Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific Tech Monitor

Vol. 36 No. 2 Apr - Jun 2019

Fourth Industrial Revolution technologies for inclusive and sustainable development

Plus

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

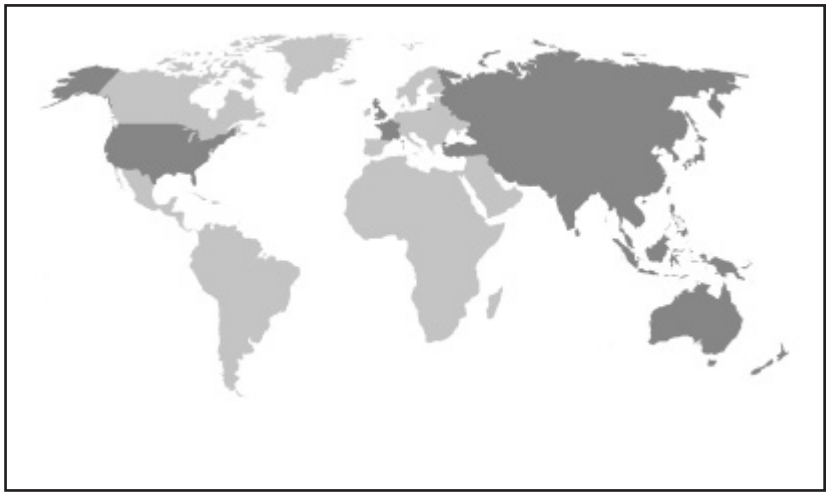
APCTT
Asian and Pacific Centre for Transfer of Technology

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

Asia-Pacific
Tech Monitor
Vol. 36 No. 2 ❖ Apr-Jun 2019

The **Asia-Pacific Tech Monitor** is a quarterly periodical of the Asian and Pacific Centre for Transfer of Technology (APCTT) that brings you up-to-date information on trends in technology transfer and development, technology policies, and new products and processes. The Yellow Pages feature the Business Coach for innovative firms, as well as technology offers and requests.

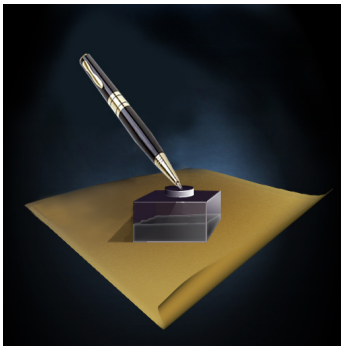
Web: www.techmonitor.net

ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY
C-2, Qutab Institutional Area
Post Box No. 4575
New Delhi 110 016, India
Tel: +91-11-3097 3700
Fax: +91-11-2685 6274
E-mail: postmaster.apctt@un.org
Website: http://www.apctt.org

ISSN: 0256-9957

Cover photo credit: Shutterstock

CONTENTS



Introductory note

Fourth Industrial Revolution (4IR) technologies are considered to possess immense potential to address developmental challenges in almost every field. Prominent 4IR technologies are Internet of Things (IoT), 3D printing, Artificial Intelligence (AI), and Blockchain technologies, among others. These technologies have applications that are known to improve the quality of life, drive economic growth, and increase the productivity and efficiency in manufacturing and service sectors.

The 4IR technologies offer many innovative solutions which can support countries to achieve the 2030 Sustainable Development Goals. For example, IoT applications are being deployed in Malaysia, Singapore and Vietnam in smart grids to track energy supply and demand, collecting usage data, and maintaining efficient energy distribution and utilization. IoT is also used on pilot scale for air pollution tracking in Thailand, water monitoring in Malaysia, and transport connectivity in Malaysia, Thailand and Singapore. 3D printing increases production efficiency, reduces waste, and offers innovation applications for sustainable development. In Nepal, as part of earthquake response, 3D printed customized pipe parts are used for sanitation infrastructure. Microsoft in India is deploying AI-based tools in agriculture for automated data collection, early detection of crop diseases, and optimization of agricultural inputs. The UN World Food Program's (WFP) Building Blocks pilot uses blockchain technology at refugee camps to facilitate cash transfers while protecting beneficiary data, controlling financial risks, allowing for greater collaboration, and reducing costs.

The 4IR technologies will also play a key role as decision-making systems for inclusive and sustainable development. For example, with AI-enabled computing advancements, more and more services could be automated using algorithmic decision-making systems. These automated systems are driven by real-time data available from public domains, social media, device sensors, mobile and smart devices. These systems can make the decision-making process much more efficient, both in time and money, and are gradually being deployed across the domains of industry, government and community. For example, FinTechs in Australia are using digital or 'robo-advice' to customers using highly sophisticated algorithms operating on the mobile and web-based environments.

The issue of Asia-Pacific Tech Monitor discusses the challenges, opportunities, strategies and best practices to harness innovative 4IR technologies for inclusive and sustainable development in the Asia-Pacific countries.

Michiko Enomoto
Head, APCTT-ESCAP

Technology Market Scan

ASIA-PACIFIC

CHINA

R&D investment

China's research and development investment increased by 11.6% year on year to 1.97 trillion yuan (US$ 293.6 billion) in 2018, accounting for 2.18% of the gross domestic product, official data shows. It's the fourth consecutive year that R&D costs in China accounted for over 2% of GDP, according to a research report published by Dalian University of Technology.

China realized 19.59% average annualized growth in R&D investment after the country announced its innovation-driven development strategy, the report said. R&D investment by enterprises increased by 40 times to 1.2 trillion yuan from 1995 to 2016, while government R&D funds rose 12.8 times to about 320 billion yuan.

The research highlighted Huawei as a representative of high R&D investment. In 2016, Huawei spent more than 82 billion yuan in R&D that year, accounting for 7% of all Chinese enterprises' R&D investment, it said. In addition, the China National Petroleum Corporation tops all mainland-listed firm's R&D investment with 17.5 billion yuan, and Alibaba spent the most (17 billion yuan) among overseas listed companies. The research said while the companies are invested heavily in R&D, more efforts may be put on basic research and applied research.

https://www.asiatimes.com

Amendment to technology transfer regulations

The Chinese government issued the State Council decree No.709, to amend a total of 49 regulations, including the Technology Import and Export Regulations ("TIER") and the Regulations for the Implementation of the Law of the People's Republic of China on Chinese-Foreign Equity Joint Ventures ("JV Regulations"). The amendments will impact particularly those companies who have entered into JV agreements with Chinese companies and/or for whom technology transfer/IP is an important consideration when investing in the China market.

TIER applies to the transfer of foreign technology into China,1 among other things, and it includes several mandatory provisions on technology import contracts. Among those, the latest amendment deleted Article 24.32 which mandated the foreign technology transferor to indemnify the Chinese transferee for third party infringement claims. This leaves the general provisions of the Contract Law to govern both technology import and other technology transfers alike, under which the parties are free to negotiate the allocation of infringement liabilities to third parties.

https://www.networksasia.net

Companies investment in R&D

Listed companies in China saw robust growth in research and development (R&D) investment in 2018, according to financial data analyzer Wind. A total of 1,178 listed companies disclosed their 2018 R&D information by Thursday, spending 384.7 billion yuan (about 57.2 billion U. S. dollars) last year, up 23.72 percent year on year.

About 81 percent of the companies invested more in R&D than in 2017, and 85 companies doubled their R&D expenditures. Companies in oil exploration, infrastructure and electronics manufacturing led R&D spending, while investment in emerging industries like computers, semiconductors and biomedicine accounted for a relatively larger proportion of revenue.

Increases in R&D personnel became one of the main drivers for the substantial increase in R&D investment, with the number of R&D professionals in 728 listed companies taking up more than 10 percent of their total employees.

http://www.xinhuanet.com

INDIA

Patent applications

India registered the largest innovation jump of any country last year. Patent applications jumped more than 27 per cent -- from 1,583 in 2017 up to 2,013. More than half of all international patent applications filed last year came from Asia, a further sign of innovation shifting "from west to east," the United Nations said Tuesday.

In the latest annual breakdown of patent filings released by the World Intellectual Property Organization (WIPO), the United States remained the leading individual country for applications in 2018. But on a regional basis, Asia's surge continued. "Asia is now the majority filer of international patent applications via WIPO, which is an important milestone for that economically dynamic region and underscores the historical geographical shift of innovative activity from west to east," the agency's director general Francis Gurry said in a statement. WIPO's complex system of registering international patents involves multiple categories.

In the main category — the Patent Cooperation Treaty — the US led the way with 56,142 applications, followed China (53,345) and Japan (49,702). Germany and South Korea came in a distant fourth and fifth, with fewer than 20,000 applications each. India registered the largest innovation jump of any country last year. Patent applications jumped more than 27 per cent — from 1,583 in 2017 up to 2,013.

https://www.financialexpress.com

NEPAL

Foreign Investment and Technology Transfer Act

Giving a boost to the aim of the Nepal Investment Summit between March 29-30, 2019, the House of Representatives endorsed the Foreign Investment and Technology Transfer Act (FITTA) on March 18, 2019. The bill was drafted with the objective of attracting Foreign Direct Investment (FDI) to fill up the investment gap and increase home-bound production. Minister for Industry, Commerce and Supplies Matrika Prasad presented the bill in the Lower House. With the endorsement of the bill, the government will now be able to accept or reject FDI within a week, unlike the prior 15-day time period.

As per the FITTA Act, the Investment Board of Nepal (IBN) can approve all projects with investments worth more than NPR 60 million. The act is now open for Department of Industry's (DoI) acceptance and assignment of projects having investment up to NPR 60 million.

https://www.nepalisansar.com

PHILIPPINES

Innovation bills

Both houses of the Philippine Congress have approved two bills that seek to promote innovation and provide benefits to start-ups and micro, small and medium enterprises (MSMEs). According to a recent press release, the bicameral conference committees of the Senate and House of Representatives have reconciled the versions of the proposed landmark Philippine Innovation Act and Innovative Startup Act and are now a step closer to becoming laws. Once ratified by both Houses, the twin bills will be sent to Malacañang for the signature of President Duterte.

The Philippine Innovation Act seeks to provide MSMEs greater access to finance, market and technology. Under the bill, a National Innovation Council, to be chaired by the President, will be created to develop the country's innovation goals, priorities, and long-term national strategy. Moreover, the proposed measure provides for a comprehensive support program for MSMEs, from incorporation to internationalisation.

The program shall include coaching and mentoring in the areas of design; technology extension services; standard business practices in contracting, accounting and project management. Other areas also include quality control; standard-setting; business services such as commercialisation and management; and patents; among others. Through a start-up MSME innovation development program, the government shall mobilise its various agencies to work hand in hand with private organisations to provide technical and financial support for the development training of entrepreneurs. Regional innovation that will harness the competitive advantages, as well as existing and potential strengths of regions and provinces shall also be promoted.

A US$ 19.12 million (PHP 1 billion) Innovation Fund will be established to strengthen entrepreneurship and enterprises engaged in developing innovative solutions benefitting the poorest of the poor. An Innovation Development Credit and Financing Program shall be developed for MSMEs to avail of loans and other financing activities. All banking institutions shall set aside at least 4% of their total liable funds for innovation development credit.

The Innovative Startup Act, meanwhile, aims to provide start-ups with benefits and incentives which include the following:

1. Subsidy for the application and processing of permits and certificates required for business registration.
2. Expedited or prioritised processing of applications.
3. Subsidy for the use of facilities, office space, equipment, and services provided by government or private institutions.
4. Grants-in-aid for research, development, training and expansion projects.

Furthermore, a Startup Grant Fund and Startup Venture Fund shall be created to provide grants-in aid and to match investments by selected investors in start-ups based in the country. Under the bill, the Department of Education (DepEd), the Commission on Higher Education (CHED), and the Technical Education and Skills Development Authority (TESDA) are directed to develop and integrate, in their respective curricula, entrepreneurial program that shall foster an environment conducive to innovation.

https://www.opengovasia.com

REPUBLIC OF KOREA

R&D spending

Leading memory chipmakers spent a record amount of money on research and development last year to hold onto their leading positions and develop emerging technologies, their financial statements showed on April 2.

Samsung Electronics said it invested 18.7 trillion won ($16.5 billion) in R&D in 2018, up 11 percent from a year earlier. The tech giant's R&D spending was equal to 7.7 percent of its 2018 sales, the highest level since 2003. In its financial report, Samsung highlighted the mass production of cutting-edge universal flash storage for smartphones, DRAM and solid-state drives based on advanced manufacturing procedures as accomplishments of its R&D efforts.

Last year, Samsung said it acquired 2,055 patents in South Korea and 6,062 patents in the United States to protect its intellectual property rights on its semiconductor technologies. SK Hynix said it spent 2.9 trillion won on R&D activities last year, a 16.4 percent rise from a year earlier. The company's R&D expenditure was above 2 trillion won for the third consecutive year. The company said its R&D is focusing on DRAM and NAND solutions as well as new products and emerging technologies to maintain growth momentum and find new business opportunities.

SK hynix's intellectual property rights on its semiconductor technologies numbered 12,786 as of December, its financial statement showed. The tech giants have been jacking up investment to maintain their dominant market position and widen gap with emerging Chinese manufacturers while developing technologies to expand their presence in the nonmemory market amid slumping memory chip prices.

http://www.theinvestor.co.kr

Patent-driven business model

Samsung Electronics has been pursuing a patent-driven business model, as the firm has gained approval for more than 50,000 patents in the United States where global leading IT firms are competing fiercely, the firm said. "We announced recently that the firm has obtained 128,700 patents around the world as of the end of 2018, which is a 7.9 percent increase year-on-year," a Samsung official said. "By country, Samsung has the largest number of its patents in the U.S. with 50,804, which accounts for 39.5 percent of the total patents."

It is the first time the firm has received more than 50,000 patent grants in the U.S.

since the firm filed its first patent request there in 1984. Samsung said it has focused on receiving more patent grants in the U.S. to be able to respond effectively to possible disputes.

The number of patent grants has been regarded as an index showing how well the company is operating. Samsung has been working around the clock to secure approval of as many patent grants as possible. "Samsung invested 18.7 trillion won ($16.5 billion) in R&D in 2018 and received 2,055 patent grants in Korea and 6,062 in the U.S.," the firm said. Of the firm's total patents, patents filed in the U.S. account for the largest proportion, followed by Europe with 25,669, Korea with 23,203, China with 11,709 and Japan with 7,170.

Samsung also beefed up its design patents in smartphones and LED TVs, with 517 of the total patent grants the firm received in the U.S. in 2018 being related to product design. The company said it has extended its intellectual property cross-licensing with global IT firms specializing in mobile and memory chip businesses. The firm has agreed terms to extend its cross-licensing agreements with Google in 2014, Western Digital in 2016 and Qualcomm and Nokia in 2018.

Samsung's efforts to intensify its R&D capabilities can be seen in active patent families, referring to the whole set of patents covering the same invention in one or more countries. Samsung has the world's largest number of active patent families with 61,608 in 2018, followed by Japanese electronics firm Canon with 34,905 and IBM with 34,376, according to data by patent research firm IFI.

https://www.koreatimes.co.kr

SINGAPORE

Boost for digital research, innovation

A national research fund in Singapore will set aside an additional S$540 million (Bt12.6 billion) for the creation of artificial intelligence (AI) systems to identify patients predisposed to chronic diseases like diabetes, robots to perform menial tasks and wearable sensors to provide early intervention for heart failure.

The financial boost will also lead to the development of other projects that will deepen the nation's expertise in digital technologies and automation through the fund called the Research, Innovation and Enterprise 2020 Plan. The five-year fund, first announced in 2016, is managed by the National Research Foundation (NRF). With the $540 million top-up, the $19 billion fund will now see a total of $900 million allocated to research and development (R&D) in fields like AI, robotics and supercomputers.

The funding boost was announced at the 11th Research, Innovation and Enterprise Council meeting last week with council members taking stock of the progress on the fund's aim to support R&D in Singapore.

The NRF is supporting a number of projects including Speedcargo, an AI software that takes digital images of cargo packages and plans how the packages should be packed to optimise space. Speedcargo is presently being used at Changi Airfreight Terminal to make air cargo management smarter. The system was created by Singapore-based research organisation TUM-Create. Founded in 2010, it is staffed by researchers from Nanyang Technological University (NTU) and The Technical University of Munich (TUM).

Besides NRF-supported projects, the AI push has seen researchers collaborating on a number of initiatives including one that involves a handheld acoustic sensor which looks like a stethoscope. When placed on a patient's chest and paired with a smartphone app, the device can detect excess fluid |in the lungs - a cause of breathlessness. Within 10 seconds, an AI algorithm determines whether the patient's lungs are clear or whether fluid is accumulating inside them.

The prototype has been developed over a decade by a team from NTU and Tan Tock Seng Hospital and has achieved an accuracy rate of more than 92 per cent, according to Associate Professor Ser Wee of NTU's School of Electrical and Electronic Engineering. This is based on a study of 86 patients from the hospital from 2012 to 2015. The team has filed a patent for the device, which is being developed for the mass market.

https://www.nationmultimedia.com

SRI LANKA

Reduction in interest rates for SMEs

Prime Minister Ranil Wickremesinghe today announced there will be a 2% reduction in the interest rates granted to Small and Medium-sized Enterprises (SMEs). Following discussions between the Prime Minister and Small and Medium scale entrepreneurs and businessmen, a special committee was appointed to address the prevailing high banking interest rates in the country.

The committee is chaired by a member of the monetary board of the Central Bank, Nihal Fonseka, and comprises of Deputy Governor of the CBSL, H. A. Karunaratne, the President of the Institute of Chartered Accountants of Sri Lanka, Jagath Perera and its Vice President, Manil Jayasinghe. In addition, the Chief Executive Officer of DFCC Bank Lakshman Silva, the CEO of Hatton National Bank, Jonathan Alles and the CFO of Commercial Bank, Nandika Buddhipala are also members of this committee.

Prime Minister Ranil Wickremesinghe noted that the members of the monetary board, bank CEO's, chartered accountants, officers of the ministries of finance, economic affairs and Minister Malik Samarawickrama have held discussions regarding the steps that should be taken to reduce interest rates in Sri Lanka. He noted that the program is prepared to address the issues faced by SME businesses. He went onto note that orders by the monetary board will be issued by next week and they hope to reduce the debt burden to develop businesses.

https://www.newsfirst.lk

ASIA-PACIFIC

CAMBODIA

Blockchain technology for rice farmers

In collaboration with Cambodian organic cooperative Reaksmey Lekkompos Kaksekor, international nonprofit organization Oxfam has completed the first rice shipment to the Netherlands last month with the help of blockchain technology. Through the pilot project called BlocRice, a "smart" contract was developed to help Cambodia's poor rice farmers to track developments in their deal with an exporter. BlocRice is the tool that creates a database that farmers and participants in the project can access. Aside from getting details about the deal through the blockchain system, farmers can also have a better chance of negotiating the price of their products. The BlocRice application can be accessed by Cambodian rice farmers through a smart phone.

While BlocRice has already helped some of Cambodia's rice farmers have access to a network that they could use for negotiating better prices, Oxfam said there is still a need to narrow the huge technological gap. Most farmers don't own smart phones. The BlocRice project was established to help empower Cambodia's rice farmers as they strive to alleviate themselves from poverty. The initiative is still under testing and much work needs to be done for target goals to be achieved, Oxfam noted. On the other hand, industry analysts said blockchain technology initiatives can actually help rice growers in Cambodia connect with sure buyers who pay fairly and are open to negotiating prices.

Blockchain technology has already gained momentum in other sectors in Cambodia, particularly in finance. Earlier this month, the National Bank of Cambodia (NBC) announced that it will integrate the technology in its payment system this year. According to a World Economic Forum (WEF) report, the blockchain-based payment system that Cambodia will use can operate commercial and private accounts. This allows for citizens and businesspeople alike to benefit from the improved services.

https://en.businesstimes.cn

CHINA

Blockchain electricity exchange cuts wastage

Researchers from one of the top universities in China say they have developed a decentralized exchange, not for crypto assets, but for unused power. A patent application filed by team from China's Fudan University in January and revealed on Friday sets out the workings of a blockchain-based electricity exchange that assigns power sellers and buyers as nodes on the network and allows them to securely trade unused electricity without a third-party intermediary.

Using the network, nodes can broadcast requests for sales or purchases, after which smart contracts will connect matching requests, based on data such as volume and price, and then trigger transactions – a mechanism similar to that of a decentralized crypto exchange. The effort is a response to the growing supply of renewable energy in China, especially solar power generated by households, which is often generated in excess of demand in some regions.

The researchers write: "Households then have no other choices but to let the unused solar power go to waste because they don't have a direct way of exchanging electricity."

To facilitate transactions over the decentralized network, a digital currency would be used between buyers and sellers, the patent application explained. Although it's not clear which digital asset(s) the platform might use, the system has so far been made to built on two blockchain systems, according to the Fudan team.

https://www.coindesk.com

INDIA

AI-based detector for malaria, TB, cancer

Researchers at the Indian Institute of Technology (IIT) here have developed an artificial intelligence (AI)-based low-power electronic hardware system that can help in detecting malaria, tuberculosis, intestinal parasite and cervical cancer in a few milliseconds. The research focuses on building a neuromorphic system which can be used for healthcare access in resource-constrained areas with limited access to human specialists.

"While several software AI models exist for healthcare and diagnostic related applications, need of the hour is to efficiently map these models on portable dedicated low-power, low-cost hardware to enable edge-AI systems accessible to all in low resource environment," said Professor Manan Suri, Department of Electrical Engineering, IIT Delhi. Suri, who is leading the team of researchers, said microscopy is particularly well adapted to low-resource, high disease burden areas, being both simple and versatile; even for diagnostic tasks. While newer technologies are available for diagnosis, the cost of specialised equipment may render it impractical in such places, he said.

https://www.business-standard.com

ISRAEL

3D-printed heart using human cells

Israeli researchers have created an entire 3D-printed heart made from human cells in what they say is a world first. The heart doesn't beat and is too small for use in people — it's only about the size of a rabbit's heart. But the little organ is considered a big advance in the ongoing effort to find new treatments for heart disease, the leading cause of death in the United States.

Heart transplantation is currently the only good option for people with severe heart failure. But donor organs are in such short supply that, on average, 18 Americans die each day before one becomes available. Being able to 3D-print a human heart when needed could conceivably help save many lives that are now lost.

"Maybe, in 10 years, there will be organ printers in the finest hospitals around the world, and these procedures will be conducted routinely," Tal Dvir, a researcher with Tel Aviv University's School of Molecular

Cell Biology and Biotechnology and the leader of the team of scientists who created the heart, told NBC News MACH in an email. A paper describing the research was published in the journal *Advanced Science*.

