Report on Hi-Tech Defence Innovation: India's Need for a National Vision and Roadmap

Smita Purushottam (Ed.)

India needs a national vision and roadmap to meet the scientific and technological challenges of the 21st century and take its place on the world stage as an advanced power with a high-tech manufacturing, including defence manufacturing, base. To achieve this objective, it needs to create a viable national innovation eco-system.

Technology is the battleground in today's fiercely competitive world. Yet India is becoming increasingly dependent for all its high-tech requirements on imports in defence, aerospace, telecommunications, electronics, railways, machine tools, and consumer durables. The Commerce Ministry has estimated that India's merchandise trade deficit will reach an unsustainable 13 percent by 2014. This is good neither for national security nor for national welfare.

India has to create a dynamic national innovation eco-system which is capable of meeting its requirements for high-tech, including defence products. It needs to better appreciate how successful innovation ecosystems work elsewhere, as currently its approach appears to neglect the crucial "soft" capabilities and systemic reforms required. China has made significant technological advances in both its civilian and defence industrial sectors. As a result, it is producing a vast array of advanced weaponry which is upsetting the military balance in the Asia-Pacific region and causing great concern to the established powers. To achieve this, China has conducted comprehensive reforms in multiple sectors

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which contain crucial lessons for India. The Chinese model is relevant because China also started from a low-tech, state-led model and is transitioning to a more grassroots innovation model. China's multifaceted strategy to create a national innovation ecosystem comprises the following:

Reverse Engineering: China has aggressively followed a strategy of reverse engineering, copying and stealing technology. In fact, many of today's advanced countries have self-admittedly gone through this phase and have not suffered any penalties. The success of India's pharmaceutical sector, now a target of foreign acquisitions, is due to reverse engineering. It is important to be aware that there are different stages of the much derided "reverse engineering" phenomenon, which correspond to the level of sophistication attained by an economy. Prof Tai Ming Cheung has lucidly categorised these stages as: duplicative imitation; creative imitation; creative adaptation and/or incremental innovation; architectural innovation (which China has reached); component innovation and radical/disruptive innovation. Like other countries, India too needs to climb this ladder. Indian firms need to start their individual innovation odysseys by opening up the black box and taking it from there.

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Developing Both Hard and Soft Capabilities: While China has still to master component and disruptive innovation, it has tackled the issue of creating both hard and soft capabilities necessary for indigenous innovation, by reforming institutional, governmental, educational and industrial structures. "Hard capabilities" include funding, manufacturing capabilities, laboratories, research institutes and universities. "Soft capabilities" include relative intangibles like leadership, institutional and organisational effectiveness, processes and synergies, the effectiveness of legal and regulatory regimes and other factors that contribute to innovative activity. It is equally important to work on soft innovation capabilities, including governance regimes and reforms, leadership direction, reengineering of organisations and cultures, market reforms, sources

of funding, entrepreneurial skills and resources, education and training. Only a combination of the two will ultimately yield disruptive innovation of the kind seen in the advanced economies.

Leadership Direction: The top Chinese leadership which is composed of technocrats is single-mindedly directing the drive for technological upgradation. China's armed forces have been a part of this endeavour.

Focussed Policy Framework for Indigenisation: China has issued clear guidelines such as the landmark State Council "Guidelines for the Medium- and Long-Term National Science and Technology Development Programme (2006-2020) of the People's Republic of China State Council."

Reengineering Government Structures: China has been experimenting with reengineering government structures to target them more precisely on the objective of technological upgradation.

Systemic Reforms and Marketisation: China is also encouraging changes in the patent regime, a transition from state to market oriented enterprises, and so on. Thus, 22.5 percent of state-owned defence firms had completed their shareholding restructuring by the end of 2007, compared with 65 percent in the national economy.

