INDIAN NATIONAL ACADEMY OF ENGINEERING

INAE Monthly E-News Letter Vol. VII, Issue 2, February 1, 2016

From the Editor's Desk

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The second observation: Innovation is a difficult and expensive process. That is the reason why a majority of us like to follow, rather than lead and take initiative. Herd instinct comes naturally to us. It is advantageous if there are only a few innovators. By observing what others are doing, we can choose the best idea without going through the difficult process of innovation. Good copiers are instinctively good observers. There is no need for all to become innovators, nor are all capable of becoming innovators. There is no need for everyone to know everything. Few things should remain hidden from the purview of the majority. Our social structure and learning mechanism have sculpted us to become very shrewd and intelligent at copying, but, perhaps, less adept at innovation and creativity. The paradox is that we want to be both innovators and copiers. We want to recreate ideas, as well as make efforts to create a variety in things already known.

ACADEMY ACTIVITIES

Academy Announcements

Recent Dispatches from INAE Secretariat

- INAE Year Book 2016 has been dispatched to the INAE Fellowship
- The Nomination Forms have been sent to the INAE Fellowship seeking nominations for election of Fellows and Foreign Fellows. The last date of receipt of nominations for Fellows is March 31, 2016 and for Foreign Fellows is May 31, 2016.
- Nominations have been invited from the Fellowship for INAE Research Schemes viz INAE Chair Professorship, INAE Distinguished Professors/Technologists, Mentoring of Engineering Teachers by INAE Fellows and Mentoring of Engineering Students by INAE Fellows.
- Nominations have also been invited for INAE Young Engineer Award 2016 and Innovative Student Projects Award 2016.

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The nominations for the above are requested from the Fellowship. In case the above forms have not been received, the same may be downloaded from INAE website www.inae.in and sent to the INAE Secretariat within the stipulated dates.

Creation of Data for INAE Expert Pool

INAE expert Pool has been created with the aim of identifying domain experts in various disciplines of engineering.

The creation of this pool was discussed in the recent meetings with DST and Technology Information, Forecasting and Assessment Council (TIFAC). During the meetings, it has been decided that the domain experts from the Expert pool would be identified and selected for initial peer review by a group of experts for screening and assessment of the project proposals received by DST and TIFAC, from time to time. In addition, the Fellows would also be identified from the Expert Pool to form part of the Project Monitoring Committees (PMC), for projects sanctioned under the aegis of DST and TIFAC. Similar efforts are ongoing for further utilization of the INAE Fellows as domain experts in ongoing programmes of national importance.

Recently a letter from Dr BN Suresh, President, INAE has been forwarded to all Fellows and Young Associates to upload their particulars on the link for the INAE Expert Pool. The INAE Fellows and Young Associates who have not uploaded their particulars are requested to submit their profile details online at the link http://inae.in/expert-search/index.php/inae-members-form .

INAE Kanpur Local Chapter

A Seminar on "Smoke, Dust and Haze: Implications to Health, Climate and Economy" by Prof Sachchida Nand Tripathi, FNAE, was organized by the INAE Kanpur Local Chapter on Jan 20, 2016 at Indian Institute of Technology Kanpur. Prof SN Tripathi currently holds the Rajeeva and Sangeeta Lahri Chair Professorship in Civil Engineering Department and is an adjunct professor in earth sciences at IIT Kanpur. Smoke, dust, and haze (atmospheric aerosol), associated with natural and anthropogenic sources, are a vital component of the Earth system. It has multi-dimensional socio-environmental impacts, which include climate modulation, adverse health effects, reduced visibility, and material and ecosystem damage. This talk presented key results on aerosol characteristics in different environmental conditions, and their implications to human health, agriculture, historical monuments, and climate.

International Conferences/Seminars being organized by IITs/other Institutions

To view a list of International Conferences/Seminars being held in the month of Feb 2016 click here.

Republic Day Awards

1	Dr Vasudev Kalkunte Aatre, FNAE, Formerly Scientific Adviser to Raksha Mantri, Ministry of Defence, New Delhi; Formerly Director, NPOL, Cochin and Former CC (R&D), DRDO, New Delhi was conferred with the prestigious award of Padma Vibhushan, by the Hon'ble President of India on Republic Day, January 26, 2016.

Honours and Awards

1	Prof Mahesh Tandon, FNAE, Managing Director of Tandon Consultants Pvt Ltd (TCPL), New Delhi received the "Indian Building Congress Infrastructure Award" on September 1, 2015 at New Delhi for his organization TCPL. TCPL was also conferred the "Industry Excellence Award" by the Institution of Engineers (India) at the Indian Engineering Congress held on December 17, 2015 at Guwahati.

News of Fellows

1	Dr BN Suresh, FNAE, President, INAE & Vikram Sarabhai Distinguished Professor, ISRO Headquarters, Bangalore and Dr K Sivan, FNAE, Director, Vikram Sarabhai Space Centre, Thiruvananthapuram have co-authored a book on "Integrated Design for Space Transportation System" published by M/s Springer . The book was printed in Netherlands and both electronic and print versions are available in the prominent book websites all over the globe. The link giving details of the book is also available in all prominent publishers' websites. Further details can be viewed in a link of Amazon http://www.springer.com/in/book/9788132225317
2	Prof Mahesh Tandon, FNAE, Managing Director, Tandon Consultants Pvt Ltd, New Delhi was conferred the "Honorary Fellowship" of The Indian Concrete Institute on October 10, 2015 at Kolkata.
3	Prof. Amlan J. Pal, FNAE, Senior Professor, Indian Association for the Cultivation of Science, Kolkata, has been elected as Fellow of Indian National Science Academy (INSA).
4	Prof Arvind Kudchadker, FNAE, Emeritus Professor, IIT Bombay has published a book as e-book on 'Creating a New Technological Institute'. Further details may be viewed in the link https://arvind1934.wordpress.com/

International Conference on Trends in Industrial and Mechanical Engineering (IC TIME 2016) on Feb 4-6, 2016 at Bhopal
http://www.conferencealerts.com/show-event?id=154545

3rd International Conference on Biotechnology and Bioinformatics (ICBB-2016) on Feb 5-7, 2016 at Pune
http://www.conferencealerts.com/show-event?id=159446

International Conference on Recent Advances in Civil Engineering, Architecture and Environmental Engineering for Sustainable Development (CEAESD- 2016) on Feb 6, 2016 at New Delhi
http://www.conferencealerts.com/show-event?id=163708

IEEE 3rd International Conference on Electronics and Communication Systems on Feb 25-26, 2016 at Coimbatore
http://www.conferencealerts.com/show-event?id=156354

IEEE International Conference on Information Communication and Embedded Systems ICICES-2016 o Feb 25-26, 2016 at Chennai
http://www.conferencealerts.com/show-event?id=160280

International Conference on Computer Vision and Image Processing on Feb 26-28, 2016 at Roorkee
http://www.conferencealerts.com/show-event?id=158391

IEEE international conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics-2016 on Feb 27-28, 2016 at Chennai
http://www.conferencealerts.com/show-event?id=159803

Make in India-Oil and Gas Sector

CR Prasad

Launch of Make in India:

The Prime Minister Narendra Modi, launched 'Make in India' on 25th September, 2014, a major national initiative which focuses on making India a global manufacturing hub. Key thrust of the programme would be on cutting down in delays in manufacturing projects clearance, develop adequate infrastructure and make it easier for companies to do business in India. The 25 key sectors identified under the programme include automobiles, auto components, bio-technology, chemicals, defence manufacturing, electronic systems, food processing, leather, mining, oil & gas, ports, railways, ports and textile. The national progamme aims at time-bound project clearances through a single online portal which will be further supported by the eight-member team dedicated to answering investor queries within 48 hours and addressing key issues including labor laws, skill development and infrastructure. The objective of the mega programme is to ensure that manufacturing sector which contributes around 15% of the country's Gross Domestic Product is increased to 25% by next few years. The 'Make in India" initiative is based on four pillars, which have been identified to give boost to entrepreneurship in India, in not only the manufacturing but also other sectors. The core objective strategy of the program lies in the following four components.

(i) New Processes: 'Make in India' recognizes 'ease of doing business' as the single most important factor to promote entrepreneurship. A number of initiatives have already been under taken to ease business environment.

(ii) New Infrastructure: Government intends to develop industrial corridors and Smart cities, create world class infrastructure with state of-the-art technology and high-speed communication. Innovation and research activities are supported through fast paced registration system improved infrastructure for IPR registration. The requirement of skills for industry are to be identified and accordingly development of workforce to be taken up.

(iii) New Sectors: FDI has been opened up in Defence Production, Insurance, Medical Devices, Construction and Railway infrastructure in a big way. Similarly FDI has been allowed in Insurance and Medical Devices.

(iv) New Mindset: In order to partner with industrial economic development of the Country Government shall act as a facilitator and not a regulator.

In order to deepen economic engagement with major economies across the world, CEOs' Forums/ Joint Business Councils are being set up with the objective of facilitating mutually beneficial partnership with other countries at the business level as well as inputs in policy making. So far, CEO's Forums/Business Leaders' Forums have been set up with USA, Japan, France, UK, Malaysia, South Africa, Brazil, Canada, Russia, Australia, China, Indonesia and Sri Lanka. An India-African Business Council (IABC) and BRICS Business Council have been setup for activating business to business contacts.

Invest India:

An Investor Facilitation Cell has been created in 'Invest India'. In order to assist and handhold foreign investors, Invest India, a Joint Venture Company (Not for Profit Company) between Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce and Industry, Government of India, Federation of Indian Chambers of Commerce and Industry (FICCI) and Various State Governments has been set up. Invest India is responsible for promoting and facilitating investments to India. The shareholding is 51% of FICCI and 49% of DIPP. Subsequently DIPP will dilute its equity to include all State Governments. Already seven states have taken up shares in Invest India.

Invest India shall act as a first reference point for investors. Invest India shall also be a facilitator and partner offering handholding services to the investors to help them speedily fructify their investment plans. Investor Facilitation Cell has been created at Invest India to assist, guide, support, handhold and facilitate investors during various stages of their project. In order to enable businesses and investors to save time and costs and to improve the overall business environment in the country, an online single window was conceptualized in the form of e-Biz Mission Mode Project under the National e-Governance Plan. The Union Minister for Commerce & Industry launched the eBiz portal at the CII Partnership Summit in Agra on 28.1.2013. The process of applying for an Industrial License (IL) and an Industrial Entrepreneur Memorandum (IEM) has been

taken online. The site, eBiz available 24x7 making it easier to file applications and making online payments of service tax.

Entry and exit regulations have been eased out, Exim regulations made infinitely easier, six PSUs brought out of sickness. Some of the Outcomes of the digitization of industry setting process can be seen from below

The initial validity period of an Industrial License has been increased from 2 to 3 years, giving licensees enough time to procure land and obtain the necessary clearances.

MHA has also stipulated that it will grant security clearances on industrial license applications within 12 weeks. Employees Provident Fund Organization (EPFO) and Employees State Insurance Corporation (ESIC) processes have been automated and ESIC registration number is now being provided on real time basis.

A National Workshop with the Industry, States and all Sectorial Central Ministries to draw up a Plan of Action in the short and medium term for creating an enabling framework for stimulating investments in manufacturing was held on 29th December, 2014.

Certain important steps taken to boost manufacturing include:
Ordinance has been issued to make land acquisition simpler for important projects.

A number of items have been taken off the licensing requirements from the Defence products list. Items of dual use have also been taken off the licensing requirement.

