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FOREWORD

It gives me great pleasure to share the Science, Technology and Innovation Profiles of OIC Member States, as prepared by COMSTECH. These profiles of member states are being printed, as well as shared on the COMSTECH website. A few words are therefore presented to explain the wider aims and purposes of this exercise.

The member countries of the OIC are vigorously engaged with science, technology and innovation, both as a pursuit of knowledge and in harnessing the forces of nature for human betterment. Depending on their circumstances they have advanced to different levels, but much needs to be done, in general, to catch up with the attainments of the more advanced countries. However, there exists a well-defined need to catalogue national efforts in this direction. In particular, to identify respective strengths, achievements and shortcomings, as well as the institutions and policies that are shaping the scientific research and development profiles of OIC member states.

It is with the above goals and purposes that COMSTECH has ventured on this ambitious task viz. preparing a summarized version of the science, technology and innovation landscape of each member state. We have initiated this effort starting with the profiles of countries leading in this area, and will be continuing and sharing as we proceed onwards.
Undoubtedly much more could be said about each country than the summary that we have presented, but our emphasis is on the essentials and on maintaining brevity. COMSTECH welcomes feedback from member states on this effort and will be happy to update the website profiles on the basis of information received officially.
I hope that the scientific community as well as the planners and administrators of member states will find these profiles both useful and inspiring.

Prof. Dr. M. Iqbal Choudhary
Coordinator General COMSTECH
UNESCO Chair
CONTENT DISCLAIMER

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MALAYSIA is a Federation comprising 13 states. Peninsular Malaysia consists of 11 states and is bordered by Thailand to the north and across the Straits of Johore by Singapore in the south. To the west lies the narrow Straits of Malacca and to the east the South China Sea. Sabah and Sarawak are separated from Peninsular Malaysia by about 750 km of the South of China Sea.

The total area of Malaysia is approximately 328.55 thousand sq km, with Peninsular Malaysia covering an area of 131,577 sq km, Sarawak 124,449 sq km and Sabah 74,398 sq km. Malaysia’s coastline extends nearly 4830 km. from the Indian Ocean to the South China Sea. The coastline of Sarawak and Sabah is 2100 km long. About 70% of Malaysia is covered with forest, the rest of the land is broad coastal plains and a mountain range that runs along the length of peninsular Malaysia, Sabah and Sarawak.
Malaysia gained independence in 1957 from the British who had colonized it since 1874. The Malaysian Federation was formed in 1963 with the addition of Sabah, Sarawak and Singapore. However, Singapore withdrew from the federation in 1965. Malaysia is a multi-racial country with a population of 24.8 million.

The population comprise of three ethnic groups; Malay, Chinese, and Indians. The predominant religion is Islam with minority religions; Buddhist, Daoist, Hindu, Christian, Sikh.

The country is rich in mineral resources; tin, petroleum, bauxite and iron ore. Malaysia has successfully transferred its economic base from agriculture and mineral resources to an economy where the electronics and electrical goods form a major percentage of exports. Manufacturing sector plays a major role in industrial expansion and economy is highly diversified. Malaysia’s large reserves of oil and gas have enabled it not only meet its own energy needs but constitutes a significant percentage to exports.
In 2019 Malaysia was the number 35 economy in the world in terms of GDP (current US$), the number 21 in total exports, the number 25 in total imports, the number 66 economy in terms of GDP per capita (current US$) and the number 26 most complex economy according to the Economic Complexity Index (ECI). The per capita GDP grew by 3.88% between 2011 and 2015.

The top exports of Malaysia are Integrated Circuits ($63B), Refined Petroleum ($17.8B), Petroleum Gas ($11.5B), Semiconductor Devices ($9.65B), and Palm Oil ($8.91B).
In 2019, Malaysia was the world's biggest exporter of Rubber Apparel ($4.37B), Other Vegetable Oils ($1B), Copper Powder($873M), Asphalt Mixtures ($417M), and Platinum Clad Metals($127M).

