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## Fire-power of DRDO's Arjun Tank takes quantum jump with new ammunition: MoD

NEW DELHI: India on Saturday said the new ammunition for Arjun Tank, successfully tested by DRDO, will provide a "quantum jump" in fire-power of the indigenously-developed main battle tank. The new tank ammunition called 'Penetration-Cum Blast (PCB) and Thermobaric (TB) Ammunition' is specially designed for Arjun Tank and was recently tested by the Defence Research and Development Organisation (DRDO). "The trials were found to be very effective and the damage was devastating with the firing of ammunition successfully destroying the target tank and severely damaging its turret, barrel, tracks, ammunition bin, various sights, antennas among others," the Defence Ministry said in a statement. The ammunitions have been developed by Pune-based DRDO laboratories Armament Research and Development Establishment (ARDE) and High Energy Materials Research Laboratory (HEMRL). During the development phase, these ammunitions were extensively evaluated against different simulated targets - armour plates, concrete structures and fortifications. The trials were conducted jointly with Army and was aimed to demonstrate the effectiveness of the ammunitions on derelict tank fitted with instrumentation to measure the shocks, blast pressure and temperature at various locations and on advanced imaging systems. "The trials were unique as for the first time such evaluation is carried out in India which will give a quantum jump in the fire-power of Arjun tanks," the Ministry said.

hindi.oneindia.com

10 जनवरी

### अर्जुन टैंक ने दागे बारूद के गोले, दहल उठा चांदीपुर!

भुवनेश्वर। 6 जनवरी, 2016 की सुबह अचानक चांदीपुर में धमाके सुनायी दिये। देखा कि भारतीय सेना का सबसे शक्तिशाली टैंक अर्जुन गोले-बारूद बरसा रहा है। धमाके इतने तेज थे, कि आस-पास के इलाके दहल उठे और आसमान से पक्षी तो मानो गायब ही हो गये। यह सब एक परीक्षण के तहत किया गया। असल में डीआरडीओ और भारतीय सेना ने अर्जुन टैंक के लिए विशेष रूप से डिजाइन किए गए नए टैंक गोला-बारूद, पेनेट्रेशन कम ब्लास्ट (पीसीबी) और थर्मोबेरिक (टीबी) का सफल परीक्षण किया। पढ़ें- कैसे ज्यादा करे भारतीय सेना, पूर्ण विवरण यह परीक्षण अति प्रभावशाली रहा। लक्षित टैंक को नष्ट करने के लिए चलाया गया गोला-बारूद काफी विध्वंसक था, जिससे टैंक का बुर्ज, बैरल, पटरियां, गोला-बारूद बिन, विभिन्न स्थान, एंटीना आदि को काफी क्षति पहुंची। यह गोला-बारूद पूणे के डीआरडीओ की प्रयोगशालाओं, आयुध अनुसंधान एवं विकास स्थापना (एआरडीई) तथा उच्च ऊर्जा सामग्री अनुसंधान प्रयोगशाला (एचईएमआरएल) द्वारा विकसित किया गया। टीबी गोला-बारूद के लिए व्यापक शोध करने के बाद एचईएमआरएल ने एक नवीन रसायनिक संघटक विकसित किया गया। यह टैंक 59.5 टन का है और 10.6 मीटर लंबा है। इसे चलाने के लिये चार लोगों की जरूरत होती है। एक ड्राइवर जो दुश्मन को खदेड़ने के लिये टैंक को सही दिशा में लेकर जाता है। लोडर, जो गोला-बारूद भरता है। गनर जो गोला-बारूद को दागने का काम करता है और एक कमांडर जिसके इशारे पर दुश्मन को नेस्त्राबूत करने का काम किया जाता है।

## Ex-DRDO chief to file key defence report

Former DRDO chief V.K. Aatre will submit this week a crucial report to the defence ministry recommending guidelines for selecting domestic private firms for strategic partnership in critical segments like submarines, aircraft and missiles. "The report is ready and it will be submitted to the defence ministry on January 15," Mr Aatre told news agencies. The recommendations, if accepted, will become part of the new defence procurement procedure (DPP) that has been in the works for

long. The ministry's top decision-making body, Defence Acquisition Council (DAC) is scheduled to meet on January 12 and the main focus would be the new DPP. Sources said the contentious point of blacklisting is set to be discussed on that day. Speaking to news agency PTI, Mr Aatre said his report focuses on the procedures to be followed while selecting a strategic partner and the kind of contracts that can be signed. Defence minister Manohar Parrikar had said on September 3 that the Aatre Committee, which has experts from banking, chartered accountancy, among other sectors, has been asked to submit a report within three weeks. A number of defence deals hinges on the new DPP and its delay may hit the modernisation process. The new DPP was originally expected to come around April, 2015. One of the major deals hinging on the new policy is the P75-I project of the Indian Navy for building six new conventional submarines. The recommendation by the Dhirendra Singh Committee, set up to recommend changes to DPP 2013, had surprised many in the defence industry. The draft DPP 2015 report had recom-

### अर्जुन टैंक को स्वदेशी गोला

■ विप्र, नई दिल्ली : देश में विकसित मुख्य युद्धक टैंक (एमबीटी) अर्जुन को अब देश में ही विकसित गोला मिलेगा जिसका परीक्षण ओडिशा स्थित चांदीपुर में किया गया। यह स्वदेशी गोला पेंनेट्रेशन कम ब्लास्ट (पीसीबी) और थर्मोबेरिक (टीबी) एम्युनिशन के नाम से जाना जाता है। यह खास तौर पर अर्जुन टैंक के लिए बनाया गया है। गोला किसी भी टैंक के कवच और कंक्रीट संरचना को ध्वस्त कर सकता है।

Navbharat Times

mended that for wider 'Make in India', the government should adopt a strategic partnership model, whereby a private firm is chosen for the development of a specific identified platform. Several Indian players are against this recommendation arguing that the government cannot select only one player for a specific sector. The six critical segments identified are - aircraft and their major systems, warships of stated displacements, submarines and their major systems, armoured fighting vehicles and their major systems, complex weapons that rely on guidance system, C4ISTR (Command and Control System) and critical materials (special alloys and composites). Even several original equipment manufacturers are against the concept arguing that they should have the liberty to choose an Indian partner. "Also, restricting one group to one platform is unprecedented. Globally, every large defence firm has a land, air and naval segment," sources were quoted as saying. There is also a fear that strategic partnerships will work against the the small and medium-scale industry in the defence sector. However, Parrikar has asserted that everybody will get a level playing field.

# Defence panel favours five areas for 'Make in India'; 49% FDI cap for private 'strategic partners'

By Manu Pubby

NEW DELHI: A key defence ministry-appointed panel to identify private sector players that will be accorded special 'strategic partner' status for major military manufacturing projects has identified five priority areas for Make in India in the defence sector and has recommended a strict three-step selection process. While consultation on the selection of strategic partners - private companies selected for military projects worth over Rs 10,000 crores - is still in the final stages and will be discussed during a high-powered meet this week, ET has learnt that comprehensive financial, technical evaluation process has been recommended as well as a composite entry gate. The panel, led by former DRDO Chief VK Atre, has identified ten segments of projects - for each of which one private sector company shall be chosen - but has said that in the first stage, only five should be prioritised. This includes aircraft, helicopters, submarines, armoured fighting vehicles and ammunition. The recommendations will restrict a single company to a particular segment. For example, a company like L&T would be able to qualify only for one sector like submarines as a strategic partner and will have to forgo other areas where it has expertise like warships and guns. However, for the three areas of metallic materials and alloys, non-metallic material and ammunition, up to two partners from the private sector will be chosen by the ministry. While the ministry is to fine tune the criteria for selection, ET has learnt that several private companies have shared concerns about the selection parameters being too restrictive and unfavourable to new entrants. Even existing players feel that the restrictions on more than one company being selected for more than one segment will hamper investments already made by them in different areas from aerospace to artillery. The Atre committee has suggested a minimum lock in period of 20 years for a strategic partner and has recommended that the process should be completed within nine months after a thorough verification of the financial records of companies applying for the partnership. A new strategic partnerships wing is also recommended to be set up in the defence ministry. The government would also have rights to take over control of the strategic partner in case of non performance or in the event of a war of emergency situation. For selection of partners, the panel has recommended a committee led by sector experts that would follow a three step process to identify private players. The first step would be composite entry gate based on financial and technical parameters. This would be followed by a verification step. The third step would be to select the remaining players on technical and financial parameters. This would include their past performance, R&D capabilities, existing facilities for manufacturing as well as quality assurance.