Civil-Military Integration: China has placed faith in the capacity of its dynamic and growing civilian economy to support technological innovation which feeds into military innovation (spin-on effects) as proclaimed in its 16-character policy. It knows that a high-tech defence innovation sector cannot exist in isolation from the civilian economy as *a dual-use manufacturing base under a civil-military integration paradigm drives technological advances*. It has accordingly promoted the integration of its defence and civilian economic sectors, having succeeded at first in creating a diversified manufacturing foundation through industry-friendly measures. India's attempts to bring out a manufacturing policy, therefore, correspond to this stage.

Reforms in Research Institutions and Science Academies: China has simultaneously reformed its research institutions and science academies in order to make them more market-oriented even while it has retained the development of strategic technologies within the government sector.

Educational Reforms: China has implemented a range of educational reforms to increase the quantity, quality and delivery of its educational institutions.

Similarly, other models such as the newly launched South Korean Defence Industry Development Council (DIDC), appropriately co-chaired by the South Korean Ministry of National Defence (MND) and the Ministry

of Knowledge Economy (MNE); the Turkish defence industrialisation strategy, and the Israeli Industrial Cooperation Authority –all directed at boosting high tech defence innovation capabilities and exports—can provide a menu of best practices for India's reforms. Based on a preliminary study, the following can provide a roadmap for a national technology strategy.

The armed forces and Defence Research and Development Organisation (DRDO) must play a leading role as they have done a lot of work in mapping out visions and strategies for indigenous technological development.

A National Vision

- Ensure leadership at the highest level for a **national vision to underpin an Integrated Science&TechnologyAdvancementStrategy (VISTAS)**—declaring that an indigenous, high-tech manufacturing, including defence production, base and a supportive national innovation eco-system are national priorities. Supportive documents like the offsets policy should reflect this.
- Set up a **National Technology Advisory Council** (NTAC) directly under the prime minister to monitor implementation of VISTAS by entities dealing with indigenisation across the government, armed forces, industry and academia. *No new department will be created*—the NTAC would include the apex representatives of all stakeholders.
- Strategy must determine force structure and acquisition plans, not the other way round. The high-tech weaponry required to meet India's security challenges should be derived from a vigorously debated Long-Term Integrated Perspective Plan (LTIPP) on war-fighting strategies under credible threat scenarios. The armed forces and Defence Research and Development Organisation (DRDO) must play a leading role as they have done a lot of work in mapping out visions and strategies for indigenous technological development.

Declare a Defence Industrialisation Strategy

- **Declare a Defence Industrialisation Strategy:** The National Manufacturing Policy is fully compatible with this strategy and further synergies can be identified.

- Apply the principles underlying civil-military integration (CMI) to defence industrialisation, encouraging the development of a dual-use, high-tech manufacturing sector as a high-tech defence production base cannot exist in isolation.
- Prioritise Indian industry in defence acquisitions and designate Indian firms or consortia as **lead integrators** for defence production and all other high-tech projects. Use the crucial levers of defence acquisitions and defence offsets to give first preference to Indian industry, as indicated in the Defence Production Policy (DPP) 2011 (Buy and Make Indian categories to get priority).
- Introduce modern management in public sector units, (PSUs) including defence public sectors units (DPSUs) and research institutes or corporatise/ debureaucratise/ privatise them.
- Explore all strategies for development of technology, including acquisition of foreign technology firms.
- Promote reverse engineering if Indian industry is to fast climb the learning curve of late catchers-up.
- Promote defence exports to expand markets. India's missions and posts abroad must actively promote India's defence exports and be proactively associated with the development of indigenous technology programmes. This will provide volumes, make Indian defence industries economically viable and cost competitive and incentivise research and development (R&D) investments.
- The proposed **Defence Industry Development Council** or **DAOITDC** can deliberate on the strategy for procurement from, or development by, indigenous sources, including reverse engineering, technology acquisitions abroad, industry/government laboratories/academic partnerships, etc. with the lead Indian integrator.

