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持續優化新創環境 為台灣經濟發展注入活水

Optimizing Startup Environment to Keep Taiwan's Economic Prosperity

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科技會報辦公室執行秘書 蔡志宏
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為促進數位經濟創新發展、提高國人生活品質，邁向「智慧國家」，並帶動 5+2 產業創新及加值應用，行政院自 106 年起推動「數位國家 ・ 創新經濟發展方案（2017-2025 年）」(DIGI⁺方案)，作為引領數位發展、帶動創新的施政藍圖，期加速我國產業及生活融入人工智慧、物聯網、大數據等智慧科技，同時發揮台灣小而精、跨域整合快的優勢，讓台灣成為智慧創新的典範國度。

全球席捲而來的人工智慧浪潮，政府自 107 年起四年共投入 366 億元，以 AI 人才衝刺、AI 領航推動、建構國際 AI 創新樞紐、場域與法規開放、產業 AI 化等五大主軸，協助產業面對 AI 科技的轉型挑戰與因應，維持國際競爭力，並能讓民眾享受相關智慧科技帶來的貼心服務與提升生活品質；透過所謂的「大數據」，為生技醫療產業帶來前所未有的轉變，不旦能給予精準且高品質的醫療照護，更可降低不必要的醫療支出；而在影視方面，除了能做出一齣齣扣人心弦的作品外，同時結合新的科技應用模式，催生台灣在數位時代內容產業的可能新趨勢，彰顯科技輔助影視文化產製的可能性；此外，台灣農業已進入新科技時代，以科技方式精準施藥的無人機精準農噴，不僅提升

To promote development in the digital economy, enhance the quality of life among citizens, become a "Smart Nation," and drive the 5+2 industrial innovation and value-added applications, the Executive Yuan launched the "Smart Nation and Innovation Economy Development Program (2017-2025)," also known as the DIGI⁺ Program, as a policy roadmap for leading digital development and driving innovation. The program is expected to accelerate the incorporation of artificial intelligence, the Internet of Things, Big Data, and other smart technologies into Taiwan's industries and lifestyles while exercising Taiwan's advantage of efficient interdisciplinary integration to launch Taiwan as a paragon of smart innovations.

In response to the global rise of artificial intelligence, the government has invested 36.6 billion TWD for a four year period starting in 2018. Five main approaches - AI talent cultivation, AI policy planning, establishing an international AI innovation hub, location availability and deregulation, and incorporating AI into the industries - will be employed to help the industries overcome the challenges of AI transformation and maintain international competitiveness, so that the public may enjoy the enhanced services and quality of life brought about by smart technologies. Big Data will instigate unprecedented transformation

用藥效率，大幅降低農藥使用量，達到省時、省工又安全的效果，更可解決農業長久以來缺工及農民噴藥中毒風險等問題；而一直被詬病的畜牧業，則以全新的「循環經濟」概念，從節水、沼氣發電到糞渣製成堆肥，零廢棄、低污染、無臭味畜養方式，開啟了「從搖籃到搖籃」的新經濟模式。

我與資誠創新諮詢公司董事長劉鏡清、中經院副院長王健全的對談中發現，目前台灣的新創產業不論在產、官、學、研各界都受到極大的重視，除了政府相關部會制定出符合時宜的政策外，在人才需求上，台灣人工智慧學校為台灣培養大量產業所需的人才。台灣的發展要靠新創再創新高，在 AI、5G、大數據及物聯網等新科技的助益下，相信台灣的新創環境將有更明顯的改變，也將會為台灣的經濟再注入一劑強心針。

▲ 全球席捲而來的人工智慧浪潮，政府自 107 年起四年共投入 366 億元，以 AI 人才衝刺、AI 領航推動、建構國際 AI 創新樞紐、場域與法規開放、產業 AI 化等五大主軸，協助產業面對 AI 科技的轉型挑戰與因應，維持國際競爭力。In response to the global rise of artificial intelligence, the government has invested 36.6 billion TWD for a four year period starting in 2018. To incorporating AI into the industries - will be employed to help the industries overcome the challenges of AI transformation and maintain international competitiveness.

in the biomedical industry by offering high-precision and high-quality healthcare while minimizing medical expenses. In terms of audio-visual entertainment, in addition to producing engaging works, new modes of technological application can be incorporated to explore possible new trends in Taiwan's content industry in the digital age and highlight the potential for technology to facilitate audio-visual production. Moreover, Taiwan's agriculture has entered an era of new technologies where drones are employed for precision pesticide application. As the efficiency of pesticide application increases, the consumption of pesticides has decreased significantly, saving time and effort while achieving safety, which solves the problems of labor shortage in agriculture and pesticide poisoning among farmers. For the controversial animal husbandry industry, the all-new concept of circular economy is applied. From water conservation, methane power generation, to animal manure composting, a new "cradle-to-cradle" economic model of zero waste, low pollution, and odorless livestock raising has been achieved.

In my conversation with Chairman Paul Liu of PwC Consulting Taiwan and Vice President Jiann-Chyuan Wang of Chung-Hua Institution for Economic Research, I discovered that tremendous attention is currently paid to Taiwan's innovation industry from industry, government, academia, to research sectors. Aside from governmental agencies formulating appropriate policies, for the demand on talent, the Taiwan AI Academy is training large numbers of talents for Taiwan's industries. Taiwan's future lies in innovation. With the help of new technologies such as AI, 5G, Big Data, and the Internet of Things, more substantial change is coming to Taiwan's innovation ecosystem, and the country's economy will once again be invigorated.

持續優化新創環境 為台灣經濟發展注入活水

影音報導

Optimizing Startup Environment to Keep Taiwan's Economic Prosperity

1990 年代啟動的半導體，帶動了台灣科技產業將近 30 年的經濟榮景，再加上原有的製造實力，讓台灣在全球市場扮演了難以取代的角色。近年來科技產業開始轉變，第三波 AI 浪潮快速興起，台灣若能將科技和製造業所累積的優勢與 AI 結合，將有機會創造出繼半導體、面板、機械之後的另一個兆元產業。因此，目前國內產、官、學、研界都已經動起來，除了行政院科技會報辦公室、科技部、經濟部、教育部等政府部會制定出相關政策外，台灣人工智慧學校也已經培養出大量產業所需的人才，再加上產業的積極投入，各種 POC 成果逐漸浮現，現在我國的 AI 發展已不遜於國外先進國家。

The semiconductors industry emerged in the 1990s have driven the economic prosperity of Taiwan's technology industry for nearly 30 years. With the existing manufacturing capacity, Taiwan has become irreplaceable in the global market. The technology industry has begun to change in recent years. The third AI wave is emerging. If Taiwan can combine the advantages accumulated by technology and manufacturing industries with AI, it will have an opportunity to create another trillion industry after semiconductors, panels and machinery. Therefore, the industry, government, academia and research communities have been on the move. In addition to relevant policies formulated by the office of Science and Technology, Executive Yuan, the Ministry of Science and Technology, the Ministry of Economic Affairs, and the Ministry of Education, the Taiwan AI Academy has incubated a large number of talents required by the industry. With the active investment of the industry, various proof of concept (POC) projects have gradually shown outcomes. The AI development in Taiwan has kept pace with advanced countries.

政府部會三箭齊發 營造絕佳新創環境

從發展趨勢來看，AI 與各產業結合，除了優化企業流程外，也會創造出全新的商業模式，也因此近年來包括科技部、經濟部、國發會在內的政府部會，近年來積極培育我國的新創團隊。科技會報辦公室執行秘書蔡志宏指出，科技部創辦的 TTA 台灣科技新創基地，就引進國際加速器，協助新創團隊與全球市場接軌，另外此基地也開放

Excellent Startup Environment Created by Three Government Agencies

According to the development trend, the integration of AI and various industries will not only optimize business process but also create brand-new business models. Therefore, ministries, such as the Ministry of Science and Technology, the Ministry of Economic Affairs and the National Development Council, have actively incubated startup teams in Taiwan. Zse-Hong Tsai, executive

◀ 行政院科技會報辦公室執行秘書蔡志宏。Zse-Hong Tsai, executive secretary of the office of Science and Technology,Executive Yuan.

給國外新創企業，讓本地與不同國家的新創團隊可以交流。

經濟部是由中小企業處負責新創團隊的培育，其將之前世運在林口的選手村改建為新創園區，此一園區除了提供場地與相關設備外，也邀請微軟、NVIDIA…等科技大廠進駐，讓新創團隊與這些大廠的人員可以緊密互動，透過大廠的技術與經驗，提升新創團隊的產品效能與市場可用性。

國發會則有亞洲矽谷推動方案，連結國際新創資源與建立國內創新場域，希望可以共同打造台灣成為先進物聯網應用的研發中心與試驗場域，並成為亞太青年創新與創業發展基地。

至於在研究機構方面，2018 年 1 月開學的台灣人工智慧學校，經過將近兩年的培訓，已經透過實戰方式培養出六千名不同領域的 AI 人才，這些人才現在已成為我國產業 AI 化的即戰力，並深入台灣各產業，協助企業開始數位轉型。

政府善用數位資源 創造更多價值

除了透過政策面積極培育 AI 人才外，政府也善用將數據協助產業升級。蔡志宏指出，政府本是各種數據的聚合者，過去各種政策、調查所累積的資料量極為龐大，近年來政府就將數據應用於公共事務、醫療與文化產業。政府近期打造民生公共物聯網，鎖定空氣、水源、地政、災防等四大領域，與國際標準與全球同類型物聯網架構對接，此一物聯網的成效已經浮現，像是環保署就

secretary of the office of Science and Technology ,Executive Yuan, pointed out that the Taiwan Tech Arena (TTA) established by the Ministry of Science and Technology has introduced international accelerators to assist startup teams to connect with the global market. In addition, TTA is also open to foreign startups so that the local and international startup teams can interact and communicate with each other.

The Small and Medium Enterprise Administration, Ministry of Economic Affairs is responsible for the incubation of startup teams. It has converted the former athletes village of the Summer Universiade in Linkou into a startup park. In addition to providing the venue and relevant facilities, it has also invited technology giants, such as Microsoft and NVIDIA, to station in the park so that the startup teams can interact closely with these big companies and use the tech giants' technology and experience to improve their product efficiency and market availability.

The National Development Council has launched the Asia Silicon Valley Development Agency (ASVDA) to link the international startup resources and establish new startup fields in Taiwan, with the hope to make Taiwan an R&D center and test field for advanced Internet of Things as well as a base for Asia-Pacific youth innovation and entrepreneurship.

As for research institutions, the Taiwan AI Academy launched in January 2018 has trained 6,000 AI talents in different fields through two years of practical training. These people have become a ready reaction force to make Taiwan's industries intelligent with AI, and will go deep into Taiwan's various industries to assist companies to start digital transformation.