# Time to deploy robots in combat

By S Nanda Kumar

It must have been a nightmare for the security forces when the Indian Air Force base at Pathankot came under attack by armed infiltrators. A strict operating procedure must have been followed, but the scenario would have changed every second. Only those in the thick of the action would know what the ground realities are. Casualties are the only grim certainties. It was heartwrenching to see men in uniform, who were not in the direct line of gunfire, lose their lives. Soldiers like Lt Col Niranjana who died when a grenade, possibly booby trap-ped, went off. If it is deeply saddening to see men go down to bullets in a combat situation, it is even sadder to see deaths that could have been avoided even by the slenderest of margins. And that slender margin could be the use of technology. Robots are being widely used across the world to defuse bombs, while drones go on reconnaissance assignments (with video and thermal-imaging cameras attached to them, sending back live pictures to a command post). They even carry small gauge arms that can open fire at a target via a remote controller. In November 2015, China unveiled three robots that can carry out surveillance, armed attack and defence procedures including small bombs disposal. In what could have been a Standard Operating Procedure (SOP) in any encounter situation between infiltrators/ terrorists and the armed forces, robots could have been immediately deployed to reconnaissance the area for possible bombs or grenades once combat operations began. The R&DE (E) wing of the Defence Research & Development Organisation (DRDO) had developed and handed over a batch of robotic units called 'Daksh' to the Army way back in 2011. The wheels of 'Daksh' are equipped to climb staircases and negotiate steep slopes, and dispose of bombs by using its water jet disruptor. It has a range of capabilities, including using a camera and an X-ray scanner to view and recover suspicious objects. It can be controlled remotely from a distance of 500 metres with a clear line of sight. Four years down the line, one can be sure that 'Daksh' has become much more sophisticated, with the basic tactical strength remaining the same - deploying it into potentially dangerous (and explosive) situations. The moot question here: Could a similar robotic device have been used by the NSG during its combat operations? It is very difficult to digest that in 2016 the Indian defence forces used humans to approach the bodies of the slain intruders, when robots could have been sent forth. Especially with field experience that slain infiltrators are most often left behind with booby-trapped grenades that go off when their body is moved or shifted. Robots need to be readily available for use in forward air bases and strategic forward posts right across the border areas, irrespective of which arm of the Indian armed forces is tasked with keeping vigil.. Electronic warfare devices There is no doubt that there is a need for a large number of highly trained bomb-disposal specialists in today's touchy security scenario in India. But they should now go hand in hand with unmanned aerial vehicles (UAVs), satellite and thermal imagery, and other electronic warfare (EW) devices. Everybody holds their breath each time a bomb disposal expert steps in to directly defuse a bomb. A huge sigh of relief goes up when the bomb is defused successfully. But Lt Col Niranjana and the others with him were not so lucky. 'It need not be this way' is what we were all probably saying when we saw the grieving families of those killed in Pathankot in the explosion. And this in an era where civilian 'gated' communities, residential apartment complexes and corporate buildings bristle with closed circuit cameras (CCTVs), an era when new drones and robotic devices are being unveiled at regular intervals, and are easily available for purchase by civilians. Armed infiltrators play on the knowledge that gaps can be created across our border. But once they are in, they would prefer to carry a limited amount of hi-tech gear for their navigational purposes, like GPS units, reserving the bulk of their luggage for weapons and material for destroying structures and humans. The huge advantage of the armed forces over such infiltrators would be the extensive use of unmanned drones and robots for surveillance, combined with sophisticated thermal and satellite imagery. This kind of surveillance could stop them from approaching so close to a forward airbase like the one at Pathankot. There is no doubt that the strategic commanders of our defence forces are using this advantage wherever possible. They are right in keeping details of the use of such unmanned vehicles out of the public domain as far as possible, for obvious reasons. But whenever there are murmurs over avoidable military deaths after an incident, such as the one at Pathankot (combined with comments about 'bad luck'), one would keep wishing for more open and extensive use of robots and UAVs - double-edged weapons that could save lives as well as deter infiltration.

## Defence council set to list purchase rules

Focus on local manufacturing: The new defence procurement procedure is likely to incorporate suggestions of the Dhirendra Singh panel that gave its report in July. It will specify rules for selection of private partners from among Indian or foreign companies for making military equipment. It will focus on attracting investment, building local confidence and allowing indigenous manufacturing. Ban on equipment for misdeeds of company staff may go. This will ensure that the supply of equipment is not blocked in the wake of a bribery case. The new procedure may allow agents/marketing intermediaries to be registered. Almost 20 months into its tenure, the Narendra Modi-led National Democratic Alliance government is set to change the all-important defence procurement procedure (DPP), the policy document for defence equipment purchases, local production and imports. The amendments to the DPP-2013 are on the agenda of the Defence Acquisition Council (DAC) slated to meet in New Delhi on January 12, sources told The Tribune. Headed by Defence Minister Manohar Parrikar, the DAC is the apex decision making body on defence matters and its decision will need ratification from the Cabinet Committee on Security. The new DPP is likely to incorporate most recommendations made by the Dhirendra Singh-headed panel of experts, which gave its report in July. It will lay down benchmarks for selection of private strategic partners from among Indian or foreign firms. The strategic partners are mandated to undertake design and development projects under the "Make in India" procedure. These firms will tie up with Indian private or public sector companies for making top-of-the-line military equipment. The new procedure will address policy issues to attract investment, build local confidence and allow indigenous manufacturing. The DPP is likely to disallow any bans against equipment for misdeeds of company employees; will seek to appoint an ombudsman to remove subjectivity in deals and have a panel of experts on cost negotiations to prevent delays. The DPP may set in clause to have the Comptroller and Auditor General (CAG) to do pre-audit of deals rather than raise objections later. It will increase the level of indigenisation and the method of calculating the local content in each defence equipment and lay down the indigenous threshold for categories "buy Indian" and "buy & make Indian" at 40 per cent and 60 per cent, respectively. A lower local content threshold could be considered by the DAC, based on technology and its availability. Globally, India is the largest buyer of weapons and military equipment, accounting for 15 per cent of all such international imports, said a report by Sweden-based think-tank Stockholm International Peace Research Institute in March. The DPP will also address the issue of banning firms. The misdeeds of an entity or its employees may not have any bearing on the equipment or system. This will ensure that the supply of equipment is not blocked in case a bribery charge emerges.

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## Ministry of Defence restricts Internet access for personnel

By Manu Pubby

NEW DELHI: The defence ministry has tightened rules on cyber security after recent incidents of hacking came to light, restricting Internet access for personnel as well as reiterating directions not to use Wi-Fi and Bluetooth-enabled devices in South Block. More worryingly, an internal audit of computer systems at the high-security defence ministry headquarters has revealed rampant breach of cyber safety measures that had been put in place, including classified documents being stored on vulnerable computers connected to the Internet. "Recently, some incidents of alleged hacking of computers in the Ministry of Defence have come to notice. During cyber security checks carried out in different offices, major cyber security breaches have been observed," a defence ministry note dated December 18 reads. Among the violations recorded were "Internet usage without security clearance, classified documents on Internet PCs and Internet-connected PCs being used for official work." Instructions have been issued to strictly follow. "Use of dongles on Internet, presence of Bluetooth/Wi-Fi features on laptop and PCs which are strictly prohibited have been detected in a few offices," the note said. Cyber security has been a major concern for the defence ministry, especially as attempts have been made in the past to target personnel based in South Block. In April 2015, a Singapore-based firm uncovered a large-scale cyber espionage network allegedly linked to the Chinese government that had been active for 10 years, infecting computer systems of key individuals and organisations.

# Army to get K9 Vajra-T howitzers

by Sushant Singh

100-gun deal estimated to cost between Rs 4,500 crore and Rs 5,000 crore The Army is likely to get the K9 Vajra-T, the 155-mm/52-caliber self-propelled howitzer, after the artillery gun co-developed by Larsen & Toubro (L&T) and Samsung Techwin cleared the evaluation trials of the defence ministry in a global competition. Although the bids were made under the 'Buy Global' provision of the defence procurement procedure, the K9 Vajra-T gun will be made at its Talegaon plant near Pune by the L&T. Defence ministry sources told The Indian Express that the evaluation process was completed in September last year, when L&T was informed of the ministry's decision. After completing the benchmarking process, the ministry, on December 22, opened the price bid of L&T as it was the only gun to qualify in the trials. Ministry sources said that the price negotiations with L&T will commence this month and are likely to be concluded in this financial year. The deal for 100 guns is estimated to cost between Rs 4,500 to Rs 5,000 crore. The contract will also have a follow-up option clause of 50 additional K9 Vajra-T guns. The first 10 guns are to be supplied by L&T to the Army within 18 months of signing, with the balance 90 guns to be supplied in the next two years. These will be the first howitzers to be inducted in the Army after the procurement of controversial Bofors 155mm guns nearly three decades ago. Four companies, including the Tatas, the OFB and the BEML, bid for the RFP (request for proposal) issued in January 2011. Along with L&T's K9 Vajra-T, an upgraded version of OFB's Russian MSTA-S SP gun participated in the field evaluation trial held from March to August 2013 at the Pokharan Field Firing Range in Rajasthan. Industry sources said that L&T has modified Samsung's K9 to create the K9 Vajra-T. About 50 per cent of the gun is planned to be indigenised by L&T in India, including the fabrication and machining of the hull and turret structure and 14 indigenously developed sub-systems.



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11 January 2016

## Mi-17s to get gunfire sensors

IAF needs light-weight systems with 'strap-on' capability; process on to identify vendors

**Russian firm to fit device** 1. IAF's Mi-17 helicopters are set to be equipped with small arms fire detection systems (SAFDS), 2. The system will warn the aircrew about the range, angle and direction of incoming hostile gunfire from the ground during combat operations, 3. This will ensure safety of helicopters during operations undertaken in close proximity to the ground 4. The system will be retrofitted on the helicopters by Russian company Kazan Helicopters, which builds the Mi series. The IAF plans to equip its Mi-17 helicopters with small arms fire detection systems (SAFDS) that will warn aircrew about the range, angle and direction of incoming hostile gunfire from the ground during combat operations. The system will be an added advantage during operations undertaken in close support of ground troops during war, heli-borne insertion of troops, special missions as well as counter-terrorist operations, where helicopters operate in close proximity to the ground. The SAFDS will also be useful in situations like the terror strike at the Pathankot air base earlier this month, where Mi-17s were also deployed for aerial surveillance and there was a possibility of them being fired upon. The Indian Air Force has also been providing logistic support to paramilitary forces deployed in anti-Maoist operations and there have been several instances of these being fired upon. At least two Mi-17s are reported to have suffered damaged in such incidents. The Air Headquarters is in the process of identifying suitable vendors for the equipment and a request for information in this regard has recently been issued by the Ministry of Defence. The systems will be retrofitted on the Indian Air Force's M-17 fleet by Kazan Helicopters, the Russian company that manufactures the Mi series of helicopters, rather than the aircraft being modified in India. The Indian Air Force is looking for SAFDS that are light-weight with a "strap-on" capability so that one system can be deployed on more than one particular helicopter airframe. These will be ruggedised, have day-night and all-weather operation capability and function effectively in all phases of flight like take-off, climb, cruise, hover, descent and landing. Apart from the Indian Air Force, the Army and the Border Security Force are also evaluating ground-based SAFDS for deployment along the Line of Control and some stretches of the International Border that have witnessed regular ceasefire violations.

