Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific Tech Monitor

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Science, Technology and Innovation for achieving SDGs in the Asia-Pacific

Plus

- Technology News and Events
- Tech Ventures & Opportunities
- Business Coach

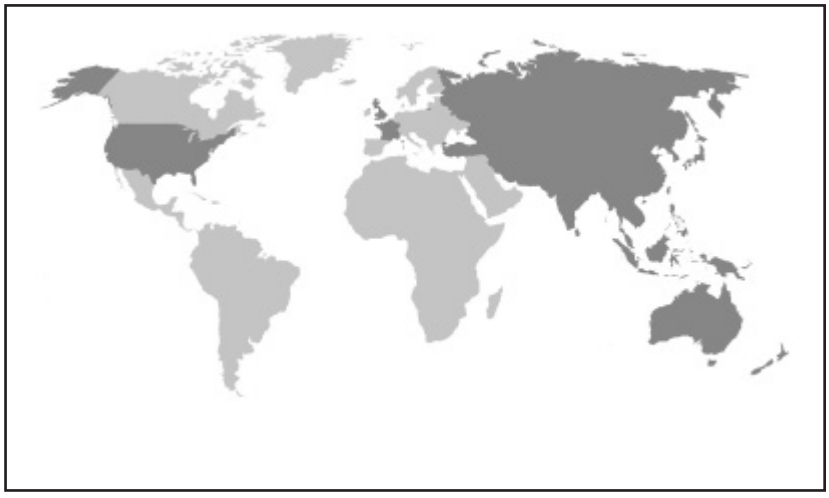
APCTT
Asian and Pacific Centre for Transfer of Technology

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

The **Asian and Pacific Centre for Transfer of Technology** (APCTT), a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives to: assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

- Research and analysis of trends, conditions and opportunities;
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



The shaded areas of the map indicate ESCAP members and associate members

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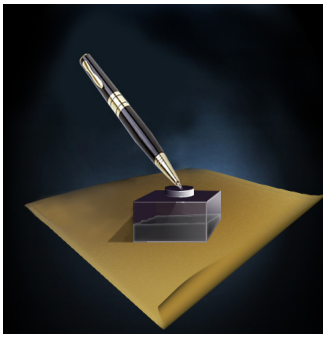
CONTENTS



Introductory note

Science technology and innovation (STI) is recognized as the key means of implementation of the 2030 Sustainable Development Agenda which aim at eliminating poverty and hunger while addressing the effects of climate change. As a major step in this direction, the Technology Facilitation Mechanism (TFM) of the United Nations is currently supporting the implementation of Sustainable Development Goals (SDGs) by facilitating multi-stakeholder collaboration and partnerships through the sharing of information, experiences, best practices and policy advice among Member States, civil society, the private sector, the scientific community, United Nations entities and other stakeholders.

STI is critical for the Asia-Pacific region which offers wide range of opportunities for technological innovation, grass-roots innovation, international technology transfer, and technology-based entrepreneurship, to name but a few. Countries should aim at creating policies and strategies that increase national capabilities not only to adopt, adapt and develop technological innovations, but also to leapfrog in new and emerging technologies.

The UN Programme of Action for the Least Developed Countries (LDCs) for the Decade 2011-2020, notes that "acquiring new technologies and building domestic capacity and a knowledge base to be able to fully utilize acquired technologies and promoting indigenous capacity on a sustainable basis for research and development are needed to enhance productive capacities in least developed countries"These efforts would require support to LDCs not only in training and skill development in the technology areas, but also mechanisms for financing and implementing STI partnerships for sustainable development projects.

Developing appropriate national STI strategies would require good analysis of existing national innovation systems (NIS) of countries. This can provide useful information for policymakers in planning changes to, and strengthening the existing STI systems and strategies in line with their development objectives. Therefore, it is essential to diagnose or evaluate the quality and efficiency of a NIS by conducting evidence-based studies to understand the strengths and weaknesses of different components of NIS and evolve informed policy decisions and implementation mechanisms.

This issue of *Asia-Pacific Tech Monitor* discusses the challenges, opportunities and strategies to develop and adapt appropriate STI policies, frameworks, institutional support mechanisms and programmes for achieving sustainable development in the countries of Asia-Pacific region.

Michiko Enomoto
Head, APCTT-ESCAP

Technology Market Scan

INTERNATIONAL

Fight against neglected tropical diseases

The World Intellectual Property Organization and its partner BIO Ventures for Global Health (BVGH) established the initiative in 2011 to boost the use of intellectual property in catalyzing innovation and product development for ailments affecting more than 1 billion people. WIPO Re:Search has launched a new five-year roadmap to guide its activities in the fight against neglected tropical diseases, malaria and tuberculosis. WIPO Re:Search now includes 126 members in 35 countries and has established 112 collaborations across the globe

The new plan, unveiled during WIPO Re:Search's biennial meeting May 23, 2017, in Geneva, will guide the public–private consortium's activities through 2021 and includes new research, capacity building and outreach efforts. WIPO Re:Search allows organizations to share their intellectual property, compounds, expertise, facilities and know-how royalty-free with qualified researchers worldwide.

The new strategic plan seeks to ensure that WIPO Re:Search harnesses new research and development trends in global health, while contributing to the achievement of the United Nations Sustainable Development Goals.As the implementing partner, BVGH will seek a more process-driven and targeted partnership-development approach to link research and development programs with gaps in research, taking into consideration the impact of the disease on people's lives.

http://www.wipo.int

ASIA-PACIFIC

CHINA

JV tech transfers

Foreign companies have no obligation to transfer their technologies to local partners under a joint-venture format in China, the Ministry of Commerce reiterated. The ministry's response follows foreign media reports that global investors were required to share their technologies with their Chinese partners, violating World Trade Organization rules. Sun Jiwen, the ministry's spokesman, said that there are no compulsory technology transfer obligations for foreign investors. All the terms and conditions in business negotiations between two parties result from market behaviour rather than such a "nonexistent duty", according to Sun. He also said that "attracting foreign investment is crucial to China's opening-up. Therefore, we need to underpin a healthy and regulated market environment".

Most industries are completely open for foreign investors in China. Only a few sectors deemed sensitive have equity share limits and restrictions, according to relevant regulations. These were reduced from 43 to 15 in 2015. Eager to maintain its core competitiveness, China started to allow foreign businesses to invest in sensitive industries such as telecommunications, internet-based sectors and education in 2016. Local governments are not permitted to make arbitrary decisions that limit foreign investment.

The Ministry of Commerce and other government bodies are now revising the catalogue of industries open to foreign investment, for example, cutting the number of industries with equity share limits.The government has repeatedly said that "because of its huge market size, industrial infrastructure foundation and logistics network, China is, in the long term, the most attractive market for global companies".

Foreign companies, such as German conglomerates Robert Bosch GmbH and Siemens AG, the United States-based Cargill Inc and Royal Philips NV of the Netherlands, have all made new plans to increase their investments in China through building new plants, joint ventures and research centres. Johnson Controls Inc, the US manufacturer of energy-efficient products, control systems and batteries, will open its second global headquarters with capacity between 1,200 and 1,600 employees in Shanghai in June.

http://www.chinadaily.com.cn

R&D spending to be raised

China will increase its annual per capita spending on research and development (R&D) from 370,000 yuan in 2014to 500,000 yuan (72,800 U.S. dollars) by 2020, the Ministry of Science and Technology said. According to the 13th five-year plan for national science and technology talent development (2016–2020) released by the ministry, China had 5.35 million people working in R&D by the end of 2015, the world's largest pool of R&D talent.

It said that more than 1.1 million overseas Chinese skilled workers returned to China from 2011 to 2015, which is three times the total number of the previous three decades. However, the country is still facing problems, including a lack of researchers in cutting-edge, high-end fields and insufficient expenditure on R&D talent.

http://news.xinhuanet.com

Tax incentives for tech SMEs

China announced measures to encourage research and development (R&D) by tech firms through favourable tax terms, the Ministry of Finance (MOF) said in a statement. Small and medium sized-enterprises (SME) in the technological sector can deduct an additional 75 percent of the R&D costs that occurred before paying taxes, effectively lowering their taxable income, according to the statement. Tech SMEs that chose alternatively to capitalize the R&D costs as intangible assets in the current accounting period can amortize the assets at 175 percent of the original costs.

The statement said that the new tax term will be in effect from the beginning of 2017 to the end of 2019. China has been offering tax incentives to spur corporate dynamism and competitiveness, offering tailored measures to firms of different types. The MOF also announced tax incentives for venture capital firms, allowing them to deduct a certain amount of taxable income for investing in startups. It also said that the value added tax (VAT) system will also be streamlined, with four VAT brackets reduced to three.

http://www.chinadaily.com.cn

INDIA

Low expenditure on R&D

According to the Research and Development Statistics, 2011–2012, published by the Department of Science and Technology, India's R&D expenditure is around 0.88 percent of GDP and number of R&D professionals per million population are 164. The Government has proposed several measures during the last three years to increase the number of R&D professionals in the country. These include launching the: Atal Innovation Mission (AIM) in Budget 2015, which is an innovation promotion platform involving academics, entrepreneurs and researchers; Impacting Research Innovation and Technology (IMPRINT) in November, 2015, which is a PAN-IIT and IISc joint initiative to develop a road map for research; and Uchhatar AvishkarYojana (UAY) in December, 2015, which is to promote innovation of a higher order to serve the needs of industry and promote a vibrant research echo system across IITs. Further, the Government has enhanced the budget allocation of the departments under the Ministry of Science & Technology during the last 3 years from Rs.8,768.36 crore in 2014–2015 to Rs. 10,353.00 crore in 2016–2017, which helped in supporting a larger number of R&D professionals in various S&T institutions spread across various states in the country under the departments.

During Budget 2016, the Government announced a reduction in weighted tax deduction on in-house R&D expenditure by industries from 200 percent to 150 percent from the financial year 2017–2018 and 100 percent beyond financial year 2019–2020. The impact of this cut in R&D tax break cannot be assessed at this stage.

The measures taken by the Government to encourage private sector to increase expenditure towards R&D since 2014 include launching of initiatives, such as Make in India and Start-up India and supporting setting up of incubation centres for industries to up-scale their innovative ideas into products and services. Besides, the Government has been announcing a number of fiscal incentives for the private sector to increase R&D expenditure. These include, Weighted Tax deduction on expenditure incurred in approved in-house R&D facility by companies, Weighted Tax deduction for Sponsored Research Programmes in approved national laboratories, universities and IITs, Customs duty exemption on goods imported for R&D and Central excise duty waiver for 3 years on specified goods designed & developed by a wholly owned Indian company, national laboratory, public funded research institutions, or university and patented in any two countries amongst India, USA and Japan, and in any one country of the European Union.

http://pib.nic.in

Royalty payment norms

A surge in royalty outflow has prompted the government to set up an inter-ministerial group to analyse payment norms and see whether there is excessive payout by Indian companies to foreign collaborators. Royalty is paid to a foreign collaborator for transfer of technology, usage of brand or trademarks."Royalty outflow has surged in the recent past and it needs to be analysed. So, the government has set up this inter-ministerial panel," an official said.

The panel will be headed by an additional secretary level officer of the Department of Industrial Policy and Promotion (DIPP). It also has representatives from departments of revenue, economic affairs and the Reserve Bank. It will submit its report by June.The terms of reference include scrutiny of the outflow and the present legal structure dealing with royalty payments and transfer pricing.

Earlier, the DIPP had raised serious concerns over the increasing outflow of such payments. The department had proposed reintroduction of restrictions on such payments by companies to their parent entities. It had argued that the curbs would help increase the profits of domestic companies, mainly in the automobile sector, prevent depletion of foreign exchange reserves, protect interest of minority shareholders and increase revenue for the government.

http://www.dnaindia.com

Technology and innovation support centres

Industrial promotion body, Department of Industrial Policy and Promotion (DIPP) of Government of India, and the World Intellectual Property Organisation (WIPO) have joined hands to establish Technology and Innovation Support Centres in the country which is expected to boost generation and commercialisation of intellectual properties. The agreement, signed between the Department of Industrial Policy and Promotion (DIPP) and WIPO for setting up of Technology and Innovation Support Centres (TISCs), will also provide an impetus to knowledge sharing, capacity building and sharing of best practices among over 500 TISCs operating worldwide by giving the host institutions access to global network.

The services offered by TISCs may include access to online patent and non-patent (scientific and technical) resources and IP-related publications; assistance in searching and retrieving technology information; training in database search; on-demand searches (novelty, state of the art and infringement); monitoring technology and competitors; and basic information on industrial property laws, management and strategy, and technology commercialisation and marketing.

WIPO's TISC programme provides innovators in developing countries with access to locally based, high-quality technology information and related services, helping them exploit their innovative potential and to create, protect, and manage their intellectual property (IP) rights. The Cell for IPR Promotion and Management (CIPAM), under the Ministry of Commerce & Industry, has been designated as the national focal point for the TISC network. CIPAM shall identify potential host institutions, assess their capacities and support them in joining the TISC project.

http://economictimes.indiatimes.com

JAPAN

Automakers R&D spending

Research and development spending by seven major Japanese carmakers is

expected to total a record 2.85 trillion yen ($25.5 billion) in fiscal 2017 as they scramble for advantage in such technologies as autonomous driving.The sum is up 7 percent from fiscal 2016. Honda Motor, Suzuki Motor, Mazda Motor and Subaru are to spend their most ever. Toyota Motor and Nissan Motor will keep their existing record levels from fiscal 2015. Mitsubishi Motors will increase its outlays by 20 percent.

The automakers' aggregate operating profit is seen shrinking about 10 percent from fiscal 2016 to 3.86 trillion yen, due in part to a slowdown in their cash cow market, North America.Yet the companies are stepping up R&D investment to cultivate green, autonomous driving and other emerging technologies. Outsourcing costs are rising amid labor shortages in Japan.

The auto industry accounted for 22 percent of around 13.7 trillion yen in fiscal 2015 R&D spending by companies in Japan, according to the Ministry of Internal Affairs and Communications.Toyota is expected to increase its R&D spending 1 percent this fiscal year to 1.05 trillion yen. This marks a fourth straight year exceeding 1 trillion yen in spending. The company is boosting spending in key areas like autonomous driving, connected cars, artificial intelligence and robotics. Toyota is bracing for a second straight year of operating profit decline this fiscal year. Nonetheless, it is spending a hefty sum on R&D to keep up with a rapidly changing competitive landscape. Many information technology and other companies are getting into autonomous driving. In 2016, Toyota created an artificial intelligence R&D unit in the U.S., headed by an external expert. The company has also decided to partner with Nvidia, a graphics processing unit maker in the U.S. Both ventures are to speed up technology development.

Overseas rivals are also stepping up R&D spending. Volkswagen spent 13.6 billion euros ($15.2 billion) in 2016, up 0.4 percent on the year. For the next five years, the German company plans to spend 9 billion euros for electrification technology. In the U.S., General Motors has earmarked $8.1 billion, up 8 percent on the year.

http://asia.nikkei.com

MALAYSIA

Fund for start-ups

Malaysian government-owned Cradle Fund unveiled a new grant product today, while scrapping two previous ones as part of its shift toward equity investing.The new product, Cradle Investment Programme 300 (CIP300), is a pre-seed program that provides up to US$69,400 in financial and "value-added" assistance to entrepreneurs who want to kickstart their businesses without giving away equity.CIP300 was the offshoot of a revamp in Cradle's grant strategy. A spokesperson told *Tech in Asia* that the agency has junked two previous grant products – CIP Catalyst (up to US$35,000) and CIP500 (up to US$116,000) – after suspending them late last year. "[They] will no longer be available," she said.

Cradle wants to lessen startups' dependence on grants and the lower amount CIP300 offers will encourage them to seek other funding options such as crowdfunding, angel or VC investments, it said."By weaning startups off grants, Cradle intends to introduce outside investors earlier ensuring local startups have the discipline, professionalism and focus required to propel them to the next level," the agency explained. But it's not going to leave startups hanging in the air after the pre-seed stage. It has DEQ800, an equity product worth up to US$185,000 that's meant to be "the next step for early-stage startups to scale up."

Launched last March, DEQ800 is Cradle's latest initiative toward equity investing and allows it to invest on its own. Before that, it could only snap up stakes in startups under a co-investment program, where it matches any funding given by its investor-partners. CIP300's key feature is a range of value-added support for recipients such as an intensive mentoring program throughout the funding period, opportunity to be matched with potential investors, training in innovation and commercialisation, participation in Cradle business and networking events, as well as media and public relations.

The investment product targets ICT, non-ICT and other technology-based fields such as semiconductors, life sciences and clean technology. Eligible to apply are Malaysian individuals or incorporated companies operating less than three years. For each grant award, Cradle expects at least 60 percent to be allocated for commercialisation costs, and the rest for product development and other costs.

https://www.techinasia.com

Technology and market radar for SMEs

SIRIM Berhadhas launched the Technology and Market Radar (TMR), a business tool to assist local SMEs to identify relevant technology and market trends to enable them to make strategic decisions on technology investment.TMR is designed to be accessed by SMEs, Ministries and Government Agencies to retrieve relevant and strategic information on technology and business trends complemented with an analysis of opportunities and challenges.

The TMR was launched by President and Group Chief Executive of SIRIM, Dr Ahmad Fadzil Mohamad Hani with more than 100 participants attending the event, comprising local SMEs, industries and government officials related to the Malaysian SME activities. Based on Technology Audits conducted on more than 300 SMEs in 2015 and 2016 by SIRIM under the SIRIM Fraunhofer Programme, the lack of data on market and technology trend was identified as one of the weaknesses affecting SMEs business growth.

To address this weakness, SIRIM and Fraunhofer IAO has collaborated to establish Technology and Market Radar (TMR) suitable for Malaysian SMEs. Ahmad Fadzil said the initial implementation stage of TMR has two main focus search topics namely Industry 4.0 and Renewable Energy as both technology fields are categorised as high interest fields among SMEs to boost productivity growth.

There will be one radar for the non-technical trend, which is based on the Social, Economic, Environment and Politics methodology.

https://www.nst.com.my

PHILIPPINES

Technology business incubators

More than 50 officers and researchers from 10 state universities and colleges (SUCs) in the Philippines recently participated in a training workshop to help them pursue their technology business incubators (TBIs). Titled "Training cum Writeshop on the Establishment of Agribusiness Technology Business Incubators", it was spearheaded by the Philippine Council for Agriculture, Aquatic and Natural Resources Research of the Development of the Department of Science and Technology (DOST-PCAARRD) and held recently at the DOST-PCAARRD Innovation and Technology Center (DPITC) in Los Baños, Laguna.

The DOST defines TBI as a facility, which hosts start-ups and provides business development services. The DOST-PCAARRD believes that helping SUCs establish or enhance their respective agribusiness TBIs can create jobs, develop entrepreneurs, and promote public–private partnerships for regional economic development.

A number of TBIs have already been established in the country, some of which are based in SUCs. Three SUCs, such as Benguet State University, University of the Philippines Visayas and Visayas State University, have shared insights on how they implement their respective business incubation programs during the workshop. Facilitated by the council's Technology Transfer and Promotion Division (TTPD), the training, besides the sharing of firsthand experiences, also presented the important concepts related to various modes of technology transfer, specifically on commercialisation through the establishment of agribusiness TBIs.

http://www.businessmirror.com.ph

REPUBLIC OF KOREA

Technology exports

The Ministry of Science, ICT & Future Planning of South Korea announced that the country posted a technology trade balance of US$28.617 billion last year, up 6.0 percent from a year ago. Specifically, the exports increased 6.6 percent to US$10.408 billion and the imports increased 5.6 percent to US$16.409 billion. The exports had reached US$5 billion in 2012 and then broke the US$10 billion mark in three years. This was led by a 111.1 percent increase in technology export from the chemical sector, where major pharmaceutical companies signed a series of big contracts. The electrical and electronics industry accounted for 47.2 percent of the total technology trade balance last year. This sector's deficit was US$4.647 billion during the same period.

That year, the country's major technology trade partners were China, Vietnam and the United States in the case of exports from South Korea, and the United States, Singapore and Japan when it comes to imports. The exports to China and the United States declined whereas the exports to Vietnam showed a significant growth. About 48.6 percent of the technology South Korea imported last year was from the U.S. and the imports from Singapore increased by as much as 254.5 percent.

http://www.businesskorea.co.kr

Tech firms' R&D investment

Republic of Korean information technology companies, mainly Samsung Electronics Co., SK Hynix Inc. and LG Electronics Inc., increased their spending on research and development last year with their R&D investment against sales higher than that of U.S. multinational tech giant Apple Inc. According to a study by Maeil Business Newspaper Wednesday on business reports of 17 companies whose market capitalization is more than 10 trillion won ($8.8 billion), they invested a total of 28.54 trillion won in R&D last year, an increase of 2 percent from 27.97 trillion won in 2015.

Samsung Electronics took the lion's share by spending 14.79 trillion won on R&D for semiconductor, home appliance and smartphone businesses in 2016, according to the company's regulatory filing. The figure accounted for 7.3 percent of its last year's sales of 201.87 trillion won, higher than Apple's R&D spending of 4.4 percent against its sales from October 2015 to June 2016.

The country's second largest chip maker SK Hynix' R&D investment against sales reached 12.2 percent last year, the highest among the 17 firms. Its R&D spending exceeded 2 trillion won for the first time last year, about 64 percent of its operating profit of 3.27 trillion won. LG Electronics also raised its investment in R&D to 7 percent of its sales, spending 3.88 trillion won last year, up 69.4 billion won from a year earlier. It has set a goal to increase its spending on the development of technologies related to the so-called fourth industrial revolution like the Internet of Things and big data this year. LG Display Co. spent 4.3 percent of its sales on R&D, but the actual amount of investment decreased by 7 percent from 2015.

On the other hand, Samsung SDS Co. cut the R&D investment by 9 percent, and Posco by 9.5 percent following its business streamlining. Hyundai Heavy Industries spent 21.3 percent less on R&D in 2016 from the previous year, hit by the protracted slowdown in the shipbuilding and shipping industries. The country's second largest car maker Kia Motors Corp. spent 3.1 percent of its sales on R&D last year, more than its bigger sister company Hyundai Motor Co. with 2.5 percent. In the cosmetic industry, AmorePacific Corp. showed greater R&D investment of 1.7 percent than LG Household & Healthcare Co. with 0.4 percent. In the chemical industry, LG Chem Ltd. spent 3.3 percent of its sales, higher than its rival Lotte Chemical Co. with 0.5 percent.

http://pulsenews.co.kr

Patents on smart automobile technology

It has been found that the number of Republic of Korea's patents on smart automobile technology ranked second in the world but in terms of qualitative levels, Korea was outmaneuvered by its competitors such as Japan and China. The Korea Economic Research Institute (KERI) said

this fact on April 5 through a report titled "Analysis of Technology Capabilities and Development Direction of the Smart Car Industry" (from 1970 to 2015, based on the US Patent Office)."

According to the report, Korea had shown the fastest growth rate of an increase of 8.8 percent points (based on the number of applications) among major countries since 2000s. Korea overtook Germany in 2013 and Japan in 2014, and ranked second in terms of annual registrations for the third year. Among Korean companies, Hyundai Motor and Hyundai Mobis ranked 8th and 24th, respectively. They were followed by Samsung Electronics (25th) and LG Electronics (30th). Harman, an auto parts company, recently acquired by Samsung Electronics, ranked 35th. The Korea Electronics and Telecommunications Research Institute (ETRI) was the only Korean research institute with the 32nd ranking. It was noteworthy that global IT giant Google ranked 10th and smart automobile patent applications by German automakers were not highly contrary to expectations.

The Republic of Korea strong in the sensor and human vehicle interface (HVI) sectors is relatively weak compared to major countries in terms of safety technology. Analysis of the number of patents filed for the top eight countries (2011–2015) based on the number of patent applications cited in subsequent inventions found that Korea with 0.94 times came in seventh before the UK with 0.91 times.

The country with the highest average number of citations was for the United States with 3.91 times. The US was followed by Germany with 2.54 times, Canada with 2.07 times, both Japan and China with 1.81 times and Taiwan with 1.14 times.However, in the field of human vehicle interfaces (HVIs), Korea finished 5th after the US, Japan, Germany, and the UK.

http://www.businesskorea.co.kr

Fund to help bio start-ups

Republic of Korea will establish a 113.5 billion-won (US$101.8 million) fund to nurture startups and venture firms in the bio sector to secure new growth engines, the science ministry said. Under the comprehensive plan finalized during a government meeting presided over by Acting President and Prime Minister Hwang Kyo-ahn, the fund will be floated to help young jobseekers launch new startups and develop new bio technology, the Ministry of Science, ICT and Future Planning said.

The ministry said it will partner with the Small and Medium Business Administration and the Ministry of Trade, Industry and Energy to nurture the fund that is aimed at bringing more investment and creating more jobs.The fund will focus on establishing infrastructure and help them in research and development (R&D), ministry officials said. "The government should push forward with measures to nurture startups, which are aimed at revitalizing the economy and creating more jobs," Hwang said.

The ministry has been making efforts to nurture the bio sector, which is viewed as the nation's next growth engine after IT. South Korea aims to become a global biotech and medical industry hub going forward.

http://english.yonhapnews.co.kr

SINGAPORE

Innovation fund to drive enterprise growth

The Intellectual Property Office of Singapore (Ipos) and home-based private equity firm Makara Capital launched a S$1 billion fund on Wednesday (April 26), with aims to invest in companies with strong intellectual property focus, to help them expand into global markets after their initial start-up phase. The Makara Innovation Fund (MIF) is among a slew of initiatives that are projected to inject S$1.5 billion value-add into the economy and double the number of skilled intellectual property experts in Singapore to 1,000 over the next five years.

"Intellectual property (IP) is going to be an important enabler of Singapore's growth moving forward," said the Senior Minister of State for Law and Finance, Ms Indranee Rajah, at the launch of the fund. "Singapore has a strong IP regime, which will enable local businesses to harness IP for growth. We will focus on helping enterprises to integrate IP into their business strategies early, and to commercialise their IP and scale up."

The initiatives are in line with the updated IP Hub Master Plan, first launched in 2013 by the Ministry of Law and Ipos. The measures will support the recommendations by the Committee on the Future Economy to strengthen Singapore's innovation ecosystem and build capabilities to help enterprises innovate and scale up, said Ipos. The fund is looking at investing in 10 to 15 companies over a period of eight to 10 years, with investments in the range of between S$30 million and S$150 million in each of these organisations. While the companies could be from any part of the globe, they must be supported by innovation and technology with the ability to create IP assets.

The idea is for the companies to tap Singapore's IP eco-system to help them deepen their value creation, compete effectively and expand into the global markets. Employing a "from Singapore and through Singapore" approach, the fund will help anchor the nation as a destination for ideas to be translated into assets, said Ipos in a press statement. Ipos will partner the Singapore Business Federation to help its 25,000 members grow through IP and innovation in their business strategies. The partnership will help build IP awareness and competencies in local companies through services such as training, executive education and IP clinics.

The enterprise engagement arm of Ipos, IP ValueLab, will also collaborate with international IP management consultancy firm EverEdge Global to reach out to more than 150 local innovative enterprises over the next three years. The joint effort seeks to provide intensive and customised assistance on IP strategy, management and commercialisation. "A new, self-help business portal will provide access to a repository of IP business guides and diagnostic toolkits", Ipos said.

http://www.todayonline.com

ASIA-PACIFIC

INDIA

Neem to cure oral cancer

India's traditional toothbrush, the neem, has properties that can prevent oral cancer, scientists from the biochemistry and biotechnology department at Annamalai University in Chidambaram have found. While neem's anti-cancer properties have been demonstrated several times by a number of researchers, scientists in Annamalai University demonstrated that a bio-active ingredient, nimbolide, activates a tumour suppressor protein called RECK (Reversion-inducing Cysteine-rich Protein with Kazal Motifs), which is found in all normal tissues but is low or absent in malignant tumours. The research, they hope, will help them find drugs that improve survival rates and treatment outcomes in patients with oral cancer.

The research study, published in a peer reviewed journal, *Scientific Reports*, Nature Publication Group in May, said nimbolide, derived from the leaves and flowers of the neem tree, could be used effectively to treat oral cancer, said biochemistry and biotechnology professor Siddavaram Nagini. In the laboratory, a team of researchers showed that nimbolide prevents cancer progression by preventing growth of uncontrolled malignant cells. It also spreads to other tissues through new blood vessels and kills cancer cells.

"RECK has tumour suppressing properties. In normal cells, it maintains tissue architecture and prevents infiltration and spread of tumour cells to other organs. In cancer, an array of molecules inhibits the function of Reck. Nimbolide suppresses the functions of the molecules that inhibit the function of RECK," Nagini said.

http://timesofindia.indiatimes.com

Edible dal from wild legume

Scientists in the National Botanical Research Institute (NBRI), a constituent laboratory of the Council of Scientific and Industrial Research (CSIR), have managed to knock off certain undesirable genetic material from a wild variety of legume crop making its grains edible and nutritive. Winged beans (*P. tetragonolobus*), also called Goa beans, is a highly nutritious legume crop that normally grows wildly. It is also cultivated in a small way in western and northeastern parts of the country. Almost all parts of this plant – leaves, pods, seeds and tubers – are edible. As the nutrients in this legume offers are very similar to those present in soybean, it is also billed as soybean of tropics.

