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Taiwan has always been a major center of the global IT industry. Not only is Taiwan a leader in terms of technological innovation, but these cutting-edge technologies are also applied to daily life and business operations thanks to the efforts of the public, private and social sectors. Science and technology are advancing with each passing day, so the existing infrastructure is bound to struggle to keep up in the future. In order to improve quality of life and assist in industrial transformation, the government launched the Forward-Looking Infrastructure Development Program in 2017 to boost Taiwan's competitiveness across the board.

The Forward-Looking Infrastructure Development Program consists of eight major plans: railways, water environments, green energy, urban-rural projects, human resources, digital technology, food safety, and child care. As for digital technology, the hardware and software infrastructures are being developed simultaneously, with the goal being to create a comprehensive and convenient digital environment. In order to develop Taiwan into a major digital hub for the Asia-Pacific region, the government has been further strengthening various national network infrastructures. Thoroughly upgraded infrastructures include public service network, national network backbone, IoT security solutions, and 5G telecommunications. To take telecommunications infrastructure as an example, Taiwan's 5G operators have their commercial launch in 2020. In order to accelerate popularization of 5G applications, the government, in addition to encouraging Taiwan's five major telecommunications operators to speedup 5G network deployment, has also diversified the 5G application field through public-private cooperation.

In addition to hardware construction, the government has also actively built up domestic businesses, especially those small

臺灣向來是全球 IT 產業重鎮，不只技術領先，政府與社會也早將各種新科技應用於日常生活與企業經營，然而科技進展日新月異，既有的基礎建設勢必難以因應未來需求。為了提升民眾的生活品質、協助產業轉型，政府在 2017 年開始啟動「前瞻基礎建設計畫」，全面升級臺灣競爭力。

「前瞻基礎建設計畫」包含八大建設計畫：軌道、水環境、綠能、城鄉、人才培育、數位建設、食品安全、育兒空間。其中數位建設從軟硬兩端同時並進，希望藉此建構完整、便利的數位化環境。為打造臺灣成為亞太區數位空間的重要樞紐，政府進一步強化各種國家網路基礎建設，將公部門網路服務、國家聯網通道建設、物聯網資安防護、5G 電信等基礎架構全面升級。以電信基礎架構為例，我國的 5G 已在 2020 年商轉，為加速 5G 應用普及，政府除了鼓勵臺灣五大電信業強化 5G 網路建置外，也透過公私部門合作，讓 5G 應用場域多元化。

除了硬體建設，政府也積極強化國內企業體質，尤其是受限於資源，導致轉型不易的中小企業，經濟中小企業處以與工業局合作搭建平臺，將資源挹注於此一族群，不僅提供各種資金補助，同時也投入人才培育、產業生態鏈構建等工作，並以群聚輔導方式，協助業者轉化經營概念，在智慧化時代創造全新商機。

面對全球智慧化變局，臺灣沒有「以拖待變」的本錢，積極擁抱數位技術，方能讓產業與國家競爭力與時俱進，即將在 2021 年開始的「前瞻基礎建設 2.0」，將透過數位建設驅動臺灣轉型，在公部門方面，政府將導入數位治理概念，讓服務更便利即時，資訊更透明安全，產業部分則可延伸既有優勢，鞏固全球領先地位。近年全球變動劇烈，美中貿易戰衝擊經濟、COVID-19 疫情蔓延各國，前瞻基礎建設將可協助臺灣在後疫情時代加快數位布局，藉此優化民眾生活品質、提升國家競爭力，落實「數位臺灣、智慧島嶼」願景。

and medium-sized enterprises that find it difficult to change quickly due to a limitation of resources. The Small and Medium Enterprise Administration, Ministry of Economic Affairs has worked with the Industrial Development Bureau and set up a platform together to make sure there are enough resources to go around among the said companies. Not only does the platform provide various financial subsidies, but it also invests in talent cultivation, industrial ecological chain building and other projects. Through industry cluster guidance, they assist businesses in transforming operational principles, creating new business opportunities in this era of smart technologies.

In an ever-changing world driven by smart technologies, Taiwan does not have the luxury to take wait-and-see approach. Actively embracing new technologies is the only way that the competitiveness of the country and its industries can keep pace with the times. "The Forward-Looking Infrastructure Development Program 2.0," to be launched in 2021, will drive Taiwan's transformation through further digital construction. In the public sector, the government will introduce the concept of digital governance to provide more timely and convenient services and strengthen transparency and security. As for businesses, the program helps extend existing

advantages to solidify their position as global leaders. In recent years, there have been drastic changes on the global stage. The US-China trade war has impacted the economy and the COVID-19 epidemic has spread across the globe. Forward-looking infrastructure development program can help Taiwan speed up its digital development in the post-epidemic era, optimize people's quality of life, strengthen national competitiveness, and ultimately realize the vision of "Digital Nation, Smart Island."

前瞻基礎建設計畫— 打造智慧國家 數位建設先行

Developing Digital Infrastructure First to Build a Smart Nation

▲「數位國家、智慧島嶼」是我國國家發展的願景。"Digital Nation, Smart Island" are the goals and vision of Taiwan.

科技已經成為決戰未來的關鍵因素，「數位國家、智慧島嶼」是我國國家發展的目標與願景，透過數位建設激發創新與創業的風潮，帶動產業創新發展，增加政府開放與透明，提升大眾的生活品質，將臺灣發展成為先進智慧化的島嶼。

Knowing technology is a key element of the future, the concepts of "digital nation, smart island" have become the goals and vision of Taiwan. Through digital development, we will set in motion a wave of innovation and entrepreneurship, drive industrial innovation and development, increase government openness and transparency, and improve the quality of life, developing Taiwan into an advanced, smart island.

開展數位建設 創新生活起點

在變化快速的時代，我國政府超前部署，於 106 年起推動「前瞻基礎建設計畫」，聚焦在八大建設計畫，包含建構安全便捷的軌道建設、因應氣候變遷的水環境建設、促進環境永續的綠能建設、營造智慧國土的數位建設、加強區域均衡的城鄉建設、因應少子化友善育兒空間建設、食品安全建設，以及人才培育促進就業建設，打造未來 30 年國家發展需要的基礎建設。

在「前瞻基礎建設計畫」的八大建設計畫中，數位建設為其中的重中

▲ 讓所有學校均能享有均等、優質的數位學習基礎，成就學生具備數位公民的素養，努力投資數位學習相關軟、硬體設施，協助師生教與學，這正是契合前瞻基礎建設中智慧學習環境的規劃精神。Assisting all schools to build an equal and high-quality digital learning foundation for the purposes of providing students with digital literacy and investing in digital learning related software and hardware facilities to assist teachers and students in teaching and learning are the core values of the "Forward-Looking Infrastructure Development Program."

Developing Digital Infrastructure to Give Rise to an Innovative Life Style

In this mercurial era, the Taiwanese government has been employing the concept of advanced deployment to build up Taiwan's infrastructure. In 2017, the government began advocating the "Forward-Looking Infrastructure Development Program," which consists of eight main development categories, including railway projects to provide safe and fast transportation, water environments to build resilience against climate change, green energy infrastructure to foster environmental sustainability, digital technology to create a smart and connected nation, urban and rural projects to balance regional development, child care facilities to reverse declining birth rate trends, infrastructure to ensure food safety, and human resources infrastructure to nurture talent and boost employment. Executing these infrastructure plans is pivotal for the next 30 years of national development.

In the eight main development categories of the "Forward-Looking Infrastructure Development Program," digital technology development is the top priority with innovation driving its two core concepts. Tsai Zse-Hong, Executive Secretary of the Office of Science and Technology, the Executive Yuan explained that we must first discard the antiquated digital infrastructure norm of "tearing up the road to pave a new one" and do away with the concept of hard infrastructure development; instead, we should satisfy the needs of the digital economy era. It is pivotal to make strides in network security, the digital culture and creative industry, smart urban and rural development, smart learning and scientific research facilities pertaining to soft infrastructure for the betterment of the country. In addition, the government's goals of investing resources and introducing digital technology are to prepare for future industrial innovation and a higher standard of life. The focus is on helping industries and companies make a profit and improve quality of life.

之重，以兩大核心理念創新出發。行政院科技會報執行秘書蔡志宏說明，首先，揚棄過往數位基礎建設「挖馬路、鋪線路」的思維，打破硬體公共建設的觀念，從數位經濟時代的需求切入，為我國導入網路安全、數位文創、智慧城鄉、智慧學習及科研設施等更具意義的軟性基礎建設。此外，政府投入資源、導入數位科技的目標，是在為未來產業創新與生活品質作準備，重點在於幫助產業與企業賺錢獲利、提升民眾的生活品質。

▲ 由科技部國研院國網中心結合華碩、廣達、臺灣大哥大，建造國家級 AI 超級電腦「臺灣杉二號」，透過國際級 AI 運算能力，加速業界與學界的 AI 創新速度與效率。National Grid Center of the National Research Institute of the Ministry of Science and Technology collaborated with ASUS, Quanta, and Taiwan Mobile to build the international-grade AI supercomputer "Taiwania 2." Equipped with international-grade AI calculation capabilities, it can accelerate the speed and efficiency of innovation in both industry and academia.

產官學研助攻數位創新亮點

在上述兩項核心理念推動下，數位建設獲得各界支持協助，已經在眾

Research Assistance in Industry,Administration and Academica Generate Highlights in Digital Innovation

Driven by the two core values mentioned above, digital infrastructure has already garnered significant cross-domain support and assistance and produced successful results across the board. For example, the National Grid Center of the National Research Institute of the Ministry of Science and Technology collaborated with ASUS, Quanta, and Taiwan Mobile to build the international-grade AI supercomputer "Taiwania 2." Equipped with international-grade AI calculation specs, it can accelerate the speed and efficiency of innovation in both industry and academia.

The wide sweeping impact of Covid-19 has spawned a new need for online digital learning tools; therefore, the Ministry of Education has responded by continually optimizing smart learning infrastructure, such as smart networks in primary and secondary school. Taiwan has deployed more than ten thousand platforms to capture water, air, ground, and disaster data with real-time remote sensors. The data are all open to private sector usage. Through public-private collaboration, real-time sensing data and AI models are used to effectively improve the timeliness and effectiveness of air pollution reporting and environmental protection field inspections, accelerating the data economy and optimizing smart governance. For people living in a more isolated rural setting, the infrastructure of telemedicine care is vital to life. Taiwan has targeted 403 rural public health centers across the country and upgraded the network bandwidth to 100Mbps. The transmission time of medical images has been greatly reduced from 30 seconds to 5 seconds, effectively improving the quality of remote medical care and making telemedicine viable.

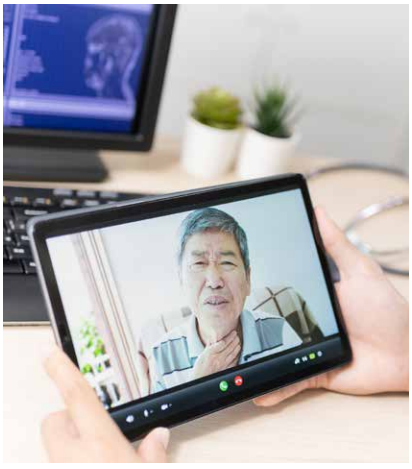
Digital infrastructure development is also focused on the cultural and creative industry. Through support of big data, 4K ultra-high-quality technology, and the basic environment for production

多面向展現突破成果。例如科技部國研院國網中心結合華碩、廣達、臺灣大哥大，建造國家級 AI 超級電腦「臺灣杉二號」，透過國際級 AI 運算能力，加速業界與學界的 AI 創新速度與效率。

有鑑於新冠肺炎的影響，因應未來線上數位學習需求，教育部持續優化全國國中小校園智慧網路等智慧學習基礎建設。我國更已布建水、空、地、災等即時及歷史感測資料超過 1 萬站，提供民間介接使用，透過公私協力，運用即時感測資料與 AI 模型，有效提升空汙通報與環保實地稽查時效與效能，加速資料經濟，優化智慧治理。

對於偏鄉民眾而言，遠距醫療照護基礎建設攸關生命，我國鎖定全國 403 處偏鄉衛生所，將網路頻寬升級至 100Mbps，醫療影像傳輸時間大幅降低，平均由過去 30 秒縮短至 5 秒內，有效改善偏鄉醫療品質，實現遠距醫療和照護。

數位建設也挹注在文創產業，透過大數據、4K 超高畫質技術與製播基礎環境，包含攝影棚、後製系統等數位建設的支持，公視「我們與惡的距離」製作水準廣獲好評，完結篇收視率達 3.4%，拿下第 54 屆金鐘獎 6 項大獎，更於國際影視平臺播出，輸出我國文創軟實力。



▲ 遠距醫療照護基礎建設，透過網路頻寬升級，醫療影像傳輸時間大幅降低，有效改善偏鄉醫療品質，實現遠距醫療和照護。The telemedicine infrastructure has been enhanced through the network bandwidth upgrade; subsequently, the transmission time of medical images has been greatly reduced, effectively improving the quality of remote medical care and making telemedicine viable.

and broadcasting (such as film studios and post-production digital infrastructure systems), Public Television Service received great praise for its high-production value film—*The World Between Us.* The viewership rate of the season finale reached 3.45%, and it won six awards at the 54th Golden Bell Awards. It was also broadcast on international film and television platforms, exporting Taiwan's cultural and creative soft power.

