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**China's Military-Civil Fusion:
A Paradigm Shift
for
India's Armed Forces to Evolve
from Technology Consumer
to
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Abstract

The evolution of dual-use technology and infrastructure necessitates a paradigm shift in military modernisation. China's Military-Civil Fusion (MCF) strategy offers a compelling model for leveraging civilian innovation to rapidly advance defence capabilities. This paper analyses the strategic implications of China's MCF for India, arguing that India's armed forces must transition from mere technology consumers to active innovators. By examining China's MCF framework, the study identifies crucial lessons for fostering civil-military collaboration and enhancing indigenous defence R&D in India. The paper proposes policy recommendations and structural reforms to recalibrate India's defence innovation ecosystem, ensuring strategic autonomy and competitiveness in the era of disruptive warfare.

Keywords: Military-Civil Fusion (MCF), Innovation for Defence Excellence (iDEX), Dual-use, Indian Armed Forces

Historically, the military has been a primary user of technological innovations developed by the civilian sector. However, the Military-Civil Fusion (MCF) framework seeks to reverse this traditional approach by positioning the military not merely as an end-user but also as an active participant in the development, innovation, and deployment of emerging technologies. With introduction of dual use disruptive technologies and dual use infrastructure, the concept of MCF has emerged as a transformative strategy in modern warfare, wherein civilian technology and infrastructure are integrated with military capabilities to enhance a nation's defence preparedness, technological innovation, and strategic influence (Kania, E.B., 2019).

According to Sun Tzu, *"The supreme art of war is to subdue the enemy without fighting"*. This ancient war philosophy even aligns with contemporary advancements in technology, which offer unprecedented opportunities to achieve strategic objectives without direct military confrontation. Modern warfare has increasingly shifted from traditional kinetic engagements to

securing technological superiority and exerting strategic influence by dominating critical technologies and infrastructure (Kania, E.B., 2019). The ability to seamlessly transition dual-use technologies such as Artificial Intelligence (AI), 5G, quantum computing, cyber security, and space-based systems, along with dual-use infrastructure like airports, ports, highways, and digital corridors, from civilian to military applications provides inherent strategic advantages to a nation. This approach subtly enhances military preparedness without substantially increasing traditional defence expenditures, allowing nations to strengthen their security posture while leveraging existing civilian assets and technological advancements. China's successful implementation of MCF under President Xi Jinping demonstrates how significant investments in dual-use technologies and dual-use infrastructure has enabled the People's Liberation Army (PLA) to achieve strategic superiority and military dominance through economic and technological influence, without even resorting to direct combat (Kania, E.B., 2019).

With the availability of similar key ingredients for MCF, including largest population, a rapidly growing economy, a strategically vital geographic location, and the world's fourth most powerful military, India too possesses significant potential to adopt MCF for inherent strategic advantage. Furthermore, India's highly trained armed forces, growing military diplomacy, and advanced industrial base can provide a solid foundation for integrating dual-use technologies and infrastructure. Unfortunately, the widening capability gap between India and China is largely due to China's full-scale implementation of MCF, which has enabled the PLA to achieve technological superiority and enhance its strategic influence, whereas India is yet to adopt a comparable approach (Bhutani, R. 2023). To bridge this gap, India must prioritise MCF by fostering civil-military collaboration, indigenous innovation, and technological integration to subtly enhance military capabilities and national security.

In the dynamic realm of modern warfare, wherein disruptive dual-use technologies are reshaping strategic landscapes, China's deepening influence in South Asia through its MCF initiatives presents considerable challenges to India's security interests. To navigate this shifting paradigm, India must adopt a fresh, holistic strategy that unites military, civilian, academic, and industrial ecosystems to foster indigenous innovation, build self-sufficient infrastructure, and enhance defence capabilities. Such a transformation will not only fortify strategic deterrence and

