India and The Netherlands
Innovation through Co-creation

Theme Paper
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Innovation through Co-creation

- India-Netherlands Bilateral Relations
- Trade and Economic Relations
- Diaspora
- Cultural and Educational Relations
- Science and Technology Cooperation

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India-Netherlands Bilateral Relations

India and the Netherlands have a long history of friendly bilateral relations dating back to more than 400 years, encompassing many areas of shared interest. The Netherlands was one of the first three countries that established diplomatic relations with independent India in 1947. In 1980, the Dutch government identified India as an important economic partner. The liberalization of Indian economy in 1991 further reinforced the trade relations between the two countries. Both the countries also share common ideals of democracy, pluralism and the rule of law. A number of bilateral Agreements and MOUs have been concluded in diverse areas covering economic and commercial cooperation, culture, science and technology and education. Over the recent years, the Netherlands and India have emerged as key partners for each other.

Trade and Economic Relations

In terms of trade and investment, India has strong economic interests in the Netherlands. On the other hand, India's economic growth, its large market, its pool of knowledge workers are of special interest to the Netherlands.

There are close to 200 Indian companies operating in the Netherlands. The Netherlands emerged as the third largest investor in India in 2017-2018 with the total investment valued at US$ 2.67 billion across an array of sectors such as services, trading, automobile, fermentation industries, chemicals and water management. The Dutch investment in India amounted to USD 3.80 billion in 2018-2019. The total investment from the Netherlands to India in the period April 2000 to March 2019 totals up to around USD 27.30 billion cumulatively.

It was the second largest destination for offshore investment worth approximately US$ 12.80 billion in 2017 by the Indian companies. Large business portfolios acquired by the Indian companies through mergers and acquisitions include Tata Steel (Corus), Serum Institute (Bilthoven Biologicals), Apollo Tyres (Vredestein), United Phosphorous Limited (Ceraxgiri) and
Lupin Pharmaceuticals (Nanomi). A few other large investors from India include LT Foods, HCL Technologies, Tech Mahindra, Tata Consultancy Services, Infosys, Wipro, Kirloskar Brothers, Synthite Industries among others. Several Indian SMEs and innovative startups are also looking to tap into the Netherlands' vibrant, innovative and flourishing business ecosystem.

India and the Netherlands have a bilateral trade of US$ 8.77 billion (April 2017-March 2018). Indian Exports to the Netherlands grew at 14.7%, while Indian Imports grew at 18.2%. During the current financial year, FY 2018-2019 (April to September), total two way trade stood at US$6.28 billion.

The Netherlands was India’s 4th largest trading partner in the EU, after the UK, Germany and Belgium. The main items of Indian exports to the Netherlands are Petroleum and related products, apparel and clothing, textile yarn, fabrics, made-up articles, manufactures of metals and iron & steel, organic chemicals and medicinal and pharmaceutical products, electric machinery, telecommunication equipment, general industrial machines and road vehicles, vegetables & fruit, marine products, rice and coffee, tea, cocoa, spices etc.

On May 25, 2018, Netherlands signed 51 agreements with India covering government and private sectors. It also joined the International Solar Alliance. Agreements have been signed in areas of trade and investment especially in clean technology, cyber security, food processing, health care and smart cities. During the last visit of Dutch Prime Minister Rutte to India 40 MOUs were signed with the private sector in the areas of agri-food, water, horticulture, hi-tech and IT for smart cities.

**Diaspora**

The Netherlands hosts the second largest Indian Diaspora (after UK) in Europe and the largest Indian diaspora community on mainland Europe, totaling around 2,35,000 comprising 35,000 Indians and 2,00,000 Suriname-Hindustani community of Indian origin. The Indian nationals in the Netherlands broadly comprise of businessmen, IT and other professionals and students. The diaspora forms an important link between the two countries and facilitates people to-people contacts.

**Cultural and Educational Relations**

In May 1985, an agreement, which provides for cooperation and exchanges in education and science, art and culture, was signed between two countries. An MoU on cultural cooperation was signed in June 2017.

Indian Cultural Centre named “The Gandhi Centre” in The Hague was inaugurated on 2 October 2011. The Centre promotes Indian culture through its active calendar of programmes including regular Yoga, Tabla and for the first time, Hindi classes. In addition to this, the Centre organizes a wide range of diverse cultural activities and programmes, such as music,
dance, workshops, movies, documentaries, lectures, celebrations of Indian festivals. It also partners with other local Dutch organizations to promote Indian culture.

The Third International Day of Yoga was celebrated on 18 June 2017 at the Atrium City Hall of the Hague. The event saw the enthusiastic participation of nearly 1000 people including members of the diplomatic corps, Dutch people, Surinami-Hindustani and Indian communities.

The bilateral relations in the cultural field received a major impetus through the highly successful Festival of India, commemorating 70 years of diplomatic relations between India and the Netherlands. The festival was organized in the Netherlands during the first quarter of 2017, in collaboration with diaspora organizations. Its showcasing of Indian dance, music and art through performances by half a dozen troupes from India was received well by both the local Dutch and the diaspora community.

An MoU was signed between ICCR and Leiden University in December 2010 leading to the establishment of an ICCR Chair of Contemporary India Studies at Leiden University since September 2011. Besides Leiden Institute of Area Studies (LIAS), International Institute for Asian Studies (IIAS) also promotes research on India. An MoU for the extension of the Chair of Contemporary India Studies at Leiden University was signed between ICCR and Leiden University in November 2017.

**Science and Technology Cooperation**

The Netherlands and India have been long-term partners in Science and Technology collaboration. The cooperation focuses on research areas, in which the Netherlands is outstanding, and India has much to offer. Netherlands Organisation for Scientific Research (NWO) shares partnerships with the India’s Department of Science & Technology (DST), Department of Biotechnology (DBT), the Indian Ministry of Electronics & Information Technology (MeitY), and the Indian Council of Social Science Research (ICSSR).

NWO runs joint bilateral calls together with the Indian partners every year. The focus is on joint research projects for three to four years. For the bilateral call in 2018, NWO and DST have adopted a mission-oriented, impact-focused approach, with one large coherent, multidisciplinary research programme.

Towards sustainable and integrated urban water management systems in fast-growing secondary cities, DST and NWO published a joint call on Urban Water Systems to provide funding for highly collaborative and interdisciplinary research partnerships between Dutch and Indian researchers. The call procedure was aimed at developing a joint Indian-Dutch research programme by means of a creative and collaborative Sandpit model. The research programme ‘Water4Change, fit-for-purpose water sensitive design for fast growing liveable cities’ focuses on new approaches in managing and using environmental resources to be able to respond to contemporary and converging trends, crises and risks.
The project LOcal Treatment of Urban Sewage Streams for Healthy Reuse (LOTUS HR) is an Indo-Netherlands joint project funded by Department of Biotechnology (DBT), Govt of India and NWO/STW, The Govt of Netherlands. The project has stakeholders from both academia and industry from India and Netherlands.

DST and NWO are jointly funding research projects in the area of computational sciences and data sciences in order to encourage the research collaboration between the Netherlands and India. The projects focus on the theme of sustainable energy, a very important factor in the development towards a sustainable society. With this call NWO and DST are focusing on the entire spectrum of energy research, from the generation of sustainable energy and its conversion, storage and transportation to the efficient use of energy. Under this programme, four projects have been funded, namely, Optimised energy harvest and storage using discrete electrolytes; Design and Synthesis of Novel Catalysts for Energy Applications via Nanoparticle Self-Assembly; Dispersed multiphase flows in sustainable energy conversion processes; Design of novel nanophotonic and plasmonic structures for improved solar cells using reverse engineering.

The Department of Biotechnology, Government of India and the Netherlands Organization for Scientific Research (NWO) / the Netherlands Organization for Health Research and Development (ZonMw) opened a call for proposal on Technology for a Sustainable Healthcare: Bio-imaging and Medical Devices. three joint projects and two mobility grants were awarded.

India and The Netherlands have collaborated in the global fight against Anti-Microbial Resistance (AMR) and are working in the areas of cooperation under India’s National Action Plan on AMR. Selection of Krishna district of Andhra Pradesh for the pilot project of ‘One Health’ approach is one such example.