Previously, scientists were able to 3D-print heart structures that lacked cells or blood vessels. But the new 3D-printed heart contains cells, blood vessels, chambers and other structures a heart needs to function normally. To make it, Dvir and his team took fatty tissue from patients and converted the fat cells into stem cells. These were added to a gel and then further processed until they turned into heart cells. The cell-containing "bioink" was added to a 3D printer and used to build the experimental organ layer by layer.

Tal said the next step for his team would be to explore ways to "teach" 3D-printed hearts to function normally and then transplant them into rats to see how well they work. The scientists will also explore the feasibility of 3D-printing larger hearts, with the ultimate goal of building functional human hearts.

https://www.nbcnews.com

EUROPE

AI to analyze floods

Social media gets a lot of negative press, but there's more to Twitter and Facebook than botnets, memes, and political trolls. In a research paper preprint on Arxiv.org ("Integrating Social Media into a Pan-European Flood Awareness System: A Multilingual Approach"), scientists at the Joint Research Center, the European Commission's science and knowledge service, detail a prototype — Social Media for Flood Risk (SMFR) — that "enriches" Europe's Flood Awareness System (EFAS) with real-time reports from Twitter users.

It builds on research published by Harvard and Google in August 2018, which described an AI model capable of predicting the location of aftershocks up to one year after a major earthquake, and by Facebook AI researchers in December, who developed a method to analyze satellite imagery and to quantify damage from fires and other disasters. More recently, scientists at Google published a retrospective on a machine learning system that accurately predicts riverine floods — that is, floods from overrun riverbanks — with 75% precision.

Separately, researchers in the U.K. have used tweet-ingesting machine learning algorithms to map out where violence is likely to occur during riots, to projectwhen mass protests might be imminent, and to identify gang members.

"Over the past decade, social media has emerged as a relevant information source during disasters, prompting researchers from diverse areas to converge on this domain," the paper's coauthors wrote. "Social media analysis has demonstrated the potential to provide timely, precious information about the spatial and temporal development of a crisis, as well as supporting the identification of key disaster-related events."

First, a quick primer on the EFAS: It's a part of the Copernicus Emergency Management Service (Copernicus EMS) and operated by the European Commission's Emergency Response Coordination Centre (ERCC), a division of the European Commission's Civil Protection and Humanitarian Aid Operations set up to support coordinated responses to disasters inside and outside Europe. Much like the U.S.'s Federal Emergency Management Agency, ERCC monitors hazards and risks, collects and analyzes data on disasters, and prepares plans for teams and equipment deployment. And ERCC sources EFAS for forecasts — principally probabilistic medium-range flood forecasts (including short-range flash floods), but also seasonal forecasts, impact assessments, and early warnings.

The researchers' system tapped EFAS to determine when the risk of floods in a certain geographic area exceeded a threshold. This triggered data collection from social media — Twitter — to the tune of up to 400 keywords at a time, the public streamer API's maximum limit.

Extracting messages with relevant keywords (i.e., words indicating a flood is about to happen or recently happened) was no easy task, given that EFAS covers an area where the population speaks more than 27 languages. The team's solution was a multi-lingual classification system that used language-agnostic mathematical representation of words, or word embeddings, to infer similarities among keywords in four tongues: German, English, Spanish, and French. To train it, they sourced a corpus containing over 7,000 annotated messages (between 1,200 and 2,300 messages per language). Meanwhile, they used a separate model to suss out "representative" messages (tweets having at least a 90% probability of being flood-related) for areas in which flood risk had been predicted.

To test the robustness of their approach, the scientists integrated SMFR into EFAS and deployed it during recent floods affecting Calabria, Italy, in early October 2018. SMFR collected two days' worth of tweets — about 14,347 in all — which SMFR analyzed for "relatedness." The researchers report that the AI-filtered messages closely correlated with actual flooding, and they say it's a promising first step toward a system which could shorten response time in early stages of disasters.

"During the development of an event, collected messages could be valuable to international rescue coordinators … because they provide insights about the local response, about whether alerts that have been issued by authorities, and about some of the concerns that those affected by a flood or a flood alert may have," the team wrote.

https://venturebeat.com

GERMANY

Transparent human organs

Researchers in Germany have created transparent human organs using a new technology that could pave the way to print three-dimensional body parts such as kidneys for transplants. The scientists, led by Ali Erturk at Ludwig Maximilians University in Munich, have developed a technique that uses a solvent to make organs such as the brain and kidneys transparent. The organ is then scanned by lasers in a microscope that allows researchers to capture the en-

tire structure, including the blood vessels and every single cell in its specific location. Using this blueprint, researchers print out the scaffold of the organ. They then load the 3D printer with stem cells which act as "ink" and are injected into the correct position making the organ functional.

While 3D printing is already used widely to produce spare parts for industry, Erturk said the development marks a step forward for 3D printing in the medical field. Until now 3D printed organs lacked detailed cellular structures because they were based on images from computed tomography or MRI machines, he said. "We can see where every single cell is located in transparent human organs. And then we can actually replicate exactly the same, using 3D bioprinting technology to make a real functional organ," he said. "Therefore, I believe we are much closer to a real human organ for the first time now."

https://www.3dprintingmedia.network

SPAIN

Traffic prediction system

Researchers of the Miguel Hernández University (UMH) of Elche have developed artificial intelligence solutions based on deep neural networks to predict traffic conditions using data from fixed sensors (such as loops) and connected vehicles. This new system makes it possible to predict traffic 15 minutes ahead of time.

To carry out this study, researchers of the UWICORE laboratory, which belongs to the I3E Centre for Engineering Research of the UMH, have digitised and implemented on the SUMO traffic simulation platform, a real traffic setting corresponding to a 97km stretch from Spain's A-7 motorway, between the cities of Alicante and Murcia. They have worked with the collaboration of the Levante Traffic Management Centre, which provided data on all of its traffic sensors from the chosen stretch over a 12-year period.

This stretch has been chosen for its high influx of traffic (daily average intensity of 100,000 cars in places) and its high number of traffic sensors (99 in total), which make it possible to accurately measure traffic every minute. With a selection of this data, researchers have developed a digital simulation setting which makes it possible to very accurately generate the traffic endured by the A-7 stretch for 10 days. To do so, the UMH researchers have developed a new calibration methodology which enables the accurate and realistic generation of digital traffic simulation settings based on real data.

With the digital traffic platform created at the UMH, researchers have developed techniques based on deep neural networks to predict traffic conditions 15 minutes ahead of time, using data from connected vehicles. Researchers have analysed how the insertion of the connected vehicle affects the accuracy of the traffic intensity, density and speed predictions. Their investigations have allowed them to prove that traffic prediction can be improved with data from just four per cent of the vehicles, compared to when the prediction is done with data from the traffic sensors that are currently deployed in the relevant A-7 stretch.

The UMH researchers have also shown that the merging of data provided by the current traffic sensors with data from connected vehicles allows for an improvement in traffic prediction accuracy. For example, the merger of traffic sensor data from just 10 per cent of the vehicles decreases prediction error by 40 per cent compared to the traffic condition prediction done with data provided by the loops.

Head of the UWICORE group, Javier Gozálvez, explained: "Connected vehicles improve comfort and security, and boosts the digitisation of mobility. Furthermore, it also offers the public administrations and traffic managers new tools to know and manage the traffic. For example, with the data from connected vehicles, it is possible to learn the state of traffic and even predict it, without having to deploy and maintain traffic sensors as is done today. However, access to this data will have a cost, which means it is important for administrations and managers to know how many pieces of data they need to conduct their functions. The research of the UMH not only offers tools based on artificial intelligence for the characterisation and prediction of traffic conditions, but also make it possible to quantify the data necessary to be able to accurately predict traffic conditions. For example, the percentage of vehicles from which data is needed."

The UMH research has been conducted in the framework of the PREDICT project (Prediction and characterisation of traffic with data from connected vehicles and autonomous vehicles), funded by the General Traffic Directorate. UMH researchers have also quantified the impact of autonomous vehicles on traffic as part of the project. Their conclusions show that until at least 15 per cent of vehicles are autonomous, there won't be a noticeable benefit regarding the fluidity of traffic and the capabilities of motorways, unless solutions are developed to guarantee an efficient coexistence between autonomous and conventional vehicles.

https://www.intelligenttransport.com

UK

AI system to track urban inequality

Artificial Intelligence (AI) could be used to identify areas of poverty in cities across the world, after researchers at Imperial College London developed a system that scans street images. Dr Esra Suel and colleagues from the university's School of Public Health used deep learning image analysis to train a computer programme, identifying social, economic, environmental and health inequalities within four UK cities.

The programme was first trained on a total of 525,860 Google Streetview images from London, corresponding to 156,581 postcodes, and provided with government statistics on local incomes, health, crime, housing, and environmental conditions. It was then trialled on three further cities – Birmingham, Manchester and Leeds – where, once researchers had benchmarked the data by manually rating 1% of the available images, it was able to correctly predict areas' economic and social wellbeing.

In their academic paper, 'Measuring social, environmental and health inequalities using deep learning and street imagery', Suel and colleagues write that "training in

one city can be transferred to predictions in other cities in the same country, especially when networks are fined-tuned with as little as 1% of target city images." The authors hypothesise that the algorithm detects visual signs such as pollution and signs of disrepair in urban locations. "Some features of cities and urban life, such as quality of housing and the living environment, have direct visual signals in the form of building materials and disrepair, sources of air and noise pollution and green space," they write. "Others, like poverty, may be visible because they influence or are related to features like housing and neighbourhood environment, the type of vehicles that people use, or even the type of shops."

The researchers found the application of deep learning to street imagery provided more accurate predictions of some measures of equality, such as income and living environment, than others – including crime and self-reported health. After their successful UK trial, the team now plans on using the technology in developing countries, where there is less up-to-date statistical data available to keep track of policies aimed at reducing inequality, *The New Scientist* reported.

https://www.globalgovernmentforum.com

NORTH AMERICA

USA

Blockchain protocol to fight counterfeit pharmaceuticals

Portland State University (PSU) researchers have made a blockchain protocol to prevent counterfeit pharmaceuticals from filling the market, according to a press release published on April 15. PSU researcher and professor of computer science at the Maseeh College of Engineering and Computer Science, Nirupama Bulusu, in collaboration with PSU computer science doctoral student Naif Alzahrani published a work dubbed "A new product anti-counterfeiting blockchain using a truly decentralized dynamic consensus protocol."

In the paper, the researchers described a new blockchain-based method to record transactionsgeared to facilitate the fight against fake pharmaceuticals by product checking and decentralization. The proposed solution represents a blockchain-based chain of information, with only users possessing a specific key to access or modify the stored data. Bulusu reportedly stated that the decision to create the protocol was due to the fact that the counterfeit pharmaceutical crisis harms the most vulnerable international populations. "This protocol could potentially disrupt and disable illicit supply networks," Bulusu said.

Blockchain technology has been widely adopted in order to fight counterfeiting in various industries. Recently, IBM and data storage firm Seagate announced a joint initiative to fight counterfeit hard drives using blockchain technology.

https://cointelegraph.com

Blockchain tech for safety of clinical research data

Researchers, including one of Indian origin, have developed a novel system based on blockchain technology for ensuring the integrity of clinical trials data. The system, described in the journal *Nature Communications*, creates an immutable audit trail that makes it easy to spot any tampering with results—such as making the treatment look more effective or diminishing side effects.

"Everyone is talking about how blockchain is going to revolutionise many of the data challenges in medicine, and here is one use that finally might make sense," said Atul Butte, a professor at the University of California-San Francisco (UCSF) in the US. "We think it could someday be useful for pharma companies running clinical trials," Butte said.

Blockchain technology utilises an old computer science technique known as hashing, which creates a unique digital signature for each so-called block of data. The hashes accumulate sequentially, as new data is entered or changed, with each block depending on the last. The resulting "blockchain" creates an audit trail for regulators that is easy to decipher and validate, even without looking at the actual data.

Daniel Wong, a PhD candidate at UCSF, built the system to operate through a web portal. Each time new data is entered on a given trial participant, the sender, receiver, timestamp, and file attachment containing the data, along with the hash of the previous block of data pertaining to that patient, is recorded onto a new block, with its own distinct signature.

While the prototype makes allowances for data entry or other errors to be corrected, new data can only be appended to the existing chain, without erasing what was there before. "It makes it really obvious when someone's changing something. You can see who put their hands on it, who made it, who changed it, and who received it," Wong said.

After entering the original data, he logged in as the trial sponsor and tried to erase adverse events that had been reported for two patients in their case report forms. Instead of deleting those reports, however, the system appended his changes to the original data, making it clear who had tried to corrupt the forms, when it was done, and what had been changed.

Wong also tried corrupting the data stored from an earlier point in the trial, when patients were assigned to different treatment arms -- drug or placebo -- to make it look as though they had been given a different medication plan. However, the blockchain ledger pinpointed exactly what had changed and when.

A prototype system like this reduces risks, but does not completely protect data from tampering. Even within a system enabled with this type of blockchain technology, the researchers said, it is still possible that those seeing patients at the point of care could enter wrong or incorrect data at the outset. However, blockchain technology could enable trials to be conducted under challenging conditions, or open doors to data exchanges that are more secure, more efficient, and more transparent for both researchers and the general public.

https://www.theweek.in

Industry 4.0, the New Industrial Revolution

R. Jayaraman
Professor, Operations Management,
SP Jain Institute of Management and Research,
Mumbai, India
E-mail: jayaraman@spjimr.org

Abstract

The world has witnessed three industrial revolutions so far. The fourth one has become possible due to the explosion in data capture, data processing and sensor controlled devices. Internet connectivity and high-speed data transmission have opened up immense new possibilities, due to which, waste reduction and conservation of resources will receive a big push. More will be produced for less, with the resultant conservation in environment, beneficial effects on climate and fossil fuel related problems. Productivity is bound to leapfrog once again, new applications for a new way of life, where remote controlled, programmable devices will enable a more comfortable and enjoyable life. Big data, high speed data transmission and computing, internet of things, cloud computing, cyber controlled equipment and remotely controlled and operated devices will be the hallmark of this new era. The five changes that will accompany the new revolution include: instantaneity, interconnectivity, wastelessness, mass customization and power processing.

Introduction

We are already in the next industrial revolution. Called Industry 4.0, or, simply, I 4 (Figure 1). This is not something which has fallen from the heavens. It is but a gradual development from Industry 3.0, or I 3, which is (was) the age of computers. The advent of computers, put into human hands, as never before, the ability to do many things in shorter times. Amongst the multifold benefits of the computer age, developments like the ERP, automation, use of large computers for weather prediction, creation of humongous databases to contain and process tera and peta bites of data are noteworthy. Information management has become a byword now. Even a kirana store operator is using Tally, a chemist at the corner is using the teller machine which can read a barcode and record details of the product sales. It only remains to be seen how a paanwala and a chaiwala can make use of this machine. For a quick update on what is the current state of I 4 and a description of the chain of events which have made I 4 happen, the reader is referred to the works of Ghobakhloo, 2018 and Sony and Naik, 2018.

Belying all fears of job losses and dehumanization, computers have now become a ubiquitous part of our daily lives. They have spawned new industries, new ways of doing things, added new shades to the myriad colours of life and generally made life more interesting for a certain section of people. No doubt, large masses of humanity are still not engaged directly in using it, but the computer has come to occupy an integral part of life of even those who have not used it. Witness the record breaking creation of 29 crore bank accounts in three months, for the Prime Minister's Jan Dhan Yojana, Indian banks can pat themselves solidly on their backs, this is a historic world record.

Industry 4.0

The computer age is now morphing into the I 4 (Figure 2). What is I 4? In its initial phases, I 4 has come to be seen as IOT, mass connectivity, social media, wireless networks, mass computing for big data, data analytics, to begin with. These are only parts of a trailer. The movie is yet to be made. The impact of the trailer is indicative of the things to come. These parts are to be followed by data integration, AI, computer integrated manufacturing, 3 D, augmented reality, and who knows what else? Smart cities have been planned all over India and these will showcase the abilities of the new age, the I 4.

Advancements already achieved in I 4

It would be a mistake to think that some parts of I 4 have not already been implemented and practiced, and great benefits achieved. First, let us look at the process idnustry, which is perhaps one of the biggest beneficicaries of I 4. An oil and gas refinery is usually controlled by a single console unit, which can make all the needed adjustments, like, increase the flow rate of crude, increase the temperature of the Crude Oil Distillation Unit (CDU), and so on, as and when needed, because the complete process is being monitored by sensors placed at several key locations. All these sensors capture data, like temperature, pressure, flow and feed it into the central computer, which contains the software to decide on the actions to be taken. Each sensor has a continuous 'dialogue' with the central computer, and the computer makes decisions based on the decision rules already programmed and stored in its memory. In later developments, sensors themselves could be programmed to take actions, with an intelligent programmed chip placed in it, with a connectivity to the central computer. This decentralised decision making, however, with constant oversight, called SCADA (Supervisory Control and Data Acquisition System), have been in use for at least three decades, if not more. And this is only one example. Typically, SCADA have been used to monitor and control the supply of utilities, like power, water, hot gas, compressed air, liquid and gaseous fuels, to equipment in the plant, apart from their use in the main process itself. Such applications are used in

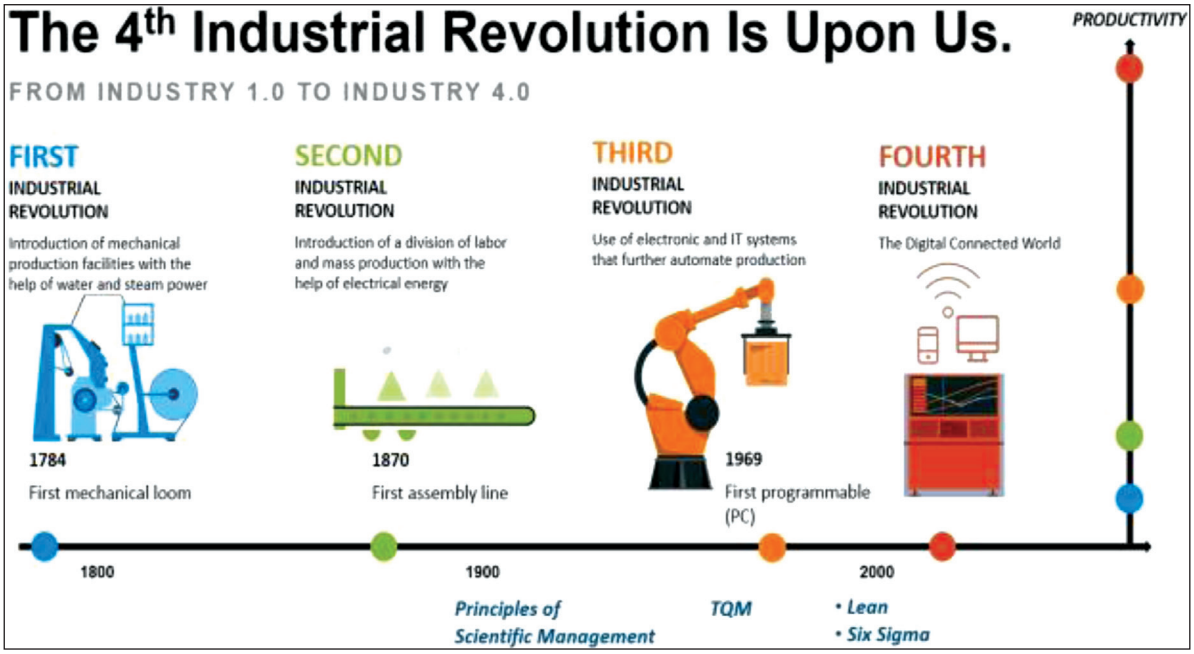


Figure 1: The context for Industry 4.0

steel plants, chemical plants, gas generating plants like liquid oxygen and nitrogen plants, and the like. IBM has designed several 'supervisory control systems' for integrated steel plants since 1990's, which can plan and control the operations in individual work areas. The IT applications in banking, using interconnectivity, are well known. In the last few years, internet based financial payments and transactions have rocketed. eCommerce has boomed, mailny through online selling. Thus, I 4 has already become visible in many businesses. However, what is yet to happen is coverage of vast areas, especially in discrete manufacturing, and the service industry, where operations could be improved. ERP systems routinely use interconnectivities to update data into several databases simultaneously, in realtime. Many 'work flow' applications use online, real time features of I 4. In tandem steel cold rolling mills, thickness of the cold rolled sheets are continuously monitored across the width by sensors, whose output is fed into an online computer which adjusts the roll gap dynamically. This is an application of 'algorithm based control'.

Drivers of I 4

What drives I 4? Market forces have driven companies to seek ways of manufacturing and selling products and services at lower costs, faster speeds, to satisfy customer needs. The assembly line at Ford was an innovation, in 1913, which made mass manufacturing possible, which boosted productivity, volumes and lowered costs, so that millions of people could be sold four wheeled automobiles. An examination of various productivity data shows that the time has now come for an improvement in this key manufacturing variable.

The continuous productivity gains since the third industrial revolution seem to have run out of steam, and there is a need to find new ways in which productivity can be boosted (Figure 3). Environmental degradation due to industrial activities has highlighted new ways in which goods and services can be produced and sold without damaging the environment. Environmental conservation has triggered off concepts like carbon credits, conservation of fossil fuels, control over climate change. All these concepts have one thing in common – socially responsible manufacturing. And I 4 is an integrator of all such considerations.

The constitution of I 4

The typical value chain in a manufacturing environment is shown in the figure 4.

