South-South Institute for Infrastructure Maintenance in Malaysia (SSIMM)

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Introduction

I was the keynote speaker on Resilient Infrastructure at the virtual ISTIC/IEM training workshop on "Electrical Maintenance in ASEAN and South-South Countries" 3 March 2021. After outlining the urgency for a structured maintenance of infrastructure training facility for South countries, I suggested that the International Science Technology & Innovation Centre for South-South Cooperation under the Auspices of UNESCO (ISTIC) through her MOUs with sister UNESCO Category 2 Centers in China, namely the International Knowledge Center for Engineering and Technology (IKCEST) of Chinese Academy of Engineering (CAE) and the International Center for Engineering Education (ICEE) of CAE/Tsinghua University; together with the Institution of Engineers Malaysia (IEM) through its MOU with the Chinese Association of Science and Technology (CAST) signed during the WFEO/CAST International Conference of Engineering Capacity Building in Beijing end 2019 to jointly explore the establishment of a South-South Institute for Infrastructure Maintenance (SSIMM) in Malaysia.

Several meetings between ISTIC and IEM under my chairmanship were carried out to explore the possibility. ISTIC and IEM agreed to set up SSIMM.

However no response has been received from CAST, IKCEST and ICEE.

The purpose of this updated Concept Paper is to make SSIMM in Malaysia as an AETDEW project.

Global Construction Industry Outlook

According to the UK Government Report "Industrial Strategy: Government and Industry in Partnership-Construction 2025" July 2013: The global construction market is forecast to grow by over 70% by 2025. The global construction industry is set to see growth of 4.3% per annum until 2025, concentrated primarily in emerging economies in the South. Due to the global financial crisis of 2008, construction as % GDP declined from 9% in 2006 to 5 % in 2011. In 2012, global GDP amounted to about 72.6 trillion U.S. dollars. At 4.3 %, the global construction industry annual turnover will amount to some 3.1 trillion US dollars.

The above 2013 Report was written before the launch of the China One Belt One Road Initiative (BRI) whose spectacular success has been anchored by

infrastructure construction by China all over the world, especially the developing world. It also did not anticipate the massive investment in infrastructure in China itself.

The current global economy downturn as a result of the COVID-19 pandemic has also forced governments in developed countries to turn to infrastructure construction to stimulate and propel economic recovery. The outstanding example is the US $3.0 trillion Infrastructure Bill of US President Biden. In point of fact, due to neglect, infrastructure facilities in the West have been in bad need of repair and renovation well before the COVID-9 pandemic.

The World Bank Group has warned the world of the increasing adverse impact of massive disasters due to climate change on infrastructure facilities worldwide. WBG is actively advocating that countries should make existing infrastructure more resilient and future infrastructure to be built more resilient. This would result in increase in infrastructure investment.

All the above factors will swell infrastructure investment significantly more than what the UK Government Report of 2013 had predicted for the global construction industry to 2025.

Maintenance of Infrastructure

Every major physical engineering infrastructure asset has long economic life and must be kept in good repair and operation over its economic life to recoup the heavy capital investment. Developing countries have traditionally neglected investment in maintenance of infrastructure. When an infrastructure facility becomes uneconomic prematurely, the solution has been to abandon it and build new one. This practice has been encouraged by major construction corporations in the West. This has beggared many developing countries financially.

Infrastructure engineers have also been very concerned at the lack of indigenous infrastructure maintenance capacity, both institutional and human resource, in the South that has contributed to the premature demise of infrastructure assets in South countries. That was the reason why ISTIC adopted the “Maintenance of Infrastructure” as its priority program agenda in 2010 and has been conducting training courses in Malaysia and other South Countries since. IEM has been ISTIC’s partner in this endeavour. In the training courses, emphasis has emphasized the importance of the provision of adequate funding for infrastructure maintenance, advocating that South countries set aside some 10% of the capital cost of an infrastructure project for its lifelong maintenance.

ISTIC and IEM have also been advocating the establishment of infrastructure training institutes in South countries to offer structured professional training courses for engineers and technicians. Using the very conservative estimate of annual turnover of global construction of US$3.1 trillion (3,100 billion) of the above-mentioned UK Government Report, 10% of that total is some US 310.0 billion. Taking the average infrastructure asset life as 25 years, the annual global budget for maintenance of infrastructure would be some US$ 12.0 billion. Thus, infrastructure maintenance is not only essential but its training courses can be very profitable.