Developing Advanced Networks For the Next Ten Years

This year, the coronavirus pandemic took its toll on the global community, resulting in a readjustment of the norms that mankind is accustomed to, speeding up the digital transformation of the industry and the expansion of Taiwan's digital infrastructure needs. The next stage of the Forward-Looking Infrastructure Development Program will be executed during the 2021-2025 period. With the vision of "building digital infrastructure that supports Taiwan's development over the next 10 years," Taiwan will invest about 95.4 billion NTD to assist the development of its six core strategic industries, put the finishing touches on the cornerstone of a digital nation with innovative economy, accelerate digital transformation, and strengthen national digital competitiveness in the post-epidemic era.

"Advanced network development" is crucial in the next stage of the Forward-Looking Infrastructure Development Program. Tsai Zse-Hong emphasized that in the face of challenges and opportunities such as the Sino-US trade war, Taiwan will, through the expansion of international communications exchange, data backup facilities, and the upgrade of Taiwan's optical cable channels, attract major international companies to settle in Taiwan and promote Taiwan's chance of becoming an important digital hub in the Asia-Pacific region.

Built on this infrastructure, Taiwan will encourage major global content platform operators to establish data centers in Taiwan to serve customers in the Asia-Pacific market. Taiwan is expected

先進網路建設 瞄準未來十年

今年新冠肺炎肆虐全球，徹底顛覆人類習以為常的運作模式，加速產業的數位轉型，也擴大國家數位基礎建設需求。前瞻數位建設的下一個階段將於 110-114 年期間展開，我國將以「建構支持臺灣未來 10 年發展的數位建設」為願景，投入約 954 億元預算，協助「六大核心戰略產業」發展，完備「數位國家、創新經濟」的基石，加速數位轉型，也累積後疫情時代的國家數位競爭力。

▲ 影音娛樂也是 5G 可以優化體驗的應用，尤其是近年來一票難求的演唱會，更可透過 5G 的力量，創造出各種智慧化功能。（圖片提供／中華電信）5G can also help optimize the audio-visual entertainment experience, especially when it comes to super popular concerts where tickets have been increasingly hard to come by in recent years. Furthermore, it can create various intelligent functions through the power of 5G. (Photo credit: Chunghwa Telecom)

在前瞻數位建設的下一個階段，「先進網路建設」至關重要。蔡志宏強調，面對中美貿易戰等挑戰和機會，臺灣將透過擴充國際訊務交換能量與資料備援設施，以及臺灣光纜通道的整備，吸引國際大廠選擇在臺灣落腳，促使臺灣有機會成為亞太區數位空間的重要樞紐。

to become a major country for submarine cable routing on the west coast of the Pacific Ocean, speeding up the transmission efficiency of domestic and foreign content/data, and driving the rapid development of digital content and data economy. In the future, when domestic and international companies evaluate their global strategic layout, Taiwan will become an important strategic partner.

From another aspect of advanced network development, Taiwan will build public service network exchange centers internally, integrate existing public networks, build up remote dual-center structure, and strengthen the cross-network transmission efficiency and backup capabilities of government networks (GSN), and academic networks (TANet and TWAREN). It will further improve the transmission efficiency and resilience of public service networks. In terms of cloud services, it will provide cloud computing, storage, and data cloud required for government public services, education, and research, and lastly provide backup services for the systems and data of key applications to strengthen the resilience and quality of cloud services.

Applying Emerging Technologies to Develop Industrial Advantages

Assisting the innovation and development of industries and enterprises is an important goal of digital infrastructure development. Taiwan's communications industry has successfully entered the international 4G market supply chain in recent years. Looking forward to the future applications of emerging technologies such as 5G, AIoT, and big data, Taiwanese manufacturers possess key advantages. Tsai Zse-Hong pointed out that Taiwan's network equipment, semiconductor, and critical parts industries enjoy strong competitive edge and have played an important role in the global supply chain. In addition, the people and enterprises of Taiwan have a high degree of acceptance of innovative technologies. The advantages of 5G technology, such

110至113年國家發展策略

The 2021 - 2024 National Development Plan

數位創新，啟動經濟發展新模式2.0

The Plan Digital Innovation Plan to Initiate the New 2.0 Model of Economic Development

▲ 國發會訂定未來四年總體目標，以四大政策主軸，持續深耕國家實力。其中在「數位創新，啟動經濟發展新模式 2.0」上，是以 5 ＋ 2 產業創新之基礎上，打造六大核心戰略產業。The NDC rolls out the national development plan for the next four years encompassing four overarching strategies that will further enhance Taiwan’ s comprehensive national strength. The Digital Innovation Plan to Initiate the New 2.0 Model of Economic Development, a new emphasis based on the existing 5+2 Innovative Industries Plan, addresses the development of the six core strategic industries.

as ultra-high speed, low latency, wide connectivity, and diverse applications, as well as emerging smart industries such as smart medical care, smart transportation, smart factories, entertainment exhibitions, and emerging technologies all contribute to the innovation, breakthrough, and application of technology.

However, there are many challenges in developing 5G: Key intellectual properties of 5G have been patented by many countries, and Taiwan lacks the support of international netcom manufacturers and needs to strengthen its cultivation of software and cross-domain talents. Tsai Zse-Hong advocates industry-government collaboration to build 5G application demonstration sites in the future to accelerate the realization of smart life application scenarios and accumulate application cases in the market. In addition, by applying Open RAN (Open Radio Access Network) and white-box base stations to enter emerging markets through 5G cross-domain industrial alliances and by developing both core 5G technologies and system trial platforms, Taiwan will join the international supply chain and participate in international organizations, increasing the visibility of international forward-looking technologies and products.

In addition, the global satellite technology industry has been developing rapidly over the past two years, with a number of low-to-medium orbit broadband communication satellite galaxies being deployed. Taiwan has been developing its satellite program for nearly 30 years and now has the capability to produce its own satellites and even possesses a partial satellite component supply system. In december of 2019, President Tsai noted in her speech at the Future Tech Expo 2019: Taiwan will enter the space industry in the next four years."

Taiwan now has the potential to become a vital R&D and manufacturing base for satellite components, ground station equipment, and related systems and equipment in the

以此基礎建設爭取全球主要內容平臺營運商在臺灣落地建置資料中心，用以服務亞太市場客群。臺灣可望成為太平洋西岸海纜路由主要國家，加速國內外內容 / 資料的傳輸效率，帶動數位內容與資料經濟的蓬勃發展，未來當國家和國際大廠在評估全球策略布局時，臺灣都將成為重要戰略夥伴。

在先進網路建設的另一個面向，我國對內將透過建置公共服務網路交換中心，整合現有公共網路、提供異地雙中心架構，強化政府網路（GSN）與學術網路（TANet、TWAREN）的跨網傳輸效率及備援能力，提高公共服務網路傳輸效率與韌性。在雲端服務方面，將提供政府公共服務及教育研究所需的雲端運算、儲存以及資料雲端服務，並針對關鍵應用提供系統、檔案與資料的備份服務，強化雲端服務的韌性與品質。

應用新興科技 發展產業優勢

協助產業與企業創新發展是數位建設的重要目標，我國通訊產業近年來已成功打進國際 4G 市場供應鏈，展望未來 5G、AIoT、大數據等新興科技應用，臺灣廠商掌握關鍵優勢。蔡志宏直指，臺灣網通設備、晶片半導體、關鍵零組件等領域專業競爭力強大，已在全球供應鏈扮演重要角色。此外，我國人民與企業對於創新科技的接受程度高，針對 5G 超高速、低延遲、廣連結以及多樣化應用等特性，以及智慧醫療、智慧交通、智慧工廠、娛樂展演、智慧學習等智慧城市場域新興科技，都有助於創新突破應用。

然而，面對 5G 關鍵智財已被多國登記、國內缺乏國際級網通大廠支持、須加強培育軟體及跨域人才等挑戰，蔡志宏建議業者，未來搭配政府計畫協力布建 5G 應用實證場域，加速實現智慧生活應用情境，

▲ 我國發展衛星計畫已有近 30 年的歷程，目前已經具有衛星自製能力與部分衛星零組件供應體系。Taiwan has been developing its satellite program for nearly 30 years, and currently has the capability to produce its own satellites and a partial satellite component supply system.

累積市場應用實績；藉由 Open RAN（開放式無線電接取網路）及白牌基地臺，透過 5G 跨域產業合作結盟進入新興市場，並建立 5G 核心技術能量及系統試煉平臺，加入國際供應鏈或參與國際組織，增加國際前瞻技術、產品知名度。

此外，近兩年全球衛星科技產業快速發展，多個中低軌寬頻通訊衛星星系正啟動布建，我國發展衛星計畫已有近 30 年的歷程，目前已經具有衛星自製能力與部分衛星零組件供應體系。蔡總統 2019 年 12 月出席「2019 未來科技展」致詞時表示：下一個 4 年臺灣將進軍太空產業。

以臺灣的能力，未來可成為衛星零組件、地面接收設備、相關系統設備的重要研發和製造基地。在太空產業領域我國有絕佳切入的機會，建立可立足全球衛星產業零組件與次系統供應鏈，並大幅提升我國太空研發的國際競爭力。

未來數位願景 創新包容永續

臺灣的數位建設持續前行，展望未來，期待在下一階段 DIGI+ 政策推動下，聚焦於數位基盤（Digitization）、數位創新（Innovation）、數位治理（Governance）、數位包容（Inclusion）等未來網路社會關鍵基礎議題，臺灣能持續「邁向創新、包容、永續的智慧國家」的願景發展，未來數位科技發展的重點，將會與社會與人文產生更多連結，更符合臺灣社會的真實需求。

在 AI、IoT、5G、6G、區塊鏈等飛快發展的科技下，搭配精準醫療健康、數位轉型、資安、下世代半導體、太空產業、先進網路建設等六大領域的未來科技布局，發揮臺灣小而精、跨域整合速度快的優勢，導入產業及社會各個層面，全方位建設臺灣成為智慧創新的典範國度。

future. Taiwan has an excellent opportunity to penetrate the field of space industry and establish a supply chain of components and sub-systems in the global satellite industry, greatly enhancing Taiwan's international competitiveness in space research and development.

The Vision of Future Digital Prospects—Innovation, Inclusion and Sustainability

The digital infrastructure of Taiwan continues making great strides in development. When envisioning the future, we look forward to the next phase of the DIGI+ program, which will focus on some essential issues of future network society: Digitization, innovation, governance, and inclusion. The key basic question is if Taiwan can continue in the development of its vision—forging an innovative, inclusive, and sustainable, smart country. In the future, the focus of digital technology development will be more connected with society and the humanities and more in line with the real needs of Taiwanese society.

The rapid development of AI, IoT, 5G, 6G, blockchain and other technologies will be compounded by Taiwan's future technological layout of six major fields including precision health, digital transformation, information security, next-generation semiconductors, space industry, and advanced network construction. By taking advantage of Taiwan's small size and rapid cross-domain integration speed and applying it to all levels of industry and society, Taiwan can be shaped into a model country of smart innovation.