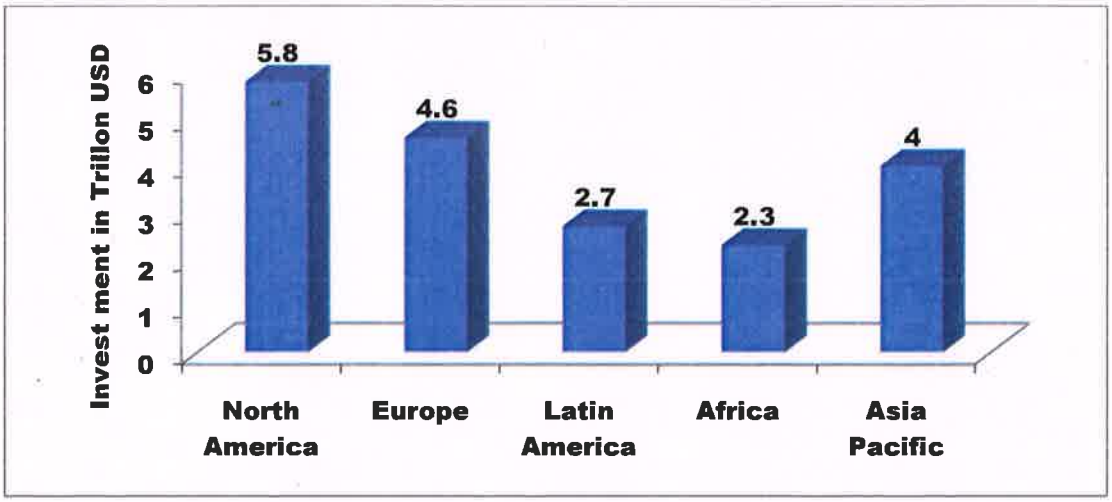
The Ministry of Labour and Employment has developed a unified Web Portal "Shram Suvidha", which shall facilitate ease of filing various law returns with a single document. And this portal can be used for allotment of unique labor identification number to Units.

Indian- Oil and gas Industry:

The Global oil and gas industry is witnessing an unprecedented wave of capital spending, driven by the need to build capacity to meet growing energy demand from emerging markets and to replace depleting supply sources. This capital expenditure has, to date, been underpinned by consistently higher oil prices, globally and gas prices outside North America. This trend is expected to continue. In its World Energy Investment Outlook 2014, the International Energy Agency (IEA) estimates a cumulative investment of US$22.4trillion in the global oil and gas sector between 2014 and 2035, equivalent to an

average annual spend of more than US$1trillon. As shown below in Graph1, spending will be dominated by North America (particularly the US), Europe and Asia-Pacific

Fig.1 Regional cumulative oil and gas investment between 2014 and 2035 (US$trillion)



Source: World Energy Investment Outlook, IEA, June 2014.

India is one of the world's largest consumers of oil and gas, the country's per capita oil and gas consumption is low as compared to that in other economies. This indicates the low availability and affordability of energy, particularly of natural gas. In 2013, India's per capita consumption of oil and gas was 176.9 Kg of oil equivalent (kgoe), while the global average was 1,011.4 kgoe. This indicates significant growth potential in the sector, given the rising economic prosperity and rising income levels.

India's oil and natural gas sector predominantly relies on its national oil companies (NOCs). Oil and Natural Gas Corporation (ONGC) holds the largest share of crude oil and natural gas production. Oil India Limited (OIL), Cairn India and Reliance Industries Limited (RIL) are other major oil- and gas-producing companies in the country. India's dependence on oil imports has increased over the past few years, along with the spike in consumption. Meanwhile, domestic production remains stagnant, hampered by limited exploration and declining production from existing maturing fields. India currently imports around 76% of its oil consumption.

Oil refinery capacity in India:

India has surplus refining capacity and is a net exporter of petroleum products. Over the past few years, many companies — private and NOCs — have expanded their refining capacities, driven by the rising domestic consumption of petroleum products and incentives granted by the Government of India (GoI).Refining companies are likely to

continue to enhance their crude processing capacity by upgrading existing facilities and building greenfield refineries. During the Twelfth plan, new refineries are likely to be commissioned by Indian Oil Corporation Limited (Paradeep, 15 MMTPA). By the end of FY17, the country's cumulative refining capacity is projected to increase to 310.9 MMTPA. Out of this, NOCs are likely to account for 197.9 MMTPA11. Access to modern technology, and research and development initiatives may become key focus areas, given the rising global production of heavy unconventional oils, coupled with the shift of consumers towards modern fuels.

Natural Gas:

The country's natural gas market is characterized by a supply deficit, primarily due to low domestic production and inadequate transmission and distribution infrastructure On the other hand; demand for natural gas in India has increased significantly, primarily from the power and fertilizers sectors, city gas distribution (CGD) sector and industrial sectors, such as refining and petrochemicals. Rising concerns on carbon emission have added to demand for natural gas. Several assets in the oil and gas segment are over 30 years old. Hence, oil companies are undertaking large projects for the redevelopment and revamp of these assets.

Initiations towards Oil and gas industry development:

The GoI has taken many initiatives for attracting investment to boost domestic output and strengthen the relative infrastructure. These efforts are likely to create several opportunities for oilfield services, EPC companies and capital goods companies.

The Government has allowed 100% FDI in upstream and private sector refining projects. In addition, FDI limit for public sector refining projects has been raised to 49%. Additionally, the Indian Government has enacted various policies such as New Exploration Licensing Policy (NELP), coal bed methane (CBM), shale gas and Petroleum, Chemicals and Petrochemical Investment Regions (PCPIR) policy to encourage investments across the industry's value chain.

Responding emphatically to the Prime Minister Narendra Modi's 'Make in India' initiative, India's foremost energy major Oil and Natural Gas Corporation Limited (ONGC) and Pan-IIT entered into a Memorandum of Collaboration (MoC) on January 19, 2015 at New Delhi to work towards a collective R&D Programme for developing indigenous

technologies to enhance exploration and exploitation of hydrocarbons and alternate sources of energy. To begin with, seven thematic research areas in the domain of geoscience, reservoir characterization, enhanced production of oil and gas, exploiting unconventional sources of hydrocarbons, software development, engineering solutions and alternate energy resources have been identified.

Oil and Gas Industry manufacturing segment:

In order to roll out the "Make in India" campaign in the Oil and Gas Industry i.e. domestic manufacturing for equipment used in Petroleum and Natural Gas Sector, Ministry of Petroleum and Natural Gas has decided to formulate a time bound action plan to successfully implement it in consultation with different stake holders. This will also create a sustained demand for oil field services like drilling rigs, offshore support vessels, tubular goods, and seismic services and equipment for constructing process platforms, pipelines and collecting stations, as well as other surface facilities for transportation of oil and gas from wells to delivery points.

Oil and gas equipment players manufacture and sell equipment used across the oil and gas value chain in exploration, production and distribution. The industry consists of large, midsize and small companies offering services such as construction and engineering, as well as manufacturing equipment. Oil and gas equipment can be primarily divided into three segments, namely, upstream, midstream and downstream, based on their presence and use across the value chain. The scope of the upstream segment generally ends at the last choke valve on a wellhead, including in processes such as exploration, drilling and well completion. The midstream segment comprises activities such as wellhead processing and the transportation of oil. The downstream segment is conventionally considered to consist of oil refining, gas processing, distribution and marketing.

Foreign investment in the sector:

With FDI of up to 100% permitted via the automatic route (through RBI), foreign companies are looking to invest in the market by setting up manufacturing bases or by forming alliances with Indian players. Further demand aggregation and the increased adoption of policies promoting local manufacturing have attracted many global players such as Alstom, Alfa Lava, GE, Honeywell and Emerson to set up base in India. As a result, the country has seen strong FDI equity inflow in the capital goods industry. The

inflow of the FDI in Oil and gas sector in India from 2000-2015 is around 6569 Million USD which is 2.64% of the total FDI inflow during the period. And by this Make in India campaign the FDI inflow in the oil and gas sector is poised to grow at unprecedented rate in the coming years.

Oil and gas equipment manufacturing in India:

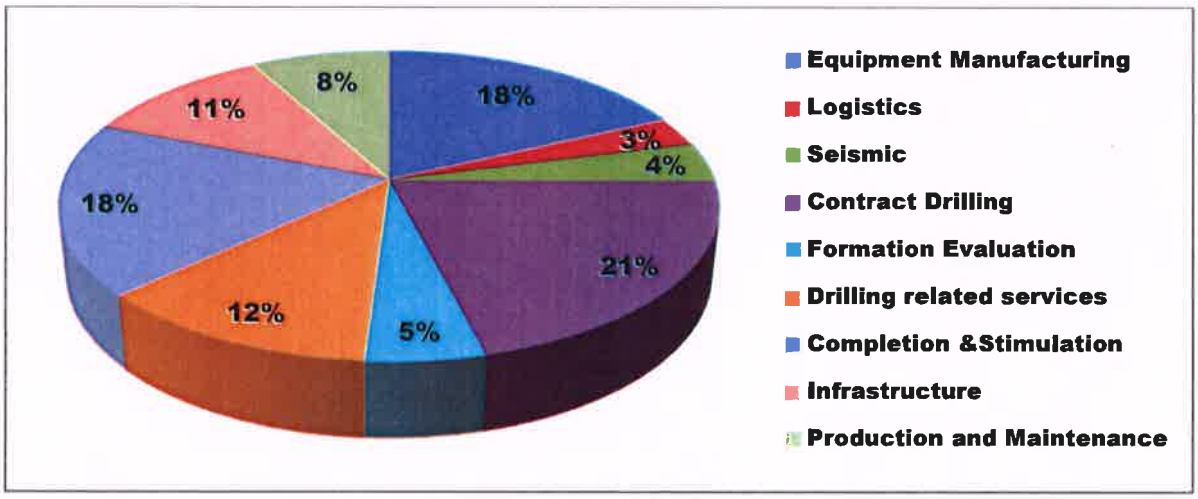
Some of the key equipment Manufacturers in India is shown below for upstream as well as mid &downstream sector.

Sector	Key Manufacturer
Up stream	BHEL, L&T, Thermax, JindalPipe, United Drilling, Deep Industries, Sarasae, inter drill, BOTIL, Praveen Industries, Akers solutions, Emerson, Weir
Mid &Down stream	BHEL, L&T, Godrej and Boyce, Alfa Laval, Thermax, Vijay tank and vessel, ISGEC Heavy engineering, Kevin enterprises, chemtrols, Alstomindia, Doosan

Global oil field equipment spending:

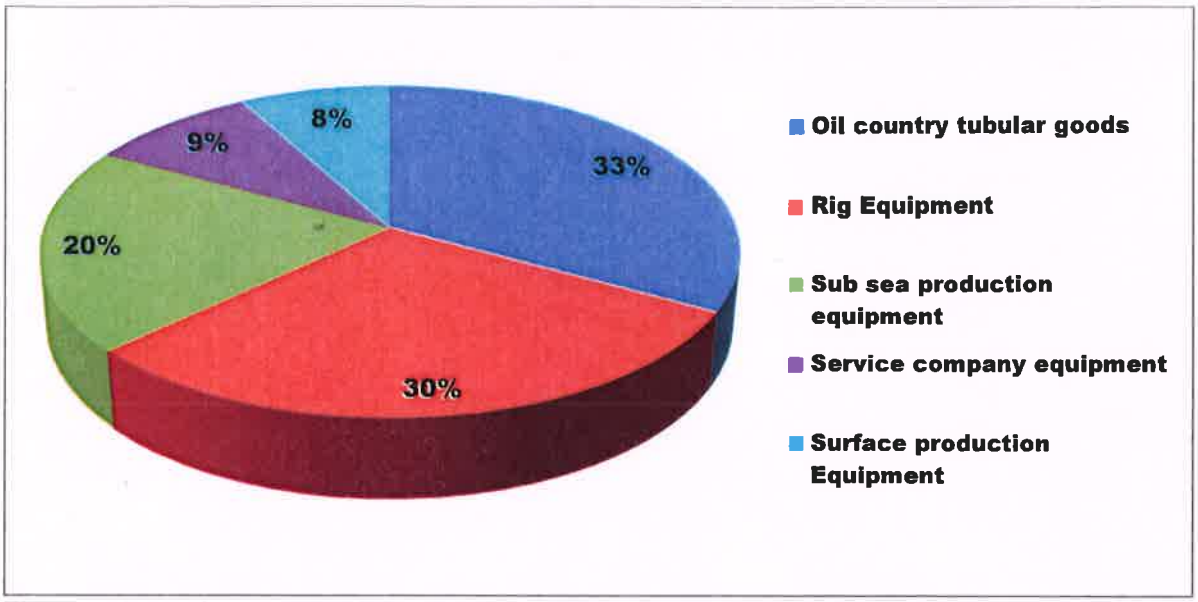
Globally, equipment manufacturing for the upstream segment accounts for 18% of oilfield services and equipment spend. Within equipment spend oil country tubular goods (OCTG) and rig equipment account for 63% share by value as shown in below graph.2&3

Graph 2 Global Oil Field Equipment Spending (2011)



Source: CII & EY

Graph 3 Global Oil Field Equipment Spending (2011)



Source: CII&EY

Oil and gas industry related equipment segments can be broadly divided in to

- ✓ Process plant equipment
- ✓ Boilers
- ✓ Valves
- ✓ Pipes.