China as the Global Infrastructure Construction Leader

In global infrastructure construction, the country that bestrides the world like a colossus is without a doubt China.

According to US ResearchandMarket July 2014, the Chinese construction industry recorded a nominal compound annual rate of growth (CAGR) of 19.99% during the period 2009–2013. The construction industry's output is expected to record a CAGR of 9.72% over the forecast period 2014–2018. The value add for Chinese construction industry is projected to reach CNY6.1 trillion (US$942.3 billion) in 2018.

The above forecast was made before the BRI and the setting up of innovative funding agencies like Asia Infrastructure Investment Bank by China. It did not anticipate the COVID-19 pandemic. It definitely did not foresee China's rapid economic recovery whilst the rest of the world is still struggling to get the pandemic under control.

The global infrastructure construction dominance of China is anchored by the amazing infrastructure development at home in the past three decades. Some outstanding examples are as follows. The US$22.5 billion *Three Gorges Project* was primarily a flood mitigation project. Disastrous floods in Yangtze River occurred about once a decade. The 1998 flood was considered the worst flood in 40 years in China. It resulted in 3,704 dead, 15 million homeless and US $26 billion in economic loss. After the commissioning of the *Three Gorges Project*, disastrous floods are a thing of the past. Besides flood mitigation and improved navigation, the project also provides 22,500 Mw of renewable hydro power, the largest in the world. The Yellow River was "China's Sorrow". It had changed its course several times in history causing immeasurable destruction. Due to many hydropower dams from Lijiaxia, through Liujiaxia, Sanmenxia, to the world bank funded Xioalongde Project, its flood frequency is now once in a thousand years

instead of once in sixty years. In fact, over drawdown of its water for human usage resulted in its delta in Shandong running dry. The massive South-North water transfer project in China transfers water from the Yangtze to the Yellow River to supply water to the Northern provinces of the Yellow River as well as the Cities of Beijing and Tianjin. The total project cost is estimated at US$62 billion. The eastern route is 1,155km long and involves the construction of 23 pumping stations. The central route totals some 1,267km in length. The eastern route was completed in 2014. The central route is now operational. The two routes provide much needed water to the North The western route involves working on the high-altitude Qinghai-Tibet Plateau. The world's highest railway is the Qinghai-Tibet Railway. China's high speed train network with speed of 200-350 km/hour covers some 38000 Km, which is two-thirds of the world total. China's highway network totals some 160,000Km in 2020.The 50km long Hong Kong Macao Zhuhai Bridge is the longest ocean-crossing bridge in the world. Other mega ocean-crossing bridges include the Hangzhou Bay Bridge connecting Shanghai with Ningbo and the Jiaozhou Bridge in Qingdao. The container pier at Yangshan Port, which forms part of the Port of Shanghai is the world's busiest trading port which handles 32million containers a year carrying 736 million tonnes of goods to the world. Seven of the top ten container ports in the world are in China. Through the application of robotics, AI and Internet of Things, the ports are mostly unmanned. China has built world's biggest single terminal US$12.0 billion Daxing Airport in Beijing designed for seven runways. It measures 1.0 million square metres.

China manufactures top supercomputers in the world and is fast catching up with the West in space and aerospace technologies. China's BeiDou Navigation Satellite System is fully operational. China leads the world in 5G broadband technology and has become the world's first cashless society. China leads the world in solar and wind power and electric vehicles. China is a world leader in reforestation and de-desertification. China is enhancing food security by salt water hybrid rice cultivation.

The speed of construction in China is unbelievable. A recent example was the completion of two hospitals in Wuhan within ten days. Chinese construction companies employ prefabricated construction using robotics, AI and allied digital technologies. Large components are manufactured in factories and then transported to site to be assembled like Lego pieces. 5G, AI, Robotics, IoT are central to smart manufacture in China.

I firmly believe that China's inclusive, comprehensive and widespread physical and virtual infrastructure development has been the foundation of China's historic achievement in 2021 in uplifting 800 million of her citizens out of poverty and becoming members of the society of moderate prosperity.