迎接 5G 時代 佈建基礎建設 躍升亞太數位樞紐

Becoming an Asian Digital Power in 5G Era with Network Infrastructure

財團法人臺灣網路資訊中心（TWNIC）
董事長暨執行長黃勝雄
Kenny Huang, Chair and CEO of
Taiwan Network Information Center
(TWNIC)

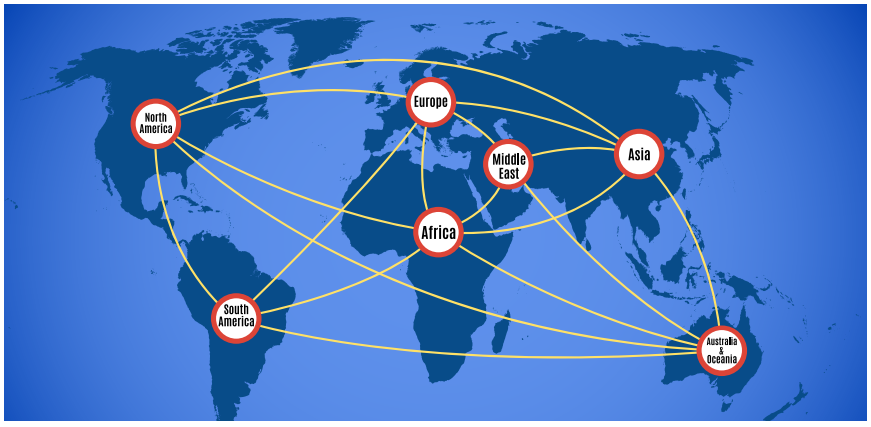
臺灣以「成為亞太區數位空間的重要樞紐」為願景，規劃包括推動強化公部門網路服務與運算基礎設施、國家聯網通道建設升級、5G 及物聯網資安防護、海纜及 5G 雲端聯網中心等先進網路基礎建設，逐步推升我國在亞洲地區網路空間的戰略地位。

With ambitions of becoming a major digital hub in the Asia-Pacific region, Taiwan has planned a series of policies such as improving the internet services provided by the public sector, upgrading national network backbone, safeguarding 5G and IoT information security, and building advanced internet infrastructure including submarine cables and 5G cloud data centers, in order to promote its strategic position among the Asian internet space.

國發會在 9 月 8 日發布我國前瞻基礎建設 2.0 推動計畫，其中數位計畫的預算從原本 5% 大幅提升至 16%，而 5G 相關建設編列 490 億元，加速加快電信商的布建速度、偏鄉基礎建設和支持應用發展，並且持續推動資安基礎建設提供網路安心服務。

創造有利環境 吸引海纜鏈結臺灣

5G 時代講求 Content is king（內容為王）、Data is king（資料為王），財團法人臺灣網路資訊中心（TWNIC，以下簡稱 TWNIC）董事長暨執行長黃勝雄強調，如果要將資料留在臺灣、吸引更多資料聚集在臺灣，就必須要透過海纜、透過資料中心基礎設施，將亞太地區連線打通，推升臺灣成為亞太地區的數位樞紐。



▲ 如果要將資料留在臺灣，就必須要透過海纜、透過資料中心基礎設施，將亞太地區連線打通，推升臺灣成為亞太地區的數位樞紐。If the government wants to keep and attract more internet traffic to Taiwan, data center infrastructure has to be established and subsea cables have to be built here to connect different Asia-Pacific regions through Taiwan to make the island an important data exchange point in the Asia-Pacific digital traffic system.

海底電纜對於任何國家而言都是重要的命脈，臺灣對外的網路、電話傳輸有超過 95% 仰賴海底電纜，強化海纜基礎設施十分重要，但是臺灣對於國際電路的需求一年僅成

The National Development Council issued the Forward-Looking Infrastructure Development Program 2.0 on September 8th, 2020 with the budget for digital infrastructure greatly increased from 5% to 16% compared to the previous phase. The program allocated NT$49 billion to establish 5G equipment, accelerate 5G buildouts by telecommunications operators, construct network infrastructure in remote areas, support the development of applications, and complete the information security infrastructure for safe internet services.

Creating Business Conducive Environment to Attract Submarine Cable Industry

In the 5G era, content and data are king. Kenny Huang, Chair and CEO of Taiwan Network Information Center (TWNIC) emphasized that if the government wants to keep and attract more internet traffic to Taiwan, data center infrastructure has to be established and subsea cables have to be built here to connect different Asia-Pacific regions through Taiwan to make the island an important data exchange point in the Asia-Pacific digital traffic system.

Submarine communications cables are key to network development in every country, especially in Taiwan, where 95% of internet and telephone transmission relies on undersea cables. Therefore, it is important for the country to fortify its submarine cable infrastructure. However, the annual growth rate of international circuit demand in Taiwan is only about 20 to 30%. Huang noted that it is almost impossible to have more submarine cables built in Taiwan if the government gives no control over supply and demand of the market mechanism. In order to avoid being marginalized and keep pace with global digital development, Taiwan has to formulate policies to facilitate building of submarine cable infrastructure. In addition, the government can create a business-conducive environment by building a terrestrial cable network from the south to the north, formulating related laws, and improving the current regulations, in order to encourage the submarine cable industry to build cables here and connect the island to the rest of Asia.

Evolving from Submarine Cable Distribution Center to Data Distribution Center

Taiwan is located at a junction where many global major submarine cables meet and pass

長約 20 至 30%，黃勝雄提醒，若是透過市場的供需機制運作，擴建海纜的可能性極低。為了避免臺灣在數位空間落後、邊緣化，政府以政策推動海纜基礎設施有其必要！臺灣可以透過創造有利的環境，包括建設從南到北的陸纜通道計畫、進行相關法規研議與優化現有法規，鼓勵更多國際海纜鏈接臺灣、過境臺灣。

從海纜集散地升級為資料集散地

由於地理位置的優勢，臺灣原本就是海纜必經要道、全球許多主要海纜的主要節點，黃勝雄指出，臺灣可以提供有如過境機場般的服務，海纜從臺灣北部或南部連接臺灣本島後，透過臺灣本島穩定的陸纜，串聯我國五大電信業者的服務與備援機制，再往南或往北連結其他海域。

臺灣將會成為海纜的集散地，以過境無須落地的方式，吸引國際海纜業者，將海纜這樣的「稀少戰略資源」留在臺灣！未來臺灣需要擴充頻寬時，就有如搭便車般，開通的成本低、時間快！此外，未來海纜業者在臺灣過境後，將進一步考慮在臺灣擴大業務，例如將資料中心設在臺灣，臺灣就能夠從海纜的集散地升級成為亞太地區資料的集散地！

在我國目前的國家聯網通道中，95% 以上對外通訊皆是透過海纜，臺灣連接國際 Internet 的總流量為 4 Terabit（TB），國內 Internet 交換的流量則是 11.5 TB，國際與國內的網路流量比率大約是 1 比 3。黃勝雄指出，在臺灣有許多資訊應用服務以國外的平臺業者為主，例如 Google、FB、Amazon 都是臺灣人經常使用的資訊服務，臺灣怎麼連結這些先進資訊服務、怎麼提升這些先進資訊服務的服務品質、服務的內容，就是我國未來對外通訊可以努力的空間。

完善基礎建設搶占轉型新商模

雲端聯網是 5G 運作的重要架構，要推升臺灣成為亞太區數位空間與創新重要樞紐，在雲端聯網中心也必須有新的思維。黃勝雄說

through. Huang suggested that Taiwan provide digital connectivity services like a transit airport for data. After subsea cables land on the island via northern or southern Taiwan, transmissions pass through the stable terrestrial cable network on land. The collected data can be further transmitted to abroad through the services and backups by the five major local operators.

This way, Taiwan will become a distribution center of undersea cables and provide non-stop rapid data traffic services to attract international submarine cable vendors and keep this precious strategic resource in the country. Moreover, expanding the network bandwidth in the future will be extremely cheap and convenient, just like hitchhiking onto a fast car. If submarine cable companies decide to extend their business to Taiwan, perhaps building data centers here, the island will turn from an intersection of subsea cables into a huge distribution center of data across the Asia-Pacific region.

Currently, more than 95% of the foreign internet traffic volume is transmitted through submarine communication cables in Taiwan. The total foreign internet traffic is 4 terabits (TB), while the domestic internet traffic has reached 11.5 TB. The ratio of foreign to domestic internet traffic is 1 to 3. Huang indicated that popular internet services in Taiwan are mainly provided by foreign platform vendors, such as Google, Facebook, and Amazon. Therefore, future development of international communications in Taiwan can start from considering how to put these advanced information services together, how to enhance service quality, and how to improve service content.

Completing IT Infrastructure and Creating New Business Model Through Transformation

Cloud networking is a key technology for 5G applications. In order to make Taiwan a crucial traffic hub of digital transmission and an important base of innovations in the Asia-Pacific region, cloud computing centers must be operated with an innovative mindset. Huang explained three major differences between 5G cloud computing centers and traditional internet data centers. First of all, data centers that have focused on computing equipment in the past have nothing to do with subsea cables, while 5G cloud computing centers have to serve as cable stations that gather

▲ 雲端聯網是 5G 運作的重要架構，要推升臺灣成為亞太區數位空間與創新重要樞紐，在雲端聯網中心也必須有新的思維。Cloud networking is the key technology for 5G applications. In order to make Taiwan a crucial traffic hub of digital transmission and an important base of innovations in the Asia-Pacific region, cloud computing centers must be operated with an innovative mindset.

明，5G 雲端運算中心與過去以電腦計算為主的資料中心存在著三個顯著的差異，首先，過去以電腦運算為基礎的資料中心無關海纜，但是 5G 雲端運算中心必須承擔海纜接續點或海纜中心的地位；其次，過去資料中心係以電腦為基礎，提供大量運算的機器，5G 雲端運算中心不再以機器為主軸，而是以資料為主、內容為王，扮演資料匯集點的功能；第三項差異為運算技術的改變，過去資料中心以電腦為主，現在則是採取邊緣運算的方式，將資料更快速遞送至使用端。

根據美國無線產業協會（CTIA）的調查，現在的 4G LTE 網路提供平均每秒 10 到 20 Mb 的連線速度，而通訊分析機構 Opensignal 的研究則顯示，5G 每秒可達 500Mb 左右的下載速度，將比 4G 快上 10 倍。隨著 5G 服務的普及，內容與商業模式也將全面更新，改變使用者的使用習慣，例如越來越多人使用手機追劇，又例如許多電視畫面已經採用 8K 攝影，源頭內容已經準備好了，就仰賴傳輸載具、打通端點跟端點，將 8K 畫質的原生內容傳送到家戶，種種全新的商業模式都將是我國前瞻計畫鎖定發展的重點。

近期「數位轉型」已是臺灣產官兩界的重要探討議題，黃勝雄認為，所謂數位轉型，就是利用數位工具協助機關或公司優化流程、優化商業模式、創新商業模式。數位工具是數位轉型重要的基礎，必須讓數位工具隨手可得，以最

and extend the cables or function as submarine cable centers. Secondly, the computer-based data centers need a huge amount of computing equipment, while 5G cloud computing centers, following the concept of "content and data are king", serve as information distribution centers. Lastly, computing technology has made dramatic advances: data centers relied on the computing techniques of computers in the past, but nowadays edge computing, a new computing model, has been applied to rapidly transmit data to the user.

According to the Cellular Telecommunications and Internet Association (CTIA), the current 4G LTE networks provide an average data speed of between 10 to 20 Mbps. However, reports by Opensignal, a mobile analytics company, show that 5G networks hit the download speed of approximately 500Mbps, 10 times faster than the last generation. As 5G networks become more widely available, it is believed that content and business models will be upgraded and consumer habits will change. For example, it will be more common for users to use mobile phones to binge-watch their favorite series. Moreover, 8K UHDTV technology has been widely used on televisions to transmit 8K resolution user-generated content to households through point-to-point connection. New business models related to these techniques are the focus of the Forward-Looking Infrastructure Development Program.

Recently, digital transformation has been one of the most important issues in both industry and the public sector. Huang believed digital transformation is to help organizations and corporations optimize operating procedures and innovate business models through digital tools. Namely, digital tools have to be handy and accessible, providing users with stable and low-latency services in the cheapest, fastest, and most convenient way. Additionally, digital transformation requires complete and abundant network infrastructure to allow users to leverage digital tools anywhere. Once the Taiwanese network operators can provide services as cheap, convenient, and accessible as operators in other countries, users in Taiwan will be able to enjoy quality digital tools. Thus, shortening the digital divide and embracing the trend of digital transformation are the goals for the country to achieve in laying the foundation for advanced network architectures.

▲ 5G 應用除了速度之外，資安更是值得關注的議題。目前世界各國已開始打造「乾淨網路」（Clean Network）。
The development of 5G applications should not only focus on data speed but also deal with information security issues. Currently, countries around the world have been trying to build a 'Clean Network'.