reduce reliance on foreign military imports but also strengthen India's geopolitical standing by aligning economic growth with military advancements. A well-adapted MCF model tailored to India's unique context could significantly accelerate its rise as a global power. For India's armed forces to transition from being mere technology consumer to active developers, embracing MCF is crucial for enhancing national security and achieving technological dominance. Seamless integration of civilian and military infrastructure, coupled with the adoption of cutting-edge technologies and a unified national effort, will be pivotal in shaping India's strategic trajectory. Without a decisive shift for adopting MCF, India risks lagging in an era where technological leadership dictates geopolitical influence. Effective MCF implementation requires robust policy interventions, institutional reforms, and coordinated collaboration across defence, academia, industry, and civil sectors. A long-term vision is essential to transform technological advancements into strategic assets, ensuring that India's military modernisation keeps pace with its economic and technological progress. Neglecting this shift could provide adversaries with a critical advantage, exposing India to emerging and asymmetric security threats. The current modernisation strategy of the Indian Army (IA), primarily centred on acquiring platform-centric weapon systems, large-scale military infrastructure, and conventional force capabilities may fall short against future security challenges, necessitating a shift to MCF by integrating dual-use technologies, infrastructure, and national resources to enhance operational capabilities, economic synergy, and strategic preparedness (Vignesh, R. 2022).

MCF: A Strategic Engine for China's Growth and Expanding Global Influence

China's MCF strategy has significantly contributed to its rapid technological advancement, economic growth, and global influence by integrating civilian infrastructure, dual-use technologies, and industrial capabilities to enhance military power. Under President Xi Jinping, MCF has been institutionalised as a national strategy to accelerate the development of cutting-edge technologies. This seamless integration of military and civilian sectors has enabled China to reduce reliance on foreign technologies, boost indigenous innovation, and strengthen the PLA without incurring massive traditional defence expenditure (Rolland, N. 2020).

A key factor driving China's global influence through MCF is its aggressive investment in dual-use infrastructure across developing nations under the Belt and Road Initiative (BRI). Projects

like 5G network installations, BeiDou satellite navigation, smart city infrastructure, and surveillance systems in Africa, Southeast Asia, and Latin America have not only expanded China's economic footprint but also established long-term strategic dependencies on Chinese technologies (Kania, E.B., 2019). This has significantly bolstered Beijing's geopolitical influence by creating economic leverage and allowing intelligence gathering through infrastructure ownership. Moreover, the Chinese State-Owned Enterprises (SOEs) like Huawei, and ZTE are leading the export of digital infrastructure, thus effectively enabling the PLA to secure strategic access to critical infrastructure in host countries (Bitzinger, A. Evron, and Yang., 2021).

The MCF strategy has also facilitated China's rapid defence modernisation due to technology transfer from civilian to military sectors. China's indigenous defence industry has benefited immensely from advancements in niche technologies, thus allowing the PLA to achieve strategic superiority without direct military confrontation (Cheung, M., Lucyshyn, W. and Rigilano, J., 2019).

This approach has not only accelerated China's military modernisation but also reshaped global technological standards, hence challenging the Western-dominated international order. The convergence of economic growth, technological dominance, and military modernisation under MCF has positioned China as a formidable global power. Contrastingly, India has historically maintained a distinct separation between its military, civilian, and industrial ecosystems, which has hindered the pace of technological advancement, sustained dependency on foreign defence imports, and restricted its strategic influence on the global stage.

MCF Strategy for India's Strategic Advancement

Drawing lessons from China's successful MCF model, India must adopt a *de novo* approach to establish a whole-of-nation strategy, integrating its military, civil, academic, and industrial ecosystems to develop indigenous technologies, strengthen infrastructure, and build self-reliant defence capabilities. Such a strategy would reduce dependence on foreign military imports, enhance technological sovereignty, and amplify India's soft power diplomacy. Another critical element in this approach would be the dual-use infrastructure development like Chinese BRI,

wherein infrastructure projects serve both civilian and military purposes, thereby enhancing strategic preparedness. Projects such as development of Chabahar Port in Iran by India can serve as a strategic gateway to Central Asia, enabling both economic growth and military logistical advantage, thus countering China's influence through the Gwadar Port (Aliasgary, S. and Ekstrom, M. 2021).

