Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific Tech Monitor

Vol. 37 No. 3 Jul - Sep 2020

Technological innovations to control COVID-19 pandemic

Strategy and best practices from the Asia-Pacific

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- Technology News and Events
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Asian and Pacific Centre for Transfer of Technology (APCTT)

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The Economic and Social Commission for Asia and the Pacific (ESCAP) serves as the United Nations' regional hub promoting cooperation among countries to achieve inclusive and sustainable development. The largest regional intergovernmental platform with 53 Member States and 9 associate members, ESCAP has emerged as a strong regional think-tank offering countries sound analytical products that shed insight into the evolving economic, social and environmental dynamics of the region. The Commission's strategic focus is to deliver on the 2030 Agenda for Sustainable Development, which is reinforced and deepened by promoting regional cooperation and integration to advance responses to shared vulnerabilities, connectivity, financial cooperation and market integration. ESCAP's research and analysis coupled with its policy advisory services, capacity building and technical assistance to governments aims to support countries' sustainable and inclusive development ambitions.

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Asia-Pacific
Tech Monitor
Vol. 37 No. 3 ❖ Jul - Sep 2020

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.

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ISSN: 0256-9957

UNITED NATIONS ESCAP
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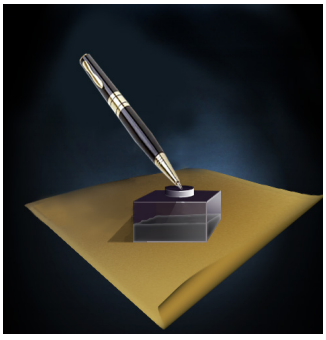

Introductory note

The year 2020 has been particularly challenging for the world due to COVID-19. The pandemic has imposed serious challenges for countries to achieve the United Nations Sustainable Development Goals.

At the same time, this is the year that Science, technology and innovation have demonstrated its true value by providing innovative solutions to adapt, manage and mitigate the impacts of the pandemic. The potential of emerging technologies in coping up with COVID-19 and post pandemic solutions has been endless specially for recovery of businesses, industries and economies. These technologies, particularly the fourth industrial revolution technologies, have helped not only in the healthcare sector but also provided adaptive solutions during lockdown such as remote working, online learning and indoor workout platforms.

Many governments have incorporated digital technologies into their public health management processes for facilitating coordinated containment and mitigation process. For example, in India more than 200 various indigenous technologies were developed as solutions to fight COVID-19 within just 2-3 months. The Republic of Korea has adopted innovative operating models such as Drive-thru and Walk-thru stations. These models helped the professionals to meet extensive testing needs by collecting samples easier and faster than the traditional methods while reducing the risk of cross infections during sample collection.

Big Data analysis which provides real-time data on COVID-19 patients has been helping officials to streamline the data collection process and augmenting its speed and accuracy. For instance, China has been using digital tools like migration maps, mobile phone tracking, and citizen awareness applications to trace and track the location and activities of its population. Targeted interventions have been subsequently made by feeding the data collected from these tools into big data and Artificial Intelligence algorithms. In Singapore, Artificial Intelligence has been used to identify emerging infection clusters and provide testing guidance to individuals.

This issue of *Asia-Pacific Tech Monitor* discusses the challenges, opportunities, strategies and best practices to develop innovative solutions to control COVID-19 pandemic in the Asia-Pacific region. Case studies from the Republic of Korea and India are presented in this Tech Monitor issue.

Michiko Enomoto
Head, APCTT-ESCAP

Technology Market Scan

ASIA-PACIFIC

BANGLADESH

Govt to establish industrial parks

The government will set up 50 more industrial parks on 20,000 acres of land which will create jobs for five million people by 2030, said industries minister Nurul Majid Mahmud Humayun. "BSCIC will have to provide speedy, easy and real services for the entrepreneurs from its 76 industrial estates at an affordable cost," he said while inaugurating a virtual workshop for BSCIC officials on innovation of civic services organized by BSCIC. The minister also urged the BSCIC authorities to render real one-stop services to the entrepreneurs aiming to draw more investment in the small, micro, medium, and cottage (SMMC) sector.

One-Stop Service Act, 2018 has a provision for Bangladesh Small and Cottage Industries Corporation (BSCIC) to provide desired services for its service seekers/entrepreneurs, he mentioned. Due to the pandemic, the minister said, an opportunity for shifting labor-intensive industries to Bangladesh has been created. "Many foreign entrepreneurs have showed their interest to invest in Bangladesh," he said and urged the BSCIC officials to ensure world-standard services for foreign entrepreneurs. He also called upon them to keep the present pace of production by showing their utmost professionalism and sincerity.

The industries minister directed the BSCIC officials to gear up their activities for creating online marketing platform and help implement Prime Minister Sheikh Hasina-declared stimulus package for affected-entrepreneurs of industrial, service, and SMMC sectors etc. due to the Covid-19 pandemic. In cooperation with BSCIC, he said, thousands of small industries have been set up in rural areas of the country which contribute a lot to boosting the country's economic growth.

https://thefinancialexpress.com.bd

CHINA

R&D spending rises in 2019

China's spending on research and development (R&D) hit a record high at 2.23% of its GDP in 2019, up by 0.09 percentage points from the previous year, data from the National Bureau of Statistics (NBS) showed. China's total expenditure on R&D amounted to 2.214 trillion yuan (about 321.3 billion U.S. dollars) last year, up 12.5%, or 246.57 billion yuan compared with that in 2018, according to a report jointly released by the NBS, the Ministry of Science and Technology and the Ministry of Finance.

The figure has seen double-digit growth for four consecutive years, with the growth pace of last year quickening by 0.7 percentage points from the previous year, said Deng Yongxu, an NBS statistician. Investment in basic research stood at 133.56 billion yuan last year, accounting for 6% of the total spending, the data showed.

https://news.cgtn.com

Global data security initiative

China will launch a global data security initiative that can serve as a global standard for data security, Chinese State Councilor and Foreign Minister Wang Yi said via video at an international seminar on "Seizing digital opportunities for cooperation and development" in Beijing. In his keynote speech, Wang also noted that China has not asked and will not ask Chinese companies to transfer overseas data to the Chinese government in breach of other countries' laws.

The initiative comes as experts believe that mounting data security risks have put national security, public interests and personal rights at stake, and pose new challenges to global digital governance. Wang said China's initiative includes eight proposals. China suggests that states handle data security in a comprehensive, objective and evidence-based manner, and opposes ICT (information and communications technology) activities that use data to conduct activities that undermine other states' national security and interests.

https://www.globaltimes.cn

Technology export control rules

People's Republic of China authorities released updated *Catalogue of China's Export Prohibited and Restricted Technologies* (the Catalogue), the first overhaul of the guidelines in more than a decade.

- Based on the 2008 version of the Catalogue, the new updates involved 53 technology items: 9 prohibited or restricted items were deleted; 23 restricted items were added; the control points and technical parameters of 21 items were revised.
- 23 areas of innovation ranging from space materials to 3D printing, encryption, and large-scale high-speed wind tunnel design have been added to the restricted export list. Any exports of technology in such restricted areas of innovation will require government approval and licenses.

According to the *Regulations of the People's Republic of China on the Administration of Technology Import and Export* (the Regulations), the Ministry of Commerce and the Ministry of Science and Technology jointly formulated, adjusted, and published the Catalogue on August 28, 2020. The main purpose of the Regulations and the Catalogue is to standardize technology export management, promote technological progress and foreign economic and technological cooperation, and safeguard the national economic security.

The last revision of the Catalogue was in 2008. With the rapid development of science and technology and the continuous improvement of China's scientific and technological strength and industrial competitiveness, the Chinese government believes that it is imperative that the Catalogue be adjusted and updated in a timely manner in accordance with international practices.

https://www.jdsupra.com

Antitrust Guidelines

Recently, a book titled *Collection of Antitrust Regulations and Guidelines 2019*, authored by the Anti-Monopoly Bureau ("AMB") of

China's State Administration for Market Regulation ("SAMR"), was published by China Industry and Commerce Press. This book officially makes public the following four long-anticipated antitrust guidelines: (1) Antitrust Guidelines for the Automobile Industry ("Auto Industry Guidelines"), (2) Antitrust Guidelines for the Intellectual Property Rights Sector ("IPR Guidelines"), (3) Guidelines on the Application of Leniency Mechanism in Horizontal Monopoly Agreement Cases ("Leniency Guidelines"), and (4) Guidelines on the Undertakings' Commitments in Antitrust Cases ("Commitment Guidelines"). For the first time, these important antitrust guidelines are released via book publication rather than official websites.

According to China's *Anti-Monopoly Law* ("AML"), the Anti-Monopoly Committee of the State Council ("AMC") is responsible for formulating and issuing antitrust guidelines. In 2009, the AMC issued its first set of guidelines on market definition.

In June 2015, the AMC empowered the National Development and Reform Commission ("NDRC"), the previous antitrust authority before the establishment of SAMR in April 2018, to draft new antitrust guidelines. The draft versions were published by the NDRC for public comments from December 2015 to March 2016. In March 2017, the revised draft IPR Guidelines were published again by the AMC for public comments.

These four new guidelines were approved in November 2018 and were issued internally on 4 January 2019 by the AMC. According to the AMB's 2019 work plan announced on 9 January 2019, these guidelines were scheduled for public release in 2019. However, they were released only recently via book publication.

https://www.mondaq.com

INDIA

Women in R&D

Research and Development (R&D) activity in India's private sector has a larger proportion of women compared to government-supported agencies even as men continue to dominate the sector overwhelmingly. The private sector has also outpaced public R&D investment over the years although the latter has put in more in absolute terms. The revelations are made by the latest edition of Science and Technology Indicators (STI-2019-20) compiled by the department of science and technology under the Centre. While the employment data is for 2017–2018, investment data is up to 2018–2019, and is the latest available on the subject.

While at least seven of every 10 women employed by private R&D facilities are actually doing research and development, not even half of the women hired by major scientific agencies are directly involved in research. Only public units in the industrial sector compare well with private R&D facilities—but the overall number of women on rolls at such units is 10 times lesser compared to private R&D facilities. Percentage of women in other Central and state government departments, and scientific and industrial research organisations all paling in comparison to the private sector.

Of the more than 20,000 women employed in private R&D companies, more than 15,000 were involved in R&D activities, while about 2,800 and 2,500 were in auxiliary and administrative activities. In the major scientific agencies funded by the government, there are more than 23,000 women employed but only 10,000 worked directly in R&D.

Further, while R&D investment by the government was about 120% more than the private sector in 2004–2005, the gap has reduced significantly. In 2018–2019, public investment was only 40% more than investment made by the business enterprises (see graphic). Compared to the 300% jump in public investment on R&D from 2004–2005 to 2018–2019, private sector investment spiked over 600%. In 2018–2019, of the 1.2 lakh crore investment in R&D, private investment was Rs 51,115 crore, while the government invested Rs 72,732 crore.

https://timesofindia.indiatimes.com

Patents applications

Despite the growth in the number of patent applications being filed by Indians, or Indian companies, data compiled by the Department of Science and Technology (DST) showed that between 2005 and 2018, nearly 8 out of 10 applications had been filed by foreigners, or foreign entities abroad. Residents from the US, Japan, and Germany accounted for over 45% of the patents filed during the same period, with those in the UK, France, Switzerland, Russia, Netherlands, and India also accounting for substantial amounts.

The trend seems particularly puzzling especially given that investment into India's private sector had been increasing at around twice the rate of that into public investment. But a deeper understanding of the intellectual property rights ecosystem shows why India isn't capitalizing on its innovative minds.

At the heart of the issue is the lack of research and funding. According to data from the Organisation for Economic Co-operation and Development (OECD), India spent just 0.7% of its GDP in 2016–2017 on research and development, compared to Japan's 3.2%, US' 2.8%, and China's 2.1%.

Yet, while funding remains a core concern, poor awareness over intellectual property rights, and especially patents is something that it also threatening to stifle India's drive towards innovation. According to the Officer of Controller General of Patents, it was US chipmaker, Qualcomm that had topped both patent filings and grants in 2018–2019, filing nearly 1,600 applications—over six times that of Tata Consultancy Services (TCS), India's top ranking company on the list.

https://www.timesnownews.com

R&D policy to bolster drug discovery

The Centre will soon unveil a new Research & Development (R&D) policy to boost drug discovery and the manufacture of medical devices in the country. Alongside, numerous production-linked incentives are also on the anvil, including to the scientists involved in the process, P.D. Vaghela, Secretary, Department of Pharmaceuticals.

The government proposes to set up three major manufacturing parks including

one in Hyderabad, with an investment of ₹1,000 crore each to help drive import substitution of basic raw materials, active pharmaceutical ingredients (API), and the making of medical devices, Mr. Vaghela said. Addressing a webinar to commemorate the 77th anniversary of CSIR-Indian Institute of Chemical Technology (IICT), the Secretary said there had to be renewed focus on bringing together research institutions, academia, and the industry to identify new chemicals, update processes, and discover new drug delivery systems. He said current approval processes were archaic and that there was a dire need to strengthen institutions and recognize scientists' role in new discoveries, and to help them commercialize the projects so they too can "become millionaires."

The Centre has so far received 13 requests for setting up the bulk drug parks. CSIR-DG Shekhar C. Mande said about 53 APIs had been identified for manufacture, of which 26 were being processed on a war footing, with results expected in 2–3 years.

https://www.thehindu.com

INDONESIA

Digitization of state-owned enterprises

In a bid to help the digital transformation of Indonesia's state-owned enterprises (SOEs), Jakarta-based MDI Ventures announced the launch of a new $500 million tech investment fund. The fresh capital will be used in tech startups that have the potential to drive digital transformation for SOEs and seek to plug its portfolio into all of Indonesia's state-owned enterprise. The Indonesian government has appreciated the fund and said it will act as a push for a full-fledged state-owned digital ecosystem.

The venture firm is looking for tech startups that have strong growth promise and are willing to help traditional and offline SOEs to join the nation's thriving digital economy. With this investment, MDI Ventures has now become the largest corporate-backed multi-fund venture capital in Indonesia with more than $790 million in assets under management.

https://www.entrepreneur.com

SMEs to create innovative products

The Industry Ministry launched the Indonesia Food Innovation (IFI) 2020 to challenge small- and medium-scale enterprises (SMEs) in the food sector to promote their innovative products by utilizing local resources.

"The Indonesia Food Innovation is aimed at encouraging innovation and business development of SMEs, especially in the food sector," the ministry's Director General of SME and Various Industry, Gati Wibawaningsih, stated at the launch of IFI 2020 held virtually. Wibawaningsih remarked that the IFI will accelerate business development of food products of SMEs and support startups in the sector to expand their businesses. The program will lay emphasis on product innovation and the utilization of local raw materials to encourage SMEs to utilize the profuse supply of local resources, she noted.

The IFI 2020 will select eligible participants to partake in the Food Camp Program wherein they will be trained and mentored by professionals to hone their capabilities both in terms of the technical aspects and business toward the realization of modern SMEs in the food industry. Participants will be segregated into the categories of intermediate product and end product. In both categories, the first winner will receive Rp40 million in cash, while the one coming second will be offered Rp25 million, and the third place holder will get Rp15 million.

Winners will also get the opportunity to scale-up their businesses through exclusive coaching and mentoring, the facility of HACCP certification, and other certificates deemed necessary to boost competitiveness. The winners will also have the opportunity to participate in various exhibitions, investor matchmaking, and obtain the membership of global e-commerce.

https://en.antaranews.com

MALAYSIA

New e-commerce platform

The Ministry of Entrepreneur Development and Cooperatives (MEDAC) has announced that it is seeking to develop an online sales channel similar to Lazada, Shopee, and Alibaba—directly competing with the e-commerce giants. Tentatively dubbed the Online Market, minister Datuk Seri Wan Junaidi Tuanku Jaafar said that it is intended to provide a more convenient shopping experience for Malaysians.

"I have asked the Small and Medium Enterprises Corporation, the National Entrepreneurship Institute, the Co-operative Institute of Malaysia (IKM) and the Co-operative Commission of Malaysia to conduct a study on the implementation of the application," said Datuk Wan Junaidi. The minister further claimed that with the new e-commerce platform, consumers will no longer need to shop at Lazada, Shopee, or Alibaba due to their higher charges. He is also confident that the Online Market will be one of the largest online sales movements in the market.

https://ringgitplus.com

REPUBLIC OF KOREA

R&D budget spending

The Republic of Korea's government said that it is seeking a 27.2 trillion won (US$22.8 billion) research and development (R&D) budget for 2021 to secure growth for future generations. The sum represents a 12.3% increase from 24.2 trillion won for 2020 and marks the second year of a double-digit annual rise following the 18% hike for 2020, the Ministry of Science and ICT said.

Of the total, roughly half, or 13.2 trillion won, will be injected into the so-called New Deal projects, helping combat infectious diseases, promoting development of industrial materials, components, and equipment, as well as supporting biohealth, future mobility, and system chips. The government said it will also allocate funding for basic R&D and fostering innovative researchers.

The ministry said it has earmarked 1.1 trillion won for the digital new deal effort covering artificial intelligence 5G mobile connectivity that can contribute to the digitization of the country's social

overhead capital. A further 800 billion won will be used in the green new deal efforts centered on renewables. The new year's budget will funnel 200 billion won into responding to infectious illnesses and dealing with outbreaks, with 170 billion won to be spent on finding local treatment drugs and vaccines for COVID-19.

To help boost the materials, components, and equipment sectors, the government will provide 2.2 trillion won to better respond to shifts in the global value chain caused by the pandemic and trade disputes. Seoul said it wants to spend 2.3 trillion won on bio-health, future mobility, and system chips, which can all enhance the country's competitiveness in critical sectors, while 7.3 trillion won is to be provided for basic R&D and 300 billion won for promising scientists, to help the country stay abreast of the latest advances in science and technology.

The R&D budget that was submitted to the National Assembly is set to be approved by lawmakers on Dec. 2. The total size of the country's budget sent to parliament stands at 555.8 trillion won, an increase of 8.5% compared to this year.

https://en.yna.co.kr

R&D in new growth-engine sectors

The republic of Korea plans to invest 5 trillion won (US$4.2 billion) in research and development for new growth-engine sectors, including semiconductor and biotechnology, the trade ministry said. The industry ministry also expanded a list of materials, parts, and equipment to 338 to reduce the country's reliance on Japanese imports and cope with a change in global supply chains after the coronavirus pandemic.

Previously, the Republic of Korea had listed 100 local materials, parts, and equipment that it aimed to cut the reliance on Japanese imports since Tokyo abruptly rolled out restrictions on exports of key industrial materials to Seoul in July last year. By 2022, the government will spend 5 trillion won in research and development to secure technologies for new growth-engine sectors, the ministry said. In particular, the government will invest 2 trillion won in research and development for semiconductor, biotechnology, and electric vehicles, it said. The government will also set up a fund of 400 billion won to support 100 firms in sectors of materials, parts, and equipment over the next 5 years, the ministry said.

https://en.yna.co.kr

AI semiconductor hub

The Republic of Korean government intends to launch a ₩1 trillion ($843.9 million) initiative to make the country the world's artificial intelligence (AI) semiconductor hub. The project also aims to increase the region's electronic components manufacturing capability. Seoul will facilitate the program by providing funding to local companies and institutions through 2029. In May, the Republic of Korea revealed AI and 5G related technological development would drive its post-coronavirus economic recovery efforts.

The Republic of Korea's Ministry of Trade, Industry, and Energy will contribute ₩521.6 billion ($439.1 million) to the initiative through 2026. In addition, the country's Ministry of Science and ICT (Information and Computer Technology) has earmarked ₩488 billion ($410.8 million) for the program over the next 10 years.

The Republic of Korean administrators have enlisted 91 businesses, 29 universities, and 8 research institutions to work on its semiconductor development project. Seoul is interested in addressing the world's need for chips that enable innovation in cutting-edge fields like biotechnology, Internet of Things (IoT) enabled home appliances, and smart vehicles.

https://www.theburnin.com

SINGAPORE

Innovation and technology in financial sector

The Monetary Authority of Singapore (MAS) is stepping up its support for fintech here. It will commit $250 million in the second edition of a scheme to speed up technology adoption and innovation-driven growth in the local financial sector. MAS also aims to strengthen support for large-scale innovation projects, and build a stronger pipeline of Singaporean fintech talent. The amount will be invested over the next 3 years under the enhanced Financial Sector Technology and Innovation Scheme (FSTI 2.0), MAS managing director Ravi Menon announced.

The funding has been ramped up from the $225 million spread over 5 years that was injected under the original FSTI scheme, launched in 2015, with a vision of making Singapore a Smart Financial Centre.

Under the enhanced scheme, the MAS will double the maximum funding amount, from $200,000 to $400,000, under the Proof-of-Concept Grant, and will increase the maximum funding support from 50% to 70% of qualifying project cost, the authority said in a separate statement.

A merit-based tiered funding mechanism will be introduced to replace the existing flat 50% funding support of qualifying project cost. The level of funding support and quantum cap for each applicant will vary according to the total number of favorable votes awarded by an evaluation panel. Funded by the Financial Sector Development Fund, the latest initiative aims to invigorate the culture of innovation in Singapore and deepen the cyber-security capabilities in the financial sector.

https://www.straitstimes.com

Cooperation for PCT applications

The Intellectual Property Office of Singapore (IPOS) has expanded its international cooperation with the Republic of Korea and Lao People's Democratic Republic for applications filed under the Patent Cooperation Treaty (PCT). With effect from 1 July 2020, nationals and residents of the Republic of Korea will be able to select IPOS, in addition to the Australian Patent Office, the Austrian Patent Office, and the Korean Intellectual Property Office (KIPO), as a competent International Searching Authority (ISA) and International Preliminary Examining Authority (IPEA) for international applications filed with KIPO or with the International Bureau (IB) as the Receiving Office under the PCT.

With effect from 7 July 2020, nationals and residents of Lao People's Democratic Republic will also be able to select IPOS, in addition to the China National Intellectual Property Administration, the European Patent Office, the Japan Patent Office, and the Korean Intellectual Property Office, as a competent International Searching Authority (ISA) and International Preliminary Examining Authority (IPEA) for international applications filed with the International Bureau (IB) as the Receiving Office under the PCT.

The Republic of Korea and Lao People's Democratic Republic are the newest additions to the list of countries that have appointed IPOS as an ISA/IPEA, which includes Brunei, Cambodia, Indonesia, Japan, Mexico, Thailand, Uganda, United States of America, and Vietnam. Enterprises in these countries can utilize this cooperation to benefit from IPOS's high-quality and efficient patent search and examination services. For example, one unique strength of IPOS is that it is able to conduct patent searches directly in both English and Chinese to cover prior art documents in both languages.

IPOS's cooperation for international applications filed under the PCT could also be leveraged, in addition to regional work-sharing networks such as the Patent Prosecution Highway (PPH) and PCT-ASEAN Patent Examination Cooperation (PCT-ASPEC), to speed up the patent grant process and to secure a patent right. Based on the cooperation of IPOS with the Ministry of Industry & Handicraft (MIH) of Cambodia and the Department of Intellectual Property (DIP) of Lao People's Democratic Republic, patent applicants will also be able to submit a Search and Examination report issued by IPOS to the MIH or the DIP for the grant of a patent in Cambodia or Laos.

The expanding international cooperation of IPOS enables applicants to enjoy patent acceleration in both the ASEAN and international regions, facilitating increased speed to markets for the benefit of stakeholders. This further contributes to Singapore's goal of becoming a global IP hub in Asia which is at the growth frontier for Research and Development (R&D) investments and IP activities.

https://www.mondaq.com

Budget to fight COVID-19

Singapore is dedicating nearly SGD $55 billion (USD $38.2 billion) to combat coronavirus impact in the region, with the introduction of additional SGD $48 billion in "resilience budget," announced by Deputy Prime Minister Heng Swee Keat. The new fund will be an addition to SGD $6.4 billion announced earlier in Feb 2020 to fight against coronavirus pandemic. This "Supplementary Budget" accounts to 11% of GDP and amounts to nearly half of the Government's $106 billion budget for 2020. This is only the second time Singapore has drawn on its national reserves to fund special budget measures, apart from the earlier 2009 global financial crisis.

Mr Heng, who is also Finance Minister said, "The Resilience Budget focuses on three key areas, -to save jobs, support workers, and protect livelihoods'. The package is also allocated to help businesses overcome immediate challenges and to strengthen economic/social resilience for the country to raise intact and stronger against the blow of raising cases". "SG Clean campaign was launched in February to drive higher levels of personal and public hygiene" he recalled. By building up a national stockpile of health supplies country is ensuring the availability of healthcare supplies.

https://www.biospectrumasia.com

THAILAND

Regulations to stop "biopiracy"

The Department of Intellectual Property is pushing ahead with amendments to the Patent Act aimed at preventing theft of traditional knowledge known as biopiracy. Jittima Srithaporn, deputy director-general, said the draft amendment, which is expected to go to a public hearing next month, will introduce mandatory profit-sharing for commercial use of traditional knowledge through patents. She said a business seeking to patent innovations involving traditional knowledge governing products such as herbs will be required to share any profits made from folk wisdom.

https://www.bangkokpost.com

VIET NAM

Resolution to promote supporting industries

The Vietnamese government approved *Resolution 115/NQ-CP* (Resolution 115) on August 6, 2020, to promote supporting industries in Vietnam. The approved resolution maps out a comprehensive approach to improve both administrative policies and enhance private sectors' capabilities through training and financial incentives. Supporting industries that are listed in the prioritized list prescribed in the Law on Investment and *Decree 111/2015/NĐ-CP* are the focus of this resolution.