Under BRI with funding support from the Asia Infrastructure Investment Bank (AIIB) and other development banks, China has become a world leader infrastructure construction in the world. Important projects outside China have been completed and/or are already ongoing. The outstanding examples are listed as follows. The 530 Km Istanbul-Ankara high speed railway, the 780 Km Addis Ababa-Djibouti electrified railway and the 480Km Mombasa-Nairobi railway are operational. The 770 km Moscow-Kazan and the Astana-Almaty 1000km high speed rail projects are in various stages of implementation. The North Eastern HSR Project in Thailand will form part of the 3,000km high-speed rail link from Kunming, China all the way down to Singapore through Laos, Thailand and Malaysia. Chinese corporations are working on the 140 Km Jakarta-Bandung high speed railway project in Indonesia. The east coast rail link between Port Kelang and Kuantan is also under construction. The Chinese has started construction of the new Port of Lamu in North East Kenya to link landlocked South Sudan and Ethiopia to the Indian Ocean. This US$ 24.0 billion Lamu Port, Southern Sudan, Ethiopia Transport (LAPSSET) Corridor Project will include major highway, railway, airport, oil refinery, power plant and oil and gas pipeline. The Chinese lease and operate the Port of Piraeus in Greece and is working on the rail connection to Budapest through Serbia. The Chinese is building the new container port of Dolareh in Djibouti. It owns the Hambantota Port in Sri Lanka. It owns the Port of Gwadar in Pakistan and is linking it through 3000km long route to Kashi, Xinjiang in China. The US $46.0 billion “China Pakistan Economic Corridor” Project is a “one in four” infrastructure project: highway, railway, oil and gas pipeline, and broadband optic fibre. Chinese constructed infrastructure projects cover all Africa and are spreading through Latin America.

The most symbolic BRI project is the China-Europe Rail Programme replacing camel trains by freight trains along the Land Silk Road. The first China-Europe freight train left Chongqing China in March 2011 via Xinjiang and Kazakhstan. Throughout 2011, only 17 freight trains departed from Chongqing. By November 2020, the network had linked over 60 cities in China with 92 cities across 21 European countries. In 2020, the trains conducted 12,400 trips between China and Europe, sevenfold that of 2016. In the first two months of 2021, over 2,000 freight train services ran from China to Europe.

China displaced US and Europe as the leading financial power in the developing world according to New York Times “The World According to China” July 24, 2015. Due to its effective suppression of the COVID-19 pandemic by April-May 2020, China’s economy has recovered rapidly. Its economy grew 0.6 percent compared with the fourth quarter of last year and 10.3 percent compared with the first quarter of 2019, suggesting the world's second-largest economy is on the road to a steady recovery from the impact of the COVID-19 pandemic and is

regaining its robust growth momentum. IMF forecast China's growth in 2021 at 8.4%. A strong plank in its growth will be continued infrastructure investmentat home and abroad through BRI.

There is little doubt that China has becoming the world leader in engineering. As engineering is not an exact science, engineering practice and experience from design, manufacture, construction, operation, maintenance to decommissioning are vital elements of the advance in engineering science. In other words, engineering progress is human made. I consider China's increasing dominance in engineering infrastructure is predicated on the following three factors:

- The first is long term political vision and will at the top. China's leadership since the reform and opening up policy of Deng Xiaoping in the Nineteen Seventies has been predominantly engineers with the firm conviction "to become rich, build road first". Though Deng Xiaoping was not educated as an engineer, he worked in steel mill and motor car factory during his "Work and Study" years in France. When he became the political chief after the liberation of Sichuan Province, one of his first priorities was the construction of the Chengdu-Chongqing railway.
- The second prerequisite is properly educated skilled human resources. China has 17 million students enrolled in its colleges and universities. In 2019, 7.6 million students graduated from undergraduate programs at public colleges and universities in China. That number was nearly double as high as the number of degrees earned at all levels of higher education in the United States. Of the 7.6 million Chinese graduates of 2019, around 3.95 million earned a bachelor's degree, whereas 3.64 million earned a more practically oriented short-cycle diploma. Around 640,000 master's and doctor's degree students graduated in China in 2019. The most favoured majors among Chinese students were finance, civil, electrical and mechanical engineering, international trade, economics, accounting, clinical medicine, law, and the English language. The graduate employment rate within half a year after graduation has been generally stable in China over the past seven years, exceeding 90 percent on average. Those that struggle to find a job are usually graduates from less technical, quantitative majors who often lack both practical "hard skills" and "soft skills" such as communication, critical thinking, and managerial abilities. Engineering, technology, IT and science majors top the employment rates as well as secure higher-starting salaries.
- The third prerequisite is financial strength, In July 2020, China's foreign exchange reserves totalled US$3.15 trillion, the highest in the world. In 2020, China completely eradicated absolute poverty of 800 million of her

population. The high consuming middle class is expanding in China, whilst that in the West is shrinking.