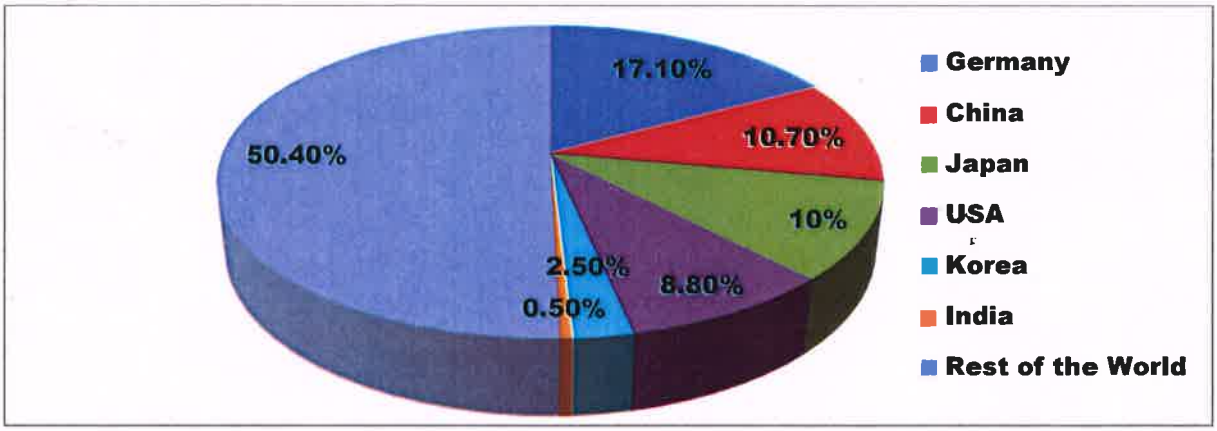
The oil and gas industry is the largest end-user market for the process plant equipment industry. Process plant equipment finds wide application in refineries and gas processing plants in critical processes such as phase separation, oil processing and storage, gas processing, and oil and gas metering and transport. On the other hand, pumps, valves and steel pipes form an integral part of both upstream and downstream equipment. These are used extensively for transporting crude oil from oilfields to refineries, as well as in marketing and distribution.

Process industry Overview in India:

Major process plant equipment includes pressure vessels, storage tanks, columns, towers, crystallizer, heat exchangers, evaporators and furnace. These find application across a wide spectrum, including oil and gas, refinery, chemical, petrochemical, energy, fertilizer, paper and pulp, sugar, cement and dairy. The process plant equipment market in India was valued at INR1, 63, 450 million in 2011. Production amounted to INR1, 98, 610 million in 2012. It is expected to touch INR3,50,000 million by 2017, growing at a

CAGR of ~12%.The process plant equipment market in India was valued at INR31,940 million in 2011, by exports. It is expected to be worth INR87,500 million by 2017. In recent years, India has enjoyed large demand for process plant equipment from foreign developing countries as a result of the increasing capabilities of domestic manufacturers. As far as domestic consumption is concerned, the process plant equipment industry is one of the most self-reliant sub-sectors within the capital goods sector, with domestic procurement accounting for ~91% of the demand. However, in terms of their share in exports at the global level, Indian manufacturers are yet to catch up with their peers from developed countries. Indian players account for very negligible share of 0.5% of total global exports as shown in below Graph4.

Graph 4 Share of Indian Manufacturers in global export with in process plant equipment (2010)



Source: CII&EY

Boiler industry overview in India:

The boiler market (includes boiler used in electrical and other industries) in India was valued at INR1,95, 000 million in 2012. It is expected to grow at a CAGR of 9.3% and 15.1% to be worth INR2,90,000 million and INR5,85,000 million by 2017 and 2022, respectively. Based on investment estimates and capacity addition targets, domestic demand for Boiler, Turbine & Generator (BTG) is anticipated between INR1,250,000 million and INR1,500,000 million by 2022.The boiler export and import market was valued at INR11,209 million and INR16,000 million as of 2012.

Valve industry overview in India:

The valve market in India was valued at INR1, 17, 129 million in 2012. It is expected to be worth INR1, 94,648 million by 2016, growing at a CAGR of 13.54%. The Indian

industrial valve market is fragmented, with the unorganized sector contributing ~40% of the market. Oil and gas accounts for ~47% of the valves market, with valves forming an integral part of the upstream equipment and downstream distribution network. Large-size complex choke valves are extensively used in the exploration and production of oil. Hence, domestic manufacturers need to improve their technological capabilities to be able to address demand for complex valves from the oil and gas sector.

Pipe industry overview in India:

Oil and gas is the largest end user of steel pipes and tubes, with pipeline being the major mode of transport for petroleum, oil and lubricant products. In 2011, ~46% of petroleum, oil and lubricant products were transported through pipelines. The percentage is expected to increase to ~53% in 2017.The increasing use of pipelines in oil and gas directly translates into higher demand for steel pipes. Crude oil, gas and product pipelines have grown at a CAGR of ~10.5%, 11.7% and ~4.7% over 2008–2012, respectively. Steel pipe commands the largest share in the oil and gas sector, primarily because of its high pressure resistance properties. Production for steel pipes and tubes is estimated to have grown at a CAGR of ~7.2% over FY 2009–13 to 7.52 million tonnes. Domestic consumption is estimated to have increased to 6.19 million tonnes for the corresponding period. Steel pipes and tube production is expected to grow by a CAGR of 5% over the next coming years.

Some Of the Highlights to make India as global Oil and Gas manufacturing industry investment destination are shown below.

Oil and gas reserves in India:

- 96 Trillion Cubic Feet of estimated shale gas reserves.
- 47 Trillion Cubic Feet of proven natural gas reserves.
- 800 MMT of proven oil reserves.
- 4th largest consumer of crude oil and petroleum products in the world.
- 2nd largest refiner in Asia.

Reasons to invest:

- Policies such as the New Exploration Licensing Policy and the Coal Bed Methane Policy have been put in place to encourage investments across the industry value

chain. Thirty-four blocks were put up for bidding in the ninth round of the N.E.L.P.

- Demand for primary energy in India is to increase threefold by 2035 to 1,516 Million Tonnes of Oil Equivalent from 563 Million Tonnes of Oil Equivalent in 2012.
- Several industries are increasing consumption of natural gas in operations. There is great scope to increase gas supply to CNG in transport and piped natural gas to houses, Small scale industries.
- Several domestic companies such as the Oil and Natural Gas Corporation, Reliance Industries Limited and Gujarat State Petroleum have reportedly found natural gas in deep waters.
- As part of pricing reforms for the natural gas sector in 2013, the government approved a new pricing scheme to further align domestic prices with international market prices and to raise investment for the sector.
- Despite being a net importer of crude oil, India has become a net exporter of petroleum products by investing in refineries designed for export, particularly in Gujarat.
- Several private companies have emerged as important players in the past decade. Cairn India, a subsidiary of British company Cairn Energy, controls more than 20% of India's crude oil production through its operation of major stakes in the Rajasthan and Gujarat regions and the Krishna-Godavari basin.
- Private companies such as Reliance Industries Limited and Essar Oil have become major refiners.
- The government is preparing to issue the 10th round of bidding for the National Exploration Licensing Policy.
- It is a transparent and level playing field for private investors and national oil companies – both enjoy the same fiscal and contract terms.
- 60% of the prognosticated reserves of 28,000 MMT are yet to be harnessed.

Statistical Data:

- The oil and gas industry ranks amongst India's six core industries.
- India was the fourth largest consumer of crude oil and petroleum products in the world in 2013, after the United States, China and Japan.
- Oil imports constitute over 80% of India's total domestic oil consumption as of May, 2014.
- Oil and gas contribute 39.2% to primary energy consumption.
- During 2013-14, natural gas constituted about 7.8% of the energy mix.

- India had 47 Trillion cubic feet of proven natural gas reserves at the beginning of 2014. Approximately 34% of total reserves are located onshore, while 66% are offshore.
- Investments worth USD 70 Billion are expected across the oil and gas value chain during 2012–17.
- At the end of 2013, India had 215.066 MMTPA of refining capacity, making it the second largest refiner in Asia after China. Private joint venture companies own about 41% of total capacity.
- India increasingly relies on imported LNG; the country was the fourth-largest LNG importer in 2013 and accounted for 5.5% of global imports.
- India's crude oil pipeline network spans just under 9,460 miles and has a total capacity of 129.4 MMTPA.

Growth Drivers:

- As part of International Energy Outlook 2013, EIA (Energy Information Administration, USA) projects in India and China will account for about half of global energy demand growth through 2040, with India's energy demand growing at 3% per year.
- India held nearly 800 MMT of proven oil reserves at the beginning of 2014, mostly in the western part of the country.
- About 44% of reserves are onshore resources, while 56% are offshore. The country's natural gas pipeline network amounted to over 15,340 kms in 2013 and a proposed expansion of 30,000 kms is envisaged by 2018-19.
- Gas Initial is in place for CDM (Clean Development Mechanism) established at 10 TCF with the possibility of an upside.
- The government has decided to set up strategic storage of 5.03 MMT of crude oil at 3 locations – Visakhapatnam, Mangalore and Padur.
- The government unveiled plans to add another 91 Million barrels to its crude oil capacity to protect India from supply disruptions by 2017.
- India projects an increase of the country's refining capacity to 307.366 MMTPA by 2017 based on its current Five Year Plan (2012-17) to meet rising domestic demands and export markets.
- The government is in the process of determining the structure of petroleum contracts between the government and companies. The current system includes a production-sharing mechanism, allowing producers to recover exploration costs during production before sharing profits with the government.

- In recent years, major discoveries in the Barmer basin in Rajasthan and the offshore Krishna-Godavari basin by smaller companies such as the Gujarat State Petroleum Corporation and Andhra Pradesh Gas Infrastructure Corporation hold some potential to diversify the country's production.

FDI policy:

- FDI upto 100% is permitted under automatic route in exploration activities of oil and natural gas fields, infrastructure related to the marketing of petroleum products and natural gas, marketing of natural gas and petroleum products, petroleum product pipelines, natural gas/pipelines, LNG re-gasification, market study and formulation and petroleum refining in the private sector.
- FDI in the above activity is subject to the existing policy and regulatory framework in the oil marketing sector and the policy of the government on private participation in exploration of oil and the discovered fields of national oil companies.