As prescribed in the Law on Investment and *Decree 111/2015/NĐ-CP*, the following supporting industrial products are prioritized in the future policy framework, particularly:

- Mechanical engineering industry: industrial products supporting high-tech industries (high precision molds, standardized mechanical details, microelectronic circuits), components and spare parts for equipment using renewable energies, new generation motors, etc.;
- Textile and garment industry: natural fibers, synthetic fibers, technical fabrics, chemicals, auxiliaries, and dyes for fabrics dyeing, etc.;
- Leather and footwear industry: leather and leatherette, chemical tanning, shoe sewing thread, shoe accessories, etc.;
- Electronics industry: basic electronics—photoelectronic components, components of quartz, materials for electronic component production (semiconductors, magnetic materials, etc.), electronic circuits, batteries, etc.; and
- Automobile industry: electrical components, engine and engine details, lubrication systems, cooling system, fuel supply system, power transmission system, etc.

https://www.vietnam-briefing.com

INTERNATIONAL

Artificial Intelligence to fight COVID-19

A number of research projects are using AI to identify drugs that were developed to fight other diseases but which could now be repurposed to take on coronavirus. By studying the molecular setup of existing drugs with AI, companies want to identify which ones might disrupt the way COVID-19 works.

BenevolentAI, a London-based drug-discovery company, began turning its attentions towards the coronavirus problem in late January. The company's AI-powered knowledge graph can digest large volumes of scientific literature and biomedical research to find links between the genetic and biological properties of diseases and the composition and action of drugs. The company had previously been focused on chronic disease, rather than infections, but was able to retool the system to work on COVID-19 by feeding it the latest research on the virus. "Because of the amount of data that's being produced about COVID-19 and the capabilities we have in being able to machine-read large amounts of documents at scale, we were able to adapt [the knowledge graph] so to take into account the kinds of concepts that are more important in biology, as well as the latest information about COVID-19 itself," says Olly Oechsle, lead software engineer at BenevolentAI.

The system suggested a number of compounds that could potentially have an effect on COVID-19 including, most promisingly, a drug called Baricitinib. The drug is already licensed to treat rheumatoid arthritis. The properties of Baricitinib mean that it could potentially slow down the process of the virus being taken up into cells and reduce its ability to infect lung cells.

DeepMind, the AI arm of Google's parent company Alphabet, is using data on genomes to predict organisms' protein structure, potentially shedding light on which drugs could work against COVID-19. DeepMind has released a deep-learning library called AlphaFold, which uses neural networks to predict how the proteins that make up an organism curve or crinkle, based on their genome. Protein structures determine the shape of receptors in an organism's cells. Once you know what shape the receptor is, it becomes possible to work out which drugs could bind to them and disrupt vital processes within the cells: in the case of COVID-19, disrupting how it binds to human cells or slowing the rate it reproduces, for example.

Human epidemiologists at ProMed, an infectious-disease-reporting group, published their own alert just half an hour after HealthMap, and Brownstein also acknowledged the importance of human virologists in studying the spread of the outbreak. "What we quickly realized was that as much it's easy to scrape the web to create a really detailed line list of cases around the world, you need an army of people, it can't just be done through machine learning and webscraping," he said. HealthMap also drew on the expertise of researchers from universities across the world, using "official and unofficial sources" to feed into the line list.

Canadian startup DarwinAI has developed a neural network that can screen X-rays for signs of COVID-19 infection. While using swabs from patients is the default for testing for coronavirus, analyzing chest X-rays could offer an alternative to hospitals that don't have enough staff or testing kits to process all their patients quickly. DarwinAI released COVID-Net as an open-source system, and "the response has just been overwhelming", says DarwinAI CEO Sheldon Fernandez. More data sets of X-rays were contributed to train the system, which has now learnt from over 17,000 images, while researchers from Indonesia, Turkey, India, and other countries are all now working on COVID-19. "Once you put it out there, you have 100 eyes on it very quickly, and they'll very quickly give you some low-hanging fruit on ways to make it better," Fernandez said.

Johannes Eichstaedt, assistant professor in Stanford University's department of psychology, has been examining Twitter posts to estimate how COVID-19, and the changes that it's brought to the way we live our lives, is affecting our mental health. Using AI-driven text analysis, Eichstaedt queried over two million tweets hashtagged with COVID-related terms during February and March, and combined it with other data sets on relevant factors including the number of cases, deaths, demographics, and more, to illuminate the virus' effects on mental health.

Google-owned machine-learning community Kaggle is setting a number of COVID-19-related challenges to its members, including forecasting the number of cases and fatalities by city as a way of identifying exactly why some places are hit worse than others. "The goal here isn't to build another epidemiological model… there are lots of good epidemiological models out there. Actually, the reason we have launched this challenge is to encourage our community to play with the data and try and pick apart the factors that are driving difference in transmission rates across cities," Kaggle's CEO Anthony Goldbloom told the Stanford conference.

https://www.zdnet.com

AI Algorithm accurately predicts COVID-19

Researchers have developed an artificial intelligence (AI) diagnostic that can predict whether someone is likely to have COVID-19 based on their symptoms. The team of researchers at King's College London (London, England), Massachusetts General Hospital (Boston, MA, USA), and ZOE, a health science company (London, England), have developed an AI model that uses data from the COVID Symptom Study app to predict COVID-19 infection, by comparing people's symptoms and the results of traditional COVID tests. This could provide help for populations where access to testing is limited, according to the researchers who plan start to conduct two clinical trials in the UK and the US shortly.

More than 3.3 million people across the world have downloaded the app and are using it to report daily on their health status, whether they feel well or have any new symptoms such as persistent cough, fever, fatigue, and loss of taste or smell (anosmia).

The research team investigated which symptoms known to be associated with COVID-19 were most likely to be associated with a positive test. They found a wide range of symptoms compared to cold and flu, and warn against focusing only on fever and cough. Indeed, they found loss of taste and smell was particularly striking, with two-thirds of users testing positive for coronavirus infection reporting this symptom, as compared with just over a fifth of the participants who tested negative. The findings suggest that anosmia is a stronger predictor of COVID-19 than fever, supporting anecdotal reports of loss of smell and taste as a common symptom of the disease.

The researchers then created a mathematical model that predicted with nearly 80% accuracy whether an individual is likely to have COVID-19 based on their age, sex, and a combination of four key symptoms: loss of smell or taste, severe or persistent cough, fatigue, and skipping meals. Applying this model to the entire group of over 800,000 app users experiencing symptoms predicted that just under a fifth of those who were unwell (17.42%) were likely to have COVID-19 at that time. The researchers have suggested that combining this AI prediction with widespread adoption of the app could help to identify those who are likely to be infectious as soon as the earliest symptoms start to appear, focusing tracking and testing efforts where they are most needed.

https://www.hospimedica.com

ASIA-PACIFIC

CHINA

AI system to diagnose COVID-19 faster

Damo Academy, a research institute of Alibaba has developed a new, Artificial Intelligence (AI) driven diagnosis system that can detect COVID-19 infections with an accuracy of up to 96% reported by Sina Tech News. AI driven tool also uses computerized tomography (CT) scans of patients to form a diagnostic, but it is faster and more reliable than human doctors at diagnosis. The tool has already been introduced in the Qiboshan Hospital in Zhengzhou, Henan province and plans are underway to expand it to a further 100 hospitals.

Researchers at Damo Academy told Sina Tech News that the AI tool can distinguish between patients infected with the COVID-19 coronavirus and ordinary viral pneumonia (the two have similar symptoms) with up to 96% accuracy by looking at a patient's CT scan. Researchers trained AI system using data from more than 5,000 confirmed COVID-19 cases which includes the latest treatment guidelines and published research on the virus and takes only 20 seconds to issue a diagnosis report. Whereas, a human doctor can take between 5 and 15 minutes for same.

The Qiboshan Hospital was built specifically to tackle cases of COVID-19. The hospital already has automated helpers on hand, such as robots that carry medicine for the staff and gadgets which monitor patients' temperature around the clock. Alibaba says they're working on introducing it to another 100 healthcare facilities in the provinces of Hubei, Guangdong, and Anhui.

It's meant to free up medical personnel for other tasks by taking over the simple yet time-consuming task of establishing a diagnosis. CT scans were added as a criterion for the diagnosis of new COVID-19 cases early in February by the Chinese National Health Commission (in addition to the previous nucleic acid test method) in an effort to speed up the process and ensure patients would get treatment as soon as possible. While definitely faster than the alternative, it's still a very time-consuming task: the CT scans of a single patient can include more than 300 images.

https://www.pharmatutor.org

AI, IoT and cloud to keep away COVID-19

Yonghe Cardinal Tien Hospital in Taipei, Taiwan Province of China, has been very proactive in protecting in medical frontliners, patients, and visitors against potential COVID-19 infection. In the early weeks of infection in February, the hospital installed a "2-in-1" detection device that automatically scans individuals entering its lobby for face masks and normal body temperature. The device uses Microsoft technology and camera equipment that continuously scans people. It immediately alerts first-line staff when problems are detected so they can stop potentially infected individuals.

"We have collaborated with Microsoft Taiwan to deploy artificial intelligence (AI) masks and infra-red (IR) temperature 2-in-1 detection device," said the hospital administration vice superintendent Liao Mao-Hung. "With the deployment of Microsoft AI technology, we can effectively and quickly detect whether hospital personnel are wearing masks or have abnormal body temperatures that need to be addressed in a timely way. It not only improves the efficiency of epidemic prevention, but it also reduces the work burden of front-line personnel, so that limited human resources can be used more effectively."

The 2-in-1 detection device employs AI, the intelligent edge, and the cloud to help protect the hospital's patients and staff from the outside spread of COVID-19. Daniel Li, Microsoft Taiwan Azure Business Group Lead, said a Microsoft team pre-emptively started design work in early February, weeks before COVID-19 was declared as a global pandemic. "Within two weeks, we developed the solution on Microsoft Azure and – together with local Internet of Things (IoT) partners – were able to launch the 2-in-1 device," Li said. "We look forward to helping Taiwan's medical intuitions, enterprises, and society to work together to go through this difficult time."

The AI mask and IR temperature detection system is built with Microsoft Azure Cognitive Services. It empowers an organization's IT staff to build modules around their proprietary databases quickly and also to deploy trained AI models to an IoT Edge module for real-time image analysis via Power BI. In addition, system alerts are available through Azure Bot services to notify authorities immediately about real-time monitoring.

https://futureiot.tech

IoT and wearable sensors to monitor COVID-19 patients

At the end of January, MobiHealthNews reported that Shanghai Public Health Clinical Center (SPHCC) was using California-based connected health startup VivaLNK's continuous temperature sensor to monitor COVID-19 patients, which reduces the risks of caregivers being exposed to the virus. SPHCC recently announced that they are using Bluetooth IoT products and solutions provider Cassia Network's gateways, together with VivaLNK's medical wearable sensors to monitor COVID-19 patients. VivaLNK's body temperature sensors are applied directly to the patient to provide continuous, real-time monitoring of any changes in body temperature. Cassia's gateways are being used to receive real-time patient data from the sensors and wirelessly transmit this data to a nurse's station for continuous monitoring.

Cassia's IoT Access Controller, a powerful network management tool is being used by medical staff to monitor patients and to provide a holistic view of their vitals in real-time. Cassia's gateways allow up to 40 Bluetooth Low Energy devices to be paired and connected simultaneously while providing the long-range connectivity needed to cover multiple rooms in the SPHCC. The SPHCC along with seven other hospitals throughout China are currently using Cassia's gateways with additional deployments in other medical centers in the near future.

SPHCC has been applying advanced tech to help in the diagnosis and monitoring of COVID-19 patients. It has also worked with Yitu Healthcare, a Shanghai-based AI startup, to co-develop the AI-powered Intelligent Evaluation System of Chest CT for COVID-19, MobiHealthNews reported. "Cassia is excited to be working with VivaLNK to help fight the spread of infectious diseases such as COVID-19 as well as helping save lives," said Felix Zhao, CEO of Cassia Networks. "With the combination of VivaLNK's continuous health monitoring solutions, Cassia's Bluetooth gateways and IoT Access Controller, we can better equip clinical centers and medical staff worldwide with the critical tools they need to address this, and future pandemics."

"The concept of remote patient monitoring using wireless medical wearables can extend into a clinical environment where there is a need to minimize patient contact and for a more flexible deployment model," said Jiang Li, CEO of VivaLNK. "The combination of VivaLNK sensors and Cassia's gateways enables medical centers to rapidly deploy patient monitoring solutions not only in China but worldwide."

https://www.mobihealthnews.com

INDIA

Disinfection using special drones

Invest India, India's National Investment Promotion Agency have closely collaborated through the AGNI Mission, and Invest India's Business Immunity Platform (BIP)—to facilitate the use of specially designed drones to support Covid-19 disinfection in Varanasi. The Government's Covid-19 strategies align with global best practice: protecting Indians against Covid-19, by minimizing their chances of catching it. To boost local authority capacities in achieving this, the Government is leveraging the power of technology.

Drones offer an answer. Using drones, authorities could spray disinfectant over large, crowded, vulnerable urban areas: protecting city-dwellers from Covid-19, while reducing human contact to keep frontline workers safe. Helping Garuda Aerospace, a Chennai-based drone startup, respond to Varanasi's interest in such disinfection: the team worked with Central, State, and local government authorities to help get Garuda's technologies and personnel to Varanasi. The team monitored and supported every step of this exercise: helping Government and innovator collaborate to fight Covid-19 together.

Drone operations in Varanasi have just commenced. The team will now extend similar capabilities to more cities across India. This forms part of a wider effort to use innovative technology, via Government–innovator collaboration, to reinforce Indian authorities' fight against Covid-19.

https://www.expresscomputer.in

AI-driven hospital pods to treat COVID-19 patients

Karnataka Government recently announced the launch of AI-driven movable hospital to treat COVID-19 patients. It has been done in an effort to contain the spread of the virus in the state. Called the Vevra Pods, these are movable capsules that are infused with artificial intelligence to prevent the spread of contagious diseases such as COVID-19, flu, TB, and more. Dr Sudhakar K, the education minister tweeted that AI has the potential to transform healthcare and urged tech startups to focus on low-cost solutions. It has been developed by Bengaluru-based design-and-build firm Vevra in association with Portugal-based healthcare IoT InnoWave Group. With an accommodation capacity of up to nine beds, it will have an ante-chamber airlock room to provide a safe area for healthcare professionals.

The Pods will have stringent control over the quality of air being circulated in and out of the room with installations such as HEPA filters, UVC lights, and high-end exhaust system. It will also have PLC-integrated air conditioning system to maintain temperature and humidity. It will also have other features such as fire-resistant structure, anti-bacterial wall, attached toilet, devices to measure oxygen level, RO water purifier, geyser, shower area, fire extinguisher, CCTV surveillance, and more. The pods are reusable with 15 to 20 years' structural warranty.

https://analyticsindiamag.com

Screening of suspected Covid-19 patients with voice samples, AI

Brihanmumbai Municipal Corporation (BMC) will start screening suspected Covid-19 patients through artificial intelligence (AI), using their voice samples. The civic body signed the memorandum of understanding (MOU) with an Israel-based startup company, Vocalis Health, for the first-of-its-kind initiative in Mumbai.

Vocalis Health is collecting voice samples of people across the globe as an initiative to develop a diagnostic tool to identify

Covid-19 infected people. Even though the concept is new, several countries like the US and Israel are using it. People can submit their voice samples for analysis on the company's official website.

The gold standard test for diagnosis of the Sars-Cov-2 virus, which causes Covid-19, is reverse transcription-polymerase chain reaction (RT-PCR). But it takes over 8 hours to provide the result. Though rapid antigen tests give test results within 30 minutes, as per the Indian Council of Medical Research (ICMR), its false negativity rate is higher. With the ongoing unlocking of the national lockdown, the civic body needs more economical alternatives to rapidly and accurately diagnose cases of Covid-19. Thus, BMC has decided to start voice analysis to detect the virus within 30 seconds.

Dr Neelam Andrade, dean of Nair Dental Hospital and in-charge of NESCO, explained the process. When the symptoms of Covid-19 manifest, the person starts having breathing problems that affect the amount of air exhaled. Then the air interacts with inflamed muscles on its journey to production voices or speeches. These interactions impact the voice modulations—measurable qualities that form the basis of their biomarkers. Depending on its variations, an individual can be detected with Covid-19.

"There is one voice application that can be installed on mobiles or smart laptops. The suspected patient will be asked to count a few numbers in front of the device like a breath-analyser. The voice samples will automatically get synced with the main server of the provider. Then, through artificial intelligence, the result will be procured within 30 seconds," she said.

The application will analyze voices of three types of people—suspected, confirmed, and negative with Covid-19. Depending on their vocal biomarkers (VB), they will be diagnosed. For example, if a person's VB is below the standard point—0.5, he/she will be considered as negative. But if anyone records VB above it, he/she will be suspected with Covid-19 and an RT-PCR test will be conducted for confirmation.

https://www.hindustantimes.com

Computer simulations to understand how the pandemic evolves

Decision makers have increasingly relied on computer simulations to understand how the pandemic situation will evolve over time. TCS, in collaboration with Pune-based Prayas Health Group, is using digital twins to forecast the spread of COVID-19 in urban districts. A digital twin is a virtual computerized model of a physical system that takes real-world data as input and predicts the future evolution of the system.

"Macro models don't work well in countries like India which have high heterogeneity. So we developed ward-level digital twins that modelled the spread of the disease as a function of the number of proximal contacts, average duration of contacts, people and place characteristics, and population demographics like age, gender, comorbidities, etc," says Vinay Kulkarni, distinguished chief scientist, TCS. "The model predictions closely match the observations reported by city corporations and empower the administration to take better locality-specific decisions."

Ensuring people wear face masks and follow social distancing is expected to be a major challenge for organizations. AI is being used to monitor live CCTV feeds and instantly report violations of guidelines to safety administrators. "It is critical that a safe ecosystem is created for businesses and schools to re-open as soon as possible in spite of COVID-19," says Atul Arya, CEO of Blackstraw, an AI company. "Our AI-powered health risk management system developed jointly by Blackstraw and Bharat Forge not only enables safety of humans and compliance with government guidelines, but also drives long-term behavioural changes that are crucial to live by in the new normal."

TCS is using AI simulations to synthesize molecules and discover new drugs to fight the virus. From a candidate set of 50,000 molecules, their simulations selected 31 molecules that are now undergoing trials as potential cures.

https://www.theweek.in

Use of AI-in-CCTV in transport to detect masks

Yolobus, an inter-city bus-service provider for distances involving 8–12 hours' travel, uses CCTVs to detect masks, apart from spraying disinfectants frequently. "We use CCTVs in buses to track whether all the bus crew and passengers are wearing masks," Shailesh Gupta, co-founder and CEO, Yolobus, told *BusinessLine*. Bus crew also check whether all passengers are sporting masks, provided for free by Yolobus, which has resumed services on half the number of routes now as against March-end. Some of its routes are newer.

Cargo-mover Spoton Logistics is installing an algorithm in its CCTV cameras at its loading and unloading locations to ensure that the workers use masks and maintain social distance. Spoton Logistics MD and CEO Abhik Mitra said that they are resorting to visual analytics and algorithm in over 300 locations as ensuring social distance becomes tough to track 24x7. Besides arming staff with sanitizers and thermometers, Spoton uses pulse oximeters at its loading and unloading sites, where the company has deployed extra workers from local areas as some of its workers from the migrant community had not returned.

Cab aggregator Uber, which uses AI globally to verify whether its drivers have masks on, relies on technology in India to verify their masks, apart from asking them to click a selfie. Also, to make both drivers and passengers safe from each other, it is putting plastic screens covering the drivers in 20,000 taxis and plastic screens in 1,00,000 autorickshaws.

Meanwhile, railway stations are installing CCTVs with features to detect temperature, mask, and social distancing. Vehant Technologies, which has Indian Railways as its customer, has developed an AI-based software that captures temperature and mask using CCTVs. Vehant's AI-cum-CCTV-based software that captures temperatures, masks on a real time basis, and social distancing are in use in railway stations including Raipur, Bilaspur, and Guwahati, according to Kapil Bardeja, the company's CEO and co-founder. Bardeja estimates the market for CCTVs with temperature and

mask-detecting features in India to be around 10,000 locations, of which 30–35% of sites are railway stations, bus terminals and airports.

https://www.thehindubusinessline.com

MALAYSIA

AI-powered Covid-19 risk profiling system

MY E.G. Services Bhd (MyEG) has developed an extensive artificial intelligence-powered (AI) coronavirus (Covid-19) risk profiling system. Malaysia's eGovernment services provider said the system has capabilities that include historical geolocation and anomaly tracking for Chinese travelers. It is now making the technology available to the governments of Malaysia and the Philippines.

MyEG said it is a fully automated system that encompasses analytics of a vast number of available data points. The data includes visitors' previous known whereabouts as well as heart rate and blood pressure readings crossed-referenced against public transportation ridership and exposure to locations with incidences of infections.

In addition, the system provides ongoing engagement with the visitor within the country, thus enabling health authorities to be alerted of any anomalies and to take immediate appropriate measures such as in the event that evacuation or quarantine of affected persons are necessary.

https://www.nst.com.my

SINGAPORE

AI clinical assistants for doctors

The National University Health System (NUHS) of Singapore partnered with a startup called Bot MD to launch SGDormBot, the first AI-powered bot developed for clinicians who are caring for COVID-19 patients, enabling real-time monitoring and telehealth intervention. SGDormBot is currently being used by 1,000 migrant workers residing in six dormitories under the medical management of NUHS.

"The idea behind SGDormBot started when I was approached by two doctors—Dr. Stephanie Ko and Dr. Jen Wei Ying—who had an idea for digitizing the collection of vital signs for the COVID-19-positive patients under their care," Bot MD co-founder and CEO Dorothea Koh told *KrASIA* in a recent interview. When Dr. Ko was volunteering to manage treatment for COVID-19 patients in the dormitories, she saw how health information is recorded on paper, so keeping track of that information, and aggregating it, was a challenge for her. It was also difficult for many doctors to communicate with the migrant workers due to language barriers, said Koh.

"In addition, there was limited healthcare manpower deployed to the dormitories. All of them are volunteers and they are usually only available during office hours. Therefore, it is challenging to monitor the patients during the acute phase of their illness if their condition deteriorated. We wanted to build a clinical tool that would enable remote monitoring of these patients by volunteer doctors, and one which would be intuitive and widely accessible so that patients could self-report their vitals without needing too much additional training," Koh explained.

For migrants living in the six dorms where SGDormBot is used, testing positive for COVID-19 means they will first be prompted by NUHS medical personnel to use the bot, which is operated through a WhatsApp business account, making it easy for them to set communications in their preferred language. A few doctors keep up with conditions in each dorm, and they receive alerts through SGDormBot whenever someone logs vitals from thermometers and oxygen monitors that suggest their condition is worsening. This functions as a flag that calls for medical intervention, which starts with a WhatsApp video call, and may escalate to a hospital visit for an in-person review.

Koh said the pilot for SGDormBot started in late April, and the project has recorded 90% compliance for two reports per day by users. To keep the project going, the Temasek Foundation has given the team behind SGDormBot a grant to improve its functionality. Based on data generated from SGDormBot, Koh believes that AI clinical assistants have the ability to empower both doctors and patients. "Our experience in launching SGDormBot has shown us that what we have created has tremendous potential to be expanded into other areas of clinical and home-based monitoring, so we are excited about this," Koh said.

https://kr-asia.com

AI platform to combat infectious diseases

Professor Dean Ho from the National University of Singapore (NUS) led a multidisciplinary team of researchers to come up with a pioneering artificial intelligence (AI) platform known as "IDentif.AI" (Identifying Infectious Disease Combination Therapy with Artificial Intelligence) to dramatically increase the efficiency of the development of treatment for COVID-19. Their results were published in *Advanced Therapeutics* on 16 April 2020.

To avoid the drawbacks of traditional drug combination therapy development, Prof Ho and his team, together with collaborators from Shanghai Jiao Tong University harnessed the processing power of AI. The research team carefully selected 12 drugs which are viable candidates for treating an infection in lung cells caused by the vesicular stomatitis virus (VSV). They then used IDentif.AI to markedly reduce the number of experiments needed to interrogate the full range of combinations and optimal dosages of these 12 drugs. "Using IDentif.AI, we took three days to identify multiple optimal drug regimens out of billions of possible combinations that reduced the VSV infection to 1.5 per cent with no apparent adverse impact. This speed and accuracy in discovering new drug combination therapies is completely unprecedented," said Prof Ho.

Importantly, the team saw that when the top-ranked drug combination was optimally dosed, it was seven times more effective compared to suboptimal doses. This shows the critical importance of ideal drug and dose identification. Similarly, when a single drug was substituted out from the top-ranked drug combination,

and this new combination was administered at suboptimal doses, the combination was 14 times less effective.

"There is a notion in drug discovery that if you discover the right molecule, the work is done. Our results with IDentif.AI prove that it is critically important to think about how the drug is developed into a combination and subsequently administered. How do you combine it with the right drugs? How do you dose this drug properly? Answering these questions can dramatically increase efficacy at the clinical stage of drug development," shared Prof Ho.

In addition to validating IDentif.AI, this study also included insights by a team of experts in operations research and healthcare economics from NUS Business School and KPMG Global Health and Life Sciences Centre of Excellence, as well as global health security and surveillance experts from EpiPointe LLC and MRIGlobal. They concluded that strategies such as IDentif.AI, which can rapidly optimize drug repurposing under austere economic conditions amidst pandemics, could play a key role in improving patient outcomes compared to standard approaches.

https://www.biospectrumasia.com

NORTH AMERICA

USA

Machine learning to design COVID-19 vaccine

Scientists at Massachusetts Institute of Technology unveiled a machine learning approach that can predict the probability that a particular vaccine design will reach a certain proportion of the population. That doesn't mean they can guarantee its effectiveness, but the scientists' work can aid in knowing up-front whether a given vaccine will have large gaps in who it can help. The MIT scholars have used their approach to design a novel COVID-19 vaccine on the computer that has far better coverage than many of the designs that have been published in the literature this year. They're now testing the design in animals.

Vaccines in development were not the direct subject of the work. Most of those vaccines are closed designs; no one knows exactly how they are composed. Instead, Gifford and colleagues designed vaccines from scratch, and then analyzed how effective they are, and extrapolated the findings to a group of vaccines whose composition is known. Based on that, one can infer there might be problems with vaccines whose exact composition is not known. The work shows the ability of large computer models to dramatically speed up the initial work of searching through many, many possible combinations within a universe of possible ingredients, a search that can itself take years at the front end of a drug development pipeline.

