



Institute for Defence Studies & Analyses

REPORT OF THE FORUM ON HI-TECH DEFENCE INNOVATION

14TH JULY 2011

The Objective

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% by 2014. This is neither good 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 its 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 established powers. To achieve this, China has conducted comprehensive reforms in multiple sectors 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 grass-roots innovation model. China's multifaceted strategy to create a national innovation ecosystem comprises the following:

1. **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.
2. **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 - including 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 organizational 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, re-engineering 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 advanced economies.

3. **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.
4. **Focused 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”.
5. **Re-engineering Govt. structures:** China has been experimenting with re-engineering government structures to target them more precisely on the objective of technological upgradation.
6. **Systemic Reforms and Marketization:** China is also encouraging changes in the patent regime, a transition from State to market oriented enterprises and so on. Thus, 22.5% of state-owned defense firms had completed their shareholding restructuring by the end of 2007, compared with 65 % in the national economy.
7. **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.
8. **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.
9. **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 Defense Industry Development Council (DIDC), appropriately co-chaired by the South Korean Ministry of National Defense (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.

A National Vision

- ⌘ Ensure leadership at the highest level for a **National Vision to underpin an Integrated Science & Technology Advancement Strategy (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 Government, the Armed Forces, Industry and Academia. *No new department will be created* – the NTAC would include 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 LTIPP on war fighting strategies under credible threat scenarios. The Armed Forces and 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 2011 (Buy and Make Indian categories to get priority).
- ⌘ Introduce modern management in Public Sector Units including DPSUs and research institutes or corporatise/ de-bureaucratise/ privatise them.
- ⌘ Explore all strategies for development of technology including acquisitions 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 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/govt. lab/ academic partnerships etc. with the lead Indian integrator.

Institutional set-up and reforms

- ⌘ Review DPPs 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, FDI and 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 MOD departments/ agencies like Defence Acquisitions, DoDP, IDS HQ, DOFA and DRDO, associating the Ministries of External Affairs, Defence, and Commerce and Industry - to implement a coordinated technology indigenisation policy by leveraging all means at a State's disposal including leveraging market access for indigenization [Thus while the main focus of the afore mentioned South Korean Defense Industry Development Council (DIDC) is boosting exports, it is also in charge of R & D strategies, defence offset including technology acquisition and training programmes. The DIDC co-operates with the Defense Acquisition Program Administration (DAPA), the Korea Defense Industry Association and the Korea Trade-Investment Promotion Agency. South Korea's existing offset policy states that defence contracts worth more than USD10 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 the world's top ten defence exporters within this decade. There is no reason why India cannot achieve the same objective].
- ⌘ 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 & Indigenisation of Technology - so DAOITDC may be preferable). All relevant stakeholders including industry, academia, IDS HQ, DRDO, G-Fast, the new National Aerospace Organisation, NAL, ADA, etc. - should be associated with the deliberations of the DIDC or DAOITDC. No separate bureaucracy needs to be created.
- ⌘ Eventually, re-engineer 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 focusing 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, commercialization 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% offset obligations 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 defence offset obligations to 100%. While 30% should continue to be reserved for the defence production sector, 70% 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). 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% 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 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 Govt. 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 offset obligations, lower thresholds, and increase the obligation regarding local content or export earnings for offset credits.
- ⌘ 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 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.
- ⌘ A unique opportunity has presented itself following a major easing of restrictions on high-tech transfers to India by the United States and other Western countries, reflecting changing geostrategic realities. Thus on January 24, 2011, the US implemented commitments given in the Indo-US joint summit statement of November 8, 2010 to remove Indian companies from the U.S. “Entity List” and support India’s membership in four multilateral export control regimes – the Nuclear Suppliers Group, Missile Technology Control Regime, Australia Group, and Wassenaar Arrangement. The reforms have laid the ground for the announcement of a host of agreements with significant scope for technology transfers between Indian and foreign partners. It is essential that this window of opportunity be fully availed of and hi-tech production be launched in India. Over time, it will encourage development of Indian capabilities.
- ⌘ Host country policies can simultaneously 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/ training/ partnership 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 industrialization in India.
- ⌘ 51% 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 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% of GDP by 2015, 2% by 2020, and 2.5% by 2025. This compares well with China's goal of reaching 2.5% of GDP by 2020 declared in its Medium-to-Long Term S & T Development Plan. China's R&D/GDP ratio more than doubled from 0.6% in 1996 to 1.5% in 2007, even as China's GDP grew at 12% annually (near verbatim quote from Science & Engineering Indicators, 2010).
- ✧ Industry must contribute an increasing proportion of R & D expenditure with a mandatory 5% of revenues for large scale industry and 3% for small and medium enterprises, as per the practice in advanced countries (exemptions for loss making enterprises would be provided). Govt. should match these expenditures. In the United States, industry funds about 67% of all R&D. For the EU, it is 55%, with nearly 70% for Germany and 45% for the United Kingdom. In China, Singapore, and Taiwan, industry funding ranges from 60% 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% offsets. The Israeli model of encouraging long term industrial partnerships can be further examined.

Information & 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 NSIC should disseminate this information to its members.
- ✧ Declassification of important reports like the Kelkar Committee report, greater consultation with entities outside Govt. 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

- ✧ Indian industry/ Government should prioritize establishment of R & D and Technology Development Centres in key strategic areas emulating the best management practices in recruitment, incentivisation and promotions followed by 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 should focus on fundamental research and accelerate outsourcing of technologies for production to the private sector.
- ✧ For disruptive technologies, a DARPA-style organization should be developed.
- ✧ Reform bureaucratized and silo-based R&D infrastructure. Modern management techniques in CSIR and DRDO laboratories must be rigorously enforced in the national interest. Options including

corporatization, privatization, and public-private partnerships must be carried out after pin-pointing reasons for cost overruns 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 startup 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 recognized 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 USA 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.

Conclusion

India has to overcome the hesitant, piece-meal and turf-led approach to defence industrialization 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, but most importantly, affect the overall welfare of its citizens.

It is recommended that Government consider these suggestions and take appropriate measures to launch a high-tech science and technological revolution in India.