How is the I 4 constituted? What are its building blocks? Curiously, it is a combination of outward-in and inward-out activities, with reference to the value chain diagram shown in the figure above. The point of focus is the individual machine, in a processing line, which could be a cog in the wheel of many such machines, producing several products, in the 'in company operations' box of the value chain. The outward-in mechanism works this way: What the customer wants is decided by the main controlling functional computer. The schedule is sent out to the shop floor/ departmental computer. This message is programmed into individual machines, through machine control computers, with appropriate algorithms, to produce the desired product in desired quantities and of desired quality. The performance of the machine is monitored by one or more sensors, which feed data into the machine control computers, which then controls machine performance using the algorithm. Each machine in the line is connected to all other – interconnectivity – to enable online, real time changes to be made in machine settings, depending on the dynamics of the line. Once the production run is over, the information is communicated to the main functional

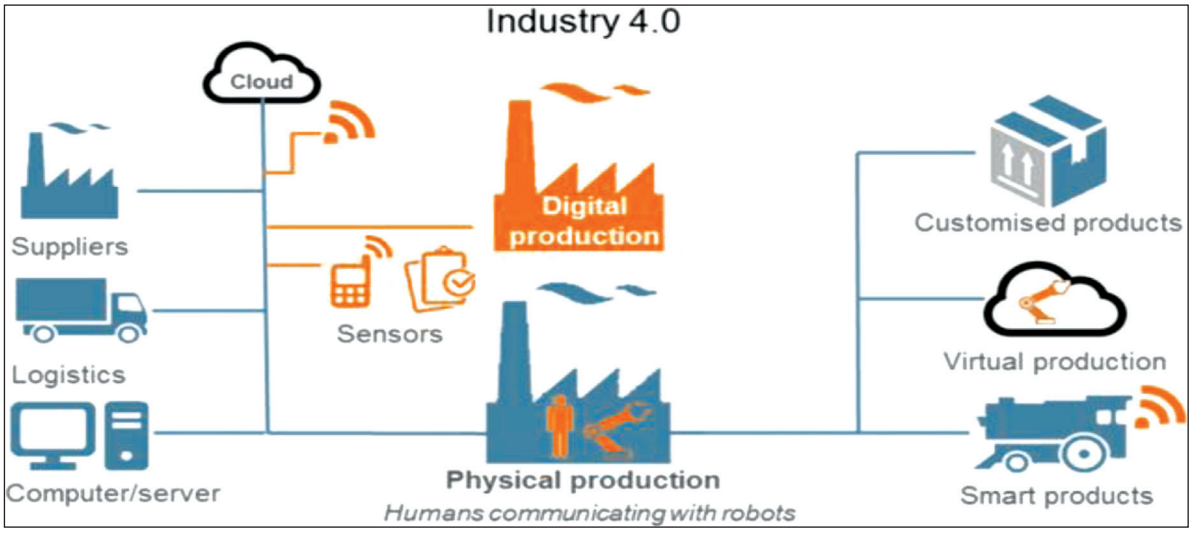


Figure 2: Constituents of Industry 4.0

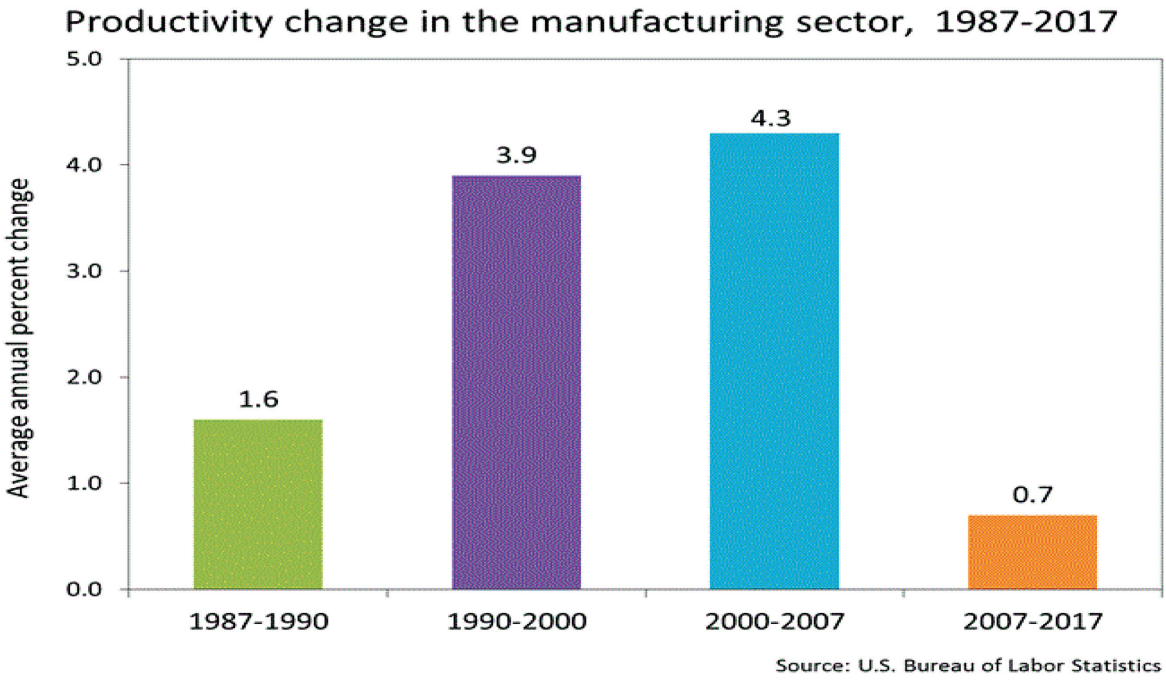


Figure 3: Productivity in the US manufacturing sector

computer via the departmental computer. And this process is repeated. All these activities take place in the 'in company operations' box.

At the next level, the main functional computer is connected to the ERP, for linking with the other functions. This is 'horizontal integration'. This is the connectivity between the 'in company operations' box with the 'in bound' and the 'out bound' boxes. Thus, an interconnected environment is established in the departments forming a part of the three boxes shown in the figure. The three boxes represent the 'operations value chain', which is a group of departments like maintenance, stores, engineering, project management, R&D, etc., which together create the core value in a manufacturing company. At the next level, the operations computer, a functional integrator, is connected to the functional computers in the other functions in the company, viz., operations, marketing and sales, accounts, HR etc., the horizontal integration is complete.

Vertical integration happens when all the interconnected functional computers connect into the company level master or corporate level computer, which then puts out the daily profit and loss account and other reports to all the functions, departments etc. Activities like corporate planning, strategic planning, long term technology

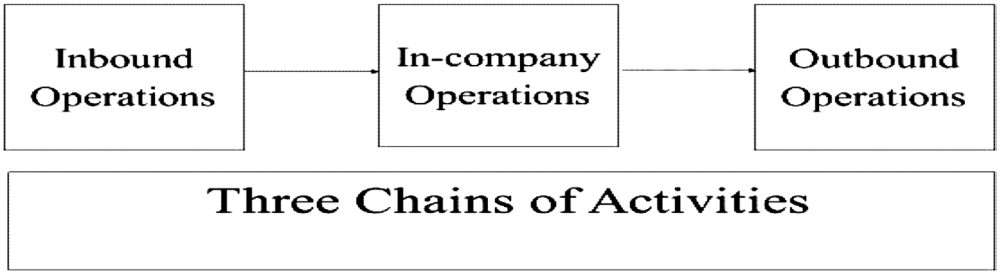


Figure 4: Illustrating the operations value chain in a manufacturing company

planning are vested in the master computer, and these are now vertically integrated with the functional computers. This is 'vertical integration'. The company level computers are then connected to other computers in a cloud, perhaps, or to vendors and suppliers, as well as distributors or other customers, which is the 'external interface'. This is the inward-out view.

Thus, I 4 builds on the SCADA, to integrate at different levels. This integration is the key differentiator, between I 3 and I 4. Whereas I 3 would lead to localized efficiencies, I 4 would lead to efficiencies across value chains. Whereas I 3 would lead to localized dynamic adjustments, I 4 would lead to integrated adjustments, which would keep the company level chain informed of the actions taken inside the organisation, thus creating a trail, whose analysis could lead to globally optimal actions. It is evident that the data volumes and speeds in I 4 are magnitudes higher than I 3. I 4 operates at four distinct levels:

Level 1: In Company Operations

Level 2: In bound, out bound, all functions

Level 3: Integration of all functions with corporate functions

Level 4: Connect with vendors, suppliers, bankers, statutory etc.

In I 3, levels 2 and 3 were made operational. The rest of the levels will get configured in I 4. A more detailed description is available in R.Jayaraman et al., 2018.

Benefits and costs of I 4

Benefits of I 4 are multifold (Figure 5). However, there is an up-front cost too. The Table 1 shows the benefits that are possible and the corresponding costs that may have to be incurred up-front. The costs do not factor in the risks- risk of failure, risk of lower than expected level of benefits, risk of poor performance, way below expected performance levels, and so on. The risks are also mentioned in the table. All descriptions are in comparison with what was possible through I 3.

I 4 is expected to be game changer in terms of the unprecedented rates of very low defects. In fact, it is expected that the current rates of defects which are in the region of '000s of parts per million, will soon be reduced to single parts per million, even lower than the six sigma limit of 3.4 defects per million. Indian companies are working on the applications which have the capability to make this happen. In one instance, as presented and reported in the website http://www.isqnet.org/wp-content/uploads/2018/12/Improvement-in-Process-Capability_Sona-BLW.pdf of the 15 th annual conference of the Indian Society for Quality (ISQ, website: http://www.isqnet.org/), Sona BLW, a Delhi based auto ancillary supplier to reputed companies like Maruti, has improved its ability to produce a machined part to required diameter, from an initial process capability of Cpk = 1.78 to an improved Cpk of 2.33, which is equivalent to 7 sigma. The part, being manufactured in a CNC machine, was hundred percent inspected for final dia. The offset of the cutting tool in the CNC machine had to be manually adjusted, to compensate for the tool wear, so as to get the same desired value of the dia. This offset correction was being done manually. However, as a part of the I 4 movement, to make machines 'SMART', an experiment was conducted to improve the Cpk value, and, after successful experimentation, the offset adjustments were done by an automated device, which was programmed to decide on the amount of offset, as per the experimental measurements. By doing so, the Cpk has improved substantially. And the company has now planned to convert many other CNC machines to this method of working. What are the implications of such an improvement? Usually, many companies operate at around a Cpk of 1, which is equivalent to 3 sigma, which means a defect rate of 66,800 ppm. If the Cpk is taken upto 2, then the defects rate will be 3.4 ppm. This means that the final production is almost defects free, thereby adding to the capacity of the equipment. If the starting Cpk is at 2 sigma, then the improvement is even more steeper, from 308,000 to 3.4 ppm. Such defects free production lifts the morale of workmen and also the entire shop floor, and, if achieved on a prolonged basis, could make the shop floors far more productive, at least cost. Other companies like Indo Japan Lighting, CEAT, GMR, Hero Motocorp, Schneider Electric, are also taking up steps to make 'SMART' manufacturing happen. (Note: 'SMART' manufacturing is a term used to denote manufacturing under I 4). One sure outcome of I 4 will be very low defect levels, leading to superior performance in production.

No change is without pain. Especially, organisational transformation. Womack and Jones, 1996, in their book, have described the pain that changes due to introduction of lean can cause in manufacturing. However, companies have realized that change is inevitable and must be embraced. Some researchers, like John Kotter, 1996, have proposed methods which can

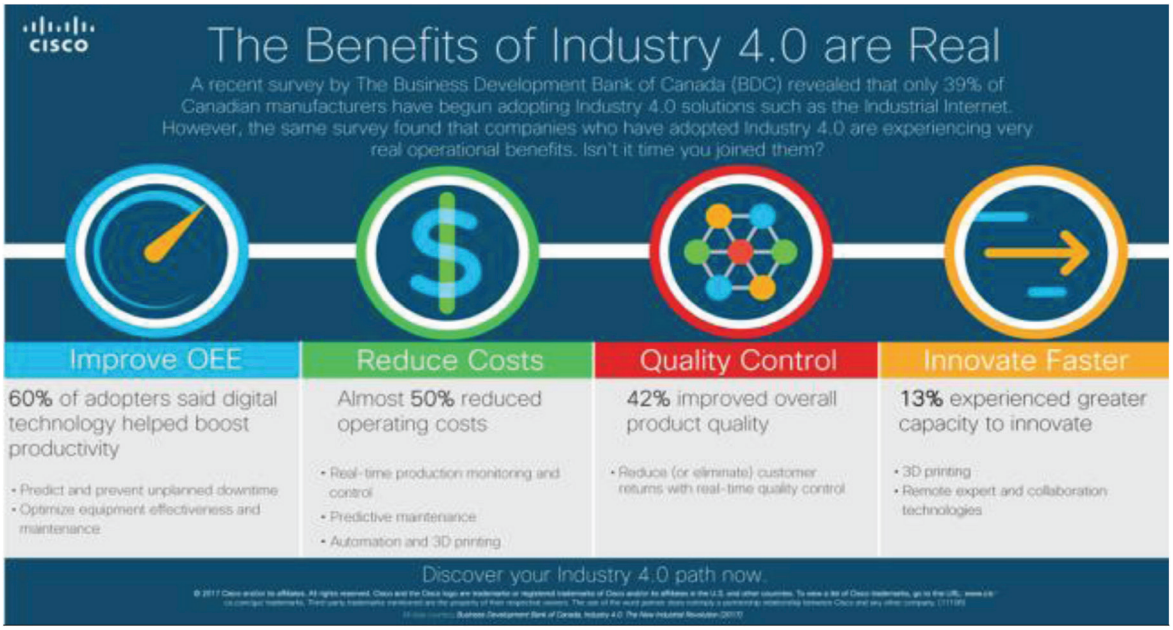


Figure 5: The many benefits of Industry 4.0

help organisations to make the transition to the new environment. What changes are likely to take place with the advent of I 4? There are at least five, which will usher in the new industrial revolution.

Five key changes due to I 4

Five important changes which will define the I 4 are: instantaneity, interconnectivity, wastelessness, mass customization and power processing. All these changes have some things in common. They will promote efficiency, reduce and eliminate waste, lead to 'minimal' manufacturing', characterized by very low to zero defect rates, automated and integrated manufacturing and sustainability of resources and materials. These common factors are possible due to the very nature of I 4, which will usher in on line, real time monitoring, instantaneous corrective actions triggered by AI driven neural networks which will activate relevant algorithms embedded in software operated sensors. A new paradigm of 'total manufacturing', meaning efficient, minimalistic, lean, 'more for less' will replace the current wasteful and profligate practices.

Instantaneity

Instantaneity is a logical extension of the computer age. Computers gave us a taste of how it will be to solve large problems in nano seconds, how it feels to be to get the latest news even before it happens (almost), how to be glued to a computer screen oblivious to anything else. The human need to feed on computer generated output has led to 'instantaneity', a word which signifies the 'instantaneous' culture. We needed everything as of yesterday, we need to know everything and also communicate the 'everything' to all and sundry, to see the 'thumbs up' or the 'like' sign. So we have become addicted to the internet, the cellphone, social media as in Facebook, Instagram, Whatsapp and the like. We will live life, for everything else, there is Google. This desire for instantaneity has led to the new way of life, on the fast lane. Only, the definition of 'fast' has changed, it is now 'now', instead of 'as soon as'.

Interconnectivity

What can feed this insane desire for 'now'? Interconnectivity. Interconnectivity is the external manifestation of IOT (Internet of Things), viz., sensors, processors, software which run the processors, the people who design and upload such software, all put together. It is this new collaboration which is taking place, without any central controls. This is laissez faire in practice. Anyone can play, anyone who can upload a website is in business, anyone who can offer a service or product based on software can enter. You are as equal as your nearest competitor will allow you to be. Behind these activities are the knowledge about how things work. Mainly engineering based, practical knowhow, knowwhy, and science driven. However, the ability to network and make things happen through virtual reality is the new paradigm. Thousands of internet based entities are now providing goods and services to an 'instant' demanding population, who are making the computer mouse their weapon of conversation and contact. Bit coin, block chain, cloud computing, big data analytics are the outcomes of interconnectivity, and we have just begun.

Wastelessness

In the 50's and 60's and 70's and 80's the Japanese company Toyota created a new paradigm by their mastery of their 'Toyota Production System' (TPS) (https://en.wikipedia.org/wiki/Toyota_Production_System). Taichi Ohno, (https://en.wikipedia.org/wiki/Taiichi_Ohno), the architect of this system, set new standards which others in industry found difficult to imitate. It took almost forty years for the Americans to catch up, but when they did, in the mid 1980's, they surpassed the mas-

Table 1: The benefits, costs and risks inherent in Industry 4.0

Benefit possible	Up-front costs	Associated risks
Higher production	Cost of sensors, other instrumentation, cost of upgrading equipment, cost of monitoring and IT infrastructure to be created	Non availability of sensors or spares, computers not custom made, space not available for additional equipment
Higher yield/ lower defect rates	As above	As above
Better quality of goods and services	Higher input costs, better materials handling costs, higher costs of JIT and other special supplier requirements, cost of faster evacuation of finished products to maintain faster rates of output	Risks of disruptions due to poor or below expectation co-ordination between stakeholders, slower receipt of raw materials, inability of some suppliers to practice JIT supplies consistently, consistency in quality of inputs
Speedier, large volumes of processed and unprocessed information transferred to several stakeholders in real time	Costs of connectivity and sensors, programmed devices, reports generation and distribution, data and information processing prior to transmittal, would be high, future customers are likely to be more demanding of information as to how their products are being manufactured. Other stakeholders in the supply chain, like suppliers, distributors are also likely to be a part of the loop	Data security, data capture by external forces like competitor, criminal elements, data leakages through 'tapping', prevention of data loss through proper maintenance of all equipment(electronic equipment are quite prone to failure in dusty environments)
Better monitoring from remote locations, of performance of products and services by the manufacturer, and take corrective and preventive actions to prolong high performance	Cost of data devices, embedded devices in products and services, internet and other types of connectivities, apps development for speedy trouble shooting	Loss of privacy, constant pressure of being monitored all the time by digital devices which may capture data which the customer may not want shared, use of customer data for competitive purposes

ter. Industry after industry in America used 'Lean' principles, a term coined by a student at MIT, Krafcik, (1988, 1989), to improve their productivity, using the principle of reducing 'muda, mura and muri', the three wastes identified by Toyota. James Womack and Jones, through their books on Lean Thinking, Reducing Wastes, (1990,1996), became the pioneers of driving practice in American Companies. Along with lean, the acid rain phenomenon of 1982 and the hole in the ozone layer, soon after, (https://en.wikipedia.org/wiki/Acid_rain) brought focus on 'waste avoidance to conserve and sustain'. Environmental protection, sustainability, climate change, the triple bottom line and reducing consumption of fossil fuels became major areas of concern. Advent of computers led to waste reduction in many ways. Less paper, less electric power due to increased throughput rates achieved due to improved communications and automation, the list is quite long.

I 4 is a different ballgame altogether. Most manufacturers know that using six sigma, one can reduce waste, by eliminating variation, and the defect rate. By reducing defects, the productivity can go up, production rates can move up, and 'more for less' can happen. In I 4, the lean management slogan of more for less can be realized far more effortlessly, consistently and intensely. For example, in an Indian automotive manufacturing company, already mentioned before, the process capability level moved up from 3 sigma to seven plus sigma, by simply applying I 4 technique of computer controlled manufacturing using learning systems and software developed based on online, real time experiments. Just imagine, at 3 sigma levels the defect rate is about 7%, and at 7 sigma, the rate is almost zero. Thus, one can gain in production, as one has to produce only 93 items, instead of the 108 items need to be produced to get 100 defect free products. Imagine the cost benefit, the time benefit and the waste reduction, in cost, time and materials. This is the power of wastelessness which can be achieved by I 4. And this is only the beginning.

Mass customization

Mass customization, (https://www.investopedia.com/terms/m/masscustomization.asp), has been in text books on manufacturing for many years now. Agile manufacturing has, to some extent, addressed this. However, it is still difficult, in spite of advancements in lean management through SMED (Single Minute Exchange of Dyes), to cater to mass customization. This can now happen, when, using I 4 methods, one can make 'production of one' happen in commercial scale. The 'production of one' is a dream of lean management, where, a company can produce just one unit of one item, and then another variant of the same item, continuously, without interruption. 'Production on the Fly', so to say. This can

now happen, and companies can cater to mass customization needs. Just to give an example, say, Kamath Hotels wants to serve customers one sada dosa, one masala dosa, one mysore masala etc on the same tawa, continuously, then it can attract huge clientele. This can be made possible by I 4.

Power processing

Power processing is the handling of huge volumes of complex data. By complex data, we mean different types of data, such as, numerical, text, video, etc. Such handling calls for super processors, heavy duty servers, high speed computers. Of course, the algorithms and the analytics abilities needed to process. All these can now be accessed by all, in cloud centres. Clouds are those where all these facilities are made available to the needed extent to individual clients. Pay per use. Interconnecitivity, IOT, big data analytics, are/ will be the new drivers of business.

I 4 promises to be a revolution in its true sense. It is going to lead to a new way of wasteless production, speedy dispatch and consumption, designed and manufactured to individual needs. Many positives. Very few negatives. One negative is the massive change. No change is painless. However, the kind of changes that will accompany I 4 will be painful, much more than the earlier revolutions. Knowledge of computers, their languages, their moods and behaviours, are all things with which only a few of us are familiar with, the vast majority of the population is totally ignorant of the internal working of a computer and computerese. While the industrial revolution enabled the blue collar workmen to upgrade their skills and get profitably engaged, the computer revolution involved only a small part of the world population to become insiders. The rest of us have had to remain outside and enjoy the benefits, as users. If one compares the chunks of population, especially the blue collars, affected by the core computer industry, the first and second industrial revolutions were far more population friendly. However, the third revolution has brought in its wake a revolution in the services industry. Maybe because of the higher leisure time created by the use of computers, and the increased speed and efficiency of operations, five day work week became the norm in society, and some countries in Europe also practice four day work week. Working from home has become increasingly an option. Due to the greater leisure and higher incomes generated, people demanded leisure goods and services, for example, tourism, eating out, other leisure pursuits like sports and games, gyms, cinemas etc. The services industry thus saw a huge growth, and most economies in the world today, especially the advanced ones in the west, have a 50 to 60 percent share of GDP from the services. The growth in this sector has outstripped the core manufacturing and agriculture.

References

- ✓ Ghobakhloo, Morteza, (2018). 'The future of manufacturing industry: a strategic roadmap toward
- ✓ Industry 4.0'. Journal of Manufacturing Technology Management, Vol. 29, Issue: 6, pp.910-936
- ✓ Jayaraman, R; Avisek Basu and Suryadipta Chakraborty, (2018). Internet of things and the future of manufacturing industry. Indian Journal of Computer Science, May June, 2018, pp 7 -26
- ✓ Kotter, John, (1996). Leading Change. Harvard Business School Press.
- ✓ Krafcik, J. F, (1988). Triumph of The Lean Production System, Sloan Management Review; Fall 1988; Vol 30, Issue 1, Business Premium Collection, pp. 41- 52
- ✓ Krafcik, J.F. (1989), A new diet for US manufacturing, Technology Review, Vol. 92, Issue 1, pp. 28-36.
- ✓ Sony, Michael and Subhash Naik, (2019) "Key ingredients for evaluating Industry 4.0 readiness for organizations: a literature review", Benchmarking: An International Journal
- ✓ Womack, J. & Jones, D., 1996. Lean Thinking – Banish Waste and Create Wealth in your Corporation. London: Simon & Schuster.
- ✓ Womack, J., Jones, D. & Roos, D., 1990. The Machine That Changed the World. New York: Rawson Associates. ■

Fourth Industrial Revolution Technologies as Decision-Making Systems for Inclusive and Sustainable Development

Anthony Wong
CEO, AGW Lawyers & Consultants
IFIP IP3 Deputy-Chair, Board Member
International Federation for Information Processing
Hofstrasse 3, A-2361 Laxenburg, Austria
E-mail: anthonywong@agwconsult.com

Abstract

With the rapid adoption of Fourth Industrial Revolution technologies including AI-enabled advancement in computing systems, more and more services are now being automated using 'robo' or algorithmic decision-making systems. While these technological advances have tremendous potential and opportunities for mankind, they also raise societal challenges and questions in areas such as ethics, morality, privacy, human rights, intellectual property and economics. What recourse do we have when these automated decisions create significant legal effects or intrude on our rights, freedoms and legitimate interests? This article considers the concept behind the 'right to explanation' and the 'right to challenge' on the decision made by automated systems and algorithms. It explores whether the call for the opening of the algorithm 'back box' for evaluation and scrutiny is practical and realistic from a technological perspective.