▲ Biobank 整合平台聯盟，整合國內的人體資料庫，讓醫療領域人員可取得資料庫內的大量數據進行研究。National Integrated Platform for Biobanks is to integrate human databases in Taiwan so that the medical personnel can use the numerous data in the database for research.

透過系統數據，從污染源找出不當排放的業者進行裁罰。

在醫療領域，今年 10 月 30 日成立的 Biobank 整合平台聯盟，就是要整合國內的人體資料庫，讓醫療領域人員可取得資料庫內的大量數據進行研究，另外為了協助需求者可加速取得資料，Biobank 整合平台聯盟也設置了單一窗口和快速審核機制，縮短行政流程時間。

在文化產業部分，今年最火熱的電視劇《我們與惡的距離》，在政府前瞻基礎建設計畫支持下，該劇組與資策會合作，在社交平台、PTT 上找出可與社會有共感的觀點，再加上編劇的田野調查與人物設定，撰寫出讓觀眾有共鳴的劇本，最後創下收視佳績，成為公共電視台史上收視率第三高的戲劇節目。

《我們與惡的距離》的成功除了劇本外，以超高畫質技術拍攝也是關鍵之一。在文化部的協助下，此劇採用 4K 技術，以逼真畫質創造出觀眾的絕佳收視體驗，而 4K 影像不僅需要更換前端的攝影器材，後端的影音處理與資料儲存也都要同步跟上，這些政策都讓我國的新創產業有了與過去截然不同的環境。

投入長期資金 打造一條龍產業體系

政府的全力支援，創造出我國有史以來的最佳新創氛圍。中經院副院長王健全指出，相對於國外，我國的新創擁有強大的利基點。首先是人才，台灣長期以來即重視教育，在此環境下，人才不但

Government Makes Good Use of Digital Resources to Create More Value

In addition to actively cultivating AI talent through policies, the government also makes good use of data to assist in industry upgrading. Zse-Hong Tsai pointed out that the government is an aggregator of various data. The amount of data accumulated by various policies and investigations is huge. In recent years, the government has applied data to public affairs, medical field and cultural industry. The government has recently created a public Internet of Things (IoT) for people's welfare, targeting at air, water, land administration and disaster prevention. The public IoT is in line with international standards and interfaces with global IoT of the same type. The IoT has shown its effect. For example, the Environmental Protection Administration identified companies with improper discharge/emissions from sources of pollution through system data, and these companies were fined accordingly.

In the medical field, the Biobank Integration Platform Alliance established in October 30 this year is to integrate human databases in Taiwan so that the medical personnel can use the numerous data in the database for research. In addition, to help people to obtain the data more quickly, the Biobank Integration Platform Alliance has also set up a single window and rapid review mechanism to shorten the administrative process.

In the cultural industry, this year's most popular TV show "The World Between Us", with the support of the government's Forward-looking Infrastructure Plan, cooperated with the Institute for Information Industry to identify the most resonated viewpoints from social network and PTT (the largest BBS in Taiwan), and with the fieldwork and character setting, the screenwriters wrote a script that resonated with the audience. This TV show has gotten high rating and become the third highest-rated TV drama in the history of the Public Television Service.

In addition to the script, the ultrahigh definition film-making technology is also one of the keys to the success of "The World Between Us." With the assistance of the Ministry of Culture, this show used 4K technology to create lifelike picture quality, giving the audience an excellent viewing experience. To make 4K images, the team had to change the front-end camera equipment as well as the back-end audio-visual process and data

▲ 財團法人中華經濟研究院副院長王健全指出，台灣的新創團隊技術能量不遜於其他國家，不過一直以來都習慣單打獨鬥，然而在新世代，單兵作戰已難見效，專業分工彼此合作，才能發揮最大戰力。Jiann-Chyuan Wang, Vice President at Chung-Hua Institution for Economic Research (CIER) pointed out that the technical capacity of Taiwan's startup teams has kept pace with other countries. However, Taiwan's startups have always been used to work alone. Nevertheless, in the new generation, working alone no longer works. Professional division of labor and cooperation is the way to go.

質精而且量多。其次則是擁有全球少見的 ICT 產業實力，在產業群聚與政府政策的鼓勵下，台灣的 ICT 產業相當活絡，除了有各種市占率全球第一的超大型廠商外，自行創業的各類型中小企業數量也相當多，這幾年政府各部會持續推出各種補助政策、設置新創基地，更優化了產業的新創氣氛。

不過王健全也指出，我國的新創要能對國家經濟與產業發展有實質助益，仍有部分思維與策略需要改善，首先是投資心態。國內投資者的心態過於保守，大多數資金投入點都在新創團隊成果浮現後的研發末期，這固然是相對安全的投資，不過對新創團對來說，此一階段的注資效益有限，因此他認為投資者在資金配置上，可將一部分資金投入早期研發，雖然風險較大，不過利潤也比較高，並且可協助新創團隊度過最艱困的初期研發階段，增加有潛力技術的市場存活機率。

除此之外，台灣新創環境仍沒有一條龍的產業體系。由於企業營運需要的專業非常多，但在資源

storage. These policies provided Taiwan's startup industry with a completely different environment.

Long-term Fund Investment in Building A One-stop Industrial System

With the government's full support, Taiwan is enjoying the best startup atmosphere in history. Jiann-Chyuan Wang, Vice President at Chung-Hua Institution for Economic Research (CIER) pointed out that, compared with other countries, Taiwan's startups has strong niches. The first is talent. Taiwan has valued education for a long time. Thanks to education, Taiwan has many high quality talents. The second is the strength in the ICT industry, which is rare in the world. With the encouragement of industrial clusters and government policies, Taiwan's ICT industry is quite active. In addition to various super-large manufacturers that have the world's largest market share, there are many diverse small and medium-sized enterprises. In recent years, the government agencies have launched various subsidy policies and set up startup bases, further optimizing the startup atmosphere in the industry.

However, Jiann-Chyuan Wang also pointed out that some ideas and strategies have to be improved for Taiwan's startups to substantially benefit the country's economy and industrial development. First is the investment mindset. Many Taiwan's investors are too conservative. Most capital investments are at the end stage of R&D where the outcomes of startup teams already emerged. This is certainly a relatively safe investment. However, for startup teams, the benefit of capital investment at this stage is limited. Therefore, he believes that the investors can invest part of their capital in the early stage of R&D, which is more risky, but with higher profit. By doing so, the investors can help the startup teams to survive the most difficult time, and increase the survival rate of high-potential technology in the market.

In addition, there is still no one-stop industry system in Taiwan's startup environment. Business operation requires a lot of expertise. With limited resources, many segments become venture capital's work. However, Jiann-Chyuan Wang believes that it is impossible for venture capital to take on all tasks. There must be a startup support team playing an integration role in the market and taking on tasks outside the expertise of startups

有限的狀況下，許多環節成為創投的工作，然而王健全認為，創投不可能肩負所有工作，市場必須要有扮演整合角色的創業扶植團隊，接下新創與創投專業以外的工作，藉此降低創業難度。

補強新創專業不足之處 鏈結國際市場

對於營造完善的新創環境，資誠創新諮詢公司董事長劉鏡清也與王健全有同樣看法，他指出台灣現在新創環境雖然熱絡，不過政府在幾個層面可以再度強化，多幫新創團隊一把，尤其是市場資訊的掌握。

他指出成功的企業必須對產業資訊有足夠的掌握，這些資訊包括市場、競爭者、消費者等三方面，不能掌握的話，產品註定會失敗。對成熟企業來說，一次損失或許還可以吸收，但對資源窘迫的新創來說，可能就會決定生死，而多半技術出身的團隊不具備這部分的知識，因此他認為政府必須要有協助機制。

另一個需要協助的是財務專業，劉鏡清以他個人多次輔導新創的經驗表示，現在的新創團隊對財務評估都太樂觀，但其實這幾年因為失敗者眾、市場不確定性過高，投資人對投資新創的意願已經降低，而失敗的常見因素就是財務管理能力不足。他表示在產業裡，Invention(創造) 與 Innovation(創新) 不同，創造者只需要把技術或產品發明出來即可，但創新必須加上管理，而現在國內多數新創團隊都缺少管理知識，因此經營起來非常艱辛。

為了增加新創企業的市場存活率，現在新創政策都有業師機制，讓具備經驗的業師協助新創團隊制定行銷策略，甚或教導財務層面的公司經營，不過劉鏡清認為，企業需要的並非經驗而是方法，經驗的形成因子是過去時空背景所構成，然而因應過去環境條件所做的策略，在不同時空的現在是否依然有效？這恐怕要打上問號，因此他指出，與其找業師，不如廣邀各領域人士，建立起新創扶助團隊，協助新創團隊以科學化的方法解決營運問題。

and venture capital to lower the barrier of starting a business.

Patch Up Startups' Weakness and Link with the International Market

Chin-Ching Liu, Chairman of Pricewaterhouse Coopers Business Consulting Services Taiwan Ltd. also holds the same view as Jiann-Chyuan Wang on the creation of a complete startup environment. He pointed out that although Taiwan's current startup environment is bustling, there are still several aspects that the government can strengthen to help the startup teams, especially the understanding of market information.

He pointed out that successful companies must have a good understanding of industrial information, including market, competitors and consumers; otherwise, their products are doomed to failure. Mature companies may still be able to absorb one loss. However, for resource-scarce startups, it means life or death. Most technology-based teams do not have this knowledge. Therefore, he believed that the government must come up with an assistance mechanism.

Another area that needs help is finance. Speaking from his own experience in coaching startups, Chin-Ching Liu said that most startups are too optimistic about financial evaluation. In fact, many investors become less willing to invest in startups because of the number of failures and high uncertainty of the market. A common factor of failure is insufficient financial management ability. He said that invention and innovation are different in the industry. For invention, inventors only need to invent technology or products. However, innovation also includes management. Most startups in Taiwan lack the knowledge of management, so they are running into difficulty in business management.