The present work, titled, "Computationally Optimized SARS-CoV-2 MHC Class I and II Vaccine Formulations Predicted to Target Human Haplotype Distributions," *is published in Cell Systems*, an imprint of Cell Press, part of Elsevier. The team built a program that designs a vaccine based on two different criteria, the intersection of which is a combinatorial problem.

The first criterion is whether parts of a virus bind to proteins on the surface of a human cell. The bits of virus, which are short strings of perhaps 8 to 25 amino acids, are known as peptides. The human proteins are what are known as surface cell receptors. When an invading organism enters the body, such as a virus, some of the peptides of that organism fit into a groove in the surface cell receptor. The surface cell receptor then presents that peptide to the body's T cells as a signal of the invasion. The T cells begin a process of killing off such infected cells. That's how natural human immunity works.

But humans need help sometimes, they need to be primed to respond, and that's what vaccines do. Vaccines duplicate this natural immune process before someone is infected, to get the body prepped to generate a T-cell response. To figure out which peptides will fit in the groove of surface cell receptors is a matching problem on a large scale: which of thousands of peptides go with thousands of variants of different surface cell receptors the body can produce.

The second part of the problem is asking which people in the population have the combination of alleles, genetic variants of the surface cell receptor, that will work with a certain group of peptides. It's a matter of finding the lowest common denominator in the matching search, which peptide–receptor combinations are common among the greatest number of individuals.

https://www.zdnet.com

Artificial Intelligence to address COVID-19

Two newly repositioned drugs with the potential to combat key symptoms of COVID-19 were announced today by Biovista an AI-driven bioscience firm that has been successfully repositioning drugs for over a decade. Biovista identified *Cablivi* and *Atozet* as particularly suited to target specific aspects of blood clotting and inflammation in the context of COVID-19. This follows the strong mechanistic rationale Biovista released in March, suggesting *Aprotinin* and *Irbesartan* as potential COVID-19 treatments to reduce the effects of the cytokine storm as well as helping reduce viral loads.

"We continue to focus on possible solutions for key complications, or sequelae, of COVID-19," said Dr. Aris Persidis, president and co-founder of Biovista. "With our latest rolling drug repositioning update, we address the micro-blood clots in the lungs and hearts of COVID-19 patients that can have devastating consequences, and suggest treatments."

Biovista's AI platform, Project Prodigy, maps all known drugs against every possible mechanism in which the COVID-19 virus operates and causes complications. "Our workflow is unique in terms of its massive coverage," said Dr. Eftychia Lekka, senior investigator, drug discovery for Biovista. "We will continue to update and share possible therapies with the world until effective treatments are found and developed." Treating COVID-19 has been especially difficult because it causes multiple complications that affect nearly every organ system in the body—from muscles and fibromyalgia, to kidney and pancreatic function, to cardiopulmonary issues, hyper-inflammation, and even neurological issues.

https://www.biospace.com

DIGITAL INNOVATIONS FOR COVID-19 MANAGEMENT

PRESENT APPLICATIONS, GAPS AND FUTURE STRATEGIES

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Abstract

Digital technology innovations in tracing, tracking, targeting, trending, tele mediating (health) and transporting services in "real time or near real time" combined with existing knowledge of past pandemic management are leading COVID-19 containment efforts across several countries. Another uniqueness is the emergence of "digital first" applications compared to "digital support". Integration of digital technology in public health management processes are enabling governments to fast track and successfully provide coordinated containment of COVID 19. Challenges in this digital model are the exclusion of population who are not accessible by digital platform and regulatory short cuts taken towards fast tracking services. As countries are being forced to chart localized and innovative containment strategies, Asia Pacific countries should value their diversity and enabling create local innovation and regulatory platforms.

Introduction

The 20th and 21st century have so far witnessed five pandemics: (1) the Spanish Flu of 1918; (2) the Asian Flu of 1957; (3) the Hong Kong Flu of 1968; (4) the Swine Flu of 2009 and (5) currently the COVID-19 of 2020 (https://www.euro.who.int).

Health care is an applied science and all around technology advances usually trickle down slowly towards health care. However hyper critical situations like pandemics open the flood gates for relevant technology advances to be fast-tracked and applied for the benefit of the society. Learning from previous pandemics combined with current advances in technologies have resulted in vastly improved tracing, tracking, targeting, trending, tele mediating (health) and transporting services in "real time or near real time". Another uniqueness of COVID-19 management is the emergence of "digital first" applications compared to "digital support". In simpler terms, digital technology is at the fore front of globally coordinated and locally executed COVID- 19 management and without digital technology, we have reached a point, where we need to acknowledge that such a response is simply not possible. This paper tries to collate: (1) presently in use digital technological innovations; (2) identify gaps that need to be addressed and; (3) relevant strategies in the Asia- Pacific ecosystem.

Tracing, tracking, targeting

Several countries governments have integrated digital technology in to their public health management processes to enable coordinated containment and mitigation process. Precise daily reports, some with even location of affected people are being published online combined with next day, next week or next month guidance.

China, is using an extensive collection of digital tools like migration maps, mobile phone tracking, payment applications enabled by mobiles, postings on social media, citizen awareness applications to trace and track the location and activities of people at population scale. Data from these applications are then fed in to big data and artificial intelligence (AI) algorithms to provide targeted interventions at individual level in real time and direct them to appropriate resources. Intervention in real time or near real time has become the hall mark of Chinese COVID-19 containment (https://www.thelancet.com).

Similarly, the Republic of Korea is also using an extensive collection of granular real time data collection tools like financial transactions, facial recognition of security camera footage from traffic rich areas, global positioning system (GPS) data from vehicles and mobile phones to source population scale details. Post processing by big data or artificial intelligence algorithms the Republic of Korean citizens receive real time location specific text alerts about COVID-19 case incidence or new cases, prevalence or existing cases, disease status of people they have come in contact with as part of their daily lives and if contact was identified, further directions on self-screening, isolation and reporting to test-centres for further evaluation.

The city state of Singapore has directed its citizens to use a mobile phone application that tags other nearby mobiles in real time continuously and stores these interactions for the next twenty one days. If the person is tested positive for COVID-19 the ministry of health downloads the data to identify tagged contacts and guide then for testing. Population scale temperature measurement is also deployed at all public spaces and mass use private spaces like work places, public transport, schools, etc… The information from the thermometers is analysed using big data or AI algorithms to precisely identify emerging infection clusters and provide testing guidance to individuals.[2]

Government of India's COVID- 19 containment application has been downloaded by 156 million smart phone users and this has led to identifying 8.5 million contact traces. Out of these 1.5 million have been tested and more than 400,000 were found to be positive and quarantined or treated thereafter. Several infection clusters were

identifies and micro containment sites were set up by field level contracting staff. However unlike other countries the downloading of the app is optional and compared to 1.3 billion population the percentage coverage of the app is very limited to be effective at population scale (https://economictimes.indiatimes.com).

Trending

Trending is a popular name given for enhanced usage or enhanced presence on Social media. As wide spread lock down, containment and quarantine was enforced globally with limited advance notice, several people were caught off guard with regard to their regular work and social lives. Digital platforms like Facebook, Snapchat, Twitter, Zoom took an entirely new meaning in the lives of people as these became part of mainstream everyday life. Meetings with work colleagues, chatting with family, friends, even neighbours, entertainment in times of no outdoor mobility, information channel to know what is happening in the outside world… all were bundled in to the social media platforms. In some ways social media platforms provided a ring side real time view to whatever, whoever, whenever we want to communicate with (https://reutersinstitute.politics.ox.ac.uk; https://theaseanpost.com). People lives started trending.

As our understanding of COVID-19 is limited and is evolving, trending social media platforms have become the primary source of information to several people. With government led restrictions on information sharing enforced over traditional media, their legitimacy is being constrained. People increasingly are alternate creating peer networks and virtual support systems for COVID-19 information exchange. Although traditional media may have expert knowledge and clear pathway with regard to information validation and sharing, the social media networks are increasingly seen as believable sources of information. These platforms are also gaining advantage as a means to share regional or localised information. People affected by lockdowns and movement restrictions are keen to know the status of life in their immediate setting. Unfortunately traditional information sources neither have the mandate nor the means to provide such granular level of information (https://www.nature.com).

Tele mediating (health)

COVID-19 has overwhelmed the health systems. Also COVID-19 patients are seen as a source of potential infection to existing users of health system services. The role of Telemedicine has been greatly expanded to provide a management platform for COVID-19 and other conditions even before they reach the health facilities. Screening, triage and remote monitoring is extensively being made available by government and private health systems and are finding favour with people as well (https://government.economictimes.indiatimes.com).

On March 2020,Government of India rolled out the first set of guidelines for telemedicine services. The guidelines acknowledge the use of all digital channels of communications including voice, audio, test and other means of information exchange. Previous restrictions on the need for first in person consultation was also removed and prescribing medicines was allowed. Subsequently a digital platform "eSanjeevani" was also deployed across 23 states, covering 75% of India's 1.3 billion population. Within 6 months of launch this platform has logged in 300,000 tele consultations. Existing digital health aggregator and scheduling service platforms saw growth of over 100% week-on-week.

Thailand launched the "new normal" telemedicine model services. This was first rolled out in the Pattani province and expanded nationally. All patients with any disease are classified based on traffic signal model – red, green and yellow. Based on the classification majority are provided tele medicine based home case with necessary medicines and other support being provided by village health volunteers (https://www.who.int).

In Vietnam chatbot based screening was implemented, followed by telemedicine based consultation and further evaluation. Anonymised information about COVID-19 patients movements were published to facilitate others to correlate with their movement and seek telemedicine consult.

Transporting

COVID-19 pandemic management has seen the emergence of novel drone based several services (https://www.weforum.org). With time playing a critical factor in response, Effective situational awareness has been achieved with drone based services like spraying disinfectants, over the air crowd managemnet, and test sample transportation. With traditional transportation methods under restriction, drones have been used to transport protective equipment and biological samples for esting in a limited way. In comparison to ground level transport drones offer significantly increased time efficiency to the order of 50 percent or more. Situations like COVID-19 where available health care staff are managing multiple services, any savinngs on time is seen as a force multiplier. Drone based transport has the advantage of minimising secondary contamination by reducing the number of trasport intermediaries.

China has deployed a huge fleet of drones for disinfecting public spaces and pandemic support vehicles travelling between deliveries. These drones were previously designed for spraying chemicals for agricultural use.

In the Republic of Korea drones were even use to show inspirational messages in the sky. About three hundred drones were programmed to form coordinated messages over the night skies of Seoul as a spectacular showcase of motivational messages.

Mumbai, India, one of the worst affected cities by the COVID-19 pandemic required strict planning and monitoring of the situation due to the growing spread of the virus.Owing to the large migrant population, extensive technological support was requied. The National Drone Rapid Response Force (NDRRF) constituted by the Drone Federation of India (DFI) developed customised drone centric solutions. Drones were used to monitor the market area and determine approximate

distances that individuals would have to maintain for minimal community exposure. Based on drone visuals, chalk markings were made on ground to position both vendors and buyers thereby reducing physical distance between people. For a more frequent form of surveillance, the DFI crowd sourced drone pilots across areas who would report procedural breaches to the local command and control centre. To handle the migrant worker crisis, on ground drone teams were deployed to support the local police in dispersing crowds and seating travellers in trains.

Identification of gaps

There are two clear gaps in the majority of the new technologies that are being used currently for COVID-19 containment. One is the need to fully validate the efficacy of these technologies and second is the create supportive regulatory and redressal mechanisms.

Tracking, tracing and targeting has several challenges and issues. The success of this model depends on the fact that most citizens possess a smart phone. Studies suggest that for this model to be successful atleast 60% of the population should be covered by this model. In several countries this is not the case. This is more likely in countries like South Korea and less likely in countries like India or Cambodia. This creates a service asymmetry where literate and economically progressive countries or sections of population with in a country benefits from digital strategies and the rest do not find favour. Even when identified by the tracing applications, not all contacts need isolation or quarantine as they could have used protective clothing or any other means. Unfortunately this information is not captured by the programs.

On trending social media there is limited distinction between verified and mis information as both share the same space. Several unverified COVID-19 possibilities have been floated and shared on social media. The overwhelming nature of these information means it is extremely challenging to verify all information sources. Repeated exposure to mis information has been known to spread panic and even mental stress. Several countries have responded by imposing fines or even internet shut down in some extreme cases. Almost all the services mediated by drones including spraying of disinfectants, aerial announcement, aerial temperature measurement, aerial surveys, transport of medical products have been labelled as either in effective or un sustainable or both. The efficacy of telemedicine is yet to be proven for several services.

Several countries fast tracked the new technology based services for COVID-19 containment under special provisions of Epidemic or disaster management acts. These regulations provide extra ordinary decision making powers and infringes on individual rights and freedom. Although they may be necessary to fast track new technology adoption they should be used as a short cut to skip on necessary validation studies.

Strategies in the Asia- Pacific ecosystem

Every crisis is also an opportunity. For long, our investment in health systems and services has been less than adequate; this is widely acknowledged and duly reflected in the constrained support ecosystem. Thoroughness of regulatory approvals are a feature or health care service industry and they are very justifiable as health care directly relates to life and death. Also, for long, we have also not been original thought leaders or action leaders in designing, prototyping, testing, trialing, manufacturing the service ecosystem that is required for efficient and effective delivery of health systems. It does seem that the process of regulatory approvals has become globally centralized and we are caught in a warp of following other countries regulations when we need to understand our requirements and support our solutions. Countries and regions within countries are being forced to chart their containment strategies.

To contain COVID 19 effectively, we need to reinvent and move rapidly forward in three areas: (1) setting up of regional rapid information sharing platforms; (2) skill development for locally focused rapid requirements analysis of current situation and drafting specifications of potential solutions; (3) creating local platform for rapid regulatory approvals with necessary oversight for rapid deployment and iterative redevelopment. Beyond existing traditional regulatory or certification agencies, appropriate localized academic, research and innovation centers who are in the forefront of multi-disciplinary innovation should be made part of the validation and regulatory platform.

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The Fourth Industrial Revolution

A NEW ENDLESS FRONTIER

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Abstract

Just as World War II ushered in a new era reset on the foundations of science and innovation, COVID-19 has opened up new potentials to transform the world based on the Fourth Industrial Revolution (4IR). The ability to make most of the new technological potentials will be critical to build robust, sustainable, inclusive, and competitive economies in the 21st century. We propose that the realization of technological potentials for prosperity and sustainability in the post-COVID-19 era calls for the 4IR New Deal, a system-wide transformation of national economies based on 4IR technologies. Underpinning the New Deal should be principles of social protection and responsible development of 4IR technologies. Specific forms and content of the 4IR New Deal will be different depending on the level of digital readiness and priorities of each country. Yet without one, virtually no country will be able to navigate the post-COVID-19 era, which is projected to become the "hybridtact" age where the best of contact and non-contact or online and offline services are combined to provide the best life experience of the humanity.

COVID-19 and the Fourth Industrial Revolution (4IR)

In response to the 1930s Great Depression, the US enacted the New Deal to reset the country's economy through revitalization, civil works, industries, agriculture, and social protection for the unemployed, which paved a path to recharging the US economy. Across the Atlantic, the Great Depression brought the rise of Adolf Hitler whose expansionist policies led to World War II. Following World War II, the US came up with "Science the Endless Frontier"[1] to reset its postwar economy through science and innovation, which, in turn, gave birth to the Third Industrial Revolution.

Currently, the world is fighting a war against the COVID-19 pandemic, which has drawn parallels to World War II and the Great Depression. In mere seven months, the deadly coronavirus has infected about 25 million people, killed more than 840 thousand of them worldwide[2], triggered a global recession[3], and laid bare the economic inequalities across the world across countries. Worse still, for the first time in history, the world came to a standstill and 290 million students were out of school due to COVID-19[4]; the list of woes is endless.

However, something else is happening. Just as World War II dawned the age of science and technology, COVID-19 has triggered a great pivot towards the age of the Fourth Industrial Revolution (4IR). For example, even as manufacturing, transportation, tourism, and economic pillars have come to a grinding halt, the 4IR innovations have been thrust forward to keep the whole machinery that moves the world economy running–from keeping supply chains open, ensuring that people and businesses stay connected, creating apps that are keeping us safe, accelerating drug discovery, and developing vaccines.

The scale, speed, and diversity by which the 4IR innovations are shaping our world are unprecedented in human history, with its impact likely to reverberate for decades to come (Schwab, 2016). Since COVID-19 is triggering the age of the 4IR, the two most important questions facing the world today are: How do we get vaccines and therapeutics to beat the deadly pandemic, and in the near term, how do we rebuild and reset an inclusive and sustainable world in the post-COVID-19 era?

In this article, we propose that the world, especially developing countries, requires a 4IR "New Deal," which we define as programs to forge a new path for inclusive and sustainable economies built on the core foundations of the 4IR technologies. Countries cannot achieve inclusive growth powered by the 4IR by wishful thinking; it requires massive investments in the 4IR-powered growth including high-speed broadband networks, renewable power infrastructures, green economies,

[1] See Vannevar Bush, "Science The Endless Frontier" (July, 1945), https://www.nsf.gov/od/lpa/nsf50/vbush1945.htm.

[2] See Johns Hopkins University Coronavirus Resource Center, https://coronavirus.jhu.edu/map.html.

[3] "COVID-19 to Plunge Global Economy into Worst Recession since World War II". See World Bank (June, 2020), https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii.

[4] "290 million students out of school due to COVID-19". See UNESCO (April, 2020), https://en.unesco.org/news/290-million-students-out-school-due-covid-19-unesco-releases-first-global-numbers-and-mobilizes

economy-wide digital reform programs, and large-scale social security programs. Without a 4IR New Deal, it is hard to imagine how countries can avoid the emerging inequalities and inequities triggered by COVID-19 intertwined with the 4IR. We base our proposal on three fundamental premises as follows.

First, COVID-19 has brought to the fore the role of the 4IR technologies as new potential pillars of human progress. Incessant innovations enabled by the assemblage of the 4IR technologies – such as artificial intelligence (AI), big data, 3D printing, robotics, blockchain, biotechnology, nanotechnology, and more importantly their fusion/hybrid technologies – hold transformational power the world is yet to fathom (Schwab, 2016). However, a "continental drift" defined by the adoption of 4IR is emerging in which one world (comprising digital haves) has been turbocharged ahead while the other (digital-have-nots) remains in massive inequity, economic chaos, and ruin. For example, universities and schools are fast-switching to online mode in advanced countries. Hospitals and healthcare systems are increasingly reliant on the power of AI, telemedicine, and digital innovations in those countries.[5] In contrast, emerging countries are scrambling to cope with both the pandemic and existing diseases. Finally, firms of advanced countries powered by digital innovations are forging new paths such as "work from home" and greener economies, while others, especially in developing countries, are on the brink of collapse. In short, as the divide is manifesting in every sector, every state, and across countries, a 4IR new deal will need to ensure that the rising 4IR lifts all boats[6].

Secondly, virtually every sector has gone online due to COVID-19 and the 4IR. Activities and services that were unthinkable to perform online are now becoming a reality, which has been coined "untact" or "ontact" in the Republic of Korea. The true reality is that the proper utilization of 4IR technologies will enable a "hybridtact" economy where the best of contact and non-contact services will be combined to propel technological and social innovations in the near future.

For example, virtual and augmented reality can be used to bring quasi-real experience to online teaching or training. Similarly, new healthcare systems are being powered by mobile innovations such as telemedicine[7], advanced sensors, AI, and drones, which, when combined with traditional expertise of healthcare personnel, will not only overcome the present limitations in disease detection, control, and management but enable access to inclusive models of healthcare delivery. Moreover, applications from precision medicine are on the verge of revolutionizing the treatment of rare diseases[8].

This "hybridtact" transformation presents unparalleled leapfrogging opportunities to inclusive economies in emerging countries by strengthening the digital cords that interlink the global economy. For instance, new models of education deliveries, such as Massive Open Online Courses (MOOCs), present the education sector in developing countries with opportunities to leapfrog the traditional, costly models that privileged the rich. In the agriculture and small-and-medium sized enterprise (SME) sectors, farmers and businesses leveraging the power of digital finance tools including FinTech, and blockchain will be able to plug into global supply chain systems to sell their products and services across oceans. In short, the opportunities for leapfrogging are plenty and are open to all countries globally.

Thirdly, the COVID-19 pandemic has triggered mass unemployment (ILO, 2020), which arrives at a time when jobs and economies are undergoing rapid digital transformations. For example, McKinsey's 2018 report on the future of work and Oxford Studies report on AI and the future of employment and other high profile studies (Acemoglu & Restrepo, 2019, 2020) have consistently suggested the imminent challenges to jobs and economies due to digital transformation. In developing countries, the studies paint an even bleaker picture, including premature de-industrialization (Rodrik, 2016). Due to COVID-19, 190 million people are out of jobs according to a recent UN report. Another 1.9 billion jobs in the informal sector are under threat (ILO, 2020). These jobs are most likely not returning due to increased automation and robotics (Martin, 2015), especially as countries are shifting to the 4IR-oriented jobs. However, such transformation implies that states will create new and better jobs, workers will have flexible working schedules, and families working from home will spend more time together. By working towards "a 4IR New Deal" with a focus on reskilling and revamping education systems and providing adequate social protection for the unemployed and those adversely affected by the 4IR transformations, countries will be able to avert the simmering unemployment crisis.

The 4IR is not a panacea for all problems that plague our societies. Yet, without making the 4IR the core to economic and social transformation, other alternatives cannot guarantee new jobs, better health, education outcomes, and national security in the future. Many wealthy countries foresaw the 4IR, introducing various digital initiatives. Germany and Japan have introduced Industry 4.0, automating industrial production. In the Republic of Korea, the "Digital New Deal" is taking shape to power

[5] "Artificial Intelligence and Digital Transformation: early lessons from the COVID-19 crisis", See EU report 2020, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC121305/covidai_jrc_science_for_policy_report_final_20200720.pdf.

[6] "Digital Divide 'a Matter of Life and Death' amid COVID-19 Crisis, Secretary-General Warns Virtual Meeting, Stressing Universal Connectivity Key for Health, Development", See https://www.un.org/press/en/2020/sgsm20118.doc.htm.

[7] Cornelius Kalenzi, "Telemedicine can be a COVID-19 game-changer. Here's how," (May, 13, 2020), https://www.weforum.org/agenda/2020/05/telemedicine-covid-19-game-changer/.

[8] "Leapfrogging with Precision Medicine". See World Economic Forum (2019) https://www.weforum.org/projects/leapfrogging-with-precision-medicine.

the new economy. In contrast, the 4IR has remained on the sidelines of national agendas in most emerging countries.

The 4IR and the role of the government

Governments have traditionally played a path-breaking role in creating science-based economic potentials. For instance, the US established the National Science Foundation (NSF), an institution that played a leading role in funding scientific and innovation research and development. Specifically, the NSF played a leading role in funding and pioneering research, such as the internet[9], supercomputing and semiconductors (Brandt, 1991), which led to the Third Industrial Revolution. While the role of the government diminished as industries took over, the digital revolution led us to the new frontiers of the Fourth Industrial Revolution. By embracing the original responsibilities of pathbreakers, governments will open new possibilities of the 4IR.

Even before COVID-19, many governments recognized the potential of the 4IR as an economic growth engine and established digital innovation policies. These include coherent strategies and significant investments in digital innovation development and promotion, which often converge to four primary areas: adoption and diffusion of 4IR technologies, strategies for collaborative innovation, research and innovation, and digital entrepreneurship. Governmental initiatives for the 4IR technologies vary between countries depending on the relationship of the government and the market.

To illustrate, the governments of countries such as China, the Republic of Korea, Singapore, and Japan view it as their responsibility to play a substantial role in promoting the 4IR innovations to correct for market failures such as capability and resource failures and to solve for inadequate national AI capabilities and knowledge base for adoption and application of new technologies (OECD, 2019).

The Republic of Korean government recently committed 58 trillion Won (about 49 billion US$) under the Digital New Deal initiative for advancing the 4IR economy[10], including via initiatives to scale 5G networks, AI, semi-conductors, and data dams. Singapore has established a plan to reset its post-corona economy on the foundations of the 4IR mega projects such as 5G, smart nation, digitalizing government, and reforming education. In Germany, the federal government has committed €3 billion for AI research and 4IR innovations[11]. Similarly, the French government unveiled a plan to invest € 1.5 billion in AI innovation[12]. In Europe, the Digital Europe Program for AI is investing €1.5billion for development, testing, and experimentation with 4IR innovations. Other countries, including the UK[13] and Japan, are pursing similar economic resets.

Other countries, such as the US and China, have left the role of shaping the 4IR mainly to BigTech companies and private sector investors. Nonetheless, they are channeling public funds to companies, albeit in different forms. In the US, AI innovations such as smart assistants/speakers (Apple Siri, Amazon Echo) were funded by public research grants. In addition, large-scale projects may leverage the Pentagon $10 billion funding. In contrast, China has a strong government and BigTech relationship as to the 4IR technology and industry development. The government provides innovation funds for R&D to companies, unlocks public data, and promotes large-scale 4IR projects such as smart cities, nationwide facial recognition, and 5G infrastructure projects through procurement programs. China also uses trade diplomacy and government programs such as the One Belt One Road to enable the 4IR companies such as Huawei and 5G to access global markets (Hemmings, 2020).

Despite the above policy and strategic initiatives to promote the 4IR innovations across the board, 4IR policies and actions have remained peripheral to economic plans in the pre COVID-19 era. The majority of the countries, especially in the developing world, had no coherent economy-wide policies for digital transformation.

However, COVID-19 has brought digital transformation to the forefront of every sector of societies. Within rich countries, the divide between the digital haves and digital have-nots has become wider. Across countries, some are using digital "Key "to ensure that educational opportunities, healthcare, and work remain open. In contrast, doors to similar opportunities are being shut in countries that lack digital capabilities. Therefore, it will be detrimental to any country, rich or poor, if digital transformation and the 4IR remain on the fringes of its national economic agendas.

The 4IR governance issues

Before COVID-19, many countries were exploring policies and governance frameworks to guard against the risks that the 4IR technologies posed to the public. These efforts ranged from wait-and-see approaches to strong and comprehensive approaches, such as Europe's General Data Protection Regulation (GDPR), 2018 California Consumer Privacy Act (CCPA) widely viewed as the "GDPR of the US," Singapore's

[9] See National Science Foundation (NSF), A Brief History of NSF and the Internet" (August, 2013), https://www.nsf.gov/news/news_summ.jsp?cntn_id=103050.