## Army asks civilians not to wear combat-pattern dresses

The Army today asked civilians to avoid wearing "army-pattern" dresses and shopkeepers to refrain from selling combat clothes, as it issued fresh guidelines to the public to prevent terror attacks. The guidelines, to be followed across the country, come nearly a week after six terrorists infiltrated through the border and launched attack at the Air Force station in Pathankot, claiming the lives of seven security personnel. Civilians have been asked to avoid wearing "army-pattern" dresses and shopkeepers were asked not to sell combat cloth, army uniforms and equipment as "it is illegal" to do so, an official spokesperson said here. Also private security agencies, police and other central forces not to wear "Combat-Pattern" dresses as "it is not authorised and leads to false alarms", the official said. "All traders and shopkeepers interested in selling Army uniforms may approach the local military authority and request for shops in units/cantonments approved areas/shops," the official said. "It is illegal to sell army uniforms to unauthorised persons," the official said, adding, "The guidelines have been issued in public interest and to prevent terror attacks." Also, the relatives of armed forces personnel and ex servicemen were requested not to use items of uniform which they may be having as they could create false reports, the official said and added that it was illegal to do so. Police and Civil administration have also been asked to check and crackdown on defaulters. "The youth is exhorted to use social media to spread awareness and start a campaign to prevent misuse of Army uniform and equipment as fashion statement," the spokesperson said. The Army and the Police keep getting information of suspicious activities of persons having been seen carrying rucksacks and wearing combat pattern dress associated with Armed Forces, they said. While during incidents such as in Pathankot, it has resulted in elimination of terrorists, in most cases these have turned out to be misleading and caused inconvenience to the people at large, the Army official said. Exhorting public to extend support in the fight against terrorism, the Army has asked them to take pledge to co-operate with defence forces by providing information and keeping vigil at local level. "We deeply regret the inconvenience caused but then these operations are inescapable to ensure your safety and security," the official said. The Army appealed and requested the public to adhere to the guidelines in national as well as their own interest.

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### **Reliance Group plans Vizag Naval Defence facility with initial Rs 5k cr**

VISAKHAPATNAM|NEW DELHI: In a boost to Prime Minister Narendra Modi's Make in India programme, the Anil Ambani-led Reliance Group said it will set up a new shipyard along the east coast in Andhra Pradesh to build nuclear vessels and aircraft carriers with an initial investment of Rs 5,000 crore. The greenfield facility - planned adjacent to a strategic naval base at Rambilli that will house Indian navy nuclear submarines and aircraft carriers in the future - will be set up by Reliance Defence Ltd. Ambani said the project near Visakhapatnam will complement its facility at Pipavav in Gujarat with a focus on building strategic assets. "Vizag is ideally suited for the manufacture of strategic assets such as nuclear submarines and aircraft carriers, critical areas of naval defence capability where we need to catch up with the rest of the world," Ambani said at the CII Partnership Summit. Reliance, which has invested heavily in defence manufacturing, has signed a memorandum of understanding with Andhra Pradesh that will give it 1,500 acres of land co-located with strategic facilities of the Indian navy and the Department of Atomic Energy, a company representative told ET. "At an initial investment outlay of Rs 5,000 crore, it will represent the single largest investment at one location anywhere in Andhra Pradesh," Ambani said about the planned yard. The investment will not only generate thousands of skilled jobs but also lead to creation of a multi-tier array of defence ancillaries, bringing in further investments of between Rs 5,000-10,000 crore and thousands of additional skilled jobs, Ambani said. The Reliance Group has been expanding its presence in the defence sector after getting 12 industrial licences last year from the Department of Industrial Policy and Promotion. Referring to India's policy of "credible minimum deterrence," Ambani said this capability is to be deployed through a triad of forces at land, air and sea. "The most reliable part of the triad and only one that can deliver assured second strike (a vital ingredient of deterrence) is SSBN or a nuclear submarine. Our proposed facility will play in critical role in complementing this mission and bringing it to fruition," he said. While Reliance has already acquired the nation's largest shipyard - Pipavav - it plans to use the new facility in Andhra Pradesh to also undertake maintenance, refit and services of ships of all categories. The shipyard is likely aimed at amega Indian navy project for a new class of nuclear attack vessels that is pegged at over Rs 1 lakh crore. The government gave approvals for six new nuclear attack submarines in 2015, with the navy starting work to design a new class of boats with a 15-year developmental period in mind.

## Hi-tech startups urge PM's support to ignite defence industry

By Peerzada Abrar

The problem is that government has same procedure for buying chairs as well as hi-technology, says Parag Naik, chief executive of Saankhya. Tucked away in a lane of Bengaluru's residential colony in Hennur and surrounded by shopping malls, schools and multi-national companies is the office of hi-tech startup Saankhya Labs. It has built a chip Pruthvi, the size of a postage stamp that functions as a software-defined radio (SDR). SDR is a radio communication system where components that have been typically implemented using hardware are instead replaced by software. This reduces cost, power consumption and size of components on a personal computer or embedded system. Pruthvi has so far been used to power satellite phones, drones and satellite receiver for the Indian Space Research Organisation's communication satellite. Software radios have significant utility for the military which must serve a wide variety of changing radio protocols in real time. Pruthvi can also integrate new technology with old legacy equipment. Interestingly, the government is spending thousands of crores of rupees on tactical communication system, battle management system and procuring satellite phones for the armed forces. The capability to build such systems is in India's backyard due to presence of scores of small hi-tech companies and startups like Saankhya Labs. But the irony is that India imports more than 70 per cent of its weapons and technology for its defence needs. Parag Naik, chief executive of Saankhya has been keen to sell such innovations for defence but finds it futile to convince the authorities that his products are best in the world.

**Start Up India programme**-As Prime Minister Narendra Modi unveils ambitious 'Start Up India' programme this week, hi-tech companies are asking the government to pay attention to the aerospace and defence innovations offered by them. Applications for defence. "There are many startups in the country which have developed products including drones and night vision systems that have got applications for the defence," said TV Mohandas Pai, former Infosys director and India's top angel investor. "The time has come for the defence minister to showcase all these firms to the top brass of the armed forces." Mr.Pai has collated a list of such firms and is planning to share it with Defence Minister, Manohar Parrikar. The difficulties and frustrations that small hi-tech companies face range from hostile bureaucratic set up on the one side and a colonial mindset on the other. Young firms have to compete for government projects with large companies "The problem is that government has same procedure for buying chairs as well as hi-technology," said Mr.Naik whose Pruthvi product is protected by 23 international patents. "What government can do for us is to provide access to the market and access to the funds." Small companies said that the government is doing little to encourage them. This is unlike in the United States, Israel and China where grants are given for companies with promising technologies.

**Collateral free venture fund**-Start up founders said that there has to be a collateral free venture fund or risk capital that invests in strategic electronics companies. This should be for product development and not contract engineering services. The fund should be at least the size of a small private venture fund, over Rs.500 crore, according to the experts. "The government venture fund should be run by a technology expert who has been an entrepreneur or experienced venture capitalist with a successful track record," said Arvind Lakshmikumar, founder of Tonbo Imaging, a Bengaluru-based maker of advanced night vision systems. Night Vision Systems

Tonbo makes night vision systems for Indian and international customers including DARPA, an advanced-technology branch of the U.S. Department of Defense. Its products are being used on observation platforms, reconnaissance drones, and artillery and naval weapon systems. But from being a purely Indian company, Tonbo had to become a global products business based out of Singapore. This is because benefits are offered to international suppliers on buy-global Indian programmes. Indian suppliers are levied customs duties at the component level and taxes at the product level. Foreign bidders don't face this problem. India's defence spending is expected to hit \$620 billion (Rs 41 lakh crore) between 2014 and 2022, according to according

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## Hi-tech startups urge PM's support to ignite defence industry