Introduction

Since Sumerian times, mankind has been recording transactions of their business activities, first on stones, then clay tablets, papyrus, paper, computers and now on a myriad of digital devices. Over the period of human activities, institutions of one sort or another have been processing personal information and data. While the world is increasingly connected by Fourth Industrial Revolution technologies including cloud computing and the Internet of Things (IoT),[1] significant disruptions to long-standing business models are taking place — from online shopping, transportation using Uber drivers, musing in driverless cars to transacting with digital currencies, all energetically driven by data with the aid of applications and networks. Data has become the catalyst for the 'data-centric age' creating a fusion of data with the collection of maturing Fourth Industrial Revolution technologies.

Financial institutions have been one of the early adopters of technology, much more so than other sectors– out of pure necessity to capture, store and to manage the deluge of transactions and data. In their endeavours to comply with money laundering legislation and 'knowing your customer', financial institutions have also discovered that they are sitting on a gold mine of data about their customers.

In the wave of innovation and with the rapid adoption of Fourth Industrial Revolution technologies including AI-enabled (artificial intelligence) advancement in computing systems (processing and machine learning), advanced intelligent algorithms, big data and predictive analytics, more and more services are now being automated using 'robo' or algorithmic decision-making systems (Automated Systems).

The human species have been on a journey of 'inventive steps' (borrowing from the words used in the patent field), and the current disruption and transformation occurring are just another 'innovative' step – but with a difference – the speed at which these innovation and inventive steps are occurring are challenging our human capacity to sufficiently absorb, comprehend and traverse the ever-widening chasm.

The declining cost of storage devices are driving the creation and assembly of vast information databases for automated algorithm processing and information-value derivation. These Automated Systems are much more efficient (both in time and money) than humans and are gradually being deployed across all domains of our industry, government and community.

As these Automated Systems may be driven by real-time data which include publicly available data, data from social media, device sensors, mobile and smart devices, transactional data and audit logs, how do we ensure that these Automated Systems use correct and un-biased data, and are transparent? Current writers suggest that it may be difficult 'to trace the precise reasons for an algorithm's choices as they may be based on vast statistical computations or on real data used as input to the algorithm[2] or that the data may have inherited the prejudices of the data collector.[3]

[1] A phrase coined by Kevin Ashton to describe the system where devices are connected through the Internet to transmit, compile and analyse data.
[2] Viktor Mayer-Schonberger and Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think* (Houghton Mifflin Harcourt, 2013) 178.
[3] Solon Barocas and Andrew D. Selbst, '*Big Data's Disparate Impact*' (2016) 104 *California Law Review* 671.

What rights do we have when these Automated Systems create significant legal effects or intrude on our individual rights, freedoms and legitimate interests?

Often these Automated Systems and their algorithms are referred to as 'black boxes', as some of the technologies behind the 'black box' could be confidential and valuable.

While these technological advances have tremendous potential and opportunities for mankind, they also raise societal challenges and questions in areas such as ethics, morality, privacy, human rights, intellectual property and economics.

This article considers the emerging challenges posed by Automated Systems and algorithms, particularly in the context of the financial services sector. The objective is to identify the key regulatory implications and to examine how our existing legal framework might need to be amended to meet the challenges posed by Automated Systems and algorithms for greater transparency and to provide the consumer with the ability to question the process of automated algorithmic decision making.

The article examines the recent regulatory and policy approaches adopted by the EU on automated processing and the regulatory approaches taken by the Australian Securities & Investments Commission (ASIC) to the regulation of automated financial product advice using algorithms (also referred to as 'robo-advice').

It considers the concept behind the 'right to explain' and the 'right to challenge' on the decision made by Automated Systems and algorithms. It explores whether the call for the opening of the algorithm 'back box' for evaluation and scrutiny is practical and realistic from a technological and legal perspective.

The article comes at a time of renewed interest into the financial sector with the publication of the final report of the Australian Royal Commission into Misconduct in the Banking, Superannuation and Financial Services Industry[4] which addresses the misconduct in the financial services industry due to the imbalances of power between the institutions and consumers; and the inappropriate financial advice leading to the loss of consumers' confidence in the industry. It also comes at a time when the Australian government has introduced professional standards legislation setting higher competence and ethical standards for human financial advisers.[5]

The state of play of 'Robo-Advice' in the financial sector

As algorithm plays a central stage in our discussions on Automated Systems, it would be remiss of me to not include a definition of algorithm in this article. Cormen in in his book, *Introduction to algorithms*, defines an algorithm as 'a computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output.'[6] He also views 'algorithm as a tool for solving a well-specified computational problem.'[7]

In Australia, financial services companies, including largely technology oriented financial organisation (FinTech) start-ups are rapidly emerging to challenge the roles of the banks and the large financial institutions. These FinTechs are rapidly transforming and causing major disruption in the marketplace once monopolised by banks and large financial institutions with their deployment and provision of digital or 'robo-advice' to customers using highly sophisticated algorithms operating on the mobile and web-based environments.

In this context, these services using automated, 'robo' or algorithmic decision-making systems are generally referred to as 'robo-advisers'.

In her address to the Harvard Law School, ex-Commissioner Kara M. Stein from the US Securities and Exchange Commission (SEC)[8] alluded to the challenges pertaining to the rapid emergence of 'robo-advisers' in the United States and the state of flux in relation to their regulation. She added, 'Do investors using robo advisors appreciate that, for all their benefits, robo advisors will not be on the phone providing counsel if there is a market crash?'.

In her remarks during her speech to the Securities Traders Association's 82nd Annual Market Structure Conference, the ex-US Commissioner added:

> Who is responsible when algorithms go awry? …In a world where programming errors are just as damaging to investors as improper sales practices, our regulatory approach may need to evolve.[9]

Although this article does not canvass the general fiduciary duty of a financial adviser, including the obligation to 'act in the best interests of the client in relation to the advice'[10] or the licensing (or regulation) of financial advisers, the rapidly emerging 'robo' environment is already putting pressure on the government's professional standards legislation setting higher competence and ethical standards for human financial advisers.[11] Should we also be canvassing for the regulation of 'robo-advisers'?

Unfortunately, like many parts of our regulatory and legislative endeavours, the law is rapidly falling behind what Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum describes as the Fourth Industrial Revolution phenomenon.[12]

---

[4] https://treasury.gov.au/publication/p2019-fsrc-final-report.
[5] *Corporations Amendment (Professional Standards of Financial Advisers) Act 2017*.
[6] Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, *Introduction to algorithms* (Cambridge, Mass : MIT Press ; New York : McGraw-Hill, 2009) 1.
[7] Ibid.
[8] US Securities And Exchange Commission, Commissioner Kara M.Stein, 'Surfing the Wave: Technology, Innovation, and Competition – Remarks at Harvard Law School's Fidelity Guest Lecture Series' Nov. 9, 2015) <https://www.sec.gov/news/speech/stein-2015-remarks-harvard-law-school.html>
[9] US Securities And Exchange Commission, Commissioner Kara M.Stein, 'Market Structure in the 21st Century: Bringing Light to the Dark' (Sept. 30, 2015) < https://www.sec.gov/news/speech/stein-market-structure.html>
[10] *Corporations Act* 2001 (Cth), s961B.
[11] *Corporations Amendment (Professional Standards of Financial Advisers) Act 2017*.
[12] Klaus Schwab, *The Fourth Industrial Revolution* (World Economic Forum, 2016).

The rapidly emerging 'robo' environments utilising smart phones and 'apps' appeal to the younger investors. The 'Millennials' with their smaller asset base are more willing and comfortable with their smart phones and apps to utilise these online services without the face-to-face meetings with their human financial advisers.

The following factors are driving the onset of 'robo-advisers':

- advisory service may be offered at a lower fee;
- millennials demanding a more convenient and cost effective way of receiving financial advice using apps and 'robo-advisers'; and
- 'robo-advice' technologies are maturing rapidly and are increasingly being provided with enhanced features.

However, the SEC has issued an investor alert, highlighting several matters that consumers should consider in relation to the use of 'robo-advisers'.[13] The alert also queries whether there are any inherent limitations or assumptions in the algorithms used in 'robo-advisers'. For example, a 'robo-adviser' may only be programmed:

- for a specific given situation;
- to consider investments from a given financial organisation; or
- to consider a limited number of factors such as time horizon for investing, age, financial and tax situation but may not take into consideration future changes in an individual's circumstances.

The EU regulation on automated processing and decision-making

In 2016, the European Parliament finally adopted the General Data Protection Regulation 2015 (GDPR)[14] which replaced the 1995 Data Protection Directive when it came into operation in May 2018.

The EU has determined the benchmark for developments in the area of Automated Systems from the broader perspective of data protection and privacy law.[15]

Article 22 is the primary provision in the GDPR which provides for automated decision-making (including profiling). Article 22 prohibits a large range of algorithmic decisions based solely on automated processing unless the conditions stipulated in paragraph 2 of the Article are met. The conditions include receiving the explicit consent of the data user, authorisation under Union or Member State law, or for the performance of a contract between the user and the provider.

The Article grants an individual the right 'not to be subject to any decision based solely on automated processing', which would have legal consequences or significant for the individual.[16]

The text of Article 22 is reproduced below for the reader's convenience:

1. *The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her.*
2. *Paragraph 1 shall not apply if the decision:*
   (a) is necessary for entering into, or performance of, a contract between the data subject and a data controller;
   (b) is authorised by Union or Member State law to which the controller is subject and which also lays down suitable measures to safeguard the data subject's rights and freedoms and legitimate interests; or
   (c) is based on the data subject's explicit consent.
3. *In the cases referred to in points (a) and (c) of paragraph 2, the data controller shall implement suitable measures to safeguard the data subject's rights and freedoms and legitimate interests, at least the right to obtain human intervention on the part of the controller, to express his or her point of view and to contest the decision.*
4. *Decisions referred to in paragraph 2 shall not be based on special categories of personal data referred to in Article 9(1), unless point (a) or (g) of Article 9(2) applies and suitable measures to safeguard the data subject's rights and freedoms and legitimate interests are in place.*

There is no apparent definition in the GDPR for 'automated processing', but references in the text suggests that it would be 'processing' (as defined) carried out without any human intervention. Recital 71 of the GDPR provides 'automatic refusal of an online credit application or e-recruiting practices without any human intervention' as examples of 'automated processing'.[17]

Recital 71 further suggests implementation of 'appropriate mathematical or statistical procedures and 'technical and organisational measures' to minimise inaccuracies and errors.[18]

The individual is further granted 'the right to challenge' the decision made by automated system and the right 'to express his or her point of view'.[19]

In addition, the organisation providing the automated system is required to provide the individual with 'meaningful information about the logic' of an algorithmic decision and the 'significance and the envisaged con-

[13] US Securities And Exchange Commission, 'Investor Alert: Automated Investment Tools' (May 8, 2015) <https://www.sec.gov/oiea/investor-alerts-bulletins/autolistingtoolshtm.html>

[14] Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC ('EU General Data Protection Regulation 2015').

[15] Contrast the Australian perspectives where the developments in areas of automated processing and algorithms are led by the Australian Securities and Investment Commission. See *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016.

[16] EU General Data Protection Regulation 2015 art 22.

[17] Ibid recital 71.

[18] Refer to the comparative measures outlined in the Australian Securities and Investment Commission, *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016, 21.

[19] EU General Data Protection Regulation 2015 art 22.3.

sequences of such processing'[20] to 'ensure fair and transparent processing' to provide safeguards to protect the individual's rights, 'freedoms and legitimate interests'.[21]

How does one go about to explain the logic behind an algorithmic decision in human intelligible terms upon a challenge? What does it mean to challenge and how does one explain a decision made by an Automated System?

The answers to the above questions are not easy, may be highly complex and technical. An individual would reasonably require some understanding of the logic behind an algorithmic decision in reasonably human intelligible terms to undertake such a challenge.

Reading and comprehending the code of an algorithm require specialised computational skills which are not readily available amongst non-technical circles. There is also added complexity in the dimension, as algorithms may operate alongside input data which one may not have much control over. In the context of the rapidly evolving learning machine algorithm, the internal logic of an algorithm may also be altered as it 'learns' from the training data.[22]

In situations through machine learning – where algorithms and decision rules are "trained" using data and historical examples to recognize patterns in the data and to learn to make future decisions based on these observations, regulators and consumers may not easily discern about the properties of these algorithms.

We have a maxim in computing: garbage in; garbage out. We have to be careful about which data is being fed to machine-learning algorithm, as any data bias/ statistical distortion will be learned and amplified. As machine learning develops, algorithms often become even more complex over time, to the point where it can become difficult to articulate and understand the inner workings- even to people who created them.

If the decision rules are not explicitly programmed by a human but rather inferred from data, how do we build in checks and balances – to hopefully ensure, a future of ethical design?

The UK Information Commissioner has provided an overview of the General Data Protection Regulation (GDPR).[23] The Information Commissioner has provided guidance as to what is required to ensure that the appropriate measures are in place under Article 22(3) to safeguard the data subject's rights, freedoms and legitimate interests and the ability of the data subject to 'challenge' the automated decision making. The measures as stated include:

- the provision of meaningful information about the logic involved with the algorithmic automated processing, as well as the significance and the envisaged consequences to ensure fair and transparent processing;
- the adoption and use of appropriate mathematical or statistical procedures for the profiling;
- the implement of appropriate technical and organisational measures to enable inaccuracies to be corrected and minimise the risk of errors; and
- securing personal data in a way that is proportionate to the risk to the interests and rights of the individual and prevents discriminatory effects.[24]

The GDPR is now approaching its first anniversary, and it would be interesting as to how the EU courts would interpret the requirement under Article 13 to provide the individual with 'meaningful information about the logic' of an algorithmic decision.[25] While novel and honourable in its approach, the EU perspective may require the assembly of specialists to decipher and explain algorithmic code which might be highly technical and complex.

I am not personally persuaded that the automated processing provisions outlined by the EU could be easily complied with without much fear and anxiety after my analysis of the subject. From my technical reading of Jenna's article on 'How the machine "thinks": Understanding opacity in machine learning algorithms'[26] and Goodman's article[27] on 'EU regulations on algorithmic decision-making and a "right to explanation"', further research would be needed before one may can draw any satisfactory conclusion on the matter.

Driven by the recent EU developments, volumes of literature have and are being written on the subject in recent times – ranging from articles in scientific magazines such as *New Scientist* to serious technical academic journals. The debate has accelerated since the EU General Data Protection Regulation came into effect.

Regulatory approaches taken by ASIC to the regulation of automated financial product advice using algorithms (also referred to as 'Robo-Advice')

Unlike the EU position, the Australian ecosystem has not matured to the extent to consider automated decision-making and processing in the context of privacy and data protection laws. Developments in automated decision-making and processing have largely been confined to the financial sector.

[20] Ibid art 13.2(f).
[21] Ibid art 22.2(f).
[22] For a good exploration of the issues and the complexity arising from machine learning algorithms including neural networks refer to Jenna Burrell, 'How the machine "thinks": Understanding opacity in machine learning algorithms' (2016) Big Data & Society 5.
[23] UK Information Commissioner's Office, *Overview of the General Data Protection Regulation (GDPR)*. Accessed online April 2019 at <https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/rights-related-to-automated-decision-making-including-profiling/>.
[24] Ibid.
[25] EU General Data Protection Regulation 2015 art 13.2(f).
[26] Jenna Burrell, 'How the machine "thinks": Understanding opacity in machine learning algorithms' (2016) Big Data & Society 5.
[27] Bryce Goodman and Seth Flaxman, 'EU regulations on algorithmic decision-making and a "right to explanation"' (Paper presented at the ICML Workshop on Human Interpretability in Machine Learning)

In March 2016, ASIC released a consultation paper 254[28] seeking the views of the financial services industry as to how 'robo advisers' should be regulated. Following a short consultation period, ASIC released its regulatory guidance in August 2016, pertaining to the provision of automated financial product advice using algorithms and technology without the direct involvement of a human adviser.[29] The guidance defines 'robo-advice' as the "provision of automated financial product advice using algorithms and technology without the direct involvement of a human adviser.

ASIC consulted with stakeholders in relation to the practicality of requiring expertise to explain on the scope, design, rules and risks behind the algorithms used to provide the automated digital financial advice.

The ASIC regulatory guide maintains that the law is technology neutral and requires a FinTech providing financial advice services under the Corporations Act to hold an Australian financial services licence or become an authorised representative of a licensed holder, unless exempted.[30] It also expands on how the 'organisational competence obligation'[31] would apply to 'robo advisers' and how the algorithms deployed in 'robo-advisers' should be tested and monitored.

The guidance requires that a business carrying out 'robo advice' must have at least one person within the business who understands the 'rationale, risk and rules' utilised in the algorithms and the technology[32] and with the skills to review the resultant 'robo advice'.[33]

ASIC laid down 8 guidelines in relation to the monitoring and testing of algorithms.[34] The extend and applicability of these measures would ultimately depend on the complexity, scale and nature of the financial services provided.[35]

These measures stipulated include:[36]

- keeping appropriate records of changes to the algorithms for seven years;
- maintaining algorithms currency in conformance with legal and market changes;
- documenting the decision rules including the scope, design and purpose of the algorithm displaying possible results and decisions;
- documenting the strategy and scope for the testing of the algorithms;
- managing changes to the algorithm including security and access to the algorithm;
- ability to suspend the 'robo-advice' using algorithm in the event of an error;
- maintaining appropriate human and technological resources, to supervise and monitor the operation of the algorithms; and
- processes to ensure that the appropriate measures are followed.

The above compliance measures are more extensive than the UK Information Commissioner's guidance[37] provided under the EU General Data Protection Regulation (GDPR).

However, the ASIC position does not go as far as the EU position in providing an explicit 'right to explain' and the 'right to challenge' on the decision made by automated systems and algorithms. The ASIC regulatory guidance does not place an explicit onus on the algorithmic provider to explain the logic behind an algorithmic decision in human intelligible form. Unlike the EU position, this may be largely intentional as the coding and design in the algorithm as expounded above, may pose highly complex and technical considerations which may be beyond the skillset of an average person working in the financial sector.

In addition, the logic behind an algorithm may comprise confidential trade secrets and other legal concerns. A forced disclosure of the logic behind an algorithm would be problematic for FinTech startups as they might lose their competitive advantage and the confidential protection of their trade secrets due to the disclosure.

On the other hand, there could be looming issues on concealment or non-disclosure in line with the concerns raised by Parquale in his book, *The Black Box Society: The Secret Algorithms that Control Money and Information,* if we would allow 'robo-advisers' and their organisation to 'keep [their] doings opaque on purpose, precisely to avoid or to confound regulation'.[38]

Hodson in his article 'Taming the tech giants' in *New Scientist*[39] raised concerns on the ability of society to hold global companies to account. He intimated that 'technically minded people' who understand the impacts of technology platforms on the autonomy of individuals should be recruited into regulatory bodies such as ASIC as a priority. However, I believe that the above may be an interim solution until the average financial advisers are

[28] Australian Securities & Investments Commission, *Regulating digital financial product advice,* Consultation Paper 254, March 2016 (*'ASIC CP 254'*).
[29] Australian Securities and Investment Commission, *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016. Accessed online April 2019 at <https://asic.gov.au/regulatory-resources/find-a-document/regulatory-guides/rg-255-providing-digital-financial-product-advice-to-retail-clients/>.
[30] Ibid [RG255.18].
[31] *Corporations Act* 2001 (Cth), s912A.
[32] Australian Securities and Investment Commission, *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016, [RG255.62].
[33] Ibid [RG255.61].
[34] Ibid [RG255.74].
[35] Ibid [RG255.73].
[36] Ibid [RG255.74].
[37] UK Information Commissioner's Office, *Overview of the General Data Protection Regulation (GDPR)*. Accessed online April 2019 at <https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/rights-related-to-automated-decision-making-including-profiling/>.
[38] Pasquale F, *The Black Box Society: The Secret Algorithms that Control Money and Information* (Cambridge, MA: Harvard University Press 2015) 2.
[39] Hal Hodson, 'Taming the tech giants', (3 September 2016) *New Scientist 16.*

educated and trained in the new art of 'explaining the logic behind an algorithmic decision in human intelligible terms'.

Should regulators hold developers and providers of Robo-advice to comparable competency standards demanded from human actors? What should be the background and competence of designers and developers of Robo-advice? For instance, should it be a group comprising only of expertise in computer science, maths and statistics or an interdisciplinary group composed by financial advisers, social scientists, lawyers and expertise in computer science, maths and statistics?

Should Australia follow the lead taken by the EU, by expanding the penalty provisions in the Australian Privacy Act 1998 for serious or repeated interference with privacy? The GDPR now sets out new maximum fines of the greater of €20 million or four percent of an undertaking's worldwide turnover. The Australian Privacy Act already provides for the Australian Privacy Commissioner to issue million-dollar fines for serious and repeated privacy breaches. Would raising the stakes focus the mind, especially amongst multinationals?

Conclusion

'Digital disruption' is here to stay and is transforming our economies, businesses, industries, governments and communities including the financial advisory sectors. Many of our laws were drafted at a time before the onset of automated, 'robo' or algorithmic decision-making systems.

As we grabbled with the transition from the 'bricks and mortar' to the digital economy, we discover that the old ways of doing things and the regulatory framework supporting them are no longer appropriate and applicable to safeguard our interests and relationships. Clearly the times ahead are both interesting and challenging, as we come to grips as to that it means to legislate and to regulate in the new world of automated, 'robo' or algorithmic decision-making systems.

For the first time, technology innovation is not only automating the repetitive and the manual aspects of our labour but also gradually supplementing, enhancing and replacing our 'minds' and our advisory services with the evolving introduction of the learning algorithmic machines.

In this short article, I have drawn on but some of the difficulties in this new endeavour. The chapter is but no means closed, but computational skills including design, coding and deciphering of algorithms may be useful skills to have in all walks of life moving into the future.

To overcome the loss of confidential trade secrets on a forced disclosure of the logic behind an algorithm, perhaps a middle ground could be adopted by deploying independent 'trusted auditor' as suggest by Parquale.[40]

Recently, one commentator indicated that innovation is putting 'the power in the user's hands, without the need for a human advisor.'[41] However, as indicated by Steiner, 'algorithms can and will do strange things. As …we can lose track of who or what is pulling the strings.'[42]

When things go wrong and investments are not realised, would 'robo-advisers' be called upon to 'account at the end of the telephone line to answer the hard questions'. We are at the precipice, and this article only captures the tip of the iceberg in a world undergoing rapidly disruptive change.