低的成本、最快的速度、最便利的方式提供，幫助使用者排除時間延遲、訊務不穩等使用障礙。在數位轉型的過程中，唯有基礎設施充裕完備的狀況下，使用數位工具才能夠破除地域限制，在便利性、可得性、使用成本都一樣時，臺灣產業就與國外產業在數位工具使用上享有相同立足點。而消除數位落差，擁抱數位轉型的趨勢，這些都是先進網路基礎架構必須做到的方向。

5G 物聯網應用 乾淨網路守護資安

在討論 5G 應用時，除了速度之外，資安更是值得關注的議題，TWNIC 自 2010 年承接行政院委託 營 運 TWCERT/CC（Taiwan Computer Emergency Response Team/Coordination Center, 臺灣電腦網路危機處理暨協調中心）業務，收到超過 80% 駭客入侵通報都是來自物聯網，正是因為物聯網設備簡易、密碼單純，容易被簡單軟體破解，因此物聯網資訊安全必須與 5G 發展相輔相成。

現今，5G 時代已經出現一個嶄新的概念：「Security by Design」，從設計源頭就考慮整體安全的重要性。目前世界各國已開始鎖定 5G 網路，著手列管電信業者、應用程式與市集、雲端儲存、海底電纜等業者，建構可靠的設備供應商名單，打造「乾淨網路」（Clean Network）計畫。從源頭的硬體開始，包括組裝、生產、製造、銷售等，都必須藉由生產履歷確實進行

Strengthening Cybersecurity by Building Clean Networks via 5G IoT Applications

Aside from data speed, information security is another important issue that deserves more attention in 5G applications. Since 2010, the TWNIC, entrusted by the Executive Yuan, has been managing the affairs of Taiwan Computer Emergency Response Team/ Coordination Center (TWCERT/ CC). According to reports by the organization, more than 80% of hacker intrusions occur in IoT networks because IoT equipment is simply-designed with easy-to-guess password combinations vulnerable to basic hacking software. Therefore, fortification of cybersecurity should be done in line with 5G developments.

Nowadays, a brand-new concept of 'Security by Design' has appeared in the 5G era, which encourages companies to consider cybersecurity at the beginning of the design process. The Clean Network program has been carried out globally, and many countries have constituted regulations on network vendors, App stores, cloud service providers, submarine cable operators, and made lists of trusted vendors. Hardware suppliers are required to maintain a production history for traceability management at every stage of production, including assembling, manufacturing, and selling. Such restrictions will certainly lead to a great upheaval in the industry's supply chain. Given that Taiwan has been carefully managing major equipment vendors as early as the 4G era, being on the list of clean network providers will undoubtedly be the great advantage for the country to further develop 5G IoT applications.

Taiwan, and thus government agencies have been building network architectures in accordance with the law. Huang pointed out that aside from cybersecurity, the government has to focus on the connection of network services between the public and the private sectors. For example, 5G networks, developed by private vendors, are being put into wider application. Government agencies should follow the 5G trend and make advances to improve the quality of domestic and international network traffic quality. In addition, the massive rise

溯源管理，此舉勢必帶動產業鏈大洗牌。而臺灣在 4G 時代即已針對主要設備供應商進行管理，此波很早就被列入網路乾淨的名單中，成為我國後續推動 5G 物聯網應用很大的優勢。

由於我國去年通過資通安全管理法，引領政府資通安全網路架構持續朝向符合法律要求的方向規劃，黃勝雄點出，當前除了資通安全，政府也應該注重並提升與民間網路服務的快速連結，例如 5G 屬於民間網路，面對快速成長的 5G 應用，政府部門網路必須追隨這波 5G 擴散而成長，提升政府與國內網路及國際網路的連線品質。此外，新冠肺炎期間，視訊流量大幅成長，主要透過邊緣運算遞送，政府的網路也應該透過邊緣運算優化服務功能。

前瞻基礎建設 2.0 推動計畫逐步開展，黃勝雄認為，「方向對了，第一步走對了，後續政策必須仰賴跨部門的通力合作！」而在成為亞太區數位空間與創新重要樞紐的路程中，未來即將成立的數位發展部更可望扮演重要角色，引領臺灣搶佔 5G 商機、成為數位大國！

乾淨網路

由美國國務院於 2020 年 4 月所提出的「5G 乾淨路徑（5G Clean Path）」計畫，目的在確保其關鍵電信網路、雲端、數據分析、行動應用、物聯網、5G 技術不使用到「不受信任」的設備供應商，以免受惡意攻擊者侵害，或受到中國共產黨等專制政府不公正的法外控制。同年 8 月又擴大「5G 乾淨路徑（5G Clean Path）」計畫，推出「乾淨網絡計畫（The Clean Network program）」，進一步保護人民隱私和企業機密，確保傳輸數據安全。其計畫包含乾淨營運商（Clean Carrier）、乾淨商店（Clean Store）、乾淨行動應用程式（Clean Apps）、乾淨雲端（Clean Cloud）、乾淨電纜（Clean Cable）以及乾淨通道（Clean Path）共六大項目。

of video conferencing traffic via edge computing technology during the COVID-19 pandemic has also urged the government to enhance the quality of edge computing services.

As the Forward-Looking Infrastructure Development Program 2.0 is developing step by step, Huang considered that "the government is on the right track and has taken a good first step, and policies should be implemented by governmental departments working together." Among all attempts to make Taiwan the hub of Asia-Pacific digital transportation and innovation, the Ministry of Digital Development, to be established in the future, will play a particularly important role in leading Taiwan to take advantage of 5G business opportunities and become a global digital power.

Clean Network

The 5G Clean Path is the program proposed by the United States Department of State (DoS) in April 2020, with the aim of safeguarding the nation's key assets including telecommunications networks, cloud-based systems, critical data, mobile applications, and IoT and 5G network technologies against threats by untrusted IT vendors, aggressive intrusions by hackers, and illegal control by autocratic governments such as the Chinese Communist Party. In August, the authority expanded the regulations by administering the Clean Network program to further protect citizens' privacy and companies' confidential information and secure data transmission systems, consisting of six categories: Clean Carrier, Clean Store, Clean Apps, Clean Cloud, Clean Cable, and Clean Path.

發展 5G 應用 縮短偏鄉數位落差 實現數位包容與平權

5G Applications to Bridge the Urban-Rural Digital Divide and Achieve Digital Inclusion and Equality

教育部資科司司長 郭伯臣
Mr. Kuo Borchen, Director of the Department of Information and Technology Education, Ministry of Education

教育部自民國 94 年起，啟動「偏鄉數位應用推動計畫」，從硬體設備、網路建設、師資培訓與數位內容資源等面向深耕，縮短數位學習落差，更協助偏鄉居民數位應用，消弭地理的差異，實現數位包容與數位平權！

Back to 2005, the Ministry of Education (MOE) launched the Digital Application Promotion Project in Remote Areas, an initiative that aims to bridge the digital learning gap through construction of facilities and broadband networks, teacher training, and digitalization of teaching materials. Furthermore, by assisting residents in remote areas with digital applications, the policy seeks to minimize geographical restrictions and ultimately achieve the goal of digital inclusion and equality.

▲ 前瞻基礎建設第一階段已建置校園智慧網路、強化智慧學習配套暨數位教學資源，讓數位教學環境更完善，遠距學習更順暢。Version 1.0 of the Forward-Looking Infrastructure Development Program has contributed to the construction of smart campus networks and development of digitized resources for smart, digital teaching. As a result, digital learning environments as well as the quality of distance education have been significantly improved.

前瞻基礎建設第一階段（106-109年）已逐步改善教室內的資訊設備，包括教學顯示器、螢幕、電腦、整合控制器等，加強完備寬頻網路建設與數位化學習資源，並建置校園智慧網路、強化智慧學習配套暨數位教學資源，支援教師在教室內的數位教學環境需求，也讓教育體系遠距學習更順暢。前瞻計畫2.0數位建設預算將投入5G網路建設及應用開發，縮短偏鄉數位落差。

四大關鍵 縮短偏鄉數位落差

教育部資科司司長郭伯臣說明，縮短偏鄉數位落差有四大關鍵，包括硬體設備、網路建設、師資培訓與數位內容資源。目前各縣市學校校園智慧網路建置已達100%，教室內具備無線上網環境，校園內網路頻寬可達光纖Gigabit上網，教育部並於前瞻基礎建設第三期特別預算（110-111年）編列經費，補助各縣市購置行動載具，強化學生個人化學習。

依據國發會近3年（106-108年）調查，國內學生超過六成未曾參與線上平臺學習課程，且多數教師不習慣線上教學方式，尚未開始推動個人化學習及教學。為了幫助教師孰悉線上教學、了解如何應用教育部線上資源，教育部持續舉辦教師研習，包括數位學習平臺使用、科技輔助自主學習概念、科技輔助自主學習教學應用及講師培訓等課程，加強教師

With the first stage of the Forward-Looking Infrastructure Development Program (2017 - 2020), digital facilities on campus have been upgraded gradually, including monitors, displays, computers, and integrated controllers in classrooms. Furthermore, construction of broadband networks has been completed to build a smart campus network, and teaching materials have been digitized to foster smart, digital teaching at school and provide resources needed for teachers to teach in a digital classroom. As a result, schools are now more adapted and ready to embrace distance education. The subsequent stage of the Forward-Looking Infrastructure Development Program will set aside a budget for the construction of the 5G network and its applications, with an aim of reducing the urban-rural digital divide.

Four Key Drivers to Reduce the Urban-Rural Digital Divide

Mr. Kuo Borchen, Director of the Department of Information and Technology Education, MOE, pointed out the four key drivers to reduce the urban-rural digital divide: digital facilities, broadband networks, teacher training, and digital teaching materials. Currently, every school in Taiwan is equipped with smart campus networks, meaning that all classrooms are now accessible to Wi-Fi services and that every school enjoys gigabit speed Internet services over a fiber-optic network. To further enhance personalized learning for students, the MOE has set aside a special budget for the third stage of the Forward-Looking Infrastructure Development Program (2021-2022) to subsidize local governments on the purchase of mobile devices.

According to a survey conducted by the National Development Council over the past three years (2017-2019), over 60% of the students in Taiwan have never been engaged in any online courses, and most teachers are not yet familiar with teaching courses online and not ready for personalized teaching and learning methods. To help teachers understand how to teach on the Internet and utilize online resources provided by the MOE, the ministry constantly holds teacher training programs on

數位教學能力。

教師之間更是彼此的數位教學資料庫，透過教師專業學習社群，教師們串聯群組共學互助，分享教育現場的務實經驗，許多教學挑戰都在群組間的問答中獲得解決，在教育現場逐步落實個人化、適性化學習與教學。

此外，為了持續強化數位內容資源，教育部在 109 年整合兩大數位學習平臺提供中小學線上課程，涵蓋國語文、數學、自然與英語領域。郭伯臣分享，依據 108 年教育部資料顯示，使用因材網進行學習扶助的學生，在「通過率」的表現上，數學高於未使用學生 3 成、國語近 2 成，使用 4 小時以上的學生高出近 5 成及 4 成！

▲ 教育部在 109 年整合兩大數位學習平臺提供中小學線上課程有助提升學生學習力。In 2020, the MOE integrated two online learning platforms to provide online courses for middle school and elementary school students and effectively enhance students' academic performance.

usage of digital learning platforms, technology-assisted autonomous learning and its application, and lecturer training, in an attempt to enhance teachers' digital skills.

To further provide abundant digital learning resources, in 2020, the MOE integrated two online learning platforms to provide online courses for middle school and elementary school students. The available courses include Mandarin, mathematics, science, and English. Kuo Borchen stated that according to 2019 MOE statistics, students who accessed Adaptive Learning to partake in autonomous learning had a higher **passing rate** than those who did not. For example, the number of students that passed mathematics in the former group outnumbered the latter group by 30%, and that number became 20% when it came to Mandarin. Moreover, students that spent more than four hours on Adaptive Learning had a 50% higher passing rate in mathematics and 40% in Mandarin. In terms of the improvement of their academic performance, students who utilized Adaptive Learning for mathematics and Chinese classes showed a 30% increase in progress than those who didn't. The figure was increased to 50% when students used Adaptive Learning for over four hours. **Resources on the digital learning platform have proven helpful in enhancing students' academic performance, and the more they access the resources, the better their performance becomes**, Kuo added.