The rapid expansion of exports in electronics from the 1970s onwards has turned Malaysia into a major hub for the production of high-tech goods. Today, Malaysia is highly integrated in global trade, with manufacturing contributing over 70% of its exports. Though Malaysia’s high-technology exports fluctuated substantially in recent years, it tended to increase through 2011 - 2020 period ending at US$92.123 billion in 2020, constituting 51.8% of all manufactured exports.

Since the launch of export-oriented industrialization in 1971, multinational corporations have relocated to Malaysia, fueling a rapid expansion in manufactured exports that has helped turn the country into one of the world’s leading exporters of electrical and electronic goods. In 2013 alone, Malaysia accounted for 6.6% of world exports of integrated circuits and other electronic components (WTO, 2014). The export of electronic integrated circuits and micro assemblies from Malaysia totalled $ 49 billion in 2020, amounting to 21% of total exports.
Malaysia’s human development indicators show an impressive improvement with time. Classified as an upper middle income country, the incidence of poverty is forecast at 1.5% for 2021 (on the basis of WBG’s poverty line of US$5.50), down from 2.9% in 2015.

The average life expectancy has increased from 73.55 to 76.15 years between 2005 and 2019. The basic amenities of life such as access to electricity are amenable to 100% of the population while 95% have access to piped water. The skilled labour force as a percentage of the total labour force constitutes an impressive 66.8% in 2016, up from 61.1% in 2009.
C. KEY GOVERNMENT ORGANIZATIONS RELATED TO SCIENCE, TECHNOLOGY AND HIGHER EDUCATION

The key actors in Malaysia’s STI system are predominantly government or government-linked organisations.

1. **Ministry of Science, Technology and Innovation (MOSTI):**
   MOSTI spearheads the development of STI in the country. It oversees more than 20 departments, agencies and companies, clustered into five focus areas: biotechnology, ICT policy, industry, sea to space, and science and technology core.

2. **Ministry of Education (MOE):**
   MOE has oversight of the National Education System at school level from pre-school to secondary and post-secondary education (excluding higher education).

3. **Ministry of Higher Education (MOHE):**
   MOHE aims to turn Malaysia into a hub of excellence for higher education. Its targets include developing at least 20 Centres of Excellence that are internationally recognised in terms of research output, copyrights, publications and research collaborations.
Several other departments contribute to other aspects of the STI system, including:

- Ministry of Natural Resources and Environment (MNRE)
- Ministry of Energy, Green Technology and Water (MEGTW)
- Ministry of Agriculture and Agro-based Industry (MOA)
- Ministry of International Trade and Industry (MITI)
- Ministry of Plantation Industries and Commodities (MPIC)
- Ministry of Health (MOH)
- The Academy of Sciences Malaysia.
The recent trend in Gross expenditure on Research and Development, the GERD, is shown in the figure. It is apparent that while the GERD increased very significantly over the 2006–2016 period, from 0.61 to 1.42% of the GDP, it has dropped to 1.04% in 2018. The government has trimmed or eliminated several funding schemes, including the Long Term Research Grant Scheme, the Transcendental Research Grant Scheme and the Fundamental Research Grant Scheme for universities.
• **Expenditure on R&D by Sectors:**
As displayed in the accompanying graph, government support for research and development (GRI) was consistently surpassed by business support for research (BE). However, it does appear that the trend over the past decade has been of decreasing research support by business. Institutions of higher learning (HLI) have generally contributed the next highest to R&D. In 2018, business (BE) and HLI funding for research are at par with 42.6% share for each.

![Expenditure on R&D by Sectors (2006-2018)](image)

Values (%)


• **Researchers Intensity:**
The number of researchers per million (head count, HC) more than doubled between 2008 and 2012 while in the same period the number of full-time equivalent (FTE) researchers tripled from 16,345 to 52,052, resulting in a researcher intensity (FTE) of 1,780 per million population in 2012. In 2018, Malaysia had about 2184 (FTE) researchers per million inhabitants with 48.2% of these being female. These researchers were employed mostly in higher education (71.4%) while 22% were employed by business and 6.6% by the government. Malaysia’s higher
education sector funds and performs a major share of R&D and most researchers also work in this sector.