Despite its high nutritional value, the legume is inedible beyond a limit. This is because a certain class of anti-nutrients called condensed tannins present in the plant can induce flatulence and stomach disorder, says Dr Chandra Sekhar Mohanty of NBRI, who led the study.

Now, NBRI researchers led by Dr Mohanty and their counterparts of the biotechnology department of the Kumaun University in Nainital, may have found a way to reduce, if not completely rid of, condensed tannins – whose primary jobs is to confer protection against predation and pathogen attacks – in winged beans. Their research work, which appeared recently in the journal *Scientific Reports*, has shown that it is possible to knock off genes that are responsible for the production of condensed tannins. "It would be ideal to produce a variety of winged bean that is high in protein content but less in condensed tannin," says Dr Mohanty. To do this, the scientists are planning to use a sophisticated technique called gene silencing.

Over the years, least attention being paid for improvement of legume crops in general orphan legumes in particular when compared with cereal crops of commercial importance, he observes. "Even though there are some 20,000 species of legumes, only 20 different types of legumes come to our daily diet for consumption," says Dr Mohanty.

http://www.downtoearth.org.in

JAPAN

Drought resistant, higher yielding GM rice

Scientists at the RIKEN Center for Sustainable Resource Science have developed strains of rice that are resistant to drought in real-world situations. Published in *Plant Biotechnology Journal*, the study reports that transgenic rice modified with a gene from the *Arabidopsis* plant yield more rice than unmodified rice when subjected to stress brought by natural drought.

In previous work, RIKEN scientists showed that *Arabidopsis* plants express the *AtGolS2* gene in response to drought and salinity stress. For this study, they created several lines of transgenic Brazilian and African rice that over-express this gene, and with their collaborators, tested how well the rice grew in different conditions in different years.

When might we see this useful rice on the market? According to [RIKEN scientist Fuminori] Takahashi, the greatest barrier to commercial availability is that they used genetically modified (GM) technology to generate the *GolS2* transgenic rice. "Now, we have begun our next collaborative project, in which we will generate useful rice without GM technology. It might take 5–10 years to reach our goal, but we must keep pressing forward because droughts and climate change might get worse in the future."

https://geneticliteracyproject.org

REPUBLIC OF KOREA

Technology to control protein therapeutics

Republic of Korean researchers have developed a technology, which leads protein therapeutics to tumor cells safely and accurately by using lights, to treat cancer. The Korea Advanced Institute of Science and Technology (KAIST) announced on August 9 that its research team led by Choi Chul-hee and Jeong Kyung-sun, professors of the Department of Bio and Brain Engineering, developed such a new technology and released it in the online version of *Nature Communications*, a renowned international scientific journal, on July 22.

The research team used proteins CRY2 and CIBN that stick to each other when blue lights with a wavelength of 450 to 490 nanometers were illuminated on them. It combined protein therapeutics with CRY2

and exosome, a nanoparticle which is used to deliver protein between cells, with CIBN, and then shoot the blue lights with the wavelength of 450 to 490 nm. In this case, protein therapeutics and exosome mingle together as CRY2 and CIBM combine together. In short, it is like guiding customers, or protein therapeutics, who head to the destination of tumor cells with lights, and helping them to get on the bus, or exosome, to the destination.

The traditional way is to inject protein, which is refined the outside of cells, into exosome. However, the new technology can reduce costs and time as it doesn't require a refining process. Moreover, it can increase the loading rate of protein therapeutics by more than 1,000 times, according to the KAIST. Unlike the traditional method, the new technology doesn't have to control the immune reaction to protein therapeutics and leads protein therapeutics to target cells.

In regard to the new technology, Professor Jeong said, "This is an innovative source technology which can mass produce safe and superior protein therapeutics." The technology has been transferred to Celex Life Science, a company founded by the KAIST, and the company is currently using it to optimize the manufacturing technology of exosome drugs.

http://www.businesskorea.co.kr

Stem cells to treat spinal cord injuries

A team of Republic of Korean researchers developed a new technology to produce customized stem cells that can be used in the treatment of severe diseases, such as a spinal cord injuries. A team led by professor Kim Jeong-beom of the Bio Science Division at the Ulsan Institute of Science and Technology (UNIST) announced on October 27 that his team successfully developed oligodendrocyte precursor cells (OPCs) by utilizing one particular gene.

An OPC is a spinal cord cell that is composed of myelin, a protective layer that surrounds spinal nerves. The use of this cell can regenerate myelin destroyed due to spinal cord injuries and finally lead to the treatment of damaged spinal cords. The research team attempted direct reprogramming with OPCs by injecting the gene Oct4 to skin cells, a core gene of a stem cell. Direct reprogramming differentiates a desired stem cell from skin cells. An OPC differentiated through this technology cannot turn into a cancer cell or a teratoma, since the OPC does not go through a pluripotent state where it can differentiate into all kinds of cells.

The research team directly proved its genetic stability and treatment effects by way of ten months of animal tests. "It took four years for us to publish our thesis after proving the characteristics of the cell and its treatment effects," Professor Kim said. "This means we developed a new cell production technology that overcomes the limitations of current OPC production methods," Professor Kim continued. "The go-ahead was given to the treatment of refractory diseases." These research results will lead to methods to treat patients with spinal cord injuries with the addition of bio 3D printing technology that produces biological tissues with a 3D printer.

"We will produce spinal cord tissues with a bio 3D printer and the produced OPC. The direct transplantation of the spinal tissues in damaged parts of patients will maximize the efficiency of spinal cord injuries," Kim added. "When the Ulsan Hospital for Industrial Disaster Victims opens, its technological commercialization will be possible. So this technology will contribute to treating and rehabilitating patients with injured spinal cords." The research results appeared in the online edition of the journal of the European Molecular Biology Organization (EMBO).

http://www.businesskorea.co.kr

SINGAPORE

DNA technology for infectious diseases, cancer

A more efficient DNA technology to detect and treat infectious diseases and cancer has been developed by Singapore researchers at the Institute of Bioengineering and Nanotechnology (IBN) of A*STAR, the agency said in a press release. The researchers improved on existing technologies to create a modified single-stranded DNA molecule called aptamer. DNA aptamers are ideal for pharmaceutical applications because they can specifically bind to any molecular target in the body such as proteins, viruses, bacteria and cells.

Once DNA aptamers are artificially generated for each target, they will bind to it and inhibit its activity. This makes DNA aptamers a promising technology for disease detection and drug delivery. But no DNA aptamers have been approved for clinical use yet because current aptamers do not bind well to molecular targets and are easily digested by enzymes. "To overcome these challenges, we have created a DNA aptamer with strong binding ability and stability with superior efficacy. We hope to use our DNA aptamers as the platform technology for diagnostics and new drug development," said IBN Executive Director Professor Jackie Y. Ying.

This study, led by IBN principal research scientist and team leader Dr Ichiro Hirao, was recently published in the journal *Scientific Reports*. To tackle the weak binding problem, the research team added a new artificial component called unnatural base to a standard DNA aptamer, which typically has four components. The addition of the fifth component greatly enhanced the binding ability to the molecular target by 100 times as compared to conventional DNA aptamers.

Furthermore, to prevent the aptamer from being digested easily by enzymes, a unique and small DNA called "mini-hairpin DNA" was added to the DNA aptamer." The mini-hairpin DNAs have an unusually stable and compact stem-loop structure, like a hairpin, of small DNA fragments. Their structure strongly resists the digestive enzymes, so I added them to specific positions on the DNA aptamer to act as a protective shield," Dr Hirao explained. "Usually DNAs are digested within one hour in blood at body temperature. With the mini-hairpin DNA, our DNA aptamers can survive for days instead of hours. This is important for pharmaceutical applications, which require the therapeutic to remain in

the body for a longer period." If successfully commercialized, DNA aptamers could replace or complement the existing use of antibodies in drugs for targeted disease treatment.

http://news.xinhuanet.com

EUROPE

DENMARK

New robust oilseed crop

Researchers have successfully developed a new oilseed crop that is much more resistant to heat, drought and diseases than oilseed rape. University of Copenhagen and the global player Bayer CropScience have successfully developed a new oilseed crop that is much more resistant to heat, drought and diseases than oilseed rape. The breakthrough is so big that it will feature as cover story of the April issue of *Nature Biotechnology*, a journal about biotechnology research.

Should the global warming continue, a golden rape field under the summer sun may soon become but a distant memory. Researchers have now developed a mustard crop with all the good properties of rape, but which, in addition, also is resistant to drought and heat.

Professor Barbara Ann Halkier, Head of DynaMo Center of Excellence, University of Copenhagen, is one of the scientists who has worked on developing a new oilseed crop with better properties. She explains:"Oilseed rape does not grow very well in warm and dry areas. We are very happy that we have succeeded in using a groundbreaking technology on a mustard plant, which is a close relative to rape. The result is an oilseed crop with improved agronomic traits that is tolerant to global warming. The new crop will enable cultivation in areas that today is not suitable for oilseed crops, such as the Western part of Canada, parts of Eastern Europe, Australia and India."

In close collaboration with Bayer CropScience – one of the major global players within plant biotechnology and breeding – she and other scientists from the DynaMo Center have found an original solution to this problem.The scientists from the DynaMo Center have invented a technology that can keep the bitter defense compounds out of the seeds while maintaining them in the rest of the plant so that the plant can defend itself against herbivores and pathogens.

The Danish scientists have shown that the technology works in a model plant, while scientists from Bayer CropScience have implemented the technology in the fields and performed large field trials with the optimized mustard plants.

https://www.sciencedaily.com

GERMANY

New malaria vaccine

University of Tübingen researchers in collaboration with the biotech company Sanaria Inc. have demonstrated in a clinical trial that a new vaccine for malaria called Sanaria® PfSPZ-CVac has been up to 100 percent effective when assessed at 10 weeks after last dose of vaccine. For the trial, Professor Peter Kremsner and Dr. Benjamin Mordmüller of the Institute of Tropical Medicine and the German Center for Infection Research (DZIF) used malaria parasites provided by Sanaria. The vaccine incorporated fully viable – not weakened or otherwise inactivated – malaria pathogens together with the medication to combat them. Their research results have been published in the latest edition of *Nature*.

The Tuebingen study involved 67 healthy adult test persons, none of whom had previously had malaria. The best immune response was shown in a group of nine test persons who received the highest dose of the vaccine three times at four-week intervals. At the end of the trial, all nine of these individuals had 100 percent protection from the disease.

"That protection was probably caused by specific T-lymphocytes and antibody responses to the parasites in the liver," Professor Peter Kremsner explained. The researchers analyzed the bodies' immune reactions and identified protein patterns which will make it possible to further improve malaria vaccines, Kremsner added.

The researchers injected live malaria parasites into the test subjects, at the same time preventing the development of the disease by adding chloroquine – which has been used to treat malaria for many years. This enabled the researchers to exploit the behavior of the parasites and the properties of chloroquine.

"By vaccinating with a live, fully active pathogen, it seems clear that we were able to set off a very strong immune response," said study leader Benjamin Mordmueller, "Additionally, all the data we have so far indicate that what we have here is relatively stable, long-lasting protection." In the group of test persons who demonstrated 100 percent protection after receiving a high dose three times, Mordmueller said, the protection was reliably still in place after ten weeks – and remained measurable for even longer. He added that the new vaccine showed no adverse effects on the test persons. The next step is to further test the vaccine's effectiveness over several years in a clinical study in Gabon funded by DZIF. Malaria is one of the biggest health threats in the African nation. The University of Tuebingen has worked with the Albert Schweitzer Hospital in the Gabonese town of Lambaréné and with the neighboring research institute, the Centre de RecherchesMédicales de Lambaréné, for many years.

https://www.sciencedaily.com

SPAIN

New virus to selectively attack tumor cells

Researchers from Barcelona have developed a new genetically engineered oncolytic virus, which can selectively infect and kill tumor cells. Eneko Villanueva and colleagues from the IDIBAPS Biomedical Research Institute and the Institute for Research in Biomedicine (IRB Barcelona) have engineered a virus that infects tumor cells without affecting healthy tissues. Their new cancer therapy approach is based on "oncolytic viruses", which can differentiate between cancer cells and normal cells based on the expression of so called CPEB proteins.

CPEB is a family of four RNA binding proteins that can control the expression of hundreds of genes by binding to their RNA. In cancer, the balance of different CPEB proteins is often disturbed, contributing to malignant gene expression of these cells. The researchers have shown that many cancer cells overexpress CPEB4, which seems to be necessary for tumor growth. On the other hand, the cancer cells loose the expression of CPEB1, which is highly expressed in normal tissues.

To make the viruses specific towards high CPEB4/low CPEB1, the researchers have inserted sequences into the genome of an adenovirus, which recognize CPEB proteins. With this strategy, they achieved attenuated viral activity in normal cells, while in tumor cells, the virus potency was maintained or even increased. Once the virus infects a cancer cell, it will destroy the cell and release even more viral particles. Oncolytic viruses make up a very promising therapeutic strategy and there are several biotechs developing such viruses for cancer therapy. Recently, Brystol-Myers Squibb signed a €850M ($886M) deal for the exclusive worldwide rights of NG-348, a next-generation oncolytic virus developed by PsiOxus. The virus is currently in preclinical development.

PsiOxus' lead viral candidate Enadenotucirev, which selectively kills cancer cells and at the same time triggers the immune system, is already in Phase I clinical trials. Amgen's IMLYGIC was the first oncolytic virus to be approved by the FDA in 2015 for the treatment of refractory melanoma. Although there are already some viruses in the pipeline, the new virus developed by the researchers in Barcelona may be a promising addition to this young and developing market.

http://labiotech.eu

UK

TB drug developed from soil bacteria

A new treatment for tuberculosis (TB) is set to be developed using compounds derived from bacteria that live in soil – according to an international collaboration of researchers, including the University of Warwick. The research partnership – involving the University of Warwick, and spanning institutions from Australia, Canada and the USA – has discovered a compound that could translate into a new drug lead for TB.

The group looked at soil bacteria compounds, known to effectively prevent other bacteria growing around them. Using synthetic chemistry, the researchers were able to recreate these compounds with structural variations, turning them into more potent chemical analogues.When tested in a containment laboratory, these analogues proved to be effective killers of *Mycobacterium tuberculosis* – the bacterium that causes TB. These chemicals target an enzyme in *Mycobacterium tuberculosis* called MraY, which catalyses a crucial step in building the cell wall around a bacterium. Attacking this part – a potential "Achilles' heel" of the bacterium – provided an essential pathway for the antibacterial compounds to attack and destroy TB strains.

Key reagents and expertise in antimicrobial resistance from the research groups of Dr David Roper, Professor Chris Dowson and Professor Tim Bugg at the University of Warwick played a crucial role in successfully targeting TB bacteria with the new compounds.

The research is published in *Nature Communications*.

https://www.sciencedaily.com

Increasing crop yields without genetic modification

A team of scientists has developed a chemical that increases the starch content of wheat crops. The new product could significantly increase wheat yields without the use of genetic modification. The details are in a paper that was just published in the journal *Nature*. Researchers from Oxford University and Rothamsted Research focused their attention on a molecule called trehalose-6-phosphate (T6P). T6P regulates the amount of sucrose used by plants. In wheat, this means that extra T6P would result in starchier wheat grains. The research team used this information to test a number of synthetic versions of T6P. The team developed a modified version of T6P that could be sprayed onto wheat plants. The plants would absorb the extra T6P, which would become active when the wheat was exposed to sunlight. This results in wheat grains with extra starch and could increase wheat crop yields by up to 20% after simple applications of the modified T6P. Furthermore, the modified chemical helped protect plants from drought stress, solving another major problem.

The team's findings show that a simple T6P spray, a modified version of a naturally occurring chemical, could improve wheat crop yields by up to 20%. The spray encourages the plant to produce more starch and also reduces drought-induced stress. The authors point out that T6P pathways are common in plants and their method could be adapted for use in other crops. This would significantly help the global food shortage while also providing a possible solution for the record droughts occurring throughout the world.

http://naturalsciencenews.com

New strains of staple crops

By developing enriched versions of staple crops, researchers aim to produce foods that can meet the nutritional requirements for a healthy diet. "We need sustainable agriculture to feed the growing population with adequate nutrients, besides just enough calories," said Dr Swati Puranik, of the Institute of Biological, Environmental and Rural Sciences at Aberystwyth University in the UK. She aims to develop calcium-rich finger millet – a staple for millions of people around the world, including some of the poorest in Asia and Africa. The hardy cereal grows in areas of low rainfall where many other grains would fail.

Using finger millet germplasm, Dr Puranik has identified more than a million genetic variations, known as single-nucleotide polymorphism markers, that she is assessing to see if they are linked with higher calcium content. She is also checking the markers for correlations with iron and zinc, as well as "antinutrient" compounds such as phytate and oxalate, which interfere with the body's absorption and use of micronutrients.

Where markers indicate higher levels of micronutrients, Dr Puranik and her col-

laborators in Kenya and India aim to use conventional genomics-based breeding to come up with varieties of finger millet that contain higher levels of calcium and vitamins, without using genetic engineering. She is also assessing if her research can help improve rice and wheat.

Vitamin and mineral supplements can help overcome dietary deficiencies, but Dr Puranik believes that improving nutrition right from the farmer's field may have the strongest impact. "Developing improved food crops has benefits for farmers and their families, both economic and nutritional," she said. "And ultimately these calcium-rich products should have an impact in lowering rates of osteoporosis and calcium malnutrition in children or pregnant and lactating women."

Her EU-funded project, CaMILLET, targets conventional breeding methods, but other research has shown the strong potential of genetic modification in improving the nutritional quality of food crops.

https://horizon-magazine.eu

NORTH AMERICA

USA

Chikungunya vaccine from virus

Researchers have developed the first vaccine for chikungunya fever made from an insect-specific virus that doesn't have any effect on people, making the vaccine safe and effective. The newly developed vaccine quickly produces a strong immune defense and completely protects mice and nonhuman primates from disease when exposed to the chikungunya virus.

Researchers from The University of Texas Medical Branch at Galveston have developed the first vaccine for chikungunya fever made from an insect-specific virus that doesn't have any effect on people, making the vaccine safe and effective. The newly developed vaccine quickly produces a strong immune defense and completely protects mice and nonhuman primates from disease when exposed to the chikungunya virus. The findings are detailed in *Nature Medicine*. "This vaccine offers efficient, safe and affordable protection against chikungunya and builds the foundation for using viruses that only infect insects to develop vaccines against other insect-borne diseases," said UTMB professor Scott Weaver, senior author of this paper.

The researchers used the Eilat virus as a vaccine platform since it only infects insects and has no impact on people. The UTMB researchers used an Eilat virus clone to design a hybrid virus-based vaccine containing chikungunya structural proteins. The Eilat/Chikungunya vaccine was found to be structurally identical to natural chikungunya virus. The difference is that although the hybrid virus replicates very well in mosquito cells, it cannot replicate in mammals.

Within four days of a single dose, the Eilat/Chikungunya candidate vaccine induced neutralizing antibodies that lasted for more than 290 days. The antibodies provided complete protection against chikungunya in two different mouse models. In nonhuman primates, Eilat/Chikungunya elicited rapid and robust immunity – there was neither evidence of the virus in the blood nor signs of illness such as fever after chikungunya virus infection.

https://www.sciencedaily.com

Scientists engineer sugarcane to produce biodiesel

A multi-institutional team led by the University of Illinois have proven sugarcane can be genetically engineered to produce oil in its leaves and stems for biodiesel production. Surprisingly, the modified sugarcane plants also produced more sugar, which could be used for ethanol production.The dual-purpose bioenergy crops are predicted to be more than five times profitable per acre than soybeans and two times more profitable than corn. More importantly, sugarcane can be grown on marginal land in the Gulf Coast region that does not support good corn or soybean yields.

Published in *Biocatalysis and Agricultural Biotechnology*, this paper analyzes the project's first genetically modified sugarcane varieties. Using a juicer, the researchers extracted about 90% of the sugar and 60% of the oil from the plant; the juice was fermented to produce ethanol and later treated with organic solvents to recover the oil. The team has patented the method used to separate the oil and sugar. "The oil composition is comparable to that obtained from other feedstocks like seaweed or algae that are being engineered to produce oil," said co-author Vijay Singh, Director of the Integrated Bioprocessing Research Laboratory at Illinois.

To date, PETROSS has engineered sugarcane with 13 percent oil, 8 percent of which is the oil that can be converted into biodiesel. According to the project's economic analyses, plants with just 5 percent oil would produce an extra 123 gallons of biodiesel per acre than soybeans and 350 more gallons of ethanol per acre than corn.

https://www.sciencedaily.com

Global Innovation Index 2017

The Global Innovation Index provides detailed metrics about the innovation performance of 127 countries and economies around the world. Its 81 indicators explore a broad vision of innovation, including political environment, education, infrastructure and business sophistication. This year's report reviews the state of innovation in agriculture and food systems across sectors and geographies.

For more information, access:

http://www.wipo.int

Big Data, Data Privacy and the Data Revolution

Challenges and Opportunities for Monitoring the Sustainable Development Goals

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Abstract

In the past two decades, our ways of doing things in both the private and public sectors have vastly changed, largely because of advances in information and communications technologies (ICT). The dynamic landscape has also affected the realm of data with a deluge of digital data (from satellite imagery to cell phone records to internet activity), known as Big Data, being collected. We describe here the potentials for generating information from Big Data to monitor the Sustainable Development Goals (SDGs). We also discuss issues of veracity and data privacy that complicate the use and examination of Big Data in the emerging Data Revolution, and their implications for monitoring progress in attaining the Sustainable Development Goals.

Introduction

"Data! Data! Data! 'I can't make bricks without clay." – Sherlock Holmes (The Adventure of the Copper Beeches by Sir Arthur Conan Doyle)

Across the world today, small- and medium-sized enterprises (SMEs) regularly generate databases on their daily business transactions, their customers, and even their employees. Large firms also collect market research data either directly or by subcontracting other organizations. Thus, managers are probably in full agreement with Sherlock Holmes that one cannot draw solid conclusions in the business world without data, in the same way one cannot build solid bricks without clay.

Likewise, in the public sector, vast amounts of data are collected for various purposes, and some of these collections are summarized to describe and manage socioeconomic conditions. Governments, through their national statistics offices, central banks, and line ministries, produce a substantial set of statistics either from primary data collections (such as censuses, sample surveys, administrative reporting systems) or compilations of secondary data. These official statistics are meant to provide a portrait of economic performance, the stability of the financial sector, labor market outcomes, social services (such as education and health), poverty and inequality, the environment, crime and security, costs of disasters, to name a few. Further, these government statistics describe results and outcomes regarding goals and aspirations espoused in national development plans, thus providing inputs to decision makers and stakeholders in policy discussions.

Monitoring of SDGs in the wake of the data revolution

At the global level, various statistics are likewise being produced by the United Nations Statistics Division and other international bodies together with governments to enable the generation of comparable statistics across countries. These statistics also serve to provide a picture of the extent to which we are attaining global goals and targets. For instance, there has been agreement to make use of 230 statistical indicators for monitoring the Sustainable Development Goals (SDGs). The SDGs consist of a set of 17 goals on ending poverty, hunger and inequality, acting on climate change and the environment, improving access to health and education, building strong institutions and partnerships, and more. In September 2015, 193 countries committed to attaining the SDGs by 2030. The SDGs have doubled the number of goals of its successor, the (8) Millennium Development Goals (MDGs); the SDGs are also supported by 169 targets (8 times more than the 21 MDG targets). The 230 SDG indicators are also nearly three times the 60 statistical indicators collected for global monitoring of the MDGs.

The Report of the High-Level Panel (HLP) of Eminent Persons initiated discussions on the SDGs (United Nations, 2013a) taking stock of the unfinished agenda from the MDGs, of the need to reach zero poverty, and of ensuring "Leaving No One Behind." Developing countries have started to craft roadmaps for statistics development, especially in the context of the data revolution that involves use of new technologies and techniques to yield more reliable data for informing policymakers and measuring the progress of societies (PARIS21, 2014).

Countries, governments and businesses are thus collecting more and more data, especially because of advancements in information and communications technologies (ICT) in the past two decades. We are swimming in an ocean of data with more and more data being more readily collected, stored, analyzed, shared, re-analyzed and re-shared. Desktops, laptops, tablets, mobile phones and other ICT gadgets, as well as the internet and social media (Facebook, Twitter, Instagram, YouTube, Dubsmash, Spotify, etc.), have provided us the means to transmit, store and exchange data much faster, whether in the form of sound, text,

visual images, signals or some other form or any combination of these forms.

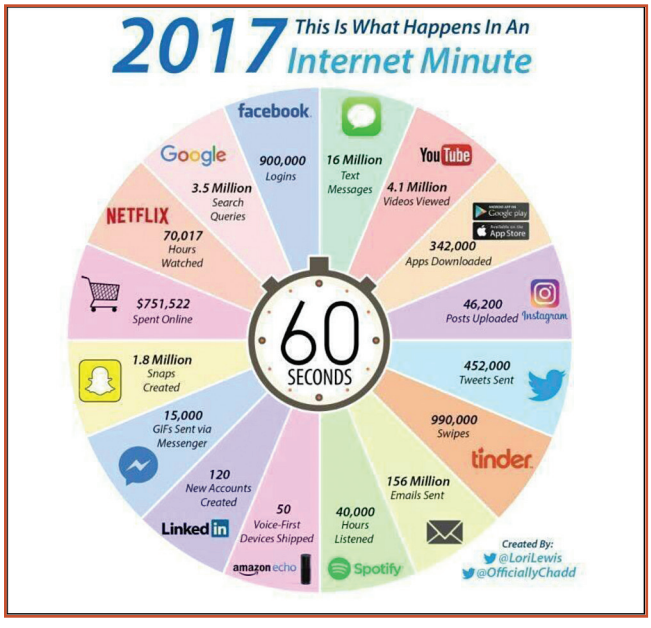
We are also amidst the beginnings of the Fourth Industrial Revolution that may further push the emerging Data Revolution to unknown frontiers. We are getting to use unmanned aerial vehicles called drones for various purposes from military applications to commercial, agricultural, recreational, and other applications. Some countries have not only developed weapons that can be readily unleashed with technology, but also begun testing the use of driverless cars on the roads. Some companies, such as Amazon, have already begun stores without cashiers, and some cities have started to use cars without drivers.

The Internet of Things (IOT) is unfolding with objects getting networked, everything linked with everything else, and things providing "feedback." It is no longer impossible to enter one's house with the living room lighting up on its own, adjusting to a temperature that we want, with the television opening automatically to our favorite TV show. Neither is it impossible to soon have a sofa buzz our phones to let us know that we have left our wallet behind; or have our refrigerator order our groceries online without us having to make a shopping list. All these conditions merely require putting intelligent chips in our TV, lights, air-conditioner, sofa, wallet and refrigerator to enable them to talk to the rest of the world. The IOT roughly means connecting any device with an 'on' and 'off' switch, and a chip to the internet (and/or to each other). This includes everything from cell phones, refrigerators, air conditioners, washing machines, cars, jet engines of an airplane, *etc.*

The analyst firm Gartner (2015) estimates that by 2020 there will be about 20.4 billion connected devices, which means for every person, there will be three devices connected to the internet by then. The relationship of connections from the IOT will be between people–people, people–things and things–things.

Big Data: What's it all about?

Together with the use of more and more new technologies, we have been creating and sharing an enormous amount of digital data, especially with more utilization across the world of smart phones, the internet, social media, sensors and other tools of ICT. In 2017 alone, in a span of minute, there have been 40,000 hours listened on Spotify, 900,000 Facebook logins, 452,000 tweets, 4.1 million videos viewed on YouTube and 3.5 million Google searches, and 156 million emails sent (Figure 1).



Source: https://bluesyemre.com/2017/03/21/this-is-what-happens-in-an-internet-minute-infographic/

Figure 1: Infographic on "What happens in an internet minute"

About one and a half decades ago, a study from UC Berkeley by Lyman and Varian (2003) that was supported by IBM, suggested that from the beginning of time until 2003, we were only able to create five exabytes (*i.e.,* five billion gigabytes) of data. Further, between two and three exabytes of that information was generated in 1999. Most of that data (about 92 per cent) was stored on magnetic media, primarily hard drives. Turek (2012) of IBM's Exascale Computing even suggested that in 2011, five exabytes were being created every two days; and that IBM predicted that by 2013, this amount of information would be created every 10 minutes.

Every time, we use our mobile phones, these gadgets send out their Global Positioning System (GPS) location, every time we use the internet and purchase something online, every time we click the Like button on Facebook, or upload photos on Instagram, or do a search on Google, we are essentially creating digital data. And this is only a part of the bigger picture: businesses, including SMEs, developing databases from their customer records, ATM transactions and their security camera videos and images.

Google has become a buzzword because of its search facility. Even students would probably be going less to their school library to seek out information, and would instead "Google" answers to their questions. When Google was founded close to two decades ago in September 1998, it was serving ten thousand search queries daily; a year after being launched, Google was already answering as much as 3.5 million search queries per day (Battelle, 2005). Internet Live Stats, a website that consolidates internet statistics from across several sources, estimates that today, Google processes globally over 4.17 billion searches per day, equivalent to 1.52 trillion searches per year.