After the introduction of Adaptive Learning, students in Dongshan Elementary School in Changhua were found to have made significant progress with the assistance of online resources. The fail rate of students falling behind on mathematics and Mandarin was reduced by 50%. Teachers were able to keep track of the challenges their students encountered through formative evaluations on Adaptive Learning. For instance, it was found a 6th-grader fell behind due to an unsolved learning barrier in the student's 3rd and 4th years at school. Another example is Xinwei Elementary School in Liugui, Kaohsiung. With a total of six classes and 47 students, Xinwei is classified as an ultra-remote small-sized school. After the school introduced Adaptive Learning in

而在「進步分數」方面，數學及國語比起未使用學生的進步幅度高出 3 成，使用 4 小時以上更高出 5 成，「正確使用數位學習平臺資源進行教學確實有助提升學生學習力，而且使用時數越高成效越好！」

導入因材網之後，彰化縣東山國小發現學習輔助教學效果顯著，學習落後的學生在數學和國語領域的「未通過率」降低了一半。老師也能夠透過因材網的節點測驗，追溯學生的學習障礙點，例如一名 6 年級學生，就被發現學習瓶頸原來是出現在 3、4 年級。高雄市六龜區新威國小全校共 6 班，學生共 47 名，屬於特偏小校，於 107 年導入因材網，數學領域從全校約 1/2（23 位學生）須要補強降低至 2 位學生，國語文領域則從全校約 1/3（15 位學生）降低至 1 人！

偏鄉數位應用推動計畫深耕 15 載

早在民國 94 年起，教育部即啟動「偏鄉數位應用推動計畫」，規劃推動「數位機會中心」（DOC）、「數位學伴」、「資訊志工」3 個專案計畫，累積偏鄉數位應用基礎。教育部於 90 年至 108 年執行「資訊志工計畫」，鎖定高中職及大專院校，鼓勵師生組織資訊志工團隊、縮減數位落差，總計 18 年來年共組織 1,566 隊志工團隊、召募超過 3 萬名師生，服務超過 29 萬名偏鄉民眾及學童。

透過數位機會中心（DOC），全國各地陸續設置電腦教室，開設免費資訊課程，引導偏鄉民眾使用手機、平板等數位工具，進行保健量測、雲端掛號、獲得用藥安全諮詢等衛教資訊，並協助當地發展特色產業，例如臺東縣鹿野 DOC 輔導自然農法栽種的牛奶果清翠果園、臺南市西港 DOC 協助學員改良芝麻產品包裝行銷全國、金門縣金城 DOC 串聯 8 個學員商家打造「鼠金嬤」品牌。

跨越城鄉空間障礙，網路是最佳媒介，教育部以線上即時陪伴與學習為基礎，推動「數位學伴」，培訓大專校院學生運用資訊工具與資源導入教學，藉由視訊設備與線上學習平臺，串聯教學端（大

2018, the number of students who needed remedial education on mathematics decreased from 23 (50% of total students) to 2, and the figure for remedial education on Mandarin was reduced from 15 (33% of total students) to only 1.

15 Years of the Digital Application Promotion Project in Remote Areas

Back to 2005, the Ministry of Education launched the Digital Application Promotion Project in Remote Areas with three specific schemes to set the cornerstone of digital application in remote areas: Digital Opportunity Center (DOC), Digital Learning Partners, and Information Technology Volunteers. The IT Volunteers scheme was implemented by the MOE during 2001 - 2019, where students and teachers from high schools, vocational schools, universities, and colleges were encouraged to form volunteer teams to reduce digital divide. In the course of the 18 years, 1,566 volunteer teams, with over 30,000 teachers and students, provided services to more than 290,000 residents and students in remote areas.

igital Opportunity Centers (DOC) are facilities serving as computer classrooms that offer free IT courses to teach residents in remote areas how to use digital devices such as mobile phones or tablets, to conduct health checkups, make a doctor's appointment online, and search for medication safety instructions. Meanwhile, they also help residents develop local industries. For example, the DOC in Luye, Taitung, guided Qingcui Orchard to plant star apples following natural farming practice. The DOC in Xigang, Tainan, assisted trainees in creating a better packaging for their sesame products and marketed them to the entire island. The DOC in Kinmen worked together with eight trainee merchants to create the brand **Golden Grandma**.

The Internet is the best medium to overcome the space barriers between urban and rural areas. The MOE launched the Digital Learning Partners scheme on the basis of online real-time companionship and learning. The scheme trained college and university students to integrate IT tools and resources with education. Through video conference equipment and online learning platforms, the scheme brings together the teaching

▲ 跨越城鄉空間障礙，網路是最佳媒介。「數位學伴」藉由視訊設備與線上學習平臺，串聯教學端（大學生）與學習端（國民中小學 /DOC 學童），進行一對一線上即時陪伴與學習。
The Internet is the best medium to overcome the distance between urban and rural areas. The Digital Learning Partners scheme utilizes video conference equipment and online learning platforms to bring together the teaching end (university/college students) and the learning end (junior high school, elementary school, and DOC students) to provide one-on-one, real-time companionship and lessons.

學生）與學習端（國民中小學 / DOC 學童），以定時、 定點、集體於學校電腦教室的方式，進行一對一線上即時陪伴與學習。

推動精進計畫 邁向數位平權

「偏鄉數位應用推動計畫」去年已完成第四期普及偏鄉數位應用，目前正進行第五期 - 偏鄉數位應用精進計畫（109-112 年）的推動，持續透過 DOC 及輔導團隊培訓種子教師、推廣數位應用與預防保健、強化偏鄉學生多元學習、推動在地特色產品數位行銷、打造數位共享環境，實現「邁向數位平權」願景。郭伯臣舉例說明，在 DOC 數位課程的帶動下，阿公阿嬤有能力了解孫子使用數位平臺的內容，進一步

end (university/college students) and the learning end (junior high school, elementary school, and DOC students) to provide regular one-on-one, real-time companionship and lessons in the computer classrooms at school.

Advancement Project to Realize Digital Equality

Universal rural digital applications, the 4th phase of the Digital Application Promotion Project in Remote Areas, was completed in 2019. The MOE is now implementing the 5th phase (2020-2023) of the project -- Advancement of Digital Application in Remote Areas. Continual efforts will be put in on the training of seed teachers through DOCs and mentoring groups, promotion of digital application and preventive healthcare, interdisciplinary learning for rural students, digital marketing of local products, and construction of digital environments. These steps aim to realize the goal of digital equality. Kuo Borchen added that the digital courses provided by DOCs have enabled grandparents to take a glimpse at how their grandchildren utilize digital learning platforms. What's more, they are now able to oversee and assist their grandchildren. This could mean brand new opportunities for skipped-generation families.

After years of hard work, digital education has been included in various teaching fields in Taiwan. To acknowledge the efforts of outstanding cities, on June 20th, the MOE presented Certificates of Outstanding Performance for cities who outperformed their counterparts in implementing the Digital Construction Plan for Junior High and Elementary Schools in the first stage of the Forward-Looking Infrastructure Development Program. The five award-winning cities and counties all had their special achievements. For example, Hsinchu County Government built a one-stop service system with LINE and utilized the app to promote policies and communicate with citizens. Tainan City Government established a Content Delivery Network (CDN), with which schools are able to access the nearest CDN nodes automatically, greatly enhancing Internet service performance. Taichung City Government

進行監督與幫助，為偏鄉隔代教養家庭帶來全新契機。

在長期耕耘下，數位教學已經進入臺灣的各個教學場域，為了表揚用心推動的縣市，今年 6 月 20 日教育部特別頒發「前瞻基礎建設 - 國民中小學數位建設計畫」第一期表現優良特頒獎狀。全國五個得獎縣市各有亮點，例如新竹縣善用 LINE 建立單一服務窗口、以社群網絡行銷、宣傳與聯絡；臺南市規劃內容傳遞網路（CDN）系統，學校可就近至各學校端 CDN 節點進行存取，提升連線效率；臺中市使用開源（Open Source）軟體或自行製作，發揮經費的最大效益；宜蘭縣透過智慧設備管理、智慧網路管理及智慧學習管理，簡化管理、提升成效；南投縣以顏色與英文數字標籤管理無線基地臺各棟大樓機櫃的各式網路線，便利資訊組長查修。

因應後疫情時代、5G 應用學習環境、雲端教育平臺、自主學習等課題，數位學習都是最佳的解答！教育部為落實 108 課綱，強調學生合作學習、批判性思維與問題解決等核心素養能力，培養下一代成為「以人為本的終身學習者」，將持續推動前瞻計畫 2.0，提供各項軟硬體支援，包括支援行動載具、專家團隊輔導與教師培力，協助學校落實推動數位學習。

由於 108 課綱的素養導向、國際教育趨勢，都走向自主學習、個別化學習，偏鄉學生人數較少，正是實現相關教育理念的最佳場域。郭伯臣也指出，與日、韓等鄰近國家相比，我國率先運用 AI 技術導入數位學習，再加上教育部推動科技輔助自主學習已經一年，前瞻計畫 2.0 將持續導入個人化載具，都是我國縮短偏鄉數位落差的優勢！

▲ 因應後疫情時代、5G 應用學習環境、雲端教育平臺、自主學習等課題，數位學習都是最佳的解答！ Facing the new challenges in the post-pandemic world, digital environments with 5G, cloud-based learning platforms, autonomous learning, and digital learning are undoubtedly the best solutions.

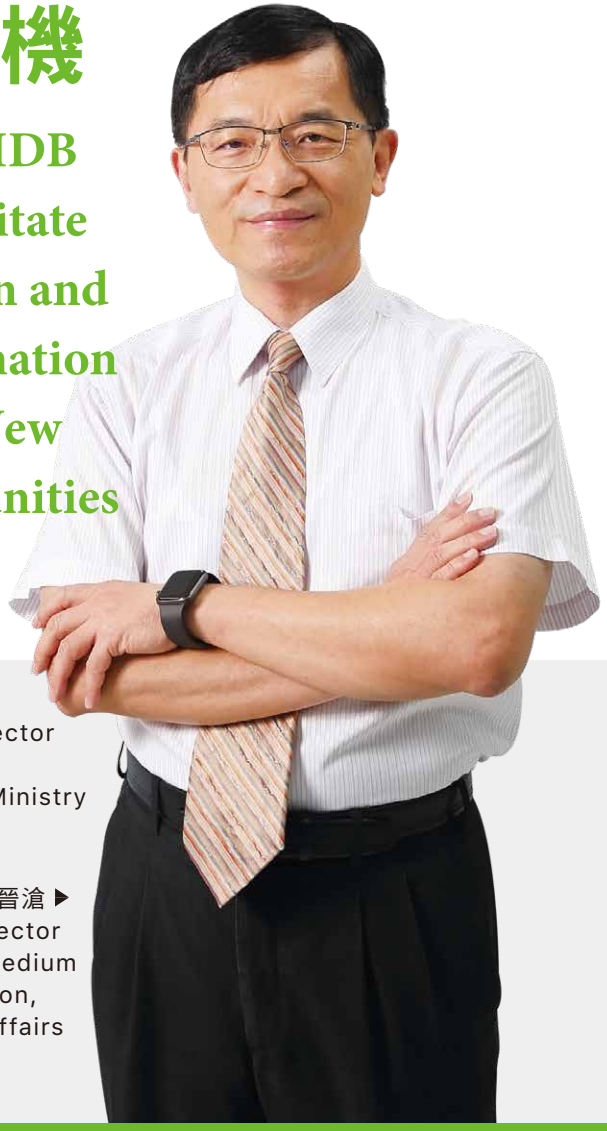
introduced open source and self-developed software to increase budget efficiency. Yilan County Government simplified management procedures and increased government efficiency with smart management systems for equipment, networks, and learning. Nantou County Government labeled the WAPs and Ethernet cables in the electrical enclosures of government buildings with dedicated colors, English letters, and numbers in order to relieve the maintenance burden for the government's IT technicians.

Facing the new challenges in the post-pandemic world, digital environments with 5G, cloud-based learning platforms, autonomous learning, and digital learning are undoubtedly the best solutions. With the goal of cultivating the next generation as **people-oriented lifelong learners**, the MOE will continue to push forward the second stage of the Forward-Looking Infrastructure Development Program. This includes development of student core competencies such as collaborative learning, critical thinking, and problem-solving. The ministry will continue to facilitate digital learning on campus by providing resources needed, such as mobile devices, counseling and guidance, and teacher empowerment.