India and the Netherlands have strong historic ties in the area of vaccines. Technology transfer through the Netherlands Vaccine Institute has made an important contribution to the sector’s development in India. The emergence of India as a global manufacturing hub and its growing strength in vaccine innovation creates opportunities for partnership where vaccine players from both countries work together and leverage each other’s strengths for new product development.

On May 25, 2018, Prime Minister of the Netherlands Mark Rutte launched “Clean Air India” initiative in New Delhi to curb air pollution in Indian cities. It is a joint collaboration of India’s ‘Start-up India’ and Netherlands ‘Get in the Ring’ platforms and INDUS forum an online matchmaking platform of Indian and Dutch businesses. For monitoring and combating air pollution the Dutch firms would market equipment such as sensors and data and solutions. The main focus is minimizing air pollution in Delhi as per the ‘INDUS impact’ project, which aims to stop hazardous burning of paddy stubbles, which cause air pollution.

Under the Indo-Dutch Ganga forum, two mission-mode projects under the National Mission for Clean Ganga (NCMG) have been started in Varanasi and in Haridwar. The Netherlands
joined hands with Uttar Pradesh to reduce water consumption and start cleaner technologies in Kanpur.

India and the Netherlands have been collaborating for cleaning of the Barapullah drain, with Dutch and Indian companies’ contributions to the project by sharing their existing technologies, which may need adjustments for the pilot plant.

India and the Netherlands strengthen partnership in agriculture and allied sectors. Under the partnership initiatives, a Centre of Excellence (CoE) for vegetables at Baramati and a CoE of flowers in Telegaon in Maharashtra were commissioned. They focus on making technology affordable and accessible to the small and marginal farmers.

Under the Indo-Dutch Start-up Initiative, Start-Up Link has been launched to enhance innovation and entrepreneurship and creating market expansion for start-ups.

There have been collaborations in space technology for efficient implementation in food security and climate change.

The Netherlands and India welcomed the deepening of cooperation on cyber security through the signing of an MoU between The Hague Security Delta and Hyderabad Security Cluster.

Other notable joint projects under the bilateral cooperation include, Erasmus MC cohort study on cognitive decline and the Imaging partnership between Maastricht University Medical Center and the NCCS in Pune which will consist of a series of joint projects and a joint master’s program.

In addition to these projects, the launch of HIV Cohort is the first-of-its-kind Collaborative Research Programme on HIV/AIDS. The programme is aimed at harnessing complementary research strengths and diverse expertise to catalyze the development of better tools to understand and address the burgeoning global epidemic of HIV.
India and the Netherlands have a long history of friendly bilateral relations dating back to more than 400 years, encompassing many areas of shared interest. The Netherlands was one of the first three countries that established diplomatic relations with independent India in 1947. In 1980, the Dutch government identified India as an important economic partner. The liberalization of Indian economy in 1991 further reinforced the trade relations between the two countries. Both the countries also share common ideals of democracy, pluralism and the rule of law. A number of bilateral Agreements and MOUs have been concluded in diverse areas covering economic and commercial cooperation, culture, science and technology and education. Over the recent years, the Netherlands and India have emerged as key partners for each other.

### S. No. | Project Title | Indian PI Name/ Institution Name | Foreign PI Name/ Institution Name | Sanction Date | Sanction Amount (Rs.)
--- | --- | --- | --- | --- | ---
1 | Optimised energy harvest and storage using discrete electrolytes | Prof. Balasubramanian Sundaram, JNCASR, Bangalore, E-mail: bala@jncasr.ac.in, +91-80-22082808 | Prof. Dr. Rene Van Roij, Utrecht University, Netherlands | 23.06.2017 | 51,80,000/-

**Project Outcome/Progress:** Area-Computer, Electronics and Mathematics.

The researchers have been able to derive force fields for mixtures of room temperature ionic liquids from quantum DFT calculations. The Dutch side has ported these force fields from publications to a well established simulations software and has reproduced the results. Classical density functional theory has been employed to study the organization of these liquids at electrified solid surfaces.
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<tr>
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<th>Sanction Amount (Rs.)</th>
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<tbody>
<tr>
<td>3</td>
<td>Dispersed multiphase flows in sustainable energy conversion processes</td>
<td>Prof. Meheboob Alam, Engineering Mechanics Unit, Jawaharlal Nehru Centre for Advanced Scientific Reserch, Jakkur P.O., Bangalore 560064, Karnataka. E-mail: <a href="mailto:meheboob@jncasr.ac.in">meheboob@jncasr.ac.in</a></td>
<td>Prof. Dr. Detlef Lohse, University of Twente, Physics of Fluids group, Meander 261, 7500 AE Enschede, Netherlands</td>
<td>25.07.2017</td>
<td>1,05,92,640</td>
</tr>
<tr>
<td>4</td>
<td>Design of novel nanophotonic and plasmonic structures for improved solar cells using reverse-engineering</td>
<td>Prof. Srikanth Sastry, Theoretical Sciences Unit, Jawaharlal Nehru Centre for Advanced Scientific Research Jakkur Campus, Bengaluru, <a href="mailto:Email-sastry@jncasr.ac.in">Email-sastry@jncasr.ac.in</a></td>
<td>Prof. Dr. Ir. Marjolein Dijkstra, Princetonplein 5, 3584 CC Utrecht, the Netherlands</td>
<td>12.07.2017</td>
<td>58,90,400</td>
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**Project Outcome/Progress:** Under the project, inter particle interactions for the specific crystal structures using reverse method for charged colloids have been designed. 2 visits from Netherlands to India have been made.

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<tbody>
<tr>
<td>5</td>
<td>India-Netherlands Conference on Climate &amp; Atmospheric Science (20-21 February, 2017)</td>
<td>Dr. Dilip Ganguly, Centre for Atmospheric Science, Indian Institute of Technology, Delhi</td>
<td>7 Dutch experts from TU Delft, KNMI (Royal Netherlands Meteorological Institute) and Wageningen University</td>
<td>06.02.2017</td>
<td>7, 51,300/-</td>
</tr>
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**Project Outcome/Progress:** No completion report. Objective was to develop a customized high-resolution climate model capturing the major structure and evolution of both Indian and Netherlands climate across a broad range of scales, improve process representations of aerosols, clouds, convection and precipitation in climate models; conduct high resolution numerical simulations of clouds and precipitation, improve simulation of deep convection using cloud resolving as well as global climate models; assess impact of climate change on wind and solar energy, set-up a meteorological observatory at IITD in collaboration with TUD for measurement of fluxes, aerosols, boundary layer characteristics, and clouds; develop this observatory as a test-bed for model validation and improvement.
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy management strategies for inter-connected smart micro-grids (Area-Smart energy grids)</td>
<td>Professor Harish Pillai, Indian Institute of Technology (IITB), Mumbai. <a href="mailto:hp@ee.iitb.ac.in">hp@ee.iitb.ac.in</a></td>
<td>Prof. Arjan Schaft, Johann Bernouli Institute for Mathematics and Computer Science, University of Groningen, Nijenborgh 9, 9747 AG Groningen, Netherlands</td>
<td>06.06.2014</td>
<td>75,00,000/-</td>
</tr>
<tr>
<td>2</td>
<td>&quot;Adaptive clustering for decentralized resilient energy management (ADREM)&quot;</td>
<td>Prof. Sri Niwas Singh, Department of Electrical Engineering, Indian Institute of Technology (IITK), Kanpur-208016, Uttar Pradesh. <a href="mailto:snsingh@iitk.ac.in">snsingh@iitk.ac.in</a></td>
<td>Dr Frances Brazier, System Engineering, TBM, TU Delft, Jaffalaan 5, 2628 BX, Delft, Netherlands.</td>
<td>04.08.2014</td>
<td>71,32,000/-</td>
</tr>
<tr>
<td>3</td>
<td>Design and Development of high-performance Multi-functional Modular Multilevel Converter Topologies for renewable energy integration in smart dc grid (M3C)</td>
<td>Prof. M. Veerchary, Department of Electrical Engineering, Indian Institute of Technology Delhi, Hauz Khas, New Delhi-110006. <a href="mailto:mvechary@ee.iitd.ac.in">mvechary@ee.iitd.ac.in</a></td>
<td>Prof. Braham Ferreira, Mekelweg 4, 3628CD Delft, Netherlands.</td>
<td>29.09.2014</td>
<td>1,09,06,000/-</td>
</tr>
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</table>

**Project Progress/Outcome:** As per progress report from IIT Delhi- The concept of the project is based on development of a novel multi-frequency power system similar to radio-broadcasting system. A 20W lab scale experimental prototype of two-course two-load interconnected system is designed as proof of concept for multi-frequency power system. Single phase H-bridge inverter with proportional resonant (PR) control scheme is designed and its performance is validated through simulations. Modular multi-level converter based power electronic interface for renewable energy source integration is designed and its performance is validated through simulations.