[10] Ministry of Economy and Finance. *Government Announces Overview of Korean New Deal* (July.14, 2020), http://english.moef.go.kr/pc/selectTbPressCenterDtl.do?boardCd=N0001&seq=4940.

[11] See public announcement by Federal Ministry for Economic Affairs and Energy, "Federal Government gives €500 million boost to funding for artificial intelligence", May. 23, 2019, https://www.bmwi.de/Redaktion/EN/Pressemitteilungen/2019/20190523-federal-government-gives-500-million-boost-to-funding-for-artificial-intelligence.html.

[12] Nicholas Vinocur, "Macron's €1.5 billion plan to drag France into the age of artificial intelligence", March. 27, 2018, Macron's €1.5 billion plan to drag France into the age of artificial intelligence, https://www.politico.eu/article/macron-aims-to-drag-france-into-the-age-of-artificial-intelligence/.

[13] Gov.uk, "AI Sector Deal policy paper", May. 21, 2019, https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal.

anti-fake news law, and extreme cases of the outright banning of AI-powered technologies. These extreme cases include San Francisco's banning of AI-powered facial recognition technologies, the de-licensing of Uber in London, the Republic of Korea's pseudo ban on the AI-powered taxi-hailing service Tada, and France's digital taxes.

As to AI governance, there are the recently adopted OECD and G20 AI principles, and national-level platforms such as the UK's Center for Data Ethics and Innovation, AI and blockchain watch towers in Europe, Sweden's Committee for Technological Innovation and Ethics, and numerous national technology advisory councils. Some countries, such as Singapore, have adopted a mixed approach combining stringent regulation (e.g., Singapore's anti-fake news law targeting AI-powered media products) with a soft approach (such as a non-binding digital governance framework).

Another emerging trend is that of the regulatory sandbox, a system that allows the market to experiment with emerging technology innovations without being hindered by regulatory burdens. Countries such as the UK and the Republic of Korea use a varying mixture of sandboxes and a comprehensive regime to guide the growth of AI technologies.

However, in most countries, the question of whether to adopt a comprehensive or limited regulatory approach is not on the agenda. Thus, predominantly, there is a wait-and-see approach to the governance of emerging technologies.

The 4IR and social protection

The unprecedented power of the 4IR has resulted in an ongoing debate to build inclusive economies powered by 4IR while also mitigating the negative impact and threats that these technologies pose to humanity such as massive unemployment, economic inequality, and social upheavals.

A handful of governments are taking proactive steps to limit the negative impacts of the 4IR technologies. One critical area in this regard is adequate social protection. The existing social protection system is rooted in the old industrial structure of manufacturing and workers' unions that sometimes worked in uneasy but okay relations to protect workers. Today, as jobs are largely disappearing in rich countries and developing countries are experiencing premature de-industrialization, governments need to make social protection as part of the 4IR "New Deal." Without adequate social safety nets, inequality will get out hand and might cause social unrest, as recently seen in the US, Lebanon, Belarus, Europe, Thailand, or Mali.

The 4IR to fight pandemics

Even as scientists are racing to develop vaccines and therapeutics for the ravaging coronavirus, the fight against the pandemic has inspired the explosive growth of new 4IR technologies, which are rapidly becoming essential secondary weapons to fight pandemics. For instance, AI systems were the first to sound an alarm of the rising epidemic of "pneumonia" in China in 2019, months before the global outbreak of coronavirus. Since then, AI has become central to fighting the pandemic, from disease detection applications including early warning and diagnosis to prevention tools for predicting a person at risk, real-time surveillance and personalized broadcasts to inform people of outbreak locations, and operationalizing response. For example, AI-powered drones are delivering critical resources to hospitals and AI chatbots are transforming self-diagnosis through triage; to recovery tools that remotely monitor patients (OECD, 2020). AI is also used to discover drugs that work as well as to fast-track the development of vaccines.

The explosive growth of AI and digital innovations during this pandemic is thanks to the decades of investment in research and entrepreneurship. Without a doubt, the new tools are playing even more significant roles in helping the world beat the pandemic. Making them mainstream in the future fight against pandemics and diseases will require bold policies, 4IR investment strategies, and social and institutional transformations.

Relatedly, digital innovations, such as telehealth, that are at the forefront of the fight against the COVID-19 pandemic are now on the brink of transforming healthcare delivery systems (Wosik et al., 2020). For example, by complementing traditional hospital infrastructures with digital innovations, telemedicine and mobile healthcare systems can provide high quality and much more convenient healthcare services to patients, without the need for the physical contact of the patient and the doctor.[14]

The torrent of digital innovations used now to combat COVID-19 will play significant roles in combating other pandemics and diseases in the future. For example, applications of digital innovations integrated with medical and biotechnological advances in detection, disease surveillance, and treatment can help in controlling and managing outbreaks of other deadly infectious diseases such as malaria, dengue fever, tuberculosis, and more worrisome 'Disease X' (defined as a hypothetical pathogen that could cause a future epidemic/pandemic by WHO). Lessons learned in applying AI and 4IR technologies to develop vaccines and drugs to develop vaccines and drugs can be used to find the best treatments for deadly diseases such as AIDS. In short, COVID-19 has brought us to the tipping point to transform every stage of the disease chain—detection, prevention, treatment, and recovery. Nonetheless, progress depends not only on science but also on combining science with digital innovations to propel such a system forward.

[14] Cornelius Kalenzi & Mekuria Haile. It's time for a great reset of Africa's e-health systems. Here's how (July. 17, 2020), https://www.weforum.org/agenda/2020/07/great-reset-africas-e-health-systems/.

Caveats for using 4IR technologies to fight pandemics

Despite the potentials of the 4IR technologies to transform how we detect, control, and treat diseases, there exist several challenges in utilizing them to fight pandemics. For example, AI applications in healthcare are useful only when algorithms are fed with reliable data. Furthermore, deploying such tools raises critical issues of liability, for example, whether AI can legally be held responsible in case of errors. These ethical issues, along with privacy and data protection questions, are yet to be resolved in almost all jurisdictions. Moreover, since data has become the new fuel for our economies, there is a frenzy of on-going national programs to limit cross-border data sharing, for example, the EU court ruling barring the sharing of European data with the US[15]. Such adverse developments, if not resolved through a bilateral and multilateral 4IR "New Deal," are likely to impede further progress of AI and 4IR innovations in healthcare and other domains.

Besides, even as digital and AI applications in healthcare delivery are at the frontlines of the COVID-19 battle, governments and other stakeholders in the post COVID-19 era have to overcome several barriers to scale these applications beyond the present crisis. These barriers include technology inertia and resistance to the 4IR innovations, especially by established healthcare systems, the need to revise and fix reimbursement rules as the existing rules are designed for traditional systems, regulatory and data-sharing issues, and massive funding of hospitals to upgrade them to hospital 4.0 including doctors and patient training. In short, the social and economic environments require a "New Deal" and social transformation to make it a reality.

The 4IR and geopolitical security struggles

Even as COVI9-19 rages on, another war, which mirrors the space race and cold war era, is emerging between the US and China over perceived 4IR technology advantages and cybersecurity. Many countries, BigTech companies, SMEs supplying chips, developers, and billions of consumers, are caught up in the 4IR-hegemonic struggle between these two superpowers. The on-going fight over AI-powered TikTok and WeChat applications is threatening to break up[16] the Internet as countries try to build barricades on global communication highways that millions of consumers and businesses depend on for their day-to-day activities.

Besides, the fight over 5G technologies because of cybersecurity threats has trapped countries and consumers in Europe in a war with no end in sight. As countries including the UK, Australia, and New Zealand ban Huawei and ZTE from implementing 5G networks, consumers and businesses will have to wait indefinitely to enjoy the speed and new economies powered by this technology. On the business front, BigTech firms and small firms that supply middleware and hardware that power these technologies are on the brink of collapse.

Moreover, while rich countries like Canada and Germany have the muscles not to be "bullied" to take sides over 5G technologies, other nations that wish to implement these technologies to power their economies will face severe geopolitical challenges and national security risks. For instance, the ability to install 5G networks and developing AI capabilities are the differentiating factors between those economies that will build competitive and sustainable economies through the Internet of Things and smart manufacturing, and those that will remain on lower ranks of global value chains.

In short, the 4IR technologies including AI and 5G may be likely to trigger a global technological race of the similar proportion as that of the nuclear arms race during the Cold War era. The 4IR goes beyond the current national digital policies to encompass foreign policy and geopolitical positioning. Within domestic economies, governments will do themselves a favor by crafting the 4IR New Deals that balance the complexities of building competitive and sustainable economies, while at the same time safeguarding consumers and businesses from "new 4IR cold war'" fallout.

At the global level, the new realities call for technology diplomacy and global cooperation akin to the Marshall Plans of the postwar era. It remains to be seen whether the existing bilateral and multilateral frameworks have the wherewithal to overcome the ongoing 4IR-hegemonic struggles.

The 4IR and public safety

AI applications, drones, and robots are increasingly used to enforce social distancing and maintaining public safety to fight COVID-19, with East Asian countries including Singapore, the Republic of Korea, and China leading the adoption of digital contact tracing in various forms. Recently, Google and Apple formed a partnership to develop AI-powered contact tracing applications, which has raised concerns with privacy and social control.

The benefits of such technologies are apparent to everyone; for example, robots and drones are complementing the scarce workforce in public safety and health departments and overcoming logistical challenges to guarantee the smooth running of public services. In the Republic of Korea, Singapore, and other countries, such tools protect both public workers and the public from exposure to coronaviruses. China, Japan, and the Republic of Korea use such AI-enabled tools for crime detection,

[15] Sam Schechner & Valentina Pop. EU's Top Court Restricts Personal-Data Transfers to U.S., Citing Surveillance Concerns (July. 16, 2020), https://www.wsj.com/articles/eus-top-court-restricts-personal-data-transfers-to-u-s-citing-surveillance-concerns-11594888385.

[16] Ana Swanson, Paul Mozur and Raymond Zhong. Trump's Attacks on TikTok and WeChat Could Further Fracture the Internet (Aug. 17, 2020), https://www.nytimes.com/2020/08/17/technology/trump-tiktok-wechat-ban.html.

crime prevention, and predictive policing reports of fall in crime rates, though with privacy risks.

The above tools will find more use in the post COVID-19 era. Even before the COVID-19 pandemic, many public agencies such as police agencies and courts of law in advanced countries were adopting the 4IR tools to enhance their work. These include automated facial recognition technologies, algorithmic risk assessment tools, and jury selection tools among hundreds of others. For instance, in the UK, London's Metropolitan Police, Leicestershire Police, South Wales, Kent, West Midlands, Avon, and Somerset use facial recognition AI for predictive policing and crime prediction. In the US, the facial recognition network covers over 117 million American adults, according to a recent report by Georgetown Law Center. Similar tools are finding their way even in developing countries such as India, Uganda, Egypt, and Rwanda, and are destined to become central to public safety and security globally.

4IR tools for public safety and security raise public fears, however, as such tools can lead to mass surveillance risking privacy, freedom of speech, and right to assembly remain unanswered. Moreover, it is unclear if existing laws and regulations cover the 4IR technologies across jurisdictions. At an application level, it remains unanswered how effective, bias-free, transparent, and accurate the 4IR technologies are. At the governance level, it is unclear how guidelines for using such tools can be established across jurisdictions to put in place the system of the authorization and supervision of deployment and monitoring of technological risk and safety assessments.

The 4IR and reimagining education delivery and reskilling the workforce

COVID-19 has led to unprecedented disruption in the education sector with close to 300 million students out of school, accelerating the transformation of education delivery across the world. In countries such as Singapore, China, the Republic of Korea, and Japan, universities, secondary schools, and elementary schools are switching to online classes. In contrast, thousands of universities and schools in the less developed countries are facing a "dead year," which is likely to extend to next year due to COVID-19 resurgences. As a result, these national failures will lead to widespread education-induced inequality, as the rich who can afford to continue education will resort to online learning while the poor will remain in a state of illiteracy. Across countries, the ability to implement a nationwide digital transformation of the education sector is becoming a differentiating factor by which some will maintain competitive and sustainable economies in the future.

The good news, however, is that the 4IR revolution has unleashed thousands of innovations, which opens up unprecedented opportunities for emerging countries to leapfrog the costly and inaccessible models of delivering education to millions of students. For example, by combining online and traditional university models, countries can now increase access to affordable and high-quality education that is currently the domain of the rich. Similarly, by connecting universities and schools to global education platforms (e.g., MOOCs), universities will enable education and build skills fit for the 21st century.

However, to realize such transformation, countries have to re-imagine their education systems on the core foundations of the 4IR technologies. This will require massive investments to revamp universities, tertiary institutions, and schools to connect them to high-speed broadband and provide access to software, and online platforms. Governments have to provide teachers and students with cheaper internet access and digital devices as well as retraining for digital skills. In short, educational transformation in non-contact environments will require institutional and regulatory reforms to meet the demands and standards of the 21st-century education system.

Besides reforming education delivery systems, countries must rethink the workforce training systems required for the 21st century workforce, as the dawning of the 4IR-driven economy requires new capabilities for digital natives. These include skills education in new 4IR technologies such as AI, machine learning, robotics, and programming, and multidisciplinary training crossing traditional fields, basic sciences, and social sciences with new skillsets. This, in turn, requires reforms of higher learning education systems.

In addition, at the national level, there is a need to set up new institutes for research and graduate education in the 4IR technologies as well as policies aimed at promoting 4IR education at the corporate level, for example, companies providing training for their employees in new skills. South Korea, for example, has established eight graduate schools to prepare the next generation of researchers and entrepreneurs that will help the country overcome a shortage of skills in the 4IR.

Concluding remarks

World War II dawned a new era founded upon science and technology. Likewise, COVID-19 is opening a new era of prosperity built on the foundations of the 4IR. The ability to take advantage of the full potentials of the 4IR technologies will be critical to build robust, sustainable, inclusive, and competitive economies in the future. We propose that the realization of technological potentials for prosperity and sustainability in the post-COVID-19 world calls for the 4IR New Deal, a system-wide transformation of national economies based on 4IR technologies. Underpinning the New Deal should be principles of social protection and responsible development of 4IR technologies. Specific forms and content of 4IR New Deal would look different depending on the level of digital readiness and priorities of each country – but without one, virtually no country will be able to navigate the post-COVID-19 era. With the post-COVID-19 world becoming "hybridtact," it will be crucial to identify which services are the best to provide online vs. offline or on the contact vs. non-contact basis.

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COVID-19 Technology Access Pool

The WHO COVID-19 Technology Access Pool (C-TAP) will compile, in one place, pledges of commitment made under the Solidarity Call to Action to voluntarily share COVID-19 health technology related knowledge, intellectual property and data. The Pool will draw on relevant data from existing mechanisms, such as the Medicines Patent Pool and the UN Technology Bank-hosted Technology Access Partnership. C-TAP aims to help accelerate the development and manufacturing scale-up of health products needed to fight COVID-19 and the removal of barriers to access in order to make products available globally and equitably.

C-TAP encourages technology holders, public and private, to voluntarily share COVID-19-related knowledge, intellectual property and data in line with the principles of the Solidarity call to action with public health organizations like the Medicines Patent Pool, the Tech Access Partnership, or the Open COVID Pledge working in partnership with C-TAP.

For more information, access:

https://www.who.int/emergencies/diseases/novel-coronavirus-2019/global-research-on-novel-coronavirus-2019-ncov/covid-19-technology-access-pool

Technological Interventions and Strategies for combating Covid-19 in India

AN OVERVIEW

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Abstract

SARS-CoV-2 (Severe acute respiratory syndrome coronavirus 2) disease (Covid-19) emerged in December, 2019 and this pandemic severely affected the health of people and economies of more than 200 countries across the globe in the relatively short span of just 4-5 months. The Economic and Social Commission of Asia and the Pacific (ESCAP) developed a framework to support the socio-economic response of Asia and the Pacific to the COVID-19 pandemic. Governments in the Asia-Pacific region are taking administrative and policy actions to cope with COVID-19 pandemic and its adverse impacts. In this review paper the authors have presented the impact the Covid-19 made in genera in different countries and the initiatives and efforts laid by Research and Industrial fraternity in both global and national spectrum are detailed. The authors have briefed how the National Innovation System (NIS) players in India have been contributing in combating the Covid-19 crises. It is observed that about 200 innovative technologies have been developed by the NIS in India over a period of about 2 months' time, which is a remarkable achievement and majority of these innovations have been implemented in the field. The Science, Technology Innovation (STI) developments taking place in India would certainly pave a way for regional cooperation between India and ESCAP Member countries in combating the Covid-19.

Introduction

The emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease (COVID-19) in Wuhan, China at the end of 2019 has spread around the world countries and captured the global attention. Realizing COVID-19 as a highly transmittable and pathogenic viral infection, the World Health Organization (WHO) identified it as a Public Health Emergency of International Concern on 31st January, 2020 and declared COVID-19 as a global pandemic on 11th March 2020. COVID-19 has shown strange characteristics by creating with new scientific and ethical challenges in terms of morbidity and mounting mortality in various demographic locations.

Coronaviruses are enveloped positive stranded RNA viruses in the order of Nidovirales [ICTV,2011]. With their characteristic surface, the virions have a crown-like appearance under the electron microscope, and therefore are named after the Latin word *corona*, meaning 'crown' or 'halo'. The subfamily *Orthocoronavirinae* of the family *Coronaviridae* is further classified into four coronavirus (CoV) genera: Alpha-, Beta-, Delta-- and Gamma - coronavirus. Betacoronavirus genus is further separated in five subgenera (*Embecovirus, Hibecovirus, Merbecovirus, Nobecovirus* and *Sarbecovirus*).

So far, no promising clinical treatments or proven drugs/vaccines or monoclonal antibodies prevention approaches have been developed or approved to effectively treat COVID-19 infection. Due to the distinguished features and characters of antigenic mutations of corona virus made this virus new to humans. Most of the general population lacks immunity against this new virus strain. Added to these characters this virus has capability of transmission through numerous routes. These factors resulted in the novel coronavirus becoming pandemic.

As the coronavirus infected cases across worldwide crossed the sixteen million-mark, global pharma and biotechnology companies and researchers are fastmoving their efforts to find a vaccine or drug. Over 110 potential vaccine candidates are in the works to find a viable antidote for SARS-CoV-19. However, some vaccine candidates are in the clinical trial stage and others have revealed less favourable results so far (Business Today, 2020). Some of the efforts towards COVID-19 vaccines globally and their progress as on July 2020 are presented in Table 1.

Global scenario

Since its discovery in December 2019, COVID-19 is affecting about 216 countries, areas or territories with cases around the world [WHO reports 2020]. SARS-CoV-2 has **infected** more than **16.15 million people** worldwide and has caused more than **646,641 deaths** as of 27th July, 2020 (Figure 1). Researchers across the world have been working hard to find and identify possible treatments to save lives from this deadly virus and to produce vaccines for future prevention.

The distribution of cases country wise till 27th July 2020 is depicted in Figure 2. The total confirmed cases are the total cumulative count (16,114,449) This data includes deaths and recovered or discharged patients (cases having outcome). The total active cases are derived by removing deaths and recoveries from total cases which are currently infected cases or active cases (cases waiting for an outcome). Actual death rates occurred may be much higher than the number of confirmed deaths reported: this is due to limited testing and problems in the attribution of the cause of death; the difference between reported numbers and total numbers varies from country to country.

Total recovered cases are the cases that are cured as per the records and got discharged.

Table 1: Few efforts of companies towards COVID-19 vaccines and advancements of clinical trials

S. No.	Company/Organization	Progress
1	Covaxin - India's first indigenous Covid-19 vaccine candidate	First part of Phase-1 of vaccine trial (Covaxin) has been completed with encouraging results.
2	ChAdOx1-S vaccine – Oxford Vaccine (in collaboration of Oxford university & AstraZeneca pharmaceutical company)	Phase 3 clinical trials in human volunteers.
3	Ad5-nCoV – (in collaboration of the Beijing Institute of Biotechnology and CanSino Biologics)	Phase 2 clinical trials completed and received approval for use in Chinese military.
4	mRNA-1273 – (US-based biotechnology company Moderna)	Phase 2 clinical trials started.
5	INO-4800 – (in collaboration of International Vaccine Institute and US-based Inovio Pharmaceuticals)	Phase 1 trials shown interim positive results and the vaccine candidate is now undergoing Phase 2 clinical trial in South Korea.
6	BNT162-01 – (in collaboration of BioNTech RNA Pharmaceuticals, Shanghai Fosun Pharmaceutical and Pfizer)	Phase 1 and Phase 2 trials simultaneously in Europe.
7	Gam-COVID-Vac Lyo – (Gamaleya Research Institute)	Phase 1 trials under progress in Russia
8	COVAC1 (Imperial College London)	Phase 1 clinical trials under progress
9	RBD-Dimer – (in collaboration of Institute of Microbiology, Chinese Academy of Sciences, Zhifei Longcom)	Phase 1 clinical trial under progress in China
10	GX-19 by Genexine consortium – (in collaboration of Korea Advanced Institute of Science & Technology and the Pohang University of Science & Technology)	Phase 1 clinical trial under progress in South Korea

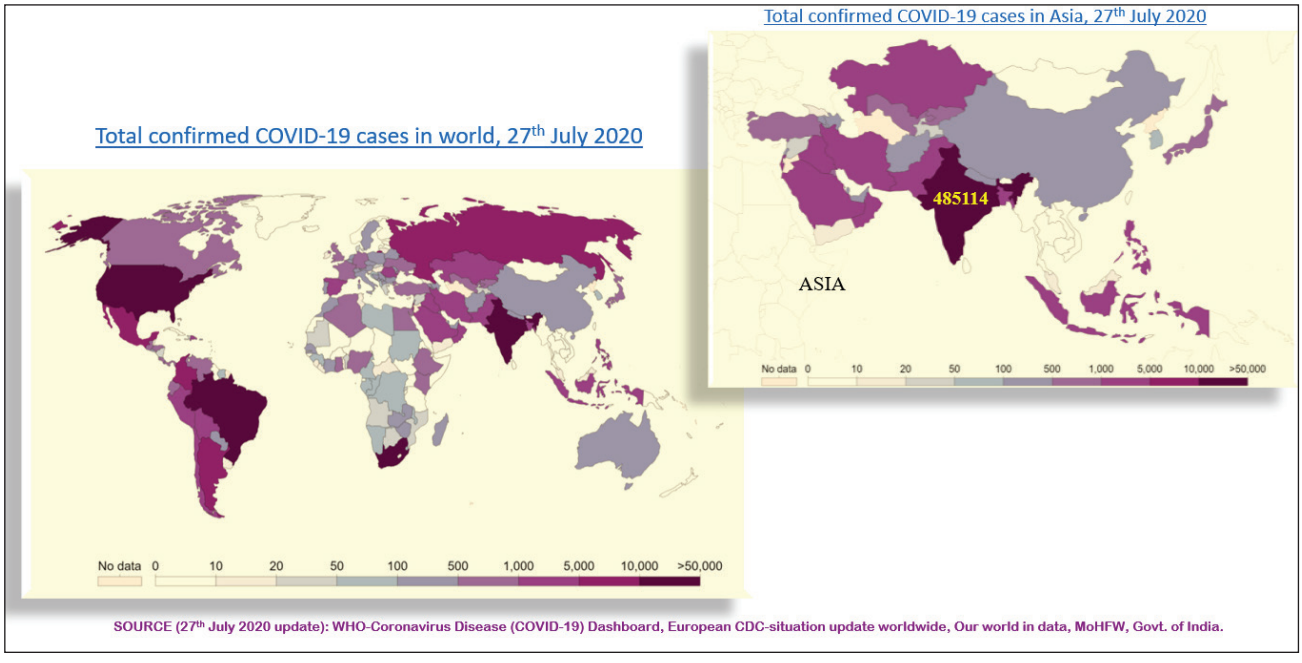


Figure 1: Total confirmed cases of COVID-19 all over world as of 27th July 2020

It was observed that the reported cases figures on a given date does not necessarily show the number of new cases on that day: this is due to delays in reporting. The actual number of cases is likely to be much higher than the number of confirmed cases: this is due to limited testing. The total confirmed death cases worldwide as on 27th July 2020 were reported to be 646,641.

India reported first case of COVID-19 on 30th January 2020 and Indian scientific and research community geared up to battle this COVID-19 relentlessly with the all the available means and methods. Currently India have 14 vaccine candidates that are working on different levels out of them four vaccine candidates are in the pre-clinical trial phase and would go for clinical trials within 3-4 months (WHO reports 2020). As of 27th July 2020, India has reported 4,85,114 COVID infected confirmed active cases with death toll raising to 32,771 (MoHFW).

COVID-19 profile and transmission

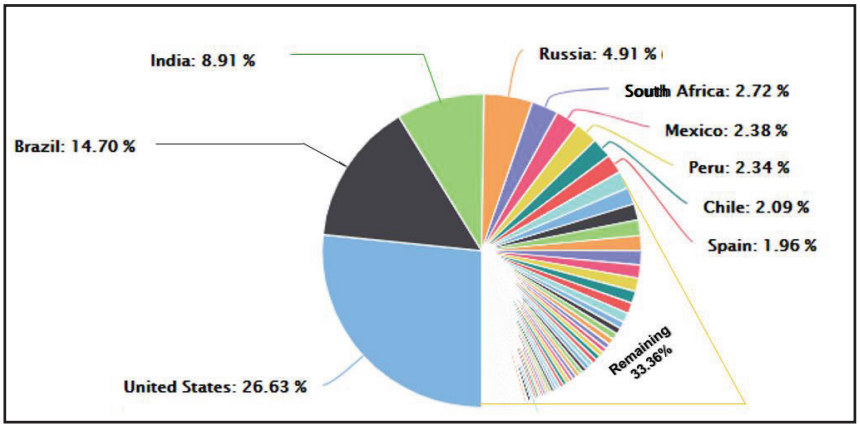
Coronaviruses (CoV) have been identified as human pathogens since the 1960's. Coronaviruses infect humans and many other vertebrates (including birds and mammals). Illness in humans is mostly respiratory or gastrointestinal infections, however symptoms can range from the common cold to more severe lower respiratory infections such as pneumonia [Channappanavar R et'al, 2017]. In late 2019, a novel coronavirus initially elated to a cluster of pneumonia cases in Wuhan, China (SARS-CoV-2) was identified and classified as SARS-CoV 2. This new coronavirus is closely related to SARS-CoV and genetically clusters within *Betacoronavirus* subgenus *Sarbecovirus* (WHO statement 2020).