In 2008, Google established a real-time flu tracker called "Google Flu Trends" by watching where people searched for terms relating to illness and mapping that data with the US Center for Disease Control (CDC). An article in *Nature* (Ginsburg *et al.,* 2009) reported

that flu incidence estimate from Google correlates strongly with the official statistics released by the CDC (Figure 2). What was astonishing here was that while the Google statistics on flu incidence were aggregates with a delay of just one day, official statistics from the CDC took a week to put together based on administrative reports from hospitals. What was also astounding was that the flu tracker was quick, accurate, and cheap to generate, while official statistics were not as timely and involved huge costs.

Currently, Google is engaged in an experiment to work on the same idea for the Flu Trends, but now for Dengue, and there are also indications of success at least for Brazil. Flu trends have also been similarly examined by other researchers using other Big Data sources. For instance, Paul and Dredze (2011) considered monitoring the incidence of flu (as measured by the CDC) with total tweets per week between mid-August 2009 and October 2010, and noticed a similar correlation of tweets with the influenza rate in the United States, just like the Google Flu Trends.

This deluge of digital data from making use of electronic devices (smart phones, tablets, laptops), social media, search engines, as well as sensors and tracking devices (including climate sensors and GPS) is referred to as Big Data, although there is no consensus on a definition of Big Data. This buzzword in business, technology and science has taken over the hype from another buzzword "Data Mining." The term Big Data is characterized by 3Vs: (high) volume, velocity and variety. A fourth V, veracity, has also emerged and will be explained in later portions of this paper. In summary, we have a huge amount of data from use of ICT tools at fast speed of availability, storing, sharing and processing. Further, we have many types of data, whether in text, sound, visual images, signals or any other form or any combination of these forms.

Across both the private and public sectors, more and more data are being collected and stored. For instance, firms in the business process outsourcing (BPO) sectors in developing countries such as the Philippines and India are also collecting cross-border transactions and information on clients. Firms, especially big businesses, have begun to examine their growing databases to gain insights about customer preferences based on Big Data analytics. For instance, Amazon periodically examines their customer database to inform clients that "customers who bought Product A also bought Product B, Product C or Product D …" based on predictive modeling association rules and collaborative filtering. In call centers, recorded conversations may allow not only the recording but a real-time analysis of what customers say that will enable call center agents to determine their best responses to clients through "text" analysis. Social media data, such as tweets on Twitter, are likewise examined through text analysis in terms of "polarity" (*i.e.,* positive, negative or neutral) of expressed sentiments on a product, such as a movie, or a political candidate. Google has also examined web searches and found a strong correlation of search with actual sales (of cars), among other statistics (Choi and Varian, 2009).

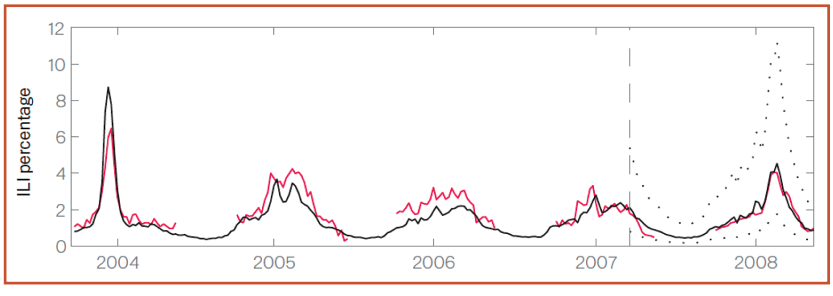
Analytics on Big Data for development needs

Big Data applications have gone beyond the realms of business into development issues, especially those involving humanitarian purposes. For instance, in the aftermath of the Haitian earthquake, Project Flowminder was conducted to essentially predict population movements to prevent cholera outbreaks using digital data. The project researchers gained access through mobile phone companies regarding the location of mobile phones as transmitted by SIM (Subscriber Identity Module) cards to the cell towers. Using 1.9 million signals from 42 days before the Haiti earthquake and 158 days after the earthquake, Bengtsson et al. (2011) used the number of signals to extrapolate to the number of people moving out of the Haiti capital Port-au-Prince, who would be potentially bringing cholera with them to the places where they move to. The data on population movements would then be able to identify areas outside Port-au-Prince at risk of cholera outbreaks because of the outmigration in the wake of the disaster. The results of Bengtsson *et al.'s* (2011) study were validated with information from Haiti's National Civil Protection Agency (which counted buses and ships leaving the affected area), and with a sample survey of households conducted by the United Nations Population Fund.

Lu *et al*. (2012) conducted a follow-up study of movements of the Haiti population in the aftermath of the earthquake, and discovered that the place where people went outside the capital during the first three weeks after the earthquake were correlated with the locations to which they had significant social bonds. In consequence, population movements in the aftermath of a disaster may be significantly more predictable than was previously understood.

Several Big Data applications on disease mapping have also been conducted outside of the context of natural disasters, including malaria mapping in Kenya (Wesolowski *et al.,* 2012), and on controlling the spread of the H1N1 virus in Mexico (Frias-Martinez *et al.,* 2011).

There has been much interest in disease mapping to particularly look at vulner-



Source: Ginsberg et al. (2009).

Figure 2: Model estimates of Influenza-like illness (ILI) incidence from Google flu trends in the mid-Atlantic region in US (in red) vs Official estimates in percentages (in black) from the US Center for Disease Control (CDC)

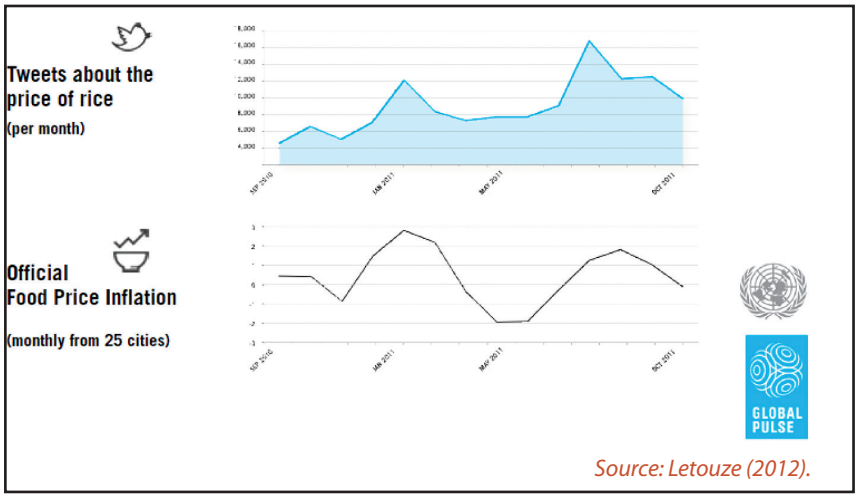
able segments of society, and find ways of improving their resilience to shocks. Governments and the development community has also been monitoring poverty conditions traditionally through an examination of results of household surveys on living conditions that collect data on income, expenditure or other nonmonetary indicators of welfare. However, in small areas, such as districts, cities or villages, there are sparse poverty data as household surveys are designed to get aggregate pictures at national or regional levels. While work has been conducted on performing regression models on survey data to predict welfare conditions of households, and on applying these regressions to census data to yield estimates of poverty status of households in a census, this has been computer intensive, and requires results from rather infrequently collected censuses.

A rather promising approach to developing data on poverty incidence at small areas in real time involves the use of call detail records (CDRs) as well as information on mobile customer behavior (to proxy poverty status of mobile users). This was tried out in Côte d'Ivoire (Smith *et al.,* 2013). Since the 1990s, no full survey of the country's population has been published owing to the civil war that Côte d'Ivoire came out of. Smith *et al*. (2013) used anonymized CDRs of five million telecommunications customers between December 2011 and April 2012 to assess the level of activity among both subscribers and the locations where subscriber calls were made. Higher levels of mobile communication, expenses for top-ups and a wider range of calls are used to proxy welfare of mobile users. Using these mobile data, poverty incidence across 11 regions of Côte d'Ivoire were quantified, and the results were validated with a multidimensional poverty index created by University of Oxford, which uses indicators such as poor health, lack of education, inadequate living standard and threat from violence among other factors.

Aside from poverty mapping, various researches have also been conducted to find socioeconomic indicators in the UK (Eagle *et al.,* 2010) and in Latin America (Soto *et al.,* 2011). Anonymized credit card and cell phone data have also been utilized to describe patterns of women's expenditure and mobility in a major Latin American metropolis (Data2X, 2017). Further, satellite imagery has also been used to improve the spatial resolution of existing data on girls' stunting, women's literacy, and access to modern contraception in several developing countries, viz., Bangladesh, Haiti, Kenya, Nigeria and Tanzania (Data2X, 2017). Studying transportation networks have also been looked by way of monitoring people's travel routes (Berlingerio *et al.,* 2013) using mobile data. The possibilities of examining population movement, especially the most devastated during a natural disaster, with digital traces from mobile phone usage as has been done in other countries would also be important to explore as a means of providing quick assistance to those who need assistance the most.

Aside from phone usage, social media use has also been examined. Letouze (2012) described work at the UN Global Pulse, specifically in its Pulse Laboratory in Jakarta, where some promising research has been undertaken relating tweets about rice and other basic food commodities on Twitter with official food price inflation from 25 cities in Indonesia (Figure 3).

Legara (2015) assesses Twitter use in the Philippines; tweets are found to correlate with population density, as well as with the economic performance of regions, as measured by the Gross Regional Domestic Product (Figure 4). Further, twitter usage, particularly in Metro Manila, provides a proxy of road networks in the region (Figure 5). This suggests how Big Data can give promising insights on traffic flow that could lead to some interventions to ease problems in Metro Manila. What deserves some extra research attention would be whether current popular apps used in smartphone such as Waze, and data on people's movements as reflected in sensors can provide information on traffic mobility or traffic flow problems that could serve as insights for intervention, especially during regular peak traffic hours in bustling cities. World Bank Philippines, together with three ride sharing companies, viz., Easy Taxi, Grab, and Le.Taxi, have started this by making traffic data derived from the GPS streams of drivers of these ridesharing companies available to public through an open data license (World Bank, 2015).



Source: Letouze (2012).

Figure 3: Tweets on rice, chillies, fish, sugar, corn, cooking oils per month versus official food price inflation

Issues on the use of Big Data

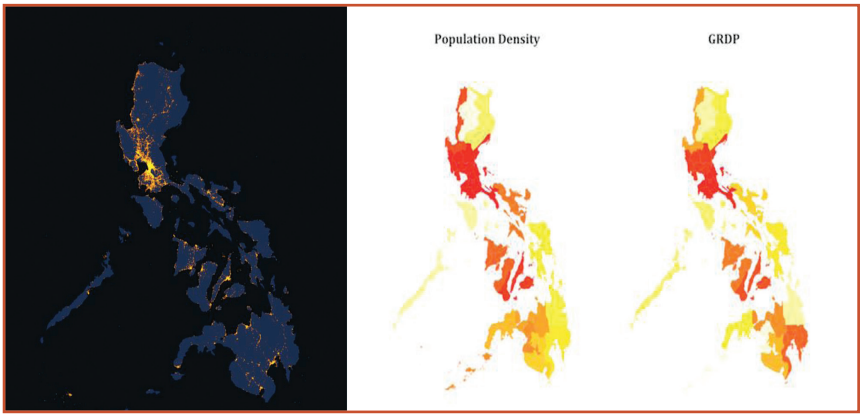
While there may be much promise in getting information from Big Data sources, there are also a host of issues about conducting research and analytics on Big Data, how much promise it offers, and how it needs to be communicated (to maximize the information leverage). The reliability of Big Data will partly depend on whether information from internet users can proxy for information of the larger population. Further, Big Data holdings are typically in the hands of private corporations who

do not necessarily make this tsunami of data available for research. If they do make this available, it will either be for a cost, and those that are publicly available are a minute portion of the actual data. For instance, only a very small subsample of twitter data is available publicly for free, and there may be questions on whether the sample made available by twitter is representative. Issues of availability for exploration of the use of Big Data can create new digital divides (Fan and Bifet, 2012).

Another issue about Big Data is the issue of data privacy. We should be aware that ecommerce sites are watching our shopping preferences; search engines are being used to examine our browsing habits; social media sites are utilized to inspect our personal data, including our social relationships and what we share; and mobile service providers are collecting data on who we talk with, or send text messages to, and possibly what we communicate to them. When we started making use of Google years ago, did we ever get to think that Google would get to make use of our search behavior to monitor the flu? When mobile users in various countries began using their mobiles, were they aware that "Big Brother" would be watching over them? In other words, did we have a "Notice and Consent" for making use of information we provide, and even if we did, did we agree to future uses? While there may be scope for justifying the monitoring of peoples' movements for humanitarian purposes, including disease mapping, but clearly there is a need to examine issues of privacy as there is a strong risk for abuse, a potential for harming people.

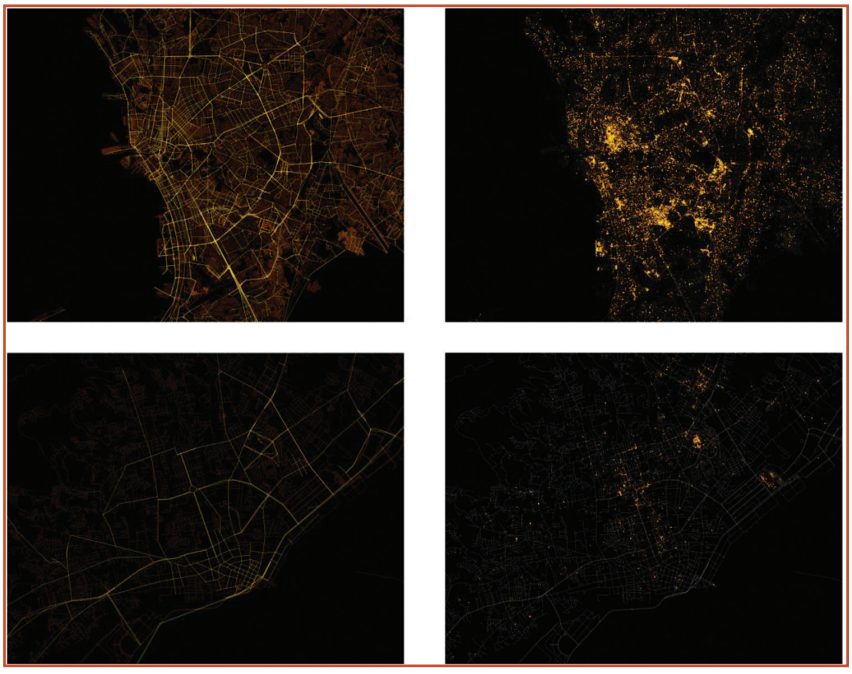
Privacy is a bedrock of human dignity and one of the fundamental human rights recognized in the UN Declaration of Human Rights. It can be thought of in terms of data protection, and thus interpreted in terms of the management of personal information, i.e., the ability of individuals to determine who holds information about them and how is that information used (United Nations, 2013b).

While there are currently various mechanisms to protect privacy, including asking people to opt out of studying the information they give, and anonymization



Source: http://erikafille.ph/2015/09/10/urbanism-in-the-philippines/

Figure 4: Geo-tagged twitter data in the Philippines vis-à-vis population density and 2014 Gross Regional Domestic Product (GRDP)



Source: http://erikafille.ph/2015/09/10/urbanism-in-the-philippines/

Figure 5: Geo-tagged twitter data in Metro Manila vis-à-vis road network

methods, such as differential privacy and "space time boxes", but these methods are not fool proof. Even when we anonymize, there is potential to re-identify. Ultimately, there will be a need to build institutional capacities to protect data privacy and to minimize risks for data breaches.

Some global firms such as MasterCard work on their huge data holdings by anonymizing their client records before conducting data mining, *i.e.,* statistical analysis on these databases. Other firms not only have specific people accountable on data privacy, but also have data philanthropists who are tasked to work on making data available for public benefit but guarding privacy. This involves having anonymized databases available for analytics to researchers, particularly for development purposes, such as to exam-

ine population movements in the wake of natural disasters, to track epidemics, and to relieve traffic congestion.

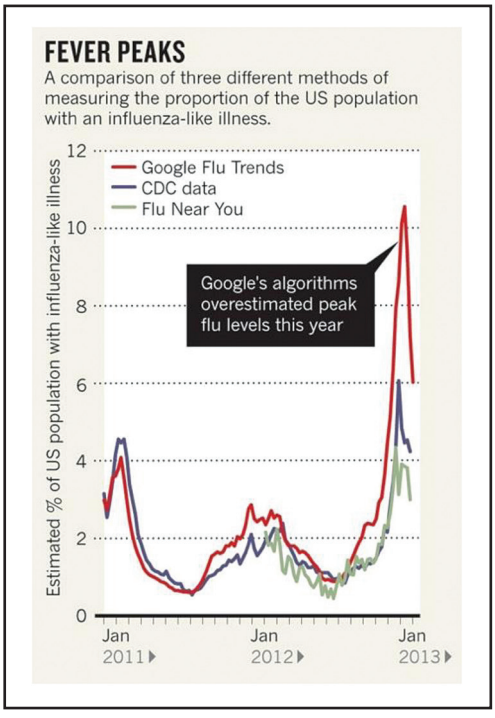
The deluge of data being generated from searches, from mobile phone usage, from customer databases provides many benefits to consumers but they include very precise, geo-location-based personal information, which pushes boundary of confidentiality/privacy. There are legal issues on privacy, and thus several countries have developed legislation on privacy. Typically, these legislations on privacy seek to protect the fundamental human right of privacy while ensuring free flow of information to promote innovation and growth. These laws impose strict restrictions on the use of such information by third parties to ensure individual's privacy.

To what extent telcos are employing insights in the huge databases they collect rather than sharing individual information such as contact numbers to other firms (the latter of which is a violation of privacy) is unknown. Currently, private firms especially in countries without privacy laws are merely policing themselves, until such time that a fully functional regulator on data privacy is performing its mandate, or a law is in place. Even in the public sector, there appears to be a lack of seriousness in dealing with the issue of data privacy and network security to protect data holdings. Consider the case of the data hack of records of voters at the Philippines' Commission on Elections (COMELEC) last March 2016. According to security researcher Troy Hunt (2016), the COMELEC data hack comprises 76GB worth of compressed files that expands out to 338GB. The database contains 55 million records of voters with as many as 228,605 email addresses, information on sex, marital status, place of birth, current address, profession, phone number, heights, weights, taxpayer identification number, parents' names of voters, fingerprint data (taken during the time of biometrics) of voters and in the case of 1.3M overseas voters, their passport numbers. This should be a cause for concern as the leaked voter data can be combined with other data holdings from bank accounts, credit cards and consumer transactions thus possibly harming people with identity theft. High-profile personalities are also more vulnerable to surveillance, intrusion and crime, given their exposure of sensitive personal information such as their current residence. Data privacy ultimately has legal, technological and ethical issues. In this data breach, for instance, the public will need to be provided guidance on remedies to their vulnerabilities because of the data breach. Further, COMELEC officials need to be held accountable for the data hack. Last January 25, 2017, the Philippine National Privacy Commission found the COMELEC head criminally liable for the data breach.

Big Data is also burdened with methodological challenges regarding veracity and reliability. An article in *Nature* (Butler, 2013) reports on the discrepancy between the Google Virus Trends estimate of flu levels in the United States and the official estimate from the CDC (11% versus 6%) in January 2013 (Figure 6). While there is no assurance that the CDC estimate is accurate, the divergence between these two estimates needs further investigation.

A study of Twitter and Foursquare data before, during and in aftermath of Hurricane Sandy (Grinberg *et al.,* 2013) reveals that the greatest number of tweets about Hurricane Sandy came from Manhattan, which created an impression that Manhattan was the most badly hit by Hurricane Sandy, when, in fact, it was not. More recently, many have been examining digital conversations on Twitter and Facebook, and internet searches, and have noticed that some candidates have been getting more interest (whether positive or negative), but that some of the spikes may be the result of bots, *i.e.,* web or internet robots or software applications that run automated tasks (such as scripts, including tweets) over the internet.

A lot of political noise can also be observed in social media. Thinking Machines Data Science (2016) examines a dataset of 116,071 tweets about the Philippine presidential candidates over the period between October 26 and November 25, 2015. The examination shows how the work of a bot artificially inflated the frequency of tweets of one candidate, thus suggesting that with volume of internet conversations is a long way from accurately measuring popularity of candidates: "When it comes to evaluat-



Source: Butler (2013)

Figure 6: Discrepancy in Google flu trends estimates in January 2013 with Official CDC estimates of influenza-like illness incidence

ing a candidate's popularity based on their Twitter buzz, perhaps quality should matter more than quantity this election season." This is similarly pointed out by Silver (2015) in his book "The Signal and the Noise" when he says that more data need not mean better data: "If the quantity of information is increasing by 2.5 quintillion bytes per day, the amount of useful information almost certainly isn't. Most of it is just noise, and the noise is increasing faster than the signal."

Conclusions and ways forward

Digital technologies have helped to overcome information barriers. We now live in a world with more data, but the more data we have, the more likely that we will also have false confidence in data. Ultimately, in utilizing Big Data, it will be important to find ways of ensuing veracity, the fourth V of Big Data. There ought to be ways to filter out the noise, and assure the quality of information. Big Data may be quick and cheap, but it can be false and dirty.

While the data revolution continues to unfold, the challenge is to explore how to make use of nontraditional data sources, such as Big Data, to complement traditional data sources for obtaining statistics for development purposes such as monitoring the SDGs. There is, however, also a need to identify legal protocols and institutional arrangements to access Big Data holdings for development purposes.

Issues on privacy, security, intellectual property, accessibility for development purposes, and accountability must be addressed to prevent the misuse of Big Data. While Big Data analytics can be used to examine development issues as well as help businesses know their customers better, the right to privacy is an ethical issue that should not be overlooked. Even after legal issues on privacy have been resolved, investments on capacity building would also be needed to harness Big Data and train analysts on ethical use of data, and for protocols to be provided for deciphering truth from falsehood. This way, statistics (from Big Data as well as traditional data sources) can be used to create wealth and opportunities, and to effect better development outcomes for everyone.

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Fight Against Neglected Tropical Diseases, Malaria and TB

WIPO Re:Search has launched a new five-year roadmap to guide its activities in the fight against neglected tropical diseases, malaria and tuberculosis. The World Intellectual Property Organization (WIPO) and its partner BIO Ventures for Global Health (BVGH) established the initiative in 2011 to boost the use of intellectual property in catalyzing innovation and product development for ailments affecting more than 1 billion people. WIPO Re:Search now includes 126 members in 35 countries and has established 112 collaborations across the globe. The new plan will guide the public-private consortium's activities through 2021 and includes new research, capacity building and outreach efforts.

WIPO Re:Search allows organizations to share their intellectual property, compounds, expertise, facilities and know-how royalty-free with qualified researchers worldwide. The new strategic plan seeks to ensure that WIPO Re:Search harnesses new research and development trends in global health, while contributing to the achievement of the United Nations Sustainable Development Goals.

For more information, access:

http://www.wipo.int/research/en/

Enhancing science, technology and innovation capacity to meet the sustainable development goals

Envisioning R&D-based innovation policy in Indonesia

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Abstract

This policy paper reveals expectations and lessons from future possibilities for R&D-based innovation in Indonesia, specifically the continued weakening attention and confidence of the industrial sector on the needs of innovation based on R&D. A variety of efforts to spur R&D-based innovation in the public and private sectors have long been introduced in Indonesia. These efforts were supposed to be relevant to and suitable for addressing the emerging issues in the past. However, at present and for the future, the efforts required to spur R&D-based innovation are different; rather than government-pushed innovation, innovation motivated by industry needs is more necessary. The policy messages for policymakers on STI in Indonesia should (i) facilitate global markets penetration for the industrial innovative products; (ii) provide incentive in tax deduction by 100% or more of R&D spending; (iii) facilitate researcher mobility between government R&D institutes and industry; (iv) support effective governance of R&D productivity; and (v) and coordinate a consortium of strategic innovation.

Introduction

Indonesia is categorized as a low–R&D country (LRDC) in terms of R&D expenditure as a percentage of GDP (Aminullah, 2015a). Generally, the countries that have greater R&D intensity tend to be developed countries. Some developing countries (including Indonesia) show impressive economic performance in the face of very little R&D or much informal learning (Oyelara-Oyeyinka and Rasiah, 2009). High economic prosperity with low R&D intensity is an uneven phenomenon in the world. High economic prosperity coinciding with a high-technology dependence society would create unstable and unhealthy economic growth in the long run (Aminullah, 2015a). Some former developing countries in the Asia-Pacific, such as Republic of Korea and Taiwan province of China, and now followed by China and India, have risen to become the control centers of operation in global production networks (GPN), especially in information and communication technology (ICT), and currently moving to become the headquarters of global innovation networks (GIN); (De Prato et al., 2013). The rise of some developing countries in global innovation networks was driven by blending between upgrading through learning and substantially increasing R&D intensity (Ernst, 2006).

A theoretical reason for Indonesia to raise its R&D intensity is its need to catch up with the players of GPN and GIN. But an important reason for Indonesia to raise R&D intensity is to meet the sustainable development goals (SDGs) by enhancing science, technology and innovation (STI) capacity. As we all understand, STI capacity building is about building scientist and engineer competency, physical technological infrastructure, entrepreneurial and managerial capacity, and scientific knowledge accumulation through R&D to solve the country's pressing social and economic problems, transform their societies, and positively impact the standards of living and quality of life (Watkins and Ehst, 2008). By raising R&D intensity, Indonesia's capacity to apply STI for domestic problem solving would increase, especially in addressing problems regarding basic needs including clean water, food availability, electricity supply, healthcare and medicine availability, etc.

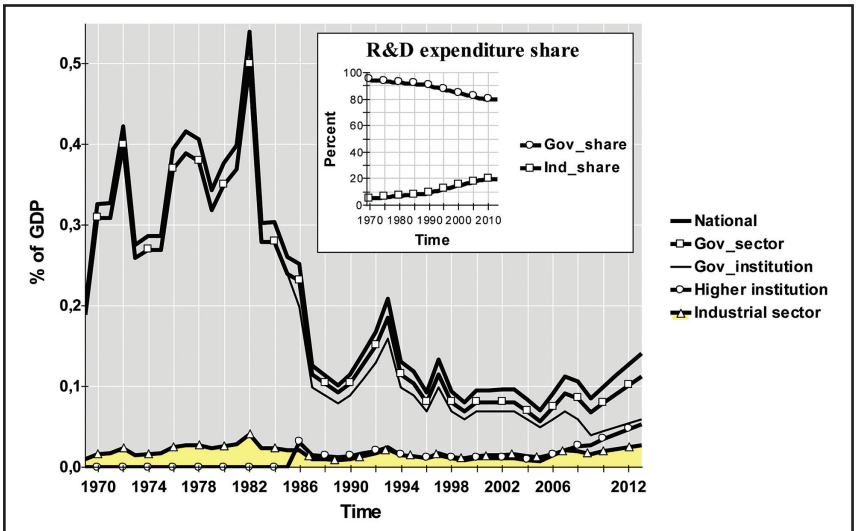
Even though Indonesia started building its STI capacity by accessing, utilizing, and improving knowledge and technology in the 1970s, it has not yet fully succeeded in capturing the benefit of S&T in fulfilling societal needs and increasing citizen welfare. Indonesia has shown a gradual improvement in almost all STI building indicators, except scientific knowledge accumulation through R&D. The Indonesian industrial sector largely consists of the low- and medium-technology manufacturing and natural resources-based industries, which were able to engage in innovation without formal R&D. This is one explanation on why Indonesia has practiced in a way that has maintained its low R&D intensity in the last 30 years.

Innovation with low R&D activity in the private industrial sector has occurred for a long time, from mid 1980s to the present. This demonstrates that the STI policy framework being implemented by Indonesian government has not been able to gain the attention and confidence of the industrial sector regarding the need for innovation based on R&D activities. Certainly, the industrial sector as a driver of industrialization has contributed to the Indonesian economic progress. But industrialization should be visible in the accumulation of knowledge and technology that is acquired through R&D-based learning and innovation. Thus far, this almost has not materialized in the industrialization of Indonesia.