- Researchers distribution by major fields:

  The distribution of Malaysia’s research workers in different major fields in 2015 is shown in the accompanying figure. It is clear that the largest number are in the fields of Engineering and Technology, followed by those in the Natural Sciences. There is then a significantly smaller number who are active in Medical and Health Sciences and in Agricultural and Veterinary Sciences respectively. We also find that Higher Education employees the overwhelm number of researchers, 57,606 out of a total of 73,566. Government research institutions employee 6,116 while Business Enterprises support 9,844 researchers. Business Enterprises support engineering and technology researchers (4,701) in almost equal numbers to those in Natural Sciences (4,310). Higher Education institutions have a significant domination of Engineering and Technology researchers (23,966) as compared to Natural Sciences (17,883). The heightened focussed on Engineering and Technology related research is
consistent with Malaysia’s successful attempts towards industrialization and knowledge economy.

Researchers by major fields (HC) - 2015

<table>
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<tr>
<th>Field</th>
<th>Number</th>
</tr>
</thead>
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<td>Agricultural and veterinary sciences</td>
<td>7,866</td>
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<tr>
<td>Medical and health sciences</td>
<td>11,755</td>
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<tr>
<td>Natural sciences</td>
<td>24,006</td>
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<tr>
<td>Engineering and technology</td>
<td>29,939</td>
</tr>
</tbody>
</table>

Source: UNESCO Institute for Statistics (UIS)

➤ **Research and Development in Private Sector**

As discussed earlier the business sector contributes very significantly to Malaysia’s R&D. R&D is conducted predominantly in large-scale enterprises in the electronics, automotive and chemical industries, where it mainly involves process and product improvements. SMEs make little contribution to R&D, even though they make up 97% of all private firms.

Some examples of private sector R&D activity:

❖ **Malaysian Industry-Government Group for High Technology (MIGHT):**

Its key role is building and driving partnerships in technology through a consensus building platform between the private and public sectors. Some examples of their initiatives are:

- In the rail industry, MIGHT was instrumental to establish the Malaysian Rail Industry Consortium (MARIC), a consortium of local rail companies to enhance the local rail industry capability and capacity.
- MIGHT led the formation of Aerospace Manufacturing Innovation Centre (AMIC). The centre is jointly funded from the Government and industry which includes Airbus, Rolls Royce and CTRM.
The palm oil industry contributes to R&D through a cess fund managed by the Malaysian Palm Oil Board. In addition, the Malaysian Palm Oil Board receives budget allocations from the government to fund development projects and for research projects approved by the Long-term Research Grants scheme.

An example of private business R&D, Top Glove Corporation Berhad, the world's largest rubber glove manufacturer, allocates about 12% of its annual profits in R&D. The company plans to increase it further.
E. HIGHER EDUCATION

Number of Public and Private Universities

* In all there are 370 including Universities, College/Institutions and Polytechnic institutions campuses of higher education institutions.

Source: Higher Education Department, Ministry of Higher Education Malaysia

Distribution of tertiary graduates in Malaysia by programme, 2019 or closest year (%)

Source: UNESCO Science Report - 2021
<table>
<thead>
<tr>
<th>University Name</th>
<th>National Ranking</th>
<th>Global Ranking</th>
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<td>Putra University, Malaysia</td>
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<td>National University of Malaysia (UKM)</td>
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Source: [https://cwur.org/2021-22/country/malaysia.php](https://cwur.org/2021-22/country/malaysia.php)

**AREAS OF CONCENTRATION**

In terms of graduating programs, Malaysia's recent tertiary graduates are distributed over a range of fields with a strong concentration in engineering (28.6%); business, administration and law (26.1%); and arts and humanities (22%). Smaller concentrations are found in the disciplines of ICT (6.9%), health (6.8%), natural sciences and maths (3.7%) and agriculture (1.6%). There is a strong participation of females in higher education with 53% of the tertiary level graduates being females.

