



## **INSTITUTE FOR DEFENCE STUDIES & ANALYSES**

### **FORUM ON HI-TECH DEFENCE INNOVATION**

FIRST MEETING: 14 JULY, 2011

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## *VISION FOR AN INTEGRATED SCIENCE & TECHNOLOGY ADVANCEMENT STRATEGY*

### *VISTAS*

#### **The Objective**

**India needs a National Vision and Roadmap to meet the scientific and technological challenges of the 21<sup>st</sup> century and take its place on the world stage as an advanced power with a high-tech manufacturing including defence manufacturing base. For this it needs to create a viable national innovation eco-system.**

#### **The Challenge**

- ⌘ India has not built a holistic high-tech manufacturing base which can inter alia support defence innovation and high-tech weapons production. India continues to import most of its high-tech defence equipment, machine tools, telecommunications and IT hardware and civil aircraft.
- ⌘ India as a result is faced with a growing and unsustainable merchandise trade deficit which the Commerce Ministry deems is unsustainable.
- ⌘ Indian defence sector PSUs, one of the very few entities aspiring to undertake the development of indigenous high-tech capabilities - have so far failed to achieve targets for indigenous production of high-tech items, barring some successes.

#### **Reason**

- ⌘ There is no national policy prioritizing in a holistic and synergised manner - the development of a high-tech manufacturing and indigenous defence production base. This is in contrast to China which has bent all its energies to create a high-tech defence innovation economy.
- ⌘ The contours and requirements of a high-tech economy which can support a dynamic high-tech defence production sector are not properly understood.

- ⌘ India's R&D infrastructure is bureaucratized and works in silos. A small beginning has been made to forge partnerships with industry and academia but it is not supported by a policy/institutional framework and thus does not go far enough.
- ⌘ Systems for development of high-tech capabilities do not work efficiently and in synergy with each other— thus Indian industry is capable of meeting high-tech defence manufacturing requirements but needs greater support and the right policy framework in defence acquisitions and offsets.
- ⌘ The small entrepreneur has limited means by which to contact the facilitator in government or in industry so well-meaning schemes remain under utilised and advertised.
- ⌘ Scientists who have marketed their product obtained patents are not given due recognition, instead publication of research papers constitutes the sole criterion for promotion and recognition.
- ⌘ There are significant governance issues which affect the viability of both SMEs and big industry in setting up pioneering high-tech ventures in the brick and mortar space, as opposed to in software.

## Roadmap

- A. Make development of a high-tech manufacturing including defence production base and a supportive national innovation eco-system a national priority.
- B. Popularise awareness regarding basic principles of successful high-tech defence innovation systems.
- C. Highlight need for political leadership and policy support at the highest level for a National Vision for an Integrated Science & Technology Advancement Strategy (VISTAS) prioritising indigenous development of technology including defence technology.
- D. Increase R & D spending across Government and Industry.
- E. Re-engineer and reform Government structures, public sector, Government research institutions, etc. to ensure results.
- F. Ensure greater transparency, user friendliness and sharing of information by Government departments, public sector etc.
- G. Prioritise Indian industry in defence acquisitions: launch a drive to identify and match procurement and import requirements with capabilities available in indigenous SME and large industry sector.
- H. Designate Indian firms or consortia as lead integrators for defence acquisition and all other high-tech projects. This will ensure that they remain in the driving seat of all high-tech production programmes.
- I. Reform the Defence Offsets/FDI/TOT policy, guidelines and implementing agencies to give priority to indigenisation, and kickstart a defence led industrialisation drive encouraging a holistic (dual-use) high-tech manufacturing base.
- J. Expand and extend defence offset obligations by removing the minimum threshold, levying 100% offset obligations and extending it to all major purchase orders.
- K. Formulate a model National Offsets Policy for telecommunications, aerospace, any large procurement order etc. along the lines of defence offsets and set up a National Offsets Agency or sectoral Offsets Agencies in aerospace, telecom etc. This will ensure development of a dual-use, high-tech manufacturing base which can support the defence production sector through supply of critically needed precision tools and parts, composites, electronics, software and other items.
- L. Implement multiple strategies to develop and acquire technology, including acquisitions of firms abroad, reverse engineering. etc.
- M. Mandate service firms to invest in Manufacturing R & D and target net export surpluses over imports.