China has successfully integrated civil-military technological development through SOEs, allowing seamless transition of technology for military modernisation and economic growth. In India, similar potential can be unlocked by establishing defence innovation hubs in collaboration with private industries, startups, and research institutions which will facilitate the development of indigenous military technologies, minimising foreign dependence and strengthening economic growth. Another critical area wherein India can learn from Chinese experience is civil-military academic collaboration. Tsinghua University, often dubbed as "China's MIT", plays a key role in advancing MCF and AI-driven defence technologies. In 2017, it launched the MCF National Defense Peak Technologies Laboratory to promote dual-use tech development, and, with backing from the Central Military Commission, is also building a high-end Military AI Laboratory (Kania, E. 2010). On similar lines, India can establish MCF National Defence Peak Technologies Laboratory at IITs in coordination with DRDO, ISRO, and top industries to develop dual-use advance technologies for civilian and defence needs, promoting indigenous innovation, closing technology gaps, and advancing MCF in line with strategic interests.

China has successfully merged its MCF strategy with economic diplomacy through initiatives like the BRI and newly launched Global Development Initiative (GDI). By offering infrastructure, technology, and financial assistance to developing countries, China has established long-term strategic influence, particularly in Africa, Southeast Asia, and Latin America, where it controls critical infrastructure and technological dependencies (PRC Annual Report to Congress, 2024). India can counter China's strategic influence by expanding dual-use infrastructure and technology in developing and under developed countries. Promoting NavIC, indigenous 5G, and digital infrastructure alongside cyber security, coastal security, and defense partnerships in the Indian Ocean Region can challenge China's 'String of Pearls' strategy. A whole-of-nation

approach to MCF integrating military, industry, academia, and technology will enhance India's self-reliance, economic resilience, and global strategic influence.

Reforms for Implementation of the MCF Strategy

India has already taken substantial steps to enforce MCF by integrating the military, industry, academia, and startups to foster defence innovation. A key initiative in this direction is the establishment of the Defence Innovation Organisation (DIO) under the MoD, that oversees the iDEX (Innovation for Defence Excellence) framework to promote collaboration between the military, industry, and academia (iDEX, 2025).

The iDEX launched in 2018, serves as a collaborative platform enabling entrepreneurs, Micro, Small, and Medium Enterprises (MSMEs), and researchers to develop advanced defence and aerospace technologies (iDEX, 2018). The scheme for iDEX, for a period of 5 years, from 2021-22 to 2025-26, was launched in May 2021 with an objective to provide financial support to nearly 300 Startups/ MSMEs/individual innovators and about 20 Partner incubators through DIO. iDEX provides grants to the Start-ups/MSMEs to fund the projects in many technological areas under Defence India Start-up Challenges (DISC) and Open Challenge through the Support for Prototype and Research Kick start (SPARK) Framework. The iDEX scheme, besides fostering innovation and technology development, is also a path to procurement for the Armed Forces as per the Defence Acquisition Procedure 2020 which states that procurement through Innovative solutions could be undertaken under iDEX and Technology Development Fund (TDF) Scheme through DRDO (Ddpmod, 2021). The Defence Testing Infrastructure Scheme (DTIS) further aids indigenous development by facilitating access to high-end testing facilities (DRDO, 2024). The spiral development approach ensures continuous improvements and adaptation of emerging technologies to meet operational challenges. The Atmanirbhar Bharat initiative underpins India's whole-of-nation approach to reducing dependency on foreign defence imports while fostering niche technologies. By leveraging India's top scientific minds, industry expertise, and startup ecosystem, India is systematically bridging the gap between operational challenges and innovative solutions, thus, ensuring long-term self-reliance in defense capabilities.

Beyond fostering indigenous capabilities, India is also engaging in international collaborations. Since June 2023, the US-India INDUS-X initiative has brought together government officials, defense firms, accelerators, and universities to co-develop cutting-edge solutions. A major milestone under INDUS-X is the Joint Impact Challenges wherein US' Defense Innovation Unit and India's iDEX selected innovative companies to address critical warfighter needs (US Department of War, 2024).

Recommended Changes for Implementation of MCF Concept

The key to MCF lies in breaking down barriers and fostering communication across multiple channels to enable dual-use development. In India, the current siloed and fragmented system, marked by inter-service, inter-departmental, and political rivalries hinders integration. To overcome this, MCF requires an empowered framework with a clear hierarchy to dismantle entrenched divisions and enable seamless coordination (Shankar, P.R. 2023). India can establish a National MCF Council, comprising representatives from the military, industry, academia, and key government ministries to oversee policy formulation, facilitate cross-sector collaboration, drive technology adoption, and monitor dual-use technology development. China's Central Military-Civil Fusion Development Committee (CMCFDC), established in 2017, can serve as a model for aligning military needs with civilian technological advancements, demonstrating the strategic benefits of an integrated approach to defence innovation and national security.