In order to increase startups' market survival rate, the startup policy has a mentor mechanism that allow experienced mentors to assist startups in formulating marketing strategies or even to teach company operation in the financial aspect. However, Chin-Ching Liu believes that companies need methods rather than experience. Experience comes from a certain background. However, do the strategies worked in the past still work now given the change of space and time? It is very likely questionable. Therefore, he pointed out that instead of looking for mentors, it is better to invite people from various fields to form a startup

政府可發揮效益之處還包括鏈結全球，王健全指出台灣的市場規模有限，因此從過去至今，外銷一直是台灣產業的重要環節，現在新創團隊也應該師法前輩，找出國際出海口，對此王健全認為政府在此可以注一臂之力，他建議可以參考以色列的作法。以色列會善用在美國華爾街猶太裔企業家的力量，將以色列國內新創企業包裝成一大型團隊，並將此方案與矽谷鏈結，由於此團隊內彙集了大量解決方案，除了可以讓需求者從中挑選合適的技術外，團隊內的技術也可以互相搭配，針對特定需求組成專用系統，大幅提升供需雙方的媒合成功率。王健全指出，台灣的新創團隊技術能量不遜於其他國家，不過一直以來都習慣單打獨鬥，然而在新世代，單兵作戰已難見效，

▲ 資誠創新諮詢公司董事長劉鏡清表示，Invention（創造）與 Innovation（創新）不同，創造者只需要把技術或產品發明出來即可，但創新必須加上管理，而現在國內多數新創團隊都缺少管理知識，因此經營起來非常艱辛。Chin-Ching Liu, Chairman of PricewaterhouseCoopers Business Consulting Services Taiwan Ltd. said that invention and innovation are different in the industry. For invention, inventors only need to invent technology or products. However, innovation also includes management. Most startups in Taiwan lack the knowledge of management, so they are running into difficulty in business management.

support team that assists startup teams to solve operational problems in a scientific way.

The government can also help link the startups with the world. Jiann-Chyuan Wang pointed out that Taiwan's market size is limited. Therefore, export has been an important segment of Taiwan's industry. The startup teams should also look for export opportunities. Jiann-Chyuan Wang believed that this is where the government can help, and recommended Israel's practice as a good example. Israel makes good use of the power of Wall Street Jewish entrepreneurs in the United States. It packs Israeli startups as a large team and connects the team with Silicon Valley. Because this big team contains a large number of solutions, in addition to allowing demanders to select suitable technologies, the technologies in the team can also be combined as a specific system for a certain purpose. This has greatly improved the matchmaking rate between the supply and demand. Jiann-Chyuan Wang pointed out that the technical capacity of Taiwan's startup teams has kept pace with other countries. However, Taiwan's startups have always been used to work alone. Nevertheless, in the new generation, working alone no longer works. Professional division of labor and cooperation is the way to go. Therefore, he believes that the government and the industry should first work together to gather the startup force to create a unicorn. With an indicative case, an ecological circle will automatically form in the market and bring business opportunities.

With Prospect of Green Economy, the Startups in Taiwan and the US Become Closer to Each Other

As for the future potential development area, Jiann-Chyuan Wang believes that green economy will be a good opportunity for Taiwan's startups. He pointed out that environmental protection has been an issue of global focus. In the past, companies did not have the concept of environmental protection, so they emitted exhaust gases and discharged waste water without care. The pollution that was supposed to be taken care of by corporates fell on the shoulder of the public, becoming a great harm to environment and national economy. In recent years, the concept of green economy has gradually risen. Not only has the United Nations formulated sustainable development goals (SDGs), promoted Principles for Sustainable Insurance, Equator Principles and other measures to encourage companies to

專業分工彼此合作，才能發揮最大戰力，因此他認為政府與產業應該先攜手，集結新創之力，先做出獨角獸，有了指標性案例後，市場就會自動形成生態圈，進而帶動商機。

綠色經濟前景可期 台美新創結合可更緊密

至於未來的潛力發展領域，王健全認為綠色經濟會是台灣新創的好機會。他指出過去的環保一直是全球的焦點議題，過去的企業沒有環保概念，任意排放廢氣廢水，這些本來企業應該要解決的污染，最後都由社會大眾承擔，對環境或是國家經濟傷害都極大，這幾年綠色經濟概念逐漸抬頭，不僅聯合國制定出 SDGs 永續發展目標，推動永續保險原則、赤道原則等措施，鼓勵企業加強綠色作為，產業界也開始推動循環經濟。例如台糖在今年開始試營運的東海豐農業循環園區，就是循環經濟的典範，這座園區導入科技系統，將養豬場過去必須耗費工夫才能處理的豬隻排泄物，轉化沼氣發電和再生有機肥料，並透過設計大量減少豬舍用水，消除養豬場過去常有的異味和髒污。

循環經濟不但可以解決過去內部環保成本外部化的問題，還可以進一步創造產業的差異化，對於環保議題，企業也會因有利可圖，從過去的消極配合甚至是抵制心態，轉為積極投入開發，對社會做出經濟貢獻。

對於近期發展，深入中美貿易研究的王健全指出，近期台商開始回流，美國政府也鼓勵台商投資台灣，政府也可順勢而為，協助台灣企業轉型，將重心從製造轉為研發，讓台灣成為亞太研發重鎮，再將研發成果獨立出來，成為各種新創團隊，此外台灣投資人也可以將資金入主美國創投，台美雙方的新創開始鏈結，進而形成生態鏈，這也有助於我國新創找到出海口，將觸角延伸到更大的海外市場。

政府法規可更開放 強化企業投入意願

最後則是政策與法規方面，劉鏡清表示，近十年

strengthen green practice, but the industry has also started to promote circular economy. For example, Taiwan Sugar's Donghaifeng Circular Agriculture Park, which started trial operation this year, is a model of circular economy. With the introduction of a technology system, the Park turns pig manure that required a lot of work to process by a pig farm into feed for biogas power generation and organic fertilizer. In addition, it also reduces water consumption in pig houses through design to eliminate odor and dirt that were common in pig farms.

Circular economy can not only solve the problem of externalization of internal environmental protection costs but also further creates industrial differentiation. Since environmental protection becomes profitable, companies have changed their mindset from passive cooperation, or even resistance, to active investment in development, making economic contribution to the society.

As for recent development, Jiann-Chyuan Wang, who has conducted in-depth research on China-US trade pointed out that Taiwanese overseas companies have begun to return recently, and the US government also encourages the Taiwanese overseas companies to invest in Taiwan. The government can also follow the trend to assist Taiwanese companies in transformation, from manufacturing to R&D, making Taiwan a R&D hub followed by turning the R&D outcomes into various startup teams. Moreover, Taiwanese investors can also invest funds to the US venture capital to link the startups between Taiwan and the US and further forms an ecological chain. This will help Taiwanese startups to find export opportunities and extend their business to bigger overseas markets.

The Government Regulations Can be More Open to Make Companies More Willing to Invest

Finally, in terms of policies and regulations, Chin-Ching Liu pointed out that new technology continuously emerged in the past decade. Each new technology has brought new idea and affected existing laws. Therefore, almost every country has faced the issue that existing legal framework cannot keep up with innovation. However, companies' practice depends on the government's attitude. He quoted Locke, a 17th-century English political philosopher, saying, "For individuals, everything, which is not forbidden, is allowed; for government, everything, which is not allowed, is forbidden." However, the government's attitude

◀ 東海豐農業循環園區的豬舍導入科技系統，將豬隻排泄物轉化沼氣發電和再生有機肥料，並透過設計大量減少豬舍用水，消除養豬場過去常有的異味和髒污。Taiwan Sugar's Donghaifeng Circular Agriculture Park is a model of circular economy. With the introduction of a technology system, the Park turns pig manure into feed for biogas power generation and organic fertilizer. In addition, it also reduces water consumption in pig houses through design to eliminate odor and dirt that were common in pig farms.

來新科技不斷問世，每一個新科技都帶來新觀念，進而衝擊現有法律，因此幾乎每個國家都面臨了法令跟不上創新的窘況，而企業的做法會取決於政府態度，他引述 17 世紀英國政治哲學家洛克的一個觀念，「個人可以做任何事情，除非法律禁止；但政府不能做任何事情，除非法律許可。」不過現在政府對新創的態度卻是偏向除非允許才能做，劉鏡清表示，此一態度會讓有意投入的企業縮手，導致新創環境萎縮，對此他鼓勵國家盡量持開放心態。

對於法規問題，蔡志宏則指出政府會因地制宜立法，如果市場有需求，就會舉行跨部會會議研商。例如今年七月正式實施的民航法無人機法案，就立下明確的規範，讓無人機的發展有法可依，進而發展出具實用性的新商業模式，聯航科技的無人機農藥噴灑就是一例。

聯航科技結合定位、通訊與控制技術，可以監控目標農地的作物狀態，精準噴灑農藥。傳統作法中，一分田的農藥噴灑至少要一小時，聯航科技的無人機不但三分鐘就可以完成，而且藥劑分布更均勻、用量更省，並且可大幅解決台灣農業缺工的問題。

從整體來看，在 AI、5G、大數據與物聯網等新科技的催化下，各先進國家近年來的新創發展越來越熱絡，台灣新創團隊在過去 ICT 產業的深厚基礎與政府政策的全力支持下也交出了亮眼成績，不過環境的建置與政策制定沒有「Best」，只有「better than better」。無論在法規或軟硬體環境建置，台灣新創產業機制都仍在進化中，透過每一環節的持續改善，台灣的新創環境將越來越貼合業者需求，為我國經濟注入源源不絕的發展動能。

towards startup is biased towards "everything, which is not allowed, is forbidden". Chin-Ching Liu said that this attitude will discourage companies that intend to invest in startups and result in shrinkage of the startup environment. Therefore, he encouraged the country to be as open-minded as possible.

Regarding regulatory issues, Zse-Hong Tsai pointed out that the government will adapt legislation to local conditions. If there is a need in the market, inter-ministerial meetings will be held to discuss the need. For example, the Unmanned Aerial Vehicle (UAV) bill of Civil Aviation Act formally implemented this July provides clear regulations on the development of UAV. Under the regulations, practical new business models have been developed. LanHang Science's drone pesticide spraying is one example.

Combined with positioning, communication and control technology, LanHang Science can monitor the crop status of the target farmland and spray pesticides accurately. In traditional practice, it takes about one hour to spray pesticides on 1,000 square meter of farmland. With LanHang Science's drones, it takes only three minutes to complete the task with more even distribution and fewer amounts of pesticides. It also significantly solves the agricultural labor shortage issue in Taiwan.

Overall, under the catalysis of new technology, such as AI, 5G, big data and Internet of Things, the startup development in advanced countries has become more and more active in recent years. Taiwan's startup teams also had good performance on the solid foundation of ICT industry and with the full support of government policy. However, there is no "best" but "better than better" for environment setup and policy formulation. Regardless of regulations or software and hardware environment setup, Taiwan's startup mechanism is still evolving. Through continuous improvement in each segment, Taiwan's startup environment will be closer to the needs of the industry, driving Taiwan's economy forward.

越基礎越前瞻 4K 應用＋ IP 跨域 台灣創作內容力再升級

影 音 報 導

Visionary Changes at the Fundamental Level Improving Content Creation with 4K+IP

人手一支行動裝置的年代，人們對影視畫質的追求，標準越來越高。電視台的影視節目製作，也像網路速度一樣不斷進階，從過去 SD、HD 到現在標準規格 4K UHD，硬體設備不斷升級，連帶也影響到拍攝後製的許多細節。在數位匯流時代，台灣的文化產製發生哪些裂變？科技應用又對文化跨域發展，產生了什麼影響？

As mobile devices become popular, people request for better visual quality in the contents they watch. This demand has inspired TV show productions to evolve at the same rate as Internet bandwidth; from SD, HD to 4K UHD, the constant upgrade of hardware and equipment also brings changes to post-production. So how has Taiwan's cultural industry changed in the face of digital convergence? And how has new technologies impacted content creation?