These viruses primary target cells are respiratory and gastrointestinal tract cells and invade and proliferate in the epithelial cells usually of the respiratory tracts causing respiratory and systemic symptoms. Thus, viral shedding occurs via these systems and transmission can occur through different routes: fomites, airborne or faecal-oral. Till date, seven coronaviruses have been shown to infect humans.

All coronaviruses originate with unique genes in ORF1 downstream regions that encode proteins for viral replication, nucleocapsid and spikes formation (S. van-Boheemen et'al, 2012). Coronaviruses are very minute in size (65–125 nm in diameter) and contain a single-stranded RNA as a nucleic material, size ranging from 26 to 32kbs in length (Figure 3). The outer surface of coronaviruses contains glycoprotein spikes which are responsible for the attachment and entry of the virus to host cells. SARS-CoV-2 uses the angiotensin-converting enzyme 2 (ACE2) as a cell receptor to invade human cells.

The infected patients exhibit pneumonia symptoms with a diffused alveolar injury which lead to acute respiratory distress syndrome (ARDS). With the series of investigations and sequence of observations indicated the ability of the SARS-CoV-2 spreading from human to the human. The spreading of the virus occurs due to close contact with an infected person, exposed to coughing, sneezing, respiratory droplets or aerosols.

Studies have reported that speech droplets generated by asymptomatic carriers



Source data (updated 27 July 2020): WHO-Coronavirus Disease (COVID-19) Dashboard and WORLDOMETER

Figure 2: Country wise distribution of COVID-19 cases till 27 July 2020

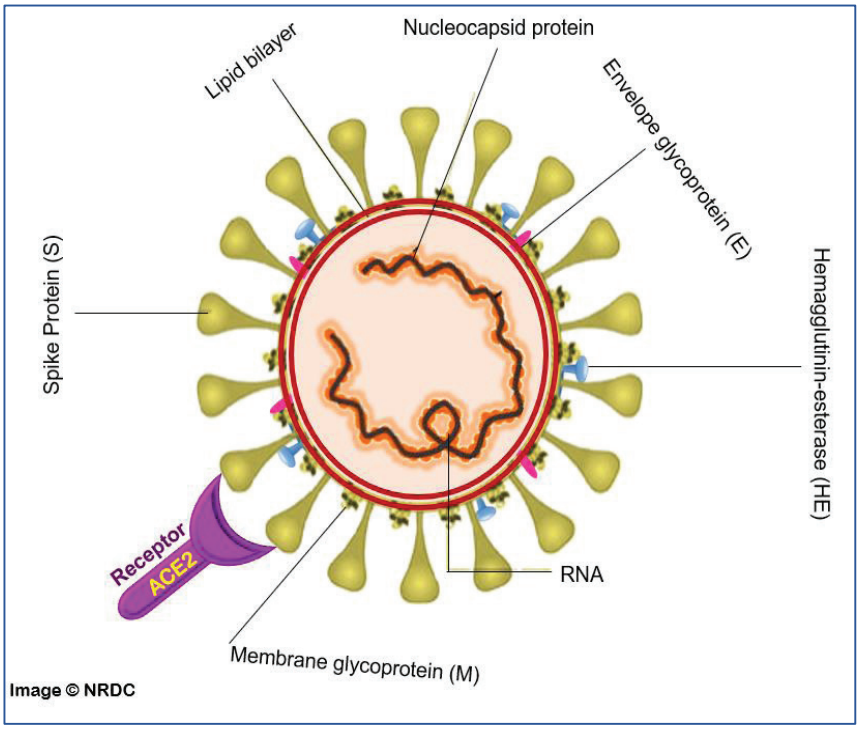


Figure 3: Structure of the coronavirus (source: microbe notes)

of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are increasingly considered to be a likely mode of disease transmission (Valentyn Stadnytskyi et'al, 2020). Researchers have concluded that wearing of face masks in public corresponds to the most effective means to prevent interhuman transmission, and this inexpensive practice, in conjunction with simultaneous social distancing, quarantine, and contact tracing, represents the most likely fighting opportunity to stop the COVID-19 pandemic (Renyi Zhang et'al, 2020).

Methodology

During the COVID-19 pandemic, encouraging signs of increased collaborations between major tech-players (example: efforts between Google and Apple to cooperate on contact tracing) are observed. Global publishers like Elsevier, Springer Nature, The Lancet Infectious Diseases, WHO publications, Open data watch publications, etc., came front dedicated to providing the best possible service to the whole research community during this fight against COVID-19 and committed to open research, offering researchers, institutions and their funders open access (OA) options for journals, books, COVID-19 preprint articles and sharing research data, free content and updated information related to COVID-19, alongside key policies and information in supporting remote access and working.

The interactive dashboards made available by WHO, Our world in data, worldometer, European CDC etc., are readily accessible to researchers and public, providing them with the latest global numbers and numbers by country of COVID-19 cases on a day to day basis.

India's proactive, preventive and productive approach to fight COVID-19 pandemic started under the eminent leadership of Hon'ble Prime Minister of India, Shri Narendra Modi were considered and detailed in the study. Government of India and WHO partnership further strengthened to overcome the COVID-19 challenge (WHO News 2020).

Ever since the coronavirus outbreak in India, the government authorities have taken several steps across India to curb the spread and make residents aware about the COVID-19 virus (MoHFW updates 2020).

The authors reviewed the open access research publications, situation reports of coronavirus disease 2019 (COVID-19), available data access information, resources provided by government of India, efforts of Indian scientific community for combating the COVID-19 (MoHFW updates 2020) for the present study.

Technology transfer to combat COVID-19

Technology transfer requires a proactive approach that combines engaging researchers towards inventing new technologies, evaluating and promoting the technologies and encouraging potential industrial partners to utilize the technology. Technology transfer aids to develop initial stage intellectual properties into tools for direct use by the research community, or into bases for new platforms, products, or services to develop products for public use (Unimed article 2020).

Technology is transferred by signing a technology transfer license agreement wherein the university/R&D individual inventor/ or institute retains the ownership of the intellectual property of the technology developed, while the industrial partner/ organization/ startup or entrepreneur obtains the conditional rights to either utilize or develop the technology. The successful technology transfer or commercialization achieved when the end goal of the commercialization strategy established between licensor and licensee by negotiating a contract (e.g., compensation).

In light of the ongoing COVID-19 crisis, multinationals are readjusting their supply chains and business strategies to meet the ever-changing demands arrived during this pandemic.

The changing business models, distinguished by the demand and supply disruptions, immunity, health and safety concerns, evolving government regulations and varying market environments altering the pricing policy for organizations. As a result, it is important that transfer pricing be at the top of the organization's strategic agenda. Universities developing the innovative and indigenous technologies are adapting technologies licensing principles designed to incentivize and allow for broad and equitable access to university innovations during the COVID-19 pandemic (Yale news 2020).

All reputed universities globally are conducting research studies following "The COVID-19 Technology Access Framework" which is a movement to share COVID-19 related intellectual property to facilitate the development of treatments and diagnostics.

From the initial stages of COVID-19 outburst, scientists are being eagerly researching to find the most effective antibodies the human body produces and turn them into drugs. One side research related to convalescent plasma therapies whereby a medley of antibodies from recovered patients given to people who are battling COVID-19"monoclonal antibody" treatments would be standardized, manufactured at scale, and believed to potentially more effective.

COVID has rapidly shifted the technology transfer strategies from university and other non-profit research organizations to the battle's front line. Globally, proactive research activities and development of prompt and effective technologies enhanced the need of technologies application, diffusion, utilization and regional cooperation. For technologies wherever legally possible, COVID-19 technologies licensing strategy is accomplished by adopting time limited, non-exclusive royalty-free licenses, in exchange for the licensees' commitment to rapidly make and broadly distribute products and services to prevent, diagnose, treat and contain COVID-19 and protect healthcare workers during the pandemic (as defined by the World Health Organization) (AUTM article, 2020).

How technology transfer and technology transfer officer plays an important role during COVID pandemic

The research productivities generated from the research and academic insti-

tutes need to be shared out from the institutes through technology transfer mechanism into other commercial organisations (like large and small scale industries, entrepreneurs, startups, government agencies, charities and for-profit business firms etc.,) who can scale up, develop, design, manufacture and make the technology or products and services available for public utilization at large. Designated Technology Transfer Offices (TTOs) can apply their proficiency to provide these services to make the availability of the products and services more effectively at faster rate in direct response to the emerged crisis.

Examples taken from the source (Technology Transfer Innovation Ltd article, 2020):

1. In the US, the TTOs at Harvard, MIT, Stanford, and Yale have published the COVID-19 Technology Access Framework
2. In London, UCL Business has made its e-lucid express licensing platform freely available to any university or researcher in the world that wishes to license under controlled conditions technologies that could help battle, model or better understand the pandemic
3. In Oxford, the University and its TTO have adopted revised guidance to accelerate the licensing of relevant intellectual property (IP) for the duration of the COVID-19 pandemic

Importance of technology transfer to beat COVID-19

Though people in all countries are being encouraged to take precautions to prevent transmission of COVID-19, the entire world is waiting for suitable, safe and effective vaccines against COVID-19 which the only best chance available now. Researchers from the medical and scientific fraternity across the world are working on war-footing to come up with a vaccine for this pandemic as soon as possible. However, to immunize people worldwide as soon as vaccines are proven needs the extensive efforts for the pharmaceutical industries to swiftly ramp up to unprecedented volumes of supply. This is the stage where technology transfer for moving the knowledge will determine how fast it can happen for making it available to produce a vaccine from development to manufacturing capabilities for societal utilization.

Presently more than 200 candidates of vaccine candidates are in testing and trailing stages. More than one candidate can be proven successful and effective which will immediately go out of stock. Whenever the successful candidates emerge from the research and development stages, abundant manufacturing capacities and rapid scale-up of production will be vital. However, this rapid scale-up of production will depend largely on technology transfer from research scale to production scale, which has not had the same level of attention previously.

Indian scenario

Since the first case reported in India by the end of January 2020, SARS-CoV-2 infections are accelerating exponentially across the country. India quickly ramped up the COVID-19 testing facilities by mid of April 2020 which were at lower rate in the initial stages of the outbreak. As of 27th July 2020, India reported 4,85,114 COVID-19 confirmed cases, 32,771 COVID-19 death cases and active cases estimated about 33.51% (MoHFW data, 2020). The total cases which had an outcome are above 987,465 showing a death rate of about 3% and recovery rate of 97% in India (ref: as per statistics from world-o-meter). Government of India proactively reacted and quickly closed the international borders and enforced an immediate lockdown which WHO praised as "tough and timely" (News Article, 2020). The death rates in India are reportedly low when compared to its confirmed and active cases showing encouraging results in recovering the infected patients successfully.

Indian government actively launched and implemented multiple initiatives through its various ministries, departments, and funding organizations aimed at screening and early providing training to young microbiologists on COVID-19 diagnostics and developing drugs and vaccines. Indian government, academia, scientists, startups, entrepreneurs and industries have been working effortlessly to find quick, deployable solutions for COVID-19.

Inspite of the efforts from every possible corner, India's population of 1·35 billion across diverse states, other variable social determinants like health inequalities, widening economic and social disparities, and distinct cultural values offers unique challenges and making hard for controlling the spread of the infection in the country. The highest COVID-19 confirmed cases are reported in Maharashtra (147896) around 30% of total reported cases followed by Karnataka (61,827, 12.4%), Tamil Nadu (54896, 11%), Andhra Pradesh (51701, 10.4%) and Delhi (26204, 5.27%) as of 27th July 2020. The highest recovery rates are observed in states Punjab (90%), Tripura (72%) and Chandigarh (67%) as reported. The data is sourced from state data source of Ministry of Health and Family Welfare (MoHFW) dash board (the data is tentative and is subject to further verification and reconciliation by ICMR).

The Indian technological interventions and strategies for combating COVID-19

Indian scientific and technological fraternity has developed more than 200 various indigenous technologies as solutions to fight the SARS-CoV-2 infection within just 2-3 months of time period. National Research Development Corporation (NRDC), an enterprise of Department of Scientific & Industrial Research, Ministry of Science & Technology, Govt. of India, has made an attempt to compile most relevant and emerging indigenously developed technological innovations, including those which are at research stage, to fight COVID-19 in their "Compendium of Indian Technologies for Combating COVID-19 (Tracing, Testing & Treating)" for the benefit of all stakeholders and this compendium will serve as a ready-reference for policy makers, industries, entrepreneurs, startups, MSMEs, research scholars, scientists and others. The compendium comprises ongoing research activities, potential technologies available for commercialisation, initiatives and efforts taken by the Government of India categorized under 3Ts of Tracking, Testing

and Treating [Vigyan Prasar Report, 2020]. List of few indigenous technologies under 3 Ts from compendium are given in Table 2.

Among the tracing solutions, the list carries various Apps such as GoCoronaGo, Sampark-O-Meter, KAWACH and the most popular one Aarogya Setu.

As on 15th June 2020, contact tracing application Aarogya Setu launched early in April has so far alerted 1,40,000 people of potential risk of infection through bluetooth contact tracing and has shown high efficacy in flagging the requirement to get tested for Coronavirus infection (The Hindu News Article, 2020).

Testing inventions include COVID-19 rapid testing kit, RT-PCR detection kit, probe-free testing kit, paper strip-based testing assay, rapid antibody test and identification of drugs by computation. Several diagnostic technologies compiled in the compendium are those which have been approved by the Indian Council of Medical Research (ICMR). Under Treatment and protective solutions innovative technologies like nasal gel, UV-tech fitted sanitising trunk, low-cost 3D face shield, bio-bodysuits, PPE suits, anti-microbial fabric and disinfection drones, mist disinfectors, herbal sanitizers, smart stethoscope, portable and low-cost ventilators, isolation chambers, etc.

These indigenous technologies are at affordable cost and most of COVID-19 diagnostic kits were approved by Indian Council of Medical Research (ICMR) and have started mass production and supplying to government of India for increasing the COVID-19 testing in the country. Table 2 details list of few indigenously developed technologies under 3 Ts. The information technologies developed and are in research stage is sourced from various government bodies and premier academic institutions including Department of Science and Technology (DST), Department of Biotechnology (DBT), Indian Council for Medical Research (ICMR), Ministry of Electronics and Information Technology (MeitY), Council of Scientific and Industrial Research (CSIR), Defence Research and Development Organisation (DRDO), Ministry of AYUSH, National Research Development Corporation (NRDC). Innovations from academic institutes like Indian Institute(s) of Technology (IITs), Science and Engineering Research Board (SERB), Technology Development Board (TDB), National Innovation Foundation (NIF), Ordnance Factory Board (OFB), Startup India and All India Council for Technical Education (AICTE), Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) and Indian Institute of Science (IISc) and other private sectors, startups are also considered.

Evolution of new inventions and prototypes to address COVID are developed and at the lightning fast journey from concept to market observed. The streamlines process involved in technology transfer like the one knowledge protection, technology development, evaluation and commercialization are done at fast pace to promptly bring the needful technologies into market for public utilization also facing the competitiveness.

Strategic measures and funding schemes to develop technologies to tackle COVID-19

The global macroeconomic outlook for current financial year 2020-21 has been adversely affected by COVID-19 pandemic which has impacted majority of countries in the world across the continents. The spread of Covid-19 in India and its mitigation plan of 65 days continuous lockdown nationwide from 25th March 2020 to 31st May 2020 by government of India, there is likely to be a significant impact across various sectors of the economy due to massive dislocation of production, supply chains and trade both domestic and global perspective. Government of India has been preparing strategic action plans to address research and development, special measures to support startups, entrepreneurs, MSMEs and also various relief measures to investors.

Government have predicted more than 3,500 hotspots in the country at sub post office levels which has had a tremendous impact in India as far as contact tracing is concerned. Beginning from 1st April 2020, more than 1,500 new hospitals, mostly private have been empanelled under the Pradhan Mantri Jan Arogya Yojana Scheme, bringing the total number of hospitals under Ayushman Bharat to 22,000 (The Economic Times News Article, 2020).

Department of Science and Technology (DST), Govt. of India is India's apex science and technology (S&T) agency. With the help of institutions under DST and sister ministries, DST is taking the lead in coordinating the effort to map and upscale appropriate technologies in India for addressing a plethora of issues related to COVID-19.

It is also scouting for solutions that are more relevant to the country and also to help prepare the country for exigencies arising out of COVID-19 pandemic (NRDC Compendium, 2020).

Role of Indian Navy & DRDO during COVID-19 pandemic

Recently the low-cost PPE known as NavRakshak - A Low Cost Breathable PPE Suite, is a unique PPE kit non laminated, breathable, no tapping/sealing is needed, 70% cheaper, ICMR/DRDO approved product. The technology has been developed by Indian Navy at the recently created Innovation Cell at Institute of Naval Medicine (INM), Mumbai. A pilot batch of PPEs has already been produced at Naval Dockyard in Mumbai. National Research Development Corporation (NRDC) filed Patent for NavRakshak and made available for commercialization to Startups and Industry. The patent was filed by the Defence Ministry in association with the National Research Development Corporation (NRDC), an enterprise under the Ministry of Science and Technology. NRDC has licensed this NavRakshak kit technology to five MSME clients. These manufacturers are planning for mass production of more than 10 million PPE's per year. The kits are available in single and double ply as per the customer requirement.

Recently Defence Research and Development Organisation (DRDO) has listed 35 (approximately 13 major items) under

'Counter Covid-19 Technologies' and the list comprises technologies like Automated Luggage Disinfector, Herbal sanitizer, IR-Based Body Temperature Probe, Kiosk for COVID-19 Sample Collection, Sewak-Robot for medical use, PPE Kits and many more related to COVID-19 pandemic for manufacturing, marketing and sale as per the standard specifications. Procuring technologies from DRDO laboratories and manufacturing them will benefit Indian industries to become a bonafied ToT holder of DRDO and use of DRDO logo on the final product (Financial Express News Article, 2020).

On 6th May 2020, a team of scientists from Naval physical and oceanographic laboratory (NPOL)-DRDO, Kochi fixed a UV light scanner at the entry point of the luggage conveyor belt towards the aircraft at Cochin international airport (CIAL) to disinfect luggage bags of passengers (Times of India Article, 2020).

Role of CSIR during COVID-19 pandemic

Council of Scientific and Industrial Research (CSIR) has a dynamic network of 38 National Research Laboratories covering a wide spectrum of science and technology. Even prior to the lockdown announced in the country, CSIR has defined their strategy to address the COVID-19 crises under five verticals of

1. Surveillance and epidemiology
2. Diagnostics
3. Drugs and vaccines
4. Hospital assistive equipment
5. Supply chain logistics.

Under the five categories CSIR has not left any stone unturned in its efforts and services to mitigate COVID-19 Pandemic (COVID GYAN, 2020).

CSIR's programmes in details for COVID-19 prevention and management are depicted in Figure 4.

ACQH, MW, Favipiravir Chloroquine or Hydroxychloroquine (ICMR approved as preventive medicine) are the drugs in clinical trial stage. India's drug regulator Drugs Controller General of India (DGCI) allowed Sun Pharmaceutical to conduct clinical trial for the first phytopharmaceutical or plant- based drug AQCH to treat COVID-19 patients in collaboration with ICGEB New Delhi and CSIR IIIM Jammu with support by CSIR and DBT on 5th June 2020. The Council of Scientific and Industrial Research (CSIR) have hailed the AQCH trails as "historic in modern medicine" (Dwight L McKee et al, 2020).

Efforts towards vaccination/ drugs for COVID-19

Vaccines for the treatment of SARS-CoV-2 infections are urgently needed. Researchers across the world conducted studies to repurpose the clinically approved drugs for the treatment of coronavirus disease 2019 (COVID-19) in a 2019-nCoV-related coronavirus model. The PM CARES Fund Trust has decided to allocate Rs. 100 crore in efforts to develop a COVID-19 vaccine. The Department of Biotechnology has been made a central coordination agency to identify pathways for vaccine development.

Researchers reported that number of candidate drugs are identified that may inhibit infection with and replication of SARS-CoV-2. Such drugs comprise inhibitors of TMPRSS2 serine protease and inhibitors of angiotensin-converting enzyme 2 (ACE2).

Blockade of ACE2, the host cell receptor for the S protein of SARS-CoV-2 and inhibition of TMPRSS2, which is required for S protein priming may prevent cell entry of SARS-CoV-2.

Studies have shown that chloroquine and hydroxychloroquine, and off-label antiviral drugs, such as the nucleotide analogue remdesivir, HIV protease inhibitors lopinavir and ritonavir, broad-spectrum antiviral drugs arbidol and favipiravir as well as antiviral phytochemicals available to date may limit spread of SARS-CoV-2 and morbidity and mortality of COVID-19 pandemic (Myupchar, 2020).

According to the guidelines laid by the Indian Council of Medical Research (ICMR) on the prophylactic use of hydroxychloroquine on 23rd March 2020, the drug was tested in the laboratories and showed promising results in treating and preventing COVID-19 infection. The ICMR revised the guidelines to expand use of this anti-malarial drug as a preventive treatment against coronavirus. The ICMR indicated that the drug should be given under strict medical supervision with an informed consent and only on the prescription of a registered medical practitioner. The six Indian companies in race to make the 1st Covid vaccine are Zydus Cadila, Bharat Biotech, Indian Immunologicals Limited, Biological E. Limited, Serum Institute of India Pvt. Ltd., Mynvax.

Hon'ble Prime Minister of India Sh. Narendra Modi virtually addressed The Global Vaccine Summit 2020 hosted by British Prime Minister Boris Johnson on 5th June 2020; Pledged $15 Million to Gavi, the international vaccine alliance. Over 50 countries - business leaders, UN agencies, civil society, government ministers, heads of state and country leaders participated in the summit (Hindustan Times News Article, 2020).

Govt of India has adopted three approaches in drug development stages.

1. Repurposing of existing drugs. At least four drugs are undergoing synthesis and examination in this category.
2. Development of new candidate drugs and molecules are being driven by linking high performance computational approached with laboratory verification.
3. Plant extracts and products are being examined for general anti-viral properties.

Consortia of Indian start-ups and industry, meeting current requirements, have addressed the problem of importing reagents for testing. The current crisis even holds promise for the development of a robust long-term industry and business in this area [DBT-BIRAC, 2020].

Ministry of AYUSH is promoting Ayurveda's immunity boosting measures for self-care during COVID 19 crisis. While there is no medicine for COVID-19 as of now, enhancing the body's natural defence system (immunity) plays an important role in maintaining optimum health.

Ayurveda's extensive knowledge base on preventive care, derives from the con-

cepts of "*Dinacharya*" - daily regimes and "*Ritucharya*"- seasonal regimes to maintain healthy life. It is a plant-based science. The recommendations include drinking warm water throughout the day, Daily practice of Yogasana, Pranayama and meditation for at least 30 minutes. Spices like Haldi (Turmeric), Jeera (Cumin), Dhaniya (Coriander) and Lahsun (Garlic) are recommended in cooking etc (Ministry of Ayush, 2020).

Funding schemes for development of Covid-19 solutions

Amongst the various COVID-19 based R&D projects from government of India, academic institutions and firms, some of them are mentioned in Table 2.

Under the research consortium, DBT and BIRAC have continuously been evaluating applications with an intent to support Industry/ Academia and Jointly Academia & Industry for developing Diagnostics, Vaccines, Novel Therapeutics, Repurposing of Drugs or any other intervention for control of COVID-19. Through a rolling multi-tiered review mechanism, 70 proposals of devices, diagnostics, vaccine candidates, therapeutics and other interventions have been recommended for receiving financial support.

The shortlisted proposals include 10 Vaccines candidates, 34 Diagnostics products or scale-up facilities, 10 Therapeutics options, 02 proposals on Drug Repurposing and 14 projects which are categorised as preventive interventions. BIRAC has also created a provision to fund COVID-19 solutions that are ready for immediate deployment under a '*Fast Track Review Process*' (H. Purushotham et'al, 2020) as updated on 10th May 2020.

Kerala and Karnataka success stories

Kerala

On 30th January 2020, Kerala got the first positive case, and in February first week, they got two other cases. Kerala has so far been successful in its fight against the novel Coronavirus and is heaving a sigh of relief over the low death rate, increasing recovery rate and the declining rate of new cases. Kerala strategy for the challenge posed by COVID-19 "Trace, Quarantine, Test, Isolate and Treat" (Indian Express Article, 2020). They could able to achieve this with

- Kerala's robust Panchayati Raj and healthcare systems.
- Using technology for contact tracing, rapid testing. Kerala face d the pandemic with early preparations.
- During second wave of transmission, On the strain put on health systems by the large numbers travelling to India Plan A).
- 3 COVID hospitals identified in each district with each comprising 1,500 beds for COVID patients.
- Changed the hospitals to Covid hospitals, and 5,000, — up to 10,000 (Plan B).
- Arranging some hotels, hostels and some auditoriums for Covid patients (Plan C)
- They have prepared for the strategy on the possibility of community transmission.

Every individual in the state has taken the slogan here: "My health is my responsibility". The successful anti-coronavirus mechanism got appreciation from worldwide. Even though Kerala recorded one of the highest numbers of patients in India from January to March, it not only registered the lowest number of deaths but also a high rate of recovery from the pandemic. Kerala has recorded COVID-19 patients recovery rate of about 50% (*MoHFW*).

Kerala has restricted secondary spread and while the international mortality rate is 5.75, the rate in Kerala is mere 0.58 with just 2 deaths.

Karnataka-Bangalore

Among all the metros compared to other metros cases per million in Bengaluru are extremely low. For every confirmed case they traced 47 contacts. It has implemented 4 Ts Model. Karnataka has also done large scale testing of patients with influenza like symptoms (SARI & ILI). Recovery rate per 100 cases in Bangalore is 51.7% as of 13th June 2020 [Twitter News, 2020].