As per progress report from IIT Bombay- Multifunctional converters using the “unified ac-dc concept” are proposed for low voltage PV integration, battery integration for hybrid electric vehicles, battery integration for fuel cell based electric vehicles. The proposed converters have the potential to reduce the size and cost as compared to the state of the art. 2 patents have been filed namely “Unified AC-DC micro-grid architecture for distribution of AC and DC power on same line” and “Low Voltage Photovoltaic Power Integration using Unified AC-DC”. 6 publications have been published. 5 visits from Netherlands to India and 3 from India to Netherlands have been made.
### 2013

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<tbody>
<tr>
<td>1</td>
<td>Graphenes-pintronics with complex oxides</td>
<td>Dr. Arindam Ghosh, Department of Physics, Indian Institute of Science, Bangalore and Dr. Tanushri Dasgupta Saha, SN Bose National Centre for Basic Science, Kolkata. <a href="mailto:arindam@physics.iisc.ernet.in">arindam@physics.iisc.ernet.in</a></td>
<td>Prof BJ Bart Van Wees, Zernike Institute for Advanced Materials, Nijmehorg, Netherlands.</td>
<td>05.05.2014</td>
<td>85,42,000/-</td>
</tr>
<tr>
<td>2</td>
<td>Design of novel bifunctional gold Ti and Fef-modified zeolite functional materials for the catalytic oxidation of hydrocarbons</td>
<td>Dr. Biswajit Chowdhury and Dr. Vinod Prabhakaran, Department of Applied Chemistry, Indian School of Mines, Dhanbad And National Chemical Laboratory, Pune. <a href="mailto:biswajit_chem2003@yahoo.com">biswajit_chem2003@yahoo.com</a></td>
<td>Prof. EJM Hensen, Eindhoven University of Technology, Netherlands</td>
<td>20.12.2013</td>
<td>58,29,400/-</td>
</tr>
<tr>
<td>3</td>
<td>Functional nanoporous membranes based on liquid crystalline and hyperbrached polymers</td>
<td>Prof S Ramakrishnan, Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore 560012. <a href="mailto:raman@ipc.iisc.ernet.in">raman@ipc.iisc.ernet.in</a></td>
<td>Dr Rint R P Sijbesma, Department of Chemical Engineering and Chemistry, Eindhoven University f Technology, P O Box 513, 5600 MB Eindhoven, the Netherlands</td>
<td>17.04.2014</td>
<td>75,89,200/-</td>
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**Project Outcome/Progress:**

1. **Graphenes-pintronics with complex oxides:**
   - As per the project progress report, an observation was made that single crystals of transition metal dichalcogenide films act as excellent tunnel barriers of spin injection and the project searches a possibility of graphene-magnetic oxide hybrids for this. Heterostructures of graphene and molybdenum di-sulphide have been created and their interfacial properties have been examined. The electrical transport across the barrier have been measured as functions of temperature and gate voltage and excellent transparency was observed.
   - 1 visit from India to Netherlands has been done.

2. **Design of novel bifunctional gold Ti and FeF-modified zeolite functional materials for the catalytic oxidation of hydrocarbons:**
   - Core shell Au@TiSiO2 was synthesized by sol gel method with different Si/Ti weight ratio. The synthesized material was tested for propene epoxidation in the presence of molecular oxygen and hydrogen, ATS 50 showed almost 2% conversion with 50% selectivity towards propene oxide (PO). At lower temperature selectivity was more PO but conversion was than 1%. Increase in the temperature led to increase in conversion but selectivity decreased. ATS 10 catalyst showed high conversion at 130 degrees Celsius but selectively formed propane. The propylene oxidation reaction has remained as a most focused reaction as propylene epoxides are useful for various products and world PO turnover is 7 million tonnes per year. We have developed silylated Au/Ti-SiO2 catalyst which has shown productivity of propylene epoxides formation as per commercial requirement.
   - 4 PhD scholars and 15 master’s thesis students have been trained from this project.
   - 4 publications and 1 research paper are an outcome of this project.

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**Theme Paper**
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<tbody>
<tr>
<td>1</td>
<td>Photo-acoustic Imaging of interphalangeal joints in the hand as a primary-line examination test for rheumatoid arthritis diagnosis and therapy monitoring-instrument development and pilot clinical study (Area: Biomedical)</td>
<td>Prof R M Vasu Dept. of Instrumentation and Applied physics, Indian Institute of Science, Bangalore, <a href="mailto:vasu@isu.iisc.ernet.in">vasu@isu.iisc.ernet.in</a></td>
<td>Dr S Manohar, Assistant Professor, Universiteit Twente, MIRA Institute Biomedical Photonic Imaging Drienerlolaan 5, 7522 NB</td>
<td>02.01.2012</td>
<td>28,58,300/-</td>
</tr>
<tr>
<td>2</td>
<td>An eye tracker perimeter-an intuitive tool for affordable glaucoma diagnosis and screening</td>
<td>Dr. Roonie Jacob George Senoir Consultant, Sankara Nethralaya, Chennai, Tamil Nadu. <a href="mailto:drrg@snmail.org">drrg@snmail.org</a></td>
<td>Dr. Johannes Vander Steen, Erasmus MC, Netherlands</td>
<td>05.10.2011</td>
<td>9,12,500/-</td>
</tr>
<tr>
<td>3</td>
<td>A cost-effective solution for the prevention of blindness using Computer-Aided Diagnosis and fundus photography</td>
<td>Dr. Jayanthi Sivaswamy, International Institute of Information Technology, Hyderabad, <a href="mailto:jsivaswamy@iiit.ac.in">jsivaswamy@iiit.ac.in</a></td>
<td>Dr. B. Van Ginneken, UMC St. Radboud, Nijmegen, Netherlands</td>
<td>26.09.2011</td>
<td>29,84,800/-</td>
</tr>
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**Project Outcome/Progress:** Developed the first photo-acoustic imaging set up suitable for clinical use, validated the prototype by collecting and reconstructing data from a healthy finger-joint, a new stochastic search algorithm developed for photo-acoustic tomography, organized a two-day workshop on optical imaging wherein the Dutch team also participated.

**Project Outcome/Progress:** The objective of the project was to assess eye tracker perimeter for reproducibility and variability, learning curve for subjects or care personnel, test results of currently applied visual field methods, performance of new test in a large population and to optimize the performance of the new technology and evaluate its clinical value by building a community database in a longitudinal study program. A screening testing strategy has been developed by reducing the testing time to test for glaucomatous visual field damage. 1 research publication has been cited in journal in “Indian J Ophthalmol”. 3 papers presented in Asia ARVO 2013 conference, 3 in Dr E Vaithilingam Memorail Scientific Session, Mar 2014 conference and 1 Indian Eye Research Group Meet, Hyderabad. 3 M Phil students have been trained.
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<tr>
<td>4</td>
<td>Effectiveness of the (S) ELANA (Suture less Excimer Laser Assisted Non-Occlusive Anastomosis) anastomosis in small vessels</td>
<td>Prof. R. Krishna Kumar, IIT, Madras, Chennai, <a href="mailto:rkkumar@iitm.ac.in">rkkumar@iitm.ac.in</a></td>
<td>Prof. L. Regli, University Medical Centre Utrecht, Netherlands</td>
<td>10.07.2013</td>
<td>26,04,280/-</td>
</tr>
<tr>
<td>5</td>
<td>Extramural maternal care for rural women: A medical device for providing diagnostic care, preventative information, pre referral services and personal digital health identity</td>
<td>Dr. Amit Sengupta, Vivekananda Tribal Hospital, PO Dharmapura, Distt. Bastar, <a href="mailto:senguptaamit@hotmail.com">senguptaamit@hotmail.com</a></td>
<td>Dr. Vikram Singh Parmar, Delft University of Technology, The Netherlands</td>
<td>19.03.2012</td>
<td>4,52,500/-</td>
</tr>
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**Project Progress/Outcome:** 1 PhD student trained. 3 publications published in journals and 7 presented in conferences. A large set of 3000 retinal images was collected from local hospital for evaluation of DR detection algorithm on the Indian population. Images of 36 patients who visited the glaucoma clinic of a hospital in Coimbatore were collected for preliminary assessment. Preliminary analysis indicated a degradation in performance, but it had enough potential for improvement with adaptation. The objectives that were met are: automatic differentiation of healthy patients and patients with eye abnormalities, automatic differentiation of patients with glaucoma, DR (diabetic retinopathy) or Age-related Macular Degeneration (AMD), evaluation of the system on different clinical environments and ethnic groups, web-based integration of the automatic eye screening system.