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**REPORT OF THE FORUM ON HI-TECH DEFENCE INNOVATION  
14<sup>TH</sup> JULY 2011**

**Setting the stage**

India has entered the 21<sup>st</sup> century with a low- to medium tech manufacturing base. While laudable advances have been made in many areas, India has in all honesty fallen behind in the possession of advanced and critical technologies and the development of an indigenous high-tech defence manufacturing sector. Defence equipment touted as indigenous turns out to have unacceptably high import content and indigenisation targets have not been met in several projects despite time and cost overruns, as detailed in CAG (Comptroller & Auditor General of India) and PAC (Public Accounts Committee) reports. India could have leveraged its vast market for defence, telecommunications, aerospace and electronics equipment to create internationally competitive high-tech manufacturing facilities in these sectors with a strong R & D base.

Instead, despite being the target of technology denial regimes, and harbouring perennial concerns over the possibility of denial of crucial spare parts in conflict situations, India does not have a plan to technologically upgrade its economy, including its defence manufacturing sector, and gain control over critical technologies.

Meanwhile, other countries are taking measures to maintain their technological lead, realizing that this is their underlying advantage both in the global competition for power and for ensuring rising living standards. President Obama has repeatedly emphasised the need to retain America's lead in science and technology. President Medvedev has launched a drive for the technological upgradation of the Russian economy, including on the foreign policy front. China is pursuing a focused policy to catapult the country from being a technology absorber to becoming a technology producer. China has prioritized the development of its national capabilities, and implementation is through a host of coordinated policies in the S & T sector, defence production, trade and FDI policy, preferences etc.

India needs a national - as opposed to a purely departmental - vision and strategy to create a high-tech industrial including defence production infrastructure for the 21<sup>st</sup> century. This will not come up on its own as tremendous investment in R. &D. have to be made to compete with the dominant global high-tech companies. The Forum on High-Tech Defence Innovation brought together key stakeholders to brainstorm

on this issue. It agreed that a country which aspires to play the role of a major power must have autonomous technological capabilities of the highest levels. There is an indelible linkage between scientific and technological (S&T), industrial and military capabilities, which contributes to comprehensive national power including military power.

The Forum concluded that India has to create a dynamic innovation eco-system and put in place a strong and seamless R & D base organically linked to high-tech industry - which can ultimately yield disruptive technologies to benefit the defence manufacturing and other sectors – as a national priority. *While building an advanced defence production sector is a priority, technological upgradation of the rest of the economy has to march in step as one cannot confine innovation and technological excellence in closed systems indefinitely. Creation of a dual use manufacturing base under a civil military integration paradigm is the philosophy behind all successful technologically advanced economies.*

The Forum also agreed that while India must leverage every tool such as investing in foreign technology firms, leveraging defence offsets, transfer of technology and FDI policies to reinforce the indigenous development of high-tech capabilities, etc. - India must rely primarily on its own efforts including restructuring and reform.

The Forum noted the reforms initiated at the working level by committed individuals in key organisations to help commercialise R & D developed in defence laboratories, assist SMEs in defence production and involve academia and industry through innovative partnerships. While these can serve as bottoms-up, best practice models for further reforms, this way of functioning and related reforms need to be made the institutional norm if India is to ever hope to create an eco-system capable of sustained technological breakthroughs. *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.* Major game changing reforms in the way Government, industry and research institutions are organized and function will be required. And only through the support and participation of the Central Leadership at the Highest Levels can India overcome the daunting barriers and move up the innovation ladder. Otherwise, India will be doomed to remain in the third tier of defence technological powers.

To this end the Forum proposed a **Road Map** centred on:

## **A National Vision**

- ⌘ Political direction, leadership and policy support at the highest level should be provided for a National Vision for an Integrated Science & Technology Advancement Strategy (VISTAS) prioritising (a) the indigenous development of technology including defence technology and (b) creation of a viable and sustainable national innovation ecosystem covering all sectors and based on solid R & D foundations and indigenous high-tech including defence manufacturing capabilities.
- ⌘ This should be declared a national priority for ensuring national security and national welfare which are inextricably interlinked.
- ⌘ VISTAS should be formulated by an independent body of experts - scientists, engineers, economists, academics and research institutions, the military, industry, and government leaders.

## **General principles and targets**

- ⌘ 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.