Low R&D activity

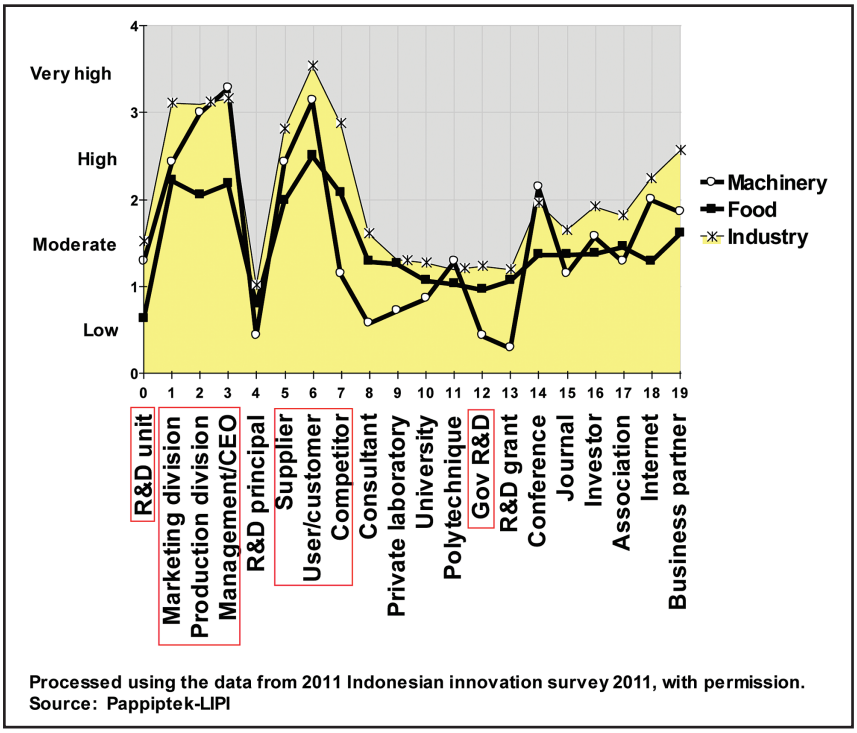
Statistical evidence

The statistical evidence shows that Indonesia has practices that has maintained its status as an LRDC for a long time (Figure 1).The declining expenditure on R&D in the Indonesian economy can be seen from the steadily falling national R&D intensity: from 0.54% in 1982 to around 0.14% of GDP in 2013. Expenditure on industrial R&D only made up around 0.028% of GDP, or around 20% of overall national R&D in 2013. While total government R&D expenditure (excluding R&D expenditure in higher education) was around 0.067% of GDP in 2013, comprising up to 80% of national R&D activity, it has little meaning due to the fact that it rarely produced commercial innovation. The Indonesian economy continued to grow though its national R&D intensity continued to decline. For the period of 1990–2010, GDP rose by thirty times at nominal value and grew consistently at 7% per year before the 1997 Asian financial crisis, then at 5% per year after. On the other hand, national R&D expenditure rose by 16 times, but R&D intensity declined from 0.13% in 1990 to 0.09% of GDP in 2010 (Aminullah, 2012).



Data and estimation based on Indonesian science and technology indicators.
Source: Pappiptek-LIPI (2013, 2011, 2007,2006)

Figure 1: Trends in Indonesian R&D activities (1969–2013)



Processed using the data from 2011 Indonesian innovation survey 2011, with permission.
Source: Pappiptek-LIPI

Figure 2: Sources of innovation in the Indonesian manufacturing industry (2011)

Based on data from the 2011 Indonesian innovation survey, 61% of industries engaged in product, process, organizational, and marketing innovations (Pappiptek-LIPI, 2013). Among these firms, around 52% innovate not by engaging in formal R&D activities, but through non-R&D and informal R&D innovations. The sources of information frequently used by industry to innovate are external sources (supplier, user/customer, and competitor), internal sources (marketing, production, management, business partner) and other sources such as the internet and conferences. The role of R&D units is less influential as a source of innovation for industry. Similar patterns of innovation without formal R&D playing a dominant role also exist in the machinery and food sectors. The machinery sector is a more frequent user of the aforementioned sources of innovation, while the food sector is likelier to utilize institutional sources of innovation such as private laboratories, universities and government R&D institutions (Figure 2).

The private industrial sectors mostly generated innovation through learning, without formal R&D. This is related to the low-skilled labor force in the economy, especially in the industrial sector. The labor forces in the industrial sector are mostly graduates of junior high school or lower, followed by general school and vocational

school graduates. Very few university graduates work in the industrial sector. Aminullah et al. (2016b) examined that the low capacity of human resources in the industrial sector is in line with the dominant industrial output, i.e. low technology products, such as recycling, wood, pulp, paper and paper products, printing and publishing, food products, beverages and tobacco, textiles, textile products, leather, and footwear. With the exception of the period of 2009–2012, there was a decrease in the share of low-tech industries as they were substituted by the increase of medium- to low-tech industries, such as building and repairing of ships and boats, rubber and plastic products, coke, refined petroleum products and nuclear fuel, and other non-metallic mineral products.

Case studies

(i) *Innovation in capital goods firms*

Product innovations in Indonesian capital goods firms are conducted with the aim to improve existing machinery products. Informal learning without conducting formal R&D activity generally results in the creation of minor innovations, which are usually "new to the firm" innovations, rather than "new to the market". Innovation is stimulated by the limited cooperative arrangements made between producer, supplier and consultant. The user–producer interactions are in the form of exchanges in goods and information as well as cooperation to stimulate innovation. Some cases of upgrading machines and related technologies in capital goods firms are as follows: (i) co-development of new machines through user–producer interaction, *i.e.* the modification of Fluidized Bed Combustion technique; (ii) collaboration between users and producers in upgrading or customizing standard machines, *i.e.* supplying control panel; and (iii) development of new machines, equipment and tools, *i.e.* development of Nozzle Air Distributor, power plant, passenger boarding bridge, and medical device (USG). The main driver of technological learning in capital goods firms is vision, as determined by top management (Aminullah et al., 2014).

(ii) *Innovation in natural resource-based firms*

Some natural resource-based firms have conducted product innovation as driven by the internationalization of production network through Outward Foreign Direct Investment (OFDI). The natural resource-based multinational enterprises (MNEs) are in the areas of foods and natural cosmetics. The MNEs have developed their own knowledge capability and then transferred and adapted the knowledge to host countries. The firms conduct product innovation with R&D activity, either with intramural or extramural R&D. One large food firm does not have its own R&D facilities and generally conducts product innovation through extramural R&D by collaborating with other innovation sources, such as universities and research institutions. The food firm provides full R&D financing and buys the intellectual property for the product innovation conducted by universities. Another food firm has invested in an R&D facility and allocated intramural R&D financing for developing new product innovations. Meanwhile, a natural cosmetic firm grew from a small firm to a large firm, then expanded into an MNE by developing various product innovations through internal R&D activity (Aminullah et al., 2013).

(iii) *Innovation in bio-based chemical firms*

Bio-based chemical firms acquire, develop, and accumulate knowledge and technology through interactive learning among R&D, production and marketing units within the firms, as well as through interactions with external sources of knowledge (universities, research institution, suppliers and users). The large-scale firms acquire knowledge through R&D activities, monitoring of scientific advancement and technology spillover, but the small firms gain knowledge and technology through learning by DUI (doing, using, and interacting) in their small laboratory. The bio-based chemical firms develop technology by conducting R&D activities to solve negative environmental impact, find effective pest control and improve soil fertility, as well as to meet standards for the safety and security of bio-based chemical products. Encouraging the chemical firms to interact with public R&D institutions and universities is important to promote technological innovation through R&D. Enabling factors for bio-based chemical products innovation are the availability of scientists and researchers in universities to collaborate in research with firms' R&D units (Aminullah et al., 2015).

Conditions and consequences

(i) *Conditions*

There are three conditions related to low R&D intensity in Indonesia, namely: (i) a large portion of low and medium technology (LMT) industry in industrial sectors; (ii) the lack of government attention; and (iii) the very low share of private R&D intensity. Such a low R&D intensity has kept Indonesia "on the defense", producing low-end products in the economy, as shown by the large portion taken up by the LMT industry in industrial sectors (Aminullah, 2011, 2012).

First, the Indonesian industrial sector is generally dominated by the LMT industry. This industry produces low-technology products that do not require R&D facilities. In the period of 1998–2007, approximately 60–65% of industries produced low-technology products, such as food products, beverages, shoes, textile products and articles of textiles, leather and leather articles, wood and paper products, rubber and plastic articles, metal, and metal goods. Around 20–25% of industries produced medium-technology products, with only a small portion performing R&D activity, and with low intensity. Parts of the medium-technology industries, such as some in the automotive industry, did not even perform their own R&D to source innovation because their R&D activities were generally performed by their parent companies abroad.

Second, Government's attention towards the development of S&T has consistently decreased since 1990s. In the 1980s, the S&T budget was about 2.5% of the total government budget, dropping to around 0.5% in the 1990s; the S&T budget then remained at approximately 0.5% of the total government budget in the 2000s. The continuous decline in the

ever-low S&T budget, parallel to positive economic growth, seems to be atypical phenomenon in Indonesia. For comparison, in China, high attention given to S&T was paired with high economic growth, with the S&T budget amounting to 4–5% of the total government budget over the last 30 years (Kou, 2010).

Third, the private sector is generally less interested in reinvesting their production yields into R&D activity. Aminullah (2012) showed that in the period of 1990–2013, the increase of production did not affect the increase of R&D intensity. The objective of investments in the private sector is normally productivity improvement through capacity enhancement, business expansion, distribution network, and sales promotion, which have less or even no need of the support of an R&D facility. In 2010, industrial R&D expenditure was very small: only 0.013% of the Indonesian GDP, or about US$90 million compared to US$700 billion (Pappiptek-LIPI, 2011).

(ii) *Consequences*

As a consequence of low R&D intensity, Indonesia has experienced delays in building innovative capability in the industrial sector. Indonesia's industries gained capability in plant operations and basic industrial skills in the 1980s. Furthermore, in the 1990s, the Indonesian industry captured capabilities in redesigning old products and processing. The increase in technological capability was facilitated by the use of imported technology without digesting the technology. The capability in technology use was gained through learning activities that was generally performed without R&D or with less R&D in selected sectors. Additionally, since the 2000s, Indonesia has focused on building capability in designing and redesigning system engineering, as well as in competing with innovative products in the global market.

By engaging in innovation without or with less R&D, the industries have successfully mastered the basic skills needed in operating plants as well as in redesigning existing products and processes towards better quality and more competitive prices. With such capabilities, the industrial sector has raised Indonesia's flag as a potential newcomer in fast runner in industrialization. However, innovation without or with less R&D has resulted in a weak absorptive capacity for foreign technology, and consequently, the Indonesian industrial sector cannot raise its technology capability level to the class needed to redesign innovative products and processes based on R&D. In other words, Indonesia maintains its position as a late comer and not as a fast runner in industrialization such as China and India nowadays.

Another consequence is that it is hardly possible for Indonesia to suddenly double its R&D intensity in a short time. Indonesian S&T indicators revealed that the low R&D intensity (around 0.09% in 2010) is related to the lack of researchers engaging in R&D. The number of researchers in R&D generally tends to increase in all countries; however, in Indonesia, the number of researchers in R&D decreased during 2000–2010. In Indonesia, between 2010 and 2015, the ratio of researchers in R&D per million people (RRD) was stable at 90. This means that the number of researchers was approximately 22,500 for its 235-million population in 2015. Although this figure is common for some developing countries, it is uneven for Indonesia as a G20 country. If Indonesia maintains a stable RRD value of approximately 100 or has no policy change giving preferential treatment for the handling of R&D institutions and the enhancement of human capital for innovative activities, then Indonesia will consistently remain a LRDC in the future given the lack of researchers in R&D (Aminullah, 2015b).

The institutional setting for intellectual capital, namely RS&E (researchers, scientists and engineers) engaging in R&D in the public sector, is subject to government employee regulations. Indonesia has for a long time faced a severely limited quantity of RS&E engaging in R&D; likewise, a diminishing in quality of such small numbers of RS&E engaging in R&D is likely to happen in the future. The government urgently needs to increase the quantity and quality of RS&E engaging in R&D by creating conducive regulations on handling intellectual capital in the public sector, especially for national research institutions and universities. The regulation under existing State Civil Apparatus Act would diminish the quality of intellectual capital, because innovative and productive intellectual capital is hardly cultivated under the working climate of rigid bureaucratic procedures as commonly fit for administrative employees or administrators (Bozeman, 2015; Coccia, 2009). The universal ethos for RS&E is that science discovery, technology invention, and process/product innovations are produced by continuously building scientific competence under the climate of scientific freedom while guided by science and research ethics.

Policy analysis

(i) *Policy shift in the past*

Policy shifts behind the STI development process in Indonesia have occurred before and after the 1997 economic crisis. First, innovation policy for the development of technological capability prior to the 1997 economic crisis emphasized industrial policy, especially the development of high-technology industry. The policy orientation placed the government in a dominant role by applying a strategy of state-led industrial transformation based on technological innovation. The policy instrument deployed was preferential treatment given to ten high-technology strategic companies.[1] The implementation of innovation policy on the developing high-technology industry was completed under strong government support. It had successfully brought industrial transformation[2], but weak public support

[1]These ten strategic state-owned enterprises were IPTN, now DI (aircraft); PAL (shipbuilding); INKA (railroad wagons); LEN (electronics); INTI (telecommunication); PINDAD (light weapons and ammunition); DAHANA (explosives); BBI (engines and machinery); BARATA (heavy equipment and construction material); and KRAKATAU (steel) (Aminullah and Fizzanty, 2016).

resulted in policy discontinuity after the effects of the 1997 economic crisis.

Second, innovation policy after the 1997 economic crisis emphasized R&D policy as a national priority, aimed at solving nationally urgent problems. The policy was strongly oriented towards market-led industrial development through the creation of a conducive climate for technological innovation. The Indonesian government has launched several STI policy instruments to intensify R&D between 2001 and 2011. In 2001, the Indonesian Ministry of Finance launched Regulation No. 231/2001, aimed at providing compensation for imported goods used for research and science purposes, as well as exemptions from the value-added tax and luxury goods tax. The regulation was restated in 2007 when the Indonesian Ministry of Finance launched Regulation No. 51/2007, aimed at providing compensation for imported goods used for R&D purposes. The next incentive was also launched in 2010, where Regulation No. 93/2010 stated clearly that R&D expenditure (for private companies) was to be included in deductible expenses, and any income-sourced donation from private companies to selected R&D institutions declared to be fully deductible. In 2011, Regulation No. 52/2011 was launched in order to promote a one-year investment allowance for private companies who spend their income in R&D activities in national R&D institutions (Aminullah and Fizzanty, 2016).

Although these STI policy instruments exist, the Indonesian innovation system is not well established yet due to some policy problems, such as policy coherency, integration, and implementation. Based on reflections from the Indonesian STI policy framework implemented in the past, there are three lessons to be learned. First, the STI policy implementation was once successful with strong support from the government, but due to the weak public support, its continuity was not sustained. Second, building technological capability from downstream (production engineering) to upstream (basic research) was successful through the national STI leadership bringing in industrial transformation through mastery of high technology, but the policy was not balanced with building technological capability from upstream (basic research) to downstream (production engineering). The negligence in science policy towards industrial technology development has been the underlying factor for the lack of government attention towards S&T development since the 1990s. Third, there was the implementation of policy using various policy instruments for supporting and stimulating R&D in the private sector. However, as explained in the prior demonstrated statistical evidence and case studies, such policy instruments appeared to have not significantly affected to increase R&D activities in private industrial sectors. Despite the lack of attention and confidence of the private sector to innovate based on R&D, this can be considered to not pose a problem for the industries that have experienced growth without R&D, but this is not a justification to keep Indonesia positioned as an LRDC in the future.

(ii) *Possible directions in the future*

Considering that the routine increase in R&D investment in the public sector is around 10–15% per year, it can be deduced that a non-routine increase in R&D investment is an urgent matter for Indonesia. In order to realize it, the Indonesian private sector is needed to drive a rapid growth in R&D investment of around 20–30% per year. To achieve this, the industrial sector must shift from innovation without R&D towards innovation with R&D. For the government, the policy discourse on tax deduction for R&D expenditure that has been long deliberated needs to be im-

Table1: Estimation of Indonesian R&D intensity (1990–2045)

TIME	1990	1990	1995	2005	2010	2015	2020	2025	2030	2035	2040	2045
RD_exp (billion)	274,55	597,66	1.378,4	2.743,8	5.843,5	14.771	40.323	123.207	227.267	353.958	546.942	769.682
Gov_RD (billion)	247,10	537,89	1.171,6	2.332,2	4.674,8	11.481	28.702	45.924	63.146	80.367	97.589	114.810
Prv_RD (billion)	27,46	59,77	206,76	411,56	1.168,7	3.289,7	11.621	77.283	164.121	273.591	449.354	654.872
RDpGDP (%)	0,13	0,128	0,138	0,114	0,0915	0,111	0,217	0,418	0,523	0,577	0,656	0,711
GOVRDsh (%)	90,00	90,00	85,00	85,00	80,00	77,73	71,18	37,27	27,78	22,71	17,84	14,92
PRVRDsh (%)	10,00	10,00	15,00	15,00	20,00	22,27	28,82	62,73	72,22	77,29	82,16	85,08
rGOVRD (%)	15,01	9,27	16,05	11,33	5,71	13,94	12,00	7,50	5,45	4,29	3,53	3,00
rPRVRD (%)	27,15	9,27	17,15	11,33	33,44	34,60	4,88	23,59	15,36	8,70	8,27	6,55
GDPpCAP_s	0,639	1,06	0,779	1,24	3,04	3,76	5,65	8,39	11,66	15,50	19,83	24,25

RD=R&D expenditure, Gov=Government, Prv=Private, sh=share, GDP= Gross domestic product, CAP= Capita, p=per, s=US$ Source: Aminullah, 2015

[2]An example of successful transformation in stages is the production of aircraft at IPTN company, starting from assembling of various small planes and helicopters in 1976, followed by the integration of previous knowledge gained in the production of CN 235 airplane with double engines and a capacity of 35 passengers, designed in cooperation with CASA (air-tech) in 1984, followed in turn by improvement of aircraft technology through R&D activities to make the N250 aircraft with double engines and a capacity for 50 passengers, fully designed by IPTN in 1989. The final stage was the full production of a jet aircraft with a capacity of 100 passengers. However, the termination of production was unavoidable, because IPTN was hit by the 1997 economic crisis (Aminullah and Fizzanty, 2016).

plemented without delay in Indonesia. By targeting an increasing rate of R&D investment in the industrial sector, which is two times greater than that in the government sector, the problems of stagnation in R&D activities, low absorptive capacity of technology and improvement of the low technological capability in the private industrial sector would be solved in the future.

If a rapid increase in the rate of R&D investment in the industrial sector can be implemented, it would gradually change the pattern and trend of R&D intensity. Indonesia's R&D intensity would increase from around 0.11% of GDP (2015) to 0.42% (2025), in which the contribution of the industrial sector would increase from approximately 22% (2015) to 62% (2025). The amount of R&D spending in the industrial sector is expected to increase exponentially in the next 10 years, from an estimated Rp 3.2 trillion in 2015 to 77.2 trillion in 2025. In the period of 2025–2045, industrial R&D spending would be expected to grow in a parabolic curve towards a stable point. In the year of 2045, Indonesia's R&D intensity would reach 0.71% of GDP, with the contribution of industrial sector amounting about 85%. Meanwhile, the public sector would routinely increase its R&D spending, from an estimated Rp 11.5 trillion in 2015 to Rp 46 trillion in 2025, and further to Rp 115 trillion in 2045. Indonesia would become a developed country with GDP per capita reach US$ 24,250 and middle level of R&D intensity (between 0.5% and 1%) in 2045 (Aminullah, 2015a).

(iii) *Policy challenges and options*

Policy failure in spurring R&D-based innovation in industrial sectors was a matter of fact in the past. Einstein once said, however, that "we cannot solve problems by using the same kind of thinking we used when we created them". Thus, consider that the present situation and future possibility need not be the same. Policy options such as policy instruments in the form of special treatment for industrial sector are no longer compatible with the global market environment. The competitive global environment, including the Asian Economic Community (AEC), now has challenged the industry to compete in innovation based on R&D. The losers and winners in the race of R&D-based innovation are determined not only by the speed of innovative product creation, but also by competitive prices in global market. In the global market competition, Japan's consumer electrical industry was defeated by Republic of Korea, and then the less competitive subsidiaries of the Japanese consumer electrical industry were taken over by their more innovative and highly efficient Chinese counterparts (Aminullah, 2015b).

For future competitiveness, Indonesia should focus its limited R&D financing on the country's potential of technological leadership or a "make some/buy some" strategy. The future identity of Indonesian technological leadership would be embedded in Indonesia's developing R&D capacity in *new materials and the life science–based* industry (Aminullah and Fizzanty, 2016). The important position of life science R&D in Indonesia has been shown by the internationally recognized scientific reputation of Indonesian researchers who engage in the area of life science R&D. The most developed data from scientific activities of Indonesian researchers, in terms of international collaboration and international publication, are that in health and medicine, biology, plant science, ecology, and environmental science. There exists therefore the opportunity of international collaboration on R&D in the health, agricultural and marine sectors that could be explored (Akil et al., 2014).

The promotion of R&D could be based on the unique mineral and natural wealth of Indonesia, utilizing Indonesia's comparative advantage of vast mineral and biological diversity in both land and sea. The development of the natural resource-based industry driven by new materials and life science-based technologies for the future should not create a totally new industry, but channeled into developing the existing industries that have strong potential. Therefore, new materials, life science R&D programs, and their implementation need to be made to cooperate with existing related industries such as steel, bio-based chemicals, biomedical and bio-technology industries, etc. The Indonesian government needs to encourage public–private partnerships or a consortium of joint research. Long-term research grants (for 5–10 years) in sufficient quantity (rather than small R&D grants) are required to achieve significant results. These efforts can be realized by implementing conducive legal and institutional support for conducting R&D domestically.

Initiatives to enhance innovation capacity by intensifying R&D in life sciences have long existed in Indonesia. The availability of life science parks, such as the so-called LIPI Cibinong Science Centers (CSC), has also been driving life science-based technology development in Indonesia. Revitalization of the CSC is currently managed by the Indonesian Institute of Sciences (LIPI) and will be developed towards progressive S&T infrastructure to support the development of leading industries in the future. The natural resource-based industries, which are driven by life science-based technologies, will further develop faster, including the bio-based chemical, biomedical, and bio-technology industries. The CSC initiative in the life sciences field should be developed into a *national science policy for industrial technology development*.

Other options for R&D policies and policy instruments in various forms of support and incentives have been launched; however, these were still not appealing enough for the industrial sector in Indonesia. Therefore, the future policy challenges are to design a "formula" for support, stimulations, and other breakthroughs that are of interest to the industrial sector. The design of policy instruments should deal with markets, funding, intellectual capital, institutional, and a consortium of strategic innovation.

The main leverage point in raising R&D intensity in Indonesia is the availability of highly qualified researchers. Therefore, universities and R&D institutions should (i) invest in sophisticated research laboratory infrastructures and recruit highly competent researchers; (ii) upgrade the quality and quantity of country's higher education to produce graduates and postgraduates; (iii) utilize competitive brain-gain by apply-

ing internationally comparative rewards to attract the return of highly qualified researchers from abroad; (iv) implement conducive legal and institutional support to maintain the positions of highly competent researchers in industrial R&D; and (v) manage new technology mastery by giving strong support to the prioritized field of sciences, where new materials and life science-based R&D for industrial technology development will be important for Indonesian competitiveness in the future.

Conclusions

Future Indonesian STI capacity needs to raise R&D intensity by applying national science policy for industrial development, such as by (i) pushing economic growth through infrastructure development, balanced with driving growth through innovation with R&D investment; (ii) driving growth through industrial innovation with R&D corresponding to the sufficiency of RS&E quantity and quality in industrial R&D; (iii) Implementing effective policy instruments to raise industrial R&D in accordance with those to attract highly qualified RS&E in industrial R&D; and (iv) focusing the limited R&D financing on the country's potential industrial technology leadership in the future, which concern new materials and life science-based technologies.

In realizing national science policy for industrial development, Indonesia needs to multiply R&D intensity in the industrial sector by 25 times in the next ten years. Some policy instruments that can be used to attract and persuade the industrial sector to spend on R&D are (i) offering market incentives by facilitating the ease of doing business, so that the market for products of innovative industries can grow from local to global market; (ii) Offering incentives for R&D spending by providing tax deductions with a minimum of 100% (with more tax deduction for potential leading technological sectors); (iii) increasing the quantity and quality of intellectual capital and facilitate the use of RS&E in government agencies by industry and vice versa under academic–industrial R&D collaborations; (iv) implementing institutional support for creating professionally and less bureaucratically scientific R&D institutions that are competent, innovative, and reliable in industrial R&D collaborations; and (v) facilitate a consortium of strategic innovation (5–10 years) in potential leading technological sectors for national competitiveness and sustainable public welfare.

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Key Reports on Science, Technology and Innovation

OECD Science, Technology and Innovation Outlook 2016

The OECD Science, Technology and Innovation Outlook is a biennial publication that aims to inform policy makers and analysts on recent and future changes in global science, technology and innovation (STI) patterns and their potential implications on and for national and international STI policies. Based on the most recent data available, the report provides comparative analysis of new policies and instruments being used in OECD countries and a number of major emerging economies (including Brazil, China, India, Indonesia, the Russian Federation and South Africa) to boost the contribution of science and innovation to growth and to global and social challenges. In this edition, detailed country and policy profiles are available on line.

Contact: OECD Rights and Translation unit (PAC) 2 rue André-Pascal, 75116 Paris, France. Fax: +33 (0)1 45 24 99 30, E-mail: rights@oecd.org or, Web: www.oecd.org

UNESCO Science Report: Towards 2030

The UNESCO Science Report series has been mapping science, technology and innovation (STI) around the world on a regular basis. The latest edition summarizes the evolution since 2010 against the backdrop of socio-economic, geopolitical and environmental trends that have helped to shape contemporary STI policy and governance. Written by about 60 experts who are each covering the country or region from which they hail, the UNESCO Science Report: towards 2030 provides more country-level information than ever before. The trends and developments in science, technology and innovation policy and governance between 2009 and mid-2015 described here provide essential baseline information on the concerns and priorities of countries that should orient the implementation and drive the assessment of the 2030 Agenda for Sustainable Development in the years to come.

Contact: UNESCO Press Service. Tel: +33 (0) 1 45 68 17 64, E-mail: a.bardon@unesco.org, Web: http://en.unesco.org/unesco_science_report

G20 Innovation Report 2016

This report is based on material from the OECD's Science, Technology and Industry Scoreboard 2015 (with data updates where available) and the forthcoming Science, Technology and Innovation Outlook 2016. The indicators presented here of science and innovation in the global economy highlight G20 economies' performance in a selection of areas, and track discussions and comments made by the G20 Innovation Task Force. Country profiles are designed to provide a concise overview of science, technology and innovation (STI) policy and performance in a given economy. Each profile is based on information gathered from the latest country's responses to the EC (European Commission)/OECD International Survey on STI

Policies (STIP), as well as various additional OECD and non-OECD sources. The STIP Survey reviews on a biennial basis major changes in national STI policy portfolios and governance arrangements. Responses are provided by government representatives. The OECD Committee for Scientific and Technological Policy (CSTP) and the European Research and Innovation Committee (ERAC) jointly guarantee the relevance of national input.

Contact: OECDInnovation, E-mail: STI.contact@oecd.org, Web: https://www.oecd.org/sti/inno/G20-innovation-report-2016.pdf

STI FOR SUSTAINABLE DEVELOPMENT

SELECTED INTERNATIONAL AND REGIONAL INITIATIVES

Compiled by

Asian and Pacific Centre for Transfer of Technology

Technology Facilitation Mechanism

https://sustainabledevelopment.un.org/tfm

Paragraph 70 of the 2030 Agenda for Sustainable Development announced the launch of a "Technology Facilitation Mechanism" (TFM) in order to support the implementation of the Sustainable Development Goals (SDGs). The TFM will facilitate multi-stakeholder collaboration and partnerships through the sharing of information, experiences, best practices and policy advice among Member States, civil society, the private sector, the scientific community, United Nations entities and other stakeholders.

APEC's Policy Partnership on Science, Technology and Innovation

http://www.apec.org

The Asia-Pacific Economic Cooperation (APEC) Policy Partnership on Science, Technology and Innovation (PPSTI) envisions that the APEC region will have achieved innovative economic growth by 2025. The PPSTI's mission is to "support the development of science and technology cooperation as well as effective science, technology, and innovation policy recommendations in APEC through collaboration between government, academia, private sector and other APEC fora."

The Partnership was formed in 2012, when APEC agreed to broaden the mandate of the Industrial Science and Technology Working Group (ISTWG) to include in its discussions innovation policy development and to intensify cooperation among governments, businesses and academia. The ISTWG was renamed to the PPSTI, and a new terms of reference outlining the PPSTI's mandate and goals was endorsed.

PPSTI strengthens the synergy of government, academia and industry, including SMEs, and engage actors involved in joint scientific research and in the technology inception, dissemination and commercialization cycle, with both its competitive commercial sectors and non-profit elements.

ASEAN Plan of Action on Science, Technology and Innovation (2016-2025)

http://astnet.asean.org

The Association of Southeast Asian Nations (ASEAN) Plan of Action on Science, Technology and Innovation (APASTI) for period 2016-2025 was adopted by the Ministers on 6 November 2015 during the 16th ASEAN Ministerial Meeting on Science and Technology. The plan envisions to achieve a Science, Technology and Innovation-enabled ASEAN, which is Innovative, competitive, vibrant, sustainable and economically integrated.
The plan aims to:

- Strengthen strategic collaboration among academia, research institutions, networks of centres of excellence, and the private sector to create an effective ecosystem for capability development, technology transfer and commercialization;
- Enhance mobility of scientists and researchers, people-to-people connectivity and strengthen engagement of women and youth in STI;
- Establish innovative system and smart partnership with dialogue and other partners to nurture STI enterprises to support MSMEs, nurture knowledge creation and STI applications to raise competitiveness; and
- Raise public awareness and strengthen STI enculturation to enhance ASEAN science and technology cooperation.