Sh. Amitabh Kant, CEO NITI Ayog, Govt. of India shared the success story of Bangalore as depicted in Figure 5 and the city, governance and public for this achievement. He shared that the success story of Bangalore city can be attributed to the 3T strategy of Trace, Test & Treat. The Technology backbone was the 4th T which made this entire process extremely efficient & robust. This was accompanied by aggressive containment & high levels of public adherence [Twitter News, 2020]. Karnataka has recorded COVID-19 patients recovery rate of about 59% (*MoHFW*).

Government of Andhra Pradesh efforts to battle COVID-19

To contain the spread of COVID-19 in the state, the Government of Andhra Pradesh took essential measures like

- Department of Health issued orders to close educational institutions and non-essential commercial establishments on 18 & 19th March 2020.
- On 22nd March 2020 the state announced a complete lockdown till 31st March 2020 and strictly implemented the lockdown measures. Thereon Government of AP has implemented all the necessary regulatory rules along with continuous monitoring during the lockdowns as and when announced by Government of India.
- On 13th March 2020, the government of AP notified the Andhra Pradesh Epidemic Disease COVID-19 Regulations, 2020 for containment of COVID in the state.
- Quarantine centres have been set up at district and constituency level.
- On 12th April 2020, the government of AP issued an order prohibiting the use and spitting of smokeless tobacco or chewable tobacco/non-tobacco product, sputum in public places.
- The government of AP announced 100% deferment of salaries of all the elected representatives of the state

Table 2: List of few indigenous technologies under 3 Ts

S. No.	Tracking & Surveillance Technologies	Developed/on-going project
1	Aarogya Setu	eGov Mobile Apps division of NIC (Indian Government)
2	COVID INDIA SEVA.	Union Minister of Health & Family Welfare, Science & Technology, and Earth Sciences, Govt. of India,
3	Sampark-o-Meter	IIT Ropar
4	GoCoronaGo	IISC
5	CORONTINE	IIT Bombay, DST funded
6	Digital and Molecular Surveillance	CSIR-CDRI+IICB
7	Machine Learning Model	CSIR-IICB
8	Modelling of epidemic spread in Indian urban conditions	IISC
9	Jarvis-AI based Thermal Camera	Staqu Technologies – startup
10	Drone equipped with infrared camera	IIT Guwahati
S. No.	**Testing / Diagnostic Kits**	**Developed/on-going project**
1	Realtime PCR test	SAAI Electro Biogenetic India Pvt Ltd & Huwel Lifesciences, Private organization
2	Paper Strip based testing assay – CRISP	CSIR- IGIB
3	Rapid Testing Kit	AP Medtech Zone (govt., of AP) + Trueprep (Molbio Diagnostics Pvt. Ltd.)
4	Chip based RTPCR test	Molbio Diagnostics Pvt Ltd.
5	Probe free detection assay	IIT Delhi
6	Reverse transcriptase loop detection - Chitra GeneLAMP-N	Sree Chitra Tirunal Institute for Medical Sciences and Technology, (SCTI), DST funded project
7	Determination of Biomarkers	The Science and Engineering Research Board (SERB), a statutory body under the Department of Science and Technology (DST), will support exploration of metabolomics alteration in COVID-19 infected patients conducted by IIT Bombay in collaboration with some hospitals in Mumbai.
8	Kiosk for sample collection	DRDL, DRDO
9	IgM/IgG Rapid Testing Kit	Medsource Ozone Biomedicals
10	IgM/IgG Antibody Detection Card	Vanguard Diagnostics India
S. No.	**Testing / Diagnostic Kits**	**Developed/on-going project**
1	Antimicrobial Fabric	IIT Delhi & Fabiosys Innovations (startup), DST funded
2	Minus Corona UV Bot test	IIT Karagpur & PerSapien (Startup)
3	Nasal Gel	IIT Bombay, DST funded
4	Smart Stethoscope	IIT Bombay, DBT supported
5	Mist Sanitizer System	CSIR-NCL,
6	Disinfection Walk Way	CSIR-CMERI
7	Anti-microbial coating	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), DST funded
8	Bio-personal protective equipment, mask	DRDO
9	HCARD-Robot	CSIR-CMERI
10	FIFATROL	Ayush Ministry

and 10% to 60% deferment for all the government employees of the state.

- The AP state government conducted door-to-door survey on regular basis to identify the persons who had recently been to novel coronavirus (COVID-19) affected countries/states by roping in Asha workers, village and ward volunteers, ANMs and other staff members to gather information and report to concern authorities.
- AMTZ manufacturing COVID-19 Kits, Ventilators & other Medical devices in the state.

Andhra Pradesh has recorded COVID-19 patients recovery rate of about 51% *(MoHFW)*.

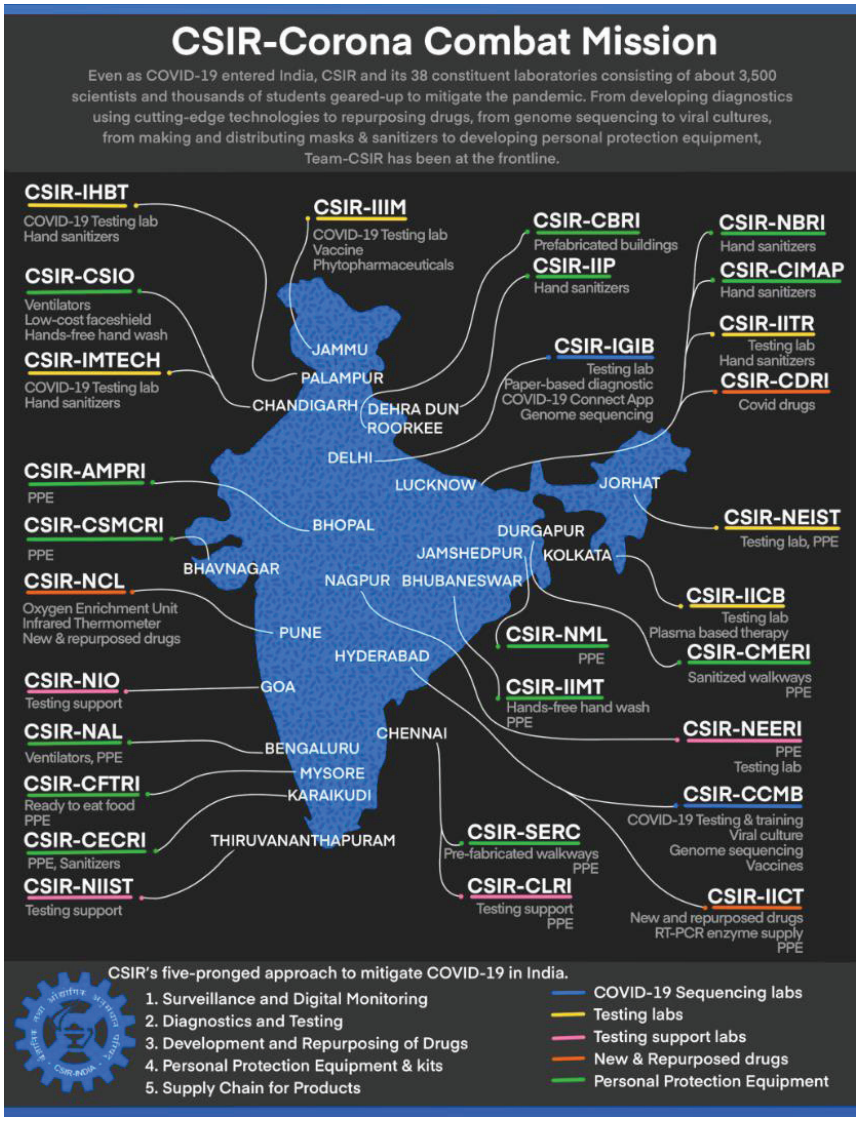
Conclusion

The authors in the present study synthesised data from across a range of surveillance settings and estimated the findings about SARS-CoV-2 gathered information worldwide. The authors have briefed about the epidemic outbreak, COVID-19 profile and transmission worldwide.

Similar to many other respiratory diseases caused by viral pathogens, COVID-19 cannot be diagnosed entirely based on observing the symptoms as they closely resemble symptoms of the common flu and are therefore not unique. Hence, diagnostic testing is key to the identification of infected individuals. It has been identified that there are testing limitations and challenges encountered. As per the current situation in the absence of proven vaccine or drug for this COVID-19, isolation and quarantining of infected individuals is emerged as the only best way of containing the spread of the virus. Maintaining personal hygiene and social distancing and adhering to the health protocols prescribed by WHO and respective governments are the only means observed to reduce the transmission of this COVID-19.

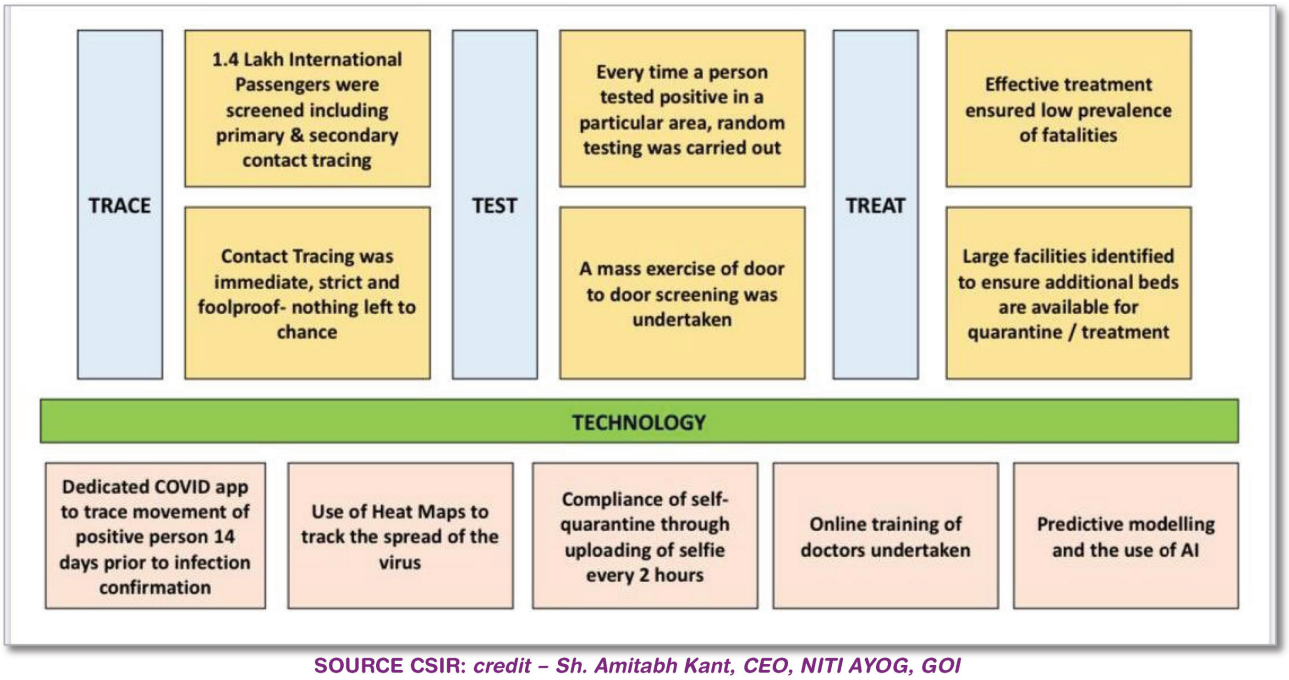
The world reported statistics (though not accurate numbers) were analysed in-depth comparing the Indian conditions. Estimating the Case Fatality Rate (CFR) the ratio between confirmed cases and confirmed deaths as reported India is observed to be of 3.13 % CFR as of 18th May 2020. The world CFR reported to be 6.73%, the majority percentage is observed for countries like Italy 14.15%, United Kingdom 14.21%, USA 6.02%. Being the second world's largest populated country with 1.35 billion, India could able to sustain this pandemic with all the efforts and initiatives taken by Government of India and ministries.

Government of India successfully mobilized number of researchers in a short period of time and is providing complete and committed support to scientific, engineering, research and technological fraternity to develop new innovations and technologies to combat this pandemic. India with the extra-ordinary network of Government funded research and development laboratories under CSIR, DAE, DRDO, DBT, DST and several other autonomous research institutions, have taken up high-end and speedily implementable research in the country. Indian scientific and research community has developed more than 200 technologies within just 2-3 month, since the outbreak of Sars-CoV-2 infection in India on 30th January 2020. Government of India has proactively taken measures to initiate multiple short-



SOURCE CSIR: credit – Vigneswar Senthivel, CSIR/Wikimedia Commons

Figure 4. CSIR's programmes for COVID-19 prevention and management – An overview



SOURCE CSIR: credit – Sh. Amitabh Kant, CEO, NITI AYOG, GOI

Figure 5: Bangalore success story fighting the pandemic COVID-19

term and medium-term research calls to address urgent issues concerning the coronavirus and COVID-19.

Health ministry indicated that the COVID-19 patients recovery rate has improved to 52.47% and the capacity has gone upto 3 lakh samples per day as of 13th June 2020 updates.

NRDC has compiled all the indigenous technologies, research activities such as repurposing of existing drugs, efforts for COVID-19 vaccine development, inventing cost effective diagnostic kits, tracing and modelling apps and various proposals from Govt. of India towards research and development, categorizing under 3 Ts (Tracking, Testing and Treating) and made available for policy makers, industries, entrepreneurs, startups, MSMEs, research scholars, scientists and other stakeholders.

Limitations

In the present study, the authors have reviewed the reported details about COVID-19 made available in open access publications and the data accessible from WHO dashboard, Government of India dashboard, world-o-meter, etc. The data may not be an accurate count of the true numbers referring to the limited testing and challenges in the attribution of the reported numbers COVID-19 cases. Research works of COVID-19 across India from government ministries and laboratories, significant innovations notified either in newspapers or funded by Government of India, reported by academic institutions and startups or innovations that are proven and at proof of concept stage are only taken into consideration. Excluded individual inventions not notified by the inventors or the inventions still at idea stage and other obvious inventions.

Acknowledgement

The authors acknowledge the infrastructural support provided by National Research Development Corporation in conducting the study.

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Innovative technological interventions to respond COVID-19 and Flattening the Curve

EXPERIENCES OF THE REPUBLIC OF KOREA

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Abstract

In the wake of the COVID-19 pandemic, the Republic of Korea suffered the second-highest numbers of COVID-19 infections after China in late February; but, has implemented several innovative measures to effectively "flatten the curve" since the end of July without implementing any draconian measures or lockdowns. In this article, two major innovative technologies utilized in the Republic of Korea's COVID-19 response are introduced, namely a Drive-thru or Walk-thru screening process, and using an Epidemiological Investigation Support System in the tracing process. Along with those explanations this article suggests successful factors such as leadership and empowering culture, institutional arrangement through policy learning, and policy communication for mutual understanding to ensure the intervention of innovative technology against COVID-19.

Introduction

Since the beginning of this year, the global COVID-19 pandemic has brought the world to a state of emergency. To date, more than 24 million cases have been confirmed (24,917,151 as of 30 August) and almost 1 million have died (841,549 as of 30 August) worldwide. Moreover, the COVID-19 outbreak is leaving an impact on global public safety and causing a multi-layered crisis for the economy and day-to-day social activities. If we consider the huge impact of this pandemic, it's crucial to benchmark the best practice COVID-19 responses.

With the advent of a religious sect super-spreader, namely "New World, Sincheonji", the Republic of Korea struggled to respond promptly to COVID-19, and soon became the country with the second-highest COVID-19 infections, in late February, after China. However, Korea has implemented several innovative measures to effectively "flatten the curve" and provided timely prevention as well as medical care to the infected. Korea managed a well-controlled number of cases through the end of July (Figure 1).

Considering almost all nations have faced a similar rise in infections without proper equipment and gear, it is useful to look into the Republic of Korean response to COVID-19. It's time for innovative strategy beyond the classical response. This is needed due to the serious pandemic impact which is globally affecting societies. This article introduces two innovative technologies that the Republic of Korea took in its fight against COVID-19 that other Asian countries could consider; namely the Drive-thru or Walk-thru screening process and the introduction of a data platform called Epidemiological Investigation Support System within the Stepwise Approach in the standard tracing process.

Technological innovation regarding testing: Drive-thru and Walk-thru screening

One of most effective factors would be an augmented testing capacity due to the adoption of innovative technology. This enabled an impressive number of tests to be conducted within a short period of time. Testing, itself, is crucial to the diagnosis of patients and it has significant meaning in that it could block the viral spread as early as possible (2,000,552tests have been conducted as of September 3).

To limit the spread of the virus, numerous screening clinics have been set up nationwide at public health centers and private healthcare institutions to make sure there is easy access to diagnostic testing. Screening clinics are exclusively dedicated to testing.

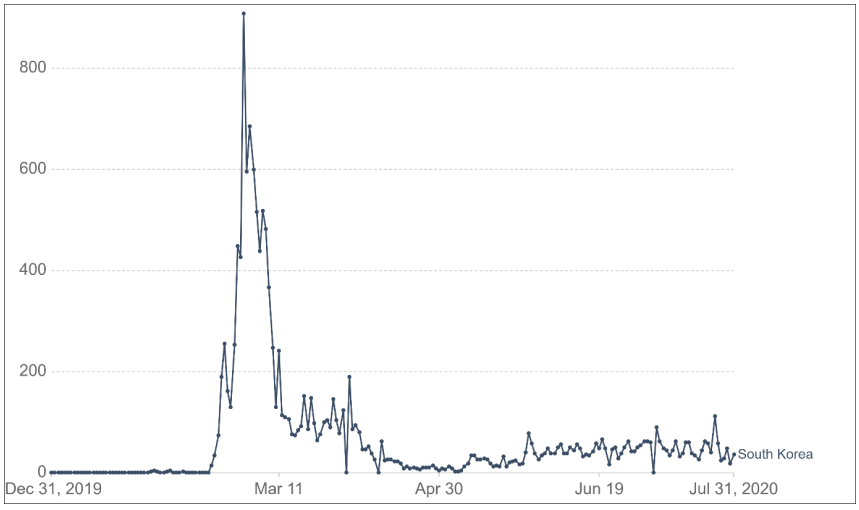
Those with suspected symptoms such as cough or fever were originally tested in a face-to-face testing booth requiring a time-consuming sterilization process between patients. However, innovative operating models have been adopted, such as Drive-thru and Walk-thru stations, to respond more effectively to the increasing demand for diagnostic testing.

Those models enabled professionals to meet extensive testing needs by collecting samples easier and faster than the traditional setting. Moreover, they could minimize the risk of cross infections during sample collection while maximizing testing capacities in the midst of the surge in the Republic of Korea's peak period of confirmed infection cases (February and March).

Newly adopted Walk-thru screening centers operated in the same way as Drive-thru, but required a much smaller space and shorter time for sample collection. The quick and safe Walk-Thru screening station is available in two different types: the negative pressure and positive pressure types. The only difference is in terms of who is inside the booth and how much time it takes for each sampling. For example, in a negative pressure type booth, patients go inside while healthcare professionals stay outside. This requires time to clean the insides of the booth after each sampling. A combination of the two types can be used depending on the situation (Figure 2).

Technological innovation regarding tracing: the epidemiological investigation support system

Contact tracing is a crucial part of COVID-19 response because it provides basic



Source: European CDC – Situation Update Worldwide – Last updated 26 August

Figure 1: Daily new confirmed COVID-19 cases in South Korea

Types	① Negative pressure booth (Booth for patients)	② Positive pressure booth (Booth for medics)
Details	Patients inside, Medics outside 	Patients outside, Medics inside 
Note	Booths need to be sterilized after each use. Medics outside the booth must wear protective gears. Takes 10 mins for each sampling due to cleaning & sterilizing of the booth inside.	Only the gloves used outside the booth need to be cleaned & sterilized. Medics inside do not necessarily have to wear protective gears. Takes 1 min for each sampling.

Figure 2: Types of Walk-Thru

information to prevent spreading and build response strategy. Contact tracing consists of 4 stages: (1) investigation, (2) exposure risk assessment, (3) contact classification, and (4) contact management (Figure 3).

In the investigation phase, basic information including the whereabouts of the patient for a certain period of time is collected through the process of face-to-face patient interviews. Additionally, family or healthcare workers may also be interviewed if needed. To cross check the personal testimonials of the confirmed patients, more objective information such as medical records, cellular GPS data, credit card transactions, and CCTV footage may be collected during the risk assessment phase. The problem is this process solely depends on manual work of epidemiologists in the local government.

The newly launched official data platform to track and analyze COVID 19 cases, developed in collaboration between the Ministry of Land, Infrastructure, and Transport (MOLIT), Ministry of Science and ICT (MSIT), and the Centers for Disease Control and Prevention (KCDC) of the Republic of Korea, was brought into service starting March 26.

With this new innovative technology in place, health officials who scrutinize each confirmed patient to trace their movements are able to correlate their interview results with the data uploaded on the platform. Moreover, the Big Data analysis gives officials real-time data on COVID 19 patients, including their whereabouts and the time spent at each location. From these multiple data points, the platform can detect incidents of cluster infections and show the source of transmission.

Compared to the conventional way of doing contact tracing, requiring numerous exchanges of documents and phone conversation among 28 relevant agencies, this new digital data platform streamlines the data collection process and enhances its speed and accuracy.

As below, benefits to be gained from this data platform are immense (Table1). This platform dramatically cuts the time consumed for contact tracing of each patient from one day to less than ten minutes. As the overall workload of health officials is reduced, a prompt response to the disease, regardless of its scale, becomes possible.

Regarding personal information, the scope of data collected should be kept to minimum in a due procedure. For example, an epidemiological surveyor should decide whether additional collection of the personal information is needed. If the answer is yes, the official should seek approval from relevant authorities to get access to the data. In the case of location information, separate permission from the National Police Agency is required.

The platform runs on a private network to shield the system from hacking and adopts advanced security technologies like double firewalls as well as the thorough log-in management system. With every user's activities put under strict surveillance, abuse of personal information can be prevented.

Successful factors enabling to adopt innovative technologies

1) Leadership and empowering culture

Top level of leadership would improve the morale of frontline medical workers and citizens. When there was a severe outbreak of

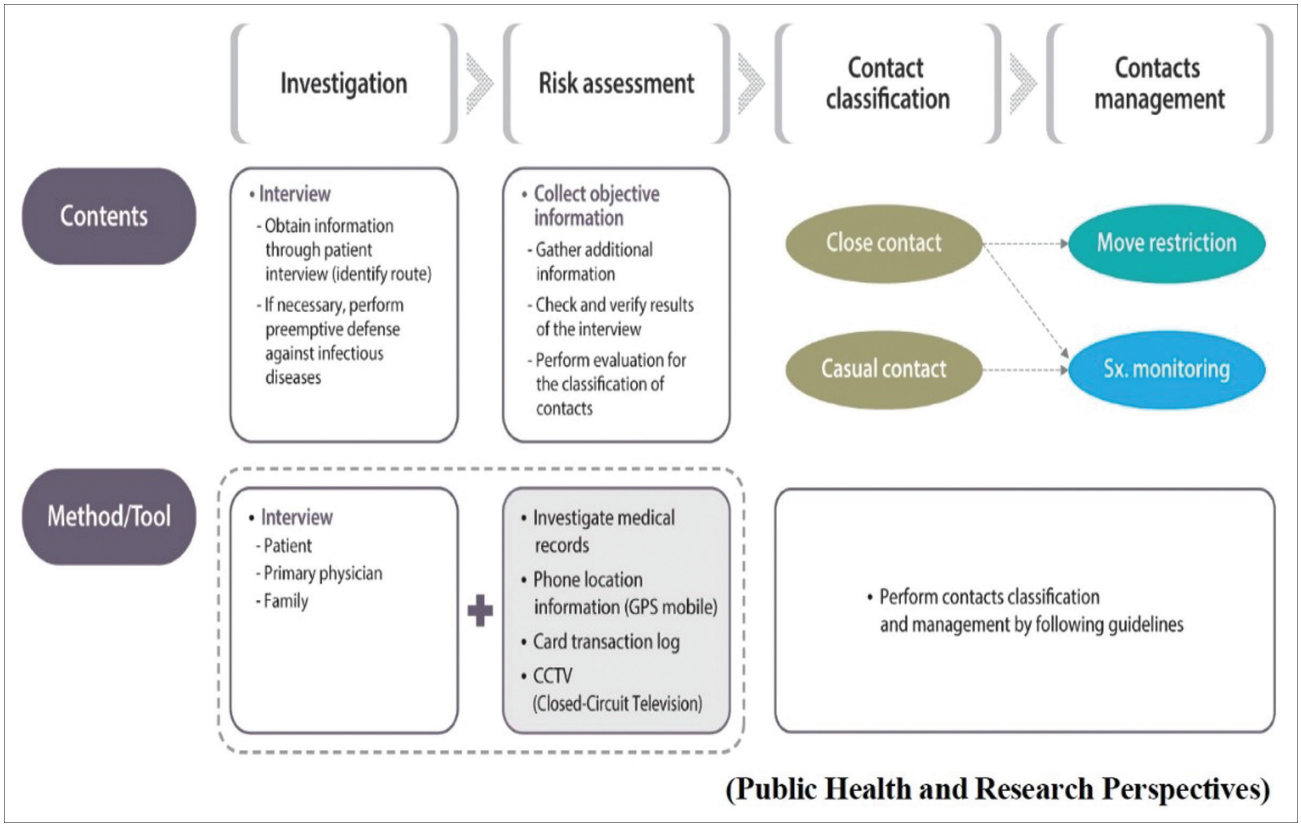


Figure 3: Contact tracing strategy: the stepwise approach

Table 1: Benefits of COVID 19 epidemiological investigation support system

	Before	After
Contact tracing method (time per case)	Manually tracked by health workers (one day per case)	Automated tracing (ten minutes per case)
Management of access record	Writing into a paper ledger	Automated tracking of log-in records
Coordination among agencies	Fragmented coordination by phone, e-mail	Multi-agency coordination under a central platform

COVID-19 in the Daegu area, the Republic of Korean prime minister positioned himself in Daegu to direct the response against the Coronavirus from there. The presence of top-leadership in the epicenter of the pandemic could enhance strong support and response to alleviate further infection, as it did in the Republic of Korea, and facilitates communication between all levels of governments.