今年公視夯劇《我們與惡的距離》，除了劇情扣人心弦，題材打破框架而吸引了極高的網路聲量，背後從劇本撰寫、演員表演到硬體拍攝，也都有相當大的科技含量，尤其應用大數據與 4K 超高畫質拍攝，讓《我們與惡的距離》能追上國際 OTT 平台的影視規格，開拓海外市場，成為應用科技與 4K 技術的典範。

充裕預算打造高品質影視作品

「這部劇在同類型的戲劇中，預算是比較高標的。」《我們與惡的距離》製作人林昱伶接手這部片的製作時，該片獲得文化部數位建設「推動超高畫質內

The World Between Us, a PTS hit show aired earlier this year, had been an exceptionally successful production not only for its intriguing and unorthodox plot, but also for the extensive use of new technologies from scripting, performance to filming. Big data and 4K UHD filming, in particular, gave *The World Between Us* the visual quality and specifications needed to stream over international OTT platforms to overseas audience, which makes it a successful example in 4K application.

High-quality Production Made Possible with Adequate Budget

"This was one of the more generously budgeted productions among shows of similar genre," said Yu-ling Lin, producer of *The World Between Us*. When Lin accepted the position of producer, the production was

▲ 《我們與惡的距離》是全台首部大數據實驗劇本。*The World Between Us* was Taiwan's first experimental script created from big data.

容升級前瞻計畫」4300 萬經費，讓製作團隊有更充裕的時間支援編劇深入田調、劇本撰寫、新聞台場景架設，並以較高等級的 UHD 規格來拍攝。

拍攝前，公視、文化部與資策會三方通力合作， 結合 5 個月的「大數據」分析，從臉書、PTT 等社群平台上，找出民眾很有共鳴的一些關鍵字或是大家關心的議題，再做精準的人物設定，在劇本開發階段就將數據導入。所以這部戲一出來，立刻攫取大眾目光，獲得很高的討論度，彰顯科技輔助影視文化產製的可能性。

4K 技術挑戰 後製難度高

《我們與惡的距離》採用 4K 超高畫質拍攝，從打光、剪接、後製、甚至到表演敘述手法，都與 HD 時代不同。「4K 不只是攝影機貴，以 Raw 檔拍攝完成後，資料量實在大的不得了，得花非常多的時間去做剪接，儲存空間也要無限擴充。」公共電視台總經理曹文傑談到公視採用 4K Broadcasting quality 時所面臨的技術挑戰。

在高畫質的時代，呈現出來的細節跟質感，會被更清楚地看見，連帶影響演員必須略略調整跟適應表演的方式。過去 SD 時代的畫質跟訊號轉播不是那麼清晰，演員有時要採用稍微誇飾的表演手法，畫面的設計也是以特寫為主。到了 4K 時代，一切都非常寫實清晰，拍得太特寫時，演員臉上一個痘痘都會令人覺得干擾，所以在化妝上也形成挑戰，必須花更多時間補強。「例如妝容很自然的一個妝，在韓國的女明星臉上要畫到 7 層，台灣的化妝時間比較有限，但至少也要做到 4 層。」

awarded a NT$43-million budget under the Ministry of Culture's "Digital UHD Content Upgrade Project" that gave the production team more ample time and support in areas such as field research, scripting, TV set construction, and UHD filming.

Prior to filming, PTS, the Ministry of Culture and Institute for Information Industry collaborated in a 5-month "big data" analysis where they gathered key words and issues of concern from social networks such as Facebook and PTT, and used the findings for more precise character setting. In other words, data analysis was incorporated into production in as early as the scripting stage. This critical step was believed to be the reason why the show found its audience as soon as it was released, and had been a successful example of how technology could be used to assist cultural productions.

Challenges of 4K, Difficult Post Production

Filmed in 4K UHD, *The World Between Us* presented very different challenges from lighting, editing, post-production to actors' performance as compared to HD. "Filming in 4K not only requires an expensive camera, the size of footage captured in Raw file was also so gigantic that we had to spend a lot more time editing and expand storage to virtually no ends," said Wen-Chieh Tsao, President of PTS, when asked about the technical challenges associated with 4K Broadcasting.

In the era of ultra-high resolution, the texture and details captured on camera are more visible to the audience, meaning that actors have to adjust and adapt slightly to a new style of performance. Back in the SD era when image quality and signals were inferior compared to today's standards, actors sometimes had to exaggerate their performance while most of the scenes were shot in close-up to accommodate the lack of clarity. 4K, on the other hand, reveals so many details that even one small pimple would become distracting in a close-up shot. This poses challenge to makeup artists as they had to make constant patch-ups. "It is common for Korean actresses to put 7 layers of makeup on their faces, and although we have less time for makeup in Taiwan, we still need at least 4 layers to cover up visible flaws, so as to achieve a flawless but natural effect."

From a technical perspective, filmmakers can now fine-tune exposure anywhere within a shot to great extremes. "We can color-grade so that a day scene looks like a night scene, and raise shadows of our night shots to very high levels. Cameras nowadays give us so much dynamic range to work with." Also in the HD era, it was somewhat difficult to recover details from an over-exposed image, so camera operators were often instructed to under-expose by half a stop in

▲ 公共電視台總經理曹文傑表示，在高畫質的時代，呈現出來的細節跟質感，會被更清楚地看見。為偏鄉注入新經濟的動能。Wen-Chieh Tsao, President of PTS, said that the texture and details captured on camera were more visible at high resolution.

從技術面來說，同一個畫面可以在不同的區塊進行非常細緻的調光。「白天拍攝的場景可以調成晚上，晚上拍攝的畫面也可以調亮，光的範圍變動很大。」另外在 HD 時代，一個畫面拍得稍微過亮，比較救不回來，所以寧可要求攝影師把光稍微減個半檔，特別是反差很大的時候，就要非常小心，害怕光的影響。到了 4K 時，反而拍亮一點好，拍暗的容易有噪點，所以攝影師必須特別注意光的變化。

4K 高畫質除了改變後製程序與戲劇的敘事語法，也有許多優點，例如能呈現更好的畫質，給觀眾更逼真的觀影體驗。很多人對林昱伶說：「你們好像在拍電影喔！」但《我們與惡的距離》其實並不是使用電影規格拍攝，而是因為 4K 超高畫質的呈現，在大螢幕上更有電影語言。「簡單來說，電影跟電視在傳統上的分野的確被打破了。」

台灣戲劇作品產製走向國際

《我們與惡的距離》播畢後，成為公共電視台史上收視率第三高的戲劇節目。除收視創下佳績，也獲得今年第 54 屆電視金鐘獎、釜山國際影展「亞洲電影市場展亞洲內容獎最佳編劇獎」等獎項。另外該劇進入到空中航線的娛樂系統，在往來台港星紐澳等國際航線上播放，也成功打入日本、美國等 23 個國家市場，在不同的電視頻道及數位串流平台上播出。

order to protect the highlights, particularly in scenes of extreme contrast. By the time of 4K, camera technology has evolved to the point where filmmakers could comfortably over-expose their images for less noise, but it also means that the camera operator has to pay extra attention to the change of light.

Despite changes to post-production and story-telling, 4K brings several advantages such as better image quality and more realistic viewing experience to the audience. After the show was aired, Yu-ling Lin received several compliments about the show's cinema-like quality, but in fact, *The World Between Us* was not shot on a cinematic scale, and it was the 4K UHD resolution that impressed the audience on a big screen to create a feel of films. "Simply put, the boundary that used to separate cinema production from TV one is no longer relevant by today's standards."

Taiwan Dramatic Production Ventures Abroad

The World Between Us ended up being the third top-rating drama on PTS. In addition to achieving high rating, the show won the 54th Golden Bell Awards and was awarded "Best Writer in Asia Contents Awards of the Asian Film Market" during Busan International Film Festival. The show also made its way into the airline entertainment system to be shown on flights to/from Hong Kong, Singapore, New Zealand and Australia, and was broadcast/streamed in a total of 23 countries including Japan and USA.

Success of *The World Between Us* represents the ability of Taiwanese content creators to make world-class productions, and all it takes is a broader mindset and more advanced equipment to produce shows of exceptional quality. "Launch the Netflix APP and you will see that we are competing against everyone. If we do not deliver shows in excellent quality, it would be difficult to stand out amongst the crowd." Yu-ling Lin believes that the international success of *The World Between Us* was largely attributed to the budget support from Ministry of Culture, as the resource was what enabled Taiwanese filmmakers to produce shows on a scale that rivaled international competitors.

Changing the Ecosystem of the Cultural Industry with Digital Construction

The prevailing challenges of Taiwan's content creation industry was quickly brought to Li-Chieh Cheng's attention after assuming duty as the Minister of Culture. To overcome issues such as lack of funding, lack of distribution, low-quality production, presence of substitutes and competition from Korea, Cheng focused

《與惡》的成功，代表台灣的影視傳媒內容產製絕對有實力可以站上國際舞台，以更國際化的製作規格，更優異的硬體設備，製做出卓越的作品。「你只要打開 Netflix 就會知道，我們是跟所有的人一起比賽。如果戲劇整體的畫質、質感沒有辦法到位，很難去跟世界 PK。」林昱伶認為，《與惡》能做到走出國際，要歸功於文化部的數位建設經費帶起一波台劇的高規格指標，讓台劇有足夠的底氣去跟國際競爭，與世界接軌。

數位建設翻轉
文化內容產業生態系

文化部長鄭麗君上任後，意識到台灣的內容產業面對很大的困境。資金不足、通路不足、產製量低，在國際上品牌被替代，例如面對韓流的競爭等等，因此她把政策更聚焦在內容產業的一次性翻轉，成立了文化內容產業生態系的工作圈。

「我們進行了資金面、產製面的檢討，尤其是對於在地 IP 內容的生產，實際上是非常不足，此外科技應用不足，故事力內容還有待提升。」鄭麗君盤點國內文化內容的痛點。另外她也檢討整體基礎設施、政策環境法規、國內外通路的拓展等議題，希望能結合科技計畫，進行數位時代文化內容生產的基礎建設。

鄭麗君指出，建構文化內容產業生態系，首要任務是聚焦提升內容力跟科技力。先協助在地 IP 內容的開發，然後結合新的科技應用模式，催生台灣在數位時代內容產業可能的新趨勢。

「在數位時代，除了發展速度跟技術，還一定要有內容的結合，才能催生出以文化內容為核心的作品，否則我們一昧追求速度與技術，很可能在服務的是他國的文化內容。」雖然影音文化載體不斷在改變，最終核心仍回到在地文化內容的產製，在數位匯流的時代，「如果能藉由數位科技的結合以及數位工具的傳播，台灣文化不僅在國內可以再振，也可以走到國際上。」

孵化原生內容
為創作者打好地基

目前文化部著力的數位建設，包含三大計畫。第一

on creating an ecosystem that would support and turn the cultural industry around.