**Project Outcome/Progress:** Established procedure to develop 3d model from CT/MRI scans, established procedure for geometry correction and structure meshing. It was found that ITK tool can be effectively used to segment blood vessels and VTK for surface rendering. Electrical model of cerebral arteries can be used to know the possible bypass to get desired physiological flow. 1 technical personnel has been trained under the project.

**Project Outcome/Progress:** Specialized trainings on fundamentals of machine intelligence, management information system were carried out. Field visits to understand the community study their living style and observe their perception regarding maternal and child health. A small mobile based application was developed to show how mobile technology can be used in rural area for healthcare purpose. Field visits for also conducted to study the information network of rural people in relation to maternal healthcare delivery system. To understand role of different stakeholders like family, friends, ANM (nurse), “Dai” (traditional birth attendant), “shira and guniya” (traditional healers).

Through the project, a model was proposed that can detect pregnancy in early stage and can give them proper information regarding maternal health care. The mobile phone app, a portable hand held system to measure health parameters was developed. The system can be used by ground level health workers and can provide point of care at doorstep of pregnant women.

1 PhD student was trained and 21 research interns were trained in the project.
Rapid innovation fostered by impactful initiatives from the government, and renewed interest of private stakeholders in the traditionally non-technical agricultural sector has resulted in creation of a vibrant technologically charged innovation ecosystem in the country.

Establishment of Technology-Business Incubators and Accelerators across the country such as the Atal Incubation Centers set up by NITI Aayog in partnership with the Universities are providing crucial resources and support to innovators to develop future proof solutions and robust business models. The Ministry of Agriculture under its RKVY-RAFTAAR programme has earmarked a sum close to US$800 million to be used for commercializing technologies developed in research institutions, and to incubate and accelerate start-ups in the incubators established within these institutions. In addition, the MSME ministry has designated over US$1.20 billion to set up 150 technology centers across the country. These centers will provide high end technical facilities to ventures for developing cutting edge solutions.

Several Impact and Venture Capital Investment Firms have also invested heavily into the sector making available much needed capital resources to the startups. The 450+ Agri-Food Tech Ventures in the country have attracted close to US$250 million by June 2019 with greater onus on digital farming and post-harvest solutions.

Entrepreneurship in the form of tech-startups and intrapreneurship within established industry giants has resulted in development of solutions that make the farming process digital, provide tools to measure performance indicators of the farm remotely, linearize the supply chain, and reduce the post-harvest losses. With easy access to inexpensive smartphones and internet, an increasing number of farmers is becoming digital and constant R&D has resulted in development of economical IoT sensors and digital farming tools that have allowed the benefits of innovation to reach the farmers.
Dutch Scenario

The Netherlands, a world leader in agriculture technology has expertise in horticulture, hydroponics, farm robotics, and post-harvest management. Through healthy partnership among the academia, government, and industry the country has created a practical and highly growth conducive environment for translating path breaking research in the field of agriculture to the market. It is one the highest exporters of agricultural and horticultural produce in the world, home to world’s foremost researchers in Greenhouse Technology and globally recognized for its horticulture industry. The tulip farms in the Holland region of the country are an inspiration for any country with an interest in floriculture. With water becoming a scarce resource, Netherland’s automated IoT enabled hydroponics farms can be a model that can be replicated in India to make the farming process water efficient and grow organic, export quality crops.

The two countries have a historically rich association and have explored several synergetic avenues to benefit the sector. The Netherlands has partnered with India to establish 10 Centers of Excellences in Agriculture with an objective to bring modern technologies to the farm and raise the output. The countries have also announced partnerships to share Best Agricultural Practices to grow export quality produce and reduce post-harvest wastages by developing an efficient value chain. A continued relationship between the nations will bring further prosperity to the sector.

As the world rapidly urbanizes, with people migrating from the countryside to the cities, there is an increasing pressure on urban areas. There is an urgent need for sustainable and healthy food solutions, taking into account concerns such as animal welfare, food safety, waste disposal and habitation and also issues such as governance, education, and a fair society.

A small big country

India does not need more agricultural production, as it already ranks in the global top 5 in many product categories. What India does need are effective supply chains, that reduce post-harvest food loss (now varying between 15-30%). While the Netherlands is the world’s second largest exporter of agriculture and food products and in 2018 their total agricultural exports were worth over 90 billion Euros. The Netherlands are in a position to combine Dutch supply and Indian demand into hybrid solutions that are at the same time climate change resilient, cost conscious and of high quality. Dutch horticultural companies, research and education institutions have shown themselves to be reliable partners doing business in India and they have every intention to continue and expand.
2. Water

Indian Scenario

Global water use has increased by a factor of six over the past 100 years and continues to grow steadily at a rate of about 1% per year. In the coming decades water will be one of the most fiercely contested resources on the planet. The drivers of this resource challenge are fundamentally tied to economic growth and development. Water is a vital factor of production, so diminishing water supplies can translate into slower growth that cloud economic prospects. Water is as an essential input for the production of food and electricity, as well as for many manufactured products. Investments in water infrastructure are therefore fundamental to unlocking the full potential of economic growth. India is one of the ten major water users in the world in terms of volume using 646 km3 of water a year. However, depleting availability, deteriorating quality of water bodies, growing scarcity, increasing demand and rising vulnerabilities are some of the challenges for India.

The Ganges, a river like no other, is vital to the existence of 400 million people, who live along its course and use the water for drinking, agriculture - and life itself. Water is also a serious concern in many Indian cities, as the rivers and lake systems across the country are heavily polluted. Agriculture sector that consumes more than 80 percent of India’s water resources has a very low overall average water use efficiency (about 38 percent). Likewise, water supply and distribution in cities in India are inefficient with high leakages/losses. Compared to international standards, Indian industries consume a relatively higher amount of water for production.

The challenge is to find a balance between water for human and economic demands and water for maintaining the ecosystem integrity and environmental sustainability. With the forecast of world population reaching over nine billion by 2050 and intensifying impacts of climate change, our abilities to develop and adapt will depend on how freshwater resources are managed over the coming years and decades.

Keeping in mind the fact that availability of good quality water is imperative for future growth, it is important to focus on innovative technologies, advances in water reuse management and share successful and sustainable global practices that would demonstrate approaches towards achieving water use efficiency and ensure there is ‘Water for All’.
Indo-Netherlands research collaboration on Urban Water System - DST-NWO Joint Programme on Urban Water Systems was launched in mid of 2018. A joint call was initiated to provide funding for collaborative and interdisciplinary partnerships between Dutch and Indian research groups, within one coherent research programme that is made up of multiple subprojects. A bilateral Indo-Dutch research programme has been evolved from a three-phase procedure including 1) Scoping based on programme ideas, 2) Joint research programme development and 3) Full research programme proposal submission. After a Joint Advisory Committee meeting during October 04-05, 2018 in The Hague, the Netherlands, Joint Advisory Committee jointly selected 15 Indian EoIs and 15 Dutch EoIs for participating in the Phase-II of the evaluation through a very unique mechanism of sandpit process that was held during November 27-30, 2018 in New Delhi through which three bilateral consortia had emerged focusing on various aspects of Urban Water Management.