References

Books and looseleafs

- ✓ Mayer-Schonberger, Viktor, and Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think* (Houghton Mifflin Harcourt, 2013)
- ✓ Pasquale F, The Black Box Society: The Secret Algorithms that Control Money and Information (Cambridge, MA: Harvard University Press 2015)
- ✓ Steiner, Christopher, Automate This: How Algorithms Came to Rule Our World (New York: Portfolio/Penguin, 2012)
- ✓ Schwab, Klaus, *The Fourth Industrial Revolution* (World Economic Forum, 2016)
- ✓ Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, *Introduction to algorithms* (Cambridge, Mass : MIT Press ; New York : McGraw-Hill, 2009)

Journals and articles

- ✓ Ashurst, 'Robo and digital advice – the way of the future?', (online), 21 April 2016 < http://www.ashurst.com/financehub/robo-and-digital-advice/>
- ✓ Barocas, Solon and Andrew D. Selbst, '*Big Data's Disparate Impact*' (2016) 104 *California Law Review* 671
- ✓ Burrell, Jenna. 'How the machine "thinks": Understanding opacity in machine learning algorithms' (2016) Big Data & Society 3(1)
- ✓ Goodman, Bryce and Seth Flaxman, 'EU regulations on algorithmic decision-making and a "right to explanation" ' (Paper presented at the ICML Workshop on Human Interpretability in Machine Learning)
- ✓ Hodson, Hal, 'Taming the tech giants', (3 September 2016) *New Scientist* 16

Legislation and treaty

- ✓ Corporations Act 2001 (CTH)
- ✓ Corporations Regulations 2001 (CTH)
- ✓ Privacy Act 1988 (CTH)
- ✓ Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (EU General Data Protection Regulation 2015)

Reports

- ✓ Australian Securities and Investment Commission, ASIC Consultation Paper 254: Regulating digital financial product advice, March 2016
- ✓ Australian Securities and Investment Commission, ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients, August 2016 ■

[40] Pasquale F, *The Black Box Society: The Secret Algorithms that Control Money and Information* (Cambridge, MA: Harvard University Press 2015) 141.
[41] Ashurst, 'Robo and digital advice – the way of the future?', (online), 21 April 2016 <http://www.ashurst.com/financehub/robo-and-digital-advice/>
[42] Christopher Steiner, *Automate This: How Algorithms Came to Rule Our World* (New York: Portfolio/Penguin, 2012) 5.

Tapping 5G to Promote Economic Development in the Developing Countries

Henry Chan Hing Lee
Visiting Senior Research Fellow, Cambodia Institute for Cooperation and Peace, Phnom Penh, Cambodia
E-mail: henry.chan.2012@phdgm.smu.edu.sg

Abstract

The 5G technology is going to be one of the disruptive General Purpose Technology underpinning the Fourth Industrial Revolution and affects the economic growth potential and security of all countries, not just for countries aspiring to be in the technological frontier. The 5G industry ecosystem is still in an early stage of development, and the industry pecking order in the 5G era is still evolving. The likely outcome will be decided by whoever can best integrate the 5G technology with its economy and develop business cases to propel their national economic growth. Developing countries can tap the potential of 5G technology by concentrating on the application layer in their current economic activities. The emerging technology brings both the opportunity and challenges to the developing countries' governments, many new rules must be put up. The issue of benfits and cost distribution in using the new technology among its different sectors can only be solved by the concerning governments.

The article looks at the current state of the 5G technology and analyzes the industry from four perspectives: (1) The economic potential of 5G vs earlier generations mobile communication technology; (2) Global 5G industry ecosystem; (3) 5G business model development; and (4) the critical role of government regulation. The article looks more particularly of what 5G can help developing countries in its economic development.

Introduction

The rollout of the 5th Generation (5G) advanced wireless system commercial services in the Republic of Korea and the United States in April 2019 heralded the arrival of the new era of mobile communication. Like other earlier generations of 1G to 4G mobile communication, this new mobile communication system is one of the General-purpose technologies (GPTs) that has the potential to drastically affect an entire economy and the societies through its impact on pre-existing economic and social structure. Examples of GPTs include the steam engine, railroad, electricity, electronics, mechanization, automobile, the computer, the internet, modern medicine and Artificial Intelligence. A glance at the economic history of developed countries today revealed that they were skilful in tapping the new applications and economic opportunities offered by the GPTs when these technologies appeared, they are either first mover or skilled, quick followers of the GPTs.

In the 1G era, voice communication moved from fixed-line telephony and two-way radio to the mobile age. The technology behind is analogue, and voice quality is often subject to signal interference. However, the 1G era brought mobility to voice communication, and it was proven popular in many developed countries. In the 2G age, the migration from analogue to digital technology allows the introduction of short message service (SMS), the SMS technology drastically lowered the cost of sending messages, and it altered the way communication is conducted in many developing countries.

In the 3G era, mobile communication integrated into the internet network. The comparatively slow data transmission speed confine most of the applications to text-based internet application with email on smartphone becoming one of the popular applications. 3G also saw the beginning of e-commerce on a mobile platform. In the 4G era, the vast data transmission speed improvement made mobile experience getting close to that of fibre optic based fixed line, interactive Web 2.0 and rich graphics contents implemented over the mobile platform and we witnessed the ascendancy of mobile e-commerce, mobile banking and social media.

It is often said that odd number mobile communication generation is a stepping stone to the succeeding even number generation and usually of relatively shorter durations that the succeeding even numbers generations. The analogy is correct in the sense that 2G is leapfrog over 1G from analogue to digital, and 4G is a leapfrog in mobile web experience from 3G which started the internet application in mobile communication. However, the transition from 4G to 5G presents a new paradigm, while the technology behind 5G is an engineering improvement over 4G, the application arena represents a revolution. The earlier 1G-4G worked mainly on how to change and improve communications and confine itself mostly to the consumer spaces in the economy. The critical application area in 5G will likely move to business and government space in the economy and holds significant promise to any countries who can successfully integrate the faster communication channels with existing economic activities and boost productivity.

Table 1 shows the increasing sophistication of application areas with each generation of mobile communications.

The economic potential of 5G vs earlier generations mobile communication technology

Each generation of mobile communication encompass all technologies of the previous generations and expand its economic footprint by embracing new activities as well as keeping the old one. There are three vital distinguishing features of the 5G network:

First is the eMBB (Enhanced mobile broadband): High bandwidth internet access suitable for web browsing, video streaming, and virtual reality. This is the Internet access service used with smartphones.

Second is the mMTC (Massive machine type communication): This is the narrowband Internet access for sensing, metering, and monitoring devices. In table 2, this feature means we can install as many as a million low power monitoring devices in an area as small as one square kilometre without physical wiring connection, collect real-time data for analysis and action.

The third is the URLLC (Ultra-reliable low latency communication): Services for latency sensitive devices for applications like factory automation, autonomous driving, and remote surgery. These applications require sub-millisecond latency with error rates that are lower than one packet loss in 10^5 packets or it means that for the URLLC service only 10^{-5} (0.001%) of 20 Byte long packets will fail to be delivered in 1ms. In Table 2, this feature means the 5G can meet the stringent operation requirement of latency and reliability requirements.

One should note that the improvements on the eight performance parameters of 5G over the 4G in table 2 are the enabling factors behind the three distinguishing features of the 5G network. In this regard, 5G is a technological evolution over 4G. However, the fact that there are so many new emerging applications shows that 5G provides the platform allowing many applications to cross the technical barrier threshold and become feasible. Hence one can look at 5G as an application revolution. An example is an automated guided vehicle, the operation of a said vehicle requires end-to-end latency of 10 ms and a maximum failure rate of 10^{-4}. It is evident that 5G can safely provide these two technical requirements on latency and reliability.

Global 5G industry ecosystem

There are three frequency bands currently in use under 5G network.: The Low Band of sub-3 GHz, the Middle-Band of 3 to 6 GHz and the High-Band of 24 GHz upward. The Low-band and Mid-Band together are known as Sub-6 GHz Band, and the High-Band is also known as millimetre wave (mmWave).

The frequency spectrum choice is important because the spectrum determines the two most important 5G network characteristics that defined the cost of a network. The first characteristic is the coverage area and the second characteristic is the message carrying capacity of the system. The coverage area determines the cellular base station density and the cost of putting up the system. The capacity means the information volume that the system can carry and the higher frequency spectrum use in the system means more information capacity for the system. However, using a higher frequency spectrum is technically more challenging. In 5G radio wave, these two characteristics associated with each other in the opposite direction.

Low-band spectrum has low capacity, but high coverage area, the cost of deployment is lower due to its smaller number of base stations required, but its top speed is way below 1 Gigabit per second (Gb/s). High-Band mmWave has a high capacity but more modest coverage, this band holds to promise to carry signals up to 10 Gb/s. Mid-Band is intermediate between the two groups in terms of capacity and coverage, and its current top speed is around 1Gb/s. Among the three leading countries on 5G deployment at the moment, South Korea and China are working on 3-4 GHz Mid-Band, while the dominant U.S carriers, Verizon is working on mmWave. The

Table 1: Five generations of mobile telecommunications

Generation	Deployment date	Download speed	Key application area
1G	1980s	2.4kb/s	Voice
2G	1990s	64kb/s	Voice/SMS digital
3G	2000s	384kb/s-14mb/s	Web browsing; Mobile data; Email on smartphones
4G	2010s	40-100 Mbps(real) 300-400 Mbps (lab)	High-speed data/video streaming
5G	The 2020s	1Gb/s-10Gb/s	Any data transmission speed, latency, data collection points and reliability sensitive applications. Examples are the Internet of Things (IoT), autonomous vehicles, telemedicine, augmented reality & virtual reality.

Table 2: Key performance difference between 4G and 5G

Performance parameter	4G	5G	Improvement
Mobile data volume per square kilometre	10 Gb/s/ km^2	10 Tb/s/km^2	1000 x
Peak unload data	1-10 Gb/s	100 Mb/s -1G/s	10-100x
Maximum carrier mobility speed	350 km/hr	500 km/hr	1.5 x
Connected device density (device per square km)	Up to 1 million	Up to 10 thousand	100x
Energy efficiency	10% of current per-device power consumption	1x	10x
Service deployment time	As short as 90 minutes	hours	Several magnitudes lower
Reliability	99.999%	99.99%	10x
End to end latency time	1ms-10ms	25-50ms	2.5x-50x

other three U.S carriers, AT&T, T-Mobile and Sprint, are working on Low-Band.

There is also non-standalone and standalone network design in the 5G. The non-standalone network means the system will use 5G frequency in the radio access network phase of 5G, but the core network at the backend will use 4G equipment, the setup facilitates the deployment but compromises on the peak speed. The standalone means 5G equipment run the entire system in the whole network, from the radio access end to the core network of servers and routers, and it is going to deliver the full benefit of 5G in speed, latency and connectivity as mentioned. At the moment, the non-standalone industry standard is already established by 3GPP Release 16, but the standalone industry standard of 3GPP Release 17 is still in the working process and likely release by the end of 2019.

Based on the findings of the U.S Defense Innovation Board, the 3-4 GHz Mid-Band has a coverage area of more than five times that of mmWave based on current technologies and the frequency spectrum offers the best balance between an economic proposition and technical performance as of now. The US government is accelerating the released of 3-4 GHz frequency for 5G use as most of the spectrum in that range reserved earlier for government use.

The commercial rollout of 5G in early April has not been smooth; the South Korea rollout saw enormous problems for a smartphone to go into the 4G network when it moves out of 5G coverage area and getting into 4G area. The US rollout saw data speed of smartphone dropping to 200-600 Megabit per second (Mb/s), a far cry from the promised 1 Gb/s. The rollout problems revealed that the technical challenge behind the deployment of the 5G system remains and the large scale adoption will likely be delayed to the early 2020s. In any case, the previous generation of 1G to 4G all use sub-3 GHz spectrum, and the requirement of the base station will be less as lower frequency means higher coverage area. The use of Mid-band and mmWave means more base station and more equipment deployment, the capital requirement of 5G will be more than all previous generations of mobile communication.

The 5G ecosystem also witnesses the rise of Asian suppliers and increasing oligopolistic trend among the supplier base of equipment. The oligopoly trend is a result of increasing technology complexity and the concentration of both technologies and patents on the hand of the giants. At the moment, three top tier player who can provide an end-to-end solution to 5G; they are Huawei, Ericsson and Nokia. Two smaller players of 5G equipment are ZTE and Samsung. Among the 5G global equipment suppliers, three are Asian, and two are Europeans. Two U.S companies actively involved in the 5G space, Qualcomm is the dominant player in the 5G semiconductors supply chain, and Cisco is involved in the backend core network router and servers. They are all considered niche players in the 5G space.

The rise of the Asian equipment supplier reflects the fact that China and South Korea are rising technology powers in digital communications. The favourable mobile business environment also helps, both countries' mobile telecommunication carriers have good monetization applications on hand. China 's mobile e-commerce, mobile payment platform and super platform integration different functions in addition to its vast domestic market created very high mobile data demand. The South Korean mobile e-commerce and mobile entertainment are among the most vibrant in the world, and the country is consistently among the highest in per capita mobile data consumption and 4G market penetration.

While it is exciting to watch the 5G technology evolution and adoption, one should not overlook the fact that 5G's role is to present an appropriate innovation platform for integrating various technologies in a particular domain to solve real-life problems. There are unique challenges in any specific areas that call for developing complementary technology before one can fully integrate the 5G features of low latency, high-reliability deployments. 5G deployment and monetization depend on the maturity of all com-

plementary technologies in a specific area, and the required timing to success is more uncertain than commonly thought. One should not underestimate the complexities of adopting 5G.

An example is to use the IoT and low latency to build a connected traffic management infrastructure. In addition to using the 5G platform to link all data collected by the various traffic monitoring sensors at appropriate control junctions, one also needs the Artificial Intelligence-based traffic management algorithms on the platform to issue real-time management instructions to direct and modify traffic at a particular traffic choke point.

The challenges of initial deployment teething problems, higher capital investment, development timing of complementary technologies and poor current monetization environment in many countries will delay the full-scale implementation of 5G. However, these problems are mostly technology base, and cost-based issues, challenges of these nature will be resolved with improved engineering research and the associated cost likely drop as technology advances. By 2020, only a handful of countries will deploy 5G, and we are still in the initial phase of monetization of 5G services. Most analysts expect the 5G deployment to pick up speed by early-mid 2020s.

It is estimated that by 2025, 4G will remain the dominant mobile communication platform, however, one notable prediction is that out of the 25 billion devices expected to attach to the 5G network by that time, about 60% will be IoT device (mainly sensors and actuators) using in the enterprise space and consumer device will only be 40%. The hype around 5G is mostly due to the new 5G use cases that are enterprise-centric and latency sensitive.

The consumer market dominates the 4G application area as Figure 1 shows. The more sophisticated application rely on fixed line fibre optics network.

The corporate market will dominate the 5G application area as Figure 2 show. The 5G platform can take over most of the functionalities of fibre optics.

5G business model development and the critical role of government regulation

It is a well-known fact that 5G is far superior to the previous generation wireless technologies. The technology keeps all the application areas of earlier generations of mobile communication and adds latency sensitive,

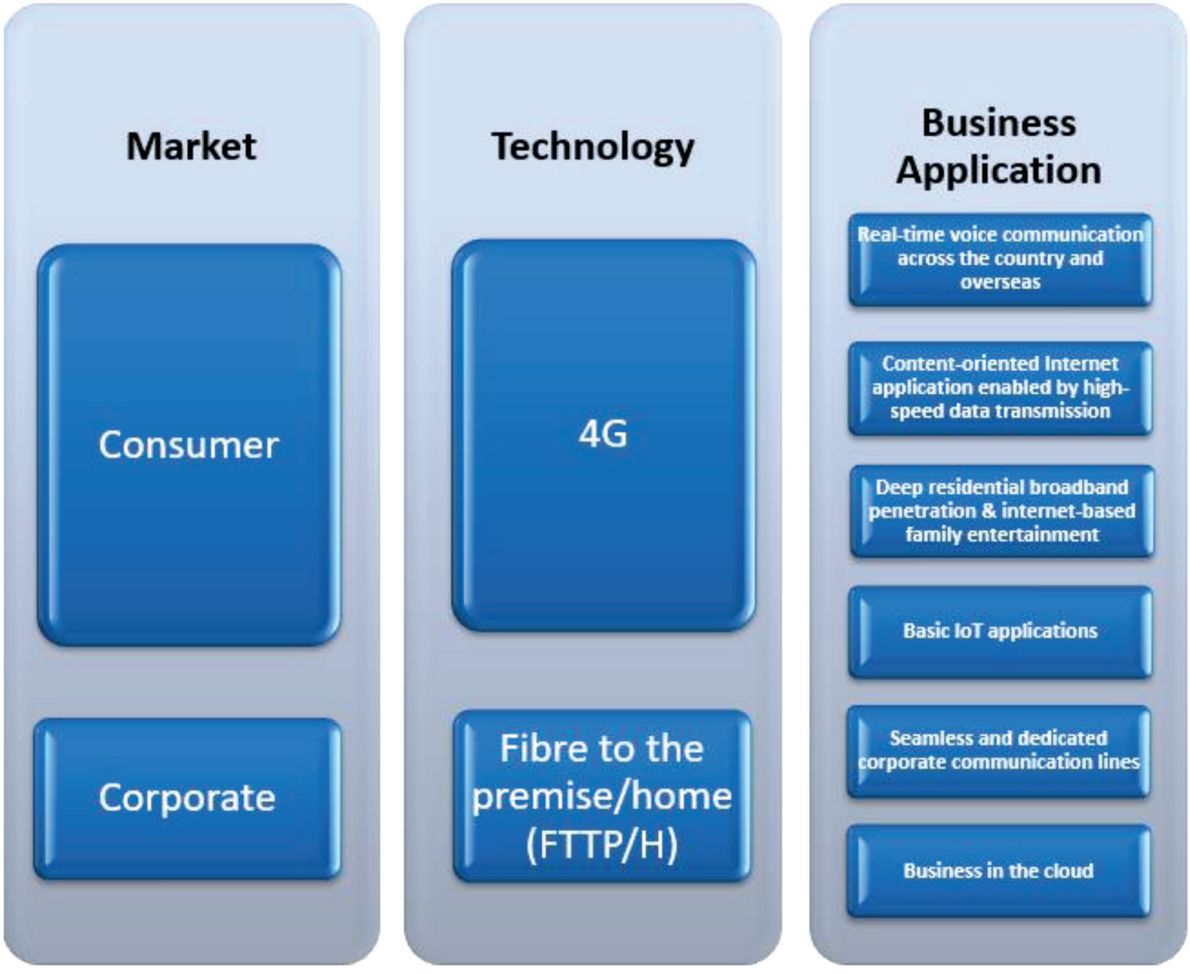


Figure 1: 4G ecosystem

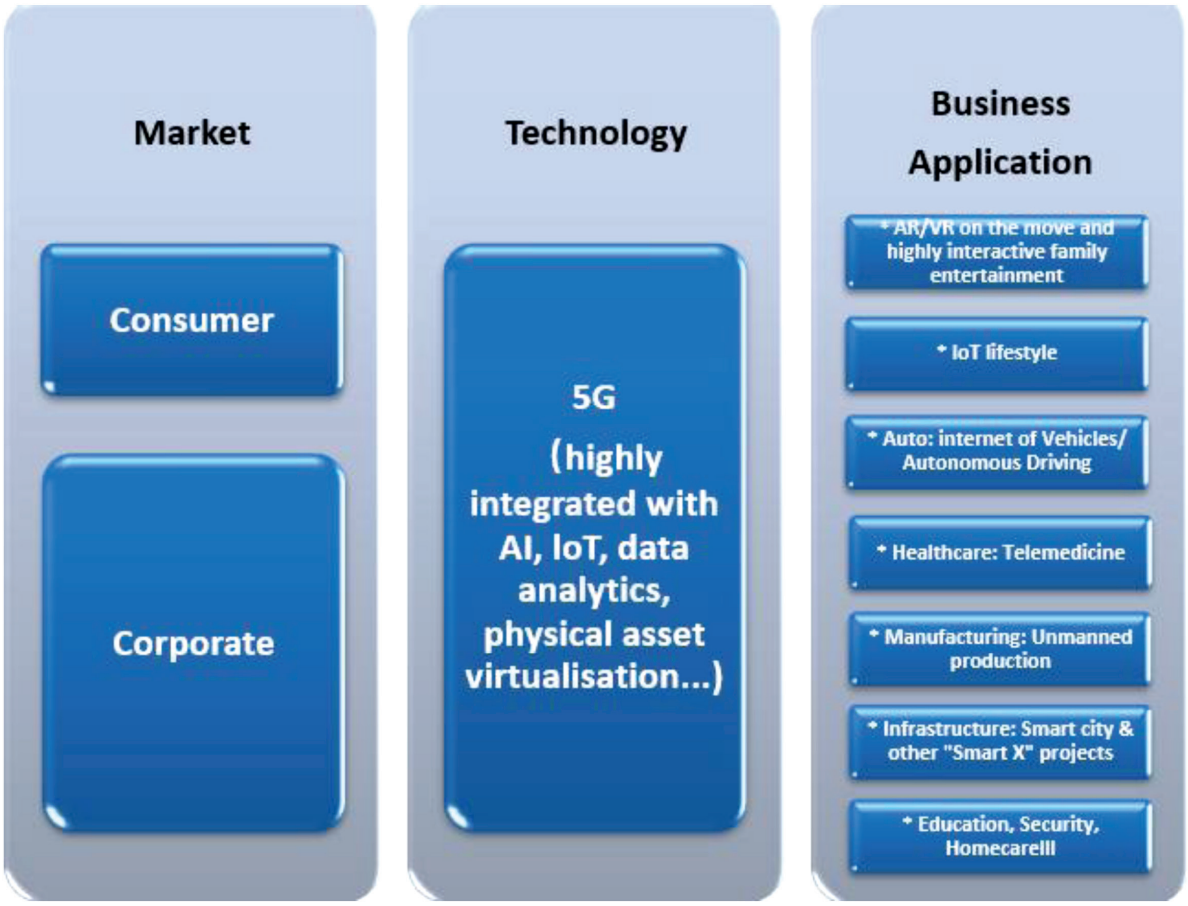


Figure 2: 5G ecosystem

connection intensive and transmission speed critical applications to its platform. 5G isn't just for mobile handsets, it supports many different use cases, beyond providing 5G connectivity to mobile phones.

Traditionally, wireless services are monetized based on bandwidth and data transmission needs and concentrate on consumer markets; pricing model is gigabit usage per period. However, 5G is different; it also supports use cases such as IOT, AR/VR, Robotic Surgeries and Live TV, service providers can cash-in on the additional performance indicators of the service. The business opportunities for improving current economic activities using the 5G platform are enormous.