"We conducted a thorough review from the funding and the production perspective, and found the industry to be severely lacking in local IPs. Meanwhile, incorporation of up-to-date technology and storyline represent two prominent weaknesses that are desperate for improvement," said Li-Chieh Cheng, highlighting some of the pain points to local content creators. Cheng also discussed issues concerning the overall infrastructure, the regulatory environment, and expansion of local as well as foreign distribution channels in order to carry out the fundamental construction of culture content production in digital era with its technology program.

According to Cheng, the first step in creating a viable ecosystem within the cultural industry was to improve the quality of contents and incorporate new technology. By assisting local IP development and incorporating new technologies, content creators in Taiwan were introduced to new possibilities under the digital era.

"In addition to development speed and technical skills, we must be able to create contents of our own in order to make good cultural productions in digital era; if we focus solely on perfecting our technical skills in a high speed, we may end up processing works of other countries." The format and means by which videos are delivered may be constantly changing, but the thing that matters the most is the ability to produce localized contents. "Digital convergence has presented Taiwan with the opportunity to recapture local as well as overseas audience by incorporating the latest technologies and tools."

Incubation of Original Contents for Creators

There are three main parts to the Ministry of Culture's support for digital content. The first part involved the creation of Taiwan Cultural Memory Bank, in which the Ministry collaborated with 22 county/city governments, National Palace Museum and Academia Historica to preserve, transcode, publish or authorize use of historical documents and original cultural contents through digital technologies and tools. Images of Chunghwa Mall and hundred-year celebration of Longshan Temple were the first memories to be preserved in digital format. This project also gathers local stories and documents from all over the nation, which may be published or licensed in the future to support development of original contents.

For example, Hualien County Niuli Community Association shared a photo of "a vicious dog" that an old lady had kept as pet earlier this year, and as it turned out, the dog in photo was actually a Formosan

是建立國家文化記憶庫，與全國 22 縣市、故宮、國史館等協力合作，讓博物館的文史資料及其他民間累積的台灣原生文化內容，可以透過數位科技工具促進保存、轉譯、開放或是授權使用，目前具體案例包含見證老台北記憶的中華商場、龍山寺百年紀錄等。此計畫還包括彙整地方知識學，採集地方文史資料，供未來開放或授權使用，促進原生內容題材的開發。

例如今年「花蓮縣牛犁社區交流協會」分享一位阿嬤收藏的照片，阿嬤曾在「家裡養過很兇的狗」，沒想到照片中的狗其實是台灣黑熊！這段逗趣的故事，是執行國家文化記憶庫時的真實案例，反應了地方知識的採集，是從地方民眾的共同記憶作為出發點。

「國家文化記憶庫，基本上是一個文化銀行（Banking）體系的建立。」鄭麗君指出，過去文化部已經進行十幾年的數位典藏，把藏品或物件文物數位化，現階段則會建立制度與平台，讓國內外的文化藝術工作者都可以找到相關內容，成為藝術創作或者是 IP 內容生產的素材。

第二項計畫是推動超高畫質電視內容升級，文化部提出 4K 相關的產製支持計畫，結合公視、公廣平台及民間業界，已經建立了 4K 產製的標準規格，並催生出許多原生 IP 內容。例如公視《我們與惡的距離》、《你的孩子不是你的孩子》，已登上國際平台並外銷海外，塑造出另一股文化台流風潮。其他如《靈異街 11 號》、《做工的人》等戲劇，也都獲得超高畫質電視節目製作補助經費。

第三是新媒體跨平台內容產製計畫。在數位傳播例如影音串流平台或新媒體部分，IP 跨域已成為最新的趨勢。在新媒體跨平台中已經有不少 ACG、AR，VR 以及跨域發展的計畫，例如陳錫煌老師布袋戲結合光雕投影、文化部首創「漫畫輔導金」輔導跨域創作的《虎爺起駕：紅衣小女孩前傳》、《用九柑仔店》，結合科幻元素的《八戒》動畫，《仙界小霹靂》手機遊戲，以及 AR 互動式親子劇等等。台灣知名漫畫家鄭問的經典漫畫，也透過前瞻計畫，開展出製作動畫或後續 IP 衍生性作品的跨域合作。

black bear! This was a true story that happened during execution of the Taiwan Cultural Memory Bank project, and it shows that gathering local stories does indeed promote common memory among locals.

"Taiwan Cultural Memory Bank is basically a banking system for cultural materials," said Li-Chiun Cheng. The Ministry of Culture has been making digital archives of valuable collections and artifacts for more than a decade; at the moment, the Ministry is focusing on creating a system and a platform where local and foreign artists may find relevant materials to inspire their creations of arts or IP contents.

The second part is an upgrade to the picture quality of contents broadcast over television, for which the Ministry of Culture has proposed a 4K support project and set 4K production standards with the help of PTS, TBS and private institutions. This project has inspired several original IPs to date, including PTS' *The World Between Us* and On Children, both of which have been streamed overseas to an increasing audience who appreciate the new Taiwanese culture. Apart from the above, other shows such as *The Fearless* and *We, the Laborers* have also been subsidized under the 4K support project.

The third part involves supporting content creation across new media and platforms. It is increasingly popular for content creators to commercialize the same IPs on different video streaming platforms or new forms of media, with ACG, AR and VR being the most popular forms of presentation. Examples of this cross-platform/cross-media presentation include: Xi-Huang Chen's puppet show on projected background; adaptation of comic books *Huyeqijia: Prequel of the Girl in Red* and *Yong-Jiu Grocery Store* funded by the Ministry of Culture's "comic production subsidy"; animation - *Pigsy* with the addition of sci-fi elements; mobile game - *Draca's Adventure*; and AR-based interactive family shows. The project is also funding Uen Chen, renowned Taiwanese artist, to make animations and subsequent IP derivative works.

Reconstruction of Lost Scenes with 3D Digital Modeling

One other film that the project has long supported in making was *Scrolls of a Northern City*, which brought to life the old Taipei City in the 1930s before it was bombed. In order to reconstruct the historical scene, the filmmaker made use of Ministry of Culture's digital models bank to present Taipei as it was in the 1930s, making it another successful adaptation of comic IP.

The digital models bank created by the Ministry of Culture houses a comprehensive collection of digital models on Taiwan's cultural assets, heritage, buildings

3D 數位模型庫 消失場景虛擬重現

另一部由前瞻計畫一路陪伴催生的《北城百畫帖》電影，原作呈現 1930 年代被轟炸前的台北城，為了讓不復存在的歷史場景重現，該片使用文化部數位模型庫，還原 1930 年代的台北場景，成為漫畫 IP 跨域又一魔幻寫實的力作。

文化部的數位模型庫，把台灣重要的文化資產、古蹟或是指標性建築，甚至是動植物標本，利用 3D 技術建成數位模型，讓這些地標從博物館走出來，甚至讓已消失的歷史場景得以重現。3D 數位模型結合電影拍攝時，可應用即時預覽技術，不需等到後製，攝影棚內的導演、演員馬上就能看到效果。又例如公視正在籌拍根據作家吳明益魔幻寫實小說翻拍的《天橋上的魔術師》，天橋指的就是中華商場，而中華商場已經不存在了，所以 3D 數位模型庫動員全台灣的中華商場老照片，以 3D 數位模型重建，讓台灣創作者有科技的支持，說在地的故事，以在地的時空脈絡及 4K 的製作品質，讓跨域的作品走向國際。

文化內容策進院成育成人才平台

鄭麗君觀察，台灣年輕創作及科技人才能量相當充沛，但是產業鏈破碎、環境不健全，因此文化部致力建構文化內容產業生態系，推動獎補助跟投融資雙軌，型塑文化金融體系，讓產製量提升，提供人才發揮關鍵能力的場域。在人才培育端，文化內容策進院將扮演人才育成銜接的平台，協助人才的轉型跟培育，以創新創業的模式來孵化新創團隊。

「台灣是亞洲最自由開放、多元、包容的社會，我們有能力做亞洲領導性、甚至全球華人社群的文化品牌。」鄭麗君認為，台灣 IP 創作及科技實力已經獲得歐美的注目，翻轉生態系後，台灣一定有能力走出去，成為下一階段亞洲文化的燈塔。

▲ 文化部支持超高畫質戲劇製作，接軌國際市場，提升我國原生內容之國際競爭力。The Ministry of Culture supports UHD production as a means to appeal to international audience and improve global competitiveness of local contents.

as well as animal/plant samples using 3D technology. This collection enabled filmmakers to learn about or even reconstruct historical scenes at a certain point in time. Nowadays, 3D digital models can be previewed live while filming, thereby giving directors and performers a general idea of the final result before post-production. Another example of the use of digital models bank was *The Magician on the Skywalk*, an adapted TV series based on Ming-yi Wu's magic realistic novel that is currently filmed by PTS. The name "Skywalk" refers to Chunghwa Mall, which no longer exists, so the 3D digital models bank went to great extent to gather old photos of Chunghwa Mall and reconstruct 3D models out of them so that Taiwanese content creators may have the materials needed to tell a local story, and perfect production quality with 4K technology to appeal to international audience.

Taiwan Creative Content Agency, a Talent Development Platform

Li-Chiun Cheng commented that there is no shortage of creative young minds and technology talents in Taiwan, but the fragmented industry and lack of support have kept them from realizing their true potentials. This is the reason why the Ministry of Culture is dedicated to creating an entire ecosystem for the cultural industry and supporting productions through subsidies and investment/lending incentives, so as to form a cultural financial system. With increased production volume, talents will have more opportunities to put skills in practice. In terms of talent supply, Taiwan Creative Content Agency will act as a platform for talent cultivation, assist in talent transformation and cultivation, and incubate new teams in the mode of innovation and entrepreneurship..

"Being the most liberal, open, diverse and tolerant society in Asia, Taiwan has every advantage to lead Asia and world's Chinese-speaking communities in content creation," said Li-Chiun Cheng. Taiwan has already impressed European and American audience with its IPs and technological capacity, and all it takes is a robust ecosystem to make Taiwan the beacon of Asian cultures after ecosystem conversion.