Sector Policy

- FDI upto 49% is permitted under automatic route in petroleum refining by Public Sector Undertakings (PSUs), without any disinvestment or dilution of domestic equity in the existing PSUs.
- The Integrated Energy Policy, 2006 outlines goals for dealing with challenges faced by India's energy sector.
- The Petroleum and Natural Gas Regulatory Board Act, 2006 regulates refining, processing, storage, transportation, distribution, marketing and the sale of petroleum, petroleum products and natural gas.
- The Auto Fuel Policy, 2003 provides a roadmap to comply with various vehicular emission norms and corresponding fuel quality upgrading requirements over a period of time.
- The National Biofuel Policy, 2009 promotes bio-fuel usage; the Government of India has provided a 12.36% concession on excise duty on bio-ethanol and exempted bio-diesel from excise duty.
- The National Exploration Licensing Policy, 1999 provides a contract framework for the exploration and production of hydrocarbons. Licenses for exploration are awarded through a competitive bidding system – nine rounds of bidding were completed as of 2011.

- 52 Blocks proposed to be offered under N.E.L.P.X . The offer is de-risked to the extent of all necessary statutory clearances having been pre-obtained.
- The Coal Bed Methane Policy, 1997 encourages exploration and production of coal bed methane as a new eco-friendly source of energy.
- The Petroleum Rules, 1976 contains provisions for regulations governing pollution, safety and other operating standards.
- The Policy on Shale Gas & Oil, 2013 allows companies to apply for shale gas and oil rights in their petroleum exploration licenses and petroleum mining leases.

Financial Support:

Key Provisions of the 2014-15 Union Budget

- Cut in excise duty of branded petrol from INR 7.50 per liter to INR 2.35 per liter.
- An additional 15,000 km of gas pipeline will be developed using appropriate PPP (Public private partnership) models.
- Reduction in fuel subsidies through appropriate measures.
- Section 25 of The Customs Act is being amended to provide that the customs duties on mineral oils like oil and gas extracted or produced in the continental shelf of India or the exclusive economic zone of India shall not be recovered for the period prior to 7th February, 2002.

Fiscal Incentives:

- All exploration and drilling costs are 100% tax-deductible. Such costs are aggregated until the year of commencement of commercial production.
- A special deduction is available for provisions made for site restoration expenses if the amount is deposited in a designated bank account. The deduction is the lower of the following amounts: the amount deposited in a separate bank account or site restoration account, or 20% of the profits of the business in the relevant financial year.

State Incentives:

- Apart from the above, each state in India offers additional incentives for industrial projects. Incentives are provided in areas such as subsidized land cost, the relaxation of stamp duty on sale/lease of land, power tariff incentives, concessional rates of interest on loans, investment subsidies and/or tax

incentives, backward areas subsidies, special incentive packages for mega projects.

Export Incentives:

- Under the Exports Promotion Capital Goods Scheme, the import of capital goods at a zero basic custom duty is allowed for export purposes. Capital goods for the pre/post production stage are also permitted. The exports are to be effected equivalent to six times the duty saved on capital goods. Exports are to be completed in 6 years.

Focus Market Scheme:

- The basic objective is to offset high freight cost and other externalities to select international markets. A benefit of 3% transferable duty-free credit entitlement for specified countries has been envisaged; special focus markets get 4% benefits.

Area-Based Incentives:

- Incentives for units in special economic zones (SEZs) and national investment and manufacturing zones (NIMZs) are specified in respective acts. Plans have been made for the setting up of projects in special areas such as the North-east, Jammu & Kashmir, Himachal Pradesh and Uttarakhand.

Investment Opportunities:

Shale:

- India has technically recoverable shale gas resources of nearly 96 Trillion cubic feet.

Under Ground Coal gasification:

- Coal gasification has been identified as one of the end uses under the government's captive mining policy.

Opportunities for E&P services and equipment companies:

- 48% of the country's sedimentary area is yet to be explored. The city gas and distribution sector offers opportunities for both incumbents and new companies. The Petroleum and Natural Gas Regulatory Board allows the following incentives

to authorized entities: the infrastructure exclusivity is available to the authorized entity for a period of 25 years. Exclusivity for the activity of marketing of natural gas is allowed to the authorized entity for a period of 5 years. For incumbents, the marketing exclusivity extends to a period of 3 years.

Opportunities for pipeline transportations:

- Compared to advanced economies like the US, where more than 60% of petroleum product movement happens by pipeline, in India, currently, only 35% of product movement happens over pipelines.

The Refining sector:

- India is already a refining hub with 21 refineries and expansions planned for tapping foreign investment in export-oriented infrastructure, including product pipelines and export terminals.

Opportunities for Foreign investments and technology partnerships in the upstream sector:

- Securing supplies is expected to remain on top of India's energy agenda for the foreseeable future. While exploration activity has taken place on land and in shallow basins across the country, it is believed by many that deep water and ultra-deep water oil and gas resources hold the key to substantially increasing domestic production. This creates a plethora of opportunities for strategic investors having relevant technical expertise and financial muscle

Conclusion:

Establishing a level-playing field for domestic and Foreign Oil and gas equipment manufacturers to set up plants in India considering the future demand requirements in the sector and to encourage exports in order achieve growth in the sector. Furthermore, to facilitate technology transfer and promote domestic dedicated R&D, new product development and testing facilities could help achieve cost savings and other financial benefits to make "Make in India" campaign a success full national policy.

_____X_____

Why can't we do it here? How early can innovation and entrepreneurship be taught?

VS Ramamurthy

"Have the institutions (in particular IISc and the Indian Institute of Technologies) over the past 60-plus years contributed to making our society and the world a better place? Is there one invention from India that has become a household name in the globe? The reality is that there is no such contribution from India in the last 60 years," thus spoke Mr. Narayana Murthy during the IISc convocation ceremony held in Bengaluru on Wednesday, July 15, 2015." (The Hindu July 16, 2015)

It is not surprising that the scientific community and the teaching community in the country were taken aback and consider this as an unfair criticism. After all, free India has always been a country in transition. When the country came out of the colonial rule in 1947, we inherited a large underfed population, poor resources and poor infrastructure including the educational infrastructure. It is our early investment in higher education and industrial infrastructure that led us to where we are today. If India is no longer a country of chronic food shortages, if India is recognized as a global player in selected areas of high technology like atomic energy and space in spite of several decades of demeaning technology denials, it is the human resource nurtured by our educational institutions. Almost the entire Indian diaspora in Silicon Valley or in Route-28 are products of the very Institutions those Mr. Murthy is critical of. US gave them a different kind of opportunities that India did not provide and they delivered differently. Can it be held against the Indian educational institutions? At the same time, the message from the full text of Mr. Narayana Murthy's address appears to me somewhat different and relevant. Mr. Narayana Murthy was simply lamenting "Where is the Indian Silicon Valley? Where is the Indian Route-28? If a small Indian diaspora can do it there, why not in India?"

It is well known that Innovation and Entrepreneurship characterize the genetic map of the US science and technology systems. How is the Innovation and Entrepreneurship ecosystem in India? Indian civilization is thousands of years old. A civilization that has survived natural disasters, external invasions and internal conflicts for so long can't but be innovative and entrepreneurial. Three centuries of colonial rule had their impact on this ecosystem. Innovation and entrepreneurship got more and more limited to trade and commerce with deliberate efforts by the colonial rulers to scuttle local resources and talents. Not only India missed the industrial revolution but it also lost the ecosystem for technology and skills related innovation and entrepreneurship. Dominated by government led initiatives in the early decades of free India, the Indian society itself evolved as a risk-averse society with emphasis on jobs and family businesses.

India did realize rather early that it is important to nurture innovation and entrepreneurship amongst the technically qualified youngsters if the country has to draw the full benefit of the technological developments of the twentieth century in the country and across the world. The establishment of the National Science & Technology Entrepreneurship Development Board (NSTEDB) under the aegis of Department of Science & Technology and a chain of Science and Technology Entrepreneurship Parks in some leading technical education institutions were perhaps the earliest efforts in the country to promote technological innovations and entrepreneurship among young students. Unfortunately, the government controlled license-quota environment of the pre-90's did very little to encourage entrepreneurship. It is interesting to note that India and China embarked on entrepreneurship training almost at the same time.

When India opened its economy to the global markets in 1991, there was of course a wide spread apprehension that India may not be able to face the global competition. There was also a perceived window of opportunity. Thanks to many new initiatives taken by the government such as the creation of the Technology Development Board and the Technology Business Incubators, the country witnessed many new technological successes some of which were indeed globally competitive. The TBI's offer not only technical and infrastructural support to aspiring youngsters but also an integrated package of support services with moderate costs. The Biotechnology Industry Research Assistance Council (BIRAC) under the aegis of the Department of Biotechnology is yet another initiative of the government to bring academia and the Industry closer leading to new products and enterprises. Who can forget the outstanding successes of Indian start-ups in the global vaccine market? It is indeed intriguing why we are not seeing such successes in other sectors. It is even more intriguing to see that some of the initiatives have become non-functional today. There is indeed an urgent need to review and understand why there were many successes in the early years after the liberalization but not now. It is my perception that today innovations in the IT industry are primarily driven by the industry itself while there is substantial participation of the industry in nurturing innovations in the biotech industry. Fortunately, these developments have also attracted venture capitalists from across the globe. The recent reverse migration of technopreneurs is yet another encouraging sign. These developments are bound to strengthen the ecosystem for innovation and entrepreneurship in the country. Unfortunately, in the manufacturing sector requiring large investments, the industry participation is minimal and entrepreneurship is yet to take roots. Government initiatives within the framework of global trade agreements are unavoidable.

Last but not the least, it is important to remember that innovation and entrepreneurship are not limited to the technology domain alone. They have to percolate across all segments of the society. This can happen only when innovation and entrepreneurship training become part of our educational system. This calls for a close cooperation between the educational institutions, the government, the industry and the public at large. Professional academies like INAE have a major role in making this possible.

A large number of people in my age group have children abroad. I am no exception. My daughter lives in California. Parental responsibilities demand that you visit them periodically. When you visit them, you do not know how to spend your time and one of the pleasant duties is to escort the grand children to the school. During one of my visits, I happened to escort my grand son to the school on a Saturday for some extracurricular activity. The teachers were kind

enough to permit me to sit in a corner of the room and watch the children without disturbing the class.

After the usual pleasantries, the teacher asked every student what they had for their breakfast. The students were asked to write it down on a wall poster. Every student was also asked to say a few words about their breakfast. Typical of most US schools, the ethnic diversity was obvious and that reflected on the breakfast menu. The enthusiasm of the students to describe what they had for breakfast to an audience, not all of whom were familiar with those items, was obvious. At the end of the day, the students were asked to bring one or more photographs of the breakfast items prepared in their house with brief descriptions of how they are prepared, their nutritional value etc. and a sample portion. The student-teacher and the student-student interactions were so lively that I decided to accompany my grand son to class the following week. The next session started off with all the photographs neatly arranged on a display board. The students took their turns to come in front and give a brief description of the items that they brought, their ingredients and how they are made. Every student was then asked to name one or more breakfast items that he liked most. It was amusing to note that every student wanted something different from what he has for breakfast in his own house. I was also surprised to see that the humble idli was one of the popular breakfast items among the students though very few of them had the luxury of having idlis in their house. Apparently, a popular Indian restaurant in the vicinity was tickling their taste buds with steaming idlis and tangy sambar and chutney.

During the week, my daughter had a call from the teacher and was asked whether she would volunteer to demonstrate idli making to the students during the next session. My daughter ended up in the class room the next week end with all the paraphernalia and made idlis in front of all the students. At the end of the day, my grand son was asked to work out how much it costed to make one idli. He had to also explain why it costs more in a regular restaurant.

It was then time for me to return. I heard from my daughter that after sometime, when there was a student fest in the school, my son wanted to put up an idli stall and ended up with a tidy sum as profit in his pocket. I now realize that the teachers had created an entrepreneur in my grandson without saying so. I now realize that it is never too early to introduce innovation and entrepreneurship.