- ⌘ The Armed Forces' LTIPP must be derived from vigorously debated war fighting strategies under credible threat scenarios which should identify capabilities required in the immediate, medium and long term. As someone said, strategy must determine force structure and acquisition plans, not the other way round.
- ⌘ The target for India's R & D expenditure should be doubled to 1.75% of GDP by 2015, 2% by 2020, and 2.5% by 2025.
- ⌘ The top priority in all government procurement orders including defence, civil aviation, telecommunications etc. and industry should be given to Indian industry.
- ⌘ Industry should contribute an increasing proportion of R & D expenditure with a mandatory 5% for large scale industry and 3% for small and medium enterprises, as per the practice in advanced countries. Govt. should match these expenditures.
- ⌘ The service sector especially in telecommunications and aerospace should invest in manufacturing R & D and set up manufacturing capabilities with indigenous technology.
- ⌘ Apart from quantitative increases, systemic obstacles should be addressed aggressively. Matching institutional reforms as per below should support implementation of a result oriented indigenisation programme in different defence production sectors.

## Studies and Research Reports

- ⌘ A Technology Benchmark Index to gauge where India stands in the international pecking order should be developed. An all-encompassing audit of Research Institutions and the Public and Private Sector engaged in defence production - highlighting critical gaps in achieving high-tech defence production and suggesting remedial measures - should be conducted. However a broad vision (VISTAS) and long term scenarios for developing high-tech capabilities must be adopted rather than purely short-term cost benefit analyses as long gestation periods, inevitable failures and setbacks have to be factored in.
- ∇ 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, and the USA and should tackle overall strategy, technology policy, reforms, defence offsets and implementation structures. In this connection renowned expert on the subject of China's defence technological upgradation strategy and member of the Forum Prof. Tai Ming Cheung suggested a collaborative study with his University on best practices and models followed by other countries and on lessons for and structural reforms required in India to smooth the way for reaching the stated objectives. The Forum welcomed this suggestion.

## Institutional set-up and reforms

- ∇ The Forum highlighted the laudable initiatives towards development of indigenous technology taken by some departments and individuals. But clearly these efforts need to be knitted together so that measurable progress is achieved on a national scale. For example, the Navy has a proactive Indigenisation Directorate and a 15 year vision for the indigenous development of technology. IDS HQ, MOD interfaces with Indian industry to ascertain their capabilities to manufacture equipment required by the Armed Forces. Defence Acquisitions in MOD is interfacing with other departments to explore the possibilities. DRDO and G-FAST are experimenting with public-private and academic partnerships to

bring crucial technologies to market. Laboratories like NAL and bodies like ADA are working to generate indigenous technologies in aerospace.

- ▽ But very few people have heard of these proactive departments and individuals. And there is no support system, articulated policy and institutional framework, which can embed and synergise their efforts into the default mode for government processes and operations.
- ▽ Moreover, apathy, red tape, delays and cost overruns are more typical of government run departments and PSUs than committed and proactive individuals. This is reflected in regular shortfalls and failures to achieve indigenisation targets, with the committed and sincere bureaucrats left to fight the tide.
- ▽ There are also a number of initiatives which need coordination – defence acquisition plans, offsets in the civilian and defence sectors, other Government schemes to make Indian products more internationally competitive and higher in technology content, projects in the aerospace SEZ, private sector projects, R & D laboratories such as the Aeronautics Development Agency and labs under DRDO and CSIR.
- ▽ So the main reforms required in the public sector (including Government) concern efficiency and synergy.
- ▽ Government organisation and processes must therefore be re-engineered and reformed, for example by merging or dynamically linking departments in charge of acquisitions, indigenisation, R&D, ToT, FDI with TOT provisions and exports - to create synchronised entities aimed at promoting development of indigenous high technology. Redundant departments should be abolished and existing departments reorganized to implement this objective.
- ⌘ The indigenous development of technology and indigenisation should be made the top priority of all government purchase departments including defence, civil aviation, telecommunications etc. and of industry also. These should be linked in their daily functioning with entities dealing with the development of indigenous technology. Very soon best practices will proliferate from better performing to laggard sectors.
- ▽ The China model could be studied in this regard. China has conducted an overhaul of State structures in charge of S & T, of the defence economy, high-tech civilian/defence sector, and research institutions and introduced market oriented reforms in all these to achieve better results. In this connection and as mentioned above Prof. Tai Ming Cheung suggested a collaborative study with his University on structural reforms required in India to smooth the way for reaching objectives.
- ▽ Without an institutionalised leadership support mechanism and policy framework, the chances of the successful execution of a long-term S&T development effort is at serious threat from competing bureaucratic interests within the government and state-led economic sector. That is why a national Vision and a national oversight body is recommended.
- ▽ **A national oversight body which can draw together representatives of all the bodies concerned with the indigenisation of technology on a revolving basis should be set up. This could be a National Technology Advisory Council (NTAC) within the Cabinet or directly under the Prime Minister's control, or a Cabinet Committee on Development of Indigenous Technology (CCDIT) to direct and monitor implementation of VISTAS. Every major entity dealing with indigenisation across Government, Industry and Academia would report progress / lack of it to it. *No new department will be created* – the NTAC would include apex representatives of all stakeholders.**