急起直追培育 AI 人才 讓台灣在 AI 世代更具競爭力

Cultivating AI Talents to Step Up Taiwan's Game in the AI Generation

影 音 報 導

為促進數位經濟創新發展、提高國人生活品質，邁向智慧國家，並帶動 5+2 產業創新及加值應用，行政院自 106 年起推動「數位國家 · 創新經濟發展方案（106 至 114 年）」（DIGI⁺ 方案），做為引領數位發展、帶動創新的施政藍圖，期加速我國產業及生活融入 AI 人工智慧、物聯網、大數據等智慧科技，同時發揮台灣小而精、跨域整合快的優勢，讓台灣成為智慧創新的典範國度。

然而，面對快速變化的世界，台灣的 AI 人才在哪裡？他們又如何才能與世界接軌？

In a bid to promoting innovation and development in the digital economy, improving living standards, building a smart nation, and facilitating innovation and value-added application of the "5+2 Innovative Industries," the Executive Yuan has launched the Digital Nation & Innovative Economy Development Program (DIGI⁺ Program) 2017-2025 as an administrative blueprint to drive digital development and innovation. The goal of the DIGI⁺ Program is to help accelerate the integration of smart technologies, such as artificial intelligence, IoT, and big data, into industry and daily life. By leveraging Taiwan's advantage as a small yet industrious nation able to quickly integrate multiple disciplines, DIGI⁺ Program aims to propel the country to become a model nation of smart innovations.

However, in the face of the rapidly changing world, where are Taiwan's AI talents? How can they connect with the international community?

目前全球普遍有著人才缺口嚴重的問題，而台灣更面臨四大人才危機：專業人才外流、高出低進、工作人口下滑和人才赤字。根據英國牛津經濟學院「2021 全球人才報告」指出，2021 年台灣將面臨全球最大的「人才缺口」，屆時人才赤字將高達 -1.5%！在一片人才荒的今日，AI 已成為產業的救星，但是面對 AI 浪潮席捲而來，許多產業

As talent shortage becomes a major concern around the world, Taiwan faces four major talent crises—brain drain, "high-out, low-in" flow of talent, shrinking workforce, and talent deficit. According to the Global Talent 2021 report released by Oxford Economics of the United Kingdom, Taiwan will face the largest "talent gap" worldwide in 2021, in which the talent deficit will reach up to -1.5%. In today's age of talent shortages, AI has come to the rescue. However, many industries have been slow to transform

▲「高中職生 AI 扎根系列活動」由行政院科技會報辦公室規劃，經濟部主責推動，教育部國民及學前教育署協辦，並由資策會集聚官產學培育能量，辦理此活動，吸引了全台千名高中職生參與。The AI High School Training Program is organized by the BOST, executed by the MOEA, and co-organized by the K-12 Education Administration at the Ministry of Education (MOE). With collaboration from government, industry, and academia pooled together by the Institute for Information Industry, thousands of high school and vocational students from all over Taiwan participated in the program.

卻遲遲無法轉型，處在全球競爭前緣的企業，遭遇的是調無兵、遣無將的困境，有什麼方式可以改變現有囧境？

AI 人才衝刺三箭 解決產業人才荒

為因應 AI 人工智慧時代的來臨，掌握 AI 發展的契機，滿足產業數位化、智慧化轉型的需求，政府繼宣示 106 年為台灣 AI 元年後，同年 8 月推出「AI 科研戰略」，並於 107 年 1 月 18 日起推動 4 年期的「台灣 AI 行動計畫」(107 至 110 年)，全面啟動產業 AI 化、AI 產業化。行政院政務委員吳政忠表示，AI 將會為人類帶來質與量的改變，影響力遍及各個產業及日常生活，有變革就有希望，所以臺灣一定要掌握住機會。AI 產業化的推動極需 AI 人才，因此行政院推動「AI 人才衝刺三箭」—培育 AI 科技菁英（研發人才）、AI 應用先鋒（應用人才）及 AI 向下扎根（國民教育）等，培訓 AI 專家，解決產業人才荒。

吳政忠指出，經濟部近年積極強化國內的 AI 產業發展。為了鼓勵台灣的新創團隊投入 AI 發展，讓 AI 在台灣生根，深化產業優勢，推出了「AI 新創領航計畫」。為了確保計畫所補助的技術可以符合國際趨勢並填補國內產業缺口，經濟部建立了專責

under the sweeping wave of AI. Companies at the leading edge of global competition are struggling with manpower deployment. Is there any way out of the current dilemma?

Three Arrows to Cope with Industry Talent Shortage

With the coming of the artificial intelligence era, the government proclaimed 2017 as the inaugural year of Taiwan's AI development in an effort to seize the opportunity to develop AI and meet demands for digitalization and intelligent transformation across industries. On January 18, 2018, the government rolled out the four-year Taiwan AI Action Plan (2018-2021) to promote incorporating AI into industry. In August of the same year, a strategy for AI scientific research was introduced. According to Tsung-Tsong Wu, Minister without Portfolio of the Executive Yuan, AI will bring qualitative and quantitative changes to mankind, and its influence will reach into industry and people's daily lives. With revolutionary change comes hope, and Taiwan must take advantage of the opportunity. To promote the industrialization of AI, AI talent is highly needed. The Executive Yuan has launched "three arrows" to develop AI talent, including cultivating AI technology specialists (R&D talents) and pioneers in AI application (application talents) and providing a strong foundation for AI development (national education).

Tsung-Tsong Wu pointed out that in recent years, the Ministry of Economic Affairs (MOEA) has actively pushed for the development of AI industry in Taiwan. To encourage Taiwan's new startups to invest in AI development, allow AI to take root in Taiwan, and gain industrial advantage, a pilot program for AI startups was launched. To ensure that the technology subsidized by the program corresponds with global trends and remedies deficiencies in the domestic industry, the MOEA has set up a team of dedicated PM staff who engage in close communication with startups, helping entrepreneurs take advantage of resources to deal with various situations during operation and bring AI products to fruition.

In addition to start-ups, the MOEA looks to Taiwan's existing advantages with semiconductors. In June, it launched the "AI on chip" R&D-subsidy program. In

▲ 台灣人工智慧學校執行長陳昇瑋表示，台灣人工智慧學校不走傳統的產學合作模式，藉此檢驗台灣產業對 AI 化的意願與學校的市場價值。According to Sheng-Wei Chen, CEO of Taiwan AI Academy, the school does not follow traditional models of industry-academia collaboration. As a result, it has demonstrated the commitment of Taiwan's businesses to adopt AI while showcasing the school's market advantage.

PM 人員制度，與新創團隊密集溝通，協助鄉創業者善用資源，處理運作時的各種狀況，讓 AI 成果可以順利落地。

除了新創團隊外，經濟部也從台灣既有的半導體優勢著手，在今年 6 月啟動「AI on chip 研發補助計畫」，7 月在行政院指導下，攜手台灣半導體協會成立台灣人工智慧晶片聯盟 AITA。AI on chip 研發補助計畫是補助具有關鍵指標意義的 AI 晶片研發，藉此刺激台灣 AI 晶片發展，協助台灣半導體產業延續以往優勢，在 AI 仍能居於全球領先群；AITA 邀請廠商和學界加入，並成立 AI 系統應用、異質 AI 晶片整合、新興運算架構 AI 晶片、AI 系統軟體等四大關鍵技術委員會，全力協助產業降低 AI 晶片研發成本 10 倍、縮短晶片軟體開發時程 6 個月以上、提升 AI 晶片運算效能 2 倍、建立自主專利，讓台灣成為 AI 產業晶片的輸出國。

AIGO 產業出題 × 人才解題 做中學 課中學

「AIGO」（AI New Generation Talent Training Program，AI 智慧應用新世代人才培育計畫）針對產業 AI 人才需求，培訓產業智慧化技術整合及創新應用人才。吳政忠指出，產業 AI 人才的培育主要是以「產業出題 x 人才解題」以及「課程培訓」雙軸線，在「做中學」及「課中學」中，同步進行各項學習培育活動，另外，也引進國際學習資源，

July, under the guidance of the Executive Yuan, the program joined forces with the Taiwan Semiconductor Industry Association to form the AI on Chip Taiwan Alliance (AITA). The subsidy program provides subsidies for cutting-edge R&D of AI chips, aiming to stimulate the development of AI chips in Taiwan and help the semiconductor industry build on its past advantages and secure its foothold as a leader in the global AI industry. AITA has brought together manufacturers and academic institutions and set up special interest groups on four major technology topics—system application, heterogeneous integration, advanced calculation framework, and AI system software for AI chips. By helping the industry reduce R&D cost of AI chips tenfold, shortening the development time of chip software by more than 6 months, doubling the computing efficiency of AI chips, and obtaining independent patents, AITA has been instrumental in enabling Taiwan to become an output country for AI industrial chips.

AIGO's Industry Problem & Talent Solution

The AI New Generation Talent Training Program (AIGO) provides AI talent training which conforms to industry needs, cultivating talents specializing in smart technology integration and innovative application. According to Wu, the program's mechanism of developing AI talent is based on the dual pillars of Industry Problem & Talent Solution and training courses. Various learning and training activities, including hands-on practice and lectures, are provided during the program, which brings in international learning resources and utilizes online learning platforms, thereby sharpening the capacities of domestic AI talents and accelerating the industrialization of AI. AIGO has also cooperated with international manufacturers to jointly train AI lecturers and AI application talents. Armed with global digital resources and faculty, the process of hands-on practice and problem-solving help boost the capabilities of AI talents through effectiveness learning.

AIGO was launched in 2018. A total of 64 AI solutions were offered for 165 industry transformation problems across 31 disciplines in 2019, compared with just 24 in 2018, evidencing significant growth. On the talent training end, 35 training institutions across Taiwan have set up AI application courses, fostering more than 1,500 industrial AI application talents for Taiwan in just over one year.