WIPO GREEN – The Marketplace for Sustainable Technology

https://www3.wipo.int/wipogreen/en/aboutus/

WIPO GREEN, an interactive marketplace that connects technology and service providers with those seeking innovative solutions, was established by the World Intellectual

Property Organization (WIPO) in 2013. The WIPO GREEN platform promotes innovation and diffusion of green technologies. It does this by connecting technology and service providers with those seeking innovative solutions.

WIPO GREEN consists of an online database and network that brings together a wide range of players in the green technology innovation value chain, and connects owners of new technologies with individuals or companies who might be looking to commercialize, license or otherwise distribute a green technology. In this way, it helps not only to accelerate innovation and diffusion of green technologies, but also contribute to the efforts of developing countries in addressing climate change.

Science, Technology and Innovation Policy Reviews (STIP Reviews)

http://unctad.org

The Science, Technology and Innovation Policy Reviews prepared by the United Nations Conference on Trade and Development (UNCTAD) aim to contribute to the development of national capacities in the field in order that national science, technology and innovation plans and programmes better contribute to development strategies and to improve the competitiveness of the productive sectors.

These reviews are intended to serve as an analytical instrument which examines a set of proposals from an external and neutral perspective, and to make some suggestions for action. They are not a rating mechanism.

UNIDO-ITU Collaboration for Country-level Innovation, Infrastructure, Industrialization

http://sdg.iisd.org

The United Nations Industrial Development Organization (UNIDO) and the International Telecommunication Union (ITU) announced a partnership to "fast forward" achievement of the SDGs, particularly on industrialization, infrastructure development and innovation. The cooperation will focus on reducing digital and gender divides, creating jobs, improving efficiency of natural resource management and e-waste management, and supporting growth of small and medium-sized enterprises, among other areas.

The partnership aims to strengthen the two agencies' collaboration at the country level on efforts that support SDG 9 (industry, innovation and infrastructure), including "action plans that are designed to attract public-private partnerships and investment."

Technology Bank for Least Developed Countries

http://unohrlls.org/technologybank/

The 2011 Istanbul Programme of Action called for the establishment of a technology bank and a science, technology and innovation supporting mechanism dedicated to least developed countries (the "Technology Bank"), a long-standing priority of the LDCs confirmed in the 2015 Addis Ababa Action Agenda and in Sustainable Development Goal 17. The establishment of the Technology Bank is expected to be the first target of the SDGs to be met.

Preparatory work towards the Technology Bank culminated with the report of the feasibility study prepared by a High-Level Panel of Experts in 2015. The Panel's recommendations highlighted that the Technology Bank, modelled on the United Nations University, has the potential to strengthen national capabilities and provide expertise to the world's least developed countries, ensuring that they are no longer left behind in achieving internationally agreed development goals. The panel underscored that the establishment of the technology bank is not only required but also feasible. On that basis the General Assembly requested the Secretary-General to take the steps necessary to launch and operationalize the Technology Bank by 2017.

Global Observatory of Science, Technology and Innovation Policy Instruments (GO-SPIN)

http://en.unesco.org/go-spin

The lack of accurate information, adequate indicators and capacities to analyse and monitor policies and instruments is a major development challenge for countries. The Global Observatory of Science, Technology and Innovation Policy Instruments (GO-SPIN) aims to fill this information gap by providing key information on STI governing bodies, legal frameworks, policy instruments and long-term series of indicators for evidence-based policy analysis, design and foresight studies. GO-SPIN is an online, open access platform for decision-makers, knowledge- brokers, specialists and general-public, with a complete set of various information on STI policies.

GO-SPIN is a methodological tool to map national science, technology and innovation (STI) landscapes and analyse STI policies and their implementation. The open-access platform offers innovative databases with powerful graphic and analytical tools for the use of decision-makers, parliamentarians, universities, knowledge brokers, companies, specialists and the general public, with a complete set of diverse information on STI policies.

TECHNOLOGY INNOVATION AND ITS IMPACT ON SUSTAINABLE DEVELOPMENT

A CASE STUDY OF CHINA

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Abstract

The deepening of the reforms and opening-up of China in the early 1980s witnessed a rapid increase of market economy and rise of environmental pollution. Water pollution from Beijing Brewery was one case in environmental dispute. Researchers from Tsinghua University were requested to develop Upflow Anaerobic Sludge Blanket (UASB), an environmental technology for water treatment to help Beijing Brewery deal with the problem under local conditions in China. Based on sharing of global knowledge, UASB brought significant technological and institutional innovations to beer industry, successfully improved sustainability of this industry, and ensured its further development. It is a typical example of how science, technology and innovation help implement sustainable development goal in contemporary history.

Introduction

With the deepening of the reforms and opening-up of China in the early 1980s, China's enterprises found themselves in the midst of a rapid increase of commercial economy calling for large amount of consumer goods. They began to introduce advanced technologies from developed countries to increase their production capacity. These introductions not only satisfied the demand of productivity growth in a short time, but also brought about severe and widespread social problems. One of these was environmental pollution. This article talks about environmental problems triggered by the discharge of high concentration organic wastewater from Beijing Brewery, a famous brewery in Beijing at that time, and explores how research team from Department of Environmental Engineering at Tsinghua University developed UASB[1] technology to solve the problem of responding to the request of Beijing Brewery. What is more, the successful innovation of UASB made this technology a significant element integrated into China's beer industry, which supported sustainable development of the industry. This can be seen as a typical example of how science, technology and innovation play a major role in the implementation of sustainable development in China.

The origin of environmental problem

In 1980, China's central government declared a long-term plan of economic development. According to this plan, China would double its gross national product within next ten years, and double again in the following decade before new century. Economic development became a main issue in China's society. The process of urbanization and industrialization began to accelerate accompanied by the rising of residents' purchasing power and demand for commodities. Per capita income in Beijing increased at an annual growth rate of 10% from 1978 to 1985, which created an expanding market of light industrial products like beer, foodstuffs and textile. In order to occupy the beer market and keep competitive, Beijing Brewery carried out a project of extending beer production lines. After a wide survey of beer industry in Western Europe around 1981, Beijing Brewery introduced a series of western technologies such as beverage-packaging production line from Germany and brewing technique from Denmark, which greatly shortened production cycle and increased production capacity.

In 1985, Beijing Brewery produced 56,000 tons of beer compared with 20,000 tons in 1980. When planning the next phase of production capacity extension, they had to stop and turn around to deal with the by-product of production capacity extension in the first phrase: a high discharge of high concentration organic wastewater from their production lines equipped with newly introduced techniques. Due to carelessness in addressing the environmental problems and lack of investment in pollution disposal device, over 1000 tons[2] of organic pollution was discharged into the river without treatment in a single year. To make matters worse, after years of urbanization and industrialization, what used to be farmlands down the river had become residential area and industrial area with a higher density of population.

Water pollution made Beijing Brewery and other beer enterprises main targets of environmental dispute in Beijing. They were criticized for being contributors of water environment degeneration as well as threat of drinking water and fishery

[1]Upflow Anaerobic Sludge Blanket, a typical method of organic polluted water treatment using anaerobic biochemical reaction of microorganism.

[2]It was measured by the method of Chemical Oxygen Demand (COD), which uses strong oxidants to simulate complete degradation consuming oxygen. The consumption of oxidants is converted into the mass of oxygen with the equivalent effect. This mean shows how much oxygen is needed when organic pollutant completely degrades into water and carbon dioxide.

industry. At that time, over 100,000 tons of organic pollution was discharged into the water body of Beijing area, more than half of which was from industrial production especially from light industries. There was no more environmental capacity for pollution from extra production. This problem was added to the intense situation of water resource shortage triggered by more population and industries in Beijing. Enterprises were faced with a high pollution fine and threat of closing production lines from Beijing local government. What they had developed in turn restricted their long-term development. Economic achievement of Beijing area was also in the danger of environmental disaster. Obviously, specific environmental technology should be integrated into the system of beer industry to help enterprises get rid of this dilemma. But for a premature industry in China, none of these beer producers had the resources to develop environmental technology to solve the problem on their own. They were compelled to seek support from outside the industry.

The starting point of UASB technology development

Water pollution problems rising from the development of China's industry had been well concerned by China's researchers of environmental technology from the late 1970s. The disposal capacity of urban domestic sewage treatment plants were based on traditional aerobic activated sludge process,[3] and unable to catch up with the increase of discharge of water pollution as the number and scale of industries increase at a high speed. Municipal sewage system had yet covered two-thirds of Beijing area even in the early 1980s. Beyond that, rapid development of industries brought about a shortage of energy supplies, which consequently caused higher energy price and more cost for water pollution treatment using traditional method. China's researchers of environmental technology realized that new technology with higher disposal capacity and lower energy cost was crucial for the solution of high concentration organic wastewater. And this technology should be operating inside industries so as to undertake the due obligations of pollution producers, at least lightened the load of municipal system. However, environmental technology in China was just a newly developing field at that time. Resources for researchers were limited as well. The good news was that after the reforms and opening-up of China, academic communication at home and abroad had become normal. China's researchers were able to contact with their foreign colleagues in developed countries. Stimulated by environmental movement from the 1960s and 1973 oil crisis, anaerobic bioreactors[4] became hot in water pollution treatment around the world especially in Western Europe. Because this kind of technology had the potential of dealing with high concentration organic wastewater with lower cost of energy and even reproducing methane to recycle energy. Therefore, anaerobic bioreactors were thought to be ideal technologies for the treatment of high concentration organic wastewater. Low rate of sludge production (potential cause of secondary pollution) was also added to its environmental friendly characters. One typical technology of this kind was UASB invented and developed[5] since 1971 by Prof. Gatze Lettinga and his team in Wageningen University, The Netherlands, based on the discovery of anaerobic granule sludge. UASB had been successfully applied in some Western European countries from 1978 and telling a good prospect of development. What could not be overemphasized is that Prof. Lettinga declared the fundamental principles of UASB would be always open to other researchers especially to ones from developing countries. This information greatly encouraged China's researchers devoted themselves to the development and promotion of UASB technology.

Although the fundamental principles and other information about application experiences were already accessible, there was still a long march before UASB technology became applied in China because of lack of investment and research conditions. Beijing Institute of Environment Engineering carried out a productive experiment of UASB in 1981.The performance was a little disappointing and far from being practical. The reasons were unawareness of some technical details and failure of representing appropriate conditions that could be easily realized in laboratory but hardly at a bigger scale. In fact, application of UASB in Western Europe in the 1980s overcame these difficulties mainly by accumulating experiences when reactors were tested and adjusted in productive experiment, in which middle or full scale of reactors were dealing with real pollutants and operated inside the factory. Some experiences were even unique in specific environment for specific kind of wastewater. When researchers from Department of Environmental Engineering, Tsinghua University, were sponsored by central government to solve these difficulties in 1983, they realized that they had to prepare a research environment approximating the working condition of China's factory, such as a working station inside factory and supported by the enterprise, as long as they wanted to put UASB technology into practice in China. In order to accomplish this mission, a group of water treatment researchers were organized as a special "anaerobic team", focusing their attention on UASB and similar anaerobic technologies. This anaerobic team quickly

[3]Aerobic activated sludge process is a traditional and widely used method of polluted water treatment using aerobic biochemical reaction of microorganism. It was invented in the 1910s. Its main weak points were (1) need quite a lot of energy to oxygenate the polluted water; (2) microorganism reproduce in a high speed creating surplus sludge with a related high rate needs further treatment.

[4]Anaerobic bioreactors make use of anaerobic biochemical reaction of microorganism turning organic pollutant into methane and carbon dioxide, but they were far from being perfect before the 1960s.

[5]UASB is based on the discovery of anaerobic granule sludge. Granule sludge was occasionally discovered when Prof. Lettinga was testing upflow anaerobic bioreactors. This granule sludge maintain a high population of microorganism and a density heavier than water, so as to keep a high level of biochemical activity when polluted water was input from the bottom with a relatively high quantity.

began to seek suitable site for technology development. As mentioned before, Beijing Brewery was seeking for technology support as well. Negotiation between University and enterprise did not take long. In 1984, Beijing Brewery made an official request that Tsinghua University should provide technology that helped solve high concentration organic wastewater problem in Beijing Brewery. And Beijing Brewery shall provide resources such as site and workers for anaerobic research team to build a working station of wastewater treatment engineering inside Beijing Brewery. Through this cooperation, anaerobic team got full access to the characteristics of wastewater and actual production situation of Beijing Brewery. They also obtained enough space and labor force for incoming pilot scale test and productive experiment. These conditions gave the research a smooth start.

Comparisons of design schemes

The anaerobic research team quickly proposed relevant schemes. In March 1985, they designed a system including a UASB reactor operated at medium temperature (around 35°C) and a submerged aeration biological filter[6] for further treatment. The design of medium-temperature UASB made use of experiences of similar medium temperature UASB in Western Europe and provided a relatively high removal rate for about 90% of organic matter when treating wastewater containing several thousands of milligrams of organic matter per liquid. It saved quite plenty of energy compared with high-temperature (around 55°C) UASB pursuing a high removal rate of 95%. In this system, medium-temperature UASB was specifically designed to dispose wastewater from saccharification process and fermentation process with a concentration of over 10,000 mg/L, making full use of UASB's adaptation to extra high concentration of organic wastewater. Anaerobic team successfully cultured and acquired ideal granule sludge that achieved a removal rate above 90% in laboratory. The remaining organic matter in the effluent of UASB reactor and lower-concentration wastewater from other processes of Beijing Brewery were left to submerged aeration biological filter. Simulated in laboratory, effluent concentration from submerged aeration biological filter was lower than 100 mg/L meeting the standard of sewage discharge in the condition that influent concentration was about 1,000 mg/L. When this system was compared with another scheme proposed also by Tsinghua University, in which two modified aerobic processes were series connected, the former system saved considerable amount of energy and produced equally considerable methane. The similarity of anaerobic process inside UASB reactor with that inside the fermentation process of beer production gave more convenience for workers and managers in Beijing Brewery to master the system. It seemed hopeful that proper controls of temperature, the situation of sludge, along with effective separations of water, sludge and gas might make medium-temperature UASB a practical process for wastewater treatment in Beijing Brewery.

But this system did not fully match considerations of Beijing Brewery, and performed several disadvantages:

(1) Uncertainty and cost of maintaining medium temperature: In order to maintain medium temperature, special devices and workers were needed. Considering the technological level and worker training of automation control in China at that time, it increased investment and operating cost of wastewater treatment as well as increased the risk of disfunction of UASB caused by failure of warm-keeping in full size reactor.

(2) Energy saving was not fully achieved: Submerged aeration biological filter, further treatment process in this system, was still an aerobic process that needed lots of energy for aeration. And warm-keeping for medium temperature was added to the total energy cost. Methane produced inside UASB reactor was unable to directly convert into energy that could be used in operating production line in Beijing Brewery or transported through power network. Moreover, it became a risk of fire and explosion if not properly collected.

(3) Complexity of the system: Using UASB for the specific treatment of wastewater from saccharification process and fermentation process led to adjustment of drainage system, which might cause interrupt of beer production. Also, two-process system required more workers and management increasing its uncertainty and cost compared with one-process system (if it was possible).

Considering practical requirements of the enterprise, obviously the potential of UASB reactor should be fully exploited. Anaerobic team found it inevitable to develop room temperature (around 20°C) UASB with high processing capacity if they wanted to solve this problem effectively and economically.

Technological innovation responding to enterprise's practical requirements

In the development of room-temperature UASB technology, two factors had tremendously changed outer social environment and put the development of this technology forward. The first factor was central government's special funding for anaerobic technologies. A special program named "Anaerobic Biological Treatment Technologies of High Concentration Organic Wastewater" was established and funded by central government in the framework of National science and technology research plan in 1986. This program, aiming for practical environmental technology requirement from a few of China's developing industries like beer and subsidiary foodstuff, provided considerable funding and other resources for technological innovation of anaerobic technologies. Anaerobic team and Beijing Brewery cooperated to apply for this program and succeeded. Through the platform serving the national research plan, they got more access to funds from central government and information about new achievement

[6]An aerobic modified process in which exchange efficiency of oxygen is reinforced and filtration of biological membrane is utilized.

of UASB inside and outside the country. For instance, Prof. Lettinga was invited to China several times in the form of assessment expert of this program, and several special teams were organized to study new application of anaerobic technologies in developed countries by on-site visit and make public reports to the whole team of program. The development of room-temperature UASB technology benefited a lot from these exchanges of information. The second factor was adjustment of municipal drainage planning. From 1985 to 1986, the environmental protection research institute of Beijing carried out a program named "Study on Technological Policy of Water Pollution Prevention and Control in China". This task, raised by State Environmental Protection Administration[7], required a systematic solution of water pollution control under specific situations of available technologies and limited investment in China. This study showed that by using municipal sewage plants dispose wastewater that had been properly preprocessed and collected from industries, total investment (public investment and enterprise investment together) would be 25% off and operating expense would be 50% off compared with those when water treatment was done entirely and separately by enterprises. According to early result of this study on the situation in Beijing area, Beijing local government adjusted local sewage discharge standard in October 1985, allowing enterprises discharge wastewater under a concentration of 500 mg/L organic matter into municipal sewage plants and requiring reasonable fee for disposal of the rest of organic matter. This adjustment meant it was possible that developed room-temperature UASB as a one-process system might fully accomplish the task of wastewater treatment apportioned to Beijing Brewery.

Driven by these factors, anaerobic team made two breakthroughs in development of room-temperature UASB.

(1) Successful cultivation and acclimation of granule sludge at room temperature: Based on experience at medium temperature, researchers used methods to investigate the relationship between processing capacity and physicochemical/biochemical characters of granule sludge. After necessary preprocess like filtration of big particle, adjustment of acidity, and controls of operation parameters, they acquired stable granule sludge with enough microbial activity at room temperature.

(2) Optimal design of UASB reactor: Great effect was also made to maximize separations of water, sludge and methane. Effective separations would help maintain granule sludge in good condition with high density of microorganism and decrease organic matter carried by effluent. Separator initially designed as combination of several bigger devices was split into dozens of smaller units, which greatly reduced the possibility of "dead zone"[8] and improved separations. Unitized design provided convenience of construction and transport of reactor as well. When it came to other supporting devices such as methane utilization and automatic control, they had to use technologies at hands to realize a relatively satisfactory result. Take methane for example, it was collected and stored in a specific tank and then burnt in kitchen for cooking or in boiler room for hot water. This kind of recycle of energy could also be very satisfying and safe.

These breakthroughs paved the way for pilot scale test of room-temperature UASB technology. The first pilot scale test of room-temperature UASB technology in China was successfully completed in Beijing Brewery at the end of 1988. In this test the potential of room-temperature UASB was fully exploited. Statistics showed a removal rate of over 85% when UASB reactor disposed mixed wastewater from all the processes of production lines and living quarter with a concentration of 2,000–3,000 mg/L, fulfilling the request of effluent concentration below 500 mg/L in one process. This performance was even better than plenty of medium-temperature and high-temperature UASB reactors in operation around the world at that time. Its operation was simplified to its best and needed no more further process in Beijing Brewery. It reduced energy cost and recycled considerable amount of methane. Supported by succeeding funding from central government and necessary resources from Beijing Brewery, the construction of the biggest practical UASB reactor in China at that time was completed in Beijing Brewery in November 1991. Based on design in pilot scale test, the reactor was designed as eight parallel units that could be operated separately providing flexibility for wastewater treatment and reducing the complexity of management. The whole reactor had a volume of 2,000 m^3 and a capacity of dealing with over 2,600 m^3 of wastewater at room temperature each day. Its removal rate was over 80%, and fulfilling the request of effluent concentration below 500 mg/L. If a reactor used traditional aerobic technology with similar capacity, it might take more than twice its volume and occupation of land. According to economic calculation of UASB reactor during trial operation in 1992, Beijing Brewery paid only 0.09 yuan RMB for electricity to deal with one cubic meter of wastewater in this reactor. Even not taking the benefit of methane recycle into account, the total cost for one cubic meter of wastewater was 0.48 yuan RMB, far lower than the price of over-standard discharge into municipal sewage system causing extra fee from sewage plant and high fines from government. The investment of construction was controlled at a reasonable level, too. In the long run, as mentioned in the reports of anaerobic team about room-temperature UASB technology at the second half of the 1990s, it saved 15–30% of construction investment and 30–50% of operation cost compared with traditional aerobic technology.

In 1993, Beijing Brewery had an increase of beer production by 11% over the last year, but still reduced organic matter discharge for 357 tons, adding to the reduction of about 500 tons in 1992 when the period of trial operation was included. The construction of UASB reactor guaran-

[7]Its function was nearly the same as that of US Environment Protection Agency (EPA) in United State.
[8]Bigger devices easily create zones where flow becomes slow or even static leading to failure of devices.

teed the production extension plan for 120,000 tons of beer per year, and the whole Beijing Brewery realized a profit of 3,789,000 yuan RMB in 1993, indicating a good future of Beijing Brewery supported by UASB technology.

Institutional innovation to sustainable development

Through the cooperation with Tsinghua University, Beijing Brewery was able to apply and share the achievements of technological innovation of UASB. Technology strength for UASB was developed in Beijing Brewery, too. More importantly, under the help of anaerobic team, a stable management system was established, which adapted to UASB and integrated UASB into the whole technology system of beer production. This integration started at the very beginning of cooperation, when workers and managers from Beijing Brewery were engaged in research and development activities. In the process of UASB development, members from enterprise were able to form personal cognition of environmental technology that was unlike other technologies used in production activities. Under the help of anaerobic team, these members became familiar with UASB technology and translated requirements, parameters, and responsibilities of every position concerning UASB reactor into language that was generally accepted in production system of Beijing Brewery. The translation was fixed in the form of "Sewage treatment station rules and regulations" establishing a special workshop and shift system for wastewater treatment. All of these were integrated as a part of the enterprise's management system. This institutional innovation proved its value as soon as anaerobic team completed their research and moved out from Beijing Brewery.

Beijing Brewery smoothly took over all the jobs of UASB operation even before the researchers left and kept the reactor in sound condition for long run. This institutional innovation also made Beijing Brewery an outstanding example of sustainable development in beer industry. It drove the spread and application of UASB in beer industry and in turn reshaped outer environment to a favorable one for the development of Beijing Brewery.

Being praised and reported by government, Beijing Brewery was frequently consulted and visited by other enterprises in beer or even other industry faced with similar environmental problems. Visitors were shocked by the fact that dirty polluted water could produce clean energy for recycle in Beijing Brewery, especially its clean dining room opened to the public using methane produced by UASB reactor. More significantly, Beijing Brewery was glad to share its practical experiences on operating UASB reactor and how to integrate it into the whole system of enterprise. These valuable experiences cooperated with supporting policies from government, they were two important factors for the promotion of UASB. They worked together to persuade a few enterprises to introduce UASB technology into their factories. It became a nationwide mode of spread of UASB technology in beer and other industries in China, and Beijing Brewery even received profit from technology transfer for being a holder of UASB technology. The successful spread of UASB technology in China had even created a market for granule sludge[9]. By stable operation of UASB reactor ahead, Beijing Brewery was able to provide considerable amount of granule sludge at a price of no less than 200 US dollars per cubic meter of sludge. The price was more than twice in some years, but the supplies even could not meet the great need for new reactors in the 1990s. It became another profit for being the first one of UASB technology user and contributed to the development of UASB in China.

Supported by UASB and other anaerobic technologies, beer industry in Beijing area made a smooth development. The total production of beer in Beijing area raised to 1,170,000 tons in 1998 compared with 135,000 tons in 1985, and the whole industry realized considerable discharge reduction at the same time. It happened in other areas of China as well. For instance, Tsingtao Brewery, mother of world famous Tsingtao Brewery Company Limited, introduced UASB technology from Tsinghua University and Beijing Brewery in the mid-1990s. The introduction solved water pollution in a short time and UASB technology was integrated into the system of Tsingtao Brewery. In the expansion of Tsingtao Brewery Company Limited, using technology to control pollution was always well concerned no matter building new factory or taking over other enterprises are concerned. According to incomplete statistics in 1999, 219 anaerobic reactors were used in China's industries and over 120 of them were UASB reactors. UASB technology had become the mainstream technology of wastewater treatment in beer industry and starch industry in China. Success of UASB technology in China also attracted attention from abroad. Around 1995, anaerobic team provided two wastewater treatment design schemes to a French beer enterprise, in which UASB reactor was a key component. In December 1996, Department of Environmental Engineering, Tsinghua University, signed a cooperate contract with Kankyo Engineering Co. Ltd., Tokyo, Japan, for "UASB technologies' transfer". Achievement of UASB technology in China was also fully affirmed by Prof. Lettinga, the original inventor of UASB, in several occasions.

What UASB brought to beer industry was not merely technological or institutional innovation, but also improvement of industry image and change of view for development. Beijing Brewery is an example. Being the first in China applying UASB technology, Beijing Brewery became a demonstration enterprise of green production in the early 1990s attracting visitors from different social organizations, industries, and government at home and even abroad. It was a free and an effective broadcast for Beijing Brewery and its products. The image of troublesome polluter in

[9]To operate a UASB reactor at full load, at least one-third of volume of reactor should be prepared with granule sludge in good condition. If not transferred from other sources, it would take mouths for cultivation and acclimation of granule sludge. No mention of the risk of failure.

citizens' minds was taken place by an environment-friendly and well-accepted beer producer. Being an outstanding example of green production, Beijing Brewery was also introduced by Beijing local government to apply for Environmental Technical Assistance Program of World Bank in 1993. This application was accepted in the framework of Clean Production subproject (B-4). It reinforced technology and management system for clean production in Beijing Brewery, and strengthened the idea of sustainable development in enterprise culture. The innovation of UASB technology was a penetration point of bringing idea of sustainable development into China's beer industry. It pushed the development of the whole industry to a more sustainable direction.

Conclusions

The achievement of UASB technology in China's beer industry can be attributed to three factors: (1) sharing of knowledge about UASB technology among environmental technology researchers all around the world; (2) great effects made by China's environmental technology researchers, including anaerobic team, to technological innovation focused on local conditions and requirements in China; and (3) active involvement of enterprises and government's support especially in institutional innovation. The innovation of UASB technology along with other environmental technologies turned China's beer industry from an extensive mode to a sustainable mode in the early 1990s. The case of Beijing Brewery more than 20 years ago makes it clear that enterprises' involvement in science and technology innovation is indeed an important way for enterprises to accomplish new development in a global atmosphere of environment concerned. It is equally clear that supporting science and technology innovation is a practical way for government to promote sustainable development in society and implement sustainable development goal.

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Climate Technology Centre and Network

The CTCN is the operational arm of the UNFCCC Technology Mechanism, hosted by the UN Environment Programme (UNEP) and the UN Industrial Development Organization (UNIDO). The Centre promotes the accelerated transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries. CTCN provides technology solutions, capacity building and advice on policy, legal and regulatory frameworks tailored to the needs of individual countries.

The Network facilitates the transfer of technologies through three core services:

- Providing technical assistance at the request of developing countries to accelerate the transfer of climate technologies
- Creating access to information and knowledge on climate technologies
- Fostering collaboration among climate technology stakeholders via the Centre's network of regional and sectoral experts from academia, the private sector, and public and research institutions

Through these services, CTCN aims to address barriers that hinder the development and transfer of climate technologies, and to thereby help create an enabling environment for: Reduced greenhouse gas emissions and climate vulnerability; Improved local innovation capacities; Increased investments in climate technology projects.

For more information, access:
https://www.ctc-n.org

A NEW COLLABORATION INITIATIVE FOR SUSTAINABLE DEVELOPMENT RESEARCH

JAPAN-ASEAN SCIENCE, TECHNOLOGY AND INNOVATION PLATFORM

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Abstract

Started in 2015, the Japan-ASEAN Science, Technology and Innovation Platform: Promotion of Sustainable Development Research (JASTIP) started aims to promote Japan-ASEAN collaboration on science and technology research and accelerate the application of its outcomes for social innovation to achieve Sustainable Development Goals (SDGs). JASTIP is the first STI platform mainly led by scientists from ASEAN countries and Japan. The Platform has established joint laboratories focusing on three fields: energy and environment, bio-resources and biodiversity, and disaster prevention.

This article introduces about the current research activities on energy and environment under the JASTIP project. It is an important responsibility for researchers to convey their research activities accurately and understandable to all stakeholders to promote implementation of scientific result to society. Natural scientists and scientists from other fields including social science and humanities are an essential foundation for accelerating STI.

Introduction

Establishing mechanisms for international cooperation in STI (Science, Technology and Innovation) is essential to achieve the United Nation's Sustainable Development Goals: SDGs (United Nation Website). The Japan-ASEAN Science, Technology and Innovation Platform (JASTIP) has established joint laboratories focusing on the three fields; energy and environment, bioresources and biodiversity, and disaster prevention in order to strengthen the cooperative research network between ASEAN and Japan. JASTIP is carrying on within the framework of the collaboration Hubs for international research program 2015 initiative, which is funded by the strategic international collaborative research program of the Japan Science and Technology agency (JST) (JST Website). JST is one of the biggest Japanese funding agency for STI and support many researchers through the several funding programs (Aizawa, 2016).