In summary, the nation carrying out the most engineering projects in the world will be the leader in defining engineering standards from engineering education to professional practice. China is the dominant nation, especially in view of its tremendous advances in smart manufacture anchored by AI, Robotics and allied digital technologies that permeate every sector of human endeavour in China. The great demand will be for bachelor degree, diploma and certificate holders in technical and vocation spheres. On 13 April 2021, Chinese President Xi Jinping called for efforts to speed up the development of the modern vocational education system and cultivate more high-quality technical professionals.

China is on an unstoppable track to become the largest economy in the world within the next few years.

Infrastructure Construction in Malaysia

According to the Malaysian-German Chamber of Commerce and Industry Report "Market Watch 2012: Construction Industry in Malaysia":

The Malaysian construction industry is generally separated into two areas. One area is general construction, which comprises residential construction, non-residential construction and civil engineering construction. The second area is special trade works, which comprises activities of metal works, electrical works, plumbing, sewerage and sanitary works, refrigeration and air-conditioning works, painting works, carpentry, tiling and flooring works and glass works. From 2011 to 2015, the Malaysian Construction Sector is expected to grow at 3.7% per annum as compared to 6% per annum GDP growth for the country. In promoting economic growth through Private Sector participation, 52 high-impact projects worth RM63 billion (US $19.0 billion) have been identified for implementation under the Public-Private Partnerships (PPP) initiatives. Malaysian infrastructure corporations have accumulated valuable project and facility management experience in their infrastructure investments at home and overseas. Malaysia's construction industry is mature with good design, construction and project management track record. The infrastructure in Malaysia has almost all been home built and largely home financed.

Whilst Malaysia cannot compare with China in engineering infrastructure design, manufacture and construction, Malaysia does possess distinct advantages with respect to maintenance of infrastructure in South countries.

The International Science, Technology and Innovation Centre for South-South Cooperation under the Auspices of UNESCO (ISTIC) is a UNESCO Category 2 Centre hosted by Malaysia. Established in 2008, ISTIC is funded by Malaysia to

assist less developed countries in science, technology and innovation through South-South cooperation. Under my advocacy as Chairman of ISTIC governing board 2008-2016 and then Honorary Chairman for life, ISTIC has made "Maintenance of Infrastructure" as one of its priority agenda. ISTIC has organized "Maintenance of Infrastructure" workshops in India (3), Kenya, Myanmar, Nigeria and Malaysia (5), eleven in total involving some 400 engineers and technicians from 30 South countries. Hosting partners were the Engineering Staff College of India (ESCI), Hyderabad; Engineers Board Kenya; Myanmar Engineering Society/Myanmar Engineering Council; the Council for Regulating of Engineering Nigeria (COREN).

ISTIC "Maintenance of Infrastructure" agenda has received the continued support of UNESCO, notably former Assistant Director General for Natural Sciences, Dr. Gretchen Kalonji, a noted engineering professor from California, and Dr. Shahbaz Khan, former Director, UNESCO Regional Science Bureau for Asia and the Pacific, Jakarta and currently the UNESCO Director of UNESCO Office in Beijing. He is UNESCO's representative to China, Japan, Mongolia, North Korea and South Korea. Dr Shahbaz Khan is an international known water resources engineering professor from Pakistan and has participated as keynote speaker in ISTIC "Maintenance of Infrastructure" training workshops in Malaysia and Myanmar. I am confident that the ISTIC agenda will receive strong support from Dr. Peggy Oti-Baoteng, UNESCO Director of Science Policy and Capacity Building UNESCO Head Office Paris. Dr Peggy is a renowned engineering professor from Ghana.

ISTIC "Maintenance of Infrastructure" agenda has gained international recognition in South countries and has received increasing international engineering support and built up an influential engineering constituency in Asia, Africa and Latin America.

ISTIC's sustaining partner has been IEM with IEM past president Ir. Choo Kok Beng anchoring this agenda as ISTIC consultant. Through IEM, ISTIC has had the support of most of the important Malaysian infrastructure role players. They include the Malaysian Highway Authority (LLM), the Board of Engineers Malaysia (BEM), the Construction Industry Development Board (CIDB), the National Power Corporation (TNB), Talikom Malaysia, Malaysian Railway, the Master Builders Association Malaysia (MBAM), and the Malaysian Service Providers Confederation (MSPC) etc. They have provided ISTIC's "Maintenance of Infrastructure" agenda with trainers for training workshops in Malaysia and abroad; and with site visits to their installations in Malaysia. Some Malaysian engineering utilities and corporations have set up their own universities and many have their own training centres.