India's R&D expenditure remains significantly lower than China's, both in terms of GDP percentage and total investment. According to the Economic Survey 2023-24, India's Gross Expenditure on R&D (GERD) is approximately 0.64% of GDP, while China spends about 2.41% of its GDP on R&D. In absolute terms, India spent USD 17 billion in FY 2020–21, whereas China's spending is over USD 600 billion reflecting a much stronger commitment to innovation and technological advancement. Moreover, the private sector contributes only 36.4% to India's R&D spending, compared to 77% in China, further widening the gap in innovation ecosystems (PTI, 2024). India, thus, have to increase investments in key R&D organisations, including the DRDO, ISRO, and private R&D firms to strengthen MCF implementation. Strengthening collaborative efforts in niche technologies will enhance technological self-reliance and military preparedness. China's rapid construction of an aircraft carrier within six months at the Guangzhou Shipyard

demonstrates the strategic advantage of integrating civilian industrial capabilities with military objectives, highlighting the need for India to adopt a similar approach to accelerate defence innovation (Seidel, J. 2024).

India can promote deeper collaboration between academia, industry, and the military by establishing Defence Technology Incubation Centres (DTICs) within premier institutions such as the IITs and NITs. These centres would serve as hubs for joint ventures in dual-use technology development, fostering collaborative R&D projects, internships, and talent-sharing among the DRDO, private industry, and academia. China's Zhongguancun Science and Technology Zone demonstrates the effectiveness of this model, wherein an MCF committee actively connects entrepreneurs with military customers to drive dual-use innovation (SPICI, 2025). The GoI can establish dual-use technology parks where defence and civilian industries collaborate in shared research and manufacturing facilities, fostering innovation through joint development efforts in emerging technologies with both military and civilian applications.

India can prioritise investment in dual-use infrastructure that supports both civilian and military operations. Key areas of focus can include developing airports and seaports to facilitate seamless commercial and military logistics, constructing highways and rail networks designed for rapid military mobilisation, and implementing fiber optic communication systems with built-in military-grade security to enhance strategic resilience. China's dominance in the global shipbuilding industry, where it controls over half of the commercial market, highlights the strategic benefits of dual-use infrastructure (PTI, 2025). This approach not only strengthens national security but also enhances economic competitiveness. Adopting a similar model in India will improve defence preparedness, reduce logistical vulnerabilities, and support the country's long-term security and economic objectives.

India can also enhance the iDEX framework by establishing specialised Defence Innovation Zones (DIZs) across major industrial hubs. This initiative will encourage MSMEs, startups, and private industries to actively participate in defence innovation, particularly in niche technologies. China's successful integration of civilian technological advancements into military applications, exemplified by the China Electronics Technology Group Corporation developing fixed-wing drone swarms using commercially available models, highlights the effectiveness of

such collaborations (Nouwens, M. and Legarda, H. 2018). Implementing a similar approach in India would accelerate indigenous defence technology development, strengthen self-reliance, and enhance national security capabilities. To reduce reliance on foreign defence technology, India can promote domestic manufacturing under its Atmanirbhar Bharat initiative by mandating a minimum threshold of indigenous content in defence procurement. Additionally, the government can also provide tax incentives, funding, and policy support to private firms engaged in the development of dual-use technologies, ensuring a stronger and more self-reliant defence ecosystem. China's BeiDou Navigation Satellite System serves as a successful example of integrating civilian and military infrastructure, enhancing strategic autonomy and global positioning capabilities (Strickland, S. 2022). Amending existing defence procurement procedures and offset policies to prioritise dual-use technologies will be essential for the effective implementation of MCF. Encouraging local procurement from private industries and fostering strategic collaboration between academia, industry, and the military will enhance technological advancements and self-reliance.