A Memorandum of Cooperation (MOC) was signed by four parties; Kyoto University, Japan; National Science and Technology Development Agency (NSTDA), Thailand Ministry of Science and Technology, Indonesian Institute of Sciences (LIPI); and Malaysia-Japan International Institute of Technology (MJIIT). JASTIP's objective is to conduct and produce innovative research and promote research cooperation between Japan and ASEAN countries lead by researchers. JASTIP will be more than mere networking for the research community, and will serve as a platform to connect research results and feed them back into society.

JASTIP will accelerate the promotion of research based on Japanese-ASEAN cooperation, and encourage discussions toward building a collaborative system with ASEAN in the areas of science, technology, and research education that moves beyond the walls of institutions or the confines of a particular project. It also aims to contribute to the efficient operation of individual projects, and to the utilization of effective results.

In December 2015, the ASEAN Economic Community came into formation, comprising a population of over 600 million people. The international position of Japan within ASEAN is being further cemented, and the fact that ASEAN growth will be a driving force in sustainable development. In particular, for science and technology, as well as research, to assume an important role, the results need to be linked to societal innovation, and their positive effects on society more clearly demonstrated.

The purpose of this paper is to clarify the situation of the current research activities of energy and environment research under the JASTIP and to demonstrate how these researches relate each other. To promote collaborative research that can be used to resolve social issues to ultimately build a sustainable society in ASEAN countries and Japan.

Energy and environment research

The JASTIP project is conducting collaboration research between Japan and ASEAN on the energy and environment field. The biomass energy is one of the important research topics especially among ASEAN which has

abundant number of residuals from agricultural sector. These abandoned residuals have been simply burnt in the field and this causes serious environmental issues. Therefore, we are working on the effective utilization of such biomass resource as fuels and value-added chemicals as presented below.

Photocatalytic conversion of biomass to value-added fuels and chemicals

Professor Takeshi Sagawa (Kyoto University)

Assistant Professor Surawut Chuangchote (JGSEE, King Mongkut's University of Technology Thonburi), Dr. Verawat Champreda (BIOTEC, NSTDA), Professor Navadol Laosiripojana (JGSEE, King Mongkut's University of Technology Thonburi)

Biomass conversion to useful materials and development of bio energy devices in combination with efficient utilization of solar energy are conducted. In particular, "Evaluations of photocatalytic conversion of biomass to value-added fuels and chemicals" has been addressed in Thai side while, "Fabrication of high-selectivity photocatalysts and development of photo-bio flow reactor for conversion of lignocellulose-derive components to chemicals" has been performed in Japan side. After the bilateral research groups obtain the results based on their expertise, those results will be integrated to construct bio energy devices in combination with efficient utilization of solar energy. Particularly, high-value products from sugars and lignocellulose-derived components with photocatalysts have been focused and the materials design and improvement of metal oxides as the photocatalysts have been investigated.

So far, materials design of hollowed TiO_2 nanofibers and their application for glucose conversion as the photocatalysts have been performed. Formic acid, gluconic acid, arabinose and xylitol are detected as the products by HPLC analyses. Ag-loading onto the surface of the electrospun TiO_2 nanofibers has also been examined in order to improve the photocatalytic activities.

Photo-induced lignin degradation to convert some useful compounds by using TiO_2 nanoparticles has also been examined. In this FY2016, Ag-loaded onto P25 TiO_2 nanoparticles were prepared and characterized in terms of their morphology, porosity, crystallinity, absorption, photoluminescence and photoelectron properties in addition to their band-gap energy diagrams.

On the other hand, for further extensions of light-driven electrochemical conversion of glucose and lignin, nanostructured ZnO-based hybrid photovoltaic cells have been developed and evaluated. Although they have not yet attained the potential of generating a high current density at the required electrochemical potential such as NHE 1.23 V for H_2 and O_2 evolution, fine tuning of the length (viz. thickness) and the density of ZnO nanorods, surface modification of ZnO nanoparticles with dispersing reagents are found to be effective to improve the interface between the electron transporting layer and the conducting polymer in terms of generating a high current density for highly efficient photovoltaic performance. Ag-In-Zn-S quantum dots-based hybrid photovoltaic cells have also been prepared and revealed that the band gaps of the metal sulfides are adjustable in some extent by changing both of the ratios of Ag-In and Zn elements, and the capping reagents such as oleylamine, pyridine, and so on.

Development of carbon materials from biomass for energy storage applications

Associate Professor Tomokazu Fukutsuka (Kyoto University), Assistant Professor Kohei Miyazaki (Kyoto University), Mr. Yuto Miyahara (Kyoto University), Dr. Sumittra Charojrochkul (MTEC, NSTDA), Dr. Yatika Somrang (MTEC, NSTDA), Mr. Thanathon Sesuk (MTEC, NSTDA), Dr. Worapon Kiatkittipong (Silpakorn University), Ms. Chulita Pornpitakdamrong (Silpakorn University)

Plantation of palm trees has been a big industry in ASEAN countries. While palm fruit is widely used for production of palm oil, other residues such as palm empty fruit bunches (PEFBs) and kernel shell have much lower value as biomass. Therefore, a lot of studies on functionalization of these residues have been extensively conducted. Among various kinds of functionalized materials, activated carbon from PEFB can be an attractive material for energy storage applications such as electric double-layer capacitors (EDLCs) and metal air rechargeable batteries (MARBs). Activated carbons are used as positive and negative electrodes, on which ions adsorb/desorb during charge–discharge process in EDLCs. The performance of activated carbon is one of the most influential factors to decide EDLCs performance. In MARBs, positive electrode reactions are oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). While carbon in the positive electrode catalysts had been considered to work only as an electronic conductive material, our group directly observed that carbon in composite electrodes functioned not only as the electronic conductive material but also as the ORR electrocatalyst. This observation motivated us to use another kind of carbons for the oxygen electrode catalyst. Therefore, electrochemical performance of biomass carbon obtained from PEFB as EDLCs and MARBs electrodes was investigated. In this report, we evaluated the electrochemical performance of the PEFB-derived biomass carbon as the electrodes for EDLCs and MARBs.

So far, electrochemical performance of CO_2-activated carbon from oil PEFB was investigated. While the particle sizes of the resultant powders after the activation were similar to those without activation, the surface area of the powders after activation was much larger than that without activation, indicating that pore development was achieved through successful activation by CO_2.

EDLC performance of the CO_2-activated carbon was much higher than that without activation, indicating that CO_2-activation process should play an important role to enhance the capacitance. On the other hand, the performance of the CO_2-activated carbon as the MARB electrocatalyst was low possibly because of large particle size and low dispersibility.

Innovations in biomass application for catalytic material synthesis and energy devices

Assoc. Prof. Noriaki Sano (Kyoto University), Dr. Kajornsak Faungnawakij, (NANOTEC, NSTDA), Dr. Vorranutch Itthibenchapong (NANOTEC, NSTDA), Dr. Pongtanawat Khemthong (NANOTEC, NSTDA),

Dr. Sanchai Kuboon (NANOTEC, NSTDA), Dr. Supawadee Namuangruk (NANOTEC, NSTDA), Dr. Chompoonut Rungnim (NANOTEC, NSTDA), Dr. Pussana Hirunsit (NANOTEC, NSTDA), Dr. Chalida Klaysom (Chulalongkorm University), Assoc. Prof. Tawatchai Charinpanitkul, (Chulalongkorm University), Dr. Sareeya Bureekaew (VISTEC), Miss. Chuleeporn Luadthong (NANOTEC, NSTDA), Miss. Rungnapa Kaewmeesri (NANOTEC, NSTDA).

The catalytic production of carbon-based materials, biofuels and biochemicals is a key activity in biorefinery industry. Also, developments in catalytic energy conversion and energy storage using bioactivities are important for sustainable societies. Consequently, searching for renewable resources that are reliable, sustainable and environmentally friendly is the big challenge, and these lead to green concepts including biorefinery and bio energy devices where renewable resources drive the world. Under such circumstances, the collaborative researches carried out by the groups in NANOTEC/NSTDA (Faungnawakij's team) and Kyoto University (Sano's team) will attack this issue via accumulating innovative knowledge about biomass conversation to useful materials and development of bio energy devices.

Extension of "Solvent Treatment Method" developed by Science and Technology Research Partnership for Sustainable Development: SATREPS (SATREPS Website) program to ASEAN region

Specially Appointed Professor Kouichi Miura (Kyoto University), Senior Vice President for Research and Innovation Bundit Fungtammasan (King Mongkut's University of Technology Thonburi), Proferssor Hideaki Ohgaki (Kyoto University), Lecturer Ryuichi Ashisa (Kyoto University), Dr. Janewit Wannapeera (Kyoto University), Professor Katsuyasu Sugawara (Akita University), Assoc. Professor Nakorn Worasunarak (JGSEE/KMUTT), Assoc. Professor Suneerat Fukuda (JGSEE/KMUTT).

We have been developing the so called "Degradative Solvent Extraction" technology under a SATREPS project between Japan and Thailand. The technology dewaters and upgrades low carbonaceous resources such as low rank coals, biomass, wastes, etc. under rather mild conditions. The upgraded products are expected to be utilized as high-quality fuels, precursors for advanced materials, etc. The purposes of our collaborative research are to extend the outcome of the SATREPS project to ASEAN countries through several schemes, including joint researches and human exchanges.

So far, low grade carbonaceous resources such as low rank coals, biomass wastes, etc. are converted to three solid products called Soluble, Deposit, and Residue, depending on their solubility. The three fractions are all free from water. Soluble which is free from ash and high carbon content is the smallest molecular weight fraction and its properties are almost independent of raw materials. The SATREPS project intends to establish the Degradative Solvent Extraction technology using a relatively large extraction apparatus and to propose the methods to utilize Soluble and Residue. Now we are designing the large extraction apparatus and have already succeeded in preparing unique carbon fiber from Soluble and to use Residue as high quality solid fuel. Residues prepared from several raw materials have been tested for combustion/gasification tests using TG and DTF. We invited researchers from Loa PDR and started transferring this technology.

We are also conducting the development of new functional materials applicable for energy and environment.

Synthesis and characterization of new photocatalytic nano-materials

Prof. Keiichi N. Ishihara (Kyoto University), Assoc. Prof. Dr. Wisanu Pecharapa (King Mongkut's Institute of Technology Ladkrabang), Asst. Prof. Dr. Wanichaya Mekprasart (King Mongkut's Institute of Technology Ladkrabang).

This research is focused on the survey of new photocatalytic nano-materials to improve the functionality of new functional materials. Meanwhile, the appropriate preparation of new nano-materials based on metal oxide have been investigated. The crucial properties especially the optical properties of new nano-materials and their mechanism were analyzed and utilized as photocatalysts and luminescent materials.

We are focusing on synthesis and characterization of two materials for optical applications. First, synthesis and development of zinc aluminate ($ZnAl_2O_4$) nanomaterial and its composite utilized as photoluminescent application by rare-earth doping based mechanical milling process were investigated. Samarium (Sm) metal phase was an alkaline element represented as doping material in $ZnAl_2O_4$ host matrix (Sm: $ZnAl_2O_4$) synthesized by vibrational milling process assisted with calcination treatment. Well-defined $ZnAl_2O_4$ spinel phase in Sm: Zn Al_2O_4 was enhanced by several milling and calcination process analyzed by XRD patterns. The emission spectra are in red-orange region comprising three strong peaks at 562, 600 and 645 nm due to the influence of Sm dopant. However, the prominent structured band in the spectra was related to the emission of residual chromium impurity during high speed vibrational process. The strongest emission was achieved at 0.5 wt.% Sm in $ZnAl_2O_4$ owning to the energy transfer from Sm to $ZnAl_2O_4$ matrix.

The second project is focused on the synthesis of bismuth oxide optical material via thermal treatment assisted quenching process that is proposed to show the facile synthesized process and efficient photocatalyst in dye degradation. The enhancement in the absorption in visible region of Bi_2O_3 photocatalyst is studied and compared with TiO_2 conventional material. Owing to high absorption in visible region, β-phase Bi_2O_3 could be efficiently active in the catalytic performance in the photodegradation of aqueous MO. Moreover, the exchanged researchers under this program have improved research skill to make an excellent collaboration between both universities.

JASTIP WP2 is promoting collaboration researches on the implementation of renewable energy issues as well.

RE implementation – PV installation program in University of Yangon

Rector Pho Kaung (University of Yangon), Associate Professor Hla Toe (Pyay University/ Univesity of Yangon), Associate Professor Aye Thant (Univesity of Yangon), Professor Hideaki OHGAKI (Kyoto University).

University of Yangon wants to supply stable electricity by using renewable energy. Electricity requirement of the university is about 2 MW. A pilot project has been launched for installation of a PV system for a basic research and education in University of Yangon. A 20-kW grid-tied PV system has been designed and installed in the newly built research compound which has the maximum available capacity of up to 48 kW PV modules in the roof. Therefore, a design work for the additional 30 kW grid-tied PV system has been started. We also continuously collect the electricity consumption pattern in the building and the grid stability, as well as the electricity generation from the installed PV system to optimization of the future PV system.

We started a basic data collection of the electricity consumption of the science building from March 2016 by using power logger PW 3365A (Hioki) and found that there were black-outs almost once in a day. However, the duration of the black-out was less than 10 minutes. The longest duration of the black-out was 40 minutes from June 6 to 7, 2016. The diesel back-up generator (750 kW) has been installed in the power distribution station and it has been manually operated. Therefore, the black-out of the grid power line could be longer than the observed one. Currently the peak electricity consumption does not exceed 50 kW, but it should be larger in the new research building. Therefore 100 kW PV system should be prepared. However, due to the limitation of the budget, the designed system is targeting only partial equipment and emergency lights which require about 3 kW.

According to the collected data and due to the limited budget, a 20kW grid-tied PV system has been designed and installed in the new research building in University of Yangon. The designed PV system consists of 72 PV modules and each module has 270 W capacity which will be installed on the 6th floor of the new building without any shadowing from surrounding objects. The Li-ion battery of 9.6 kWh has been installed at the same floor so that it can support maximum 3 hours in the night time via the emergency power supply line. During the day time, the power from the PV system will be supplied to the emergency power supply line as well as the battery charging. The surplus PV power will be supplied to the general power line which is connected to the grid to reduce the power consumption.

Study on energy usage and quality of life for rural community through rural electrification using renewable energy

Professor Nasrudin Abd Rahim (University of Malaya), Lecturer Che Hang Seng (University of Malaya), Associate Professor Wallace S.H. Wong (Swinburne University of Technology Sarawak), Associate Professor Mohd Amran Mohd Radzi (University Putra Malaysia), Professor Hideaki Ohgaki (Kyoto University)

This project aims to study the energy usage pattern and lifestyle before and after rural electrification of rural community in interior Sarawak, Malaysia. Several rural villages in Sarawak, where some of the villages received electrification via renewable energy sources, particularly solar energy, while some others remained unelectrified due to their more remote geographical locations. This project will study the energy usage pattern and living life style of the villagers under different rural electrification scheme. Based on the findings on the differences and similarities between the energy usage pattern and life style of the villages under different rural electrification schemes, the more effective approach of implementing rural electrification can be deduced.

So far, four Iban villages have been surveyed and interviews have been conducted, namely Menangkin, Tabong, Jenggin and Kampung Sungai Merah. The first two villages are in the process of being electrified through extension of power grid while Jenggin have been provided with standalone PV solar systems. Kampung Sungai Merah has not received any form of electrification, and will be electrified using standalone solar system in this project. Based on the survey conducted so far, the following findings have been made:

- Most of the villagers (75%) have received education only up to primary school level.
- Their incomes are lower than average (RM 3,831/month).
- 90% villagers are satisfied their lives.
- The villagers give importance to connect with neighbors, and are in good health/mental conditions.
- Personal activities, i.e. watching movies or going for shopping, are at very low level because their access to transportation is very poor.

Apart from the quality of life, the electricity consumption pattern will be monitored to understand how the rural electrification schemes change the way the rural communities consume electricity, and how the change in electricity consumption pattern is beneficial to the communities.

Local energy governance and Community renewable energy (CRE) in Viet Nam

Mr. Ryo Takeuchi (Kyoto University), Asst. Prof. Takuo Nakayama (Kyoto University), Professor. Keiichi Ishihara (Kyoto University), Professor Ialnazov Dimiter Savov, (Kyoto University), Professor Toru Morotomi (Kyoto University), Lecturer Nguyen Thi Hoang Lien (Vietnam National University of Science, Hanoi), Research Fellow Dr. Yao Lixia (University of Singapore), Dr. Danh Tanh Tu (Vietnam Academy of Science and Technology), Mr. Kazuki Hao (Kyoto University).

The purpose of this project is to attain sustainable development in ASEAN, especially Viet Nam, through expanding Community Renewable Energy (CRE) as a tool for Local Energy Governance. CRE is the renewable energy system, which is initiated, operated and owned mainly by a community such as a group of residents. Most of them are small scale energy systems such as small hydropower, biomass power or biogas. CRE has significant benefits for the social and the environmental sustainability by 4D: Decarbonizing, Decentralizing, Democratizing and Demonstrating. CRE also improve the lives of community by providing low-cost energy. Our study will give a proposal to expand it to ASEAN.

So far, we focused on how to introduce and expand CRE into Viet Nam. Previous

studies show that biogas system is familiar at the household level and small hydro system at the private company level as RE in Viet Nam. It is a big challenge for Viet Nam to develop such RE to CRE. There are mainly three steps in this study. Firstly, this study will clarify the present situation of RE and CRE in Viet Nam. Although there exists a lot of previous studies focusing on RE, there are few studies from the point of view of community. Second, based on the present situation, this study will clarify obstacles to and concrete benefits from introducing CRE into Viet Nam. There are expected to be obstacles to develop RE to CRE, laws such as the regulations of land use and the regulations of cooperative association and economic system such as electricity pricing will be obstacles. Finally, this study will propose a concrete project on introducing CRE and how Japan and Viet Nam can cooperate for it.

During 2016, we had tackled the first step and grasped the present situation of household and enterprise-level RE. As a result of the field studies in northern Viet Nam, we found some obstacles to developing RE to CRE such as low electricity pricing and stagnation of household raising pigs, and found promising initiators and operators. In the next term, we will try simulating the cost and benefit of introducing CRE in Viet Nam by inter-industry relations analysis to propose a desirable way.

Community renewable energy implementation in Thailand

Associate Professor Chatchawan Chaichana (Chiang Mai University), Assistant Professor Wongkot Wongsapai (Chiang Mai University), Professor Keiichi Ishihara (Kyoto University), Ms. Nilubon Luangchosiri (Kyoto University).

During 2013-2016, the Ministry of Energy of Thailand and Chiang Mai University supported 26 communities to establish community-scale Renewable Energy (RE) projects. Apart from these communities, there are more than 100 communities interested in the program but cannot participate in the program. It is very interesting to learn about factors that prevent them from successfully involved in the program. Then, recommendations can be made in order to improve the future program.

Visualization of research "Catalog"

We introduce about the current research activities of energy and environment research under the JASTIP project. It is an important responsibility for researchers to convey their research activities accurately and understandable to all stakeholders especially to those from non-academic fields. Toward the social implementation process from research to private companies, administrators, and venture capitalists should distinguish research results which can be useful for solving the social issues, commercialization etc.

As scientists have their own strength which is surely research, even for the case of industry-academia collaboration, researchers tend not to focus on commercialization and business models. However, we suppose that research activities and their results can be understood by experts including entrepreneurs and venture capitalists.

First of all, as shown in this paper, it is necessary to clarify the position of each research and concrete research activities like a research catalog in order to make them available for stakeholders to promote implementation of scientific result to society. Furthermore, as a way to explain the position of research for understanding, is it possible to reveal the relationship among researches like a map?

Visualization of research "Relationship map"

Tentatively, we tried to make a map of the research activities already mentioned above, with the vertical axis as basic research and applied research, with the horizontal axis as energy field and biology field (Figure 1). As an example, this map explains a relationship and position of energy research within JASTIP. It can be seen in the map that the energy researches are closer to the biology side. As a proof, energy research and biological research groups already have started carrying out the joint study under JASTIP.

There are gaps between social implementation and fundamental research activities. It is suggested that research collaboration is not enough even among researchers of same academic field of study. Before focusing the promotion of industry-university collaboration, there is not enough number of research collaborations both in quality and in quantity between natural science and non-natural science. Even though researchers are of the same field, they did not understand

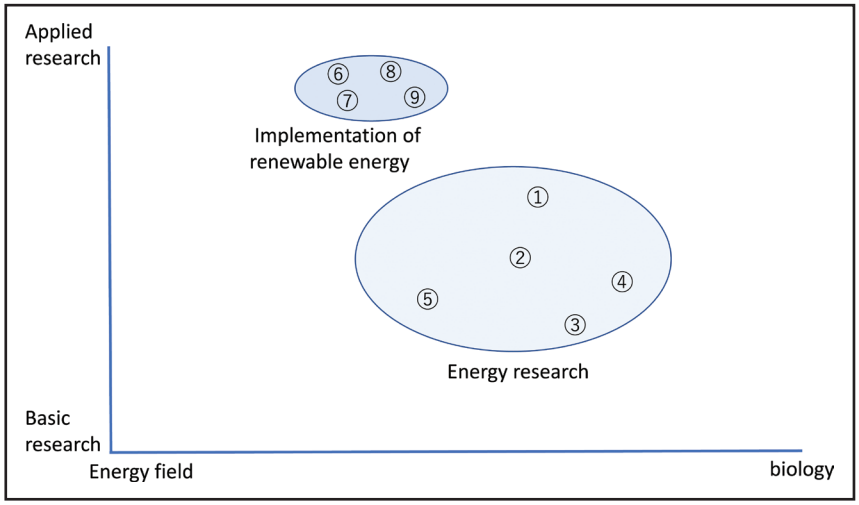

Figure 1: Research relationship map between energy and environmental research under the JASTIP platform

well what kind of studies carry out in other laboratories. It might be necessary to bridge the gap as "the valley of death" of research (Branscomb 2001 and 2003). We believe that it is the first step to promote STI by visualizing its own research to promote dialogue and collaboration with researchers in other fields near them.

Overcoming problems and future development

We believe that active cooperation with natural scientists and scientists from other fields including social science and humanities is necessary as a foundation for collaboration that will cover gaps in the research. JASTIP is first STI platform that is mainly led by scientists from ASEAN and Japan. JASTIP actively promotes and supports efforts to show the activities of researchers to researchers, private companies, governments and societies of ASEAN and Japan as a platform to encourage various kinds of collaboration. We hope that social challenge will be succeeded.

Acknowledgments

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✓Branscomb Lewis M (2003). National Innovation Systems and US Government Policy International Conference on Innovation in Energy Technologies September 30, http://www.oecd.org/dataoecd/20/16/16454388. pdf

✓JST Website, http://www.jst.go.jp/inter/english/sicorp/index.html

✓SATREPS Website, http://www.jst.go.jp/global/english/index.html

✓United Nation Website. http://www.un.org/sustainabledevelopment/sustainable-development-goals/

ASEAN-EU Cooperation in Science, Technology and Innovation

(SEA-EU-NET)

The "SEA-EU-NET" project has been set up to expand scientific collaboration between Europe and Southeast Asia in a more strategic and coherent manner. The project increases the quality, quantity, profile and impact of bi-regional Science and Technology (S&T) cooperation between Southeast Asia and Europe. The project supports the internationalisation policy of the EU, the specific objectives of FP7 but also contributes to building the S&T foundation essential to the EU achieving its political, economic and social objectives.

"SEA-EU-NET 2" is the second project that has been set up to expand scientific collaboration between Europe and Southeast Asia (SEA) in a more strategic and coherent manner. The four-year long project was launched in October 2012, involves 21 institutions from the two regions and is coordinated by the Project Management Agency at the German Aerospace Center (DLR). SEA-EU-NET 2 is deepening collaboration by:

- Continuing and intensifying the bi-regional dialogue between EU and ASEAN S&T policy makers on Senior Officials level as well as creating an annual exchange forum for researchers, innovation stakeholders, policy makers and private business to improve EU-SEA cooperation and exchange through the series of the ASEAN-EU Science, Technology and Innovation Days.
- Jointly tackling societal challenges in the fields of Health, Food Security and Safety, Metrology as well as Water Management with relevance to both regions by organising events, providing fellowships for SEA researchers and conducting studies on future collaboration potentials.

For more information, contact:

Centre for Social Innovation (ZSI)
Linke Wienzeile 246, A – 1150 Vienna, Austria
Tel: +43 1 495 04 42 - 0
E-mail: institut@zsi.at
Web: https://www.zsi.at/
https://sea-eu.net

Tech Events

2017

Aug 16–18
Guangzhou, China

GUANGZHOU INTERNATIONAL SOLAR PHOTOVOLTAIC EXHIBITION 2017
Contact: Guangzhou Grandeur Exhibition Services Co., Ltd,
Room 2303–2305, The 4th Tower,
Dong Jun Plaza, No.836,
Dong Feng Dong Road,
Yuexiu District,
Guangzhou, 510080
China
Tel: +86 20 2207 4185
Fax: +86 20 8257 9220
E-mail: grand.ad@grahw.com

Aug 11–13
Guangzhou, China

ASIA-PACIFIC BIOMASS ENERGY TECHNOLOGY & EQUIPMENT EXHIBITION - APBE 2017
Contact: Guangdong Grandeur International Exhibition Group Co., Ltd,
Room 202, Meijing Garden,
No.318, Chebei Road,
Guangzhou, China
Tel: +86 20 2918 8160
Fax: +86 20 8257 9220
E-mail: grand.gz@grahw.com

Sep 6–8
New Delhi, India

1ST INTERNATIONAL CONFERENCE ON LARGE-SCALE GRID INTEGRATION OF RENEWABLE ENERGY IN INDIA
Contact: Conference Secretariat
E-mail: info@regridintegrationindia.org
Web: http://regridintegrationindia.org

Sep 6–8
Busan, Republic of Korea

ENVIRONMENT & ENERGY TECH 2017
Contact: Bexco (Busan Exhibition & Convention Center),
55 Apec-ro, Haeundae-gu
Busan, 612-704
Republic of Korea
Tel: +82 51 740 7518,7520
Fax: +82 51 740 7360
E-mail: bisfekorea@gmail.com

Sep 6–9
Jakarta, Indonesia

ELECTRIC, POWER & RENEWABLE ENERGY INDONESIA 2017
Contact: PT Pamerindo Indonesia,
Menara Jamsostek, Menara Utara Lantai 12 unit Ta-12-04,
Jl. Jend. GatotSubroto No.38,
Jakarta 12710,
Indonesia
Tel: +62 21 2525 320
Fax: +62 21 2525 032
E-mail: maysia@pamerindo.com

Sep 11–13
Kuala Lumpur, Malaysia

BIOMALAYSIA 2017
Contact: Malaysian Biotechnology Corporation Sdn. Bhd.,
Level 16, Menara Atlan,
161B JalanAmpang,
50450 Kuala Lumpur,
Malaysia
Tel: +60 3 2116 5588
Fax: +60 3 2116 5411
E-mail: secretariat.biom@biotechcorp.com.my

Sep 19–21
Bangkok, Thailand

RENEWABLE ENERGY WORLD ASIA 2017
Contact: PennWell Conferences & Exhibitions,
1421 S. Sheridan Road,
Tulsa, Oklahoma 74112,
USA
Tel: +1 918 835 3161
Fax: +1 918 831 9497
E-mail: Headquarters@PennWell.com

Sep 20–22
Noida, India

RENERGY-RENEWABLE ENERGY INDIA EXPO 2017
Contact: Exhibitions India Group Pvt. Ltd.,
217-B,Okhla Industrial Area,
Phase - III,
New Delhi 110020,
India
Tel: +91 11 4279 5000
Fax: +91 11 4279 5098
E-mail: exhibitionsindia@vsnl.com

Oct 20–22
Bali, Indonesia

2ND INTERNATIONAL TROPICAL RENEWABLE ENERGY (THE 2ND I-TREC 2017)
Contact: TREC FTUI,
Room, EC. 308-309,
Engineering Center Building,
Faculty of Engineering,
Universitas Indonesia,
Jawa Barat 16424,
Indonesia
E-mail: i-trec@ui.ac.id
Web: https://i-trec.ui.ac.id

Oct 24–27
Almaty, Kazakhstan

REENERGY KAZAKHSTAN 2017
Contact: Iteca
2nd Floor, 42 Timiryazev Str.
480057 Almaty
Kazakhstan
Tel: +7 3272 583434
Fax: +7 3272 583444
E-mail: astana@iteca.kz

Nov 1–4
Seoul, Republic of Korea

ECO-EXPO KOREA 2017
Contact: Ministry of Environment – South Korea
Government Complex-Sejong
11, Doum 6-Ro
Sejong-si 339-012
Republic of Korea
Tel: +82 44 201 6568

Nov 7–9
Melaka, Malaysia

2017 4TH RENEWABLE ENERGY AND GREEN TECHNOLOGY INTERNATIONAL CONFERENCE (REEGETECH)
Contact: Secretariat
E-mail: admin@maltesas.org
Web: https://reegetech.com

Nov 14–15
Manila, Philippines

ASEAN SOLAR + ENERGY STORAGE CONGRESS & EXPO 2017
Contact: Leader Group,
Suit 209, Building A4,
925 Yecheng Road,
Jiading District,
Shanghai ,
China
Tel: +86 21 3102 1580
Fax: +86 21 3102 1581
E-mail: info@leader-xtet.com

Nov 23–25
Yangon, Myanmar

GREENPOWER MYANMAR 2017
Contact: AMB Tarsus Events Group,
Unit 37.08, Level 37, Menara Multi-Purpose,
Capital Square, No. 8,
JalanMunshi Abdullah,
50100 Kuala Lumpur,
Malaysia
Tel: +60 3 2692 6888
Fax: +60 3 2692 2788
E-mail: support@ambtarsus.com

Dce 5–7
Mumbai, India

INTERSOLAR INDIA
Contact: Project Director,
MesseMuenchen India Pvt. Ltd.,
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Tel: +91 22 4255 4707
Fax: +91 22 4255 4719
E-mail: brijesh.nair@mm-india.in
Web: https://www.intersolar.in

Dec 14–15
Colombo, Sri Lanka

4TH INTERNATIONAL CONFERENCE ON NANOSCIENCE AND NANOTECHNOLOGY 2017
Contact: ICNSNT 2017, Conference Secretariat,
#288/1/1, Old kottawa Road,
Embuldeniya, Nugegoda,
Sri Lanka.
Tel: +94 113 098 521
Fax: +94 112 848 654
E-mail: info@nanoconference.co
Web: http://nanoconference.co

Tech Ventures & Opportunities

Business Coach

Tech Opportunities

Guidelines for corporates to set up incubators

Department of Industrial Policy & Promotion, Government of India
http://startupindia.gov.in

Introduction

India, already home to the world's third largest Startup ecosystem, witnesses the emergence of 3-4 new startups each day, making it the fastest growing Startup base in the world. With the influx of over $5 billion in investments from both Indian and global investors, the ecosystem has generated employment for over a million people and continues to improve the macroeconomic indicators of the nation.