Eventually, DST-NWO Joint Advisory Committee through its second meeting which was held through Digital Video Conference (DVC) to evaluate the short listed three full proposals under the DST-NWO Urban Water Systems Call on 15th March 2019 recommended one Indo-Dutch consortia proposal titled “Water for Change. Integrative and Fit-for-Purpose Water Sensitive Design Framework for Fast Growing Livable Cities” with IIT Roorkee as Indian lead and Delft University of Technology as Dutch lead organization. On 1st October 2019, this Indo-Dutch consortia programme has been supported by DST and NWO on either side. The Indian and Dutch consortia members are listed below:

<table>
<thead>
<tr>
<th>Indian Consortia members</th>
<th>Dutch Consortia members</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main applicant</strong></td>
<td></td>
</tr>
<tr>
<td>Dr. Mitthan Lal Kansal</td>
<td>Dr. T. Kuzniecow Bacchin</td>
</tr>
<tr>
<td>Indian Institute of Technology Roorkee (IITR), Uttarakhand</td>
<td>Delft University of Technology, Netherlands</td>
</tr>
<tr>
<td><strong>Co applicant</strong></td>
<td></td>
</tr>
<tr>
<td>Dr. Mona Iyer</td>
<td>Dr. Ir. S.J. Oude Elberink</td>
</tr>
<tr>
<td>CEPT University, Ahmedabad, Gujrat</td>
<td>Universiteit Twente Faculty of Geoinformation Science and Earth Observation (ITC), Netherlands</td>
</tr>
<tr>
<td><strong>Co applicant</strong></td>
<td></td>
</tr>
<tr>
<td>Dr. Puthenveedu Sadsivanpillai Harikumar</td>
<td>Ms. K.H. Hölscher</td>
</tr>
<tr>
<td>Centre for Water Resources Development and Management (CWRDM), Calicut</td>
<td>Erasmus Universiteit Rotterdam Dutch Research Institute for Transitions &amp; Stichting KSI, Netherlands</td>
</tr>
<tr>
<td><strong>Co applicant</strong></td>
<td></td>
</tr>
<tr>
<td>Dr. Manmohan Kapshe</td>
<td>Dr. C.A. Bons</td>
</tr>
<tr>
<td>Maulana Azad National Institute of Technology (MANIT), Bhopal</td>
<td>Deltares, Netherlands</td>
</tr>
</tbody>
</table>
Dutch Scenario

As water management is deeply rooted in the Netherlands’ history and culture, it is hardly surprising that it is one of the priorities of its trade and aid agenda. Too much, too little or polluted water presents a major threat to many people around the world. The Netherlands focuses its efforts on increasing water security and safety in urban deltas and on maintaining sustainable access to clean water, sanitation and hygiene in both urban and rural areas.

The Netherlands as a country was forced to create inventive solutions to build a society below sea level. The Dutch Delta works, engineered for the country’s flood protection, are a prime example of success. With its innovative water management measures, the Netherlands wants to work together with Indian partners in finding solutions, which also make a business case. The strengths of the Dutch water expertise are characterized by:

- recognized specialists in the treatment of industrial waste water;
- design and construction of storm surge barriers and levees;
- reclaiming land through high-tech dredging;
- engineering entire coastal areas and harbors;
- the world largest flood defense project, the Delta Works;
- the single tidal barrier in the world, the 9 km Oosterschelde dam;
- 5th worldwide for global patents in the field of water purification the Netherlands
3. Life Sciences and Healthcare

Indian Scenario

The healthcare sector, one of the fastest growing sectors in India, is expected to advance with a CAGR of 22 per cent to reach US$372 billion by 2022. India is expected to rank among the top three healthcare markets in terms of incremental growth by 2020. There is immense scope for enhancing the penetration of healthcare services in India, thus presenting ample opportunities for the industry. The key components of the healthcare market in India are hospitals, pharmaceuticals, diagnostics (imaging and pathology), medical equipment and supplies, medical insurance and telemedicine.

• The hospital industry in India is witnessing a huge investor demand from both global as well as domestic investors. It is expected to grow at a CAGR of 16-17 percent to reach US$132 billion by 2022

• The diagnostics industry in India is valued at US$4.0 billion. The share of organized sector is almost 25 per cent in this segment (15 per cent in labs and 10 per cent in radiology)

• India is among the top 20 global medical device markets and the fourth largest medical device market in Asia. medical devices market is expected to cross US$ 11 billion by 2022.

• The pharmaceutical sector in India accounts for about 2.4 per cent of the global pharmaceutical industry in value terms. It is expected to grow to US$100 billion by 2025

• India is the largest vaccine producer in the world supplying over 50 per cent of global demand for various vaccines

Rising income levels, ageing population, growing health awareness, focus on preventive healthcare, cost advantage, advancing research are some of the factors, which are contributing towards increasing demand for healthcare services.

The launch of Pradhan Mantri Jan Arogya Yojana (PMJAY) as a major government policy initiative will help the nation move closer to the Sustainable Development Goal of UHC. PMJAY is expected to shape the new healthcare ecosystem and define the new normal that will be cost effective, patient centric and technology-enabled.
Disease coding, AI/predictive analysis. Electronic Medical Record (EMR) and patient data handling, cyber security, aggregators and insurance portals are some of the new systems that will come into play.

The presence of world-class hospitals, skilled medical professionals and superior quality healthcare, coupled with low treatment costs in comparison to other countries have all strengthened India’s position as a preferred destination for medical tourism which has, in turn, enhanced the prospects of the Indian healthcare market.

**Dutch Scenario**

Being able to grow old in a healthy way is perhaps one of the most desirable and universal aims; it is closely linked to United Nations’ Sustainable Development Goal- 3:Good Health and Well-being. The Netherlands has an exceptional standard of healthcare, which is not only accessible but also affordable.

The country’s healthcare sector effectively addresses the challenges such as providing quality healthcare in remote areas, dealing with demographic shifts and the possibilities of exploring MedTech and E-health to make healthcare more accurate and accessible. Life Sciences and healthcare is a priority sector for strategic investment in both the Netherlands and India. Growing market opportunities in India, combined with the Netherlands’ strengths in areas such as Therapeutics & Vaccines, Diagnostics, Medtech and E-health create excellent opportunities for partnerships that address shared societal challenges with smart solutions. The Netherlands is a global market leader in mobile healthcare and the only country to consistently rank in the top three of the Euro Health Consumer Index since 2005. Accessibility being the key for healthcare, the Netherlands ranks #1 on the Global Access to Healthcare Index (2017).

The country’s strengths are:

- 8th worldwide in patent applications for medical technology;
- 2nd in patent applications for biotechnology;
- approximately 375 innovative life sciences companies clustered within a 120 mile radius;
- excellent medical research infrastructure;
- global market leader in mobile healthcare;
- public-private partnership model that sets an international standard
4. Creative Industry and Design

Indian Scenario

Design plays a crucial role in innovation by improving functional and aesthetic aspects of a product, quality of services and enhancing user experiences. Design encompasses the entire spectrum of form, function, aesthetics, engineering, culture and lifestyle needs. It aims to improve quality of life, creates new value and markets. With a systematic and creative approach and keeping human needs at the core, design helps augment quality of usage and bring about responsible change.

Design has been high on the national agenda for many countries, therefore importance of strategic use of design for competitive growth has been emphasized throughout the world. Many governments are developing and implementing design policies and promotion programs not only to boost their industry and business competitiveness, but also to increase awareness of design in public lives, even to solve complex social issues such as public health systems, crime abatement, energy saving, geriatric needs, and so on. Several studies have shown a strong interrelationship between national competitiveness and design.

Of late there have been awareness and realization to adopt good design practices among several Indian companies considering it a very important factor for their operations, sustenance and growth.

The potential size of design industry is Rs.116.81 billion and is expected to be Rs. 188.32 billion by 2020. Of this presently only a market worth Rs. 21.00 billion is realized meaning more than 80% of the design potential is yet to be realized in India. The industrial design segment alone has the potential of Rs. 110.00 billion by 2020. Only a fifth of the design market is currently tapped.