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to a report by industry lobby Federation of Indian Chambers of Commerce and Industry and financial services firm Centrum Capital. India was the largest importer of major arms in 2010-14, accounting for 15 per cent of the global total, according to Sweden-based Stockholm International Peace Research Institute (SIPRI). In 2010-14 India's imports were three times larger than those of either of its regional rivals China and Pakistan. "We have become so used to foreign technology," said Mohandas Pai. Drones With 22.5 per cent of the world's unmanned aerial vehicle (UAV) imports, between 1985 and 2014, India ranked first among drone-importing nations, followed by United Kingdom and France, according to data provided by SIPRI. In Navi-Mumbai, ideaForge Technology is in pursuit to change this by making indigenous UAVs. But it needs support from the government. Founded by IIT-Bombay graduates ideaForge has developed Netra, an unmanned aerial vehicle in collaboration with Defence Research and Development Organisation. It can be deployed for counter insurgency, border management, hostage situations and disaster management. It flies autonomously and returns on its own to the home base after completion of the mission. "The government has to set a shining example of being a 'great customer'," said Ankit Mehta, 32-year-old cofounder and chief executive of ideaForge Technology. "Also there is not sufficient funding available." The firm already supplies its drones to customers like Central Reserve Police Force, The Border Security Force and various State police forces. they were also used in the recent Nepal earthquake and the Uttarakhand flood relief and rescue operations. Robots Experts say to turbocharge the aerospace and defence innovation India require programmes like the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) in the United States. These programmes are one of the largest sources of early-stage capital for innovative small companies in the United States. These initiatives allow small businesses to engage in federal research and development that has a strong potential for commercialization. "I was surprised to discover that Internet, shielding technology for jet fighters and bomb disposal robots were developed by smaller companies in the US as part of these programmes," said Aakash Sinha, founder of New Delhi-based Omnipresent Robot Technologies. The firm has designed, developed and supplied indigenous unmanned robots to Indian defence. These robots can go into difficult terrains and send back audio and video data wirelessly. They can also detect explosive material. Omnipresent is also developing a navigational module for ISRO's Chandrayaan-2 moon mission. Mr. Sinha, a 35-year-old robotics scientist, had worked at US companies including Lockheed-Martin and iRobot Corp before returning home. As the technical head at iRobot his team delivered over 3000 packbot robots to the US Army. These were deployed in Iraq and Afghanistan to dispose bombs. Startup entrepreneurs said they are not asking for any preferential treatment. But at the same time preference should not be given to public sector units as well. "They (small firms) will become complacent like public sector units and not innovate to be competitive," said Mr. Lakshmikumar of Tonbo. The only place they should be given flexibility is payment terms to support cash flow. The venture money should only be used for product development and market development. Small companies should get advance payment and exemption from Earnest Money Deposit (a form of security deposit) and letter of credit payment terms. As Mr. Modi interacts with global CEOs and founders of over 1,500 startups from across the country this week at 'Startup India' programme, he has a big chance to connect with India's hi-tech firms. "'Digital India' and 'Make in India' is the last chance to build a robust electronics hardware industry," said Mr. Naik of Saankhya Labs.

## Queen-size R-Day parade, king size celebrations

By Rahul Datta

The duration of the Republic Day parade this year will be shorter but the festivities associated with it will continue for two to three days after the event. The main objective of reducing the parade time from 115 minutes to nearly 90 minutes is to retain spectator interest. Simultaneously, planning is on to showcase the unique features of the parade at several places in the national Capital apart from the main venue Rajpath. It includes initiatives like throwing open the tableaux of various States and organisations to general public once the parade terminates at the Red Fort. The decision to curtail the parade by reducing the number of marching contingents and armoured columns like tanks but involving more cultural troupes was taken after the good response to celebrations last year to mark 50 years of India's victory over Pakistan in the 1965 war. The main event including a fly-past, exhibitions and live demonstrations of military manoeuvres was held at Rajpath in September with minimum security restrictions to ensure mass participation. Similarly, some changes were also made during Independence Day celebrations last year with the Government holding exhibitions to highlight the contribution of freedom fighters, painting competitions for children and display of weapons at various centres all over the country. It also saw encouraging response from the common people, officials said here on Saturday. Carrying forward this practice to involve citizens in national events, the Republic Day this year will see a reduced number of marching contingents of the three Services and paramilitary forces, they said. Moreover, lesser number of tanks will take part in the parade in order to reduce the time from 115 minutes to 90 minutes. Incidentally, it was for the first time last year that the turret guns of the tanks faced the VIP dais while driving past it and dipped them as part of the salute to the President, who is the Supreme Commander of the armed forces. Earlier, the turret used to remain in front due to security aspects. Elaborating upon the plans for this year's celebrations, officials said the tableaux, which are theme-based and selected after stiff competition, will remain parked at the Red Fort for two or three days after the parade. Given the security cordon all along the Rajpath and the entire eight km parade route, general public cannot have a closer look at these colourful models mounted atop tractors. This time though, children will have fun time at the Red Fort as they can even enter these tableaux, they said. The authorities are also mulling over a proposal to allow general public to see tanks and artillery guns from close quarters once they are parked at India Gate after the parade. Unlike marching contingents and tableaux which march all the way to Red Fort, tanks, artillery guns and armoured personnel carriers end their part at the India Gate. The Army may also be asked to hold exhibitions, band concerts and martial arts display at various popular places like Connaught Place and Chandni Chowk besides Rajpath after the Republic Day. As of now, the Army is holding these events at Connaught Place and Dwarka for the masses in the run up to the Army Day on January 15. These events include martial arts display by soldiers of Assam Regiment and cultural shows like 'lezim' of Maharashtra and Chang dance from Rajasthan. The other event drawing people is the infantry soldiers' bayonet training drill known in military terms as 'dhawa (attack)'. Dog squads of the Army are showing their military training skills like sniffing out an enemy and alerting the handler without barking. An Army aerobics and 'malakhamb' team will display gymnastics skills at these venues in the coming days to motivate the spectators to lead a healthy lifestyle. French President Francois Hollande is the chief guest for the parade. In another first since the Independence, a French Army contingent will march down the Rajpath on that day along with their Indian counterparts.

## **America flexes its muscles as heavy B-52 Stratofortress that can carry nuclear weapons flies just 45 miles from North Korean border**

The US sent a heavy bomber which is capable of carrying nuclear missiles in a show of force just 45 miles from North Korea in response to Kim Jong-un's underground H-bomb test on Wednesday. The Boeing B-52 Stratofortress conducted a low fly pass of Osan Air Base, just south of the border. The heavy bomber, which is capable of carrying nuclear missiles and bombs, was accompanied by a pair of South Korean air force F-15s and two US air force F-16s. North Korea announced on Wednesday that it had conducted its first ever hydrogen bomb test. The test caused massive international controversy and was condemned by the United Nations, while at the same time increasing tension with South Korea. The B52 conducted a low-level flight before heading back to Andersen Air Base in Guam, where it is stationed. The 4,000-mile round trip mission was conducted 'in response to recent provocative action by North Korea', US Forces Korea said in a statement. The B-52 was accompanied by two South Korean Air Force F-15s and a pair of US Air Force F-16s as the massive bomber was just four minutes' flight time from the North Korean border.. The aircraft are known to have taken part in joint annual US-South Korea military exercises that have enraged Pyongyang, but their flights over South Korea are rarely publicised. The last time such a flight was made public was in 2013, after North Korea carried out its third nuclear test. At that time, the US dispatched both a B-52 and the more sophisticated B-2 stealth bomber to South Korea in a show of military muscle against the North. On Sunday, Pyongyang state media called for the establishment of a peace accord to stabilise the Korean Peninsula and described the nation's nuclear arsenal as a 'treasured sword' that defends the country's sovereignty. The two Koreas remain in a technical state of war because the 1950-53 war ended with an armistice, not a peace treaty. 'Gone are days never to return when the U.S. could threaten the DPRK with nuclear weapons,' said ruling party newspaper Rodong Sinmun. Wednesday's nuclear test was Pyongyang's fourth, though experts have questioned North Korea's claim of the explosion having been triggered by a hydrogen bomb. On Friday, the North's state broadcaster also released video footage of a submarine-launched ballistic missile test, though South Korean media have suggested the footage was an edited compilation of a previous test. B-52s were heavily involved in the wars in Vietnam and Iraq. They were also used in Yugoslavia and against the Taliban in Afghanistan. Lieutenant General Terrence J. O'Shaughnessy, commander of the US 7th Air Force and Deputy Commander of the US Forces Korea, said on Sunday that the United States maintained an 'ironclad' commitment to the defence of South Korea. This commitment includes 'extended deterrence provided by our conventional forces and our nuclear umbrella', he said in a statement. 'B52 missions reinforce the US commitment to the security of our allies and partners, and demonstrate one of the many alliance capabilities available for the defence' of South Korea, he said. 'As demonstrated by today's mission, the combined US and Republic of Korea air forces work and train together closely every day, and we are totally prepared to meet any threat to our alliance.' The annual US-South Korea joint military exercises regularly spark angry reactions from North Korea, which brands them 'nuclear war drills' against it. Key Resolve/Foal Eagle, one of the annual joint exercises, is expected to take place in March. South Korea hosts 28,000 US troops as the two Koreas technically remain at war because the Korean War of 1950-53 ended in an armistice instead of a peace treaty. Sunday's show of force came as Kim Jong-Un claimed the nuclear test was carried out in self-defence, to prevent a nuclear war with the United States. In his first public remarks since the explosion, Kim said the test was 'a self-defensive step for reliably defending the peace on the Korean Peninsula and the regional security from the danger of nuclear war caused by the US-led imperialists'. 'It is the legitimate right of a sovereign state and a fair action that nobody can criticise,' he added, according to the official Korean Central News Agency (KCNA). The North regularly accuses the US and its ally South Korea of warmongering. An official commentary published by KCNA late Friday also cited toppled leaders Saddam Hussein of Iraq and Colonel Gaddafi of Libya as examples of what happens when countries forsake their nuclear ambitions. The nuclear test has angered world powers, including the North's key ally China, and the UN Security Council has said it will roll out new measures to punish the maverick state.