Institutional Set-up and Reforms

- Review DPP 2011 with inclusion of clear and straightforward defence technology development and indigenisation guidelines (DTDIG), which should include mutually reinforcing provisions of acquisitions, offsets, exports, manufacturing, foreign direct investment (FDI) and transfer of technology (ToT) policies for indigenisation purposes.
- Reform and realign all relevant policies (offsets, defence acquisitions and production, FDI/ToT policy, exports and the new National Manufacturing

Policy), mechanisms and implementing agencies of government – to the task of developing indigenous technology.

- Create a combined **Defence Industry Development Council** from Ministry of Defence (MoD) departments/agencies like defence acquisitions, Department of Defence Production (DoDP), Integrated Defence Staff Headquarters (IDS HQ), Defence Offset Facilitation Agency (DOFA) and DRDO, associating the Ministries of External Affairs, Defence, and Commerce and Industry – to implement a coordinated technology indigenisation policy by leveraging all the means at a state's disposal, including leveraging market access for indigenisation. Thus, while the main focus of the aforementioned South Korean Defence Industry Development Council (DIDC) is boosting exports, it is also in charge of R&D strategies, defence offsets, including technology acquisition and training programmes. The DIDC cooperates with the Defence Acquisition Programme Administration (DAPA), the Korea Defence Industry Association and the Korea Trade-Investment Promotion Agency. South Korea's existing offsets policy states that defence contracts worth more than US$10 million must have offset clauses amounting to a minimum of 30 per cent of the total value of the deal. South Korea aims to be among the world's top ten defence exporters within this decade. There is no reason why India cannot achieve the same objective].

Merge existing organisations and labs in the aerospace/naval sectors into a National Aerospace Organisation and the proposed Naval Indigenous Systems Development Organisation (NISDO) to coordinate the development of aerospace/naval technologies.

- If not possible, then at least set up a defence acquisitions, offsets and indigenous technology development committee devoted to this purpose (or **DAOITDC;** another acronym turns out to be DACOIT – defence acquisitions committee for offsets and indigenisation of technology – so DAOITDC may be preferable). All relevant stakeholders, including industry, academia, IDS HQ, DRDO, G-Fast, the new National Aerospace Organisation, National Aerospace Laboratory (NAL), Aeronautical Development Agency (ADA), etc. should be associated with the deliberations of the DIDC or DAOITDC. No separate bureaucracy needs to be created.

- Eventually, reengineer government organisations and processes by merging or dynamically linking departments in charge of acquisitions, production, indigenisation, R&D, ToT, FDI with ToT provisions, manufacturing and exports – to create synchronised entities focussing on promoting indigenous high technology.
- Merge existing organisations and labs in the aerospace/naval sectors into a National Aerospace Organisation and the proposed Naval Indigenous Systems Development Organisation (NISDO) to coordinate the development of aerospace/naval technologies. China's experience in its aerospace sector which rests *inter-alia* on civil-military integration should be studied. A similar apex body could be considered for the army.
- Make the promotion of indigenisation, commercialisation of technology, and encouraging R&D a criterion for promotions.

Offsets, FDI, TOT

- Expand and extend defence offset obligations by removing the minimum threshold, levy 100 percent offset obligation and extend it to all major purchase orders. This is becoming the international norm.
- Studying and incorporating international best practices in offsets and evolving the Indian system while ensuring accountability must be encouraged. Pilot projects can be encouraged.
- Formulate a model National Offsets Policy for the telecommunications, aerospace, railways, IT sectors, etc. – all of which are responsible for huge imports.
- Set up offsets agencies in all these sectors.
- Meanwhile, raise the defence offset obligation to 100 percent. While 30 percent should continue to be reserved for the defence production sector, 70 percent can be invested in high-tech sectors such as aerospace, telecommunications, railways, composites, engines, machine tools, electronics hardware, and other requirements of India's high-tech industry. This would create a dual use manufacturing base which will benefit the defence sector as better quality items become available indigenously, the philosophy behind civil and military integration (CMI). The defence industry cannot grow in isolation.
- Give verifiable offset credits for transfers of core technologies. Boeing transferred "composite materials" technology to a Malaysian company at the government's direction and it now supplies 70 percent of all composite

materials used in the Boeing 787 Dreamliner. China has achieved several successes through offsets.