As the New Curriculum Guideline for the 12-Year Basic Education and international education trends both focus on autonomous learning and personalized learning, remote schools with limited numbers of students are indeed the best places to realize these educational goals. Kuo Borchen indicated that Taiwan began to adopt AI technologies in digital learning way ahead of its neighboring countries, such as Japan and South Korea. The MOE has been promoting technology-assisted autonomous learning for an entire year. In addition, the second stage of the Forward-Looking Infrastructure Development Program will introduce personalized devices. These steps will further help Taiwan reduce the urban-rural digital divide.

經濟部中小企業處與工業局攜手合作 產業人才數位轉型 擁抱新商機

The SMEA and IDB Altogether Facilitate Talent Cultivation and Digital Transformation and Embrace New Business Opportunities



◀經濟部工業局長 呂正華
Mr. Leu Jang-Hwa, Director General of Industrial Development Bureau, Ministry of Economic Affairs

經濟部中小企業處處長 何晉滄▶
Mr. Ho Chin-Tsang, Director General of Small and Medium Enterprise Administration, Ministry of Economic Affairs

在前瞻基礎建設軟性數位建設部分，聚焦在中小微企業產業數位轉型，由經濟部中小企業處與工業局搭建平臺、挹注資源，協助中小微企業導入數位工具、培育數位人才，並建立體系、群聚或價值鏈，擁抱數位商機，持續創新經營。

In the government's Forward-Looking Infrastructure Development Program, digital infrastructure focuses on digital transformation for micro-, small-, and medium-sized enterprises. As of now, the Small and Medium Enterprise Administration (SMEA) and the Industrial Development Bureau (IDB) of the Ministry of Economic Affairs (MOEA) have set up a platform and allocated resources to assist micro-, small-, and medium-sized enterprises with the introduction of digital tools and digital talent cultivation. The joint effort of the two agencies will help to establish systems, clusters, and value chains for industries and embrace business opportunities and keep innovating in the digital era.

根據經濟部中小企業處公布之2020中小企業白皮書，2019年臺灣中小企業家數為149萬1,420家，占全體企業97.65%，隨著創業潮、零工經濟等趨勢，臺灣中小企業家數勢必不斷上揚。相較於大型企業擁有豐沛的人力與經費資源，小微企業在數位轉型上面臨更多困難與挑戰，卻也擁有眾多機會與優勢。

▲ 面對產業迫在眉睫的轉型壓力，經濟部工業局自105年起即透過智慧製造輔導團等多元方式，協助產業數位轉型。In response to the urgent need for transformation in various industries, the IDB of the MOEA has implemented various measures to facilitate digital transformation since 2016, including establishing a smart manufacturing coaching group.

數位化升級 創造新商模

從民國89年開始，臺灣第一步跨進數位化，由經濟部技術處推動「資訊業電子化計畫」（ABCDE計畫），當時是因應國外大廠客戶要求而啟動數位化，影響的企業多為製造業、中大型企業；然而近期這一波數位轉型是以小微企業為主體，因為企業經營者看見數位應用不可擋的趨勢、期待增加競爭力而主動參與，嚴重特殊傳染性肺炎（COVID-19，以下簡稱新冠肺炎）疫情更是推動的一大助力。

「小微企業必須運用策略，透過群聚登上平臺的方式，運用數位工具創新營運模式、創造價值、提升收益、優化顧客體驗、強化消費者忠誠度！」經濟部中小企業處處長何晉滄指出，隨著

According to the 2020 White Paper on Small and Medium Enterprises in Taiwan published by the SMEA, MOEA, in 2019, there were 1,491,420 SMEs in Taiwan, accounting for 97.65% of all enterprises. With the rise of entrepreneurship and the gig economy, the number of SMEs is expected to continue to grow. Compared with the talent pools and financial resources large enterprises have, micro- and small-sized enterprises encounter more difficulties and challenges in the process of digital transformation. That being said, there are silver linings to operating a smaller scale enterprise in that they have advantages of their own and unique business opportunities.

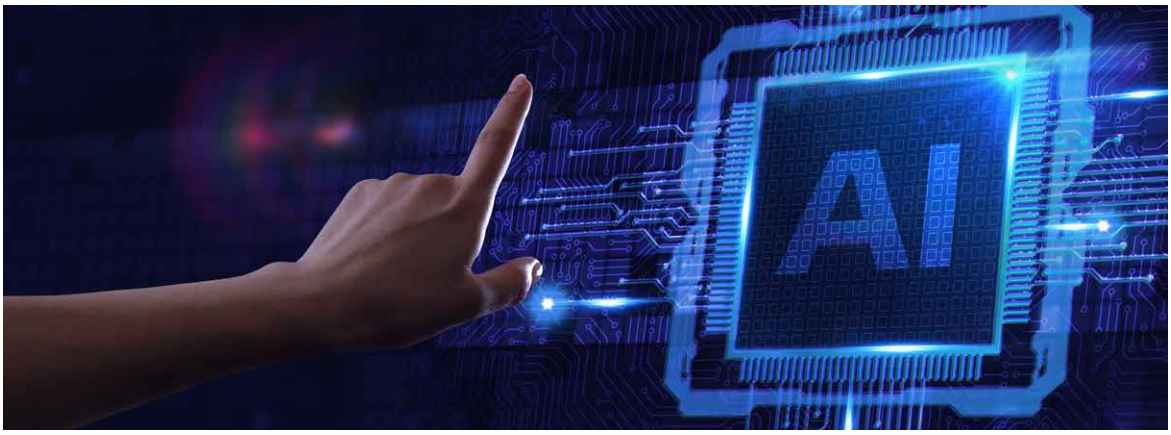
Digitization 2.0 Creates New Business Models

The year 2000 marked Taiwan's first step towards digitization. In response to the request of foreign business clients, the Department of Industrial Technology, MOEA proposed the Digitization Program for the IT Industry and initiated the process of digitization, benefiting manufacturers and medium- and large-sized enterprises mostly. The recent wave of digital transformation, however, focuses on micro- and small-sized enterprises. Facing the unstoppable trend of digital applications, these business owners actively embrace the transformation and hope to sharpen their competitive edges. In addition, the pandemic caused by the severe pneumonia with novel pathogens (COVID-19) also serves as an impetus behind this wave of digital transformation.

According to Mr. Ho Chin-Tsang, Director General of Small and Medium Enterprise Administration, Ministry of Economic Affairs,"Micro- and small-sized enterprises have to adopt strategies, join online platforms as business clusters, and take advantage of digital tools so as to develop innovative business models, create values, increase revenue, optimize user experience, and retain customers." As e-commerce and online platforms become the new normal due to the impact of the COVID-19 pandemic, all business owners are realizing the necessity and urgency of digital transformation. The silver linings for these micro- and small-sized enterprises lie in notable online platforms such as Foodpanda, PChome, and Shopee. By catching the e-commerce wave and standing on the shoulders of giants, these enterprises can seize business opportunities, collect user data, and learn brand new business models to brace themselves for

新冠肺炎帶動的電商經濟、平臺商機等產業新常態，所有企業都意識到數位轉型的必要性與急迫性，小微企業的機會就是透過成熟的平臺，例如 foodpanda、PChome、蝦皮等，搭著平臺經濟的便車，站在巨人的肩膀上，抓緊商機、收集數據，學習全新的商業模式，及早在第二波疫情升溫前超前部署。

面對產業迫在眉睫的轉型壓力，經濟部工業局自 105 年起即透過智慧製造輔導團、智慧機上盒（SMB）輔導計畫、公版連網服務平臺、導入 AI 應用等多元方式，協助產業數位轉型。例如 108 年補助工具機、紡織、化學材料等產業共 12 家中小型製造業與供應鏈業者約 230 家，透過系統整合（SI）業者串聯資訊系統，導入



▲ AI 人工智慧是產業發展的重要趨勢，經濟部工業局祭出「智慧應用新世代人才培育計畫」幫助產業培育 AI 人才。Given that artificial intelligence (AI) is a crucial industry development trend, the IDB of the MOEA has launched the AI New Generation Talent Training (AIGO) Program to cultivate AI talent for a wide variety of industries.

the impact of a second wave of COVID-19.

In response to the urgent need for transformation in industries, the IDB of the MOEA has implemented various measures to facilitate digital transformation since 2016, including establishing a smart manufacturing coaching group, launching the Smart Machine Box (SMB) Guidance Program, setting up the National IIoT PaaS (NIP), and introducing the application of AI. For instance, a total of 12 small- and medium-sized manufacturers and 230 supply chain companies in the industries of machine tools, textile, and chemical materials received government subsidies in 2019. With a system that integrates business information and the introduction of AI applications, these enterprises successfully optimized their manufacturing processes and increased customer satisfaction. In the future, in order to prepare for different stages of transformation, including digitization, digital optimization, and digital transformation, the IDB will integrate the expertise of various sub-industries by setting up a digital platform with cloud service providers. Accompanied by the Cloud Generation Industry Digital Transformation Program by the Executive Yuan, Taiwan's capacity for technology and innovation is likely to increase.

When it comes to providing guidance for enterprises, the SMEA of the MOEA believes that teamwork is another key factor in digital transformation. Mr. Ho Chin-Tsang points out that people used to focus on supply chains in the past; nowadays, however, the key to success lies in the whole ecosystem. To maximize industry capacity and values, it is a must to integrate the expertise and resources not only within the same industry, but also across different industries, and develop an ecosystem of diversity. This year, the Digital Transformation Program for SMEs proposed by the SMEA focuses on systems, clusters, and value chains. Each scheme consists of at least five companies and aims to formulate strategies that continuously increase service value and provide transformation guidance, introducing digital tools to SMEs. For example, in response to the rise of e-commerce and the impact of the pandemic, the SMEA offers smart retail services

AI 應用，優化製造流程、提升顧客滿意度。未來工業局也針對中小微企業數位化、數位優化、數位轉型等不同階段，串聯各種次產業領域之專業與雲端數位服務的業者建置數位平臺，配合行政院推動雲世代產業數位轉型計畫，發揮加乘科技創新的能量。」

團隊戰更是經濟部中小企業處輔導企業的重點！何晉滄強調，過往講求供應鏈，現在則是生態系為王，必須串聯同業、異業的專業與資源，發展具備多樣性的生態系，匯聚最大的戰力與價值！今年中小企業處推動中小企業數位轉型計畫，就是以體系 / 群聚或價值鏈型態為主體，每案至少由 5 家相關廠商組成，建立可持續性提高服務價值與升級轉型輔導策略，協助中小企業導入數位化工具。例如近期在電商崛起與疫情衝擊下，中小企業處透過時尚文創新零售智慧化服務，協助林百貨帶領旗下 22 家品牌，共同開發「行銷智慧化服務系統」，善用消費者輪廓動態標籤模組及 AI 行銷互動模組，創造以消費者為中心的個性化體驗，提升客群黏性與忠誠度，逐步提高成交率、新增會員人數、節省行銷成本！

產業務實人才 數位轉型關鍵

在數位轉型的過程中，人才是成敗的關鍵，為了培育產業數位人才，經濟部串聯小微企業、資訊業者、人力銀行與青年人才，以類似德國三明治教學，在企業場域做中學，除了資訊能力，更培養產業領域知識（Domain Knowledge）。

AI 人工智慧是產業發展的重要趨勢，經濟部工業局祭出「智慧應用新世代人才培育計畫」（AI New Generation Talent Training Program, 簡稱 AIGO），以「產業出題 x 人才解題」創新作法，聚焦於電腦視覺、數據分析、自然語言等人工智慧應用技術領域，幫助產業培育 AI 人才。

在 107 到 108 年間，AIGO 計畫邀集 130 間企業、14 個公部門提出超過兩百個題目，產業領域遍及醫療、法律、安控、零售等，由新創企業、學研單位、臺灣人工智慧學校組成的 212 個團隊解題，產出 85 個 AI 產業解題方案！經濟部工業局長呂正華說明，例如楓康超市攜手朝陽科大，利用 AI 圖像辨識功能與物件偵測技術，研發出實用且準確度近九成

for the fashion industry as well as the cultural and creative industry by developing a smart service and marketing system for the Hayashi Department Store and 22 brands under its lead. The system takes advantage of dynamic customer profiles and AI marketing data to create a more personalized customer experience, retain customers, build customer loyalty, gradually increase sales, attract new members, and save marketing costs.

Talent Determines the Success of Digital Transformation

Talent plays a pivotal role in the process of digital transformation. In order to cultivate digital talent, the MOEA works with micro- and small-sized enterprises, IT service providers, online manpower service, and young talent and implements cooperative education inspired by Germany's Sandwich Courses. By learning as they work in corporations, these people can develop information capability and acquire domain knowledge.