There are approximately 7000 qualified designers in the country and approximately 5000 in the various campuses pursuing design education. By 2020, the total number of designers required in industrial, graphic, communication, packaging and other design domains is approximated at 62,000 provided the design potential is fully realized.

The market for education in India was about US$ 100 billion in 2015-16. The higher education contributes 59.7 per cent of this market size and at current spend is about US$ 6.78 billion,
and is expected to grow at an average annual rate of over 18 per cent to reach US$ 34.12 billion in the next 10 years.

The National Sample Survey Office (NSSO) reported that the average annual private expenditure for general education (primary level to post graduation and above) has shot up by a staggering 175 per cent. During the same period, the annual cost of professional and technical education has increased by 96 per cent.

By the year 2030, India is expected to be the most populous country. The population aged between 18 to 23 age group is estimated to be 142 million by 2030, which would approximately be 10 per cent of the total population (Higher Education in India: Vision 2030 by Ernst & Young). The government aims to raise its current gross enrolment ratio to 30 per cent by 2020 from the present 23.6 per cent (http://www.ibef.org/industry/educationsector-india.aspx). By 2030, the GER is expected to be 45 per cent meaning an opportunity space of 63.9 million students.

A large section of the Indian population is upwardly mobile and moving from lower income category to middle class, from middle class to upper middle class and so on. The size of the middle class is expected to be more than one billion by 2025.

Given the positive demographics, rising awareness about the importance of education, openness to explore and pursue alternative careers and the propensity to spend more on higher education, the design education sector in India will be extremely attractive in the coming years.

**Dutch Scenario**

From Rembrandt and Van Gogh to Viktor & Rolf, Dick Bruna, Armin van Buuren and Tiësto: Dutch creativity inspires the world. These iconic names exemplify the strengths of Dutch design: pragmatic, open-minded, conceptual, out-of-the-box, and adhering to the principle, ‘less is more’.

There is an idiosyncratic mentality particular to the creative industry in the Netherlands. Rather than seeking safety the Dutch embrace risks in creative processes. This leads to unpredictable outcomes. The Dutch creative industry is accustomed to cooperation and collaboration across different domains. This results in valuable contributions to solutions for societal issues such as healthcare, safety, and energy. The Dutch creative industry:

- is in the top 10 of the world;
- combines creativity and business (representing 1.9% of the Dutch economy);
- pioneers in different areas all around the country and beyond;
- is famous for prestigious Dutch architecture all around the globe;
- creates original and well-known TV programme concepts;
- has an active online gaming industry.
5. Start-Ups

Indian Scenario

Start-ups are the indicators of innovation capabilities of the citizens thus measuring the competitiveness of a nation. Majority of the start-ups devoted to developing novel product offering or service delivery design directly contribute to building the knowledge economy. While scripting the saga of success for a vibrant economic growth, they are the new avenues today for creating a great deal of wealth and simultaneously for generating a sizeable employment in the quickest possible manner. While some start-ups work on the new service delivery models directly catering to the users at large, many of them work on the niche technology areas for very specific end use. The start-ups such as Ola Cabs, Swiggy, Zomato, Oyo Rooms etc. can be classified under the first category. The start-ups working on new medical devices, algorithm for improving diesel engine efficiency, design & fabrication of small satellites come under the latter category of start-ups.

An individual’s greatest satisfaction comes when his ideas gain wider acceptance and shape into fruition simultaneously generating revenues and jobs thus promising a highly motivational career path the youths. Thus, start-ups in the recent past have assumed top order career option for many graduates from the leading schools of business and technology. The success of start-ups depends on an innovative ecosystem comprising incubators with the availability of appropriate technology and hardware systems, effective mentoring, access to easy finance, assistance in the marketing of products and services etc. Such ecosystems have played crucial roles for creating start-up havens in Cambridge (UK), Silicon Valley, Tel Aviv and also in our own Bengaluru.

But as India not only needs to feed 1.30 billion mouths but also would like to reap benefits from 1.30 minds, we need myriads of start-ups spawning from multitudes of ideas for every conceivable service, application or social benefit. Realizing the multiplier effect of start-ups for the national economy and also their direct impact on fostering the creativity and innovation, Govt. of India has launched the ambitious programme following the clarion call of ‘Start-up India, Stand up India’ by the Hon’ble Prime Minister. Towards building a strong ecosystem for nurturing innovation and start-ups in the country, the ‘Start-up India Action Plan’ was launched on January 16, 2016 in New Delhi. While the start-ups have been quite successful
in e-commerce, and other IT based applications of the services sector till date, they are yet to take off in a big way in the manufacturing sector. We need to accelerate spreading start-up movement from IT & ITES to a wide array of sectors encompassing agriculture, manufacturing, social sector, education etc.

There have been exemplary successes by a few start-ups in India. This is measured by how many of them graduate to the Unicorn Club. A unicorn is defined as a private company with a valuation of over US$1 billion. As of August 2018, there are more than 260 unicorns around the world and India have 13 of them.

**Dutch Scenario**

Start-ups and scale-ups drive the new economy: they create jobs, open up markets, and play a crucial role in devising solutions for the challenges our society faces today. The Netherlands offers an environment that gives talented people from all over the globe the freedom to change the world on their own terms.

The Netherlands is one of the top startup ecosystems in the world. The country offers talented people from all over the globe the opportunity to communicate, create, explore, grow and live like a successful innovator. The following characterizes the thriving start-up and scale-up scenario of the Netherlands:

- The Dutch are the best non-native English speakers in the world, over 90% of the population speaks English
- No place is more than 90 minutes away from 10+ top notch innovation hubs
- All 13 Dutch research universities are ranked in the world's top 200 universities and amongst the best in Europe
- 70+ accelerators and incubators
- Ranks 1st in EU startup business climate
- 170 million consumers within 500 km
- World’s 4th most innovative economy
- Most connected economy in the world
- Amsterdam ranks 3rd in Europe for startups and scaleups
6. Waste to Value

Indian Scenario

*Municipal Solid Waste (MSW) to Value*

Urban India generates about 52 million tons of solid waste per year. The per capita waste generation in India depends on the diversified life style, primary occupation of workforce, climate, cultural habits, religious & tourist importance etc. Today, India's per capita waste generation varies from 339 to 430 gm/capita/day (GIZ, 2015).

The composition of waste also widely varies across India. Most of the Indian cities have 65% to 75% of biodegradable waste (including food and garden waste). The presence of Construction & Demolition (C&D) wastes in MSW is the major challenge for India.

As per Report of Central Pollution Control Board (CPCB), 2016, various waste to compost processing plants are set-up by 595 Urban Local Bodies (ULBs) in India for the treatment of MSW fully or partially. There are total 666 waste to energy units set up viz. Refused Drive Fuel (RDF)-12, Power plant-05 and Biogas plant- 648 units in India. Thiruvananthapuram (Kerala) alone has 600 biogas plants at the household level. There are 05 waste to power plants in India, with installed capacity of 66 MW.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>States/ UTs</th>
<th>Plant Commissioned</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Delhi</td>
<td>Narela Bawana</td>
<td>24.0</td>
</tr>
<tr>
<td>2</td>
<td>Delhi</td>
<td>Okhla</td>
<td>12.0</td>
</tr>
<tr>
<td>3</td>
<td>Delhi</td>
<td>Ghazipur</td>
<td>16.0</td>
</tr>
<tr>
<td>4</td>
<td>Madhya Pradesh</td>
<td>Jabalpur</td>
<td>11.0</td>
</tr>
<tr>
<td>5</td>
<td>Himachal Pradesh</td>
<td>Solapur</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Around 95 landfill facilities are constructed in India, as per CPCB report. Initiatives for construction of new landfills are taken by 242 ULBs and new sites are identified by local bodies for the construction of 1285 landfills.
**Government Initiatives**

1. **Swachh Bharat Mission:** On 2nd October, 2014, the Hon’ble Prime Minister of India launched the Swachh Bharat Mission (SBM), with an objective to manage the MSW in scientific way. Significant initiatives have been taken to irradiate this menace. The revised guidelines by the SBM (U) Directorate were released on 5th October 2017 in response to changing ground realities and there is increased focus to streamline and formalize Solid Waste Management (SWM) systems by ULBs. The major components of SBM (U) are as below:

   - 100% cost reimbursement for preparing the DPR by GoI as per unit cost and norms set up by NARC.
   - 35% viability gap fund (VGF) available for solid waste management. States to provide VGF on sharing or additional basis. State share will be 23.3% of the project cost. For UTs, the Central government incentive for SWM projects will be 35% of project costs, and UT share will be 11.67% of project cost.
   - 3% of the total Central Government allocation under the mission will be earmarked for capacity building, administrative and office expenses of States and ULBs.
   - States will contribute a minimum of 40% of project costs towards IEC & Public awareness to match 40% of project costs as Central Share.
   - 2% of the total Central Government allocation under the mission will be utilized at the Ministry level for capacity building, convening national and regional workshops, various awards and best practice recognition, programme research, studies, international cooperation for capacity building and technology development, A&OE etc.