The GoI can establish an integrated National Space, Cyber, and Electronic Warfare Command under the MCF umbrella to enhance defense capabilities in emerging domains. This command will effectively leverage ISRO's satellite infrastructure for military intelligence, facilitate the development of dual-use satellites for navigation, surveillance, and communication, and integrate cyber warfare and electronic warfare capabilities with civilian IT networks for rapid threat response. China's Strategic Support Force (created in 2015 and disbanded in 2024) can serve as a model for such integration, ensuring technological superiority, improved information dominance, and strengthened national defence resilience in the face of evolving threats (Costello, J. and McReynolds, J. 2019).

Attracting top talent— similar to the lines of Chinese programs like Thousand Talent Programs, Young Thousand Talents Program, Ten Thousand Talents Program, and 111 Project etc. (Cong, C. and Simon, D.F., 2021) from premier Indian institutions such as the IITs, IIMs, and ISRO into the defence sector will be crucial for implementing MCF strategy in India. Offering competitive salaries, research grants, and structured career advancement opportunities will encourage skilled professionals to contribute to defence innovation and modernisation. Additionally, implementing a Defence Technology Act that mandates whole-of-nation cooperation

for MCF, will provide the necessary legal backing for MCF partnerships. Establishing policy frameworks to support defence startups and aligning defence procurement strategies with national industrial policies will strengthen India's long-term self-reliance and technological superiority. To successfully implement the MCF concept effectively in the Indian Armed Forces, adoption of structural, technological, and policy-driven reforms is essential that would integrate civilian advancements with military modernisation.

Recommendations for MCF Implementation

Since “*charity begins at home*”, MCF cannot be effectively implemented without first ensuring the integration of Service HQs. The establishment of Integrated Theatre Commands (ITC) and integration at the Service HQ level is essential before the national-level execution of MCF. The establishment of ITC aims to unify the Army, Navy, and Air Force under a single command to enhance joint operations and is a pragmatic step to promote synergy and operational efficiency (Sagar, P.R. 2025). Recent developments of cross-posting of Aides-de-Camp (ADCs) among the services from January 2025, and establishment of a Joint Division at the Defence Services Staff College to foster inter-service cooperation are encouraging steps undertaken to foster a collaborative and inter-service approach to jointness and integration in warfare and focus on inter-service understanding and cooperation (Singh, M. 2025). A proposal is now lying with the defence ministry to establish a China-focused Northern Theatre Command in Lucknow, a Pakistan-centric Western Theatre Command in Jaipur and a Maritime Theatre Command in Thiruvananthapuram (Sagar, P.R. 2024). India has already established Joint Logistics Nodes (JLNs) in Mumbai, Guwahati, and Port Blair to enhance resource-sharing among the tri-services (Swarajya Staff, 2021), similar to China's Joint Logistics Support Force (Bommakanti, K. 2021).

After establishment of ITC, JLN and integration of Service HQs, the next step is to foster collaboration between the armed forces and private industry from inception stage to strengthen domestic defence manufacturing. A significant milestone in this direction is the establishment of India's first private military aircraft plant for C-295 in Vadodara—a joint venture between Tata and Airbus Spain, is set to deliver the first Indian-made aircraft for IAF by 2026 (Ajit Solanki, 2024). Similar initiatives at apex level will positively facilitate in implementation of MCF at

ground level wherein niche technologies can be prioritised. The designation of 2025 as the “Year of Reforms”, by MoD signals a strategic push towards modernising and enhancing the country’s military capabilities across several key domains through emerging technologies, simplifying acquisition procedures, Public-Private Partnerships (PPP), defence exports and research, and developing cultural pride and indigenous capabilities (ET Online, 2025). As part of 2025 as “Year of Reforms”, a dedicated and integrated MCF Task Force can be created within the Indian Armed Forces to coordinate with civilian industries, academia, and technology firms. This task force can act as a bridge between the military and private sector, ensuring faster adoption of emerging niche technologies. Through MCF Task Force, the Indian Armed Forces can actively engage with private defence manufacturers and startups under initiatives like Atmanirbhar Bharat and iDEX to co-develop dual-use technologies. The Indian Armed Forces can also refine defence procurement procedures to allow for faster acquisition of advanced technologies from private firms and quicker deployment of dual-use innovations on the battlefield. The Indian Armed Forces can also scale up AI and robotics integration by working with private startups and firms. Developing autonomous systems for battlefield operations, logistics, and surveillance would also enhance operational efficiency and reduce human risk in high-conflict zones. Encouraging PPP for defence production can also considerably reduce reliance on foreign imports and enhance self-sufficiency in critical defence systems.