Given that artificial intelligence (AI) is a crucial industry development trend, the Industrial Development Bureau of the Ministry of Economic Affairs has launched the AI New Generation Talent Training (AIGO) Program through the innovative concepts of"industry issues addressed by talent." Focusing on AI applications, including computer vision, data analysis, and natural language processing, the program aims to cultivate AI talent for industries.

From 2018 to 2019, the AIGO Program invited 130 enterprises and 14 government agencies to raise more than 200 issues that needed solving. These issues involved several industries, including healthcare, legal, security and surveillance, and retail. Composed of start-ups, academic and research institutions, and the Taiwan AI Academy, these 212 teams came up with 85 AI solutions for dealing with the aforementioned issues. Mr. Leu Jang-Hwa, Director General of Industrial Development Bureau, Ministry of Economic Affairs, gives a successful example of the program. Using image recognition and object detection, the Taiwan Fresh Supermarket worked with Chaoyang University

▲「DIGI+Talent 跨域數位人才加速躍升計畫」吸引近千名學生至海選會，與法人主管進行一對一面談。The DIGI+Talent Accelerator & Jumpstart Program attracted nearly one thousand students to the open audition to have one on one conversations with corporate executives.

的 App，消費者只要使用手機相機掃描蘋果外觀，便可檢測甜度，幫助民眾選購，也幫助廠商降低水果耗損量。

串聯產業與人才 跨域數位育才

在培育人才的過程中，除了資訊科技外，每個產業專屬的專業與特性更為重要！經濟部工業局自 106 年起推動「DIGI Talent 跨域數位人才加速躍升計畫」，邀請企業與產業共同合作培育務實人才。經濟部工業局長呂正華說明，工業局串聯公協會與人力銀行的資源，媒合企業與研習生，開放企業申請成為實務研習單位，培養研習生兼具數位科技專業知識與產業領域務實技能。目前已開設包括人工智慧、資料科學、智慧聯網、數位行銷等共 127 門線上課程，並透過遠距培訓方式，在疫情期間持續為產業培育人才。

在「DIGI Talent 跨域數位人才加速躍升計畫」推動下，許多跨域數位人才陸續投入企業營運，呂正華舉例，心理系的研習生結合心理學理論與軟體開發知識，

of Technology and designed a practical mobile application that detects the sweetness of fruits. With 90% accuracy, consumers only need to use their phone camera to capture the image of an apple, and they can find out how sweet it is through the app. This invention has helped consumers to better select fruits and reduced the waste of fruits since consumers no longer have to pick them up or gently squeeze them to test for ripeness.

Connecting Industries to Cultivate Cross-Disciplinary Digital Talent

In the process of talent cultivation, apart from information technology, the expertise and characteristics of each industry are even more important. The IDB of the MOEA has been promoting the DIGI+Talent Accelerator & Jumpstart Program to cultivate talent with enterprises in various industries since 2017. Mr. Leu Jang-Hwa, explains that the program integrates the resources of associations and online manpower services, serves as a matchmaker for enterprises and interns, encourages enterprises to join the internship program, and equips interns with digital technology knowledge and practical skills for a wide spectrum of industries. Currently, there are a total of 127 online courses, including AI, data science, AIoT, and digital marketing. With the distance training program, the progress of talent cultivation continues despite the pandemic.

In fact, many cross-disciplinary talent started to engage in business operations after the DIGI+Talent Accelerator & Jumpstart Program was promoted. Mr. Leu gives some successful examples: Combining psychological theories and software development knowledge, a psychology major intern managed to optimize human-machine interface design and was offered a job at Qisda Corporation as a software product manager right after the internship ended; the Metal Industries Research & Development Centre integrated molding expertise and medical expertise and offered internship opportunities for mold and die engineering students. These interns as well as some medical students altogether finished a project regarding urine protein testing devices, taking advantage

優化人機介面設計，在研習後直接進入佳世達科技擔任軟體產品經理；金屬工業研究發展中心則跨界連結模具與醫學專業，培育模具系研習生，並且結合醫學系學生，共同完成尿蛋白檢測裝置專題，發揮不同專業領域人才的專業與創意。

因應新冠肺炎疫情的衝擊，工業局在今年更推出「數位轉型人才培訓補助計畫」，辦理智慧機械與數位轉型等在職免費課程，並提供培訓津貼，鼓勵受疫情影響的企業以人才培訓取代減班休息，幫助在職員工利用多餘工時進修，已有超過 900 家企業、8,000 名員工參訓受惠。

在電商崛起與疫情的雙重衝擊下，生產與消費模式的改變讓中小微企業加速科技創新工具如 AI、5G、機器人等跨界數位服務的需求，中小企業處也感受到了疫後數位工具需求大增的趨勢，協助業者利用群聚輔導的模式，提升中小微型企業數位能力發展更有效率的營運模式。

2020 年，因為新冠肺炎疫情這隻黑天鵝的出現，數位轉型不再是一個選項，而是一個必備條件。遠距教學、外送平臺、線上購物、雲端視訊、在家工作……等成為日常，我國產業鏈再次展現韌性，在經濟部中小企業處與工業局的幫助下，持續導入 5G、AI、IoT 等新科技與數位工具，加速中小微企業組織與人才數位轉型的進程！

▲ 因應新冠肺炎疫情，在家工作已成為日常，而持續導入 5G、AI、IoT 等新科技與數位工具，加速中小微企業組織與人才數位轉型的進程！ In response to the COVID-19 pandemic, working from home has become the new normal. With continuous introduction of new technologies and digital tools such as 5G, AI, and IoT, the progress of talent and digital transformation for micro-, small-, and medium-sized enterprises is expected to speed up.

of expertise and creativity of different fields of study.

In regards to the impact of the COVID-19 pandemic, the IDB launched the Digital Transformation Talent Training Subsidy Program this year. Offering on-the-job training courses, including smart machinery and digital transformation, and training subsidies, this program encourages the enterprises affected by the pandemic to let their employees stay in the company and take training courses instead of giving them unpaid leave. As of now, more than 900 companies and 8,000 employees have benefited from this program.

Considering the rise of e-commerce and the impact of the pandemic, the changes in production and consumption patterns highlight the urgent need for micro-, small-, and medium-sized enterprises to introduce digital tools such as AI, 5G, and robotics and provide cross-industry digital services. As the trend for adopting digital tools emerges after the outbreak of COVID-19, the SMEA aims to enhance the digital capability of micro-, small-, and medium-sized enterprises and develop more efficient business models through industry cluster guidance.

This year's black swan event, the COVID-19 pandemic, has made digital transformation no longer optional—it's absolutely compulsory. Distance education, food delivery platforms, online shopping, video conferencing, and working from home have become the new normal of everyday life. Under these circumstances, Taiwan's supply chain has once again shown its tenacity. As the SMEA and the IDB of the MOEA continue to introduce new technologies and digital tools such as 5G, AI, and IoT, the progress of talent and digital transformation for micro-, small-, and medium-sized enterprises is expected to speed up.

積極發展跨域創新應用 電信業者創造 5G 時代絕佳體驗

Actively Developing Cross-Domain Innovative Applications Telecom Operators Create Excellent User Experience in the 5G Era

▲ 中華電信於中華職棒樂天桃猿主場精選賽事，首度推出 4K 高規格多視角轉播，讓光世代高速寬頻用戶享受精彩視覺饗宴（圖片提供／中華電信）。Chunghwa Telecom launched 4K high-definition multi-view broadcast for the first time during the featured home event of the Rakuten Monkeys, allowing HiNet high-speed broadband users to enjoy a wonderful visual feast. (Photo credit: Chunghwa Telecom)

2021 年即將釋照的企業專網，讓使用者對 5G 的未來充滿了各種應用想像，臺灣五大電信業者，近期創新動作頻頻，透過新技術與絕佳創意，打造出令人驚喜的各種智慧應用。

The corporate private network will stir users' imagination about the future of 5G. Recently, Taiwan's five major telecom operators have been making frequent innovations, creating amazing smart applications through the smart application of new technologies and great ideas.

全球近年掀起智慧化浪潮，透過人工智慧（AI）、物聯網（IoT）、大數據（Big Data）、雲端運算（Cloud Computing）……等新科技所打造的系統，將大幅翻轉人類社會與產業的運作狀態，更快速、即時、聰明的滿足各類需求。在所有新技術中，5G 被視為智慧系統的最後一哩路，尤其是 2021 年即將釋照的企業專網，更被認為是此技術的主戰場，透過 5G 的大頻寬、低延遲與廣連結特色，各種智慧化服務將逐一問世。

▲ 亞太電信 5G 飆速，「GtTV 首場 5G 4K 多視角演唱會」提供嶄新影音娛樂體驗。（圖片提供／亞太電信）Asia Pacific Telecom unleashes 5G's full potentional by holding "Gt TV's First 5G Live Multi-view Concert," redefining live entertainment experiences. (Photo credit: Asia Pacific Telecom)

為了協助電信業者強化 5G 世代的競爭力，科技會報辦公室以「鼓勵跨域創新應用」為目標，鼓勵電信業者在不同場域建置 5G 網路，強化訊號涵蓋範圍，並促成公私部門合作，讓 5G 垂直應用的場域更多元，並協助業者創造加值服務，同時也將公共服務與公益應用升級 5G 時代。

以低延遲特色 打造絕佳影音體驗

5G 的特色是高網速、低延遲、廣

In recent years, there has been a wave of smart technology around the world. Systems built through new technologies such as artificial intelligence (AI), the Internet of Things (IoT), Big Data, and Cloud Computing will greatly remodel human society and industries. The operation of the systems can meet various needs more quickly, instantly and smartly. Among all new technologies, 5G is regarded as the final piece of smart systems. In particular, the corporate private network is regarded as the main battlefield of this technology. Through 5G's wide spectrum bandwidth, low latency and wide-linking features, various intelligent services will roll out consecutively.

To help telecom operators strengthen their competitive edges in the 5G era, the Board of Science and Technology (BOST) aims to "encourage cross-domain innovative applications." It encourages telecom operators to build 5G networks in different fields, strengthen signal coverage, and promote public-private cooperation. As a result, the field of 5G vertical applications will be more diverse. The BOST also assists the industry to create value-added services, while also upgrading public services and public welfare applications to the 5G era.

Creating an Excellent Audio and Video Experience with Low Latency

The main features of 5G are high network speed, low latency, and mass connectivity. Observing the field verifications promoted by various telecom companies, they have all tried to develop services based on these three characteristics, with smart stadiums being the focus. Three of the five major telecom operators have initiated their field verifications.

Chunghwa Telecom is a prime example. The company launched 4K high-definition multi-view broadcast for the first time during the featured home event of the Rakuten Monkeys, a team in the Chinese Professional Baseball League. Hu Xuehai, Vice President of Chunghwa Telecom Mobile Business Group, pointed out that Chunghwa Telecom's ultra-high-speed and low latency 5G network provided users with an ultra-high-quality 4K film and television feast,

▲ 臺灣大哥大於新莊球場展出 VR 棒球遊戲，林之晨總經理率先出擊。（圖片提供／台灣大哥大）Taiwan Mobile revealed VR baseball games in Xinzhuang Baseball Stadium. General Manager Jamie Lin took the lead. (Photo credit: Taiwan Mobile)

連結，觀察目前各電信商推動的場域驗證，也都盡量發揮這三大特色，智慧球場更是其中焦點，五大電信業者就有三家展開場域驗證。

以中華電信為例，在中華職棒樂天桃猿主場精選賽事，首度推出 4K 高規格多視角轉播，中華電信行動通信分公司副總經理胡學海指出，中華電信以 5G 超高速、低延遲的特性提供用戶超高畫質的 4K 影視饗宴，引領臺灣賽事轉播邁入 5G 新紀元。

智慧球場主要是透過低延遲與高網速特色，讓球場中的種種影像快速傳送至各地觀眾的視聽設備中，無論是場內或場外，都可以身歷其境的感受現場氛圍。臺灣大企業用戶事業群副總經理暨商務長吳傳輝表示，臺灣大哥大在新莊棒球場設立的臺灣第一座 5G 智慧棒球場，觀眾可於現場利用 5G 訊號在手機上即時觀看，多視角、高清畫面，不漏接精彩比賽內容；此外，這座球場也將導入沉浸式 VR 實境應用、3D 即時回放、AR 虛擬開場展示、3D 全息投影與 AR 即時互動娛樂、智慧環境監控、球隊訓練資訊平臺等功能。

另外遠傳與臺灣之星也分別啟動智慧球場計畫，其中遠傳選擇與桃園棒球場合作，將此球場覆蓋遠傳 5G 訊號。在此同時遠傳也將在桃園臺茂購物中心的戶外廣場廣設 5G 基地臺，讓身處臺茂購物中心戶外廣場的民眾可以零時差觀賞精

leading Taiwan's event broadcasting into a new era of 5G.