- ∇ Inter-ministerial coordination between the Ministries of External Affairs, Defence, and Commerce and Industry - to leverage market access for technology transfers and implement a coordinated technology indigenisation policy by leveraging all means at a State's disposal – must be established under the NTAC or CCDIT.
- ∇ For disruptive technologies, a DARPA-style organization should be developed.
- ∇ Sectoral re-organisation to tackle ambitious projects would be in order. For example, in view of India's vast defence and civilian aerospace market and the indigenisation projects suffering time and costs overruns, an over-arching National Aerospace Council to coordinate a master plan for technological excellence and production should be considered.
- ∇ A similar apex council could be created in the Navy, which has an excellent record of indigenisation and several ongoing initiatives - and Army.
- ∇ Technocrat-cum-management experts with a proven record of turning organisations around (examples include Dr. V. Saraswat, Dr. Vikram Sarabhai, Dr. Sridhar of Delhi Metro) – should be appointed to head the bodies implementing the indigenisation effort in a time bound manner. China's technocratic leadership gives it a great advantage.

## **Information & Transparency**

- ∞ Transparency should be the guiding principle in Government dealings on the indigenous development of technology. Declassification of important reports like the Kelkar Committee report, greater consultation with entities outside Govt. and data access is imperative.
- ∞ The public must be updated on the projects awarded for indigenisation under the defence procurement procedures.
- ∞ The list of desirable technologies for indigenisation should include a list of civilian dual-use technologies and should be made public.
- ∞ Every Government Department / private or public sector company should carry on its website a list of items imported from abroad. Industry associations and the NSIC should disseminate this information to its members.
- ∞ 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, so that SMEs and companies with fewer resources can immediately reach the concerned official and get movement on their requests.
- ∞ Incentives and rewards to Government officials promoting indigenisation, commercialization of technology, and encouraging R & D should be made a criterion for promotions.
- ∞ Names of facilitating officers should be placed on a well-known government website. The proposed National Council for the Advancement of Technology should have a website which has all these names listed in it.
- ∞ The same criterion should be applied in academic, R & D and technology institutions.

## Industry reforms

- ⌘ Public sector units including DPSUs must be restructured to be made more responsive to the market and de-bureaucratized to make them more approachable to public requirements. China's model can be studied in this regard.
- ⌘ A consortium approach to win big projects and supply major tenders like multi transport aircraft should be adopted by Indian industry.
- ⌘ Greater industry participation in and funding contribution to R & D through governance reforms and incentives must be ensured.
- ⌘ Telecommunications majors and firms in other service sectors such as civil aerospace should contribute funds for R & D to kickstart a manufacturing base. Imports in these sectors should have mandatory 100% offsets.
- ⌘ The constraints on SMEs and Industry must be reduced and rent-seeking behaviour including the near impossibility of getting land allotments have to be tackled.
- ⌘ SMEs and small technology companies as sources of patentable technology need to be more actively tapped. Incubation centres can be located in industrial and high-tech technology parks with a common pool of rentable equipment, which would also encourage collaboration with different institutes.
- ⌘ Indian industry must be encouraged to explore all strategies for development of technology-acquisitions of foreign technology firms, aggressive reverse engineering etc.

## Reforms in the Defence Acquisitions/Offsets/FDI/TOT policies and implementing agencies

The Department of Defence Production (DoDP) has a very important lever for promoting the indigenous development of technology – defence acquisitions and defence offsets. It is recommended that:

- ⌘ DoDP/ IDS HQ must ensure that first preference for defence acquisitions must really be given to Indian industry, as indicated in the Defence Production Policy of 2011. This would mean that in defence acquisitions, Buy and Make Indian categories would be given first consideration and **Indian industry given the role of lead integrator/ developer.**
- ⌘ There should be a combined Defence Acquisitions, Offsets and Indigenous Technology Development Committee completely devoted to this purpose (or DAOITDC; unfortunately another acronym turns out to be DACOIT - Defence Acquisitions Committee for Offsets & Indigenisation of Technology - so DAOITDC may be preferable) rather than separate agencies like MOD, DoDP, IDS HQ, DOFA, DRDO etc. dealing with acquisitions, offsets and indigenisation separately. A Committee rather than Agency/departmental format is preferable since expertise exists within various bodies on this issue and instead of recreating capacities within the proposed DOITDC, the different bodies including outside government, should be brought together when deciding on defence offsets and indigenisation projects. No separate bureaucracy needs to be created.
- ⌘ Since the present Defence Procurement Policy 2011 contains only piecemeal references to indigenous development, a simplified Defence Technology Development and Indigenisation Guidelines (DTDIG)



devoted exclusively to indigenisation and containing simplified procedures for implementing indigenisation in the various categories - Make, Buy and Make Indian, Buy and Make Global — should be formulated. The DTDIG should leverage the mutually reinforcing nature of Acquisitions, Offsets, FDI and ToT for indigenisation purposes, based on other country experiences in managing offsets credits / FDI/ TOT.

- ⌘ The Committee should decide with the lead integrator, preferably Indian, on the overall strategy for procurement from indigenous sources and also on indigenising a technology/ equipment including reverse engineering, technology acquisitions abroad, industry/govt. lab/ academic partnerships etc. This will ensure that foreign technology partners will tie up with Indian majors. Strategies to ensure development of a dual use high-tech manufacturing base which can support the defence productions sector through supply of critically needed precision tools and parts, composites, electronics, software and other items should be aggressively pursued.
- ⌘ A public list of technologies/equipment/components that have to be indigenously produced under an Indian-led consortium should be advertised and continually updated.
- ⌘ The Government can even tolerate 51% FDI participation under a weapons procurement programme that has already identified an Indian firm or consortia of firms as the lead integrator/ entity for the programme, since the foreign majority firm will have to be under the overall leadership of the Indian entity. Together with mandatory provisions for phased indigenisation, technology transfer will take place over the years and the product will be indigenised. Please see below.
- ⌘ All participants should be represented in the DAOITDC on a revolving needs basis when deciding on defence offsets and indigenisation projects. These could include industry, academia, IDS HQ, DRDO, G-Fast, the new National Aerospace Council, NAL, ADA, etc. depending on the offset – naval, airforce or aerospace, army, etc. DOITDC should work closely with the designated indigenisation body in that sector to target offsets to the indigenisation project decided by the agency concerned.

### **FDI, TOT AND OFFSETS**

- ⌘ In Europe, indirect offsets, 100% offsets, export-linked or indigenisation content related offset credits and very low thresholds appear to be the norm (pl. see copy of Jane's Defence article on Turkish reforms in offsets policy). This encourages local production, transfer of technology, and upgradation of a wide swathe of industrial infrastructure. The importance of indirect offsets lies in the fact that if properly conceived, it can complement high-tech defence industrialisation by contributing to the creation of a high skills, high-tech production capabilities, given that even simple items require a worldwide web of supply chains.
- ⌘ Absolutely transparent and fool-proof guidelines for evaluating offset credits must be instituted. Creative solutions like those adopted by Malaysia and Turkey which have yielded quantifiable progress towards indigenisation should be adopted.
- ⌘ India should raise offset obligations to 100%. While 30% should continue to be reserved for the defence production sector, the rest 70% can be invested in high-tech sectors such as aerospace, telecommunications, composites, fuses, miniaturizations, sensors, 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.