The Indian Armed Forces can also establish a Armed Forces Technology Research Cells within IITs, NITs, and DRDO labs to promote military-oriented research in niche technologies. Collaboration with leading academic institutions will accelerate the integration of advanced research into defence applications. The DRDO has already established eight advanced technology centres dedicated to conducting research on next-generation military applications in 2020 (PTI, 2020). The Indian Armed Forces can also collaborate with NHAI and other private infrastructure firms to develop logistics corridors that enable rapid military mobilisation and utilisation of civil infrastructure during emergencies (Dixit, S. 2023). As part of personnel and human resource reforms to implement MCF, the Indian Armed Forces can also holistically utilise the Territorial Army (TA), the Agnipath scheme, ex-servicemen, and NCC to enhance the operational effectiveness.

Utilising civilian experts through the TA is a cost-effective alternative to maintain a large pool of full-time military specialists in every field. This approach can allow the armed forces to access specialised expertise when needed, ensuring a more agile, adaptable, and capable military force while optimising resources efficiently. The TA can enlist civilian experts across various specialised fields viz. cyber, AI, engineering, medical, languages, enabling the seamless integration of their expertise into military operations. By leveraging these civilian professionals, the TA can establish a vital link between civilian knowledge and defence requirements, facilitating the transfer of advanced technical skills, innovations, and best practices.

The Agnipath and NCC scheme can also strengthen MCF by integrating youth, who can bring fresh perspectives and technological adaptability essential for modern warfare. Many Agniveers possess civilian-acquired expertise in areas that can seamlessly be integrated into military operations during service and post retirement. This initiative will enable cost-effective human resource utilisation, ensuring a tech-savvy, agile force without long-term personnel overheads. Post retirement, Agniveers can bridge the gap between the defence sector, private industry, and academia, fostering cross-domain collaboration for rapid military modernisation. Structured pathways for post-service employment in defence startups, DRDO, or DPSUs can also ensure sustained contributions. By integrating Agniveers (Dixit, S. 2023), and TA personnel, the Indian Armed Forces can accelerate MCF, creating a future-ready, technology-driven defence force

The Indian Armed Forces can encourage the establishment of defence-focused startups by supporting armed forces-led incubation centres under iDEX. This will promote indigenous defence innovations and strengthen India's defence technology ecosystem. The Indian Armed Forces can also leverage ISRO's satellite capabilities to enhance real-time intelligence, navigation, and surveillance. Promoting the development of dual-use satellites will enable seamless military-civil communication, ensuring enhanced battlefield awareness. China's BeiDou Navigation Satellite System is a prime example of how MCF can strengthen national security (Bitzinger, A. Evron, and Yang, 2021).

The Indian Armed Forces can also implement specialised training programs in cyber warfare, AI, space and other emerging technologies by collaborating with academic institutions and tech companies. Training military personnel's in niche technologies will enhance battlefield

adaptability and improve real-time decision-making. For example, a program with IITs and DRDO can train personnel in AI-driven threat detection, while partnerships with private cyber security firms can enhance skills in cyber defence and ethical hacking. Additionally, exposure to satellite-based surveillance through ISRO collaborations can improve space warfare capabilities. These initiatives will ensure a tech-driven, future-ready force capable of tackling modern security threats.

Conclusion

China's MCF approach offers a model worth emulating for nations seeking to substantially boost their economic and strategic power while minimising international backlash or concern. India has significant potential and resources to implement a MCF approach similar to China's model. The Chinese framework provides India with an instructive template that could be adapted as per its unique context and strategic needs. By shifting the role of its armed forces from mere consumer to active developers of technology, India can unlock untapped infinite capacities and capabilities that rival those of China. Embracing a whole-of-nation approach, supported by strong legal frameworks and robust government backing can bridge the existing gap between the two nations, boosting India's self-reliance while increasing global dependencies on Indian defence technologies. This transformation will not only reduce reliance on foreign imports but also accelerate indigenous innovation and expand India's soft power footprint globally. The Indian Armed Forces, at the forefront of this shift, have a pivotal role in catalysing this paradigm change and propelling India towards becoming a true technology-driven military power.

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