Startup India is a Government of India initiative aimed at fostering entrepreneurship and promoting innovation by creating an ecosystem that is conducive to the growth of startups. The initiative was formally launched by the Hon'ble Prime Minister Narendra Modi on January 16, 2016 at the Start-up India Stand Up India event, following the announcement of the StartUp India Action Plan which aims at accelerating the spread of the Startup movement by: Simplification & Handholding, Funding Support & Incentives, Industry-Academia Partnership and Incubation.

Incubator ecosystem in India

India's first incubator, STEP (Science and Technology Entrepreneurship Park) at Tiruchirappalli Regional Engineering College was set up in 1986. As of 2016, there are 68 approved incubators supported by DST, 14 approved incubators supported by DBT, 30 approved incubators supported by DeitY, and 47 approved incubators supported by MSME as well as several incubators in the private sector. These approved incubators currently are assisting entrepreneurs with executing their ideas and providing them with a platform to showcase the same. Although the quality of business incubation in the country is very high, India lags behind in numbers when compared to other developing economies such as China and Brazil. An increase in the number of incubators would have a positive implication for the startup ecosystem by catering to the growing demand and increasing the success rate of startups, thereby promoting entrepreneurship and innovation. Estimates show that incubated companies grow much faster than their non-incubated counterparts and their survival rate is also 40% higher, at 80%. The following steps have been stated under the Action Plan in order to augment the incubator ecosystem:

- The government plans to set up 31 centers of innovation and entrepreneurship to provide facilities to over 1200 new Startups and 18 new Technology Business Incubators in national educational institutions like IITs, IIMs, NITs etc. as per the funding model of DST with MHRD providing smooth approvals for TBI's to have their own society and built up space.
- The establishment of a network of Atal Tinkering Laboratories (ATL), a workspace where young minds can give shape to their ideas through hands on do-it-yourself mode and learn innovation skills.
- The setting up of 35 new incubators in existing institutions with funding support of 40% from the Central Government and 35 new private sector incubators with a grant of 50% from the Central Government.

CSR policy with regards to supporting incubators

Schedule VII of the Companies Act, 2013 provides a list of possible contributions that would qualify as Corporate Social Responsibility (CSR). The possibilities vary from eradicating hunger and poverty, to promoting education, and also include "contributions or funds provided to technology incubators located within academic institutions which are approved by the Central Government".

Prominent incubators associated with institutions such as IIM Ahmedabad, IIT Delhi, IIM Calcutta have received grants from corporations as part of their CSR. However, the number of incubators receiving CSR grants is negligible. Possible explanations forthcoming for this include a lack of awareness of this recent addition to Schedule VII, along with the notion that providing grants to an incubator is inconsistent with the idea behind CSR.

Avenues for CSR spend to foster the startup ecosystem

Corporate houses can take advantage of the above mentioned provision in the Company Act by supporting recognized incubators in the following manner:

A) **Grants for Incubators:** There are 220+ Govt. recognized Incubators in India (70+ by DST, 15 by DBT, 45+ by DeitY and 75+ by MHRD) established in Higher Technology, Management and Research Institutions. Through the mandated CSR budget in the Companies Act, 2013 corporates can make direct contributions to the corpus of an Incubator. Once the funds are disbursed, it becomes the asset of the incubator.

B) **New Incubator Development/Public Sector Entrepreneurship schemes**: Corporates can dedicate their CSR spend on build-

ing new Incubators and allocating CSR budget under different Entrepreneurship focused schemes, under:

a. Science and Technology Entrepreneurship Development Scheme (STEDS)

b. Innovation and Entrepreneurship Development Centre (IEDC)

c. Innovation – Science & Technology Entrepreneurship Development (i-STED)

d. Science and Technology Entrepreneurs Park (STEP)

e. Technology Business Incubator (TBI)

C) **Incubator Infrastructure Fund**: Funding the expansion of existing incubator space, shared facilities, equipment, components and raw materials for incubate startups.

D) **Startup Seed Fund**: Funding startup specific, limited term programs with clear milestones. For ex: Funding an annual batch of 10-20 incubatees in the focus sector of the corporate.

E) **Accelerator/Boot Camp Fund**: Specialized fund for helping a group of startups to accelerate their business growth in a short time-period (usually 3-6 months).

F) **Fellowships/Internships Fund**: Facilitating existing incubators to hire talent including mentors, interns, Entrepreneurs in Residence (EIRs), leveraging the corporate network and CSR fund.

General avenues for corporates association

Funding and support are documented areas of challenge for startup incubators in India. To bridge the gap in the area, Indian corporates can assist in Incubator Infrastructure development through various schemes setup by the GoI.

A Company can either establish a presence in terms of incubators/accelerators or provide support to the existing ones. The available routes through various arms of the Govt. are:

NSTEB: Institution under DST, to help promote knowledge-driven and technology intensive enterprises. It has designed several institutional mechanisms over the years to inculcate the culture of innovation and entrepreneurship across the country.

STEDS: The S&T Entrepreneurship Development Scheme maps the available material resources in industrially backward regions and prepare a basket of technically feasible and economically viable project profiles for enterprises that could be promoted by local S&T entrepreneurs.

Innovation-STEDS: Aims to identify challenges and issues in an area/industry/cluster and their solutions based on technological interventions and innovative approaches.

IEDC: Innovation & Entrepreneurship Development Centre is promoted in educational institutions to create entrepreneurial culture in S&T academic institutions and to foster the growth of innovation and entrepreneurship.

STEP: S&T Entrepreneurs Park is an initiative that helps in creating an atmosphere for innovation and entrepreneurship; for active interaction between academic institutions (in the capacity of HI) and industries for sharing ideas, knowledge, experience and facilities for the development of new technologies and their rapid transfer to the end user.

TBI: Technology & Business Incubator is an organizational setup that nurtures technology based and knowledge driven companies by helping them survive during the startup period, which lasts around the initial two to three years. They promote growth through innovation and application of technology, support economic development strategies for small business development, and encourage growth from within local economies, while also providing a mechanism for technology transfer.

Translation tool for patent documents

The World Intellectual Property Organization (WIPO) has developed a new "artificial intelligence"-based translation tool for patent documents, handing innovators around the world the highest-quality service yet available for accessing information on new technologies. WIPO Translate now incorporates cutting-edge neural machine translation technology to render highly technical patent documents into a second language in a style and syntax that more closely mirrors common usage, out-performing other translation tools built on previous technologies.

WIPO has initially "trained" the new technology to translate Chinese, Japanese and Korean patent documents into English. Patent applications in those languages accounted for some 55% of worldwide filings in 2014[1]. Users can already try out the Chinese-English translation facility on the public beta test platform. The high level of accuracy of the Chinese-English translation is the result of the training of the neural machine translation tool, which compared 60 million sentences from Chinese patent documents provided to WIPO's PATENTSCOPE database by the State Intellectual Property Office of the People's Republic of China with their translations as filed at the United States Patent and Trademark Office.

For more information, contact:

Media Relations Section
World Intellectual Property Organization (WIPO)
Tel: (+41 22) - 338 81 61 / 338 72 24
Fax: (+41 22) - 338 81 40
Web: http://www.wipo.int

Setting up a business in Thailand

Accounting and financial reporting requirements

Thailand Board of Investment, Thailand
http://www.boi.go.th

Books of accounts and statutory records

Companies must keep books and follow accounting procedures as specified in the Civil and Commercial Code, the Revenue Code, and the Accounts Act. Documents may be prepared in any language, provided that a Thai translation is attached. All accounting entries should be written in ink, typewritten, or printed. Specifically, Section 12 of the Accounts Act of 2000 provides rules on how accounts should be maintained:

"In keeping accounts, the person with the duty to keep accounts must hand over the documents required for making accounting entries to the bookkeeper correctly and completely, in order that the accounts so kept may show the results of operations, financial position according to facts and accounting standards."

Accounting period

An accounting period must be 12 months. Unless the Articles of Association state otherwise, a newly established company should close accounts within 12 months of its registration. Thereafter, the accounts should be closed every 12 months. If a company wishes to change its accounting period, it must obtain written approval from the Director-General of the Revenue Department.

Reporting requirements

All juristic companies, partnerships, branches of foreign companies, and joint ventures are required to prepare financial statements for each accounting period. The financial statement must be audited by and subjected to the opinion of a certified auditor, with the exception of the financial statement of a registered partnership established under Thai law, whose total capital, assets, and income are not more than that prescribed in Ministerial Regulations. The performance record is to be certified by the company's auditor, approved by shareholders, and filed with the Commercial Registration Department of the MOC and with the Revenue Department of the Ministry of Finance (MOF).

Accounting principles

In general, the basic accounting principles practiced in the United States are accepted in Thailand, as are accounting methods and conventions sanctioned by law. The Institute of Certified Accountants and Auditors of Thailand is the authoritative group promoting the application of generally accepted accounting principles.

Any accounting method adopted by a company must be used consistently and may be changed only with approval of the Revenue Department. Certain accounting practices of note include:

Depreciation: The Revenue Code permits the use of varying depreciation rates according to the nature of the asset, which has the effect of depreciating the asset over a period that may be shorter than its estimated useful life. These maximum depreciation rates are not mandatory. A company may use a lower rate that approximates the estimated useful life of the asset. If a lower rate is used in the books of the accounts, the same rate must be used in the income tax return.

Accounting for Pension Plans: Contributions to a pension or provident fund are not deductible for tax purposes unless they are actually paid out to the employees, or if the fund is approved by the Revenue Department and managed by a licensed fund manager.

Consolidation: Local companies with either foreign or local subsidiaries are not required to consolidate their financial statements for tax and other government reporting purposes, except for listed companies, which must submit consolidated financial statements to the Securities and Exchange Commission of Thailand .

Statutory Reserve: A statutory reserve of at least 5% of annual net profit arising from the business must be appropriated by the company at each distribution of dividends until the reserve reaches at least 10% of the company's authorized capital.

Stock Dividends: Stock dividends are taxable as ordinary dividends and may be declared only if there is an approved increase in authorized capital. The law requires the authorized capital to be subscribed in full by the shareholders.

Auditing requirements and standards

Audited financial statements of juristic entities (i.e. a limited company, registered partnership, branch, representative office, regional office of a foreign corporation, or joint venture) must be certified by an authorized auditor and be submitted to the Revenue Department and to the Commercial Registrar for each accounting year.

Patent rights in Viet Nam

ASEAN Intellectual Property Association (ASEAN IPA)

http://www.aseanipa.org

Compulsory license

The right to use an invention shall, without permission of the patentee, be granted to another entity or individual upon decision of the State competent authority if (i) the use of the invention is intended for the public interest, non-commercial purposes, national defense, security, prevention and treatment of disease, for people's nutrition, or meeting other urgent needs of society; (ii) the patentee fails to fulfill the obligation of using the invention after the expiration of four years from the date of filing of the patent application and three years from the granting date of the patent for invention; (iii) the person who wants to use the invention fails, within a reasonable period of time for negotiation on reasonable considerations and commercial conditions, to reach an agreement with the patentee on a license to use such an invention; or (iv) the patentee is regarded as performing an act of anti-competition prohibited under the competition law and regulations.

The right to use the invention under the compulsory license granted by a decision of a State competent authority shall meet the following conditions:

a. The right to use shall be non-exclusive;

b. The right to use shall only be limited to such a scope and duration sufficient to attain the purpose for which the compulsory license was granted, and predominantly for the supply of the domestic market;

c. The licensee of the compulsory license shall not assign the right to use the patented invention to another person, except where the assignment is made together with his/her business establishment and sub-license others to use the patented invention;

d. The licensee of the compulsory license shall pay the patentee/licensor adequate remuneration, taking into account the economic value of the allowed use, in compliance with the remuneration frame provided for by the Government;

e. The patentee of the dominant invention shall also be entitled to grant a license to use the dependent invention on reasonable terms and conditions; and

f. The licensee of compulsory license to use the dominant invention shall not be entitled to assign such right, except with the assignment of the entire right to the dependent invention.

Other cases

The following shall be exempted from patent infringement:

1. Use of the invention or industrial design for personal needs or non-commercial purposes, or for the purposes of evaluations, analysis, research, teaching, testing, pilot production or for collecting data to carry out procedures to obtain a production license, import or product marketing permit;

2. Use of the invention or industrial design only for the purpose of maintaining the operation of a foreign vehicle in transit or only temporarily entering into the territory of Vietnam.

Who may file and where to file patent applications

The right to file a patent application for invention or industrial design generally belongs to inventors who have created the invention or industrial design by his/her own efforts and expenses. In case an invention or industrial design is created by the inventors during the course of employment or hire, the entitlement to file patent applications for such invention or design shall belong to the entities or individuals who have invested finance and material facilities to the inventors through employing or hiring, unless otherwise agreed by the parties (the employee invention). In this case, the employees shall enjoy some moral rights over the invented technology in addition to some remuneration. Moral rights of employee-inventor(s) are to be named as inventor in relevant patent letters as well as in any documents in which the invented technology is published or introduced. The remuneration for the employees is stipulated as 10% of benefits obtained from using the invention, and 15% of the sum amounted from each royalty for granting a license to use the invention, unless otherwise agreed by the parties. In addition, persons entitled to file an application may assign that right to other organizations or individuals through written contract or inheritance in accordance with the law.

The right to file patent applications for inventions/industrial designs made by using the State budget belongs to the State.

All applications must be lodged with the National Office of Intellectual Property (NOIP), which has been entrusted to be the State administrative authority under the jurisdiction of the Ministry of Science and Technology. Vietnamese entities and individuals, foreign individuals permanently residing in Vietnam, and foreign entities having an industrial or commercial establishment in Vietnam may file patent applications directly or through an IP agency licensed to practice before the NOIP.

Managing and enforcing patents in Singapore

Intellectual Property Office of Singapore (IPOS)
https://www.ipos.gov.sg

Term and renewal

The term of a patent is 20 years from the Date of Filing of the patent application, subject to the payment of annual renewal fees. To maintain your patent, you will need to pay an annual renewal fee, starting from the end of the 4th year from the Date of Filing, and every year thereafter, until the patent expires.

In the event that grant was issued after 45 months from date of filing, all renewals due will only be payable within 3 months after the date of grant. You can renew your patent by submitting Patents Form 15 together with renewal fees. If you have made an entry in the register for License of Right (LOR), you can renew your patent at half price, using Patents Form 53.

Applying for a LOR

If you are interested in licensing your patent to a third party, you may wish to endorse your patent with a LOR after the patent is granted. This can be done by applying for an LOR entry to be made in the Patents Register. An LOR may help you attract licensees, and your patent renewal fees that are payable after the LOR entry is made would also be halved. However, this means that you cannot refuse to license the invention. The terms of the LOR are to be negotiated between you and the licensee. If both parties are not able to reach an agreement on the terms of the LOR, either party may request the Registrar to settle the terms of the LOR.

Cancelling a LOR

If you wish to cancel an LOR entry in the Patents Register, you will need to complete and submit Patents Form 28 (S$40). If the Registrar is satisfied that there is no existing license under the patent or that all licensees under the patent consent to the application, and the balance of all renewal fees which would have been payable if the entry had not been made have been paid, the Registrar may cancel the entry.

Obtaining a license to a patent

If you are interested in obtaining a license to someone's patent but do not know where to start, you may start by looking at our Patents Register for patents that are endorsed with a **LOR** entry. To facilitate the search process, IPOS has consolidated a list of Singapore patents with such endorsements. The LOR list contains details of all live granted patents with a LOR status extracted from the Patents Register. However as the LOR status of a patent can change (e.g. if a LOR endorsement is cancelled), you should check the Patents Register before relying on the information in this list.

Infringement of registered patent

If you discover that a person, without your consent:

- (in the case where the invention is a product) makes, disposes of, offers to dispose of, uses or imports the product or keeps it whether for disposal or otherwise
- (in the case where the invention is a process) uses the process or he offers it for use in Singapore when he knows, or it is obvious to a reasonable person in the circumstances, that its use without the consent of the proprietor would be an infringement of the patent or
- (in the case where the invention is a process) disposes of, offers to dispose of, uses or imports any product obtained directly by means of that process or keeps any such product whether for disposal or otherwise

You can exercise your rights under the Patents Act by taking legal action against the infringing party, including seeking relief in the form of an injunction to stop the infringing action, demanding for the profits gained by the infringing party at his expense and/or, seeking damages for the loss suffered.

Revocation of patent

Even though your patent has been granted, anyone can revoke the patent by applying to the Registrar. Revocation proceedings can take place on the grounds that:

- The invention is not a patentable invention.
- The patent was granted to a person who is not entitled to the grant.
- The specification does not disclose the invention clearly and completely for it to be performed by a person skilled in the art.
- The matter disclosed in the specification extends beyond that disclosed in the patent application as filed.
- The amendment or correction to patent application or patent should not have been allowed.
- The non-disclosure/inaccurate disclosure of prescribed material information.
- The patent was obtained on any misrepresentation.
- The patent is one of two or more patents for the same invention having the same priority date and filed by the same party or his successor in title.

Starting a business: Source of funds

SME Corporation Malaysia
http://www.smecorp.gov.my

How much money do you need?

It depends on your type of business and how quickly you plan to expand. You should sit down and write out how much your expected expenses will be for at least the next 24 months and how much you project to bring in as far as income on a monthly basis. There are several companies that can help you get started with funding your business. You can refer back to your business plan or start asking yourself what type of expenses do you need the money for? Generally, for a start-up business, there will be a few costs involve:

- **Cost of sales:** Product inventory, raw materials, manufacturing equipment, shipping, packaging, shipping insurance, warehousing
- **Professional fees:** Setting up a legal structure for your business , trademarks, copyrights, patents, drafting partnership and non-disclosure agreements, attorney fees for ongoing consultation, retaining an accountant
- **Technology costs:** Computer hardware, computer software, printers, cell phones, PDAs, website development and maintenance, high-speed internet access, servers, security measures, IT consulting
- **Administrative costs:** Various types of business insurance, office supplies, licenses and permits, express shipping and postage, product packaging, parking, rent, utilities, phones, copier, fax machine, desks, chairs, filing cabinets – anything else you need to have on a daily basis to operate a business
- **Sales and marketing costs:** Printing of stationery, marketing materials, advertising, public relations, event or trade show attendance or sponsorship, trade association or chamber of commerce membership fees, travel and entertainment for client meetings, mailing or lead lists
- **Wages and benefits:** Employee salaries, payroll taxes, benefits, workers compensation

Where to get the money?

All businesses require some form of financing. The most basic rule in financing a business is to commit yourself and your savings or other resources to the business. This will ensure your whole hearted commitment to its success. This is also a strong sign of good faith and commitment for other potential lenders/investors as, if you are not seen to be willing to risk your own funds why anyone else should! Further, for a start-up business, there may not be a wide variety of sources of funds as it is still untested. Hence, you will have to come up with the capital, from personal savings or through selling off surplus assets you may have.

Personal saving

There's nothing like having your own money saved, to put into your startup. You have the satisfaction of having saved it on your own, and the knowledge that you don't owe anyone. When using your own money to finance a business, you will feel more personally invested in the project, because it is basically your money on the line. However, there is more flexibility in using your own money. For example, if your business is having a slow start, you do not need to worry about paying back a bank loan because you used your own money.

But the risk you may face is that – It's your money, and if you're not successful, the money is gone, and with it the opportunity to do anything else with it later. It can also create another financial burden. Most people have a savings account for general purposes. In other words, the money is not saved for any particular purpose and is used whenever it is needed for whatever reason. As such, draining such an account may negatively affect your financial situation if you need to dip into that savings account for an emergency.

However, if the personal savings you use to finance a business was money saved for that particular purpose, you should not have any financial troubles as a result of the draining of that account. If your savings account was set up for the purpose of opening a business, this means that you planned ahead and reserved that savings account for that purpose only, and thus, will not feel the pinch in an emergency because you will have other funds available for that purpose.

Financing with debt

Financing a business with debt involves securing a loan. This can be in the form of either unsecured or secured debt. Unsecured debt refers to a loan taken without having to put up any specific form of security or collateral. This involves mainly borrowing from family or friends, a credit card, line of credit and other similar means.

Secured debt, on the other hand, refers to loans where you are required to put up some form of collateral in exchange for the loan, for example, mortgage on the house or refinancing your car, among others. For secured debts, you need to be able to assure the lender about your ability to meet your payments either

through your business or other means. To secure such debt is some cases you will need to present a solid business plan, evidence of your experience and of your ability to repay.

Family and friends

Raising finance from family and friends can be rewarding for both parties: you get the finance to start or expand your business, while your family and friends have the satisfaction of helping you while earning interest on their spare cash. Family and friends may accept more flexible terms and conditions that are better suited to your business than those offered by commercial banks.

Often arrangements with family and friends are informal and based purely on trust and verbal assurances. However, a formal written agreement is strongly advised in order to minimise disputes in the future. Preserving your relationships with friends and family is as important as pursuing your business opportunity.

Personal loan

Financing a business with personal loans means that you borrow the money personally to invest it in your business. This is typically used at start-up or early stages where the business has not established enough history or performance to be able to secure a loan on its own merit.

Mortgage loan

Another source for financing a business is a home mortgage loan. Some banks allow you to mortgage or refinance your house. This may be a risky move as if you are unable to make the scheduled payments, you risk losing your home. It is therefore crucial that you are confident on your continued ability to make all payments scheduled.

Insurance loan

Another source of loan could be from your insurance policy. If you have been paying for a life insurance policy that builds up a cash value you are entitled to take up a loan on the cash value amount. Many insurance companies will loan you money with the cash value as security. This is a rather expensive method of financing a business and also means reduced benefits if you are unable to clear the loan and interests accrued.

Credit cards

Credit cards can also be a source for financing a business when you are first getting started. However, this is another expensive method as the rates charged can be high and it could also affect your credit rating, required for other sources of financing.

Government small business loans

There are a variety of government small business loans and programs that can be used in financing a business, including those specifically for Bumiputeras and micro entrepreneurs. Most of these loans are administered by the Financial Institutions like the Development Financial Institutions (DFIs) and the commercial banks. While some are directly administered by the department/agency involved. Funding from these sources may be relatively easier to secure as the government department/agency guarantees your loan, if you are approved.

Grants

There are often a variety of government grant programs for specific types of startup businesses. For more information, search online on government websites. Unless they're reputable, don't pay money to sites that tell you they'll give you a big list of where you can get grant money. The risk is that - While grants are rarely required to be paid back, accountability is higher, and you might have to work within a difficult deadline, to show your progress. If you do not achieve the progress you indicated in your proposal, there may be some sort of penalty.

Bank loans

Banks lend money to existing businesses but for a start-up, it may be very difficult to get a bank loan as they do not have a track record. Banks require a sound business plan and must be convinced of the viability of your business before they agree to lend you money. Banks also normally need collateral as security. If you have a solid business plan and the lender agrees, this can often be the cheapest (interest rate-wise) loan sources available. The risk is that besides the fact that it's often hard for a startup to qualify - since there's little evidence you'll be profitable - if you do get a loan, it can be like a ticking time bomb if your business isn't doing well.

Equity financing

Equity Financing is borrowing where the investor/financier becomes a part-owner of the business in the process. This could be through venture capital or issuing shares.

Venture capital

Venture capitalists do not want to remain in your business forever. Generally, they want to see an exit strategy that will see them out in about 5 years, with a high return on their investment as their reward. In terms of areas of interest, venture capitalists are interested in both high technology and various other industries. Normally they fund businesses which have already been launched and have probably reached profitability.

The angel investor, on the other hand, is a special type of venture capitalist. Usually an individual with substantial funds, the 'angel' provides capital to start-up companies and takes a personal stake in the venture. Depending on the individual 'angel', their requests for any form of control or a quick return on investment will differ. However, similar to regular venture capitalists, they seek high returns on their investment for the risks they take on.

Credit support schemes for MSMEs in India

Ministry of Micro, Small & Medium Enterprises, Government of India

http://msme.gov.in

Credit linked capital subsidy scheme

The Scheme aims at facilitating technology up-gradation by providing 15 per cent upfront capital subsidy up to a maximum cap of ₹ 15.00 lakhs (i.e., maximum investment in approved machinery is ₹ 1.00 crore) to MSE units including tiny, khadi, village and coir industrial units on institutional finance availed by them for induction of state-of-the-art or near state-of-the-art technology for up-gradation of the present technology level to a substantially higher one involving improved productivity, and/or improvement in quality of product and/or improved environmental condition including work environment. It would also include installation of improved packaging technique as well as anti-pollution measures, energy conservation machinery, in-house testing and on-line quality control.

IP Facilitation Centre for MSME

Objectives

To enhance the competitiveness of the MSMEs sector, a scheme "Building Awareness on Intellectual Property Rights (IPR)" for the MSME is administrated with the objectives as under:

- To enhance awareness of MSMEs about Intellectual Property Rights (IPRs)
- To take measure for the protecting their ideas and business strategies.
- Assists to SMEs in technology up-gradation and enhancing competitiveness and for effective Utilization of IPR Tools by MSMEs.

Salient features

Sensitise entrepreneurs on IPR related matters by providing financial assistance for taking up the identified initiatives covering broad areas of interventions as noted below:

- Sensitising SMEs on IPR related issues by organizing Awareness / Sensitisation Programmes
- Conducting Pilot Studies and Interactive Seminars / Workshops for selected Clusters and Groups of Industries.
- Specialized Training programmes for Government officials and Industries.
- Assistance is being provided to the Granted Patent & Geographical Indications.
- Implementing agency has to contribute 10% of the GOI assistance for each activity prescribed in the scheme guideline.

Design clinic

Objectives

- To create a sustainable design eco system for the MSME sector through continuous learning and skill development
- Bring the industrial design fraternity closer to the MSME Sector
- Develop an institutional base for the industry's design requirement;
- Increase the awareness of the value of design and establish design learning in the MSME
- Increase the competitiveness of local products and services through design.

Salient features

- Applicability of project funding is to an individual MSME or a group of MSMEs coming together.
- A Design Company/ Academic Institutions will visit the unit and scrutinize all designs relevant fields & will suggest next steps to be taken.
- Project Proposal to be prepared and to be submitted to Design Clinic Centre for consideration.
- Mobilization and co-ordination workshop for MSME officials.
- Seminar / Workshops (including need assessment survey).
- Promotional Activities such as Orientation programme for stake holders, Study on Global
- Practices & Design Clinic Programme of other countries and National Level Workshop, etc.
- Implemented through National Institute of Design (DIPP Institution).

Lean manufacturing

Objectives

The objectives of the scheme is to enhance the manufacturing competitiveness of MSMEs through the application of various Lean Manufacturing (LM) techniques by:

- Reducing waste
- Increasing productivity
- Introducing innovative practices for improving overall competitiveness

- Inculcating good management systems
- Imbibing a culture of continuous improvement

Salient features

- The Lean Manufacturing Competitiveness Scheme was started as a pilot phase in 2009 for 100 Mini Clusters (10 or so manufacturing MSME units) in 11th Five Year Plan. National Productivity Council (NPC) was selected as National Monitoring and Implementing Unit (NMIU) for facilitating implementation and monitoring of the Scheme. Intervention of Lean Techniques started in 89 Mini Clusters and successfully. Work completed in 59 Mini Clusters with an expenditure of Rs 16.17 cr under the Pilot phase of LMCS.
- The Scheme was up-scaled in September, 2013 considering the recommendations of the evaluation report conducted by Quality Council of India (QCI). The evaluation report on Implementation of pilot LMCS has recommended the continuation of the Scheme keeping in view benefits amounting to about 20% increased in productivity to the units. The up-scaled Scheme approved with a Total Project cost of Rs 240.94 cr. (GOI contribution Rs 204.94 cr.) for 12th Five Year Plan for 500 Mini Clusters.