- Quantify offsets credits (FDI brought in, higher local content obligations, exports, high skilled jobs created) and subject offset credits to the national audit. Absolute transparency, zero tolerance for rent seeking behaviour and fool-proof guidelines for evaluating offset credits must be instituted.
- Instead of reintroducing licensing, measure offset credits against specific indigenous content requirements/ procurements/exports or measures indicating tangible progress towards indigenisation, like Malaysia and Turkey. Under the Turkish ToT policy – the defence supplier can determine the price of the technology – there is no verification done by the Government of Turkey. However, offset credits for the technology are only given when the exports using the technology exceed the value of the technology transferred. A *Jane's Defence* article indicates that Turkey is going even further along the path to increase the offset obligation, lower thresholds, and increase the obligation regarding local content or export earnings for offset credits.

Instead of reintroducing licensing, measure offset credits against specific indigenous content requirements/ procurements/ exports or measures indicating tangible progress towards indigenisation.

- Lower the threshold for offsets from the current $66 million.
- At the same time, the guidelines should not be an excuse for stifling flexibility, common sense and even experimentation. Officials should have enough delegated powers to decide on the national interest.

Increase FDI Ceiling in Defence Industry in a Calibrated Manner

- There was some unease regarding indiscriminately raising the FDI cap as some forum members felt that no meaningful technologies enter through the FDI route. However, it was recognised that the goal of a strategic defence industrial policy should be to create employment and capabilities at home. The success of Maruti and the auto sector was cited. Some liberalisation is, therefore, in order. This is essential to relocate production of high-tech defence items to India, since attainment of autonomous technological

capabilities is still several years in the future. Local high-tech manufacture will also encourage development of local high-tech supply chains. Also, some technology diffusion does take place through the FDI route though it is not always optimal.

- Moreover, host country policies can be formulated to derive maximum benefit from FDI, for example, access to India's market must be accompanied by transfer of technology and phased indigenous sourcing obligations. China has done this successfully. Inter-ministerial coordination is crucial to enable this.
- Thus, the existing policy of permitting higher FDI ceilings on a case by case basis must be continued but much more liberally, with conditions that facilitate high-tech defence industrialisation in India.
- Fifty-one percent FDI participation for various projects related to an acquisitions programme that has already identified an Indian firm or consortia of Indian firms as the lead integrators for the main platform can be permitted more extensively. This will encourage tie-ups with small and medium enterprises (SMEs) in countries like Taiwan and Germany which are important sources of high technology.
- A calibrated tariff policy to protect indigenous manufacture, along with the relaxation of FDI norms, resisting pressure for tariff reductions under multilateral trading arrangements should be instituted.

Funding (Hard Capabilities)

- Double the target for India's R&D expenditure to 1.75 percent of Gross Domestic Product (GDP) by 2015, 2 percent by 2020, and 2.5 percent by 2025. This compares well with China's goal of reaching 2.5 percent of the GDP by 2020, as declared in its medium-to-long term S & T development plan. China's R&D/GDP ratio more than doubled from 0.6 percent in 1996 to 1.5 percent in 2007, even as China's GDP grew at 12 percent annually (near verbatim quote from Science & Engineering Indicators, 2010).
- Industry must contribute an increasing proportion of R&D expenditure with a mandatory 5 percent of revenues for large scale industry and 3 percent for small and medium enterprises, as per the practice in the advanced countries (exemptions for loss making enterprises would be provided). The government should match these expenditures. In the United States, industry funds about 67 percent of all R&D. For the European Union (EU), it is 55 percent, with nearly 70 percent for Germany and 45 percent for the United Kingdom. In

China, Singapore, and Taiwan, industry funding ranges from 60 percent upward (near verbatim quote from Science & Engineering Indicators, 2010).

- The service sector, especially in telecommunications and aerospace, should invest in manufacturing R&D and set up manufacturing capabilities with indigenous technology. Imports in these sectors should have mandatory 100 percent offsets. The Israeli model of encouraging long-term industrial partnerships can be further examined.