## N Korea's muscle-flexing could trigger arms race

Saibal Dasgupta

North Korea may have sparked off a grave arms race in China's neighbourhood, one of the reasons Beijing is alarmed by the bomb test. There has been a cooling off of relationship between China and North Korea in recent years -not least because supreme leader Kim Jong-un has executed two top officials who were known to be close to China since he took charge after the death of his father, Kim Jong-il, in 2011. What China finds disturbing is the risks that North Korea's latest adventurism poses for the rest of the region. The first obvious consequence will be increasing demand from within South Korea for nuclearisation, against a reckless, adventurist and nuclear-fanged leadership of DPRK. South Korea's ruling party has said the time has come for Seoul to arm itself with nuclear capability to counter the next-door rogue state. Second, Japan, the only country that has suffered an atomic holocaust, could begin an intense phase of militarisation. For Japan's PM Shinzo Abe, Kim Jong-Un's action has provided the justification he needs to obtain, support and invest heavily in his militarisation programme. Abe, who faced resistance to his military programme from the country's pacifist groups, will now have a strong validation to push forward with his agenda. Japan's militarisation would mean a new arms market for the US, which would cause serious concern in its main rival, China. The third consequence could be the rise of US military presence in the region. Finally, an unstable North Korea - which has long played a key role in containing the influence of US and Japan (just as Pakistan has in the instance of India in South Asia) - could hit China's economic interest: DPRK imports close to 80% of its domestic essential needs from its western neighbour. With the UN considering the possibility of economic sanctions as a means to rein-in Kim, China has begun asking a question that was unthinkable until a few years ago: Should it join the sanctions? But, among the fallouts of economic sanctions could be starvation in North Korea, resulting in a refugee influx in China's Liaoning province. Therefore, while in his first public statement after the bomb test, Kim Jong-un blamed the US for driving it to this action, in reality Kim has posed greater risks for China. "China has very limited capability in controlling DPRK's behaviour," said Prof Wang Dong of Peking University in the show 'Dialogue' on CCTV, state television. For the full report, log on to <http://www.timesofindia.com>

Show of alliance: US flies B-52 over S Korea The United States deployed a B-52 bomber on a low-level flight over its ally South Korea on Sunday, a show of force following North Korea's nuclear test last week. North Korean leader Kim Jong-un maintained that Wednesday's test was of a hydrogen bomb and said it was a self-defensive step against a US threat of nuclear war. North Korea's fourth nuclear test angered both China and the US, although the American government and weapons experts doubt the North's claim. The B-52, based in Guam and capable of carrying nuclear weapons, could be seen over Osan air base, 77km from the DMZ that separates the two Koreas.

**The Pioneer**

**10 January 2016**

### US, China agree to coordinate on North Korea's "provocative" actions

WASHINGTON: The US and China have agreed to coordinate closely on taking appropriate action against North Korea's "provocative" behaviour, after the reclusive nation claimed it has successfully conducted its first hydrogen bomb test. US Secretary of State John Kerry and his Chinese counterpart Wang Yi discussed over phone, the "highly provocative" nature of North Korea's actions, and its grave threat to international peace and security, State Department spokesperson John Kirby said. "The Secretary and Foreign Minister Wang agreed that the United States and China would continue to coordinate closely in the UN Security Council and with partners within the Six-Party Talks framework to take appropriate action," Kirby said yesterday. Meanwhile the White House confirmed that US will be in consultations with its allies in the region, including South Korea, about an appropriate international response to North Korea's "blatant violation" of multiple UN Security Council resolutions. "This is also something that is being discussed at the United Nations around the table of the Security Council. We'll continue to consult closely with our friends and allies as we determine an appropriate response," White House Press Secretary Josh Earnest told reporters on Thursday.

## Beyond 'free' and 'neutral': An Internet policy for India

By Amit Prakash

That a lot is at stake in the ongoing framing of Internet-related policy in India is evident from the sudden deluge of content with contrasting positions on the recently uploaded Trai Consultation Paper on Differential Pricing for Data Services in almost all forms of media, traditional and new. Most of these positions seem to invoke either of the two seemingly innocuous but, very powerful terms - 'free' and 'neutral'. While one set of arguments are in favour of a 'free' Internet, implying the absence of a direct monetary charge for accessing the Internet or parts thereof, the others are framed around the concept of Internet as a 'neutral' carrier of content. Both these positions, however, seem to be in agreement when it comes to the impact of Internet access in improving the living conditions of the income-poor and other socially marginal population groups. For advocating a particular policy prescription, they mainly invoke different aspects of the prevailing dominant global discourse where Internet is considered a neutral technology, paraded as an outcome of broad-based participation and, therefore, along with other information and communication technologies (ICTs), the best available means to solve health, education, employment and other similar development concerns of countries such as India. This, despite increasing evidence that does not always support such claims unequivocally. Evolution of the Internet and its unprecedented proliferation over the past few decades is often seen as a reflection of its design logic that has allowed more and more application and content providers to participate in its production, akin to a 'free' democracy (where every citizen has the same [theoretical] right to participate in governance). The fact that most of the content on the Internet continues to be in English and that most of the application and technology providers come from high-income countries in the Americas and Europe - as per a recent International Telecommunication Union report, 80.4 per cent of the total Internet domain registrations were restricted to these regions in 2013 - is, many a time, overlooked as a temporary aberration which will vanish when more and more people from low-income countries are provided access to the Internet. There are other important points of privileged access in Internet governance, such as in assigning unique global identifiers and in deciding standards and protocols. But these are considered necessary to ensure the operational stability of Internet, and have only recently been subjected to a more open public debate. Neutrality of technology, including of the ICTs and the Internet, is often invoked when deterministic claims are to be made about its effects, of the type that 'an increased Internet penetration will lead to improved health and education indicators'. This view considers the nature of technology and the direction of change it can lead to as unproblematic or pre-determined, often subject to an inner technical-logic (as Robin Williams and David Edge point out in their oft-cited 1996 article on social shaping of technology) - hence, the notion of neutrality. What it does not consider is that the production and use of technology is a social process, influenced by individual dispositions and social structures. A number of choices are made, both during the production and use of technology, many of which are governed by cultural, political, economic and other institutional factors. Socially shaped technology. The current debate about the way Internet should be provided in India, for example, captures many such factors, all of which have a potential to influence the way Internet production and use could get shaped in the country. The form, direction of change or outcomes are not taken as a given when technology is seen as socially shaped. Here, the inquiry process is explicitly concerned with the various ways in which social structures and individual agencies influence design and use of technology. When Internet is being promoted as a democratising technology with a potential to address complex development and governance challenges in lower income countries of the world, adopting deterministic and unidirectional claims about its effects seems a bit out of place. In its present form and with its historical production process strongly embedded in specific contexts, the Internet embodies socio-cultural and political values that may often not make much sense in many of the lower-income regions of the world. The state-of-the-art in global development thought is moving away from Rostow's stages-of-economic-growth model and is now more appreciative of local contextual variation and diversity in charting national and regional development trajectories. There is no reason to

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**Beyond 'free' and 'neutral': An Internet policy for India**

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provide a privileged position to ICTs and the Internet, despite the significant changes they are bringing in the everyday lives of millions of individuals across the world, by not subjecting them to critical scrutiny when they are to be adopted as key drivers of national and regional development policies. Use of terms such as 'free' and 'neutral' when talking about the Internet can lead to a certain degree of reification which could prevent a proper appreciation of its constitution and affordances, thereby affecting the way it could be developed and deployed to tackle problems in healthcare, education or livelihoods, all of which display a strong affinity to local contextual factors. A less deterministic approach to designing public policies related to ICTs and the Internet, will not take the effects as given but see it as an outcome of an engagement process involving increased participation of a greater number of people, both during its production and use. Along with policies that are concerned with improving Internet access to all sections of our society, it is equally important to promote local production and design capacities so that Internet, and other forms of ICTs, are embedded and more reflective of social structures and relationships that are of greater value to us as a country. This will also resonate well with the ideas of 'Make in India' and 'Make for India' that the present Central government is actively promoting.

(The writer is faculty at the Centre for IT and Public Policy, International Institute of Information Technology, Bengaluru)

**The Hindu****11 January 2016****ISRO conceives two 'space parks'****By Madhumathi D. S.**

To engage domestic firms in launch vehicles - from integrating sub-systems to assembling and launching the PSLV. Two space industry enclaves or "parks" that have been conceived - one for launchers at Sriharikota and a smaller one at an existing Bengaluru spacecraft campus - signal increased privatisation of the nation's space programme over the next five years. For now, the facilities will be "captive" to drive the future missions of the Indian Space Research Organisation. First, ISRO wants to groom and engage domestic industry in the launch vehicles area from integrating sub-systems up to assembling, and even launching the PSLV. This well-established rocket has put Indian and foreign satellites of up to 1,600 kg into space. ISRO Chairman and Secretary, Department of Space, A.S. Kiran Kumar, told The Hindu: "Internal discussions have just started on the mechanism of forming a (launch vehicle) consortium. A few key industry players working in the space programme have been sounded." Eventually the future consortium will be fully responsible for building and launching the light-lift PSLV rocket. Currently industries such as Hindustan Aeronautics Ltd, Godrej & Boyce, Larsen & Toubro, MTAR and Walchandnagar Industries produce 80 per cent of the launch vehicle parts and sub-units. These production works are scattered across their respective locations. The launch industry initiative must be close to ISRO's launch complex, the Satish Dhawan Space Centre, at the 145-sq km Sriharikota range, on the lines of the launch complex of Europe's Arianespace in French Guiana, Mr. Kiran Kumar told The Hindu. Satellite support On the spacecraft front, ISRO plans to increasingly support small and mid-sized industries at its 10-year-old second spacecraft complex, the 100-acre ISITE, at Marathahalli in Bengaluru. ISITE, short for ISRO Satellite Integration & Test Establishment, is already open to a few suppliers who assemble and test their spacecraft systems for the ISRO. In the coming years, more satellites will be needed for replacing the ageing ones in orbit and new advanced communication, Earth observation and navigation spacecraft.