Quality management standards & quality technology tools

Background and salient features

The scheme is aimed at improving the quality of the products in the MSE sector and inculcates the quality consciousness in this sector. With the adoption of this scheme, MSEs will become more competitive and produce better quality products at competitive prices. The adoption of these tools will enable MSEs to achieve efficient use of resources, improvement in product quality, reduction in rejection and rework in the course of manufacturing, reduction in building up inventory at various stages etc.

The scheme insists of multifold activities out of which following major activities are being implemented through various expert agencies/organization, viz.

- One day Awareness Campaign,
- 2 days duration workshop at Metros,
- One National Level workshop at Delhi,
- Implementation of QMS/QTT in selected MSEs Cluster,
- Monitoring International Study Mission,
- ITI/Polytechnic teacher training,
- Course module in polytechnic syllabus, etc.

Technology and quality upgradation

Objectives of the scheme

- The first objective of the present Scheme is to sensitize the manufacturing MSME sector in India to the use of energy efficient technologies and manufacturing processes so as to reduce cost of production and the emissions of GHGs.
- The second objective of the scheme is to encourage the MSMEs to acquire product certification/licences from National/International bodies and adopt other technologies mandated as per the global standards.

Salient feature of the scheme

- Sensitize the manufacturing MSME sector in India to the use of energy efficient technologies and manufacturing processes so as to reduce cost of production and the emissions of GHGs by providing EET equipments.
- Creating awareness among the MSMEs within and around the identified Clusters about Market Transformation of Energy Efficiency, Carbon Credit Trading, etc.
- Increased adoption of National /International Product Certification standards by the MSME sector to enhance profitability of the implementing MSMEs by reducing energy costs and also through possible income from carbon credits.

Incubation

Objectives

- To promote emerging technological and knowledge based innovative ventures that seek the nurturing of ideas from professionals.
- To promote and support untapped creativity of individual innovators and also to assist Individual innovators to become technology based entrepreneurs.
- To promote networking and forging of linkages with other constituents of the innovation chain for commercialization of their developments.

Salient features

- Under this scheme Government of India is providing opportunity to the innovators in developing and nurturing their new innovative ideas for the production of new innovative products which can be sent in to the market for commercialization. This Ministry has been implementing this scheme since 2008 under the approved guidelines which permits the Govt. GoI financial assistance of 75 % to 85 % of the project cost up to the maximum of 8.00 Lakh. This fund is routed through the Business Incubator (BIs).
- These BIs are IITs, NITs, Engineering Colleges approved by AICTE, Central / State Universities recognized by UGC and other recognized R & D and / or Technical Institutes / Centres, Development Institutes of DIP&P in the field of Paper, Rubber, Machines Tools, etc. These Institutions are also known as host institutions.
- Host Institutions (HI) are exploring the new innovative ideas from the Incubatee of various sectors that may be existing and prospective entrepreneurs. Even the students from the various streams are also participating in nurturing their new ideas through the Host Institutions as a part of their studies and carrier building.

Innovation and capability voucher in Singapore

SPRING Singapore

https://www.spring.gov.sg

The innovation and capability voucher (ICV) is a simple to apply, easy-to-use voucher valued at $5,000, to encourage small and medium-sized enterprises (SMEs) to develop their business capabilities. SMEs can use the voucher to upgrade and strengthen their core business operations through consultancy in the areas of innovation, productivity, human resources and financial management. Apart from consultancy, ICV also supports SMEs in the adoption and implementation of pre-scoped Integrated Solutions to improve business efficiency and productivity.

Eligibility

All local SMEs can apply for ICV if they meet the following criteria:

- Registered and operating in Singapore
- Have a minimum of 30% local shareholding
- Have group annual turnover of not more than $100 million OR group employment size of not more than 200 employees

Consultancy projects

For consultancy projects, each voucher may be redeemed for services from the participating Service Providers. An SME may apply for a maximum of two vouchers per capability area for supported services.

Consultancy – financial management

- Planning & Budgeting
- Cash-flow & Working Capital Management
- Financial Assessment and Planning for Growth

Consultancy – human resources

- Recruitment & Selection
- Compensation & Benefits
- Performance Management
- Learning & Development

Consultancy – innovation

- Technical Feasibility Study
- IP Business Diagnostic
- IP Legal Diagnostic
- Customer Insights

Consultancy – productivity

- Quality Management – ISO 9001 : 2015
- Environmental Management – ISO 14001 : 2015
- Occupational Health & Safety Management – OHSAS 18001
- Business Diagnosis
- Service Improvement

Integrated solutions

For Integrated Solutions projects, each voucher may be redeemed for an Integrated Solution from the participating Integrated Solution Providers (ISP). Each SME can apply up to a maximum of two vouchers to implement pre-scoped Integrated Solutions out of the available eight vouchers for each SME.

Created in collaboration with SMEs, industry partners and experts, Integrated Solutions are tried-and-tested, plug-and-play tools that help SMEs overcome common business challenges and achieve overall productivity gains. With Integrated Solutions, minimal effort is required from SMEs to design and test innovation and capability development solutions.

Operating costs, such as the following, will not be supported:

- Government licensing and permit cost
- Accounting/audit/legal fees
- Set-up costs for new businesses e.g. Renovation for new outlets / purchase of operating items and etc.
- Essential business costs i.e. Costs required to be incurred so that basic operations of the company can be carried out
- Replacement cost due to damages, wear and tear and etc

Consultancy service and solution providers

Consultancy service and solution providers need to be pre-qualified to assist SMEs in implementing ICV-supported Consultancy and/or Integrated Solutions projects. Companies that would like to be pre-qualified should participate in upcoming Call-for-Collaborations (CFCs).

Effective 1 January 2017, management consultants are required to possess SPRING-recognised certification in order to participate in ICV CFC for consultancy service providers. Consultants under the existing list of pre-qualified consultancy service providers for ICV-Consultancy will retain their pre-qualified status up to the end of their current term of appointment.

Innovation promotion in India

National Institution for Transforming India, Government of India

http://niti.gov.in

Atal Innovation Mission (AIM) including Self-Employment and Talent Utilization (SETU) is Government of India's endeavour to promote a culture of innovation and entrepreneurship. Its objective is to serve as a platform for promotion of world-class Innovation Hubs, Grand Challenges, Start-up businesses and other self-employment activities, particularly in technology driven areas.

The AIM shall have two core functions:

- Entrepreneurship promotion through SETU, wherein innovators would be supported and mentored to become successful entrepreneurs
- Innovation promotion: to provide a platform where innovative ideas are generated

Atal grand challenge awards

The factors holding back rural and semi-urban India are lack of 24/7 electricity, roads that are usable round the year, clean water, suitable housing, access to basic healthcare, quality education, lack of farm mechanisation and employable skills. While state-of-the-art technology can address a number of these challenges, the existing solutions have been out of reach due to their excessive high costs.

Atal Grand Challenge (AGC) Awards, under the AIM, has the objective of developing novel disruptive technologies that are ultra-low cost, low maintenance, durable and customised to the local conditions of India. AGC will award grand prizes to anyone who delivers in a timely manner the desired solution as per the challenge specific criteria. The National Institution for Transforming India has called on the national and the international community to join the initiative and in finding solutions to the most intractable problems.

Atal Tinkering Labs

With a vision to 'Cultivate one Million children in India as Neoteric Innovators', AIM is establishing Atal Tinkering Laboratories (ATLs) in schools across India. The objective of this scheme is to foster curiosity, creativity and imagination in young minds; and inculcate skills such as design mindset, computational thinking, adaptive learning, physical computing etc.

ATL is a work space where young minds can give shape to their ideas through hands on do-it-yourself mode; and learn innovation skills. Young children will get a chance to work with tools and equipment to understand the concepts of STEM (Science, Technology, Engineering and Math). ATL would contain educational and learning 'do it yourself' kits and equipment on – science, electronics, robotics, open source microcontroller boards, sensors and 3D printers and computers. Other desirable facilities include meeting rooms and video conferencing facility.

In order to foster inventiveness among students, ATL can conduct different activities ranging from regional and national level competitions, exhibitions, workshops on problem solving, designing and fabrication of products, lecture series etc. at periodic intervals.

Atal Incubation Centers

AIM intends to establish 'new' incubation centres (Atal Incubation Centres) across India by providing them with financial support. AICs would further support and encourage start-ups to become successful enterprises. They would provide necessary and adequate infrastructure along with high quality assistance or services to start-ups in their early stages of growth.

AICs would be established in subject specific areas such as manufacturing, transport, energy, health, education, agriculture, water and sanitation etc. Each AIC would be required to choose at least one area for specialisation.

AICs can be established either in public/private/public-private partnership mode. These can be established in:

- Academia - This includes higher educational institutes and R&D Institutions.
- Non-academic - This includes Companies/ Corporates/ Technology parks / Industrial Parks/ any individual/ group of individuals.

AIM will provide a grant-in-aid of Rs. 10 Crore to each AIC for a maximum of 5 years to cover the capital and operational expenditure cost in running the centre. The applicant would have to provide a built up space of at least 10,000 sq. ft to qualify for the financial support.

Scale-up support to established Incubators

The scheme envisages to augment capacity of the Established Incubation Centres in the country. It will provide financial scale-up support to enable Established Incubation Centres. The scheme would radically transform the start-up ecosystem in the country by upgrading the Established Incubation Centres to world-class standards.

- Legal entity registered in India as public, private or public-private partnership.
- Legal entity must be in operation for a minimum of three years.

Schemes for promotion of energy efficiency

Small Industries Development Bank of India (SIDBI)

https://smallb.sidbi.in

Needs and benefits of energy efficiency

Micro, Small and Medium Enterprises (MSMEs) are particularly vulnerable due to limited resources and constrained operating margins. Rising energy costs can further lead to higher production and distribution costs for MSMEs, thus eroding long-term competitiveness and profitability. Reduction in energy costs could be beneficial for MSMEs for reducing production costs and distribution costs.

Some favorable benefits of implementing energy efficiency in MSMEs include the following:

- **Improved employee productivity** – Controlling air temperatures for improving air quality and installing high-efficiency lighting can have positive effects on productivity.
- **Health and safety** – Energy efficiency systems in residential, commercial and/or industrial entities can also enable conducive conditions that are not harmful for health and safety of the occupants.
- **Improved product quality** – Large investments in energy efficient equipments can lead to savings in energy costs and costs of long-lasting investments had shorter pay-back time thus ensuring product quality in business units.
- **Environmental impact** – Greenhouse gas (GHG) emissions through energy efficient systems are tested across relevant business standards in India. Accordingly, GHG emissions have been considerably limited.
- **Competitiveness** – The summation of the above mentioned benefits can provide an edge to small and medium-sized enterprises (SMEs) and the ability to compete in the market.

Energy efficiency in SME scheme

SMEs can avail financial scheme provided by SIDBI that can encourage MSME investments in the energy saving equipments. The Bureau of Energy Efficiency (BEE) of Government of India has been engaged in conducting information dissemination workshops regarding energy efficiency opportunities for 28 select SME clusters.

Bachat Lamp Yojana

The "Bachat Lamp Yojana" is a voluntary CFL lighting scheme operated and implemented under the Small-Scale Programme of Activities (SSC-PoA) by BEE in collaboration with Electricity Distribution Company (DISCOMs). The scheme is considered a result of the powers bestowed on BEE under the 'Indian Energy Conservation Act, 2001' of formulating and facilitating the promotion of efficient use of energy and encouraging innovative financing of energy efficiency projects. Following are few, select features of the scheme:

- The scheme would involve distribution of quality long-life, self-ballasted CFLs through SSC-PoA to residential households in exchange of the Incandescent Lamp (ICL) at ` 15. The price of CFLs under the scheme is much lower than the market prices of approximately ` 80 to ` 130.
- The SSC-PoA implementers are responsible for arranging collection and disposal of CFLs that have either reached their end of life or failed prematurely during project implementation.
- Long-life CFLs meet more than expected requirements of IS 15111 standard that specifies a minimum 6000 hours rated life time.
- The self-ballasted CFLs usually have 2, 4 or 6 small fluorescent tubes mounted in a base attached to ballast and the efficacy ranges from 51 to 56 lm/W, which is four to five times higher than a similar ICL.

Standards & labeling scheme

The scheme aims at providing the consumer an informed choice about energy saving and accordingly cost-saving potential of the marketed household appliances and other equipments. The scheme was launched in May 2006 that covers mandatory and voluntary schemes shown in the following tables for equipments and appliances such as frost-free refrigerator, tubular fluorescent lamps, room air conditioners, direct cool refrigerators, distribution transformers, induction motors, pump sets, ceiling fans, LPG, electric geysers and TV.

Energy conservation building code (Star Ratings program)

BEE has introduced various schemes related to providing 'Star Ratings' to commercial buildings of BPOs, office buildings, schools, healthcare facilities and hotels (Refer to Table 3). Star ratings program will involve rating by computing the performance of energy efficiency in buildings on a scale of one to five with five star labeled buildings being the most energy efficient.

Strengthening institutional capacity of state designated agencies (SDA)

BEE has identified SDA that are responsible for coordination regulation and enforcement of the provisions of the Energy Conservation Act, 2001.

Resource efficient and cleaner production

United Nations Environment Programme (UNEP)

http://www.unep.fr

Resource efficient and cleaner production (RECP) continuously applies integrated and preventive strategies to processes, products and services. This increases efficiency and reduces risks to humans and the environment. RECP specifically works to advance

- **Production efficiency** – through optimization of productive use of natural resources (materials, energy, water) at all stages of the production cycle;
- **Environmental management** – through minimization of the adverse impacts of industrial production systems on nature and the environment;
- **Human development** – through minimization of risks to people and communities, and support to their development.

The joint UNEP-UNIDO programme

The Rio Declaration and Agenda 21 that were adopted by the United Nations Conference on Environment and Development (UNCED) held in 1992 called on the international community to support developing countries and economies in transition with capacity building and implementation of preventive environmental approaches. In response to this call, UNEP together with the United Nations Industrial Development Organization (UNIDO) launched the International Project on establishment of National Cleaner Production Centers (NCPCs). This has led to the establishment of NCPCs in more than 40 developing countries and economies in transition to provide core RECP services. The independent evaluation that was carried out in 2008 had shown that these Centers have made significant contribution on demonstrating the benefits of applying Cleaner Production in industries. The evaluation also underlined the need to further strengthen the support provided through a programmatic approach in order to upscale the application of RECP. This led to the development of the Joint UNIDO-UNEP Programme on RECP in Developing and Transition Economies.

RECP objective

The objective of the Joint Programme is to contribute to sustainable industrial development and sustainable consumption and production in the participating developing and transitional economies, through the greater uptake of RECP by businesses, governments, financial institutions and other stakeholders. The Programme provides a strategic and coherent framework for the up-scaling and mainstreaming of RECP activities in national development frameworks and facilitates regional and global cooperation through knowledge management and experience sharing network.

The Programme is structured in four outcome areas, each with dedicated activities and outputs:

- **Effective networking and peer learning** amongst a network of competent, nationally directed initiatives that deliver high quality, value-adding RECP services, responding to the needs of enterprises and other organizations. RECP service delivery capacity is enhanced and expanded through such activities as establishment of NCPC and NCPPs in new countries, intensification of networking and peer learning, and RECP up-scaling through existing NCPCs and NCPPs;
- **Implementation of RECP by businesses and other organizations** with verified resource productivity, environmental, economic and other societal benefits. Key activities and outputs are thematic and multi-country projects in three categories: resource efficiency; waste and emission prevention; and corporate responsibility safe and responsible production;
- **Effective enabling environment for RECP implementation** through government policy and enterprise finance. The principal activities and outputs include the development and trial of flexible frameworks for mainstreaming RECP in government policy and enterprise finance; and
- **Enhancement of national capacities to facilitate and manage the transfer, adaptation and replication of Environmentally Sound Technologies (ESTs) and sustainable product developments.** The main activities and outputs relate to strengthening national innovation systems as a mechanism for bolstering and accelerating sustainable innovations in technologies and products.

Key elements

RECP describes a preventative approach to environmental management. It is neither a legal nor a scientific definition to be dissected, analysed or subjected to theoretical disputes. It is a broad term that encompasses what some countries/institutions call eco-efficiency, waste minimization, pollution prevention, or green productivity.

RECP refers to a mentality of how goods and services are produced with the minimum environmental impact under present technological and economic limits.

RECP does not deny growth, it merely insists that growth be ecologically sustainable. It should not be considered only as environmental strategy, because it also relates to economic considerations.

RECP is a 'win-win' strategy. It protects the environment, the consumer and the worker while improving industrial efficiency, profitability, and competitiveness.

Technology Offers

HUNGARY

Bio-compatible plug for orthopedic hip prosthesis

A Hungarian SME developed the prototype of bio-compatible bone plug that is suitable for use as a cement restrictor for hip prosthesis. Advantages of bio-compatible bone plugs over actually used cement stop are lower costs and shorter convalescence. This bio-absorbable bone plug can be used for the primarily implantation and revision of cement restricted hip prosthesis. Plugs actually used are made from femoral head of the patients, plastic and gelatin.

Area of Application

Surgery, Physiotherapy, Orthopedic technology

Advantages

- It shortens the time of the hip revisions operations by 25%, which means this technology makes the time of procedure shorter by one hour.
- It simplifies the procedure needed to be done in case of a prosthesis revision, lower the risk, which is caused by the removal of permanent plugs.
- Bio-absorbable bone plug of hip prosthesis causes no injury and/or health problem for the patient.
- It does not need specific know-how to be use.
- After short preparations of surgeons they will be able to use bio-compatible plugs.

Development Status

Commercial prototype

Legal Protection

Secret know-how

Transfer Terms

- Joint venture
- Technology licensing

Natural preparation for relief of anxiety

Description

We offer a food supplement in the form of tablets that effectively relieves mild to moderate anxiety problems. The active ingredient is an herbal extract with a scientifically proven efficacy.

Area of Application

Pharmaceuticals

Advantages

The active principle of the preparation is a specific extract of *Echinacea angustifolia*. Recent studies suggested that this plant contains active principles that have beneficial effects on the brain mechanisms involved in the generation of anxiety. A two-year long research program confirmed anxiolytic efficacy but also showed that only a small fraction of available Echinacea preparations has anxiolytic effects of any kind.

Development Status

Fully commercialized

Transfer Terms

Equipment supply

Target Countries

Worldwide

For the above two offers, contact:

Laser Consult Ltd (Hungary)
H-6701 PO Box 1191
Szeged
Hungary

INDIA

Herbal formulation for healing and protecting skin

It is composed of a natural wax as an emulsifier, extract of *Centella asiatica*, Aloe vera gel and the gum of Acacia, Colophonium, or Shorea. The gum gives a synergistic effect in binding and healing the skin with natural wound healing herbal extract selected from the aqueous extracts of *Centella asiatica*. This is combined with wound healing fragrant oil; basil, chamomile oil, or mentha oil.

Area of Application

Pharmaceutical and cosmetic industry

Advantages

Safe for topical use, do not produce any adverse effect on the skin, eco-friendly, prevents water loss and promotes healing, spreads evenly on the applied parts.

Environmental Aspects

Healthcare

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing
- Research partnerships

Herbal formulation for urinary tract infection

The herbal formulation comprises amla (*Emblica officinalis*), bahera (*Terminalia bellirica*), harad (*Terminalia chebula*), corn silk (*Zea mays*), cone flower (*Echinacea purpurea*), and plantain (Plantago major). The herbal formulation may be developed into different dosage forms such as powder, tablet, or capsules.

Area of Application

Pharmaceutical industry

Advantages

The components of the formulation act synergistically against pathogenic bacteria of urinary tract infection, no side effects, cost effective, more effective than already available medicines in the market.

Development Status
Laboratory model

Legal Protection
Patent

Transfer Terms
- Consultancy
- Technical services
- Technology licensing
- Research partnerships

Target Countries
Worldwide

Herbal nutraceutical formulation

The nutraceutical formulation comprises the combination of probiotics that essentially includes *Lactobacillus acidophilus* and *Lactobacillus sporogenes*, and medicinal plants that essentially includes *Commiphora wightii* and *Terminalia belerica*. The nutraceutical composition can be used as a side effect-free alternative to drug therapy in the treatment of high cholesterol and heart disease.

Area of Application
Pharmaceutical industry, Healthcare industry

Advantages
Enhanced curative properties, no side effects, cost effective.

Development Status
Laboratory model

Legal Protection
Patent

Transfer Terms:
- Consultancy
- Technical services
- Technology licensing
- Research partnerships

For the above three offers, contact:
Amity University Uttar Pradesh
Sector-125, Noida
Distt.Gautam Buddha Nagar - 201303
U.P.
India

Sanders wood powder

Red sanders wood is a precious crude drug in the ayurvedic system of treatment, and being very hard and tough, it is very difficult to pulverize. Pulverizing by the conventional technologies leads to generation of very high temperature, which in turn leads to high ash in the sanders wood powder. Due to high temperature, other desirable drug properties and also lipid values get adversely affected. Besides, powder so produced contains lot of impurities such as particles of sapwood, dilapidated parts of wood, etc.

Area of Application
Ayurvedic pharmaceutical, food and cosmetic industries

Advantages
The new red sanders powder is microfine, pure, and free from ash. It looks bright and maintains the original odor. It has high drug and colour values and hence, much more acceptable in the domestic and export markets. As it is pure, it finds more applications in the ayurvedic system of treatment.

Environmental Aspects
Cleaner production

Development Status
Pilot plant

Legal Protection
Complete specification will be filed soon

Technical specifications
- Bright dark-red colour
- Sweet-bitter smell
- Microfine
- Free from ash and impurities

Transfer Terms
- Turnkey
- Others

Target Countries
India

Contact:
InnovaReserach Centre Pvt Ltd
Ochanthuruth
Kochi 682508
India

Nanoparticle–polymer complex for oral care

National Chemical Laboratory (NCL) scientists have developed a process for constructing nanoparticle–polymer complex for sustained release of active agents for oral care (for applications in toothpastes and oral rinses).

Area of Application
Oral hygiene application – sustained release of antimicrobial/ flavour compounds

Advantages
- Precisely controlled polymer multilayers can be built on nanoparticles without the requirement of the cumbersome separation step after each coating of the polymer layers.
- Active compounds localized as per the requirement by fine tuning the outer layer of the complexes retained in the complex despite extensive rinsing with water.
- Enables designing systems that can anchor and retain on the surface enamel of the teeth for extended periods by adjusting the ionic strengths.

Technology Offers

CZECH REPUBLIC

Development Status
- Laboratory model
- Commercial prototype

Legal Protection
Patent

Transfer Terms
Technology licensing

Contact:
National Chemical Laboratory, CSIR
A208, PAML Building, National Chemical Laboratory
Dr Homi Bhabha Road, Pune - 411007
India

Chitin and chitosan

Chitin and chitosan are important byproducts form the shell of shellfishes. Chitin is the most important organic constituent of the exoskeletal material of invertebrates and the important economical source of this material is the shrimp processing industry. Chitin and its derivatives, chitosan, find various industrial applications like, biotechnology, food processing, pharmacy, and medicine.

Area of Application
Various industrial applications like biotechnology, food processing, pharmacy, and medicine

Environmental Aspects
Waste utilization

Development Status
- Pilot plant
- Fully commercialized

Transfer Terms
- Consultancy
- Technology licensing

Contact:
Central Institute of Fisheries Technology
CIFT Junction, Matsyapuri, Willingdon Island
Cochin - 682029
India

HUNGARY

Herbal pesticide

The present technology provides a sprayable biopesticidal composition *comprising Photorhabdus* luminescens for controlling and eradicating various agricultural pests. For the first time, the insecticidal activity of *P. luminescens* is used without its symbiotic carrier nematode. In the present technology, the actively growing cells of *P. luminescens* are encapsulated in sodium alginate beads and examined for their ability to infect insect hosts.

Area of Application
Agriculture

Advantages
- Better alternatives to the conventional chemical compositions
- Effective in controlling the spread of *Ceratovacuna langiera*
- Effective for both soil and aerial applications
- Useful for crops such as cabbage, cotton, pulses, peas, sugarcane, bamboo, grapes, citrus, mango and guava
- Capable of being applied with commonly used agricultural equipment like sprayers and dusters
- Results are comparable to chemical insecticides
- Environment friendly

Development Status
Laboratory model

Legal Protection
Patent applied for

Transfer Terms
Technology licensing

Contact:
SkyQuest Technology Consulting Pvt. Ltd.
501, Krishna Complex, Opp. Devashish School,
Bodakdev Ahmedabad - 380054
India

ISLAMIC REPUBLIC OF IRAN

Hemodialysis machine

Hemodialysis machine which is the most essential equipment for the patients with the kidney failure has been designed based on the international standards IEC 601-1 and 601-2.16 and also is competitive with the most advanced machines from the USA and Germany.

Area of Application
Medical Technologies

Advantages:
Acetate dialysis, bicarbonate dialysis, control and monitoring of temperature, conductivity and flow, volume control ultra-filtration (UFC), safety blood leak detector, safety air bubble detector, auto printing, automatic self-testing, high and low flux dialysis.

Development Status
Fully commercialized

Legal Protection
Trade mark

Technical Specifications
- Flow rate range: 0.5–5 cc/hr, ± 0.2
- Line voltage: 200–240 V AC/1
- Line frequency: 50 Hz
- Line current: 7A
- Power consumption: 1.5 kW
- Safety: Class I type B

Transfer Terms:
- Equipment supply
- Others

Target Countries
Worldwide

Contact:
Iranian Research Organization for Science and Technology (IROST)
No. 71 S.A.Mosavi (Forsat) St., Enghelab Avenue
Tehran15815
Islamic Republic of Iran

ISLAMIC REPUBLIC OF IRAN

Cotton seed oil extraction and refining plant

An Iranian company is planning to establish a cotton seed oil extraction and refining plant. It is looking for help of established Indian company in this field. It will decide about the contribution of each side for manufacturing part of the project after negotiations.

Area of Application
Agriculture, Agro-industry

Transfer Terms
- Technology transfer
- Others

Project Type
New idea

Contact:
Iranian Research Organization for Science and Technology (IROST)
No. 71 Forsat St. Enghelab Ave. P.O. Box 15815, Tehran
Islamic Republic of Iran - 15819
Tel: +982188280517; Fax: +98218838340

POLAND

Recycled PET polyester polyols plant

A Poland-based company specialized in recycled PET polyester polyols manufacturing is looking for alternative proposal of design and engineering of bigger (approximately 25 ktpa) production plant.

Area of Application
Plastic industry, Polymer industry

Project Type
Start-up

Contact:
Alfa Systems,
ul.Sienkiewicza 11 56-120 BrzegDolny
Tel: +4871 319 22 25; Fax: +4871 319 26 95
E-mail: ww@alfasystems.com.pl

SRI LANKA

Plastic recycling technologies

We are in need of latest plastic recycling technologies: automatic sorting, washing, metal detection, granulation process system, washing plants, crushers, extruders.

Area of Application
Plastic recycling

Project Type
Start-up

Target Countries
Worldwide

Assistance from Partner
Technical assistance and equipment supply to start

Additional Information
Please quote with detail specifications

Contact:
National Engineering Research & Development (NERD)
Center, Sri Lanka 2P/17B, Industrial Estate, Ekala, JaEla
Colombo, Sri Lanka

THAILAND

Biotechnology for wastewater treatment system

We need new idea of technology to develop our strength in this wastewater field, including cleaning canal; removing sediment in waterway, biogas, microbiology detector; and treating system quality.

Area of Application
Biotechnology, Engineering, New technology

Studies
Environmental Impact Studies (EIA/EIS)

Project Type
Expansion/Modernization

Target Countries
Worldwide

Contact:
Utility Business Alliance
21 Tst Tower 16th Floor, Viphavadee-rangsit Road, Jompol, Jatujak
Bangkok 10900, Thailand

UNITED KINGDOM

Proteins and polyphenols from dried plant materials

We are looking to identify new processes or technologies that are able to effectively remove/extract proteins and/or polyphenols from dried plant materials, with the aim of using the remaining material in a consumable product. The desired technology should fulfill the following criteria:
- High yield of the remaining material after the extraction process
- Simple and potential to be an economic process
- Preferably the original form of the plant material is maintained after the process, but this is not critical.
- The plant material must be suitable for human contact at the end of the process

Area of Application
Consumable product

Transfer Terms
- Joint venture
- Technical services
- Technology licensing

Project Type
New idea

Target Countries
Worldwide

Contact:
Strategic Allies Ltd.
The Red & White House 113, High Street Berkhamsted, U.K HP4 2 DJ
Berkhamsted HP4 2DJ, United Kingdom

PUBLICATIONS from APCTT

PERIODICALS

(Free access at www.techmonitor.net)

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❑ Proceedings of the Consultative Meeting on Technology Management Education and Training for Developing Countries, 1997	800.00	40.00

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