Solving Talent Shortages with AI High School Training Program

A strong AI education foundation is the fundamental

搭配線上平台社群學習方式，增強國內 AI 人才實力，也加速產業 AI 化，同時還與國際大廠合作共同培訓 AI 種子講師和 AI 應用人才，透過國際數位教材、師資，在實作與解題交流過程中，提升 AI 人才專業能量、強化學習成效。

AI 智慧應用新世代人才培育計畫自 107 年開始實行，今 (108) 年共募集橫跨 31 個領域、165 道產業轉型題目，產出 64 個 AI 解決方案，較去 (107) 年 24 個解決方案大幅成長。在人才培育部分，也串連全台 35 家培訓機構開設 AI 應用課程，一年多時間即為台灣孕育超過 1500 名產業 AI 應用人才。

高中職生 AI 扎根系列 從根本解決 AI 人才荒

將 AI 教育向下扎根才是解決 AI 人才荒的根本之道。在行政院科技會報辦公室規劃、經濟部主責下，資策會集聚產學能量，與台灣微軟及 Google 兩大國際知名企業合作，推動「高中職生 AI 扎根系列活動」。此活動鎖定全台高中職生，利用高三學生推甄放榜後至大學開學前、升學壓力解除之期間，搭配全台灣共 10 所新興科技區域推廣中心的教學資源，以三階段培訓模式，包括 AI 應用線上課程、AI 一日實作營，以及至台灣微軟與 Google 進行企業實地參訪等不同於學校教育的學習體驗，並提升高中職生 AI 應用國際視野。今 (108) 年首度辦理便吸引總計來自 138 間學校、1,052 位同學參與，在 8 月的結訓典禮上展現亮眼的專題成果，包括台灣微軟樹莓派神經網路自走車、Google AIY Voice Kit & Vision Kit 等作品，彰顯台灣學生非凡學習力與創造力，展現 AI 人才向下扎根的可行性與亮眼成效。

AI 教育 × 教育 AI 從小培育 AI 種籽

教育部從基礎開始，制定「AI 教育 x 教育 AI －人工智慧及新興科技教育總體實施策略」，以我國 12 年國教資訊科技教學為基底，從小培育學子對 AI 的認知，在中小學階段就讓學生有運算思維和程式設計的基本能力，國高中再進階實作程式設計、資料處理與演算法，大學階段則是將 AI 的技術結合各科系專業，培養跨領域的 AI 專業人才。

way to solving the shortage of AI talents. Under the auspices of the office of Science and Technology ,Executive Yuan and MOEA, the Institute for Information Industry has garnered momentum from government, industry, and academia and collaborated with Microsoft Taiwan and Google to promote the AI High School Training Program, which targets high school and vocational students in Taiwan. Making use of the window of time in the final semester before school starts for university, when seniors admitted to college are free from academic pressure, it blends resources from 10 regional promotion centers for emerging technology in Taiwan. Training is provided in three stages, including AI application online courses, one-day hands-on AI camps, and visits to Microsoft and Google in Taiwan. Distinct from school education, these learning experiences expand the horizons of high school and vocational students in regard to AI application. In 2019, the first year of the program, it attracted the participation of 1,052 students from 138 schools. Outstanding results were showcased at the commencement ceremony in August, such as the Raspberry Pi neural network autonomous car from Microsoft Taiwan, and the AIY Voice Kit & Vision Kit from Google. The program is testament to the extraordinary learning capacities and creativity of students in Taiwan, demonstrating the feasibility of AI talent cultivation and its excellent outcomes.

Planting Seeds for AI Education

The MOE has initiated the "AI Education × Educating AI" general implementation strategy for AI and technology education. Basing on the information technology curriculum of Taiwan's 12-year compulsory education, the strategy aims to cultivate students' understanding of AI from an early age. Starting from the basics, students in elementary school are to gain basic comprehension of computational concepts and programming, while further coding, data processing, and algorithm courses are incorporated into the junior and senior high school curriculum. At the university level, AI technology will be integrated into various disciplines to cultivate cross-domain AI specialists.

Grand Strategy for a Small Country: Building a World-Class AI Innovation Hub

The Ministry of Science and Technology (MOST) has also been a major proponent of domestic AI development. Since 2017, MOST has promoted five key facets of the "grand strategy for a small country" objective— creating AI R&D platforms, establishing AI innovation research centers, building a smart robot innovation facility, launching the

AI 小國大戰略 打造出世界級 AI 研發聚落

科技部也是國內 AI 發展的重要推手。從 2017 年開始，科技部以「AI 小國大戰略」思維，推動建構 AI 研發平台、設立 AI 創新研究中心、打造智慧機器人創新基地、啟動半導體射月計畫、創辦技大擂台等五大策略，讓台灣可以小博大，發揮既有優勢的最大效益，開發在地化應用及服務，帶動下一波經濟轉型動能。這五大策略中，科技部將建構國家級 AI 雲端服務及高速算平台，讓國內產學研界共用、共享高速運算環境，並強化人才的培植，打造出世界級 AI 研發聚落，目前在中科與南科已有智慧機器人創新自造基地，提供年輕研發人員動手做的實作舞台，此外科技部也舉辦了科技大擂台，以總獎金新台幣一億元為誘因，透過擂台賽方式設定挑戰議題，吸引國內外團隊參賽，除了發掘人才與技術外，也激發出更多創意。

台灣人工智慧學校 AI 人才培育的搖籃

「台灣人工智慧學校」則是民間培育 AI 人才的重要搖籃之一，成立兩年就擁有一千五百家以上企業參與，校友超過六千名，高達兩百位講師，授課時數超過一百二十萬小時，是目前台灣最大的 AI 族群。

台灣人工智慧學校執行長陳昇瑋表示，台灣人工智慧學校由財團法人科技生態發展公益基金會與台灣資料科學協會共同主辦，並在台塑、聯發科技、義隆電子、友達光電、奇美實業、英業達等六家企業的支持下，於 2017 年年底正式成立，是以培養 AI 技術領袖與經理人為目標，

陳昇瑋指出，台灣製造業發展多年，在各領域培育了大量人才，而 AI 必須與專業領域的知識結合，才能打造出適合該產業的系統，但如果從頭培養 AI 人才，無疑緩不濟急，而且現在各科技大國都已積極發展 AI，在「紅皇后效應」下，如果大家都以同樣速度前進，台灣頂多與競爭者同步，唯有以兩倍速度發展，才能取得優勢。因此，台灣人工智慧學校不走傳統的產學合作模式，反而向企業募款成立基金會，向人士在四個月內密集上課，透過期中考與專題實作檢驗上課成績。這樣冒險的做法，除了落

semiconductor "moonshot" program, and organizing technology competitions. As a small country, Taiwan can still dream big by capitalizing on existing advantages and developing localized applications and services, thereby driving the next wave of economic transformation. Under the five facets of the objective, MOST will build an AI cloud service along with a high-speed computing platform at the national level to provide shared-use high-speed computing environments for domestic industry, academia, and research communities, focusing on cultivating talents to create world-class AI R&D clusters. AI Robot makerspaces have been built in the central and southern Taiwan science parks to provide a place for young R&D personnel to gain hands-on experience. MOST has also hosted the "Formosa Grand Challenge" technology competition. With NT$ 100 million in total prize, it features task-oriented challenges that take place in an arena, attracting participation from domestic and foreign teams. In addition to sparking innovation, the efforts have helped uncover new talent and further technology development.

Taiwan AI Academy, the Cradle of AI

Taiwan AI Academy is one of the important cradles for cultivating AI talents in the private sector. More than 1,500 companies participated within two years of its establishment. There are currently more than 6,000 alumni, up to 200 lecturers, and a total of more than 1.2 million hours of lectures. It is the largest AI community in Taiwan.

According to Sheng-Wei Chen, CEO of Taiwan AI Academy, the school was co-sponsored by the Science & Technology Ecosystem Development Foundation and the Taiwan Data Science Foundation, with support from six companies including Formosa Plastics, MediaTek, ELAN Microelectronics, AU Optronics, Chi Mei Industrial, and Inventec. It was established at the end of 2017 with the aim of training leaders and managers in the AI tech industry.

According to Chen, Taiwan's manufacturing industry has fostered a slew of talents in various areas after many years of development. In order to develop a system suitable for industrial application, AI must be combined with specialized knowledge and expertise. However, it would be a case of too little, too late to develop AI talent from square one, especially since all major tech countries have been actively developing AI. Under the "Red Queen Effect," if everyone is to move at the same pace, Taiwan would only match competitors in terms of development in the best-case scenario. Only by doubling the speed of development

▲「台灣人工智慧晶片聯盟」會員暨四大委員會成立大會，期待透過聯盟來強化台灣既有的優勢，讓裝置端 AI 晶片成為台灣半導體產業未來的發展重心，在下一波智慧革命中掌握優勢。
The AITA Membership & SIG Kick-Off Meeting presented four SIGs (Special Interest Groups), aspiring to leverage Taiwan's existing edge through forging an alliance. Edge AI is slated to become the next big thing in Taiwan's semiconductor industry and AITA is making sure Taiwan will stay on top in the next wave of smart revolution.

實使用者付費的意義外，也藉此檢驗台灣產業對 AI 化的意願與學校的企業招生、對學員收取學費，並集結台灣最優秀的師資大量開課，讓各領域的專業市場價值。

事實證明，經過兩年的人才訓練與產業合作，台灣人工智慧學校交出了豐碩成績。創辦兩年來，從台灣人工智慧學校畢業的校友已超過六千名，這些校友不但成為台灣發展 AI 的最強力量，校友會也有完整組織，設立了創新育成、產官學、進修交流等三大委員會，協助有意發展新創的校友進行創新育成規劃，並積極推動與政府、團體的會議，進行產學政策合作，同時也透過各種論文、線上課程研讀、產業趨勢的交流分享，讓校友可以持續進修，強化 AI 技能。

經濟部、教育部、科技部與台灣人工智慧學校，政府與民間分別從不同面向培養 AI 人才，推動產業發展，為台灣的 AI 打下良好的基礎。而對於未來展望，吳政忠刻劃了 2030 年的臺灣社會樣貌：隨著數位科技發展成熟，將促成一個人與人、人與萬物相連的網路社會，而且，由於網路社會的成形、通訊速度加快，資料的蒐集將會更廣泛且容易，如何進行「資料治理」將成為未來的重要議題，伴隨來的還有不容忽視的「資訊安全」。因此，政府與企業，在應用 AI 之餘，也要在未來網路社會中，擬定標準化的資料治理方法並加強資安防治，才能保障網路社會的穩定安全。

can the country gain an advantage. Therefore, instead of following the traditional model of collaboration between industry and academia, Taiwan AI Academy has set up a foundation with funds raised from businesses. Students are recruited from corporations, and tuition is collected from the students. A faculty of some of Taiwan's best teachers offers a wide array of intensive courses, which professionals from various fields can attend within four months' time. Class performance is determined by mid-term exams and special topics. This risky approach not only implements the "user pays" principle, but also demonstrates the willingness of Taiwan's businesses to adopt AI in addition to showcasing the market advantage of the Academy.

Two years of talent training and industry collaborations have led to great achievements from the Taiwan AI Academy. In the two years since its establishment, more than 6,000 alumni have graduated from the school. Not only have these alumni become the strongest proponents for AI development in Taiwan, but they have also come together to form a far-reaching alumni association. The association includes three committees: Innovation and Development; Industry, Government, and Academia; and Continuing Education and Academic Exchanges. The committees assist alumni who are in the process of developing new initiatives to set up innovation incubation and actively promote meetings with governments and interest groups for industry-academia collaboration. At the same time, through the sharing of theses, online course studies, and information on industry trends, alumni can continue to further their education and proficiency in the field of AI.