2. **Solid Waste Management Rules 2016:** The Union Ministry of Environment, Forests & Climate Change (MoEF&CC) has notified the Solid Waste Management Rules 2016. The new rules have mandated citizens for segregation of waste at source to channelize waste-to-wealth by recovery, reuse and recycle. Institutional waste generators, market associations, hotels & restaurants etc. have been directly made responsible for segregation of the waste generated and its management in collaboration with the ULBs. The ULBs have been given the authority to decide user fees and are expected to provide door-to-door service for collection of segregated waste. To operationalize the SWM Rules, The Ministry of Housing & Urban Affairs (MoHUA) published a SWM manual providing necessary specifications and actions for implementation in cities.

3. **Waste to Wealth by Principal Scientific Advisor (PSA):** The Prime Minister’s Science, Technology and innovation Advisory Council, a 21-member panel appointed last year has chosen ‘Waste to Wealth’, one of the projects for India. The office of the Principal Scientific Adviser (PSA) to the Govt. of India has been working on a project ‘Waste Mining and Land Recovery at Ghazipur Dump site’, in partnership with East Delhi Municipal Corporation (EDMC) and invited the proposals from technology partners for recovery of land at Ghazipur open dump site in New Delhi for improvement of the landfill waste.
4. **Projects by Ministry of Science & Technology:** Since the introduction of National Swachh Bharat Mission, Department of Biotechnology (DBT) has been supporting research projects on generation of energy from waste. A total 08 waste to energy projects initiated to develop / demonstrate novel and viable technologies for sustainable utilization of Municipal Solid Waste (MSW) for cleaner and pollution free environment as well as generation of the energy.

**Biomass to Value**

India is one of the key producers of food grain, oilseed, sugarcane and other agricultural products. Agricultural crops generate considerable amounts of leftover residues, with increases in food production crop residues also increasing. These leftover residues exhibit not only resource loss but also a missed opportunity to improve a farmer’s income. These crop residues in various fields can be used for generation of energy in terms of electricity & biogas; and production of recycled products, packaging, compost and manures, etc.

According to the study conducted by IISc., Bangalore, India produces about 450-500 million tons of biomass per year. It has got 145 million tons of biomass surplus every year from more than 30 major varieties of biomass sources, which can be utilized to produce value-added products and bio-energy.

Today, India has a potential to generate about 18 GW of energy from Biomass. About 32% of total primary energy used in India is derived from Biomass. Today, India has ~10+ GW capacity biomass powered plants - 83% are grid connected while the remaining 17% are off-grid plants (table below). The off-grid plants are divided between cogeneration plants that do not utilize bagasse, biomass gasifiers for rural applications and biomass gasifiers for thermal applications in industry. Around 70 Cogeneration projects are under implementation with the total capacity aggregating to 800 MW.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Sector</th>
<th>Capacity in MW (as on 31 March 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grid Interactive Power</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biomass Power (Combustion, Gasification and Bagasse Cogeneration)</td>
<td>9407.61</td>
</tr>
<tr>
<td></td>
<td>Waste to Power</td>
<td>138.3</td>
</tr>
<tr>
<td></td>
<td>Sub-total (I)</td>
<td>9545.91</td>
</tr>
<tr>
<td>2</td>
<td>Off-Grid / Captive Power</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biomass (non-bagasse) Cogeneration</td>
<td>651.91</td>
</tr>
<tr>
<td></td>
<td>Biomass Gasifiers</td>
<td>163.4</td>
</tr>
<tr>
<td></td>
<td>Waste to Energy</td>
<td>175.28</td>
</tr>
<tr>
<td></td>
<td>Sub-total (II)</td>
<td>990.59</td>
</tr>
<tr>
<td></td>
<td>Total Biomass to Power</td>
<td>10536.5</td>
</tr>
</tbody>
</table>
The leading States for biomass power projects are Maharashtra, Uttar Pradesh and Karnataka each one having more than 1 GW of grid interacted biomass power. Other states with favorable policy and opportunities in biomass are Punjab and Bihar.

**Government Initiatives**

1. **Biomass power & cogeneration programme by the Ministry of New and Renewable Energy (MNRE):** A programme to support promotion of biomass-based cogeneration in sugar mills and other industries was also announced in May 2018, by MNRE’s biomass power division. The programme also aims at promoting technologies for optimum use of country’s biomass resources for grid power generation.

2. **Concession & Incentives by MNRE:** MNRE has developed an overarching policy for biomass and bagasse cogeneration. It includes financial incentives and subsidies, both for biomass projects and sugar mills that use this technology. Government gives 10 years Income tax holidays and 80% depreciation in the 1st year that can be claimed for some equipment required for co-generation systems.

   Concessional customs duty and excise duty exemption are offered for machinery and components for initial setting up of Biomass power projects. General sales tax exemption is available in certain States. State governments have also instituted their own incentives and subsidies and these initiatives differ across states.

3. **National Policy on Biofuels by GoI:** For the development and utilization of indigenous agricultural & residual wastes and production of biofuels, a National Policy on Biofuels was announced in December 2009. For increasing farmers’ income, employment generation, waste-to-wealth creation, the Government of India had revised the National Policy on Biofuels in 2018. The National Policy on Biofuels-2018 approved by the Government envisages an indicative target of 20% blending of ethanol in petrol and 5% blending of bio-diesel in diesel by 2030.

4. **Generation of ethanol by 2nd generation Feedstock in DBT-IOC Centre:** The DBT-IOC Centre for Advanced Bioenergy has installed and commissioned India’s first continuous Steam Explosion pilot plant & Extractor system. This 300 kg/day pre-treatment pilot facility shall be used for developing process technology for 2G ethanol to feedstock (cotton, mustard stalk etc).

   The Centre has successfully scaled up its enzyme technology at 5 KL fermenters at third party premises with 8 FPU/ml activities. The whole enzyme broth material was evaluated at 1MT/Day pilot plant of M/s Praj Industries, Pune. The enzyme showed comparable hydrolysis efficiency to the commercial enzyme.

5. **INDUS Projects:** In some parts of India, crop residues especially paddy stubbles are burnt as waste, which leads to polluting the environment and destroys a valuable material that can be used in a multitude of ways. INDUS project focuses on the impact of the burning paddy stubble in India. The INDUS is an initiative by India and the Netherlands. It is a
collaboration between MVO Nederland, the Dutch Embassy in India, Indian Centre for Responsible Business, Indian Institute for Corporate Affairs, TERI, Biosfera and CII-ITC Centre of Excellence for Sustainable Development.

**Dutch Scenario**

The Netherlands has a strong standing in the areas of renewable energy and energy efficiency. The Dutch have a leading position in wind energy at sea, biomass processing, and greenhouse farming. Innovation and public-private partnerships are inherent to the Dutch approach. Government, private sector and academia co-operate on priority topics like energy savings in industry and the built environment, gas, smart grids, wind at sea, solar energy and bio energy. The country’s strengths are:

- courageous vision: a sustainable, reliable and affordable energy system in 2050;
- experimenting with decentralized energy;
- Europe’s leader in green gas;
- great experience in energy efficiency;
- international reputation for research in renewable energy;
- leading expertise in offshore wind energy;
- aims to become ‘Europe’s biofuel hub’.
7. Education

Indian Scenatrio

With 993 Universities, 39931 Colleges, 10725 Stand Alone Institutions and an estimated total enrolment of 37.4 million students, Indian higher education system is the third largest in the world. There are 548 General, 142 Technical, 63 Agriculture & Allied, 58 Medical, 23 Law, 13 Sanskrit, 9 Language Universities and 106 other category universities in India. India is known to have one of the oldest education systems in the world dating back thousands of years. India has earned a reputation of providing the best talent to the world in all fields. Indian education system has an innate diversity that manifests into a range of courses right from cutting edge ones like Virtual Reality and Artificial Intelligence to traditional ones like Yoga, Ayurveda, Sanskrit and ancient art forms.