R&D in Indian PSUs: My Experience

P.V.Ananda Mohan

At Andhra University

I was initiated into research at Applied Physics Laboratories, Andhra University to work in the area of Thin films with specific task initially on the development of a thickness monitor for films formed using vacuum evaporation. In those days, still universities did not introduce transistors in the curriculum. Only circuit design using vacuum tubes used to be taught and laboratories were equipped with the needed electronic components. The problem was to use reflectance of thin films as measure of thickness when aluminium is being deposited. Unfortunately, the light from the tungsten filament was much more than the reflected light of a source. In order to distinguish these two one signal and another noise, the reflected beam needs to be made different in some way. One known solution was to use modulation for the source being beamed on the thin film on glass substrate by chopping it. Thus one is having a frequency component depending on the motor speed and number of holes on the circular disc connected to the axle of the motor through which light is sent to fall on the device under test. The job was to design a bandpass filter to select he needed frequency component and reject the huge noise (light from the filament). The whole process happens in few seconds to take the aluminium or other metal like tin, copper in a crucible kept in the heated filament. The library of Andhra University was perhaps the best in India at that time. The author had to browse through Journal of Scientific Instruments, Review of Scientific Instruments, Wireless world, Electronics and other magazines to look for designs of filters. At that time itself, my research trajectory in my career was defined perhaps. Then some design was implemented using vacuum tubes and it was working quite well meeting the requirements. The author had to discontinue at Andhra University his research due to some differences with his research supervisor and had to join NSTL, Visakhapatnam as a Junior Scientific Assistant. The laboratory was very newly started and the author could procure bipolar transistors and build some circuits picked from some journals – a relaxation oscillator using a SCR like deviceusing a PNP and a NPN transistor. The author could thoroughly understand the operation and design.

At I.I.Sc, Bangalore

Yet, I was keen in pursuing Ph.D programme and applied to I.I.Sc, Bangalore and was interviewed by Prof. B.S. Sonde and a big I.I.Sc selection committee and was selected to work with Prof. Sonde. Interestingly, the topic was Negative resistance in Bipolar Transistors. The training given by Prof.Sonde: asking me to read Classic papers on Bipolar transistor modelling, books on VLSI technology by Motorola, SEEC six volumes, selected IEEE Papers etc has really changed my understanding of the subject. He then asked me to build a test set for studying negative resistance phenomena without killing the transistors-pulse based testing. He used to give me variety of transistors which were based on various fabrication technologies-alloy, alloy-diffused, planar epitaxial etc and find out whether anything interesting breakdown phenomena is observed. I had to conduct experiments and whatever interesting anomalous behaviour I used to report everyday evening at 6PM -8PM based on his free time. He used to then ask me to explain what could be the reason for that anomalous behaviour. Most important idea was asking me to investigate negative resistance in inverted mode operation of the transistor. This led to significant results. Then of

course, at theend of two and half years, he asked me to start writing the thesis. I have asked him: have I done enough work? He said that while writing the thesis, you know the gaps and then actually youwill do real work, tie up lose threads, which was found to be true. He advised me to join ITI Limited. He was insisting that he wanted his students to serve industry. I learnt how to draw circuits meticulously using pen on paper as though they are printed and how to analyse circuits.

At Indian Telephone Industries Limited

I must stress that ITI limited was a great company. When I have joined the Electronic Switching system group, Space Divlsion telephone exchanges using reed relays were being used which occupied lot of space for the switching matrix. I have been asked by the then Executive Director Shri M.S.Jayasimha a visionary although just a B.E from Madras Institute of Technology to develop a semiconductor version of the switch in place of reed relay. I had then first used PNPN diodes of ITT and the supply voltage needed was very high due to large breakdown voltage of > 50volts but concept was proven. Then, suddenly I got an idea why cannot I use NPN PNP transistors in inverted mode an extension of my Ph.D work and build a PNPN diode. This has resulted in the invention of a new PNPN diode which needs a breakdown voltage of 7V for switching [1]. This device was manufactured by Semiconductors limited Pune and Continental Devices India Faridabad using two transistors in a single package and was extensively used for 50 line telephone exchanges where 700 devices were assembled on one card. Then PCM came into existence for switching. ITI had meanwhile used PAM based TDM exchanges a forerunner for today's E1 based trunks. In those days, multiplexed codec chips were available and Filters were realized outside. No chips were readily available. ITI limited thought of having Active RC filters. My passion for filter design made me design Active RC filters and new techniques for sinx/x correction were envisagedand these were published as design ideas [2]. Next, I was asked to design line cards using these filters made in Thick fimhybrids, design of SLIC without usingbulky transformers. Small exchanges using Microprocessor based stored program control were designed by my colleagues using 8008 processor (used in Indian Navy ships) initially, then using 8080, later 8085 based processor cards. My passion for Filters continued as a parallel effort. The author has published lots of papers on tuning see e.g [3,4], some even on fundamental theoretical aspects [5] since there was a need for designing Voice Input filters for FDM equipment which had stringent requirement on low noise, low pass-band ripple, steep cut offs. I have designed several filters for Thick film hybrids which did not need any post tuning other than using laser trimming for resistors and using low tolerance capacitors. These filters used low noise opamps and scaled low value resistances and were fabricated by ECIL and at ITI limited facilities. Defence services have used these extensively in their Voice plus data multiplexers using FDM technique. Numerous papers have been written by the authorwhich were published in Proc. IEEE letters. This section in Proc. IEEE in those was for fast publication and most authors used to publish therein. Unfortunately with the arrival of numerous transactions catering for different areas, the letters section was discontinued.

During 1980s, India had outstanding researchers in the area of Active RC filters whohad the foresight to investigatenew techniques. Notable was the use of opampfinite bandwidth to advantage,. Following the trend, the author has worked in partially Active R filters, Active R filters [6],[7]. Experimental results were included in the publication due to the availability of devices, ease of assembly and testing.

At Concordia University, Montreal

During 1980-1983, the author was offered a post-doctoral fellowship at Concordia University, Montreal to work with Prof. M.N.S. Swamy and Prof. V. Ramachandran. They have asked the author to work in an emerging area Switched capacitor filters. At the beginning, the author was rather scared to work in a new area but the urge to contribute otherwise being considered as not good made him to pursue deep into this area and within one year new results have been obtained; numerous papers were published in reputed journals jointly with Dr.Swamy and Dr. Ramachandran.

Then the author got an idea to write a book and then it took about a year to comprehensively study and write the book. It appeared much later from Prentice-Hall London in 1995 [8]. Meanwhile, in 1983, the author had to return to India and continue in ITI Limited. The research in SC filters was continued and the author could adapt to new areas such continuous-time filters [9], OTA-C filters [10], current-mode filters [11] etc.

At I.T.I. Limited

During 1987, there was need for Indian army to introduce a new communication network using the first integrated voice and data switch with full media encryption on digital microwave links. Again Shri M.S. Jayasimha picked up the author amongst all the R&D engineers of ITI limited and assigned this task. The author had built an outstanding group of algorithm and hardware designers with knowledge of Telecom interfaces to build state of the art systems. In those days, FPGAS were not available. Building a massive encryption hardware was a problem due to space constraints. The then Director R&D of ITI Limited Dr.Prabhakar had taken up the challenge of designing and fabricating ASICs totally in ITI limited foundry (now SITAR). About fifteen thousand ICs of about 2500 gates each using 0.8 micron technology was used to set up the army network. This network was first of its kind in India with comprehensive distributed network management system, redundancy to yield a fail safe network. The Army Generals described it as a Force Multiplier.

The work in encryption continued at ITI and numerous solutions for Satellite networking, optical fibre links etc later using FPGAs. The author had to inspire the teams to add novelty in design, new features, cater to higher and higher bandwidths upto 622 Mb/s. During this time, the author was studying public domain algorithms for encryption, Authentication and digital signatures etc. Several papers on Architectures and implementations were published. Research in residue number systems was a by product. Noticing the absence of a book on Residue number systems after the one published in 1967 by Szabo and Tanaka, the author has pubished a book on the same with Kluwer Academic Publishers in 2002 [12]. ITI limited was encouraging original research and the author was deputed to several IEEE annual International symposia on Circuits and Systems at Hesinki, Japan, Port land USA, San Jose U.S.A, Munich.

At ECIL, Bangalore

Later in 2003, the author has resigned from ITI Limited and joined ECIL at Bangalore. The work on Encryption continued and numerous products for the Armed forces have been developed and supplied. The two research tracks were followed in analog filter design and in Cryptography and Residue Number Systems. Two more books on Analog filters- current-mode VLSI analog filters from Birkhauser, Springer in 2003 [13] and VLSI analog filters in 2013 [14] were published. These involved hard work in compiling information, designing examples, problems and sharing knowledge with the readers. I was delighted to be elected as a IEEE Fellow in 2005 and FNAE in 2010.

Concluding Remarks

I was delighted to work with numerous young engineers, inspire them to be creative and create leaders and quickly deliver the results to the customers. I feel that self-motivation is needed to excel in research. R&D institutions belonging to Indian Government sector have done much for the development of indigenous technologies in Space, Atomic research, encryption, telecommunication and digital Electronics. Much of my workin cryptography could not be published due to strategic reasons. Government funding for scientific shall be enhanced and methodologies to attract and nurture talent, inspire them need to be thought of. I truly enjoyed working in India and I am grateful to institutions like ITI Limited, ECIL and Indian Armed Forces for their trust in Indian capabilities in strategic areas.

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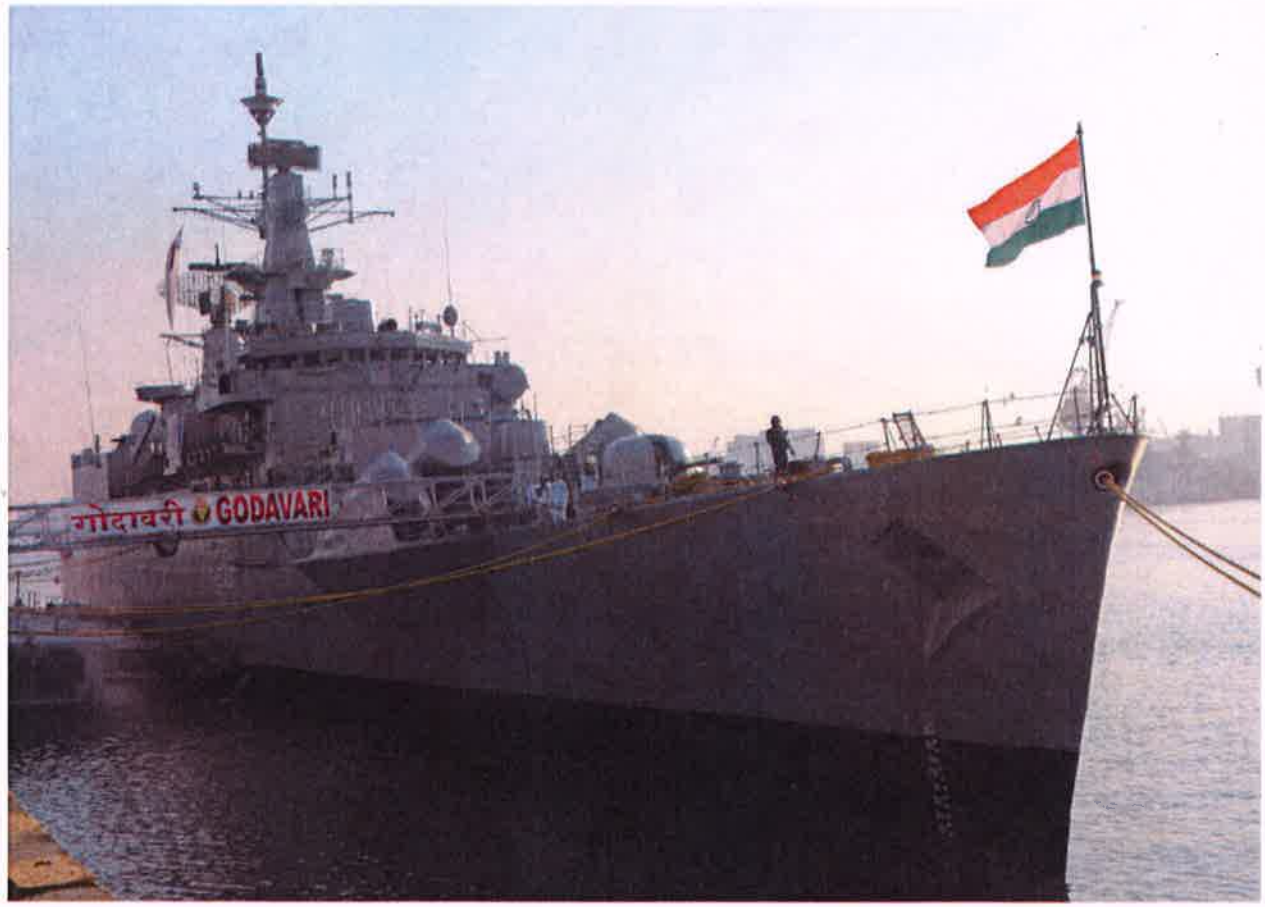
The First Indigenously designed and built frigate INS Godavari Decommissioned