In fact, IEM's advocacy for maintenance of infrastructure in South countries

started during my term as Chairman of the Commonwealth Engineers' Council (CEC) 1994-2000. As Chairman of the Commonwealth Board of Engineering Board of Education and Training (CBEET) under CEC, Ir. Choo Kok Beng initiated two training circuits of training workshops for maintenance of buildings by Malaysian trainers with financial support from the Commonwealth Secretariat in London. The East Asian circuit covered Hong Kong, Brunei, Singapore and Malaysia whilst the African circuit covered Mauritius, Zimbabwe, Kenya and Botswana. The training workshops were much appreciated in Africa.

Through ISTIC's "Maintenance of Infrastructure" training workshops in Malaysia, visiting professional engineers and policy makers in technical ministries and departments from Africa and other South countries have marvelled at the modern, widespread and inclusive infrastructure in Malaysia. They are also impressed by the good repair and maintenance of infrastructure in Malaysia. In infrastructure development, they regard Malaysia as a first world nation. They admire the established participation of the Malaysian private sector in infrastructure investment, construction, operation and maintenance. Through participation of ISTIC's "Maintenance of Infrastructure" training workshop, they have come to accept Malaysia as the South hub for human capital capacity building in infrastructure maintenance. They support ISTIC's ambition to make Malaysia a hub for the maintenance of infrastructure for South countries.

South-South Institute for Infrastructure Maintenance in Malaysia (SSIMM)

China's ambition in BRI has been to establish an expanding track record of infrastructure projects overseas below budget and ahead of time. This is understandable in their desire to establish themselves as the top infrastructure construction nation in the world. Their contractors look at operation and maintenance at the contract level wherever the long life of the infrastructure assets requires lifelong and continuous professional training of indigeneous engineers and technicians. The language barrier between Chinese engineering staff on site who are not schooled in English and the indigenous engineers and technicians has been a major barrier. The other is the increasing use of Chinese standards in turnkey infrastructure projects. I believe Chinese engineering standards

will become the model for international standards in future. Currently they are not understood outside China. Malaysia is a multi-racial nation, Malaysians are linguists by nature. Many receive their engineering education overseas and are conversant also in the language of their alma maters. Engineering degrees of Malaysian universities are recognized worldwide as the Board of Engineers Malaysia is a signatory of the Washington Accord. Malaysian construction industry is thus well staffed by competent and skilled human resources. It is also well supported by many indigenous small and medium enterprises.Such a combination is generally lacking in most South countries. Thus,Malaysia's construction industry is mature with good design, construction, project management, operations and maintenance track record. Infrastructure projects in Malaysia have almost all been home built and largely home financed.Malaysian infrastructure corporations have also accumulated valuable project and facility management experience in their infrastructure investments at home and overseas in UK, Australia, India, ASEAN countries, Africa and Middle East. Many infrastructure projects have been undertaken by the private sector. As such loans are on non recourse financing basis, the project financing banks must insist that the infrastructure concessionaires pay special attention to the maintenance of their infrastructure assets to assure the necessary operational efficiency.

It is well known that China dominates the infrastructure development landscape in Africa. What is less known is the fact that Malaysian companies and policymakers have built a sizeable presence across Africa over the past two decades. In 2011, with investments of US $19 billion, Malaysia was in fact Africa's most important Asian investor, ahead of China and India in terms of the size of its foreign direct investment (FDI).

Malaysia's membership in the Commonwealth, Organisation of Islamic Cooperation (OIC), APEC, ASEAN, TPP, BRI, AIIB and RCEP helps to

open up markets in Africa.

IEM is the secretariat of the ASEAN Federation of Engineering Organisations (AFEO) and the Federation of Engineering Institutions in Asia and the Pacific (FEIAP). Under FEIAP president Professor Huang Wei of CAST, FEIAP has signed MOU with FAEO to assist in African engineering development, especially in the accreditation of engineering educational qualifications under the “Africa, Asia and Pacific Accord” .

Thus ISTIC and IEM are well positioned to partner AETDEW ininfrastructure development in South countries, especially in Africa in the area of infrastructure maintenance by joint establishment of the South-South Institute for Infrastructure Maintenance in Malaysia (SSIMM).

In BRI, developing countries are all waiting for infrastructure project funding and other related facilities from China. BRI is a win-win and mutually beneficial concept. Malaysia should be the first to offer to enhance BRI from outside China. SSIMM is such a project.

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