(Source: UNESCO Science Report 2021)
Public Expenditure on Higher Education:

In 2006, the government introduced a *Higher Education Strategic Plan Beyond 2020* which established five research universities over the next three years and raised government funding for higher education. For more than a decade, public expenditure on higher education has accounted for about one-third of the education budget. But the level of commitment had slipped somewhat between 2003 and 2007 from 2.6% to 1.4% of GDP. The government restored higher education and in 2011 it accounted for 2.2% of GDP. However, government expenditure on tertiary education as % of GDP was reported at 0.9466 % in 2019, according to the World Bank collection of development indicators, compiled from officially recognized sources.

To develop endogenous research capabilities, The Higher Education Strategic Plan Beyond 2020 fixed the target of producing 100,000 PhD-holders by 2020, as well as increasing the participation rate in tertiary education from the current 40% to 50%. As part of this effort, the government allocated MYR 500 million (circa US$ 160 million) to financing graduate students, a measure which helped to double enrolment in PhD programmes between 2007 and 2010.
There has been a strong rise in scientific publications since 2009 where the number of scientific publications was 4326. This is understood to have been a positive outcome of the government’s decision to promote excellence at the five research universities, namely: Universiti Malaya, Universiti Sains Malaysia, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia and Universiti Teknologi Malaysia. Major increase in research funding to these institutions followed. In 2019, with over 11700 published articles in impact factor journals, Malaysia ranks 6th amongst the OIC countries in terms of number of scientific publications. In 2021, the number of scientific research publications increased to 16180.
Before 1960, Malaysia has published only 395 research documents. After that a significant increase (in publications) can be observed in the figure. In fact in the last decade (from 2012 to 2021), 346209 (or 82.10%) documents are published in twenty-seven (n=27) different areas of research. The per era data is presented in the figure. For the last ten years (2012-2021), we presented the scholarly output (SO), citations, citations per publications (CPP), and field-weighted citations impact (FWCI) of all (n=325450) documents in the table. Article field weighted citation impact (FWCI) “indicates how the number of citations received by an article compares to the average or expected number of citations received by other similar publications”. The highest documents are published in 2021 (n=42805), followed by 2020 (n=39100). All publications received 3469355 citations or 10.7 citations per publications. The total citations increased till 2016, which later decreased. At the same time, the FWCI crossed the standard 1.0 mark. For example, 1.02 means the articles received 2% higher citations as compared with global average.

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We also retrieved details about the research publication in twenty-seven (n=27) subject areas. In fact, the number of scholarly output (SO), citations, number of authors, citations per paper (CPP) and field weighted citation impact (FWCI) are provided. The highest documents are published in Engineering (n=105140), followed by Computer Science (n=59251) and Material Science (n=44044). The journals quality of metrics can be employed to present the quality of publications. Scopus categorized all journals in quartile sets. For example, Q1 is occupied by the top 1%, and Q7 is occupied by journals in the 75 to 100% group. The ten years data is presented in the table.

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We will specifically state that 79.08 (or 257164) publications are published in Q1 to Q7 journals. Or in other words 20.98% publications sources do have not Citescore data. 47.13% documents (n=121206) are published in Q6 & Q7 sources, and 22.45% are published in Q5 sources.
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<th>Authors</th>
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- Based on the number of publications, the highest documents are published by University of Malaya (n=43387), followed by Universiti Teknologi Malaysia (n=39417) and Universiti Kebangsaan Malaysia (n=36753). For each university we also provided total citations, CPP and FWCI data.

**International Collaboration (%)**

![Graph showing international collaboration over years](image)

- The degree of collaboration for the last ten years is depicted in the figure. In 2012, it was 32.1 which increased to 50.7 in 2021. The average degree of collaboration was 39.9%.
Based on Scopus record, Malaysia also showed strong collaboration with more than 160 countries. In fact, Malaysia published at least 500 research publications with 81 countries. In the last ten years, the highest collaboration was noted with UK (n=22597), Australia (n=17755) and USA (n=17131).
G. International Cooperation and Support Initiatives (selected)

- **International Science, Technology and Innovation Centre for South-South Cooperation under the auspices of UNESCO (ISTIC),** Kuala Lumpur, Malaysia. Its goal is to implement a programme for South-South cooperation in science and technology with the objective of facilitating the integration of a developmental approach into national science and technology and innovation policies; capacity building in science and technology through providing policy advice and exchange of experience and best practices; and creating a problem-solving network of centres of excellence in developing countries as well as supporting the exchange of students, researchers, scientists and technologists among developing countries.  
  [https://www.istic-unesco.org/v1/programme-2021/](https://www.istic-unesco.org/v1/programme-2021/)