Capt. (IN) NS Mohan Ram (Retd)

As the sun set on 23rd December 2015, the Indian Navy hauled down its ensign from the historic guided missile frigate, Indian Naval Ship Godavari, for the last time. In a solemn ceremony at the Naval Dockyard, Mumbai, Vice Admiral R Hari Kumar, Chief of Staff, Headquarter Western Naval Command, decommissioned the 32 year old ship. The ceremony was attended by a large number of people including ex-Commanding Officers and crew of the ship, and senior officers of the Western Naval Command.



INS Godavari was designed by the Indian Navy's Design Directorate and Mazagon Dock Shipbuilders Limited (MDL) and was constructed at MDL. Godavari was the first major warship which was completely designed and constructed in India and thus was a significant milestone for the country in its transition from being a 'buyers Navy' to a 'builders Navy'. Commissioned on 10 December 1983, she had completed 32 years of glorious and action packed service to the nation at decommissioning. She has thus proven the success and effectiveness of the Indian designers and shipbuilders.

Being the first to be designed and made in India, lessons learnt during her construction and operations have helped the nation's shipyards and designers in refining subsequent indigenous warships. Today, Kolkata class destroyers built in the country are among the best destroyers in the world.

I was the leader of the team that designed the ship at Directorate of Naval Design. I also headed the Design department of Mazagon Docks when the ship was launched, went on sea trials and was finally accepted by the Navy. I was awarded the VishishtSeva Medal for the same.

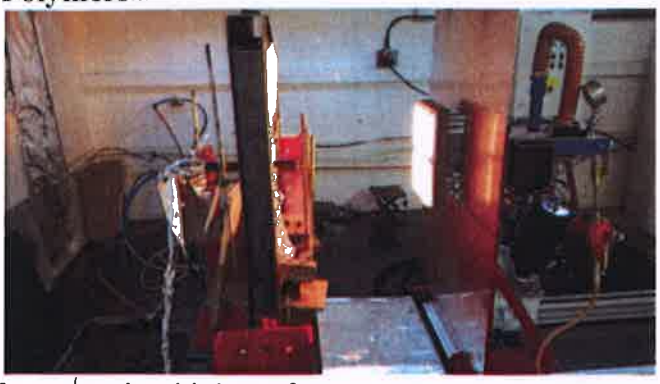
The Indian Navy invited me as a special guest for the decommissioning ceremony flying me over to Mumbai. I was introduced as the designer of the ship to the press and media. There was extensive coverage on both print media (TOI, Economic Times, Business Standard etc.) but also on the visual media. I was honored that even after thirty five years, the Navy remembered my services as a pioneer of naval design. Some of the URLs featuring my role in passing.

Visual Media
https://www.youtube.com/watch?v=aLIUrdMrekc
https://www.youtube.com/watch?v=AxGkwkI7dl4

Print Media
http://timesofindia.indiatimes.com/city/mumbai/Warship-easier-to-build-than-bike-Designer/articleshow/50303271.cms
http://economictimes.indiatimes.com/news/defence/designer-of-ins-godavari-gets-nostalgic-on-its-farewell/articleshow/50302226.cms

Civil Engineering

1. Polymers Render Concrete Fire-Resistant

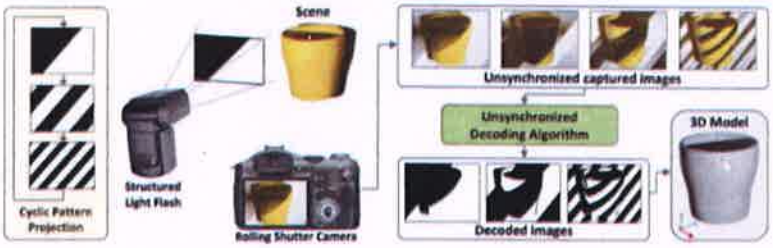


Researchers from Empa tested a SAP-containing concrete slab with a radiant heater. Some discolouring emerged at the surface of the concrete element, but no spalling occurred.

Self-compacting high-performance concrete (SCHPC) has till now suffered from one weakness: when exposed to fire it flakes and splits, which reduces its loadbearing capacity. Empa, Switzerland scientists have now developed a method of manufacturing fire-resistant self-compacting high-performance concrete which maintains its mechanical integrity under these conditions. When concrete is exposed to fire it chips and flakes -- a process known as spalling. This effect is due to the phenomenon: water trapped within the concrete element vaporizes due to the high temperature. As more water vapour is produced the pressure within the concrete structure increases. In concrete structures, chips split away from ceilings, walls, and supporting pillars, reducing their loadbearing capacity and increasing the risk of collapse in a burning building. The resistance of conventional vibrated concrete to the heat of a fire can be optimized by adding a few kilograms of polypropylene (PP) fiber per cubic meter of concrete mixture. When exposed to fire the fibers melt, creating a network of fine canals throughout the concrete structure. These allow the water vapour to escape without increasing the internal pressure, so the concrete structure remains intact. Self-compacting high-performance concrete (SCHPC) behaves differently though. Adding more than 2 kg of PP fiber per cubic meter to the SCHPC mixture affects its ability to self-compact, so the proportion of PP fiber in SCHPC must be kept relatively low. This in turn means that if the concrete is exposed to fire, the network of fine canals created by the melting fibers is not continuous throughout the entire structure, allowing spalling to occur. The question is therefore how to make SCHPC fire resistant, so buildings made of it are safer, whilst keeping the proportion of polymer fibers low enough that the concrete remain self-compacting. Researchers from Empa's "Concrete/Construction Chemistry" and "Mechanical Systems Engineering" Laboratories have now managed to find an answer. They manufactured a series of thin-walled concrete slabs which were prestressed with cables made of carbon fiber reinforced polymer. The concrete from which the slabs were made also contained 2 kg of PP fiber per cubic meter of mixture. In some slabs the scientists also added a small quantity of super absorbing polymer (SAP), a special synthetic material which is capable of absorbing many times its own weight in water. They then exposed the concrete slabs to fire, reaching temperatures of up to 1000°C. After 90 minutes it became clear that whilst the SAP-containing concrete slabs showed some minor cracking, spalling occurred only in the SAP-free slabs. The explanation for this behaviour is as follows: during the manufacturing process the SAP is saturated with water, swelling to several times its dry volume. As the concrete is setting the water is drawn out of the SAP by capillary action in the porous cement matrix. The SAP shrinks and creates hollow spaces which link the individual, hitherto unconnected networks of PP fibers. The result is a dendritic network of SAP and PP fibers which permeate the entire volume of concrete, allowing it to tolerate the heat of the fire for sufficiently long to maintain the structural integrity of the building. With their innovative development the Empa researchers have widened the opportunities for exploiting the economic and environmental advantages offered by self-compacting concrete (SCC).

Source http://www.sciencedaily.com/releases/2016/01/160107094751.htm

2. Algorithm Helps Turn Smartphones Into 3-D Scanners



Structured light 3-D scanning normally requires a projector and camera to be synchronized. A new technique eliminates the need for synchronization, which makes it possible to do structured light scanning with a smartphone.

While 3-D printers have become relatively cheap and available, 3-D scanners have lagged well behind. But now, an algorithm developed by Brown University researchers my help bring high-quality 3-D scanning capability to off-the-shelf digital cameras and smartphones. "One of the things my lab has been focusing on is getting 3-D image capture from relatively low-cost components," said Gabriel Taubin, a professor in Brown's School of Engineering. "The 3-D scanners on the market today are either very expensive, or are unable to do high-resolution image capture, so they can't be used for applications where details are important." Most high-quality 3-D scanners capture images using a technique known as structured light. A projector casts a series of light patterns on an object, while a camera captures images of the object. The ways in which those patterns deform over and around an object can be used to render a 3-D image. But for the technique to work, the pattern projector and the camera have to precisely synchronized, which requires specialized and expensive hardware. The algorithm Taubin and his students have developed, however, enables the structured light technique to be done without synchronization between projector and camera, which means an off-the-shelf camera can be used with an untethered structured light flash. The camera just needs to have the ability to capture uncompressed images in burst mode (several successive frames per second), which many DSLR cameras and smartphones can do. The problem in trying to capture 3-D images without synchronization is that the projector could switch from one pattern to the next while the image is in the process of being exposed. As a result, the captured images are mixtures of two or more patterns. A second problem is that most modern digital cameras use a rolling shutter mechanism. Rather than capturing the whole image in one snapshot, cameras scan the field either vertically or horizontally, sending the image to the camera's memory one pixel row at a time. As a result, parts of the image are captured a slightly different times, which also can lead to mixed patterns. "That's the main problem we're dealing with," said the graduate student who led the development of the algorithm. "We can't use an image that has a mixture of patterns. So with the algorithm, we can synthesize images--one for every pattern projected--as if we had a system in which the pattern and image capture were synchronized." After the camera captures a burst of images, algorithm calibrates the timing of the image sequence using the binary information embedded in the projected pattern. Then it goes through the images, pixel by pixel, to assemble a new sequence of images that captures each pattern in its entirety. Once the complete pattern images are assembled, a standard structured light 3D reconstruction algorithm can be used to create a single 3-D image of the object or space. The researchers showed that the technique works just as well as synchronized structured light systems. During testing, the researchers used a fairly standard structured light projector, but team envisions working to develop a structured light flash that could eventually be used as an attachment to any camera, now that there's an algorithm that can properly assemble the images. "We think this could be a significant step in making precise and accurate 3-D scanning cheaper and more accessible," Taubin said.

Source http://www.sciencedaily.com/releases/2015/12/151223141326.htm

Mechanical Engineering

3. Heat-Resistant Ceramic Parts Are Now 3-D Printable

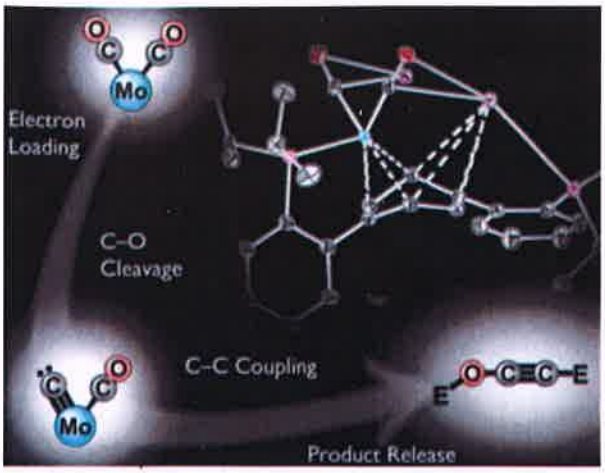
Researchers demonstrate high-resolution printing of objects made of versatile ceramic materials.