Most of the identified new use case is based on advanced countries experience, and they focus on areas catering to their markets. Notable use cases are connected auto, AR/VR development and advanced consumer cases like 4K/8K television broadcasting, autonomous factories, remote medicine, smart energy & utilities and smart cities. However, there are many current social activities and business applications in developing countries that can tap the 5G platform and significantly enhance economic development.

A notable case is city traffic management; there are many megacities in developing countries that suffer from far worse traffic problem than developed cities in advanced countries. In Southeast Asia, one can quickly identify Jakarta, Bangkok and Manila. In South Asia, Delhi, Mumbai, Banglore and Kolkata are among the worst cities in the world in terms of road traffic.

Another case is agriculture if a network of IoT devices can be placed strategic location in the irrigated areas to measure the subsoil moisture level, the release of water from the dam can link to real-time feedback of subsoil moisture and significantly improve the utilization of the precious water.

The 5G technology opens the door of using the new communication technology to enhance the growth of the developing countries by boosting the productivity of existing economic activities; the opportunity can only be exploited by entrepreneurs who are also well versed on the details of the particular application domain. The developing countries should take the initiative to foster the development of such entrepreneurship and help the entrepreneur to become the drivers in developing relevant business models for 5G.

Many new issues emerge along with the new technologies and use cases in 5G. For example, 5G network slicing allows operators to divide a single physical network (everything from the radio to the core

network) into multiple virtual networks. Each network slice can have different speed limits, different latencies and different quality of service configuration. The charges levy by the carrier will materially affect the development of the use cases by the entrepreneurs, and the government must formulate policies to encourage non-carrier related entrepreneurs developing the new applications.

Many policies related to the 5G is socially sensitive; the expensive investment on 5G might require the government to invest in a national network and then lease out the facilities to private sector carriers as they might not be financially capable of doing so. In this case, how to partition the revenue of different stakeholders through different fee structure is going to be a social issue.

Most of the countries have multiple legacy carriers, and we have noted that the economies of each one of them building its proprietary 5G network might not be financially viable. How to help these operators to share resources such as tower pooling and allow the operation of Over-the-top media services (OTT) service are also within the preview of the government.

Aside from using simple data consumption model using gigabit consumption, the charging can use network latency as a currency to charge customers. The carrier can levy charges differently based on the applications served by the network. If the application is latency sensitive (such as robotic surgery), customers may pay a premium to avail the service.

Similarly, use cases such as IOT would result in more 5G connections hitting the small cells - while the bandwidth consumption of those devices may be meagre. Customers availing such IOT services can be charged based on the number of 5G connections. 5G provides unimaginable possibilities to both the carrier service providers and the customers.

A key challenge to the government in using 5G to improve its economy is the re-orientation of research & development setup. In the example of using 5G in dam water release in an earlier paragraph, one should realize that mobile communication traditional belong to the purview of the agency in charge of Information & Communication, while the dam management is that of agriculture. The country concern should break the potential silo problems commonly existing in countries around the world and make ICT and agriculture agencies work together. A re-orientation of government thinking on technology policy and putting an organizational structure that facilitates technology integration with government services is needed in the effective 5G implementation.

Conclusions

The emergence of 5G technologies offered a new way of enhancing economic growth in developing countries. The GPT can serve as a platform to allow new use cases to be prepared to improve existing economic activities. Any operation that will benefit from more real-time data collection, analysis and response are candidates for new use cases development. The government's role in both setting the new rules for the new cases and fostering the entrepreneurship required for the new use case development will be instrumental in the success of 5G in the country.

References

- ✓ 5G Americas. (2018, October). Wireless Technology Evolution: Transition from 4G to 5G , #GPP Release 14 to 16. Retrieved from http://www.5gamericas.org/files/8015/4024/0611/3GPP_Rel_14-16_10.22-final_for_upload.pdf
- ✓ Abecassis, D., Stewart, J., & Nickerson, C. (2019, April). Global Race to 5G-Update. Retrieved June 4, 2019, from https://api.ctia.org/wp-content/uploads/2019/03/Global-Race-to-5G-Update.pdf
- ✓ CTIA. (2019, April). A National Spectrum Strategy to Lead in 5Gin 5G. Retrieved May 4, 2019, from https://api.ctia.org/wp-content/uploads/2019/04/A-National-Spectrum-Strategy-to-Lead-in-5G.pdf
- ✓ Defence Innovation Board. (2019, April 3). The 5G Ecosystem: Risk & Opportunities for DoD. Retrieved May 4, 2019, from https://media.defense.gov/2019/Apr/04/2002109654/-1/-1/0/DIB_5G_STUDY_04.04.19.PDF
- ✓ Iphytics. (2019, February). Who is leading the 5G Patent Race? Analysis on Decalred Standard Essential Patents, 3GPP Contributions & Attendance Data. Retrieved May 4, 2019, from https://www.iplytics.com/report/who-is-leading-the-5g-patent-race/
- ✓ Nokia. (n.d.). 5G transformation: 7 streams for success. Retrieved May 4, 2019, from https://pages.nokia.com/T003RI.5G-transformation-7-streams-for-success.html ■

Tech Events

2019

Aug 16–18
Guangzhou, China
Guangzhou International Solar Photovoltaic Exhibition 2019
Contact: Guangzhou Grandeur Exhibition Services Co., Ltd, Room 2303-2305, The 4th Tower Dong Jun Plaza, No.836 of Dong Feng Dong Road Yuexiu District, Guangzhou, 510080, China
Tel: +86 2022074185; Fax: +86 20-82579220
E-mail: grand.ad@grahw.com

Aug 22-23
Bengaluru, India
IoT India Congress
Contact: Secretariat
E-mail: register@iotindiacongress.com
Web: http://www.iotindiacongress.com

Sept 03–05
Kuala Lumpur, Malaysia
RENEWABLE ENERGY WORLD ASIA 2019
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

Sept 18–20
Busan, Republic of Korea
ENVIRONMENT & ENERGY TECH 2019
Contact: Bexco (Busan Exhibition & Convention Center)
55 Apec-ro, Haeundae-gu, Busan, 612-704
Republic of Korea
Tel: +82 51-740-7300; Fax: +82 51-740-7320
E-mail: bexco@bexco.co.kr

Sept 06–08
Gandhinagar, India
Agri Asia 2019
Contact: RADEECAL Communications
402, 4th Floor, "Optionz" Complex,
Opp. IDFC BANK, Between Girish Coldrink and Xaviers Corner, Off C.G Road, Navrangpura,
Ahmedabad - 380009, Gujarat,India
Tel:+91 079-26401101/ 02/ 03
E-mail :agriasia@agriasia.in
Web: http://www.agriasia.in

Sept 10–12
Singapore
IoT World Asia 2018
Contact: Secretariat
Tel: +44 (0) 20 755 19200
E-mail: danny.danzieri@knect365.com
Web: https://tmt.knect365.com/iot-world-asia/

Sept 18–20
Noida, India
RENERGY -RENEWABLE ENERGY INDIA EXPO 2019
Contact: India Expo Centre & Mart
Plot No. 25,27,28,29, KnowledgePark-||
Greater Noida - 201308, Uttar Pradesh, India
Tel: +91 120 2328011-20; Fax: +91 120 2328010
E-mail: Info@Indiaexpocentre.com

Sept 25–27
Bangkok, Thailand
Bio Investment Asia 2019
Contact: Project Manager / Head of Science & Technology Unit
Tel: +662 670 0900 ext. 202
E-mail: anucha@vnuexhibitionsap.com
Web: http://www.bioinvestmentasia.com

Oct 10–12
Bangkok, Thailand
Smart Energy Transformation Asia 2019 (SETA 2019)
Contact: GAT International CO.,Ltd.
19/117 Soi. 28 Kubon Rd. Ramintra ,
Kannayao , Bangkok , Thailand 10230
Tel: +66 (0) 2 519 2727; Fax: +66 (0) 2 509 8585
E-mail: info@setaasia.com
Web: http://www.setaasia.com

Oct 14–17
Ludhiana, India
8th Asian-Australasian
Conference on Precision Agriculture
Contact: Dr. J. S. Mahal (Dean)
College of Agricultural Engineering and Technology
Punjab Agricultural University, Ludhiana, India
Mobile: +91-9501500367
E-mail: deancoae@pau.edu
Web: http://www.8acpa.org.in

Oct 30–Nov 01
Singapore
Asia Clean Energy Summit (ACES)
Contact: ACES Secretariat
Tel: +65 6831 1320
Web: https://www.asiacleanenergysummit.com

Oct 30–Nov 01
Singapore
Asia Clean Energy Summit (ACES)
Contact: Faith Tan (Ms)
ACES Secretariat
Tel: +65 6831 1392
Web: https://www.asiacleanenergysummit.com

Oct 30–Nov 02
Hong Kong, China
ECO EXPO ASIA 2019
Contact:
HKTDC (Hong Kong Trade Development Council)
38/F, Office Tower, Convention Plaza
1 Harbour Road, Wanchai, Hong Kong,
Hong Kong
Tel: +852 1830 668
Fax: +852 2824 0249
Web: hktdc@hktdc.org

Oct 31–Nov 02
Hong Kong, China
IWA-ASPIRE 2019
Contact:
IWA-ASPIRE 2019 Conference Secretariat
C/o International Conference Consultants Ltd.
Unit C-D, 17/F, Max Share Centre,
373 King's Road,
North Point, Hong Kong,
Tel: (852) 2559 9973; Fax: (852) 2547 9528
E-mail: info@iwaaspire2019.org
Web: http://www.iwaaspire2019.org

Nov 06–08
Singapore
5th Annual Biopharma Development & Production Asia Pacific
Contact: Customer Service
103 Penang Road,
#04-01 Visioncrest Commercial
Singapore 238467
Tel: +65 6508 2401
E-mail: register@ibcasia.com.sg
Web: https://www.ibc-asia.com

Nov 09–11
Yokohama, Japan
2019 4th Asia Conference on Environment and Sustainable Development (ACESD 2019)
Contact: Nancy Liu
Conference Secretary
Tel: +86-28-86512185
E-mail: acesd@iacsitp.com
Web: http://www.acesd.org

Nov 27–29
Bangalore, India
Intersolar India
Contact: Brijesh Nair
Project Director, India
Tel: +91 22 4255-4707;
Fax: +91 22 4255-4719
Web: https://www.intersolar.in

Tech Ventures & Opportunities

Business Coach

Tech Opportunities

Bookkeeping - anticipate your accounting cycle

SME Corp. Malaysia
http://smeinfo.com.my

Bookkeeping

The main objective of starting a business is definitely to reap a profit. Many startups failed within 3 years of establishment due to poor financial management and no proper bookkeeping. It is important for entrepreneurs to have a proper recording of business transactions; income and expenses to determine whether your business is operating at a profit or at a loss. Knowledge of basic bookkeeping will ensure the consistency of your business financial reporting.

Cashbook

The basic accounting system would be keeping a cashbook record. It is important to keep all your record of expenses and original documents such as bills, invoices, receipt, payment and sales voucher as a proof of the statement of your entry in your cashbook. From this cashbook, later on, you will transfer all the data to your business account for the monthly statement. For small business entrepreneurs normally they just use a cashbook to manage their daily transaction.

Cash flow from operating activities

The cash flow includes activities from generating principal revenue such as a purchase of goods and services and sales. It can be computed using two methods which are Direct and Indirect Method.

Direct method

The direct method is to record all operating activities that involve various types of cash receipts and payments such as cash paid to suppliers, cash receipts from customers, salaries etc and then putting it together into the operating section of a cash flow statement.

Indirect method

In the indirect method, the amount of net cash flow from operating activities is calculated by using the net income figure from the income statement. It uses net income as a starting point makes adjustments for all transactions for non-cash items, then adjust for all cash-based.

Statement of cash flow forecast

A statement of cash flows forecast shows the estimation of money flow in and out of a business. This includes all projected income and expenses over a period of time. Statement of cash flows forecasting is a very important and useful tool for an entrepreneur. It will help entrepreneurs in budgeting and plan their expenses commitment and payment to relevant parties.

We have already projected the amount of money that is needed to start a business i.e.the "outflow" for ABC Enterprise. We also have to project how much money will come in through business activities i.e. sales or additional cash injected. Amounts forecasted from sales should be shown with the accurate expected period under "inflow".

Determine your own fund capacity

Estimate the loan disbursement timing

Business might apply for a loan and the process might take some time. The timing of the cash inflows from the loan will greatly affect your cash flow forecast.

Sales estimation

A sales estimation is a plan of how much you expect to sell in the future, normally broken down by month. For a startup business, you'll need to estimate your forecasts based on information from customer surveys, market research, suppliers, industry experts, the performance of similar businesses and the capacity of your business operation. For a mature business, sales estimation can be based on the sales history or trends.

Payment timing

It's important to understand that the timing of cash inflow and cash outflow comes down to the operating cycle of your business. This involves the timing of buying and selling, sales collection time, credit payment terms and specific time payment commitment.

Cost estimation

Cost estimation is a forecast of all expenses that a business may incur. It can be estimated daily, monthly or annually

Financial management through statement of cash flow forecast

Statement of cash flows reports all the in and out cash flows for a given accounting period. Statement of cash flows shows the changes in capital from the beginning of a year and breaks it down to sources and usage. It also can be categorized into three main activities: Non-Recurring Expenses, Fixed Assets, and Operating/ Working Capital.

Statement of comprehensive income (profit and loss statement)

A statement of comprehensive income (profit and loss statement, P&L) is a financial statement that summarises the revenues, costs and expenses incurred during a specific period of time.

How to Setup a Project in India

The office of Development Commissioner (MSME), Ministry of Micro, Small & Medium Enterprises, Government of India

http://www.dcmsme.gov.in

It all begins with an idea

The overriding reason for anyone to think of establishing a MSME unit can be summarised in one word - opportunity. An opportunity to provide a product or service, which can generate sufficient surplus. This is all the more true if one is a believer in the maxim, "Small is Beautiful".

However, ideas need to be filtered through a multi-layer sieve. This model is shown in the following flow:

- Does the idea fire up your motivation?
- Is it a viable business proposition in your area?
- Does it match the needs of your clientele?
- Check it out with basic market research
- Test it out at market place
- Consult with the experts
- Look out for competition in the field
- Is it a sunrise industry?
- Your business opportunity
- Project conceptualisation

Once the ideas are screened and a viable business opportunity emerges the project has to be conceptualised in all its dimensions. The 4 Ps of Project Conception is:

- PRODUCT (Shape, Size and Nature)
- PROCESS (Technology to produce the product)
- PLACE (Location of Plant)
- PARTNER (Technological of Financial Collaborator)

Making a product choice

In a project conceptualisation stage while making a product choice following factors are related to product need to be considered:

- Product Line
- Depth, Width
- Packaging
- Branding
- Warranties
- After Sales Service

Some other factors that one should consider while finalising the product choice are:

- Ease of availability of raw-material
- Process Technology
- Accessibility to the market
- Incentive and support from Government

Market information is also important for product selection. Products, which are likely to have a number of players in the market, are best avoided. Some such products in the recent past have been plastic footwear, audio cassettes, disposable gloves and bulk drugs.

In case the entrepreneur is looking for a product, which has export potential, the following additional questions need to be asked:

- What should be the contents of export-product portfolio?
- What are the special requirements for packaging if one has to export the products?
- What product adaptations are needed to be made for exporting a product to a specific country?
- Are any WTO conditionalities involved e.g. "child labour free", ISO 9000 certified, GMP followed etc.

The development of export-product portfolio can be done by considering 4 parameters viz.

- External demand conditions
- Internal supply capability
- Complexity of marketing tasks
- Amount of investment required to penetrate the market

Analysis can be conducted using this four dimensional model. The obvious choice is a product which scores a high rating on first two parameters and low rating on last two parameters.

EXIM (Export Import Bank of India) Bank has also developed an excellent model to conduct the export-product portfolio analysis based on three parameters viz.

- Supply Capability In Product Group
- Domestic Environment
- Export Market Attractiveness

This analysis gives rise to product groups with high potential or low potential.

With regard to special packaging requirements one has to be careful about laws of the country one is exporting to. For instance, while exporting to Australia, wooden-packaging cannot be done.

Product adaptations for country's specific needs look into things like whether voltage supply is 220V or 110V for electric appliances and for automobiles whether left-hand drive or right-hand drive is appropriate.

Registration of licensing agreement in Thailand

Department of Intellectual Property, Thailand
http://www.ipthailand.go.th

Consideration criteria

Licensing Agreement to use the patent is the contract, with which the patent/petty patent owners grants the specific right to the licensee. The permission shall not exceed the protection period as prescribed by law.

- The protection period of invention patent lasts 20 years.
- The protection period of petty patent lasts 6 years, or upon the petty patent renewal application according to Article 65 paragraph 2 of the laws.

Conditions of application submission

1. To register a licensing agreement, the applicant shall submit the form as determined by the Director-General, together with a licensing contract to use the invention patent/petty patent.
2. Authorization

   2.1. In case the applicant of the patent does not reside in the Kingdom of Thailand, he shall authorize the patent agent/patent attorney registered with the Director-General of the Department of Intellectual Property to act on his behalf. In this regard, the power of attorney shall be presented to the Director-General in accordance with the following regulations;

   (1) If the authorization is done outside the Kingdom of Thailand, the signatures in the authorization letter or power of attorney shall be certified by the authorized official of the Thai embassy or consulate or Director of the office of the Ministry of Commerce located in the country where the principal or power grantor resides, or the person authorized to act on behalf of the said officials or the person authorized to certify the signature according to the law in that country, or

   (2) In case the authorization is done in the Kingdom of Thailand, the applicant shall submit a copy of passport or temporary residence certificate of the principal or power grantor, or any evidence indicating that at the time the authorization was made, the principal or power grantor was in Thailand.

   2.2. The Power of Attorney shall be attached with the revenue stamp of 30 Baht/patent agent or patent attorney/application.

Proceeding according to the official's instruction

1. In case that the official finds a correctable defect in the application, the official shall notify the applicant or his patent agent/patent attorney for the correction. The applicant shall finish the correction within 90 days of the notification reception date. After such period, without the correction, the applicant shall be deemed to have abandoned the application, except the Director-General extends the period for correction as deemed appropriate due to any necessity.
2. After the applicant corrected the application, the applicant shall submit the correction application and the fee to the Department of Intellectual Property or the provincial office of the Ministry of Commerce. The corrected application shall enter the consideration and initial inspection processes respectively, similarly to the re-submission of the application.
3. In case of application submission via the website of the Department of Intellectual Property, the inspecting official shall check the completeness of information and details in the patent/petty patent application, request or other applications based on information and details appearing in the e-patent filing system. In this regard, the applicant shall present the application and supporting documents to the Department of Intellectual Property within 15 days of application number reception date and patent/petty patent application filing date via internet. The inspection of application submitted via internet shall be in accordance with the Notification of the Department of Intellectual Property Re: Principles and conditions for submission of patent/petty patent application, requests or other applications via internet.

Notes

1. The working process starts after the inspection of the documents is completed, as specified in the manual of the public service.
2. In case the application or documentary evidence is not correct or incomplete, the official shall record the defect of the document or indicate the required additional documentary evidence (Record of conditions on application reception). The applicant shall correct the document and/or submit the additional document within 90 days of the application filing date. If the applicant fails to submit all additional documents within the specific period of time, the applicant shall be deemed to

have abandoned the application. The official shall return the application to the applicant and inform the reason of the return and his appeal right.

3. Any person fee paid to the Department of Intellectual Property shall not be refunded in all cases, except
   (1) The law stipulates that the fee must be refunded, or
   (2) The applicant double-paid or overpaid the fee, by which the faulty payment resulted from the mistake of the state official, not the payer. In this regard, the Department of Intellectual Property shall consider the refund case by case.
4. In case the applicant is required to submit many additional documentary evidences, the applicant shall submit all additional documentary evidences in the same time.
5. In case the applicant submits the copy of the documentary evidence, the applicant shall certify the copy of the documentary evidence.
6. In case the applicant submits the document in foreign language, the applicant shall submit the document with Thai translation and the correct translation certification of the translator.
7. In case the applicant or the authorized patent agent/patent attorney does not submit the application by himself, and granted power to the other person to submit the application, the application submitter shall present a sub power of attorney or temporary power of attorney, so that he is eligible to submit the application and sign in the record of conditions on application reception. If it appears that the application and the documentary evidence is not correct or incomplete, and the application submitter is not authorized to sign on the said record, the official shall not receive the application.
8. The working period does not include the time period when the applicant follows the official's instruction or corrects the application, or the period of temporary suspension of registration.

Relevant laws

The Ministerial Regulation No.25 (B.E. 2542) issued by virtue of the Patent Act B.E. 2522 (Dated 24 September 1999).

The Patent Act B.E. 2522 as amended by the Patent Act (No. 2) B.E. 2535 and the Patent Act (No. 3) B.E. 2542

Artificial Intelligence-Based Image Search Tool for Brands

The World Intellectual Property Organization (WIPO) has launched a new artificial intelligence (AI)-powered image search technology that makes it faster and easier to establish the distinctiveness of a trademark in a target market. The new search functionality covers the national collections of 45 trademark offices already participating in the project - even if they have not been using a classification system for figurative elements. This represents a total number of almost 38 million trademarks to date. WIPO periodically adds new collections from around the world to the database.

Earlier-generation image search tools primarily determine trademark image similarity by identifying shapes and colors in marks. WIPO's new AI-based technology improves on this technology by using deep machine learning to identify combinations of concepts – such as an apple, an eagle, a tree, a crown, a car, a star – within an image to find similar marks that have previously been registered.

The new technology results in a narrower and more precise group of potentially similar marks, facilitating greater certainty in strategic planning for brand expansion into new markets. With fewer results to scrutinize, this also translates into labor-cost savings for trademark examiners, attorneys and paralegals, industry practitioners and researchers.

WIPO's new AI search technology leverages deep neural networks and figurative elements classification data from the Madrid System for the International Registration of Marks and from large trademark offices. All users can access the AI search technology for free through WIPO's Global Brand Database, where it has been fully integrated into the database search engine.

For more information, contact:

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

Exploitation of intellectual property in Malaysia

Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), Malaysia
https://mastic.mestecc.gov.my

The provisions pertaining to the exploitation of intellectual property in Malaysia are the following.

8.0 exploitation of intellectual property

8.1. Where an Inventor or creator creates Intellectual Property he shall notify the Innovation and Commercialisation Centre in writing.

8.2. The Innovation and Commercialisation Centre shall determine the party in whom the Intellectual Property should vest in accordance with this Policy.