Empowering administrative leadership strengthens the culture of scientific judgement-based response to an infectious disease outbreak. A chief of the agencies respects the experts' scientific judgement about a response to an infectious disease outbreak, the disease control agency can speed up the translation of the response innovative ideas and technologies to actions.

2) Institutional arrangement through policy learning

Innovative technology needs an institutional arrangement to establish and support accordingly a new idea on the spot. Regarding this pandemic, the Republic of Korean government enacted the Emergency Use Authorization (EUA) beforehand. The reactions by the Republic of Korean government to the COVID-19 outbreak is largely attributable to the clear COVID-19 protocol in place that guided all levels of the health governance systems about what everyone needed to do, and many of these protocols were institutionalized after the MERS outbreak. When MERS hit the country in 2015, diagnostic testing for MERS was very cumbersome and medical staff had to wait on the lab-based diagnostics for at least several days to confirm, while a newly adopted, faster, in-vitro diagnostic kit for MERS testing had not passed the clinical trials needed to meet the government regulation. After the MERS outbreak, the Republic of Korean government enacted a new Act in 2016 that allows using unapproved in-vitro diagnostic kits during serious public health emergencies. In the early stage of COVID-19, the Republic of Korean government quickly expanded testing in order to diagnose as many as possible and didn't stick to who met the criteria and who didn't. They also made it free to get tested, to detect and reign the super-spreaders as quickly as possible.

Korea turned to the network of public and private laboratories to develop tests. On February 4, the South Korean government granted a fast-track approval for a company's coronavirus test and began shipping the kits. A second company was approved

a week later, and two more soon followed. The Republic of Korean government has continued to increase the number of testing institutions and test kit manufacturers, thereby successfully raising the maximum daily testing capacity from 3,000 (February 7) to 18,000 (March 16). The total number of testing reaches 1,563,796 on 31th July.

3) Policy communication for mutual understanding

Pandemic demands for governments to provide sufficient information to the public in a timely manner to protect themselves according to government's countermeasures. All of those who are involved in the COVID-19 policy implementation, including the public, need to have a clear understanding of the nature of the problem and the policy response to it. In this context, innovative ideas and technology could be raised and adopted efficiently. Various methods for the building of mutual understanding between the public and private sectors can be used, such as media briefing, fact-checkers, promoting participation campaigns for self-quarantine, wearing face masks and social distancing - failure to do so could raise a distrust and cynicism in government response, which in turn hinders required citizen compliance.

Conclusion

As we have shown above, a distinguishing core feature of the Republic of Korean model of emergency management is that it did not use restrictive nationwide lockdowns, and harsh control of people's movements but used innovative technologies to "flatten the curve". On the one hand, Drive-thru and Walk-thru testing stations have contributed to the speedy response regarding the process of massive testing. On the other hand, the data platform "Epidemiological Investigation Support System" within the Stepwise Approach has played a crucial role in tracing patients and preventing further spreading of disease.

Based on those effective interventions through innovative technologies, this article suggests policy implications for boosting their usage as follows: leadership within an empowering culture as well as institutional arrangement through policy learning could be a solid foundation to facilitate innovative technologies. Furthermore, policy communication for mutual understanding should be stressed in a pandemic situation because the public could contribute to suggestions of suitable innovative technology and thereby enhance compliance of self-quarantine. Although the Republic of Korean Government has made a conscious effort to create a sense of trust by being transparent and sharing information through a daily public briefing, there is a trade-off between the transparent disclosure of information, and the public concern that emergency alerts would divulge personal information when assembling contract-tracing results. Some analysts also worried that the accumulated fatigue of receiving lots of text messages might reduce the willingness of citizens to be tested and to practice social distancing. Despite the international community's interest in Korea's action to contain the spread of the coronavirus, the Republic of Korea's fight against the pandemic is still ongoing with an ever-present risk of resurgence. The Republic of Korea has been effective in controlling the spread of the virus thus far and their efforts could suggest possible guidelines elsewhere in the world.

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Study on Access to Medical Technologies and Innovation

The World Health Organization (WHO), the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO) have jointly launched a new edition of the Trilateral Study on Access to Medical Technologies and Innovation. The publication seeks to strengthen the understanding of the interplay between the distinct policy domains of health, trade and intellectual property (IP), and how they affect innovation and access to medical technologies, such as medicines, vaccines and medical devices.

A COVID-19 section at the start of the publication provides a factual overview of the developments and measures taken to address this extraordinary public health crisis, which began after the work on the second edition of the study had been completed. The section guides the reader to parts of the study that are of direct relevance to the issues that have been raised during the pandemic. The study is designed to serve as a reference tool for policy-makers in the widest sense – lawmakers, government officials, delegates to international organizations, non-governmental organizations (NGOs), researchers, and all others who seek a compendium of the issues at the intersection of global health, innovation and intellectual property and trade.

For more information, access:

https://www.wipo.int/policy/en/news/global_health/2020/news_0003.html

Tech Events

2021

Jan 2–3
Singapore
2021 International Conference on Green Energy and Environmental Technology (ICGEET-2021)
Contact: Interglobe Research Network
Tel: +91-8895188931
E-mail: info@igrnet.org
http://www.icgeet.igrnet.org/

Jan 8–10
Kuala Lumpur, Malaysia
2021 7th International Conference on Renewable Energy Technologies (ICRET 2021)
Contact: Amber Tseng
Tel: +86-28-8777-7577
E-mail: icret@young.ac.cn
http://icret.org/

Jan 14–16
Thailand, Virtual Conference
5th International Conference on Control Engineering and Artificial Intelligence (CCEAI 2021)
Contact: Ms. Yury Yu
Tel: +852-30506939
E-mail: cceai@apise.org
https://www.cceai.org/

Feb 23–25
Singapore
2021 7th International Conference on Biotechnology and Agriculture Engineering (ICBAE 2021)
Contact: Ms. Erica Han
Conference Secretary
Tel: +852-3500-0137
E-mail: icbae@cbees.net
http://www.icbae.org/

Mar 24–25
Singapore
IoT Asia
Contact: SingEx Exhibitions Pte Ltd
11 Tampines Concourse #01-01,
Singapore 528729
Tel: +65 6403 2100
E-mail: sales.iotasia@singex.com
https://www.internetofthingsasia.com/

Mar 27–29
Singapore
2021 2nd Asia Conference on Renewable Energy And Environmental Engineering (AREEE 2021)
Contact: Nancy Liu
Conference Secretary
Tel.: +86-28-86512185
E-mail: areee@iacsitp.com
http://www.areee.org/

Apr 5–7
Abu Dhabi, UAE
World Future Energy Summit
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Tel: +971 2 4917615
E-mail: info@worldfutureenergysummit.com
https://www.worldfutureenergysummit.com/

Apr 20–21
Singapore
3rd annual Cleantech Forum Asia
Contact: Secretariat
E-mail: forums@cleantech.com
https://www.cleantech.com/event/cleantech-forum-asia/

May 12–14
Bangkok, Thailand
Renewable Energy Asia
Contact: Ms. Jittraporn Kulwanich
Tel: +66 2036 0500 ext. 244 and 235
Fax: +66 2036 0588
E-mail: jittraporn.k@informa.com;
asew-th@informa.com
https://www.asew-expo.com/2021/

May 22–24
Hong Kong, China
2021 3rd Asia IoT Technologies Conference (AIOTT 2021)
Contact: Ms. Penny Gan
Tel: 86-13290000003
E-mail: aiott_conf@yeah.net
http://www.aiott.net/

30 June–2 July
Bangkok, Thailand
Future Energy Asia 2021
Contact: Secretariat
E-mail: info@futureenergyasia.com
https://www.futureenergyasia.com/

July 20–22
Dalian, China
2021 Asia-Pacific Conference on Robotics, Automation and Communication Engineering (RACE 2021)
Contact: Ms. Hailey R. Wu
Tel: +852-30697093
E-mail: race@hksra.org
http://www.apcrace.org/

Sep 3–5
Gandhinagar, India
Agri Asia 2021 – 10th International Exhibition and Conference on Agriculture Technologies
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
https://www.agriasia.in/

Aug 26–28
Sapporo, Japan
4th International Conference on Bioenergy and Clean Energy (ICBCE 2021)
Contact: Ms. Hedy Zhao
HKCBEES Senior Editor
Tel: +852-3500-0137
E-mail: icbce@cbees.net
http://www.icbce.org/

Oct 12–14
Tashkent, Uzbekistan
3rd Central Asian International Exhibition and Business-Forum «Green technologies, environmental protection and recycling – GET Central Asia 2021
Contact: CCA, Mustakillik Avenue, 59A 2nd floor
Tashkent, Uzbekistan
Tel: +998 71 237 15 54
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Startup support in Bangladesh

StartUp Bangladesh

https://startupbangladesh.gov.bd

Venture capital investments spur innovation, create employment, and make a significant contribution to economic growth. With our population growing, globalization rapidly changing the international business climate, and sometimes making it uncertain, a culture of innovation can provide its own energy for Bangladesh by affording us opportunities for our young entrepreneurs. Where done correctly, the impact of government intervention in fostering an innovation economy has successfully created venture capital ecosystems in many countries. The Government of Bangladesh hopes to replicate similar success by founding Startup Bangladesh that will catapult its young generation of entrepreneurs to the next level who can accelerate the pace of innovation and lead the economy to a self-sustained path to growth. With this in mind, Startup Bangladesh aims to pursue the following goals:

- Create an accelerator and its accompanying ecosystem of entrepreneurs, investors, mentors, advisors to promote Bangladesh as a global hub for tech entrepreneurship.
- Actively collaborate with entrepreneurs, industry, academia, financial institutions, and government to stimulate innovation.
- Create the appropriate business, operational, and regulatory frameworks to support bold dreams.

Funding

Startup Bangladesh – iDEA provides pre-seed (idea), seed, and growth stage fund to startups. Pre-seed or idea stage startups can apply for grant which is up to 10 lakhs BDT. Seed and growth stage startups can apply for investment. For seed stage the investment can be up to 1 crore BDT and for growth stage startups, it can be up to 5 crore BDT. The growth stage startups may raise several rounds from us. The investment process and amount depend on the valuation and due diligence of the startups. And, all the funds are given in tranches.

Mentoring

Startup Bangladesh – iDEA provides mentoring to its portfolio startups. Startup Bangladesh – iDEA has a pool of expert mentors. The mentor's pool consists of national and international industry leaders, university professors, angel investors, successful entrepreneurs, and specific-field experts.

Academic programmmes

The iDEA academy provides different courses to train up entrepreneurs working in different industries. The academy provides long term and short-term courses in different levels considering entrepreneur's need. Workshops and training programs are also arranged regularly.

Networking

As the central hub of the startup ecosystem of Bangladesh, Startup Bangladesh – iDEA collaborates with national and international stakeholders who are working with startups. Startup Circle is created to foster the collaboration among the member organization. Match making sessions between startups and investors are arranged regularly.

Legal and IP support

Startup Bangladesh – iDEA guides and helps startups to protect their legal and intellectual property rights. If needed, the startups can also seek supports from Startup Circle members.

Coworking space

Startup Bangladesh – iDEA has a great coworking space for startups. Fifty-one desks have been furnished for the startups. Startups can also use the meetings rooms and other facilities created by the project.

ASEAN Startup Awards

ASEAN Startup Awards is part of the Global Startup Awards, providing an annual spotlight to those who dare to dream big and shape the way our future will look. The competition not only provides global recognition, access to the global network and to be matched with active investors, startups, incubation/acceleration programs and government initiatives from all around the world.

Having categories for Startups, Investors, Incubation/Acceleration programs, Ecosystem heroes and Co-working spaces, the mission of the award is to find, recognize and connect future-shapers from all over the world while keeping the independence of the competition, so we never sell your data and or charge you for anything.

The competition process for finding the winners involves all aspects of a startup ecosystem by using a network of local ambassadors, country partners, national jury members, international jury members from the entire globe as well as key advisors counting everyone from top investors, political stakeholders, founders and community builders.

For more information, access:

https://aseanstartupawards.com/

Startup Sri Lanka initiative

Startup Sri Lanka
https://www.startupsl.lk

Startup Sri Lanka was an initiative by the Ministry of Digital Infrastructure & Information Technology and is currently being operated under the Digital Infrastructure and Information Technology Division, Ministry of Defence, Sri Lanka. Our mission is to transform Sri Lanka through technology and entrepreneurship. We are working to support the tech community and accelerate the growth of Sri Lankan startups and freelancers. We believe that strong homegrown startups and freelance community is vital to the future growth of Sri Lankan jobs and wealth.

This platform is the single largest online platform for startups and freelancers in Sri Lanka, connecting them to thousands of other startups, as well as other key stakeholders such as investors, mentors, and incubators.

The efforts are focused on trying to get the big picture right for Sri Lankan startups and freelancers – improving the regulatory environment, building a case for the right sort of government support for a fast-growing sector, and increasing public awareness of the impact of tech startups and freelancers across the country. We work with startups, freelancers, and investors to help around the country get the settings right to create successful startup ecosystems.

The partners provide the backbone of this initiative and are vital to our success. We would not be able to do what we do without this generous support.

Accreditation

Startups can get accredited from the Ministry of Digital Infrastructure and Information Technology, where it will be a value addition in terms of applying for any grants or loans when submitting applications for new tenders and bids.

Financing

Special finance schemes for startups. Government concessions, loans, grants, and in future tax holidays as well as other tax benefits will be available for startups and freelancers. Government-led venture capital schemes could also be accessed by the registered startups.

Partnerships

Startup Sri Lanka will have partnerships among different professional bodies within Sri Lanka and overseas, where Sri Lankan startups and freelancers could benefit out of the links in terms of expanding their business within the country and outside the country.

Market access

Startups will be given information and subsidized rates for expanding outside Sri Lanka. Registered startups and freelancers will be given priority when taking part in global access market programs led by government initiatives.

Technology Bank for Least Developed Countries

The United Nations Technology Bank for Least Developed Countries is a global organization dedicated to enhancing the contribution of science, technology and innovation for sustainable development in the world's least developed countries. The UN Technology Bank became operational in 2018 and serves the 47 least developed countries (LDCs) and former least developed countries for up to five years after their graduation from the category.

the UN Technology Bank actively engages with national, regional and international partners to deliver its programme and projects which strengthen science, technology and innovation capacity in least developed countries. The UN Technology Bank supports national and regional technological efforts, reinforces partnerships across sectors and helps nations identify and use appropriate technologies to transform their economies and improve livelihoods.

The UN Technology Bank has been established to help least developed countries build science, technology and innovation capacities, ecosystems and regulatory frameworks. These can harness the benefits of newly available technologies by:

- Attracting outside technology and facilitating technology transfer on voluntary and mutually agreed terms and conditions
- Supporting homegrown innovation and research
- Bringing imported and indigenous technologies to market

For more information, contact:

UN Technology Bank for the LDCs
TUBITAK Gebze Kampusu, Teknoloji Serbest Bolgesi, No: 26/1
41470 Gebze, Kocaeli, Turkey
Tel: +90 2626766300
Fax: +90 2625022169
E-mail: UNTB@un.org
https://www.un.org/technologybank/

Petty patent registration in Thailand

Department of Intellectual Property, Thailand

http://www.ipthailand.go.th

Consideration criteria

1. Invention applied for the patent should be characterized as follows;
   - 1.1 The invention shall be a new creation.
   - 1.2 The invention can be used for industrial applicability.
   - 1.3 The following inventions shall not be protected by the Patent Act.
     - (1) Microorganism and any component of the micro-organism naturally existing in animal, plant or extract from animal or plant;
     - (2) Scientific or mathematical principles and theories;
     - (3) Database for computer functions;
     - (4) Method of diagnosis, treatment, or care of human and animal diseases;
     - (5) The invention that contradicts public order, morality, health or welfare;
2. To apply for a petty patent, the applicant shall submit supporting documents as follows;
   - (1) Title of the invention
   - (2) Describe features and objectives of the invention
   - (3) Invention details. The invention shall be described in details completely, concisely, and clearly, with which an ordinary person specialized in the relevant technical field can create such invention.
   - (4) Claim
   - (5) Other documents stipulated in the Ministerial Regulation

Conditions of application submission

1. To receive a petty patent, the applicant shall submit the form as determined by the Director-General.

The petty patent application shall be accompanied with invention details, claim and summary of invention. If necessary, the applicant shall provide drawing(s) as supporting documents of the application for the better understanding of the invention.

If the invention applied for the patent is involved with a new microorganism, the invention details shall mean the certificate of bio-organism deposit and/or document describing its features or properties issued by an institution for bio-organism deposit. In this regard, the Department of Intellectual Property shall announce the list of institutions from time to time.

2. Authorization
   - 2.1 In case the applicant of the petty 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/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 from or since the notification reception date. After such period, without the correction of the applicant shall be deemed to have abandoned the application according to Section 27, 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 corrected 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 or internet/E-patent filing system 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.

4. In case the application is correct or the correction is completed, the official shall notify the applicant to pay the registration and publication fees within 60 days from or since the notification date. If the applicant does not pay the fees after the second notification, the applicant shall be deemed to have abandoned the application. As for the publication, the registration application shall be announced in the petty patent publication book.
5. After the publication, any interested person can request the inspection against the petty patent application whether it complies with the laws within 1 year of the publication date. After 1 year, the examination shall complete the consideration. If the applied patent does not comply with the laws, it will be revoked.
6. In case of the application revocation, the appeal can be submitted to the official in accordance with the laws.

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 for petty patent. 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 examination or corrects the application, or the period of temporary suspension of registration.
9. The applicant is entitled to convert application to change the protection category (i.e. from petty patent to patent) prior to the issuance or prior to the publication, as the case may be. In this regard, the date of request for the change is deemed as the first day of the protection period.

Relevant laws

1. The Ministerial Regulation No.21 (B.E. 2542) issued by virtue of the Patent Act B.E. 2522 (Dated 24 September 1999).
2. The Ministerial Regulation No.22 (B.E. 2542) issued by virtue of the Patent Act B.E. 2522 (Dated 24 September 1999).
3. 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

Regional Initiative on Climate Change

The Regional Initiative on Climate Change (RI-CC) supports the FAO Strategy on Climate Change and Action Plan Results Framework at the regional and national levels. The RI-CC directly responds to member-country emphasis during the 33rd Session of the APRC on the importance of the SDGs and the Paris Agreement in guiding future actions in agriculture, food security and nutrition. It will also contribute to the Global Action Programme on Food Security and Nutrition in Small Island Developing States (SIDS), through regional evidence and knowledge sharing for more climate policy action in SIDS.
For more information, access:

http://www.fao.org/asiapacific/perspectives/climate-change/en/

Registration of transfer of patent and petty patent in Thailand

Department of Intellectual Property, Thailand

http://www.ipthailand.go.th

Consideration criteria

The patent transferring contract is a contract with which the assignor grants the right to the assignee right (assignment of patent/petty patent). In this regard, the right transferring shall not exceed the protection period as follows;

* 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 the laws.

Conditions of application submission

1. To register a transfer of the patent/petty patent, the applicant shall submit the form as determined by the Director-General, together with the transferring contract of 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/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

Pat-INFORMED – The Gateway to Medicine Patent Information

The Patent Information Initiative for Medicines (Pat-INFORMED) provides a service to the global health community, particularly those involved in procurement of medicines, by facilitating easy access to medicine patent information. The data is provided directly by the biopharmaceutical companies and hosted by WIPO.

Anyone can search the Pat-INFORMED database simply by entering a medicine's INN (International Nonproprietary Name) to obtain relevant information about its patent status in a particular country. Uniquely, Pat-INFORMED also provides a facility for procurement agencies to make follow-up inquiries directly with participating companies. While it is not a tool to provide Freedom to Operate analysis, it facilitates access to patent information and can improve efficiency in procurement processes.

Pat-INFORMED currently provides information on key patents for all small-molecule products submitted by participants in the Initiative. The following therapeutic areas are covered:

- HIV/ AIDS, Cardiovascular diseases, Diabetes, Hepatitis C, Oncology, Respiratory conditions; and
- All products on the WHO Essential Medicines List (EML) that are not within these six areas.

The database is being gradually expanded to cover other small molecules products outside these areas.

Pat-INFORMED is of particular use to pharmaceutical procurement services and related specialists of:

- National pharmaceutical services
- Ministries of health
- National patent offices
- International procurement agencies

The follow-on inquiry facilities is reserved to procurement agencies. Companies' responses are not confidential.

For more information, access:

https://www.wipo.int/pat-informed/en/

Stages of startups and sources of funding

Startup India

https://www.startupindia.gov.in

There are multiple sources of funding available for startups. However, the source of funding should typically match the stage of operations of the startup. Please note that raising funds from external sources is a time-consuming process and can easily take over 6 months to convert.

Ideation/pre-seed stage

This the stage where you, the entrepreneur, has an idea and are working on bringing it to life. At this stage, the amount of funds needed is usually small.

Given the fact that you are at such an initial stage in the startup lifecycle, there are very limited and mostly informal channels available for raising funds. Common funding sources utilized by startups in this stage are:

- **Bootstrapping/self-financing:** Bootstrapping a startup means growing your business with little or no venture capital or outside investment. It means relying on your own savings and revenue to operate and expand. This is the first recourse for most entrepreneurs as there is no pressure to pay back the funds or dilute control of your startup.
- **Friends and family:** This is also a commonly utilized channel of funding by entrepreneurs still in the early stages. The major benefit of this source of investment is that there is an inherent level of trust between the entrepreneurs and the investors
- **Business plan/pitching events:** This is the prize money/grants/financial benefits that is provided by institutes or organizations that conduct business plan competitions and challenges. Even though the quantum of money is not generally large, it is usually enough at idea stage. What makes the difference at these events is having a good business plan.

Validation/seed stage

This is the stage where your startup has a prototype ready and you need to validate the potential demand for your startup's product/service. This is called conducting a 'Proof of Concept (PoC)', after which comes the big market launch. To do this, the startup will need to conduct field trials, test the product on a few potential customers, onboard mentors, and build a formal team. Common funding sources utilized by startups in this stage are:

- **Incubators:** Incubators are organization set-up with the specific goal of assisting entrepreneurs with building and launching their startups. Not only do incubators offer a lot of value-added services (office space, utilities, admin and legal assistance, etc.), they often also make grants/debt/equity investments
- **Government loan schemes:** The government has initiated a few loan schemes to provide collateral-free debt to aspiring entrepreneurs and help them gain access to low-cost capital. Some such schemes include CGTMSE, MUDRA, and Stand-up India.
- **Angel investors:** Angel investors are individuals who invest their money into high potential startups in return for equity. Reach out to angel networks such as Indian Angel Network, Mumbai Angels, Lead Angels, Chennai Angels, etc. or relevant industrialists for this.
- **Crowd funding:** Crowdfunding refers to raising money from a large number of people who each contribute a relatively small amount. This is typically done via online crowdfunding platforms.

Early traction/series a stage

This is the stage where your startup's products or services have been launched in the market. Key performance indicators such as customer base, revenue, app downloads become important at this stage. Funds are raised at this stage to further grow user base, product offerings, expand to new geographies, etc. Common funding sources utilized by startups in this stage are:

- **Venture capital funds:** Venture capital (VC) funds are professionally managed investment funds that invest exclusively in high-growth startups. Each VC fund has its own investment thesis – preferred sectors, stage of startup, and funding amount – which should align with your startup. VCs take startup equity in return for their investments and actively engage in mentorship of their investee startups.
- **Banks/NBFCs:** Formal debt can be raised from banks and NBFCs at this stage as the startup can show market traction and revenue to validate their ability to finance interest payment obligations. This is especially applicable for working capital. Some entrepreneurs might prefer debt over equity as they debt funding does not dilute equity stake.
- **Venture debt funds:** Venture debt funds are private investment funds that invest money in startups primarily in the form of debt. Debt funds typically invest along with an angel or VC round.
- **TReDs:** To decrease the financing concerns faced by MSMEs in India, RBI introduced the concept of TReDS in 2014, an institutional mechanism for financing trade receivables on a secure digital platform. Trade Receivable Exchanges such as M1xchange, standardizes the process of funding MSMEs via Invoice Discounting. TReDS addresses the gaps in MSME in-

dustry as enterprises face challenges in getting their payments on time, thus creating working capital discrepancies. TReDS is a timely and effective solution to drive the MSME sector to the next phase of Indian economy.

Scaling/series B and above stage

At this stage, the startup is experiencing fast rate of market growth and increasing revenues. Common funding sources utilized by startups in this stage are:

- **Venture capital funds:** VC funds with larger ticket size in their investment thesis provide funding for late stage startups. It is recommended to approach these funds only after the startup has generated significant market traction. A pool of VCs may come together and fund a startup as well.
- **Private equity/investment firms:** Private equity/Investment firms generally do not fund startups; however, lately some private equity and investment firms have been providing funds for fast-growing late-stage startups who have maintained a consistent growth record.

Initial public offering

Initial Public Offer (IPO) refers to the event where a startup lists on stock market for the first time. Since the public listing process is elaborate and replete with statutory formalities, it is generally undertaken by startups with an impressive track record of profits and who are growing at a steady pace. One of the benefits of an IPO is that a public listing at times can increase the credibility of the startup and be a good exit opportunity for stakeholders.

Any Angel investor, VC, or PE fund may buy out investors of a previous round to get their equity share as well. Also, there are various State Policies also which help the startups in various phases of funding or give them incentives and allowances to help them grow such as:

Startup India: State Policies

There are various initiatives by the respective states that are taken to help accelerate the growth of startups in various states. They proactively work towards helping the startups and the entrepreneurs in their ventures by giving them relaxation in building Angel Network, State funded grants, Matching Loans, Success Fee for fundraising. Various initiatives have been taken by States like Karnataka for setting up Idea2POC and Rajasthan for setting up Istart etc.