The promise of additive manufacturing or 3-D printing—faster and cheaper manufacturing of more customizable parts—is limited by the palette of printable materials, which until now has included mainly polymers and some metals. Now we can add ceramics, an important class of materials whose high strength and resistance to heat, chemical degradation, and friction make them attractive for use in the military and the aerospace industries for everything from exterior airplane parts to small components for rockets. Thanks to a materials science innovation demonstrated by researchers at HRL Laboratories, USA engineers can now use additive manufacturing to quickly build customized, intricate ceramic parts that take advantage of all these attractive properties at once. It's challenging to make ceramics into durable parts, especially ones with complex shapes. The materials are not compatible with conventional manufacturing techniques like machining and casting, and the typical method entails using heat to consolidate powder and build solid forms. This approach, which can also be used in additive manufacturing, is not very reliable, however, and commonly introduces flaws that can lead to cracks and fractures. The researchers at HRL Labs got around this by developing a new printable resin made of so-called preceramic polymers, which can be converted into ceramics by heating them at high temperatures. They demonstrated that the new resin is compatible with a popular additive manufacturing technique called stereolithography, in which a laser beam is used to build structures layer by layer from a liquid polymer. The researchers also showed that it works with a specialized technique that employs ultraviolet light and patterned masks to build complex 3-D structures like lattices, 100 to 1,000 times as rapidly as conventional stereolithography can. After printing, the researchers heated the parts to turn them into ceramics and demonstrated their impressive mechanical properties. Two classes of useful ceramic parts—large, very lightweight lattice structures that could be used in heat-resistant panels and other exterior parts for airplanes and spacecraft, and small, intricate parts for use in electromechanical systems or in components of jet engines and rockets—are now printable thanks to the new approach, says a HRL Labs senior scientist. The researcher says the group now has funding to use the new technique to develop a ceramic aeroshell, essentially a shield that protects spacecraft or hypersonic aircraft from heat, pressure, and debris. Ceramic foams are attractive for this application because of their thermal properties, but their poor mechanical properties make them largely unsuitable for use in load-bearing structures, says the researcher. Ceramic lattice structures created by HRL Labs are 10 times stronger than commercially available foams.

Source http://www.technologyreview.com/news/545086/heat-resistant-ceramic-parts-are-now-3-d-printable/

Chemical Engineering

4. Towards Liquid Fuels from Carbon Dioxide



C1 to C2: Connecting carbons by reductive deoxygenation and coupling of CO

In the quest for sustainable alternative energy and fuel sources, one viable solution may be the conversion of the greenhouse gas carbon dioxide (CO_2) into liquid fuels. Through photosynthesis, plants convert sunlight, water, and CO_2 into sugars, multicarbon molecules that fuel cellular processes. CO_2 is thus both the precursor to the fossil fuels that are central to modern life as well as the by-product of burning those fuels. The ability to generate synthetic liquid fuels from stable, oxygenated carbon precursors such as CO_2 and carbon monoxide (CO) is reminiscent of photosynthesis in nature and is a transformation that is desirable in artificial systems. For about a century, a chemical method known as the Fischer-Tropsch process has been utilized to convert hydrogen gas (H_2) and CO to liquid fuels. However, its mechanism is not well understood and, in contrast to photosynthesis, the process requires high pressures (from 1 to 100 times atmospheric pressure) and temperatures (100-300 degrees Celsius). More recently, alternative conversion chemistries for the generation of liquid fuels from oxygenated carbon precursors have been reported. Using copper electrocatalysts, CO and CO_2 can be converted to multicarbon products. The process proceeds under mild conditions, but how it takes place remains a mystery. Now, Caltech researchers have developed a model system to demonstrate what the initial steps of a process for the conversion of CO to hydrocarbons might look like. The findings provide a foundation for the development of technologies that may one day help neutralize the negative effects of atmospheric accumulation of the greenhouse gas CO_2 by converting it back into fuel. Although methods exist to transform CO_2 into CO, a crucial next step, the deoxygenation of CO molecules and their coupling to form C-C bonds, is more difficult. In their study, the researchers synthesized a new transition metal complex -- a metal atom, in this case molybdenum, bound by one or more supporting molecules known as ligands -- that can facilitate the activation and cleavage of a CO molecule. Incremental reduction of the molecule leads to substantial weakening of the C-O bonds of CO. Once weakened, the bond is broken entirely by introducing silyl electrophiles, a class of silicon-containing reagents that can be used as surrogates for protons. This cleavage results in the formation of a terminal carbide -- a single carbon atom bound to a metal center -- that subsequently makes a bond with the second CO molecule coordinated to the metal. Although a carbide is commonly proposed as an intermediate in CO reductive coupling, this is the first direct demonstration of its role in this type of chemistry, the researchers say. Upon C-C bond formation, the metal center releases the C_2 product. Overall, this process converts the two CO units to an ethynol derivative and proceeds easily even at temperatures lower than room temperature. "To our knowledge, this is the first example of a well-defined reaction that can take two carbon monoxide molecules and convert them into a metal-free ethynol derivative, a molecule related to ethanol; the fact that we can release the C2 product from the metal is important," researchers say. While the generated ethynol derivative is not useful as a fuel, it represents a step toward being able to generate synthetic multicarbon fuels from carbon dioxide. The researchers are now applying the knowledge gained in this initial study to improve the process. The scientists are also working on a way to cleave the C-O bond using protons instead of silyl electrophiles.

Source http://www.sciencedaily.com/releases/2016/01/160106125646.htm

Electrical Engineering

5. Engineers Demo First Processor That Uses Light For Ultrafast Communications

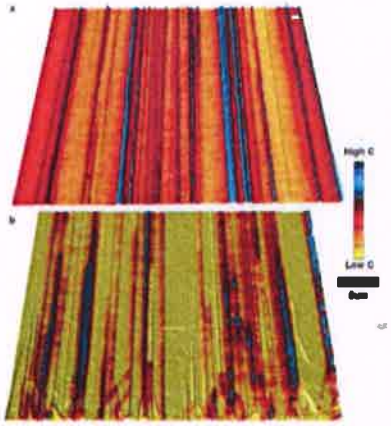
This packaged electronic-photonic processor microchip under illumination reveals the chip's primary features. The light rays emanating from the chip are drawn to show that the processor talks to the outside world using light.

Engineers have successfully married electrons and photons within a single-chip microprocessor, a landmark development that opens the door to ultrafast, low-power data crunching. The researchers packed two processor cores with more than 70 million transistors and 850 photonic components onto a 3-by-6-millimeter chip. They fabricated the microprocessor in a foundry that mass-produces high-performance computer chips, proving that their design can be easily and quickly scaled up for commercial production. The new chip marks the next step in the evolution of fiber optic communication technology by integrating into a microprocessor the photonic interconnects, or inputs and outputs (I/O), needed to talk to other chips. "This is a milestone. It's the first processor that can use light to communicate with the external world," said Vladimir Stojanović, an associate professor of electrical engineering and computer sciences at the University of California, Berkeley, who led the development of the chip. "No other processor has the photonic I/O in the chip." The researchers teamed up with Rajeev Ram at the Massachusetts Institute of Technology and Milos Popović at the University of Colorado, to develop the new microprocessor. "This is the first time we've put a system together at such scale, and have it actually do something useful, like run a program," said a researcher, who helped develop the free and open architecture called RISC-V (reduced instruction set computer), used by the processor. Compared with electrical wires; fiber optics support greater bandwidth, carrying more data at higher speeds over greater distances with less energy. While advances in optical communication technology have dramatically improved data transfers between computers, bringing photonics into the computer chips themselves had been difficult. That's because no one until now had figured out how to integrate photonic devices into the same complex and expensive fabrication processes used to produce computer chips without changing the process itself. Doing so is key since it does not further increase the cost of the manufacturing or risk failure of the fabricated transistors. The researchers verified the functionality of the chip with the photonic interconnects by using it to run various computer programs, requiring it to send and receive instructions and data to and from memory. They showed that the chip had a bandwidth density of 300 gigabits per second per square millimeter, about 10 to 50 times greater than packaged electrical-only microprocessors currently on the market. The photonic I/O on the chip is also energy-efficient, using only 1.3 picojoules per bit, equivalent to consuming 1.3 watts of power to transmit a terabit of data per second. In the experiments, the data was sent to a receiver 10 meters away and back. "The advantage with optical is that with the same amount of power, you can go a few centimeters, a few meters or a few kilometers," said researchers. "For high-speed electrical links, 1 meter is about the limit before you need repeaters to regenerate the electrical signal, and that quickly increases the amount of power needed. For an electrical signal to travel 1 kilometer, you'd need thousands of picojoules for each bit." The achievement opens the door to a new era of bandwidth-hungry applications. One near-term application for this technology is to make data centers more green. Further down the road, this research could be used in applications such as LIDAR, the light radar technology used to guide self-driving vehicles and the eyes of a robot; brain ultrasound imaging; and new environmental biosensors.

Source http://www.sciencedaily.com/releases/2015/12/151223221346.htm

Electronics and Communication Engineering

6. Researchers Gauge Quantum Properties of Nanotubes, Essential for Next-Gen Electronics



(a, b) MIM capacitance images overlaid on top of AFM 3-D surface topography of an array of CVD grown aligned SWNTs on quartz substrates. Each sample has a 3.5 nm dielectric layer of (a) MgO and (b) SiO2.

Imaging method allowed researchers to measure the nanotube quantum capacitance. How do you get to know a material that you cannot see? That is a question that researchers studying nanomaterials -- objects with features at the sub-micrometer scales such as quantum dots, nanoparticles and nanotubes -- are seeking to answer. Though recent discoveries -- including a super-resolution microscopy which won the Nobel Prize in 2014 -- have greatly enhanced scientists' capacity to use light to learn about these small-scale objects, the wavelength of the inspecting radiation is always much larger than the scale of the nano-objects being studied. For example, nanotubes and nanowires -- the building blocks of next-generation electronic devices -- have diameters that are hundreds of times smaller than the light could resolve. Researchers must find ways to circumvent this physical limitation in order to achieve sub-wavelength spatial resolution and explore the nature of these materials for future computers. a group of scientists from the University of Illinois at Urbana-Champaign; Lehigh University and Harvard University -- are reporting on the discovery of an important method for measuring the properties of nanotube materials using a microwave probe. The researchers studied single-walled carbon nanotubes. These are 1-dimensional, wire-like nanomaterials that have electronic properties that make them excellent candidates for next generation electronics technologies. In fact, the first prototype of a nanotube computer has already been built by researchers at Stanford University. The IBM T.J. Watson Research Center is currently developing nanotube transistors for commercial use. For this study, scientists grew a series of parallel nanotube lines, similar to the way nanotubes will be used in computer chips. Each nanotube was about 1 nanometer wide -- ten times smaller than expected for use in the next generation of electronics. To explore the material's properties, they then used microwave impedance microscopy (MIM) to image individual nanotubes. "Although microwave near-field imaging offers an extremely versatile 'nondestructive' tool for characterizing materials, it is not an immediately obvious choice," explained researchers. "Indeed, the wavelength of the radiation used in the experiment was even longer than what is typically used in optical microscopy-about 12 inches, which is approximately 100,000,000 times larger than the nanotubes we measured." They added: "The nanotube, in this case, is like a very bright needle in a very large haystack." The imaging method they developed shows exactly where the nanotubes are on the silicon chip. More importantly, the information delivered by the microwave signal from individual nanotubes revealed which nanotubes were and were not able to conduct electric current. Unexpectedly, they were finally able to measure the nanotube quantum capacitance-a very unique property of an object from the nano-world-under these experimental conditions. "We began our collaboration seeking to understand the images taken by the microwave microscopy and ended by unveiling the nanotube's quantum behavior, which can now be measured with atomistic resolution," said researchers. As an inspection tool or metrology technique, this approach could have a tremendous impact on future technologies, allowing optimization of processing strategies including scalable enriched nanotube growth, post-growth purification, and fabrication of better device contacts. One can now distinguish, in one simple step, between semiconductor nanotubes that are useful for electronics and metallic ones that can cause a computer to failure. Moreover this set of imaging modes sheds light on the quantum properties of these 1D structures.