8.3. If the Innovation and Commercialisation Centre determines that the Intellectual Property ownership belongs to the Relevant Body, it shall be responsible for any

Intellectual property commercialisation policy

Commercialisation of the Intellectual Property, including, but not limited to, one or more of the following:

a) taking the appropriate measures to protect the Intellectual Property and the Relevant Body;
b) obtaining an independent valuation of the Intellectual Property;
c) identifying potential licensee(s);
d) assigning the rights to a third party(s); and
e) determining an appropriate vehicle to exploit the Intellectual Property.

8.4. In the event the Innovation and Commercialisation Centre decides to commercialise the Intellectual Property, the Inventor(s) shall provide all reasonable assistance in furtherance of this goal, for example, by providing information promptly on request, attending meetings with potential licensee(s) and providing technical advice regarding further development.

8.5. Should the Innovation and Commercialisation Centre not be interested in seeking Patent protection or to commercialise the Intellectual Property, it shall inform the Inventor in writing. The Inventor may then make a written request to the Innovation and Commercialisation Centre for the Intellectual Property to be assigned to him.

The Centre shall write to the funding Agency to obtain leave. If leave is granted, the Innovation and Commercialisation Centre will retain a non-exclusive, non-transferable, irrevocable, royalty-free, worldwide Licence on the Intellectual Property for research and educational purposes. In the event the Inventor does not commercialise the Intellectual Property within five years without any reasonable grounds, the Innovation and Commercialisation Centre may exercise any Commercialisation rights in relation to the Intellectual Property.

8.6. The Innovation and Commercialisation Centre may retain the ownership of the Invention but grant a Licence to the Inventor to exploit the Intellectual Property, if it considers it advantageous to do so.

8.7. In the event the Innovation and Commercialisation Centre determines that the Intellectual Property does not belong to a Relevant Body, it shall inform the Inventor in writing of its decision, whereupon the Inventor shall be free to exploit it in any way he chooses.

8.8. In all cases where the Intellectual Property is to be jointly owned, the parties shall ensure that any rights to commercialise the Intellectual Property and share in the profits is pre-determined by written contract among themselves.

Source: Intellectual Property Commercialisation Policy for Research & Development (R&D) Projects funded by the Government of Malaysia, Ministry of Science, Technology and Innovation, Malaysia (MOSTI), June 2009

Venture capital funding in Bangladesh

Startup Bangladesh
http://startupbangladesh.gov.bd

Bangladesh is one of the youngest countries in the world, with more than half of its population being under the age of 25. The nation is transitioning towards becoming a middle-income country by year 2021. In order to develop an innovation-centered economy and sustain its remarkable growth, Government of Bangladesh (GoB) has undertaken a pioneering initiative to create a national entrepreneurship platform and its supporting ecosystem. This effort will enable the nation to innovate faster, create new jobs, develop technical skills and realize the vision of Digital Bangladesh. In support of the above-mentioned objectives, GoB has created a fund (the Fund) under iDEA project. The Fund will provide financial support to entrepreneurs in the form of equity, convertible debt and/or grant (the Investment). The Investment will provide the necessary capital to accelerate development and achieve success. The Fund is committed to fostering innovation and entrepreneurship through a process that is equitable, transparent and accountable.

Investment objectives

1. Support technology-based innovation
2. Create new employment opportunities
3. Provide training and develop technical skills
4. Promote groups that are under-represented in the tech sector
5. Connect Non-Resident Bangladeshis (NRBs) with the local ecosystem
6. Foster an entrepreneurship culture in Bangladesh
7. Attract foreign investment and expertise

Investment risks

Venture investment carries high inherent risks. All submitted proposals will be assessed for certain major risks that include but are not limited to:

1. Market Risks: market receptiveness to product/service; size of potential customer base; competitive dynamics & pace of competing innovations; scalability of product/service
2. Management and Execution Risks: strength and experience of management and technical teams
3. Financial Risks: ramp-up period; burn-rate, profitability; capital required to operate; additional capital required to scale and distribute
4. Other Risks: Additional risks may pertain to internal factors (i.e., legal, technical, operational) as well as external considerations (regulatory compliance, economic conditions)

Despite the risks, Venture Capital investment takes place in dynamic economies worldwide because of the potential rewards – business success, technical breakthrough, skill development, employment generation, public benefits, international branding and so on.

Investment categories

The following types of Investments may be made:

- Idea (Pre-Seed) support
- Venture capital
  a: Seed stage
  b: Growth stage
  c: Guided startups
- Targeted investments
- Strategic partnerships
- Co-investments

Detailed policies and procedures for each category of Investment are discussed below:

- Idea (pre-seed) support

The Fund will support innovative ideas thorough mentoring and funding:

1. Requirement: Viable business idea and an executable business plan
2. Investment amount: up to Tk. 10 lakh
3. The Investment will be provided in tranches based on achievement of defined milestones
4. Fund participation: Grant

The Fund will require regular progress reports and financial statements for performance monitoring purposes.

Venture capital

The Fund will make the following kinds of Venture Capital investments:

a : Seed stage

1. Requirement: Prototype and an executable business plan
2. Investment amount: up to Tk. 1 crore
3. The Investment will be provided in tranches based on achievement of defined milestones

4. The Investment may be used for product development, operations, expansion, marketing and other approved purposes
5. Fund participation: Equity and/or Convertible Debt. The equity ownership percentage may be up to 49%, based on Investment amount and company valuation. In case of Convertible Debt, the amount financed will be interest-free. The Convertible Debt may be fully or partially convertible
6. The Fund may have representation on the Board commensurate to its equity ownership
7. The Fund will require regular progress reports and financial statements for performance monitoring purposes.

b : Growth stage

1. Requirement: Minimum Viable Product, existing customer base and an executable business plan
2. Investment amount: up to Tk. 5 crore per round
3. The Investment will be provided in tranches based on achievement of defined milestones
4. The Investment may be used for product development, operations, expansion, marketing and other approved purposes
5. The Investment may be made during one of the financing rounds generally known as Series A, Series B and Series C rounds
6. Fund participation: Equity and/or Convertible Debt. The equity ownership percentage may be up to 49%, based on company valuation and Investment amount. In case of Convertible Debt, the amount financed will be interest-free. The Convertible Debt may be fully or partially convertible
7. The Fund may have representation on the Board commensurate to its equity ownership
8. The Fund will require regular progress reports and financial statements for performance monitoring purposes

c : Guided Startups

1. Requirement: Specific startup ideas that the Fund considers to be in the national interest
2. Investment amount: up to Tk. 5 crore per round
3. The Investment will be provided in tranches based on achievement of defined milestones
4. The Investment may be used for product development, operations, expansion, marketing and other approved purposes
5. Fund participation: Equity and/or Convertible Debt. The equity ownership percentage may be up to 49%, based on company valuation and Investment amount. In case of Convertible Debt, the amount financed will be interest-free. The Convertible Debt may be fully or partially convertible
6. The Fund may have representation on the Board commensurate to its equity ownership
7. The Fund will require regular progress reports and financial statements for performance monitoring purposes.

Targeted investments

The Fund may make investments to create, support, augment or procure specific products, services, applications, and hardware or technology platforms. The Fund may also invest in training programs to create skilled resource pools in selected technology areas. Additionally, the Fund may make strategic investments in selected entities, projects or initiatives to bring about substantial public benefits. The investments may be made solely, in collaboration with other entities or following the Public-Private partnership (PPP) model.

Strategic partnerships

The Fund may invest in strategic partnerships with local and international institutions (universities, companies, governments, incubators/accelerators, research organizations, media and other suitable entities) to acquire expertise, technology, products, services and/or support entrepreneurship development.

Co-investments

The Fund may enter into joint investments with other venture capital funds or funding entities in order to scale its investments and leverage partner expertise while sharing risks. Investments may be made in a single company, in a venture fund or in a fund-of-funds.

Fund participation: Equity and/or Convertible Debt. The equity ownership percentage will be based on company valuation and Investment amount. In the case of Convertible Debt, the amount financed by GoB will be interest-free. The Convertible Debt may be fully or partially convertible.

The Fund may have representation on the Board commensurate to its equity ownership. The Fund will require regular progress reports and financial statements for performance monitoring purposes.

ASEAN-India Science & Technology Cooperation

ASEAN-India Science & Technology Cooperation supports collaborative S&T projects and activities between India and ASEAN countries. A dedicated ASEAN India S&T Development Fund (AISTDF) has been established to support R&D projects and associated project development activities. The ASEAN-India Innovation Platform is the major element of enhanced AISTDF.

For more information, access:

https://aistic.gov.in

Guidelines on equity policy and foreign investment in Malaysia

Malaysian Investment Development Authority (MIDA), Malaysia

http://www.mida.gov.my

Equity policy in the manufacturing sector

Malaysia has always welcomed investments in its manufacturing sector. Desirous of increasing local participation in this activity, the government encourages joint-ventures between Malaysian and foreign investors.

Equity policy for new, expansion, or diversification projects

Since June 2003, foreign investors could hold 100% of the equity in all investments in new projects, as well as investments in expansion/diversification projects by existing companies, irrespective of the level of exports and without excluding any product or activity.

The equity policy also applies to:

- Companies previously exempted from obtaining a manufacturing licence but whose shareholders' funds have now reached RM2.5 million or have now engaged 75 or more full-time employees and are thus required to be licensed.
- Existing licensed companies previously exempted from complying with equity conditions, but are now required to comply due to their shareholders' funds having reached RM2.5 million.

Equity Policy Applicable for Existing Companies

- Equity and export conditions imposed on companies prior to 17 June 2003 will be maintained. However, companies can request for these conditions to be removed and approval will be given based on the merits of each case.

Protection of foreign investment

Malaysia's commitment in creating a safe investment environment has attracted more than 8,000 international companies from over 40 countries to make Malaysia their offshore base.

Equity ownership

A company whose equity participation has been approved will not be required to restructure its equity at any time as long as the company continues to comply with the original conditions of approval and retain the original features of the project.

Investment Guarantee Agreements

Malaysia's readiness to conclude Investment Guarantee Agreements (IGAs) is a testimony of the government's desire to increase foreign investor confidence in Malaysia. IGAs will:

- Protect against nationalisation and expropriation
- Ensure prompt and adequate compensation in the event of nationalisation or expropriation
- Provide free transfer of profits, capital and other fees
- Ensure settlement of investment disputes under the Convention on the Settlement of Investment Disputes of which Malaysia has been a member since 1966.

Malaysia has concluded IGAs with the following groupings:

- Association of South-East Asian Nations (ASEAN)
- Organisation of Islamic Countries (OIC)

Convention on the Settlement of Investment Disputes

In the interest of promoting and protecting foreign investment, the Malaysian government ratified the provisions of the Convention on the Settlement of Investment Disputes in 1966. The Convention, established under the auspices of the International Bank for Reconstruction and Development (IBRD), provides international conciliation or arbitration through the International Centre for Settlement of Investment Disputes located at IBRD's principal office in Washington.

Kuala Lumpur Regional Centre of Arbitration

The Kuala Lumpur Regional Centre for Arbitration was established in 1978 under the auspices of the Asian-African Legal Consultative Organisation (AALCO) - an inter-governmental organisation cooperating with and assisted by the Malaysian government.

A non-profit organisation, the Centre serves the Asia Pacific region. It aims to provide a system to settle disputes for the benefit of parties engaged in trade, commerce and investments with and within the region.

Any dispute, controversy or claim arising out of or relating to a contract, or the breach, termination or invalidity shall be decided by arbitration in accordance with the Rules for Arbitration of the Kuala Lumpur Regional Centre for Arbitration.

Inclusive and grassroots innovations in Malaysia

Malaysian Foundation for Innovation, Malaysia
https://www.yim.my/

By trailblazing an innovation and science-driven path for grassroots-centric innovations, Yayasan Inovasi Malaysia (YIM), or the Malaysian Foundation for Innovation, has played an integral role in leading Malaysia's towards enhanced growth, competitiveness and prosperity.

Our supportive awareness, development and financing environments help innovations come to life with both economic potential and social impact to grassroots communities. From ground events to grants to commercialisation and market diffusion programmes, YIM's programmes has generated continuous and sustainable impact nationwide.

High Impact Project 6 – Inclusive Innovation

Specifically designed to empower the bottom 40% of the income group to leverage on innovations to promote the transformation of communities including microenterprises in the rural areas through handholding and technical and management support, the High Impact Project 6 – Inclusive Innovation (HIP6) programme is part of the SME Masterplan 2012-2020 organised by SME Corp and managed by YIM as appointed Lead Agency.

HIP6 promotes public-private partnership to share responsibility and accountability in creating drivers of change that can empower the bottom 40% of the income pyramid to leverage on innovations created for the benefit and wellbeing of the communities.

Since the programme was incepted, almost 23,000 people have participated in the HIP6 Inclusive Innovation Challenges which is organised to identify deserving innovations for support and funding.

Mainstreaming grassroots innovations

YIM's Mainstreaming Grassroots Innovation (MaGRIs) programme is a project that focuses on upscaling and accelerating the development and diffusion of potential grassroots innovations in Malaysia via collaboration with various parties from government, industry, grassroots community and youth.

The MaGRIs programme provides an environment to develop grassroots innovators with potential innovations and groom them to become community role models. New methods to stimulate grassroots commercial activities into mainstream commercial activities are often uncovered while grassroots innovators leverage through opportunities to mainstream their innovations into mainstream commercial activities. Often, academic and industry collaborators are roped in to support the MaGRIs programme activities.

From innovation development to commercialisation with market diffusion to inclusive communities, the programme even has its own MaGRIs Ambassador originating from the same communities, sharing community success stories and creating engagement with this targeted community. Since MaGRIs was incepted in 2016, more than 13,000 people have engaged with the programme.

MOSTI Social Innovation (MSI) FUND

The MOSTI Social Innovation (MSI) project was launched with the objective of improving the well-being of the society through the implementation of project, services, capacity and skill building or innovation output using the existing technology that can be implemented sustainably.

As a start, the implementation of MSI involves outreach programmes to the grassroots level and scaling up innovative ideas from the outreach programme with the objective of "humanising innovation".

Innovators can submit their project ideas to MESTECC for the MSI grant. MESTECC functions as a one-stop centre for innovators to submit their innovations with proof-of-concept. The innovation projects will be matched with its agencies and collaborators to facilitate and monitor the projects.

Lifelong Learning Initiative

Grassroots innovators (GRIr) have benefited the community by innovating products and services that are useful and of values to their community. However, their contributions are often neglected, not brought to proper authorities for their development and advancement. GRIr are national assets contributing to social and economic growth. GRIr need proper recognition, capacity building initiative to motivate, sustain them to innovate better solutions, provide leaderships at grassroots level.

This project was funded by The Boeing Company under Boeing Global Corporate Citizenship (BGCC). In the first sequel, the project has successfully accredit 20 grassroots innovators in 2016 and with the BGCC support again an additional 20 grassroots innovators are selected for APE in the second sequel, 2017.

Through Lifelong Learning Initiative – Accreditation of Prior Experience (APE) platform, an individual's expertise, skills and experiences officially recognized based on National Occupational Skills Standards (NOSS) into Malaysian Skills Certificate qualifications: Certificate of Competency, MSC levels 1 to 3, Diploma Malaysian Skills or Advanced Diploma Malaysian Skills; awarded by the Government.

The program will be implemented throughout Malaysia, segmented into six (6) zones which are North, South, Central, East Coast, Sabah and Sarawak.

Promoting grassroots innovations in India

National Innovation Foundation, India

http://nif.org.in

The National Innovation Foundation (NIF) is India's national initiative to strengthen the grassroots technological innovations and outstanding traditional knowledge. Its mission is to help India become a creative and knowledge-based society by expanding policy and institutional space for grassroots technological innovators.

NIF scouts, supports and spawns' grassroots innovations developed by individuals and local communities in any technological field, helping in human survival without any help from formal sector. NIF helps grassroots innovators and outstanding traditional knowledge holders get due recognition, respect and reward for their innovations. It also tries to ensure that such innovations diffuse widely through commercial and/or non-commercial channels, generating material or non-material incentives for them and others involved in the value chain.

NIF has pooled a database of over 310,000 technological ideas, innovations and traditional knowledge practices (not all unique, not all distinct) from over 608 districts of the country. NIF has till date recognised 847 grassroots innovators and school students at the national level in its various National Biennial Grassroots Innovation Award Functions and annual Dr A P J Abdul Kalam Ignite Children Award functions. In collaboration with various research & development (R&D) and academic institutions, agricultural & veterinary universities and others institutions, NIF has helped in getting several hundred grassroots technologies validated and/or value added.

NIF has also set up an augmented Fabrication Laboratory (Fab Lab) for product development and strengthening in-house research. Pro bono arrangement with intellectual property firms has helped NIF file over 1040 patents, including eight filed in the USA and 28 Patent Cooperation Treaty (PCT) applications, on behalf of the innovators and outstanding traditional knowledge holders. Of these, 72 patents have been granted in India and 5 in the USA. In the same time period NIF has filed 21 Design registrations for innovations of the grassroots and student innovators.In addition to this 10 trade mark applications have also been filed.

Key initiatives launched by NIF are summarized below:

Grassroots Innovations Design Studio (GRIDS)

Grassroots Innovation Design Studio (GRIDS) facilitates formal design inputs to the grassroots innovations at premier institutes viz National Institute of Design (NID) - Ahmedabad, Indian Institute of Technology (IIT) - Gandhinagar, National Institute of Technology (NIT) - Srinagarand Srishti School of Arts, Design & Technology, Bengaluru.

Students' Club for Augmenting Innovations (SCAI)

A nationwide student movement, comprising students from India's best management and technology institutes,SCAI provides product development, mentoring and monitoring support to innovators and traditional knowledge holders at the grassroots.

Micro Venture Innovation Fund (MVIF)

One of its kind of dedicated risk fund in the world, setup with the support of SIDBI in October 2003 and operationalised in January 2004, MVIF provides financial support to grassroots innovators. It is extended under a single signature on a simple agreement of understanding without any collateral or a guarantor.

Grassroots Technological Innovations Acquisition Fund (GTIAF)

Sanctioned in 2011 and operationalised in 2012, GTIAF obtains the rights of technologies from innovators after compensating them for the same, with the purpose of disseminating and diffusing them at low or no cost for the larger benefit of the society.

Gandhian Inclusive Innovation Challenge Awards

The Award aim towards developing new solutions for three challenges -- paddy transplanter, wood stove and tea leaf-plucking machine.

Grassroots to Global (G2G)

NIF has proved that Indian innovators can match anyone in the world when it comes to solving problems creatively. They perform better than others in generating greater sustainable alternatives by using local resources frugally. Those who see poor only as the consumers of cheap goods, miss the richness of knowledge at grassroots level. The G2G model propagated by NIF is all set to change the way the world looks at creativity and innovations at grassroots.

In situ incubation

NIF provides in situ incubation of grassroots technologies to the innovator at his/her place. All incubation facilities (financial or technical support, mentoring, etc.) are extended to the innovator at his place where he continues to work on his/her ideas or innovations.

Promoting cleaner production in Sri Lanka

National Cleaner Production Centre, Sri Lanka
http://www.ncpcsrilanka.org

Resource Efficient and Cleaner Production (RECP) assessments

A cleaner production audit is often the first step towards managing, controlling and improving the environmental performance of a company. If a company was not previously concerned about the environmental impacts of its production, an audit is the best way to establish the actual status and determine the best approach to reducing waste, wastewater and emissions. It analyses and quantifies input, output and waste generation at each step of a production process. As a proactive environmental measure CP helps companies to comply with rules and regulations. There are three types of audits focuses on improving resource efficiency.

GHG assertion

NCPC has the expertise and capacity to measure and report your organization carbon footprint. Our services are ranging from organization level to product level in line with GHG Protocol, ISO 14064-1 & 2, ISO 14067 and PAS 2050 carbon foot printing standard. Our inhouse expertise in cleaner production and energy will help to propose comprehensive GHG mitigation opportunities to the company.

Quantification of GHG emissions of your business activities or product will help you to:

- Understand the impact that your product/ business has on the climate at each stage of its life cycle.
- Identify the most effective way of reducing emissions, whether it is in your own operations, with your suppliers, or in how your customers use and dispose of your product.
- Reduce costs through greater energy efficiency and waste reduction.
- Respond to customer demand – and enhance your brand reputation (credible, confident and positive external messaging)
- Develop successful, long-term and economically competitive relationships with suppliers.
- Minimize risk by ensuring compliance with the carbon legislation

Product Carbon Footprint (PCF)

The PCF sums up the total greenhouse gas emissions generated by a product over the different stages of its life cycle. Different types of PCFs exist.

- "Cradle to Gate"- From raw material extraction to point of distribution
- "Cradle to Grave" -From raw material extraction to point of consumption & disposal
- "Cradle to Cradle"- From raw material extraction to point of reuse

There are three main Product Carbon Footprint standards that are or will be applied worldwide:

- PAS 2050
- GHG Protocol
- ISO 14067>

Environment management

Centre conducts water and energy audits and facilitates the clients' relevant information on enhancing their water and energy performances. NCPC has been registered as an ESCO (Energy Service Company) with the Sustainable Energy Authority (SEA) since 2009. NCPC has acquired modern energy measuring equipment to carry out electrical and thermal energy measurements.

Energy management

The concern on energy consumption and energy cost has been increasing across all energy intensive industry sectors not only because of its immediate impact on production costs, but also because of environmental impacts. Cost of energy in any organization can potentially bring significantly down to improve business benefits, through proper energy services. NCPC, Sri Lanka is a member of "RECPnet" global network, leading the global Cleaner Production agenda, with a network of over 70 such Centres around the globe. As such, there is no organization better equipped to deliver a robust solution that best suits your energy efficiency needs.

Chemical management

This component is carried out according to Responsible Production which is a unique initiative that drives continuous improvement in health, safety and environmental performance.

Water auditing and water footprint

Water is an indispensable but scarce resource today, hence demonstration of the corporate commitment to protect the fresh water resources through conducting water audits & implementing the recommendations, quantifying the water footprint (ISO 14046) inevitably boost the corporate image of a company. Using water efficiently support in savings of energy and raw materials as well as to cut down waste water treatment costs. Every business is a little different, but a water audit is an easy way to start.

Green technology in Malaysia

Malaysian Investment Development Authority, Malaysia

http://www.mida.gov.my

In line with Malaysia's aim to become an inclusive and sustainable advanced nation by 2020, Green Technology (GT) has been identified as one of the drivers of the future economy for the nation that would contribute to the overall Green Growth and Sustainable Development. Under the National Green Technology Policy, the cross-sectoral GT focuses on four sectors namely energy, building, waste management and transportation.

Renewable energy

Malaysia is emphasizing greater importance for Renewable Energy (RE) generation through specifically formulated policies and initiatives to spur the growth of the sector as a major step towards green economy. Other than the Feed-in-Tariff (FiT) mechanism, the Net Energy Metering (NEM) and Large Scale Solar (LSS) Photovoltaic plant schemes were introduced in 2016 to boost RE generation. NEM benefits users in terms of savings in electricity bill through lower electricity usage and energy credit from solar power generation while LSS allows developers to produce renewable energy in larger capacities.

