribute to the national well-being. This would also help better define the role of private players during conflict and the role of government agencies in incorporating their capabilities and protecting them against harmful attacks. A more robust structure is required for military specific reform and to cater to military specific requirements, which in the future could explore private sector participation in strategic or military domains.

Of vital importance to the MCF process is awareness and understanding of the demands/requirements and the supply/capabilities and the possibilities that exist for synergy. This can only be achieved through educating the constituent elements, constant interactions and even cross-directorate attachments.

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