India is well known for being a cost-effective market. This is extended to our education system too with the higher education institutions offering world-class courses at a quarter of the cost compared to the developed countries. Over 47,000 foreign students in India come from 164 different countries from across the globe. Through its ‘Study in India’ programme, India is keen to increase the number of international students manifolds in the coming years. Also, Indian students pursue higher education overseas in large numbers every year. With the Indian economy on a high growth trajectory and continuously expanding incomes, more and more students are in a position to afford education overseas. Exchange programmes and joint courses as well as research partnerships between Indian and Dutch institutions can prove very attractive for students and researchers from both the countries.

India’s strengths in education:

• Third largest education system
• Very low costs
• Opportunities for short term traditional courses
• Fastest growing economy and one of the largest world markets
• Exposure to rich and diverse culture
Dutch Scenario

Dutch higher education institutes belong to the top 2% of the world and are very active in international collaboration. Attracting talent from abroad is crucial for an internationally oriented country like the Netherlands. International students bring global perspectives into classrooms. With the knowledge, experience and networks that they bring from their own country, international students enhance the quality of education in the Netherlands even further. Many of them also continue to live and work in the Netherlands after their studies and as such, they contribute to innovation and the Dutch knowledge economy.

Nuffic is the center of expertise and service for internationalization in Dutch education, funded primarily by the Dutch government. Besides promoting high-level education, Nuffic is also responsible for mobility statistics, scholarships, diploma recognition and capacity building. Nuffic’s head office is located in The Hague and it is supported by 11 offices worldwide.

Globally more and more students want to pursue a higher education abroad. Research has shown that international students choose the Netherlands for the academic quality and the cosmopolitan atmosphere. Dutch higher education institutions value the presence of international staff and students because they contribute to an international classroom environment and a more ambitious culture. The Netherlands is now the largest provider of English-taught education programmes in mainland Europe, with over 2,100 programmes available in higher education. To promote the Dutch higher education system abroad, the associations of the research universities and the universities of applied sciences offer a special toolkit.

With the brand ‘Study in Holland’, Nuffic, together with the Dutch higher education institutes, wants to attract more international students to the Netherlands. ‘Study in Holland’ has developed promotional materials, like posters, a brochure, flyers, a website and social media. Worldwide, the ‘Study in Holland’ logo plays a key role in the international branding of Dutch higher education. The logo combines traditional symbols of Holland – the tulip and the windmill representing higher education and research. The tagline ‘Study in Holland: open to international minds’ captures the international character of the programme.

Strengths of the Netherlands in education:

• 2,100 + programmes in English
• High quality education
• Interactive way of education
• Value for money
• Openness to International minds
8. Cyber Security

Indian Scenario

Cyber security is emerging as one of the most challenging aspects of the information age. It has implications on national security, the economy, human rights, civil liberties and international legal frameworks. Cyber security consists of a considerable set of multidisciplinary knowledge, processes, discrete technologies, capabilities and services that stem from and expand on practices of computer information and network security. Cyber security technology encompasses software & hardware tools, techniques and risk management processes that assure confidentiality, integrity and availability of data, thus providing the means to share information across the Internet without threat of attack or theft.

Indian economy, now amongst the world’s top five, faces increasing cyber threats. It is highly important for Indian businesses to be prepared for cyber incidents and manage cyber risks effectively. Protecting and strengthening the digital economy are high on the legislative and policy agenda of the Indian Government.

Threats and vulnerabilities are growing rapidly with the move to cloud and mobile. Cyber criminals are proving very adept and skillful at using the latest digital technologies and exploiting the loopholes and vulnerabilities in cyber world. Rise in intensity and sophistication of cyber risks now necessitates a more proactive approach to cyber defence and risk mitigation.

Cyber security is a skill deficient industry. According to a survey, the gap between cyber security professionals and unfilled positions will expand to nearly 1.8 million globally by 2022. In India, the demand for skilled cyber security professionals is high and rising. With sound investments in cyber security skilling, India can provide the cyber security workforce for the world.

Globally as well as in India, there is growing awareness about cyber security risks among board level professionals and CXOs. An increasing number of corporate leaders sees cyber threats as high risk in comparison to other business risks. While most evolved business organizations have dedicated cyber security strategy, perhaps more than two-thirds in India, do not have dedicated cyber security budgets.
Secure software development and security applications of AI, ML, blockchain, Cloud, IoT and other disruptive technologies are generating considerable interest. Laws governing technologies and cyber security are struggling to keep pace with the sheer speed and scale of technology development.

The Government of India is committed to making India a safe place to do business online. The year 2019 is likely to see India coming up with the dedicated cyber security laws to define the roles, duties and responsibilities of various stakeholders in the cyber security eco-system. Being borderless in nature, cyber security would also require collaboration among nation-states and multiple stakeholders to win the fight against ‘cyber criminals, terrorists and those with bad motives.

Privacy and security compliance are becoming a serious concern around the world. Strong data protection regimes like GDPR require companies to step up their legal compliances. Due to this, companies now necessarily have to invest a lot more in data protection and also their security. India’s draft Personal Data Protection Bill would be an important piece of legislation to be taken up by the Government. An Indian Supreme Court ruling limiting the use of Adhaar Data and the promulgation of sector-specific regulations in India - such as those for financial services, critical information infrastructure, smart cities and DISHA (for healthcare- which could mark health as sensitive data, not just personal data) - would have major implications for stakeholders. India’s Ministry of Corporate Affairs (MCA) also seems determined to enforce stronger breach notification guidelines, requiring companies to inform affected users in case security is compromised; this will necessitate more investment in cyber security.

**Government Initiatives**

The following mechanism and measures are in place to ensure digital safety and cyber security in the country:

- **Indian Computer Emergency Response Team (CERT-In)** is designated as the National nodal agency to coordinate matters related to cyber security incidents in the country.

- **National Critical Information Infrastructure Protection Centre (NCIIPC)** has been set up to enhance the protection and resilience of Nation’s Critical information infrastructure.

- Government has issued general guidelines for Chief Information Security Officers (CISOs) regarding their key roles and responsibilities for securing applications / infrastructure and compliance Organizations are encouraged to develop their own cyber security policy.

- **Cyber Crisis Management Plan (CCMP)** for countering cyber threats and cyber terrorism has been developed and so far, 60 workshops have been conducted for Central Govt. Ministries/Departments, States/Union Territories and other organizations.

- Government has initiated setting up of National Cyber Coordination Centre (NCCC) to generate necessary situational awareness of existing and potential cyber security threats and enable timely information sharing for proactive, preventive and protective actions by individual entities. Phase-I of NCCC has been made operational.
Government has launched the Cyber Swachhta Kendra (Botnet Cleaning and Malware Analysis Centre) which provides detection of malicious programs and free tools to remove the same.

Dutch Scenario

As one of the world’s most wired nations, the Netherlands is a pioneer in data innovation. The country’s excellent digital infrastructure makes it an IT hotspot. Society’s growing dependence on online connectivity, however, makes people and organizations vulnerable to cybercrime. So the Netherlands has made cyber security a major priority by creating an innovative ecosystem for cyber expertise.

The cyber security market in the Netherlands has been growing at a rapid annual pace of around 14.5 percent. Of the 66,000 IT companies in Holland, 3,600 have cyber security as their core business and more than 2,500 sell cyber security products and services. The strengths of the Netherlands are:

- Ranked No. 1 as Most Connected Country in the World
- Ranked No. 1 in the Europe for Outstanding use of IT
- Ranked No. 2 for the Highest Quality Broadband Network in Europe
- 4th Largest Exporter of IT Services
- World’s largest Internet Exchange – AMS - IX