In 2016, a total of 111 projects in renewable energy with total investments of RM1.9 billion were approved incentives. Out of the total, RM1.7 billion (88%) were from domestic sources and RM233.8 million (12%) were from foreign sources. These projects are expected to create 615 employment opportunities in this subsector.

The approved investments include 81 projects (RM588.8 million) that will generate energy from solar power, 12 projects (RM145.7 million) from biogas, 10 projects (RM806.6 million) from mini-hydro and six (6) projects (RM343.6 million) from biomass as the sources of energy generation.

Energy efficiency

As price of energy steadily increases over the years, there is a need to adopt energy efficiency measures to ensure productive use of energy and minimize waste. The use and adoption of energy efficiency systems and technology is encouraged through introduction of incentives and import duty exemptions on qualified machines and components. Consecutively, energy efficiency activities also open up opportunities for energy service companies (ESCOs) to provide energy efficiency services to potential clients.

In 2016, a total of 19 projects in energy efficiency with total investments of RM248.5 million were approved incentives. Investments were mainly from domestic sources i.e. RM235.6 million (95%) meanwhile RM12.9 million (5%) were from foreign sources. These investments are expected to provide 142 employment opportunities in the sub-sector.

Green technology incentive

Under the provision of Budget 2014, tax incentives for Green Technology in the form of Green Investment Tax Allowance (ITA) for the purchase of green technology assets and Income Tax Exemption (ITE) on the use of green technology services and system were introduced to further strengthen the development of green technology.

Application for incentive is to be submitted to MIDA for green technology projects and services, and to Malaysian Green Technology Corporation (MGTC) for purchase of green technology assets as listed in MyHijau Directory, by 31 December 2020. Projects which qualify for this incentive are renewable energy; energy efficiency; integrated waste management and green building / green data centre. In addition, eligible services activities include system integration of renewable energy; energy services; services related to green building / green data centre; green certification of products, equipment & building; and green township.

ASEAN Standards Harmonization Initiative for Energy Efficiency

Funded under the EU SWITCH-Asia affiliated program, ASEAN SHINE aims at increasing the market share of higher efficient air-conditioners in ASEAN through harmonization of test methods and energy efficiency standards, adoption of common minimum energy performance standards, and changing consumer purchasing attitudes in favour of energy efficient air-conditioners.

For more information, contact:
ASEAN Centre for Energy
Jakarta, Indonesia
Tel: (62-21) 527 9332; Fax: (62-21) 527 9350
E-mail: secretariat@aseanenergy.org
Web: http://www.aseanenergy.org

HUNGARY

Transdermal medical gas delivery

The technology is capable of delivering all kinds of noble and medical gases through non-invasive means. The company's first application of this technology is with CO2 gas. The physiological change with dry CO2 balneotherapy naturally occurs in the human body when CO2 is delivered into the microcirculation in the skin. In the blood stream CO2 enables hemoglobin in red blood cells to release more oxygen and automatically deliver the O2 to tissues where the body needs it. This well-known and studied naturally occurring process was discovered in 1908 by Christian Bohr (the father of the 1922 Nobel Prize winner quantum physicist Niels Bohr) and it is called the Bohr-effect.

Area of Application

- Spas, skin care and wellness centers, bath houses, and alternative treatment centers, with limited therapeutic claims
- Medical clinics, home healthcare service providers, nursing homes, elder care centers, retirement homes, etc., with targeted medical claims
- Mass end user market, targeted medical claims
- Sport centers, teams, sport medical centers and sports related service providers, with targeted medical claims
- Veterinary products, professional veterinary and home veterinary markets with targeted medical claims

Advantages

The technology is completely mechanical and no electricity is needed for operation, has no moving parts and therefore requires almost no maintenance. The device provides treatment at the point of care (effected body parts) or full body treatment. It is small (size of a shoe box) and portable, completely safe and user friendly. It is fast, requiring only about 3 minutes for preparation for a first-time user and 20 minutes for the treatment. Absolutely no training or special knowledge is needed to operate it. The technology has "instant" measurable health effects after the first treatment. It costs quarter of the price of rival technologies.

Development Status

Commercial prototype

Transfer Terms

- Technology licensing
- Research partnerships

Target Countries

Worldwide

Room-temperature biodiesel production

Our partner, a Hungarian Institute has developed a novel continuous process for the room-temperature production of biodiesel. The main advantage of this technology is the avoidance of soap formation which so far cause many problems during biodiesel production (emulsion formation, washing problems, slow phase splitting, etc.) They are interested in a license agreement or selling of production equipment.

Area of Application

Biofuel production plants, fuel mixing firms

Advantages

- Room temperature process, energy saving
- Avoidance of soap formation, thus many other problems do not occur
- Continuous production technology in a simple apparatus (tube reactor)
- Cheap catalyst removing (KHSO4 or H2SO4) by recyclization of catalyst-removing KHSO4 (acid) with regenerable ion-exchangers
- The byproducts (K2SO4, glycerol or methanol)) can be used as rapeseed production fertilizer or starting material for biogas production
- No water in glycerol phase
- Low methanol and potassium content in the raw ester phase

Environmental aspects

- Cleaner production
- Energy efficiency

Development Status

Pilot plant

Legal Protection

Patent

Technical Specifications

Vegetable oil methyl esters are generally produced at 60°C in the presence of 1 % KOH/NaOMe catalyst with stirring for 15-60 min.

Transfer Terms

- Technical services
- Technology licensing
- Equipment supply

Target Countries

Worldwide

For the above two offers, contact:

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

INDIA

Nanogold-loaded carbon bullets as gene carriers

National Chemical Laboratory (NCL) scientists have developed a process for the preparation of carbon embedded nano gold particles with sharp edges which can be used as gene carriers. The bullets are sharp enough to penetrate hard material, with less damage (a comparatively lower force of 0.1-0.2 nN required for

penetration) and can be delivered with a convenient delivery gun. Intracellular gold particles (biogenic) synthesized by a fungus *in situ* are embedded on a carbonaceous matrix.

Area of Application

- Gene therapy/ improved gene delivery for research and other applications
- DNA based immunization, to study gene function and its regulation, to establish various disease models, metal ion removal, fuel cells, anti-bacterial applications, catalysis

Advantages

- Preparation process is very simple and easy to implement
- The carbon matrix forms 95% of the carrier reducing the amount of gold needed and the plasmid used per transformation
- Advantages of usage of gold particles- High DNA packing density, better transformation efficiency, low nuclease degradation, being in nano scale, higher surface area is obtained- more gene cargo handled
- Advantages of usage of carbon support- Inert and less damage causing- wound caused due to penetration healed faster, better piercing capacity, for example, can effectively pierce hard plant cell walls, less force required to penetrate the plasma membrane as compared to silver nano needles

Development Status
Laboratory model

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

Plant biomass-based metal sorption column

The invention provides a process for developing a plant biomass based biosorption column for the removal of metal ions. The biomaterial comprising of leaves of Jatropha is immobilized on a modified silica gel. The silica gel is modified with cationic polymers for improving the binding of the biomaterial, porosity of the column and to maintain uniform flow rate. The biosorption column may have possible application in the removal of specific ions from contaminated sites or wastewater. The prepared biosorbent column are very cheap, recyclable and can be used for selective sorption of Cr (VI) and Cu (II) ions from synthetic multi-elemental water samples.

Area of Application
The biosorbent can be used for purification of water in terms of heavy metals.

Advantages
The prepared biosorbent column are very cheap, recyclable and can be used for selective sorption of Cr (VI) and Cu (II) ions from synthetic multi-elemental water samples.

Environmental Aspects
Environment friendly

Development Status
Laboratory model

Legal Protection
Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing

Tea catechins as anti-aging compounds
The invention relates to the preparation of consumable composition for oral administration that contains tea catechins. The composition prepared by the process of this invention is useful in providing controlled release of catechins contained therein.

Area of Application
Application includes antiaging agents

Environmental Aspects
Environment friendly

Development Status
Laboratory model

Legal Protection
Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing

Sensor for detecting nitrogen dioxide gas

A novel nitrogen dioxide gas detecting film has been developed. The detecting film is based on light emitting conjugated polymer Poly [2-methoxy-5-(3',7' –dimethyloctyloxy) -1,4-phenylenevinylene (MDMO-PPV). It has been demonstrated for the first time that a thin film of MDMO-PPV deposited on glass substrate or filter paper can be used to sense NO2 gas by just change in color at room temperature. It has been observed that the bright orange fluorescence of MDMO-PPV is quenched to yellow in color in the presence of NO2 gas above 150 ppm level in few seconds.

Area of Application
The tecnology is useful for monitoring nitrogen dioxide in:

1. Factories
2. Environmental monitoring
3. Medical applications

Advantages

- Easy detection procedure in the form of color code in few minutes above 150 ppm.
- A sensor based on conjugate polymer on various substrate such as glass, plastic or paper.
- No change in color of the sensor is observed on exposer to any other gases and chemical vapors like LPG, ammonia gas, hydrogen peroxide and alcohols.
- Process is very cheap and hence can be used as disposable strips.

Development Status
Laboratory model

Legal Protection
Patent

Technical Specifications
A conjugate polymer polyp[2-methoxy-5-(3',7'-dimethyloctyloxy) -1, 4-phenylene-vinylene (MDMO-PPV) based NO2 gas sensor film.

Transfer Terms

- Consultancy
- Technical services
- Technology licensing
- Research partnerships

Target Countries
Worldwide

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

Biofertilizers from industrial waste

We can offer the technology to manufacture biofertilizers using waste material available from industries.

Area of Application
Agriculture

Advantages

- Waste used is the cheapest source of growth media which has ever been used for production of biofertilizers and biopesticides.
- Effectively controls the pathogens of crops and fruits.
- Increases the growth and yield of the crops.
- Increased shelf life of the product at room temperature.
- Can be used as foliar application, seed treatment or soil treatment.

Environmental Aspects
Waste utilization

Development Status
Pilot plant

Transfer Terms

- Joint venture
- Technical services
- Technology licensing
- Research partnerships

Target Countries
Worldwide

Contact:
Hiran Biotech
Research and Developemnt Division
66 Turner Road Cantt., Kanpur 208004, U.P., India

Waste plastics into industrial fuel

We offer plants for converting non-recyclable waste plastics into industrial fuel. Fuel quality far superior to the conventional industrial fuels such as furnace oil or light diesel oil. All types of plastics can be processed.

Area of Application
Converting waste plastics (non-recyclable cheap plastic scrap) into industrial fuel.

Advantages
Disposal of non-recyclable waste plastics keeps environment clean, gets excellent monetary returns, for the industries that have their own plastic scrap generation can generate fuel at a very low price.

Environmental Aspects

- Cleaner production
- Waste utilization
- Energy efficiency
- Systems integration

Development Status

- Pilot plant
- Commercial prototype

Legal Protection

- Trade Mark
- Patent

Technical specifications:

- Plants having capacity as low as 1 TPD of plastics are offered.
- No upper limit on higher capacities.

Transfer Terms

- Consultancy
- Joint venture
- Technology licensing
- Turnkey

Contact:
Atharva ProcTek, Pune 411052, India

Technology Requests

Magnetized fertilizer from fly ash

An Indian firm is interested in the technology for production of magnetized fertilizer from fly ash. The company wants the technical know-how for this technology and wish to receive technical and price quotes for the same.

Area of Application
Agriculture industry

Project Type
Start-up

Contact:
Biocare India Pvt Ltd.
Biocare House, M. A. 23, Laxminagar Nagpur – 22, India
Tel: +91-712 - 2224344
Telefax: +91-712 - 5611766
E-mail: info@biocareindia.biz

Rice husk ash to concrete blocks
We are looking for a partner to provide us the technology to convert Rice husk ash or any other ash into construction of concrete blocks consist of ash cement sandetc. as these blocks will then be used for poor people. The conventional bricks are getting costlier day by day so these blocks will prove to be very beneficial. Also by the making of these blocks a very huge problem of ash use will be solved and envionment can be made more eco-friendly.

Area of Application
Construction sector

Studies

- Environmental Impact Studies (EIA/EIS)
- Others

Project Type
New idea

Contact:
Nav Bharat International Lmited
C-3/19, Ashok Vihar, phase-2
Delhi 110052, India

INDIA

Manufacture of bio-fertilizers

An Indian Non-Governmental Organization based in Uttarakhand, would like to start up a venture in Bio-Fertilizer industry. They need more information on the know-how of manufacturing aspects of biofertilizer and also about the cost factor.

Area of Application
Agriculture and Agroindustry, Biotechnology

Project Type
Start-up

Contact
Mr.Preetam Singh Lingwal
Village:Thamana, Pauri Garhwal, Uttarakhand, India
E-mail: preetam.lingwal@gmail.com

Tropical multi-fruit processing and canning plant

An Indian firm is interested in the technology to set up a multi-fruit processing and canning plant. They need a detailed report including technical details and project cost for the same.

Area of Application
Food processing industry

Project Type
Start-up

Contact:
Suboneyo Chemicals & Pharma. P. Ltd,
A,86-89, M.I.D.C., Industrial Estate,
Jalgaon 425 003, Maharashtra, India
E-mail: cheminfo@dataone.in

White asparagus

A Peru based firm is interested in acquiring technology for production of white asparagus. They need technology providers consultants and price quotes for this project.

PERU

Area of Application
Agriculture industry

Project Type
Start-up

Contact:
Inversiones,
Tacala SAC, Lima, Peru
E-mail: tacalasac@gmail.com

Biotechnology for wastewater treatment system

We are a wastewater service provider and need new idea of technology to develop our strength in this wastewater field, include cleaning canal, remove sediment in waterway, biogas, microbiology detector and treated system quality.

THAILAND

Area of Application
Biotechnology, Engineering

Studies
Environmental Impact Studies (EIA/EIS)

Project Type
Expansion/Modernisation

Target Countries
Worldwide

Contact:
Utility Business Alliance
21 Tst Tower 16th floor.
Viphavadee-rangsit rd., Jompol, Jatujak
Bangkok 10900, Thailand

Asia-Pacific Tech Monitor

Readers are requested to complete the Response Form to the best of their knowledge/opinion and return it to APCTT by fax or email. We look forward to your cooperation to serve you better.

Technology Intelligence
Asian and Pacific Centre for Transfer of Technology (APCTT)
C-2 Qutab Institutional Area, New Delhi -110016, India
Fax: +91) (11) 26856274, Email: sahus@un.org, dasm@un.org

I read Tech Monitor

☐ Always ☐ Often ☐ Sometimes ☐ Never

1. **I find the design and layout of the Tech Monitor**

   ☐ Excellent ☐ Very Good ☐ Good ☐ Not Good

2. **I find the language used in the Tech Monitor**

   ☐ Easy to understand ☐ Little difficult to understand ☐ Difficult to understand

3. **I find the Tech Monitor**

   ☐ Very valuable ☐ Generally valuable/interesting ☐ Somewhat valuable/ interesting

   ☐ Little value ☐ No value

   I read Tech Monitor because I appreciate

   ☐ Technology Market Scan ☐Technology Scan ☐ Special Feature (articles)

   ☐Tech Events ☐Technology Opportunities ☐Business Coach

4. **I find the following sections**

	Very useful	**Useful**	**Less useful**	**No use**
Technology Market Scan	☐	☐	☐	☐
Technology Scan	☐	☐	☐	☐
Special Feature (articles)	☐	☐	☐	☐
Tech Events	☐	☐	☐	☐
Technology Opportunities	☐	☐	☐	☐
Business Coach	☐	☐	☐	☐

5. **Tech Monitor facilitated/contributed to:**

☐ Understand issues related to technology development and transfer
☐ Enhance my knowledge on latest technological developments and events
☐ Identity technology/business partners
☐ Negotiate technology/business transactions
☐ Establish contact with institutions/authors/experts
☐ Conclude a technology transfer
☐ Acquire a technology
☐ Selling a technology
☐ (Any other, please specify)

6. **To get similar information, I read other periodicals like:**

7. **I would like Tech Monitor to cover the following:**

About Myself

Name:

Gender: ☐Female ☐Male

Nationality:

Profession:

☐ Policy Maker ☐ Small and Medium-sized Enterprise (SME)

☐ Consultant ☐ Financier ☐ Researcher

☐ Professor/ Teacher ☐ Student ☐ Others (Please specify)

Contact details:

Organization:

Designation:

Street Address:

P.O Box:

Country:

Telephone:

Fax:

E-mail:

Website:

Note: *The survey results would be used for APCTT's internal purposes only.*

Selected Analytical Reports and Technology Platforms & Databases of APCTT

Analytical Reports (available online)

1. National Assessment Framework on Enabling Environment, Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible (For Indonesia and Lao People's Democratic Republic), January 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/National-assessment-framework_-final_ESCAP.pdf

2. Report on the National Assessment Framework of Enabling Environment and Technology Innovation Eco-system for Making Sustainable Energy Options Affordable and Accessible – Indonesia, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Indonesia_Report-on-National-Assessment-of-Sustainable-Energy_optimized.pdf

3. Indonesia National Sustainable Energy Strategy Report on Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Indonesia-National-Strategy-Report_final.pdf

4. Report on the National Assessment Framework of Enabling Environment and Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible - LAO PDR, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Lao_Report-on-National-Assessment-of-Sustainable-Energy.pdf

5. Lao People's Democratic Republic National Sustainable Energy Strategy Report on Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Lao-National-Strategy-Report_final.pdf

6. National Innovation System (NIS) training manual - "NIS Diagnosis and STI Strategy Development to Achieve National Sustainable Development Goals", 2016

   http://apctt.org/nis/sites/all/themes/nis/pdf/NIS%20Training%20Manual.pdf

Technology Platforms and Databases

1. APCTT's Technology4SME Database

   The Technology4SME Database serves as an online platform for information exchange on the availability and sourcing of technologies for small and medium enterprises in countries in the Asia Pacific region.

   http://apctt.org/technology-transfer

2. Renewable Energy Technology Bank

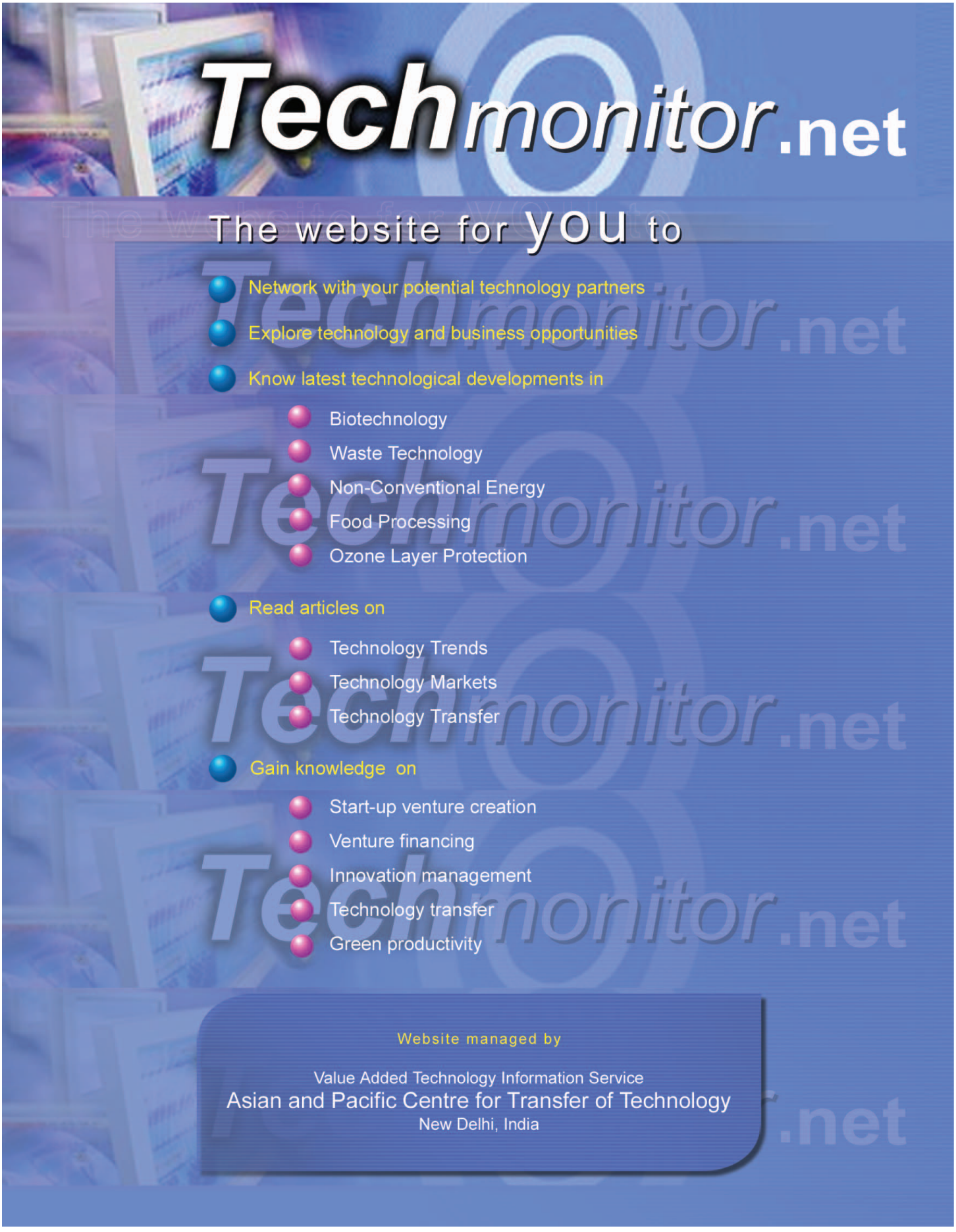
   The primary objective of the Renewable Energy Cooperation-Network for the Asia Pacific (RECAP) established by APCTT is to facilitate technology transfer cooperation among countries in the Asia-Pacific region in the area of renewable energy. RET-Bank provides tested and proven renewable energy technologies (RETs) initially in the areas of solar, biomass, wind, mini-hydro power and geo-thermal energy.

   http://apctt.org/recap/renewable-energy-technology-bank

3. Global Technology Databases

   APCTT has compiled a list of global as well as country-wise technology databases that deal with the technology transfer related services for SMEs and entrepreneurs.

   http://apctt.org/aptitude/


Techmonitor.net
The website for you to
Network with your potential technology partners
Explore technology and business opportunities
Know latest technological developments in
Biotechnology
Waste Technology
Non-Conventional Energy
Food Processing
Ozone Layer Protection
Read articles on
Technology Trends
Technology Markets
Technology Transfer
Gain knowledge on
Start-up venture creation
Venture financing
Innovation management
Technology transfer
Green productivity
Website managed by
Value Added Technology Information Service
Asian and Pacific Centre for Transfer of Technology
New Delhi, India