- **Malaysian Technical Cooperation Programme (MTCP)**

  Malaysia through MTCP, shares its development experiences and expertise with other developing countries through technical cooperation programmes. MTCP emphasises the development of human capital through trainings in various areas including agriculture, education, environment, industrial technical training, and science,
and science, technology and ICT. To-date Malaysia has extended trainings to 143 recipient countries and has trained more than 32,000 participants.


❖ **The Malaysia-UNESCO Funds-in-Trust** places special emphasis on Small Island Developing States and Least Developed Countries in Asia and the Pacific, and in Africa. It draws on the expertise of Malaysian institutions, including the International Centre for South-South Cooperation for science, Technology and Innovation (ISTIC) and on the Regional Humid Tropics Hydrology and Water Resources Centre for South-East Asia and the Pacific (HTC).

H. INNOVATION, ENTREPRENEURSHIP & TECHNOLOGY PARKS

Malaysia scored a perfect 10 score in terms of performance and market reach in the Global Startup Ecosystem Report 2020 (GSER 2020). Kuala Lumpur was ranked 11th in the Top 100 Emerging Ecosystem category, and scored 9 for talent and 8 for funding. Furthermore, the Global Innovation Index 2020 ranked Malaysia second after China for most innovative country in the upper middle-income group category.

Source: WIPO: https://www.wipo.int/ipstats/en/statistics/country_profile/
In February 2021, the Ministry of Science, Technology and Innovation launched the Malaysia Grand Challenge to encourage disruptive innovation and reduce reliance on foreign technologies. This body will allocate funds to start-ups and SMEs through the following five new mechanisms to help them commercialize their products and services: the Strategic Research Fund, Technology Development Funds 1 and 2 (TeD 1 and TeD 2), a Bridging Fund and an Applied Innovation Fund.

The government has sought to strengthen Malaysia’s industrial zones and science parks by developing the surrounding ecosystems in Malaysia’s five economic corridors. A total of RYM 1.1 billion (ca US$ 270 million) was allocated in the 2020 budget to the five corridors to support projects such as the Chuping Valley Industrial Area and Kuantan Port.
TECHNOPARKS

The Malaysian government has been supporting local technological development by establishing science and technology parks, technology incubators and the Multimedia Super Corridor. These physical development initiatives involve offering affordable office spaces and access to modern facilities e.g. telecommunications, linkages to researchers, networking and venture capital funding. The science park strategy has been adopted by the government to stimulate innovation among small and-medium sized enterprises (SMEs) and to enhance university–industry collaboration. The following are listed as the technology parks of Malaysia:

- Technology Park Malaysia (TPM), Kuala Lumpur
- Multimedia Super Corridor (MSC) / Cyberjaya, Selangor
- Selangor Science Park, Selangor
- Selangor Science Park 2, Selangor
- Subang Hi-Tech Industrial Park, Selangor
- FRIM-MTDC Technology Centre, Selangor
- UPM-MTDC Technology Centre, Selangor
- UKM-MTDC Technology Centre, Selangor
- UITM-MTDC Technology Centre, Selangor
- Penang (Known as "Silicon Valley of the East")
- Penang Science Park, Penang
- Penang Cybercity, Penang
- MSC Cyberport, Johor
- Johor Technology Park, Johor
- Nusajaya Tech Park, Johor
- Kulim Hi-Tech Park (KHTP), Kedah

More than 3,000 technology driven companies have benefited from the Technology Park Malaysia (TPM) – both local and multi-national within various clusters of industry. The ICT cluster has recorded the highest tenancy within TPM, followed by Engineering and Biotech, Telecommunication and Content, and Support Services.
I. COMBATING THE COVID-19 PANDEMIC

- **Vaccine Development for Covid-19:** The Covid-19 vaccine in development in Malaysia is expected to be ready in 2024, and it is also being designed as a booster shot, say Malaysian Government reports. The current status of the country's first Covid-19 vaccine development is at the laboratory or proof of concept (POC) stage. The research conducted for the vaccine development covered virus inactivated technology such as Sinovac and genetic sequencing or mRNA for the Pfizer vaccine. Development of the vaccine was being spearheaded by local experts from the Institute of Medical Research (IMR) with the cooperation of experts from Universiti Putra Malaysia and Veterinary Research Institute.