## Major science endeavours of 2015

Paul Rincon, Jan 5, 2016, The New York Times: Pluto turned out to be a much more dynamic place. While astronomers homed in on habitable worlds beyond our Solar System, negotiators in Paris were very much focused on preserving our own bit of real estate in the cosmos. Here's a look at the year 2015 in science and environment news. Last year's Paris summit was billed as a last-ditch chance for world leaders to find a way to prevent dangerous climate change. In the end, the deal struck in the French capital was partly legally binding, partly voluntary. Many participants agreed the outcome was less than perfect. But the crucial part had been done: uniting all the world's nations in a single agreement on tackling climate change for the first time in history. The process sets out a clear long-term plan for keeping global temperature rise under two celsius (the threshold for dangerous warming). But, importantly, it also incorporates a review process allowing ambition to be increased in the future. Brit in space: When Tim Peake was selected as a European Space Agency astronaut in 2009, the UK paid virtually nothing towards human spaceflight. Had this state of affairs continued, the Chichester native might have been left watching from the sidelines as, one-by-one, his classmates flew to the space station. But the government was persuaded to change its policy and, consequently, Tim got his flight on 15 December 2015. It's almost 25 years since Britain had an astronaut, Helen Sharman, who flew to the space station Mir under a privately-sponsored programme. In the intervening years, the International Space Station was built and flights to and from the orbiting outpost have appeared to become so routine that they rarely merit much news copy in the UK. However, the launch from Baikonur Cosmodrome has reinvigorated interest in the life of the orbiting outpost. Pluto revealed: When Nasa's New Horizons spacecraft was launched in 2006, Pluto still held full planetary status. By the time the probe finally flew by its target in July, carrying the ashes of Pluto discoverer Clyde Tombaugh, it had been relegated to a lesser category of object. While the arguments rumble on, none of this detracted from the mind-blowing spectacle of seeing the last of the classical nine planets up close for the first time. By all accounts, Pluto turned out to be a much more dynamic place than anyone could have imagined. A home away from home?: In the quarter of a century since the discovery of the first planet beyond our Solar System, a trickle of discoveries has turned into a deluge. In 2015, we were treated to a world about 60 per cent larger than Earth, but which circles a Sun-like star at a very similar distance to our own, suggesting that conditions might be suitable for liquid water. This is important, of course, because liquid water is considered a prerequisite for life. How Earth-like a planet is deemed to be depends to some extent on the properties one chooses - and it is not known for certain that Kepler-452b is rocky, rather than gaseous. But, on the other hand, most previous potentially habitable planets are around so-called red dwarf stars, which are cooler than our own. That means these worlds need to be located much closer to their parent star to receive the same level of heating. A new branch on the tree: The discovery in a South African cave system of 15 partial skeletons belonging to a new human species caused a sensation. They assigned the individuals, which possess a mixture of primitive and modern features, to the grouping Homo, which includes us. The researchers were not able to date the remains of Homo naledi, but think they could be about three million years old. That would place them in a crucial period where more ape-like creatures evolved with bigger brains, a more human-like body plan and, with it, the capabilities to begin mastering their environment. In another significant discovery, researchers identified the remains of modern humans in China that proved to be at least 80,000 years old. This was a big surprise, since genetics and archaeology both point to a dispersal of Homo sapiens from Africa no earlier than 60,000 years ago.

# The electronic brains that run the world

Mark Miodownik

The silicon chip in your mobile phone is not perfect because it is a single crystal like diamond, even though it is; nor because it is ultra pure, even though it is. No, it is perfect because it is an orchestrated collection of defects; it is these that give your phone its immense social power. Silicon chips are the electronic brains that run the world. They fly our planes, drive our trains, take care of the washing while we are out, keep us alive in hospital and handle our most intimate conversations. We get all this from a thin sliver of material the size of a postage stamp that was invented in the 20th century when the popularity of the telephone and the radio led to a general enthusiasm for all things electronic. Harnessing electricity to do more complicated things like computation relied then on thermionic valves that were essentially souped-up electric light bulbs. They were hot, unreliable and bulky. But they could act as switches, turning electricity on and off, providing the ones and zeros of the digital world and so when connected formed the first programmable computers such as Colossus, which was pivotal for the British in the second world war. After the war, it became clear that connecting yet more valves and other electronic components to get more powerful computers was not going to work. The engineers encountered something they called the "tyranny of numbers", which meant that as the machines got more complex they became more unreliable. They needed a way to make computers simpler but more powerful. The answer was to make all the electronic components of a computer out of one material: silicon. Silicon, a semiconductor. It is a semiconductor, which means that it conducts electricity, but not very well. This sounds like a problem, but is exactly what you want if you are trying to create a computer out of a single material because you need some parts to conduct electricity and others not to conduct at all. Engineering the material to do this involves adding tiny amounts of impurities. Silicon has four outer electrons, which are bound up in the chemical bonds holding the crystal together. By adding a tiny amount of phosphorous, which has five outer electrons, you in effect add a free electron to the crystal and make it conduct moderately well. Similarly you can add boron, which has only three outer electrons and in effect do the same thing, only now the conducting charge is called an electron hole. If you put a phosphorus silicon layer next to a boron silicon layer, the holes and the electrons cancel each other out at the junction but create an electric field that means that electrons like to flow in only one direction across the junction. This is called a diode, but the computational magic happens by adding another phosphorus layer, which creates a diode that will allow electrons to flow only if the voltage applied to the sandwich layer is just right. This is an electronic switch, called a transistor. It does what thermionic valves do but is smaller than a hair on a flea. Being able to make electronic components like resistors, diodes and transistors out of a single piece of silicon and connecting them all yielded the archetype of the integrated silicon chip that we have today. But hindsight is a wonderful thing and none of the pioneers believed it would work, because initially it didn't solve the tyranny of numbers. The chip still involved thousands of components linked together, albeit out of a single material, but if there was one part that was in error the whole chip didn't work - some ways it was worse because these parts being so tiny could not be repaired. The solution to the problem turned out to be cleanliness. Chip technology relies on tiny amounts of defects being introduced into the silicon, such as phosphorus or boron atoms, but any other impurities are severely detrimental. So the starting point for all silicon chips is extremely pure silicon, what is called 9 nines silicon, which is 99.9999999% pure. Silicon chips are made in a clean room environment where workers have to wear special suits and must enter and exit via an airlock. The craft of these silicon makers is not so much about learning technical skills, but their ability to be precise, calm and methodical in an alien environment more akin to a spacecraft than a traditional workshop. A powerhouse: But even purest cleanest silicon isn't free enough of defects. This is because solid silicon forms crystals, billions of them, and where these crystal meet are yet more defects. The solution is to rid silicon chips of the crystal boundaries completed by making every chip out of a giant single crystal. The Czochralski process is used to do this: pure silicon is melted in a crucible, then a tiny seed crystal is lowered into the crucible to touch the surface of the liquid and removed slowly. As it moves away from the surface of the molten silicon, liquid solidifies on to the seed, growing an immense single crystal of silicon often more than two metres in length. You may have visited some wonderful crystal grottos in your life, but they are nothing compared to the wonders that assault your eyes in a silicon fabrication facility. The crystals are sliced into thin ultra pure 9 nines silicon wafers ready to be manufactured into silicon chips by the selective addition of impurities, etching with acid, and using a photographic method to create the interconnections. It is the industrial scale of the operation that makes silicon chips so cheap, and the precision of the silicon makers that makes them so reliable. Over the years the power of each individual chip has increased as the size of the transistors has become smaller. It is this ability to miniaturise the fabrication of precise amounts of impurities that has made silicon such a powerhouse: there is more computing power in a modern smartphone than the Apollo spacecraft that landed on the Moon. If any material proves that defects are necessary for perfection, it is undoubtedly silicon.

## NASA mission finds 100 new alien planets

New York, Jan 10, 2016 (IANS). The information about the planets, some of which are very different from what the spacecraft observed during its original mission, was shared by University of Arizona's Ian Crossfield at a conference of the American Astronomical Society, National Geographic reported. File photo for representation NASA's planet-hunting revamped Kepler mission has found more than 100 confirmed planets orbiting other stars. The information about the planets, some of which are very different from what the spacecraft observed during its original mission, was shared by University of Arizona's Ian Crossfield at a conference of the American Astronomical Society, National Geographic reported. According to the report, many newly-found planets are in multi-planet systems and orbit stars that are brighter and hotter than the stars in the original Kepler field. It has also found a system with three planets that are bigger than Earth, spotted a planet in the Hyades star cluster -- the nearest open star cluster to Earth -- and discovered a planet being ripped apart as it orbits a white dwarf star. "Scientists have also found 234 possible planets that are awaiting confirmation," Andrew Vanderburg of the Harvard-Smithsonian Center for Astrophysics, said. Meanwhile, Tom Barclay of NASA's Ames Research Centre said that spacecraft is probing different types of planets (than the original Kepler mission). "We are focusing on stars that are much brighter, stars that are nearer by, stars that are more easy to understand and observe from the Earth. The idea here is to find the best systems, the most interesting systems," Barclay said. With a mission to determine how common Earth-like planets are, Kepler stared at the same patch of star-filled sky, watching for periodic blips in starlight caused by orbiting planets and from 2009 to 2013, Kepler discovered more than 1,000 new planets. With a tweak to its steering ability, scientists rectified the mechanical malfunction of Kepler's lost ability to stare at the same exact spot. Since then, K2 has been spying on supernovas, and studying planets orbiting our star. In 2014, it spent about 70 days observing Neptune, studying the ice giant's extremely windy weather and would also attempt to spot planets that are wandering through the galaxy without stars of their own. Among its notable discoveries, K2 has spotted strong evidence of a tiny, rocky object being torn apart as it spirals around a white dwarf star and discovered a new planet orbiting two stars and located within its host stars' "habitable zone", the area around the stars in which life could potentially exist. It also collected data to reveal that our solar system was born 4.6 billion years ago and only eight percent of the potentially habitable planets that will ever form in the universe existed. NASA's Kepler mission had also confirmed the first near-Earth-size planet in the "habitable zone" around a Sun-like star.