- ⌘ Offsets should be extended to other sectors of the economy (including the academic sector) and even the private sector, and for all major imports (telecom, IT hardware, infrastructure etc.).
- ⌘ The threshold for offsets from the current \$66 million should be lowered if not abolished, as Turkey is reportedly contemplating. Exports and higher local content obligations should be made conditions for offset credits.
- ⌘ **A model National Offsets Policy for telecommunications, aerospace, any large procurement order etc. should be formulated and a National Offsets Agency or sectoral Offsets Agencies in aerospace, telecom etc. set up. This will ensure development of a dual-use, high-tech manufacturing base which can support the defence production sector through supply of critically needed precision tools and parts, composites, electronics, software and other items.**
- ⌘ Instead of reintroducing Licence Raj, the Turkish and Malaysian examples can be incorporated: under the Turkish TOT policy– the defence supplier can determine the price of the technology – there is no verification or validation done by Govt. of Turkey. However, offset credits for the technology would only be given when the exports of products using that 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. There is no reason India should not follow these examples.
- ⌘ South Africa, Malaysia and some other countries adopt what is called as a “prescriptive” offset policy. The Malaysian government simply told Boeing that the technology they would like Boeing to transfer is “Composite Materials”. Boeing transferred the technology and today that company supplies 70% of all Composite Materials used in the Boeing 787 the Dreamliner. China has achieved several successes through offsets. The power of offsets is tremendous IF used properly.
- ⌘ The Defence Technology Development and Indigenisation Guidelines (DTDIG) referred to above should incorporate utmost transparency and zero tolerance for rent seeking behaviour. Offsets should be quantified and subjected to National Audit.
- ⌘ FDI should be leveraged for transfer of technology as China does and the cap raised.
- ⌘ There was some unease regarding raising the FDI cap as some Forum members felt no meaningful technologies enter through the FDI route.
- ⌘ However, it was recognised that (a) if the lead integrator is Indian, then a variety of strategies may be required to produce the entire weapons system. Some sub assemblies and parts can be produced locally through FDI enterprises which will only bring in technology if they are given majority holding; (b) thus 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 obligations and phased indigenous sourcing requirements; (c) this would help to relocate production to India and develop a major part of the supply chain - both high and relatively low technology - including many technologies that are not under embargo - in India. Some technology diffusion does take place through this route even though it is not optimal.
- ⌘ However, it was re-affirmed that India has to first and foremost rely on its own efforts and develop its own R & D and technological base.

- ⌘ Monitoring of indigenisation/ local sourcing and production targets must be maintained to ensure effective TOT outcomes from FDI even if the FDI ceiling is raised.
- ⌘ 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.

## **Reforms in public/private research institutions and academia**

- ⌘ Reforms in the management of PSUs, CSIR and DRDO laboratories (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. These organisations should be de-bureaucratized on priority basis and modern management techniques rigorously enforced in the national interest.
- ⌘ Establishment of R & D and Technology Development Centres in key strategic areas following best management practices in recruitment, incentivisation and promotions followed by MNC R & D Centres in India - should be prioritized by Indian industry/ Government. 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.
- ⌘ Government including DRDO should focus on strategic technologies and basic R & D through its own network of institutions. DRDO should continue to accelerate handing over R & D discoveries to industry for exploitation. There should be a commercial element but at the same time fundamental research should not be sacrificed this should be the province of the government.
- ⌘ R&D Institutes should be tasked with producing marketable technologies. The research projects should not be given to the research labs and institutes but to the private sector. The reason for this is that if an assignment is given to the private sector they can choose the best people from different institutes and avoid parochialism, and restriction of the available pool of talent in institutional silos and politics.
- ⌘ The malaise in academic institutions is due to their appraisal systems which give importance only to publications, and mediocre ones at that (the rate of international citations for Indian papers is not upto standard). By prioritizing only publications we are wasting our national resources by educating others. The promotion criteria should be based on the marketability of product/ patents acquired and only then number of internationally recognized and cited publications, not merely publications in India. Publication can happen AFTER it is patented.
- ⌘ Real innovative research the world over is done by startup companies. Incubation centres must be attached to industrial parks with rentable basic infrastructure. The industrial parks could take shares as collateral and at the end of 5 years encash it, make the company move out and fend for itself.
- ⌘ The biggest bottleneck for a startup is the black money required for land purchase. Renting is difficult as the plethora of permissions bind the person down and the landlord can eject him anytime. If he rents land as a part of an existing unit he becomes excisable if the COMBINED turnover exceeds the limit. These lacunae need to be examined and ironed out.

## **Education and offsets**

- ⌘ The Forum strongly emphasised strengthening India’s educational foundations especially in science and technology, and learning from the experiences of foreign countries that have been able to harness their

universities to become the key drivers of innovation. The USA stands out as the best example. Understanding how the government and Congress there played such a vital role such as through legislative initiatives such as the Dole-Sabxly act- would provide a useful comparative roadmap for India to learn from.

- ⌘ 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.
- ⌘ New funding sources can be tapped for example uses 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. The Chinese experience with its 211 and 985 projects has found that cultivating an elite of around 10-30 universities offers the optimum strategy. 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.

## Conclusion

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 imperative for Government to consider these suggestions and take appropriate measures to launch a high-tech science and technologic revolution in India.

Jai Hind!