- **Vaccine Administration of the population:** Malaysia secured doses for 40 per cent and 110 per cent of its population by December 2020 and February 2021 respectively. At its peak, about 1 per cent to 2 per cent of the population were vaccinated daily. As of 31 October, 2021, 74.9% of Malaysia’s total population (95.5% of the adult population and 66.4% of the adolescent population) have received their second dose of the COVID-19 vaccine.

- **Development of Detection Technologies:** Science, Technology and Innovation (MOSTI) Ministry is working in collaboration with the Ministry of International Trade and Industry (MITI) and the Higher Education Ministry to provide funding and
support for university research and development of new technologies to detect Covid-19. This includes developing Covid-19 testing using DNA and fiber-optic sensor to detect the virus from saliva samples.

- **Digital Solutions for Fighting the Pandemic:**

  Malaysia's Ministry of Health has been provided digital solutions to support the country's efforts to fight the Covid-19 pandemic. These include Huawei Telemedicine Video Conference, Hospital Wireless Network Communication Solution, AI Cloud Auto Detection Solution and Nova 7i smartphones. (Huawei Cloud AI-assisted Diagnosis solution empowers local medical personnel with AI capabilities by providing an AI solution for CT image analysis of possible COVID-19 patients).

- **Indigenous production to meet pandemic needs:**

  a. **I3S Cubicle for COVID-19 Screening:** The I3S Cubicle which is based on Isolate, Examination, and Sampling concept can reduce the risk of infection as it does not require any face-to-face contact between health workers and those getting screened. The space inside of the cubicle is only for the health worker to avoid the transmissions of air contamination from the patient.

  b. **MCK19 Delivery Robot.** MCK19 or "Makcik Kiah" is the first Malaysian-made delivery robot designed to assist the delivery of healthcare to COVID-19 patients. The use of MCK19 to deliver foods and medications to patients' rooms on its own can reduce the exposure of health workers from isolated patients who may be highly contagious. It can be instructed via its touchscreen interface, laptops, phones, or tablets. An LCD screen enables health checks to be done remotely through teleconferencing.
c. **Aerosol Box or Intubation Box for Intubation Procedure:**

An intubation procedure for a COVID-19 patient is performed in Aerosol Box with video laryngoscopy to prevent virus infections toward the health workers from the possible occurrence of aerosol generated by the patient's airway. It is used to ensure the safety of medical frontliners. Over 1,000 units of these Aerosol Boxes were successfully distributed to hospitals and medical centres in Johor, Pahang, Negeri Sembilan, Melaka and Selangor to be used by the health workers.

d. **Ventilator and Splitter Kit:**

University of Technology, Malaysia (UTM) in collaboration with the Ministry of Health (MOH) Malaysia has developed a ventilator prototype using 3D printing technology to give patients infected with coronavirus chances to survive. A splitter kit prototype that enables a standard ventilator unit to be shared by two patients from the same settings while receiving breathing assistance was also developed in collaboration with a private company.

e. **3D Printed Face Shields & Hand sanitizer**

- **Covid-19 and Digital Transformation of Malaysia**

Covid-19 has fast-tracked digital transformation of Malaysia. This includes:

a. Education technology (EdTech) being used extensively for remote learning.

b. Remote workforce being employed extensively.

e. E-commerce expansion. (Between March 1 and October 31, 2020, a total of 373,213 entities registered their businesses with the Companies Commission of Malaysia under the online category).

f. Digital speed: A new national digital infrastructure project, known as Jendela, will spearhead Malaysia’s transition to 5G, a game-changer for many industries. The concerned company is expected to roll out 5G technology by the end of 2022 or early 2023.