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## 'Moon villages' could be a reality by 2030: Experts

Villages on the Moon, constructed through cooperation between astronauts and robotic systems on the lunar surface, may become a reality as early as 2030, scientists say. Moon villages could serve as a potential springboard for future human missions to Mars and potentially other destinations, a team of scientists, engineers and industry experts said at the European Space Agency's (ESA) symposium "Moon 2020-2030 - A New Era of Coordinated Human and Robotic Exploration," held in the Netherlands. In order for that vision to become a reality, scientists must first determine if the resources on the Moon are as significant as we think they are, said Clive Neal, from the University of Notre Dame in US. "We keep talking about lunar resources, but we still need to demonstrate they can be used, (that) they are, in fact, reserves," he said. "So ground truth verification of deposit size, composition, form and homogeneity requires a coordinated prospecting programme as a first step," Neal said. "The next step would demonstrate extraction techniques followed by refinement of the product into usable commodity. A successful programme would then clearly demonstrate that lunar resources can enable solar system exploration," he said. Neal said the ESA meeting highlighted technology development in terms of precision landing, robotic sample return, and cryogenic sampling, caching, return and curation. "Significant investments in the latter are required and starting to be made," he said. Neal's research explores the origin and evolution of the Moon, focusing on the petrology and geochemistry of returned samples coupled with geophysics and other remotely sensed datasets; geophysical instrumentation and investigations of the moon; formation of impact melts; and more basalt petrogenesis.

## Rosetta mission makes last-chance bid to contact space robot-lab Philae

**Depiction of Philae's.** Part of the European Space Agency's Rosetta mission, the Philae probe, has yielded spectacular scientific results, since its near crash-landing onto comet 67P/Churyumov-Gerasim--enko in Nov. 2014. Scientists on Friday initiated a last-chance manoeuvre to contact a long-silent robot-lab dropped more than a year ago onto the surface of a comet hurtling through our solar system. Part of the European Space Agency's Rosetta mission, the Philae probe has yielded spectacular scientific results - and a few moments of high drama - since its near crash-landing onto comet 67P/Churyumov-Gerasimenko in November 2014. But it has been six months since mission control engineers at the German Aerospace Centre in Darmstadt have been in communication with Philae, and the odds of reestablishing contact are diminishing fast as the solar-powered investigation speeds away from the Sun. "The last clear sign of life was received from Philae on July 9, 2015," the German Space Agency said in a statement. "Since then it has remained silent." Scientists sent a command to the fridge-sized robot to spin up its flywheel, initially used to stabilise the probe when it landed. The hope is that so doing will "shake dust from its solar panels and better align it with the Sun", explained technical project manager Koen Geurts. It is also possible, however, that the command - routed through the Rosetta spacecraft orbiting the comet - will never even reach Philae. Several further attempts will be made, he added. "It's an admittedly desperate move," Philippe Gaudon of the French National Space Agency told AFP. "It is very unlikely the robot will become functional again." Mission managers believe that one of the lander's two radio transmitters, and one of its two receivers, have both failed. Even the remaining ones are believed to be not fully functional. The window of opportunity for making contact with Philae will close definitively toward the end of January, when the comet and its companion hardware will be some 300 million kilometres (185 million miles) from the Sun. That's when the temperature is likely to fall below minus 51 degrees Celsius (minus 60 degrees Fahrenheit), the threshold beyond which Philae can no longer operate. The robot-probe -

packed with nearly a dozen instruments - landed on 67P after a 10-year, 6.5-billion-kilometre journey piggybacking on mothership Rosetta. It bounced several times on the craggy surface before ending up at an angle in deep shade, where it sent home some 60 hours of data before going into standby mode on November 15, 2014. The lander's power pack was recharged as 67P drew closer to the Sun on its elliptical orbit, and Philae woke up on June 13. After that, it made intermittent contact, uploading



data, only to fall silent again on July 9. The ground-breaking mission was conceived to learn more about the origins of life on Earth. Comets are pristine leftovers from the Solar System's formation some 4.6 billion years ago. Many experts believe they smashed into our infant planet, providing it with water and the chemical building blocks for life and sustenance. As part of its scientific probe, Philae has found several organic molecules, including four never before detected on a comet.

## India takes up Zika virus threat with health experts

Teena Thacker

After swine flu and Ebola, a lesser-known-Zika virus is the new global threat that has put many countries on alert. With international experts raising concerns over its possible spread being similar to dengue and chikungunya, the Union health ministry has called health experts from the National Vector Borne Disease Control Programme and National Centre for Disease Control to closely follow the trend so as to keep the virus at bay. "The virus is posing threat to all the countries around the world. While, as of now, there is no case that has been reported from India. We are examining the reports. The matter will be taken up with public health experts on Monday after which we will indicate our appropriate response," said a senior official in the health ministry. So far, the outbreaks of Zika virus - in which babies are born with unusually small heads - have been reported in central and south America. Locally transmitted (autochthonous) cases of Zika have been detected in Colombia, El Salvador, Guatemala, Mexico, Paraguay, Puerto Rico, and Venezuela. Zika virus is an emerging mosquito-borne arbovirus that was first isolated from a rhesus monkey in Uganda in 1947, and caused sporadic human infections in some African and Asian countries, with usually mild symptoms of fever, rash, and arthralgia. In 2007, it caused an epidemic on Yap Island in the Federated States of Micronesia, then spread to many countries in Oceania, before arriving in the Americas in 2014-15, probably via Easter Island. With an estimated 4,40,000-1,30,0000 cases currently in Brazil alone, "Zika virus could be following in the footsteps of dengue and chikungunya, which are also transmitted by the Aedes aegypti mosquito. Given that an outbreak anywhere is potentially a threat everywhere, now is the time to step up all efforts to prevent, detect, and respond to Zika virus," said the Lancet. So far, the Phylogenetic analyses show that the strains of Suriname belong to the Asian genotype, and are closely related to the strain that was circulating in French Polynesia in 2013. Last month, the ministry of health in Brazil reported a twenty-fold annual increase in cases of newborn babies with microcephaly in the northeastern region of the country. While a causal link between Zika virus in the mother and microcephaly in the newborn baby is yet to be firmly established. Other congenital neurological anomalies and an increased frequency of Guillain-Barré syndrome linked to Zika virus have also been reported.

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The Asian Age

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## Waterless loo uses nanotechnology to treat waste, banish stench

A toilet that does not need water, a sewage system or external power but instead uses nanotechnology to treat human waste, produce clean water and keep smells at bay is being developed by a British university. The innovative toilet uses a rotating mechanism to move waste into a holding chamber containing nano elements. The mechanism also blocks odors and keeps waste out of sight. "Once the waste is in the holding chamber we use membranes that take water out as vapor, which can then be condensed and available for people to use in their homes," Alison Parker, lead researcher on the project, told agencies. "The pathogens remain in the waste at the bottom of the holding chamber, so the water is basically pure and clean." Cranfield University is developing the toilet as part of the global "Reinvent the toilet Challenge" launched by the Bill and Melinda Gates Foundation. Nanotechnology is the science of creating and working with materials about one nanometer wide, or one-billionth of a meter. A human hair is about 80,000 nanometers wide. Parker said that despite "significant" interest from developed countries, the toilet is being designed with those in mind who have no access to adequate toilets. According to the U.N. children's agency UNICEF and the World Health Organization (WHO) 2.4 billion people, mostly in rural areas, live without adequate toilets. Poor sanitation is linked to transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid and polio, the WHO says. Cranfield University says its toilet is designed for a household of up to 10 people and will cost just \$0.05 per day per user. A replaceable bag containing solid waste coated with a biodegradable nano-polymer which blocks odor will be collected periodically by a local operator, it says. Initial field testing of the toilet is likely to take place later this year, Parker said.