The smart stadium mainly uses the features of low latency and high internet speed to quickly transmit all kinds of images in the stadium to the audio-visual equipment of spectators everywhere. Regardless if you were physically in the stadium or watching at home, you could feel the excitement of the game. Wu Chuanhui, Vice President and Chief Business Officer of Taiwan Mobile Enterprise Business User Group, said that Taiwan Mobile set up Taiwan's first 5G smart baseball stadium in Xinzhuang, letting audiences use 5G signals to watching the game instantly in a high quality and multi-view way on their mobile phones without ever missing one moment of exciting game content. Also, the stadium will also introduce immersive VR applications, 3D instant playback, AR virtual opening display, 3D holographic projection and AR instant interactive entertainment, smart environment monitoring, and a team training information platform and other functions.

In addition, Far EasTone and T Star also launched smart stadium projects respectively. Among them, Far EasTone chose to work with Taoyuan International Baseball Stadium to cover the stadium with 5G signals. Far EasTone will also set up 5G base stations in the outdoor plaza of TaiMall Shopping Center in Taoyuan, allowing people in the outdoor plaza to watch exciting events with zero-time difference, and order meals and purchase tickets through an app. In addition, T Star teamed up with the Wei Chuan Dragons baseball team to create a 5G AIoT smart technology stadium, which will introduce new technologies such as the Internet of Things, AI, AR/VR, and integrate baseball games, smart technology, and regional revitalization into the ballpark.

In addition to sports events, 5G can optimize the experience of audio-visual entertainment. It can be especially useful in ticket-nabbing concerts, where 5G can create various intelligent functions. In the New Year's Eve concert in Taipei City at the end of 2019, Far EasTone applied an experimental 5G private network to an open site for the first time. Applying its low latency and zero-time

采賽事，並透過 App 點餐、購票。至於臺灣之星則攜手味全龍球隊，打造 5G AIoT 智慧科技球場，將導入物聯網、AI、AR/VR 等新科技，將職棒賽事、智慧科技、地方創生與創新體驗融入智慧科技球場。

除了體育賽事之外，影音娛樂也是 5G 可以優化體驗的應用，尤其是近年來一票難求的演唱會，更可透過 5G 的力量，創造出各種智慧化功能。2019 年底臺北市的跨年演唱會中，遠傳首度將 5G 封閉型實驗網路應用於開放型場域上，利用其低遲延、零時差特色，進行異地合演歌舞秀，成為全臺第一個運用 5G 娛樂表演。而今年 7 月由中華電信與經濟部工業局已經聯手打造的 5G 實證場域 digiBlock C 數位創新基地，舉辦了臺灣第一場 5G 虛擬演唱會「HyperLIVE 2020:Bii Alive」，這次演唱會，採用 5G 及 VR 虛擬舞臺技術，讓歌手表演時透過虛擬攝影棚即時合成技術，擁有更多元的場景轉換。亞太電信也不讓其他電信業者專美於前，今年 10 月在臺北三創舉辦「Gt TV 首場 5G 直播多視角線上及線下演唱會」，這場演場會透過 5G 網路與 Gt TV 平臺，讓觀眾可用多視角模式同步觀賞，不僅現場門票銷售一空，線上觀賞人數也爆表。

5G 為智慧交通完成最後一哩路

在影音串流之外，5G 也被視為智慧交通發展的最後一哩路。近年來全球科技與汽車產業全力推動無人

▲ 中華電信舉辦了臺灣第一場 5G 虛擬演唱　會「HyperLIVE 2020:Bii Alive」，這採用 5G 及 VR 虛擬舞臺技術，讓歌手表演時透過虛擬攝影棚即時合成技術，擁有更多元的場景轉換。（圖片提供／中華電信）Chunghwa Telecom hosted the first 5G virtual concert in Taiwan "HyperLIVE 2020: Bii Alive", which used 5G and VR virtual stage technology, allowing singers to have more diverse scene transitions through real-time synthesis in virtual studios. (Photo credit: Chunghwa Telecom)

difference advantages to perform joint singing and dancing shows in different places, it became the first performance to use 5G in Taiwan. In July this year, Chunghwa Telecom and the Industrial Development Bureau of the Ministry of Economic Affairs jointly established the 5G demonstration field, the digiBlock C Living Lab, where Taiwan's first 5G virtual concert "HyperLIVE 2020: Bii Alive" was held. Using 5G and virtual stage technology, singers could have more diverse scene transitions through real-time synthesis technology in a virtual studio while performing. In addition, Asia Pacific Telecom didn't let other telecom operators beat them to the punch. In October this year, the "Gt TV's First 5G Live Multi-view Online and Offline Concert" was held in Taipei Syntrend Creative Park through the 5G network and the Gt TV platform, allowing viewers to watch simultaneously in multi-view mode. Not only were on-site tickets sold out, but the number of online viewers was also staggering.

Completing the Last Mile for Smart Transportation with 5G

In addition to video and audio streaming, 5G is also regarded as the last mile of the development of smart transportation. In recent years, the global technology and automobile industries have made every effort to promote unmanned vehicles. Although there are still some kinks to be worked out before they can be on the road, most telecom companies have made every effort to make it a reality and have already achieved preliminary results. In the layout of this application, Chunghwa Telecom has cooperated with local governments to introduce self-driving car applications in such places as Danhai New Town, Hutou Mountain in Taoyuan, and Changhua Coastal Industrial Park in Lukang. Among them, the monitoring center established in Danhai New Town has succeeded showcasing the first self-driving car monitoring center and Internet of Vehicles application services in Taiwan; the 5G Internet of Vehicles experimental field in Hutou Mountain, Taoyuan, is the first to combine 5G with the wireless communication technology of the Internet of Vehicles (cellular vehicle to everything, C-V2X). The cellular communication network is used

車，雖離實際上路仍有一段距離，不過多數電信商均已全力投入，並已有初步成果。在此一應用的布局中，中華電信已與地方政府合作，在淡海新市鎮、桃園虎頭山、彰濱鹿港等場域導入自駕車應用，其中在淡海新市鎮建立的監控中心，成功展現國內第一個自駕車監控中心與車聯網應用服務；桃園虎頭山的 5G 車聯網實驗場域，則為首創第一個透過 5G 結合車聯網無線通信技術（cellular vehicle to everything,C-V2X）蜂巢式車間通訊做為自駕車與路側設備通訊的測試實證園區。

另外，遠傳電信則是參與臺北市的信義路公車專用道自駕巴士創新實驗計畫，在信義路上建置高精地圖、路口偵測設施、充電站、路側安全告示牌，並由乘載測試人員在北市信義路公車專用道上路運行測試。在此計畫中，遠傳提供了 5G 網路、C-V2X、終端設備、網路切片（Network Slicing）與企業專網規劃。

至於臺灣大哥大則與與 iAuto、臺塑汽車貨運、明志科大攜手發表 5G 工商業用自駕車，已經在長庚養生村場域試驗上、下坡和轉彎路段等較高難度的自駕測試，除了規劃接駁長者之外，目前積極推廣應用在大型廠區，例如港口，可以載送員工及運送物料。

政府推動跨界應用 協助 5G 多元發展

在下階段前瞻數位建設的推動 5G 發展，政府端則預計於文化、救

▲ 臺灣之星攜手 Funique VR，合攻 5G 新商機。（圖片提供／臺灣之星）T Sar teamed up with Funique VR to seize the new business opportunities of the 5G era. (Photo credit: T Star)

as a test demonstration park for the communication between self-driving cars and roadside units.

Furthermore, Far EasTone Telecom is participating in the Taipei Xinyi Road bus lane self-driving bus innovative experimental project, building high-precision maps, intersection detection facilities, charging stations, and roadside safety signs on Xinyi Road, and testing them by passengers. The personnel run the test on the bus lane of Xinyi Road in Taipei. In this project, Far EasTone provides 5G network, C-V2X, terminal equipment, network slicing and a corporate private network.

As for Taiwan Mobile, it has joined hands with iAuto, Formosa Plastics Cargo, and Ming Chi University to publish 5G industrial and commercial self-driving cars. The cars have already been tried out in more difficult self-driving tests such as uphill, downhill and turning sections in Chang Gung Health Village. In addition to shuttling the elderly, the team is actively promoting and applying the cars in large industrial areas, such as ports, where they will carry employees and transport materials.

Promoting Cross-Domain Applications to Assist Diversified Development of 5G

In the next stage of the Forward-Looking Digital Infrastructure Development Program, the government is expected to launch cross-domain 5G applications in the fields of culture, disaster relief, agriculture, medical care, and other emerging technologies. For example, in the domain of culture, the program will assist Taiwan's culture creative industry in applying emerging technologies such as 5G, AVMR, and AI to the integration of information and communication across domains. The policy is expected to drive digital transformation advancements in the cultural creative industry. In addition, 5G Forward-Looking Infrastructure Development Program will be introduced in the demonstration site National Palace Museum to create an immersive autostereoscopic 3D surround view display space and XR 5G real-time interactive experience. In terms of disaster prevention, 5G

災、農業及醫療等領域之場域展開跨界 5G 應用，例如：文化部份，協助臺灣文化內容業者應用 5G、AVMR、AI 等新興科技，以臺灣在地內容力跨域整合資通訊技術力，驅動文化內容產業進行數位轉型升級；另將於故宮示範場域導入 5G 基礎建設及智慧化場域管理，打造沈浸式裸視 3D 環景展示空間、XR 5G 即時互動體驗。在防災方面，將於消防訓練中心建置 5G 基地臺，提升通訊涵蓋率及回覆速率；並佈署防救災行動通訊平臺，緊急災害發生時，能透過該平臺即時傳遞災情訊息，發揮緊急機動通訊。

農業上，將善用 5G 廣連結、高傳輸的特性，運用高解析度的影像辨識與低延遲傳輸速度等技術，協助產業進行即時有效之決策判斷；並建構智慧農業科技服務體系，形成產銷一體之安全農業物聯網絡，加速數據的整合。與民生重要相關的醫療領域，衛福部將善用大數據導入 5G 及智慧科技，提升醫療與健康照護於偏鄉離島醫療機構，以及區域級以上醫療單位；利用遠距醫療及行動醫療改善偏鄉醫療環境，帶動智慧醫材，提升居家醫療服務效率。

在政府政策全力支援與電信商的積極布局下，多種場域的 POC 已然展開，5G 帶來的智慧化願景正逐步從概念化為真實，這些智慧系統除了造福臺灣民眾外，政府也將協助業者向外輸出技術，讓臺灣的科技產業再創高峰。

▲ 台北市信義路 5G 自駕巴士即日起開放線上預約試乘，提供民眾體驗 5G 時代的劃時代大眾運輸工具。（圖片提供／遠傳電信)The 5G-powered autonomous bus operated on Xinyi Road, Taipei, is now open for public through online reservation. Citizens can now enjoy the new transportation experience made available by the 5G era. (Photo credit: Far EasTone Telecom)

base stations will be built in the fire training centers to increase signal coverage and response rate. Furthermore, a disaster prevention and relief operation communication platform will be deployed. When a disaster occurs, the platform can instantly transmit disaster-related information through the platform and employ emergency mobile communications.

In agriculture, the government will make good use of 5G's mass connectivity and high bandwidth, and use high-resolution image recognition and low-latency transmission speed to assist the industry in real-time and effective decision-making. It will also help build a smart agricultural technology service system, forming a safe agricultural Internet of Things and accelerate data integration. In medical fields related to people's livelihood, the Ministry of Health and Welfare will employ big data to introduce 5G and smart technology to improve medical and health care in remote medical institutions on outlying islands, as well as medical centers and regional hospitals. The ministry will also use telemedicine and mobile medical care to improve the healthcare quality in rural areas. In addition, the introduction of smart medical materials will enhance the efficiency of home healthcare.

With the full support of government policies and the active deployment of telecom companies, proof-of-concept in various fields has been launched, and the smart vision brought by 5G is gradually turning from concept to reality. These smart systems will benefit the people of Taiwan, and the government will further assist the industry to export technology abroad, making Taiwan's technology industry reach new heights.

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