Source http://www.sciencedaily.com/releases/2016/01/160107104814.htm

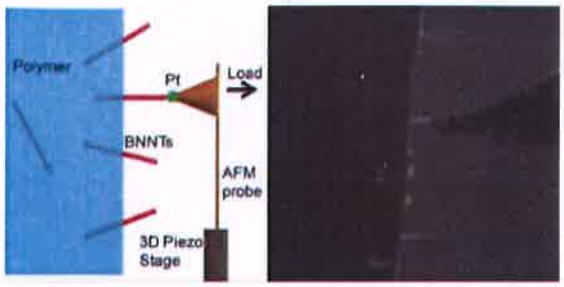
7. Rover Rounds Martian Dune to Get to the Other Side

This Dec. 18, 2015, view of the downwind face of "Namib Dune" on Mars covers 360 degrees, including a portion of Mount Sharp on the horizon.

NASA's Curiosity Mars rover, partway through the first up-close study ever conducted of extraterrestrial sand dunes, is providing dramatic views of a dune's steep face, where cascading sand has sculpted very different textures than the wavy ripples visible on the dune's windward slope. Researchers are using Curiosity to examine examples of the Bagnold Dunes, a band of dark sand dunes lining the northwestern flank of Mt. Sharp, the layered mountain the rover is climbing. A characteristic that sets true dunes apart from other wind-shaped bodies of sand, such as drifts and ripples previously visited by Mars rovers, is a steep, downwind slope known as the slip face. Here, sand blowing across the windward side of the dune suddenly becomes sheltered from the wind by the dune itself. The sand falls out of the air and builds up on the slope until it becomes steepened and flows in mini-avalanches down the face. The mission's dune-investigation campaign is designed to increase understanding about how wind moves and sorts grains of sand, in an environment with less gravity and much less atmosphere than well-studied dune fields on Earth. The Bagnold Dunes are active. Sequential images taken from orbit over the course of multiple years show that some of these dunes are migrating by as much as a yard, or meter, per Earth year. Curiosity has not caught a sand slide in action, but the rover's images of the Namib Dune slip face show where such slides have occurred recently. These dunes likely are most active in Mars' southern summer, rather than in the current late-fall season. A few days of rover operations were affected in December due to an arm-motion fault, diagnosed as a minor software issue. Normal use of the arm resumed Dec. 23. Curiosity has been working on Mars since early August 2012. It reached the base of Mount Sharp in 2014 after fruitfully investigating outcrops closer to its landing site and then trekking to the mountain. The main mission objective now is to examine successively higher layers of Mount Sharp.

Source http://www.sciencedaily.com/releases/2016/01/160105160055.htm

8. Better Fighter Planes, Space Shuttles on the Way, Thanks to New Research



Researchers tested the force required to pluck a boron nitride nanotube (BNNT) from a polymer by welding a cantilever to the nanotube and pulling. The experimental set-up is shown in a schematic on the left and an actual image on the right.

Thousands bound together are still thinner than a single strand of human hair, but with research from Binghamton University, boron nitride nanotubes may help build better fighter planes and space shuttles. A team of scientists led by Changhong Ke, associate professor of mechanical engineering at Binghamton University's Thomas J. Watson School of Engineering and Applied Science were the first to determine the interface strength between boron nitride nanotubes (BNNTs) and epoxy and other polymers. "We think that this could be the first step in a process that changes the way we design and make materials that affect the future of travel on this planet and exploration of other worlds beyond our own," said Ke. "Those materials may be way off still, but someone needed to take the first step, and we have." Ke's group found that BNNTs in polymethyl metacrylate (PMMA) form much stronger interfaces than comparable carbon tubes with the same polymer. Furthermore, BNNT-epoxy interfaces are even stronger. A stronger interface means that a larger load can be transferred from the polymer to nanotubes, a critical characteristic for superior mechanical performance of composite materials. Future airplane wings and spacecraft hulls built of those BNNT composite materials could be lighter and more fuel efficient, while maintaining the strength needed to withstand the rigors of flight. Since nanotube wall thickness and diameters are measured in billionths of a meter, Ke and co-workers extracted single BNNTs from a piece of epoxy and then repeated the process with PMMA inside an electron microscope. Their conclusions were based on the amount of force needed to do the extractions. This was the first time that BNNTs --more chemically and thermally stable than the more common carbon nanotubes (CNTs) --were in this kind of experiment. BNNTs can shield space radiation better than CNTs, which would make them an ideal building material for spacecraft. "They are both light and strong," Ke said of the two kinds of tubes. "They have similar mechanical properties, but different electrical properties. Those differences help to add strength to the BNNT interfaces with the polymers." Metaphorically, think of the epoxy or other polymer materials with the BNNT nanotubes inside like a piece of reinforced concrete. That concrete gets much of its strength from the makeup of the steel rebar and cement; the dispersion of rebar within the cement; the alignment of rebar within the cement; and "stickiness" of the connection between the rebar and the surrounding cement. The scientists essentially measured the "stickiness" of a single nanotube 'rebar' -- helped by molecular and electrostatic interactions -- by removing it from polymer "cement."

Source http://www.sciencedaily.com/releases/2016/01/160104163702.htm

9. New Efficiency Record Set with Dual-Junction Solar Cell

Scientists at the Energy Department's National Renewable Energy Laboratory (NREL) and at the Swiss Center for Electronics and Microtechnology (CSEM) have jointly set a new world record for converting non-concentrated (1-sun) sunlight into electricity using a dual-junction III-V/Si solar cell. The newly certified record conversion efficiency of 29.8 percent was set using a top cell made of gallium indium phosphide developed by NREL, and a bottom cell made of crystalline silicon developed by CSEM using silicon heterojunction technology. The two cells were made separately and then stacked by NREL. The record was published in 'Solar cell efficiency tables.' "It's a record within this mechanically stacked category," said David Young, a senior researcher at NREL. "The performance of the dual-junction device exceeded the theoretical limit of 29.4 percent for crystalline silicon solar cells." "We believe that the silicon heterojunction technology is today the most efficient silicon technology for application in tandem solar cells" said researchers. "CSEM partnered with the NREL scientists with the objective to demonstrate that 30 percent efficient tandem cells can be realized using silicon heterojunction bottom cells, thanks to the combination with high performance top cells such as those developed by NREL," said Matthieu Despeisse, the manager of crystalline silicon activities at CSEM. A new design for the dual-junction solar cell and the contributions from CSEM were key to setting the record. These first collaboration results further indicate that even greater efficiency can be achieved by the combination of NREL and CSEM cells.

Source http://www.sciencedaily.com/releases/2016/01/160106101039.htm

10. Robotic Glove Helps Patients Restore Hand Movements

A research team from the National University of Singapore has developed a new lightweight and smart rehabilitation device called EsoGlove to help patients who have lost their hand functions due to injuries or nerve-related conditions to restore their hand movements.

Patients who have lost their hand functions due to injuries or nerve-related conditions, such as stroke and muscular dystrophy, now have a chance of restoring their hand movements by using a new lightweight and smart rehabilitation device called EsoGlove developed by a research team from the National University of Singapore (NUS). Made of soft materials, this novel device is an improvement from conventional robotic hand rehabilitation devices as it has sensors to detect muscle signals and conforms to the natural movements of the human hand, reducing discomfort and risk of injury. This robotic glove is also compact and portable, so patients who are recovering at home or are bedridden could carry out rehabilitation exercises with greater ease and comfort. Researchers from the NUS Department of Biomedical Engineering, who specialise in soft wearable robotics explained, "For patients to restore their hand functions, they need to go through rehabilitation programmes that involve repetitive tasks such as gripping and releasing objects. These exercises are often labour intensive and are confined to clinical settings. EsoGlove is designed to enable patients to carry out rehabilitation exercises in various settings – in the hospital wards, rehabilitation centres and even at home. Equipped with technology that can detect and interpret muscle signals, EsoGlove can also assist patients in daily activities, for instance by guiding the fingers to perform tasks such as holding a cup." Conventional robotic devices for hand rehabilitation consist of rigid electromechanical components, which are heavy and uncomfortable for patients. "EsoGlove is unique as it is made entirely of soft components and does not require complicated mechanical setups. The main body of the glove is made of fabric, with soft actuators embedded. It also has adjustable Velcro straps to cater to different hand sizes," researchers said. EsoGlove is connected to a pump-valve control system that modulates the air pressure which directs the soft actuators. When the actuators are pressurised by air, they apply distributed forces along the length of the finger to promote finger movements, such as bending, extending and twisting, to support different hand motions. This novel method does not constrain the finger's natural movements, unlike conventional devices that make use of rigid links and joints. Each actuator also functions independently, providing assistance to each finger separately. The robotic glove can be applied in a table-top version for bedridden patients, as well as a waist-belt version for patients who are mobile and recovering at home. EsoGlove uses an intuitive control mechanism that involves the coupling of electromyography and radio-frequency identification technologies. With this feature, the robotic glove can detect a patient's intent to perform a hand action on a particular object, such as picking up a pen or holding a mug. By interpreting the muscle signals of the wearer, the robotic glove can help the patient move the fingers to accomplish the specific tasks, involving objects of various shapes and sizes, in an intuitive manner. "As the soft actuators in the EsoGlove are made from non-ferromagnetic materials, they are suitable for use in functional magnetic resonance imaging studies. We hope that the robotic glove can contribute towards investigating the brain's activity in relation to motor performance during hand rehabilitation, and unravel the functional effects of soft rehabilitation robotics on brain stimulation," added researchers.

Source http://www.sciencedaily.com/releases/2016/01/160111092604.htm

Engineering Innovation in India

Indian Engineer Wins British Award for Innovation

A software engineer from Tamil Nadu has received a prestigious British award for developing an innovative electronic smart key system. Nandagopal Lakshminarayan, who has been working as a knowledge transfer partnership (KTP) associate at Lincoln Security Ltd. for the past two years, won the "Business Leader of the Future" award at Innovate Britain's "KTP Best of the Best Awards 2015", a company statement said. Lakshminarayan was awarded in November but the announcement was made public on Dec 22, 2015. The software for the electronic locking system, called eLOQ, enables the creation and management of electronic keys and locks that cannot be copied or picked. "The project has enabled me to get involved in both the academic and business sides. The KTP project has presented a unique challenge because it was not just about innovation and technicality but also about creating awareness of a new product," Lakshminarayan said. Lincoln Security has established a separate company, Dynamic Access Solutions, in order to take the product to market. "The KTP between the university and the company has enabled the company to diversify the business and offer a unique product when compared to traditional locking systems that meets the needs of the 21st Century," said Peter Corlett, managing director for Dynamic Access Solutions Ltd. "Over the past two years Nanda has provided the company with the necessary skills to develop a high-level online management platform where keys and locks can be programmed and managed," he said. Britain's national KTP scheme helps businesses to innovate and grow by linking them with a university to work on a specific project.

Source http://www.business-standard.com/article/news-ians/indian-engineer-wins-british-award-for-innovation-115122200806_1.html