# Gains and pains of digital transformation

By B. Pradeep Nair

A big challenge is the change in the IT customer who is now behaving like a consumer. Social, cloud, analytics and mobility are rapidly changing the way companies operate. Their synergy has resulted in easy-to-use products and services for customers on the one hand, and richer dividends for companies on the other. Seeing a positive correlation between business performance and the emerging technologies, companies are fast-forwarding to digital transformation. Customer expectations are changing faster than what IT teams can anticipate. "With multiple conversation platforms, it doesn't matter where it starts: may be with a chat, then goes on to a social platform. Digital transformation is about integrating platforms and departments to get a unified experience," says Suman Reddy, Managing Director, Pegasystems. Some companies are even looking at new functions. Sudhir Tiwari, Managing Director, ThoughtWorks, says they now have a Chief Capability Officer. "One of his mandates concerns capabilities we need to build, and how we match them with what we believe where the market is headed." Enterprise mobility is an emerging area. "Apps are being created for specific tasks that would otherwise take a long time to punch in if one has to follow traditional methods of accessing company's intranet," says Mohit Bhishikar, Chief Information Officer, Persistent Systems. Data analytics is no longer a geek's domain. It's become mobile, visual and accessible to common people. Vizable is a free iPad application from Tableau Software that can be used to explore data, personal or business, by using gestures such as pinching, swiping and dragging. Users can sculpt data into visual patterns in seconds, and the visualizations can be shared with friends and colleagues through email, instant message or social media, according to Deepak Ghodke, Country Manager, India, Tableau Software. The challenges- New technologies are fascinating but transitioning to them can be challenging for companies. According to a global survey of 444 executives conducted by The Economist Intelligence Unit, and sponsored by Accenture and Pegasystems, most companies say their digital processes are only partially integrated with their traditional business functions, and very few claim to be able to present a seamless customer experience across channels. A big challenge is the change in the IT customer who is now behaving like a consumer, feels M. G. Raghuraman, Senior Vice-President and Chief Information Officer, Mphasis. "The customer now wants everything quick, flexible, scaleable, and as much as possible on fingertips." Though cloud is perceived as a panacea for many infrastructural issues, moving on-premise data is easier said than done. There is also the problem of awareness, especially among established old economy enterprises. "Financial services organizations have always been intrigued by cloud and what harnessing its power could mean to them," says Snehal Fulzele, CEO and Co-Founder, Cloud Lending Solutions. Public cloud comes with issues of security and policies regarding backing up of data. According to Siddhesh Naik, Director, Enterprise Business Group, India and South Asia at Lenovo, the budgets allocated to CIOs are shrinking which makes it difficult for them to draw the line and the whole IT operation becomes a complex balancing act for them. Since technology now becomes obsolete faster than ever before, companies have to scout for fresh talent. Often there aren't programmers with required knowledge base. Coupled with this is the need to re-skill existing employees. "If you take 100 programmers, the chances are that a majority are trained in native language that is tied to a platform. There are fewer people trained in open source. If a company has to hire a PHP programmer, it will have to shell out a much higher amount," says Gerald Jaideep, COO of Simplilearn. Companies are adopting multiple means for training. Deepa Mukherjee, Vice President - HR & Head - Learning and Development, NIIT Technologies, says, "We leverage MOOCs (Massive Online Open Courses) for the foundation learning and invest in instructor-led training for advanced levels." EMC collaborates with colleges to make students industry-ready. "The Academic Alliance program offers courses that focus on technology concepts applicable to any vendor environment, enabling students to develop skills required in today's evolving IT industry," says Abhijit Potnis, Director Technology Solutions, India & SAARC, EMC. Obstacles notwithstanding, companies are fast-forwarding to new technologies, often fearing competition, as Ray Wang, CEO of Constellation Research and author of Digital Disruption puts it. "Things are moving so fast, companies that have been built over 100 years are disappearing. In the 1950s the average age of a company in the Standard & Poor's index was about 60 years. It's trending towards 15 years now, and we think it's going to be about 12 years by 2020. Digital Darwinism is unkind to those who wait."

## Monkey cannot own copyright to selfies, judge rules

A macaque monkey who took now-famous selfie photographs cannot be declared the copyright owner of the photos, a U.S. judge said. U.S. District Judge William Orrick said in federal court in San Francisco on Wednesday that "while Congress and the president can extend the protection of law to animals as well as humans, there is no indication that they did so in the Copyright Act." The lawsuit filed last year by People for the Ethical Treatment of Animals sought a court order allowing PETA to represent the monkey and let it to administer all proceeds from the photos for the benefit of the monkey, which it identified as 6-year-old Naruto, and other crested macaques living in a reserve on the Indonesian island of Sulawesi. The photos were taken during a 2011 trip to Sulawesi with an unattended camera owned by British nature photographer David Slater, who asked the court to dismiss the case. Slater says the British copyright obtained for the photos by his company, Wildlife Personalities Ltd., should be honored worldwide. PETA sued Slater and his San Francisco-based self-publishing company Blurb, which published a book called "Wildlife Personalities" that includes the "monkey selfie" photos. The photos have been widely distributed elsewhere by outlets, including Wikipedia, which contend that no one owns the copyright to the images because they were taken by an animal, not a person. In court documents, Slater described himself as a nature photographer who is deeply concerned about animal welfare and said it should up to the U.S. Congress and not a federal court to decide whether copyright law applies to non-human animals. Jeff Kerr, general counsel for PETA, said the organization will continue fighting for the monkey's rights. "Despite this setback, legal history was made today because we argued to a federal court why Naruto should be the owner of the copyright rather than been seen as a piece of property himself," Kerr said. "This case is also exposing the hypocrisy of those who exploit animals for their own gain."

## World Book Fair opens, spotlight on China this time

New Delhi, PTI: Union Human Resource Minister Smriti Irani on Saturday inaugurated the 43rd edition of the New Delhi World Book Fair which commenced here with China as the guest of honour country and a theme presentation of the cultural heritage of India. The nine-day fair, touted as the largest in Asia, is hosting about 30 countries in which a series of programmes including panel discussions, dramas, classical and folk dances, workshops, discussions, authors' meets, conferences, seminars and cultural programmes will be held. Talking about the Chinese participation, Irani said, "I believe that 50 publishing houses and 9 eminent authors bring with them to this World Book Fair around 5,000 titles so that through this exchange our people across both nations can be enriched." China was invited to be the guest country after the visit of Chinese President Xi Jinping here last year where he signed a memorandum of understanding with Prime Minister Narendra Modi. "During the visit of President Xi Jinping an MoU was signed with China's role in World Book Fair and I am happy to note that promise that we made through paper has fructified in person," the minister said. Referring to the growth of publishing business in both the countries the minister said, "Today we celebrate the exponential growth of the publishing business both in India and China." Emphasising on the importance of publishing exchanges between China and India, Sun Shoushan, Vice Minister State Administration of Press, Publication, Radio, Film and Television (SAPPRFT) said, "As one of the key international book fairs the NDWBF has set up an important platform for cultural exchanges of Indian classic and contemporary works which is now going on smoothly." "The important publishing exchanges between China and India have played an important role in cementing the friendship between people and promoting cultural exchanges between the two countries," he said. This year the fair has introduced a special 'Navlekhan' programme which seeks to promote and publish young authors under the age of 40 writing in Indian languages. Referring to the same Irani said, while this year they are being published in 6 regional languages by next year she assured that books in 22 languages recognised by the Constitution of India will be published. Tickets to the fair, which is being held at the sprawling Pragati Maidan, will be priced at Rs 20 and sold from 9 AM till 5 PM at 47 stations of the Delhi Metro network from January 9-17. Schoolchildren and disabled are permitted free entry. "I am happy to know that this WBF gives free invite and entry to children in school uniform, senior citizens and physically challenged," Irani said.

## If Indian science congress is a joke, it's because science in India is a tragedy

By Subodh Varma

If Nobel laureate Venkatraman Ramakrishnan's description of the Indian Science Congress as a circus set you thinking about the state of science in the country, here are some numbers that should stop you in your tracks: 59% of secondary schools in India don't have an integrated science laboratory although science is compulsory till class 10. So, a vast majority of students 'study' science without ever seeing any experiment, let alone doing it. At the +2 level where students opt for science, just 32% schools have separate rooms for laboratories and a quarter of them are 'partially equipped'. Perhaps they are being taught via the web? No chance, because just 37% of schools have a computer with net connection. Describing the present educational and scientific scenario as "depressing", eminent scientist and Bharat Ratna awardee CNR Rao lamented to TOI that in the large young population of rural India, "there must be a Ramanujan or a Raman somewhere". So how do we find them? Not an easy prospect since the problem begins in schools and colleges. Students who do go through the grind and finally get into science and technology related jobs see their dreams die in India's vast but faltering science establishment. As nuclear scientist VS Ramamurthy, who was part of the design team for India's first nuclear test at Pokharan in 1974 and later headed the department of Science & Technology, told TOI, "The human resource pipeline cannot be turned on and off at will. Tomorrow's teacher has to be trained today." One of India's top genetic scientists and former director general of CSIR, Samir Brahmachari told TOI that the crisis in science is because it is not attracting the best minds. "Science education has moved from being a curiosity-driven exploration to a mark-scoring exercise to get admission in elite institutions and bag a fat corporate salary. In the process, academia has also lost high quality teachers who shape young minds," he said. Besides the sorry state of affairs in all but the elite science education centres, there are serious problems facing Indian science, ranging from resource crunch to policy confusion. The current attempts to turn mythology into science make the future look even bleaker. "Building a knowledge-based society demands significant increase in investment for S&T at several levels including education as well as research leading to outcomes in pure and applied areas," eminent space scientist K Kasturirangan, former head of ISRO and ex-member Planning Commission, told TOI. India has just 4 scientific researchers for every 10,000 people in the workforce, much lower than not just advanced countries like the US or UK but even China and Brazil. "The goal of spending at least 2% of GDP on scientific research - outlined in the govt's science policy of 2003 - has not been achieved. Even industry funding, which was declared as the magic wand for finances, hasn't delivered," rues Dinesh Abrol, visiting professor at JNU. As per latest available figures, India is spending less than 1% on research and development compared to 1.9% in China and 2.75% in US. The combined result of defective grounding at the school/college level and limited resources for research is evident in the metrics that provide a partial measure of India's scientific output and its significance. Scientific papers published by Indians numbered about 90,000 in 2013 compared to 4,50,000 by Americans and 3,25,000 by Chinese. Citations too were below the world average. Indians filed just 17 patents per million population compared to 541 in China and 4,451 in South Korea. "I am not worried about the quantity as much as the quality of science coming from India. It is also not showing any improvement. India still contributes less than 1% of the world's top 1% of research," Rao said. However, he clarified that this did not mean that there were no good scientists in India. "There are a few individuals in various places who are doing well, but this is not enough. We need many good institutions doing outstanding work, so that we can accommodate capable young scientists," he added. Brahmachari sees the glass half full. Given the low input, and that the best minds have left India for greener pastures, he feels Indian science has done "outstandingly well". Ramamurthy highlights another key problem in the way science is being practised in the country - the project mode. "In today's environment of research in project mode with well-defined objectives, milestones and deliverables, curiosity-driven research is a casualty," he said. Research objectives too are increasingly disconnected from society, asserts Abrol. Giving the example of agriculture, he says that an obsession with increasing yield while ignoring the consequences of intensive agriculture in the five major grain producing states has led to a sustainability crisis - ground water depletion, waterlogging, chemical over-kill. "Yet our research goals continue to be better yielding varieties rather than sustainable productivity," he said.