The following are some initiatives by the states:

- **Karnataka:** Government of Karnataka provides seed funding under the "Idea2PoC" scheme of Startup Policy of Karnataka 2015–20. *Idea2POC* is given in the form of Grant-in-aid but limited to a one-time grant of up to INR 50 lakhs. Aspiring entrepreneurs can apply for the scheme incentive during call for proposal through an online portal. The website also mentions the required eligibility criteria.
- **Gujarat:** State Government provides seed funding to startups in the form of Sustenance Allowance, Product Development Assistance and Marketing Assistance. An amount of INR 10 lacs is provided as seed funding
- **Jammu and Kashmir:** Government of J&K has launched Seed Capital Fund Scheme under which Seed Money up to maximum INR 10 lacs the project cost is provided to eligible prospective entrepreneurs to kickstart their ventures
- **Rajasthan:** Government of Rajasthan provides seed funding in form of monthly sustenance allowance under the 'Assistance for Startup at Idea or prototype stage' of Rajasthan Startup Policy 2015. All eligible startups can apply for seed funding through their iStart Startup dashboard.

The Least Developed Countries Report 2020

Least developed countries (LDCs) have so far been spared from the worst effects of the health emergency, yet the fallout from the COVID-19 pandemic has taken its toll on their economies, rolling back some of the progress made towards sustainable development and possibly leading to long-term damage. Not only has the crisis laid bare structural weaknesses of LDCs, but also the deep-seated flaws of the international support measures at their disposal. It has also brought back to the fore the pivotal role of productive capacities for a sustainable, inclusive and resilient recovery.

UNCTAD's The Least Developed Countries Report 2020: Productive Capacities for the New Decade maintains that the broadening and full utilization of LDC productive capacities remains central to upgrade LDC economic structure, and bridge their development gaps vis-à-vis other countries. In the same vein, using UNCTAD's Productive Capacities Index as a yardstick, the report documents how the performance of LDCs against the objectives enshrined in the Istanbul Programme of Action has been uneven and overall lackluster, with only a handful of LDCs displaying sustained progress.

The advent of digitalization and the Fourth Industrial Revolution are modifying the very nature of productive capacities and reshaping global value chains. Advanced technologies offer ample scope for spillovers and productivity gains, but also risks deepening entrenched inequalities and technological divides.

Against this background, bold concerted policies to strengthen LDC productive capacities are as imperative as ever; in fact, the report maintains that they should constitute a key pillar of any sustainable recovery and development strategy.

For more information, access:

https://unctad.org/webflyer/least-developed-countries-report-2020

Green technology financing in Malaysia

Malaysian Green Technology Corporation

https://www.gtfs.my

As part of the effort to ensure continuous supports toward Green Technology projects, the Ministry of Finance has agreed to the recommendation proposed by Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), with several enhancement and improvement to the scheme and known as GTFS 2.0.

Malaysian Green Technology Corporation, also known as GreenTech Malaysia, is an organization under the purview of the Ministry of Energy, Science, Technology, Environment & Climate Change.

Established in 2010, our mandate is to spearheading the development and promotion of green technology as a strategic engine for socio-economic growth in line with Green Technology Master Plan 2017–2030.

GTFS 2.0 also offers a financial support [subject to only to the green technology/component cost finance by Participating Financial Institutions (PFIs)] for producer, user and also offer a financial support to a new category, which is for Energy Services Companies (ESCOs) also offer a rebate of 2% on interest/profit, is to accelerate the expansion of green investments by providing easier access to funding via financing from participating financial institutions (PFIs) with a total funding earmarked up to RM2.0 billion. The new category is to support ESCOs to finance investment or assets related to energy efficient project and/or energy performance contracting.

All applications of the Scheme are channeled to Malaysian Green Technology Corporation (GreenTech Malaysia) on which conducts the initial screening and certification prior to applying financing from financial institutions. The Scheme is made available until 31 December 2020 or upon reaching a total financing/funding approval amount of RM2.0 billion whichever is earlier or any subsequent extension on the availability date expected to facilitate the growth of local green businesses and generates new markets and job creation.

Malaysian Green Technology Corporation (GreenTech Malaysia) and Credit Guarantee Corporation Malaysia Berhad (CGC) are the agencies tasked with administering the Scheme. GreenTech Malaysia is responsible for the promotion, assessment, certification, and monitoring to producers, users, and ESCOs under the Scheme, while CGC administers the rebate payments.

In April 2018, the MOF had approved an extension of the GTFS known as GTFS 2.0 with a financing amount earmarked up to RM 5.0 billion. The Scheme was later launched on 3 May 2018 in Kudat, Sabah. However, after the 14th General Election in May 2018, the new Government administration had decided to discontinue the Scheme. Later, on 6 March 2019, MOF had approved to reinstate GTFS 2.0 with the allocation of RM 2.0 billion for the period of January 2019 until the end of 2020. The Scheme which will last for 2 years will be offering a 2% p.a. interest/profit rate subsidy for the first 7 years with 60% government guarantee on the financing.

Key areas and projects criteria

What technology can be funded?

Funding will be provided for any project that qualify the PFI requirements and meets green technology project criteria under GTFS program. Evidences of proven business model and technology may be required to ensure that only viable projects will be funded.

General Criteria

All products, equipments, and systems that satisfy the following criteria:

- Minimize degradation of environment;
- Zero or low green house gas emission;
- Safe for use and promotes healthy and improved environment for inhabitants;
- Conserve the use of energy and natural resources;
- Promote the use of renewable energy resources.

Connect2Recover Initiative

Information and communication technology (ICT) infrastructure has proven vital in helping countries and consumers adapt and respond to the COVID-19 pandemic. ICTs have enabled them to continue working and learning remotely, and to access the latest health information, updates and directives from local and national authorities.

Connect2Recover is a global initiative that aims to reinforce the digital infrastructure and ecosystems of beneficiary countries. In addition, its objective is also to provide means of utilizing digital technologies such as telework, e-commerce, remote learning and telemedicine to support the COVID-19 recovery efforts and preparedness for the 'new normal' (and potential future pandemics), and, where it is still needed, to prevent the spread of COVID-19 infections while maintaining socio-economic activities.

The key focus of the initial phase of Connect2Recover will be to ensure its further scalability, including through engaging additional partners and donors, and widely sharing the results of the outcomes.

For more information about participation and contribution to Connect2Recover, please contact: bdtdirector@itu.int

https://www.itu.int/en/ITU-D/Pages/connect-2-recover.aspx

Technology facilitation and business innovation

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

The Malaysian Foundation for Innovation (YIM) Technology Facilitation & Business Innovation division drives innovation development through a variety of mechanisms, initiatives, and programmes such as Mainstreaming Grassroots Innovations (MaGRIs) and High Impact Programme (HIP6).

YIM provides support and funding varies throughout various stages of the innovation life cycle, ranging from research and development, prototyping improvement, capacity building, market diffusion, and technology deployment through multi-stakeholder collaboration. Such partnerships enhance the sharing of expertise, information and best practices with innovator coaching, and step-by-step facilitation managed by YIM's trained and dedicated Project Managers.

IP management

While YIM provides grants, facilitates capacity building and innovation development, for the innovation to be protected against idea duplication and risk of copyright infringement, it is important to implement intellectual property (IP) protection.

IP registration that covers a limited period of time provides innovators some measure of legal property rights to prevent others from duplicating the innovation design, exact component composition, logos or other discoveries which are proprietary to the innovator for commercial use without the agreement of the IP owner.

YIM plays the role of advising and connecting innovators to registered IP registration companies for professional consultancy. There are instances when YIM funds the registration of the IP.

The result is that innovators or the companies that owns the innovations are able to gain and retain their competitive advantage. Innovations protected with IPs are also more likely to win the approval of potential angel investors, venture capitalists, funders, financial institutions, and potential partners for strategic collaboration.

Licensing

One of the strategies to help innovators or startups with new innovations to raise funds is through licensing.

YIM provides licensing advisory services and supports in the negotiation of term agreements by connecting the innovators to regional distributors whereby revenue can be generated through further research and development exercises and product sales or usage royalty.

Industrial design

In YIM, project managers are assigned to innovation projects to help innovators improve their prototypes.

Part of this involves industrial design whereby YIM guides innovators on how to conduct research, connect with industry experts and other specialists in improving the prototype design and functionalities.

YIM also aids in the training of innovators in creative design thinking methodologies such as TRIZ which accelerates innovators' design improvement capabilities through structured and algorithmic analysis approach. Integrating the industrial design thinking processes into innovation development inculcates creativity with customer-driven strategies and improved innovation outcomes.

Product testing

New innovations require to undergo concept testing and product testing in order to identify the market opportunities. Feedback on product usage potential, utility, features, and functions are obtained and functionalities are obtained from prospective users or customers. This is followed by prototype development or improvement, and if funds are available, pilot products may be commissioned.

The prototypes or pilot products will undergo product testing in the form of technical or process testing, ease of usage, and actual product benefits.

Market testing

Market testing is conducted once remedial actions or product improvements are made following the product testing feedback.

The objective of the market testing is to test the potential market receptiveness of the product through evaluations across the distribution channels such as retailers, agents, and potential customers.

Market research

Market research is one of the strategies employed in YIM's innovation development projects. This is vital to ensure the right product–market fit achievement.

The activities that are conducted as part of this market research include product field tests, feasibility reports, and business plans that outline the innovation's commercialization strategy. Conducting market research helps innovators and potential new startups to engineer their products to meet the needs of the target audience, buyers, and potential customers.

Atal Innovation Mission

National Institution for Transforming India (NITI) Aayog, Government of India

https://aim.gov.in

Atal Innovation Mission (AIM) is Government of India's flagship initiative to promote a culture of innovation and entrepreneurship in the country. The objective of the AIM is to develop new programmes and policies for fostering innovation in different sectors of the economy, provide platform and collaboration opportunities for different stakeholders, create awareness, and create an umbrella structure to oversee innovation ecosystem of the country.

Five major initiatives taken in the first year of establishment:

1. Atal Tinkering Laboratories (ATLs) – Creating problem-solving mindset across schools in India.
2. Atal Incubation Centers (AICs) – Fostering world class startups and adding a new dimension to the incubator model.
3. Atal New India Challenges – Fostering product innovations and aligning them to the needs of various sectors/ministeries.
4. Mentor India Campaign – A national Mentor network in collaboration with public sector, corporates, and institutions to support all the initiatives of the mission.
5. Atal Community Innovation Center – To stimulate community centric innovation and ideas in the unserved/underserved regions of the country including Tier 2 and Tier 3 cities.
6. ARISE – To stimulate innovation and research in the micro, small, and medium enterprises (MSME) industry.

Atal Tinkering Laboratories

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

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

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

Atal Incubation Centers

AIM intends to support the establishment of new incubation centers called Atal Incubation Centers that would nurture innovative start-up businesses in their pursuit to become scalable and sustainable enterprises. The AICs would create world class incubation facilities across various parts of India with suitable physical infrastructure in terms of capital equipment and operating facilities, coupled with the availability of sectoral experts for mentoring the startups, business planning support, access to seed capital, industry partners, trainings, and other relevant components required for encouraging innovative startups. Moreover, AICs would be established in subject-specific areas such as manufacturing, transport, energy, health, education, agriculture, water, and sanitation.

Atal New India Challenge (ANIC)

One of primary goals of AIM is to incentivize innovation in areas critical to India's growth. The innovative solutions in the areas like health, housing, hygiene, energy, and water can impact directly on livelihood of all sections of society. Researchers have long talked of the 'Valleys of Death' at the early stage and commercialization stage in taking innovations to market. The Atal New India Challenge aims to address the second Commercialization Valley of Death, in which innovators are unable to access resources for piloting, testing, and market creation. In total, 24 challenges are launched in partnership with five different ministries and departments of central government.

The vision of ANIC is two-fold:

- help create products from existing technologies relevant for national and social causes (productization);
- help new deep-tech products find markets and early customers (commercialization) in the context of India.

The scope of the program extends to developing an institutional mechanism and structure to channel potential innovative ideas for products and technologies from startups and MSMEs on their own or along with R&D organizations, academic institutions, and even individual innovators.

Mentor of Change Program

Mentor of Change Program is a strategic nation-building initiative to engage leaders who can guide and mentor students in thousands of ATLs and startups and incubators under the programs of AIM across India. We are looking for leaders who can spend 1 to 2 hours every week in one or more such laboratories or with the startups/incubators and enable them to experience, learn, and

practice future skills such as design and computational thinking and inculcate the spark of innovation and entrepreneurship.

These laboratories are nonprescriptive by nature, and mentors are expected to be enablers rather than instructors.

Possible areas of contribution could be, but not limited to:

- Technical knowhow: building prototypes,
- Innovation and design: inculcating solution-oriented approach,
- Inspirational: leadership and self-motivation, and
- Business and entrepreneurship: encouraging ideas and team building
- Sounding board/guide, break stereotypes, and bias to bring about mind set and behavioral change.

Atal Community Innovation Center

AIM has taken this new initiative to support community innovation drive in the country. The program is directed to encourage the spirit of innovation through solution driven design thinking to serve the society. It will focus on undeserved/unserved regions of the country which at present lack a vibrant startup and innovation ecosystem.

Aatmanirbhar Bharat ARISE-Atal New India Challenge (ANIC)

The Aatmanirbhar Bharat ARISE-Atal New India Challenge (ANIC) program is national initiative to promote research and innovation and increase competitiveness of Indian startups and MSMEs. The objective of Aatmanirbhar Bharat ARISE-ANIC program is to proactively collaborate with five esteemed ministries and the associated industries to catalyze research and innovation, and facilitate innovative solutions to sectoral problems. The objective is also to provide a steady stream of innovative products and solutions where the central government ministries/departments will become the potential first buyers.

The Aatmanirbhar Bharat ARISE-ANIC program is in line with the Honourable Prime Minister's mandate of "Make in India,""Startup India," and "Aatmanirbhar Bharat" to fast track the growth of the Indian MSME sector.

New Patent Information Tool for Innovators

The World Intellectual Property Organization (WIPO) has expanded its suite of online services with an online platform providing free access to comprehensive, unbiased, and structured reports on many patent databases. WIPO INSPIRE (Index of Specialized Patent Information Reports) will help a range of stakeholders in searching the myriad of patent databases around the world.

WIPO INSPIRE is a digital product to help innovators spread innovation for the widest human benefit. It is a platform that helps users reach informed decisions on the patent-search tools that suit them best in their work, whether they are examining patents or making R&D related decisions. Patents disclose important technical information that also serves as building blocks for other innovators and innovations. WIPO INSPIRE facilitates this process and we hope that it will pave the way for more innovations to move faster to the market.

WIPO INSPIRE offers a range of powerful but easy-to-use functionalities for both novice and expert patent information users in mind. They include:

- a comparison of features for up to four patent databases,
- an interactive world database coverage map, allowing users to determine, at a glance, which patent databases offer coverage of a specific jurisdiction.

WIPO INSPIRE is integrated with WIPO's Patent Register Portal and eTISC, providing a seamless environment for users to get information about patent databases and patent registers and an opportunity to interact with patent information experts and discuss these tools.

F For more information, access:

https://inspire.wipo.int/

Greening manufacturing in the Philippines

Department of Trade and Industry, Philippines

http://industry.gov.ph

Greening the Philippine manufacturing industry roadmap

The manufacturing sector of the Philippines is challenged to significantly strengthen its competitiveness in order to be prepared for the challenges lying ahead. Seeing the worldwide dynamics of industrial development and the integration process of the ASEAN Economic Community, it becomes obvious that the manufacturing industry needs to successfully position itself as a globally competitive industry on domestic, regional, and global markets.

Asia's economies and their businesses are increasingly becoming main drivers for Green Economic Development (GED) worldwide. It is obvious that the manufacturing industry of the Philippines is challenged to be responsive and proactive to this worldwide trend. Already today, the business community sees in the overuse of natural resources and the impacts of climate change a key challenge to do business successfully and to ensure its long-term economic growth perspective.

In a common effort, industry and government in the Philippines have launched an initiative, in which sectoral road maps have been elaborated and submitted to the Department of Trade and Industry and the Board of Investments. The so-called Road Map Process is a unique opportunity to define a well-focused stimulation and promotion for an industry-driven GED that is integral part of a modernization and innovation process of the economy of the Philippines. Within the industry sectors, each company has to elaborate and implement their own strategy to unleash the specific market potential for products and service delivery.

Public policies on regulation, subsidies, incentives, and information have a central role to play for the green modernization of the industry. Green investment from both the public side and the private side is an investment for immediate returns and for the future.

Worldwide experiences show that without a forceful and coordinated set of actions that removes barriers and sets favorable framework conditions, it is unlikely that even the most economically beneficial options would overcome a short-term sighted "Buy-the-Cheapest" or "Business-as-Usual" attitude. In cooperation with other government entities, the BOI and DTI should contribute to setting framework conditions and to building up capacities that support a paradigm shift toward an innovation process that results in competitiveness, good environmental performance, climate change resilience, and job creation.

Promotion of Green Economic Development (ProGED) project

ProGED is a project of the Department of Trade and Industry (DTI) with the Federal Republic of Germany through the Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ). It is primarily aimed at improving the competitiveness of MSMEs while coping with climate change adaptation and mitigation requirements through the adoption of environment-friendly, climate-smart, and inclusive strategies and measures.

Interventions are implemented at the operational level through the Regional and Provincial offices of DTI (to support the enterprises in greening their operations), as well as at the policy level through the Regional Operations Group (ROG), where the green perspective is integrated into the programs and projects of DTI. A Green Growth Core Group has likewise been established within ROG to steer their initiatives on greening MSMEs within the Department.

ProGED promotes a green economy strategy founded on the five pillars of mitigation, adaptation, competitiveness, green jobs, and preserving or even improving nature's capital. The project focuses initially on the tourism sector with its high potential for investment, employment, and poverty reduction due to its linkages with upstream and downstream industries in other economic sectors.

The project is implemented from 2013 to 2016 and piloted its approach in the Provinces of Cebu and Bohol. Since 2014, it has expanded to include fourteen replication provinces in seven regions, namely Pampanga and Tarlac (Region 3), Laguna and Cavite (Region 4A), Palawan and Occidental Mindoro (Region 4B), Albay and Camarines Sur (Region 5), Negros Occidental and Capiz (Region 6), Negros Oriental and Siquijor (Region 7), and Agusan del Norte and Surigao del Norte (Region 13). Aside from tourism, additional priority sectors are taken up according to the location's competitive advantages.

In relation to its efforts to support the greening of enterprises and upon the request by DTI, ProGED also supported the Greening the Manufacturing Industry Roadmaps process, which aims at integrating green economic development elements in selected industry roadmaps and the overall manufacturing roadmap. This will create climate smart, environment friendly, and globally competitive manufacturing industries in the Philippines.

Started in 2014, the initiative has fielded three missions by Dr. Bernd Gutterer, an international GED consultant commissioned by GIZ to the Philippines. The first mission was held in July 2014, wherein initial consultations with various industry associations and stakeholders were conducted to assess awareness of GED concepts. The second mission was held in November 2014, wherein one-on-one discussions with six industries selected by DTI (automotive, copper, furniture, mass housing, plastics, and pulp and paper) were conducted to determine how green elements could be integrated in their respective roadmaps.

Green Technology in Malaysia

Malaysian Investment Development Authority (MIDA), Malaysia

https://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 toward green economy. Other than the feed-in-tariff mechanism, the net energy metering (NEM) and large-scale solar (LSS) photovoltaic plant schemes were introduced in 2016 to boost RE generation. NEM benefit 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 RE in larger capacities.

In 2019, a total of 350 projects in RE with total investments of RM3.78 billion were approved incentives. Out of the total, 88.5 percent was contributed by domestic investments and 11.5 percent by foreign investments. Solar energy projects made up the bulk with 330 projects amounting to RM2.10 billion comprising of 314 solar self-consumption projects worth RM413.35 million and 16 LSS projects valued at RM1.69 billion. In that period, six mini-hydro projects worth RM1.52 billion were also approved, while the remaining approved projects were made up of 13 biogas projects worth RM149.33 million, and one biomass project worth RM6.58 million. These projects are expected to create 761 employment opportunities in this subsector.

Energy efficiency/energy conservation

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 to provide energy efficiency services to potential clients.

In 2019, a total of 75 projects in energy efficiency/energy conservation with total investments of RM536.44 million were approved incentives. Investments (RM168.86 million) were mainly from domestic sources; meanwhile, RM367.58 million were from foreign sources. These investments are expected to provide 148 employment opportunities in the subsector.

GT incentive

Under the provision of Budget 2014, tax incentives for GT in the form of Green Investment Tax Allowance for the purchase of GT assets and income tax exemption (ITE) on the use of GT services and system were introduced to further strengthen the development of GT.

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

Source: MIDA Investment Performance Report 2019

Technology Offers

HUNGARY

Transdermal medical gas delivery

The technology is capable of delivering all kinds of noble and medical gases through noninvasive means. The company's first application of this technology is with CO_2 gas. The physiological change with dry CO_2 balneotherapy naturally occurs in the human body when CO_2 is delivered into the microcirculation in the skin. In the blood stream, CO_2 enables hemoglobin in red blood cells to release more oxygen and automatically deliver the O_2 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 min for preparation for a first-time user and 20 min 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 ($KHSO_4$ or H_2SO_4) by recyclization of catalyst-removing $KHSO_4$ (acid) with regenerable ion exchangers
- The byproducts (K_2SO_4, 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 are 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 NO_2 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 NO_2 gas above 150 ppm level in few seconds. The quenching time is proportional to the concentration of the NO_2 gas. The quenching of the fluorescence of the detecting film after exposure to NO_2 is also studied by absorption and emission spectroscopy.

Area of application

The technology is useful for monitoring nitrogen dioxide in the following areas:

1. Factories
2. Environmental monitoring
3. Medical applications

Technology Offers

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. We are interested in transferring this technology to potential business firms who are keen in the biofertilizer market.

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 Development Division
66 Turner Road Cantt., Kanpur 208004, U.P., India

Waste plastics into industrial fuel

We offer plants for converting nonrecyclable 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. We can also supply technology. Serious customers can get their waste plastics tested on our Demo Plant. Plants as small as 1 TPD of plastics up to 30 TPD can be supplied.

Area of application

Converting waste plastics (nonrecyclable cheap plastic scrap) into industrial fuel.

Advantages

Disposal of nonrecyclable 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

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.

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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

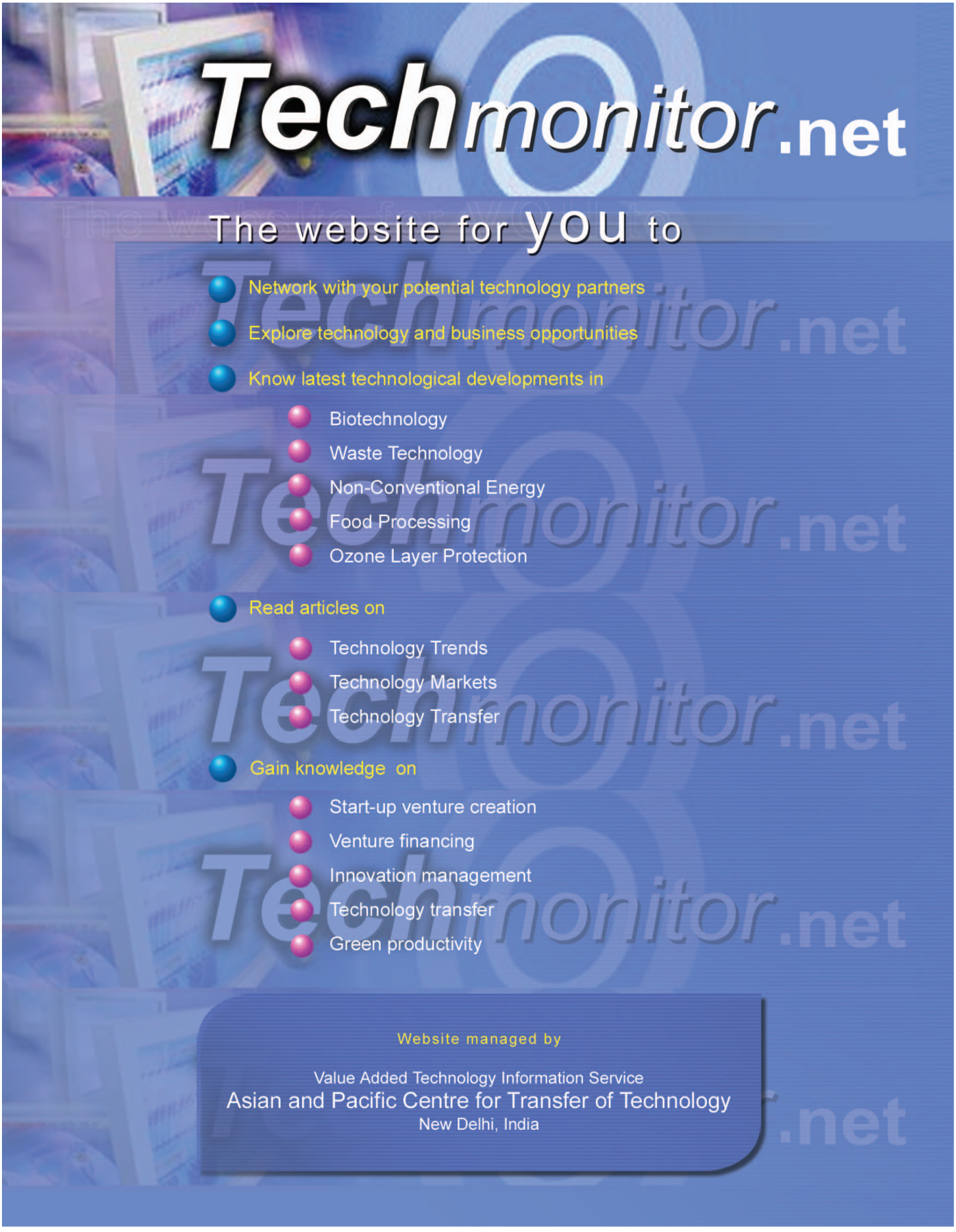
   The primary objective of the Renewable Energy Cooperation-Network for the Asia Pacific (RECAP) established by APCTT is to facilitate technology transfer cooperation among countries in the Asia-Pacific region in the area of renewable energy. RET-Bank provides tested and proven renewable energy technologies (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