Information and Transparency

- Ensure transparency in awarding government contracts.
- Every government department/private or public sector company should carry on its website a list of (a) projects to be awarded for indigenisation; and (b) items imported from abroad. Industry associations and the National Small Industries Corporation (NSIC) should disseminate this information to its members.
- Declassification of important reports like the Kelkar Committee report, greater consultation with entities outside the goverment and data access is imperative.
- Every government department/private or public sector company should carry on its website a list of proactive departments and officials charged with indigenisation, with full contact details.

Reforms in Public/Private Research Institutions and Academia

- The Indian industry/government should prioritise establishment of R&D and technology development centres in key strategic areas emulating the best management practices in recruitment, incentivisation and promotions followed by Multinational Corporations Research and Development (MNC R&D) centres in India. These should take over the bulk of non-strategic R&D and technology development in partnership with industry and academia and with partial government funding support. Commercialisation of technology should be actively pursued.
- DRDO and CSIR (Council of Scientic and Industrial Research) should focus on fundamental research and accelerate outsourcing of technologies for production to the private sector.
- For disruptive technologies, a Defence Advanced Research Projects Agency (DARPA)-style organisation should be developed.

- Reform bureaucratised and silo-based R&D infrastructure. Modern management techniques in CSIR and DRDO laboratories must be rigorously enforced in the national interest. Options, including corporatisation, privatisation, and public-private partnerships, must be carried out after pin-pointing reasons for cost over-runs and huge delays in achieving ToT and indigenisation.
- Reform incentives system in research institutions – award recognition to scientists who have marketed their product or obtained patents, not just for publications.
- An academic revolution to upgrade the quality of research institutions in fundamental sciences and key technologies should include parity of incentives with the private sector, strict merit criteria for induction and promotion (no reservations but preference given to equally qualified people from underprivileged sections of society in key R&D institutes and science academies), modern 360 degree and user-based evaluations, and social recognition and prestige.
- Incubation centres should be attached to industrial parks with rentable basic infrastructure to get away from land acquisition and start-up problems in the brick and mortar space.

Education and Offsets

- India's educational foundations, especially in science and technology, must be strengthened.
- New funding sources can be tapped, for example, use some of the defence offset funds or the proceeds of disinvestment to select a handful of key universities and concentrate resources to turn them into leading universities.
- Offset obligations for setting up of internationally recognised research institutes and science academies in universities of applied sciences on the German model, vocational education facilities; innovation clusters with manufacturing units and related R&D units/tie-ups with scientific institutes – yielding massive welfare benefits – should be introduced.

Studies and Research Reports

Study international best practices. VISTAS should be formulated by an independent body of experts – scientists, engineers, economists, academics and research institutions, the military, industry, and government leaders.

A detailed study to inform broader policy planning—of how other countries have undertaken successful catching-up efforts in national and defence innovation – should be conducted. This should include countries such as China, Japan, South Korea, Turkey, Israel and the USA and should tackle overall strategy, technology policy, reforms, defence offsets and implementation structures. The US model – whose universities have become the key drivers of innovation – should be studied. The Chinese experience with its 211 and 985 projects has found that cultivating an elite of around 10-30 universities offers the optimum strategy. The offer of renowned expert on China's technological upgradation strategy and member of the forum Prof Tai Ming Cheung from the University of California to conduct a collaborative study with his university on reforms required in India was welcomed.

India has to overcome the hesitant, piecemeal and turf-led approach to defence industrialisation and innovation if it wishes to catch up with the world's technological leaders.

Conclusion

India has to overcome the hesitant, piecemeal and turf-led approach to defence industrialisation and innovation if it wishes to catch up with the world's technological leaders. Without the above reforms and changes, India will be unable to take its place as an advanced technological nation which will affect its standing, autonomy in conducting foreign policy, and, most importantly, the overall welfare of its citizens. It is recommended that the government consider these suggestions and take appropriate measures to launch a high-tech science and technological revolution in India.