From the MOEA, the MOE, the MOST to Taiwan AI Academy, the government and the private sector are grooming AI talent in an effort to promote industrial development and lay a strong foundation for AI in Taiwan. Regarding future prospects, Wu envisions a new social landscape for Taiwan in 2030. As the development of digital technology fully matures, a network society that connects people with people and people with everything would emerge, which along with the acceleration of communication speeds would render data collection even more pervasive and effortless. "Data governance" and "information security" would rise in importance and garner attention. Therefore, besides embracing AI, governments and businesses must set data governance guidelines and strengthen information security and protection in order to ensure the stability and safety of the network society.

科技下鄉 智慧農業的進擊 聯航科技飛越田野

影 音 報 導

Smart Agriculture: Deep into the Countryside with Science and Technology LanHang Science Flies Over the Fields

智慧農業的本質不是科技，也不是先進的設備，而是在專業背景下，執行一次又一次空噴累積起來的各種參數，有了大數據，智慧農業才有更大的可能性。

The nature of smart technology is neither technology nor advanced equipment, but various parameters established through numerous air spraying implemented under professional background. With big data, smart agriculture has greater possibility.

四季如春的南台灣進入十一月，仍然是艷陽高照的季節，同時也是萬丹紅豆的重要產季。萬丹是台灣重要紅豆產區，紅豆農無不卯足全力務求得到最大的產能，今年有了聯航的無人機加入，農民的工作明顯減輕不少，而產能也提高了。

聯航科技的工作人員來到田間，透過手上的操控儀器，閑熟的把等會兒要空噴農藥的紅豆田，邊界先定位出來，估算出里程、面積，設定好噴灑的路徑、間距和高度，並檢視身邊一如八爪章魚般的無人機，測量現場風速，這時另一位工作人員已經完成農藥的調劑工作。

一會兒在指揮人員手勢和飛手的搭配默契下，這架可以搭載十公升溶劑的無人機，就像一朵低飛的雲朵，沿著剛剛設定好的路徑，在距離紅豆莖上方兩公尺多的低空來來回回，均 的噴灑藥劑，而農場的主人則在一旁關注噴藥的情形，並向飛手提議哪些區塊應作補強。

It is November. Southern Taiwan is still sunny and warm. It is also an important production season for Wandan's red beans.

An employee of LanHang Science stood in the field, and used the remote control in hand to position the border of the red bean field that will be air sprayed with pesticides. He estimated the distance and area, set the spraying route, spacing and height, checked the octopus-shaped drone, and measured the wind speed at the site. Meanwhile, another worker had completed pesticide adjustment.

With well-coordination between the commander and operator, the drone that can carry 10 liters of solvent is like a low-flying cloud, flying back and forth and evenly spraying pesticides two meters above red bean stems along the route that was just set, while the owner of the farm standing nearby, paying close attention to the spraying and suggesting the areas to be enhanced to the operator.

New Agricultural Technology: Drones Take Off

It is a beautiful day today. In just 10 minutes, the staff of the LanHang Science completed the pesticide spraying of a red bean field of about 2000 m2.

▲ 聯航科技與聯利農業科技公司的相互配合，能為農民提供完整的「一條龍服務」。The cooperation between LanHang Science and Lanlix Crop Science Co., Ltd. provides farmers with a complete one-stop service.

農業新科技 無人機起飛

今天風和日麗，短短的十幾分鐘，聯航的工作人員就已完成這兩分紅豆田[1]的農藥噴灑任務；而同時，也有另一組工作人員正在另一處芒果園裡，採用 RTK(Real Time Kinematic，實時動態載波相位差分技術) 定位技術，進行果園的噴藥工作，UAV(Unmanned Aerial Vehicle，無人飛行載具) 噴藥車隊的升降梯，可以讓飛手居高臨下，監控果樹的樹冠，精準的進行施藥。

在無人機運用到農業之前，除草、施肥、定期噴藥防治病蟲害可說是台灣農業的日常，而打著赤腳、揹十幾公斤重的噴桶，頂著烈日在田間噴藥施肥，更是大家再也熟悉不過的場景，卻也常常傳出農夫因為吸入過多藥劑中毒，或是中暑、體力不支臥倒田間的憾事發生。

「最大的問題是農村從業人口老化的問題。」聯航科技董事長，也是聯利農業科技負責人的陳吉昌就表示，幾十年來看見台灣真正從事農務的農民愈來愈老，到現在都是六、七十歲，甚至是八十歲的老人，他們愈來愈沒有體力負荷繁重的農務，農忙時花錢僱工，也難保不錯過最好的時

[1] 土地面積一分 =293.4 坪 =969.9 平方公尺。

Meanwhile, another group is using real time kinematic (RTK) positioning method in a mango orchard for pesticide spraying. The lift of the UAV (Unmanned Aerial Vehicle) fleet allows the operator to monitor the canopy of fruit trees from high above for precise spraying.

Before the application of drones to agriculture, weeding, fertilizing and regular pesticide spraying to prevent pests and diseases were the daily life of farmers in Taiwan. It was very common that farmers carried spraying buckets of more than 10kg, walked in the field with their bare feet and sprayed pesticide under scorching sun. However, tragedies like poison due to excessive inhalation of pesticides, heatstroke or physical exhaustion were also common.

"The biggest problem is the aging of the rural working population," said Ji-Chang Chen, Chairman of the LanHang Science Co., Ltd. and the responsible person of Lanlix Crop Science Co., Ltd. Over the past decades, he has seen farmers in Taiwan getting older and older. These farmers are now in their sixty, seventy or even eighty. It has become harder and harder for them to carry out daily heavy farming practice. They hire workers to help the farm work during peak season, but it is not a guarantee that they will not miss the best timing. The invention of drones not only brings a hope of mitigating labor shortage in rural areas but also introduce a group of lively youth for Taiwan's agriculture.

The drone technology started to become mature two years ago, and since then, they have been rapidly and widely applied to photography and various services. Ji-Chang Chen, who has deep roots in agriculture, also saw the possibility of using drones in agriculture, and thus established LanHang Science Co., Ltd. with drone operators in Taiwan focusing on air pesticide spraying. In the past two years, Chen established an

機，幸好無人機的發明，不僅為農村缺工問題帶來一線曙光，也會台灣農業帶來一批年輕而活潑的從業人員。

兩年前無人機技術趨於成熟，快速而廣泛的被運用在攝影及各種勤務上面。而與農業淵源深厚的陳吉昌在當時也看準了無人機在農業上運用的可能性，而與國內無人機業者合作成立聯航科技，投入農藥空噴的領域，兩年來已建立一個擁有七架無人機、五部車、十個飛手的空噴團隊，成員清一色都是大學畢業到卅多歲的小伙子，他們有的讀機械、有的讀電子，少數是農業科班，甚至還有女性投入，因為對無人機操作的興趣進入新農業的領域，這個團隊服務的範圍已經遍及全省。

安全用藥 一條龍服務

「聯航不同於一般的無人機的代噴業者，支撐聯航的是全省 180 家的聯利植物連鎖醫院，十年來我們透過肥料、農藥等資材的供應，建立農民精準用藥、對症用藥的觀念。」陳吉昌指出，聯利農業科技公司是一家老字號的農業資材工廠，擁有認證的福爾摩莎檢驗、實驗室，對於各種生物肥料、農藥、有機無毒資材、環境衛生用藥等，具有高度的自主研發能力，再投入無人機的代噴業務，除了希望可以解決農村缺工的問題之外，為農民提供「一條龍服務」才是成立的機隊的初衷。

陳吉昌指出，過去農民缺乏用藥常識，僅僅靠零售商推薦、販賣，經常病急亂投醫，不精準的用藥，不僅造成經濟上的負擔，也造成農田的污染，因此農委會對精準用藥的宣導也極為重視，但是「空噴」技術，並不能真正解決精準用藥的要求。他表示，隨著農業科技日新月異，聯利開發出各種緩效型的肥料或農藥，可以有效減少噴藥和施肥的次數，但是如何用藥才是關鍵！所謂一條龍的服務，就是在噴藥之前，就要先鑑定病虫害的種類、密度和危害程度，才能對症下藥，提供正確的病理處方與濃度才能執行噴藥作業。

因此聯航工作團隊每次出任務，都得遵循一套嚴謹的 SOP，包括拍照上傳照片跟後台確認田間作物和施藥的目的和內容，測量風速和執行任務。

air spraying team of seven drones, five vehicles and ten drone operators. The team members are a group of young guys in their twenties and thirties. Some majored in mechanics, electronics, while a small number of them studied agriculture. Even women are involved. These young people enter the new agriculture field because of their interest in operating drones. The scope of this team's service covers all regions in Taiwan.

Safe Pesticide Application and One-stop Service

"Unlike other commissioned drone spraying operators, the LanHang Science is supported by Lanlix, which has 180 plant chain retailers in Taiwan. In the past ten years, we have established the farmers' concept of symptom-based precise pesticide application through the supply of fertilizers and pesticides," Ji-Chang Chen pointed out. Lanlix Crop Science Co., Ltd. is a well-established agricultural material factory with a certified inspection laboratory, Formosa Laboratory. It has highly independent R&D capacity in various bio-fertilizers, pesticides, organic non-toxic materials and environmental health medication. With its investment in commissioned drone spraying business, it hopes to solve the problem of labor shortage in rural areas, and more importantly, provide a one-stop service to the farmers, echoing its original intention of forming a fleet.

Ji-Chang Chen pointed out that, in the past, farmers lacked common knowledge on pesticides so they solely relied on retailers' recommendation and sales. False application and imprecise application resulted in not only economic burden but also farmland pollution. Therefore, the Council of Agriculture also attaches great importance to the promotion of precise pesticide application. However, the air spraying technology cannot really meet the requirement of precise pesticide application. He said that with the advance of agricultural technology, Lanlix has developed various slow-acting fertilizers or pesticides, which requires less number of spraying and fertilizing. Nevertheless, how to apply the pesticides is the key. The so-called one-stop service is to identify the type, density and degree of harm of pests and diseases before applying the right pesticides, and to provide the correct prescription and concentration before spraying.

Therefore, every time the LanHang Science team follows a rigorous SOP for each mission, including uploading photos, confirming field crops, purpose and content of pesticide application with the backstage, measuring wind speed, and performing tasks. Ultra-fine spray gas has strong penetrating power and wide dispersion. With water mist, it can overcome the problem of less pesticide. "However, if the wind speed is over gentle breeze, the pesticides sprayed will drift with the wind, making it unable

▲ 隨著農村人力的老化，農噴服務已是大勢所趨，未來無人機勢必會進一步擴充到農地的管理監控與救災。With the aging of rural manpower, agricultural spraying service has been a trend. In the future, drones will be extended to farmland management monitoring and disaster relief.

超微細噴霧氣體穿透力強，飄散空間廣，配合水霧還可以克服著藥量較少的問題。「但是—風測超過三級，噴灑的藥物會隨風飄散，就無法達到精準用藥的要求，只要擇期再來。」

後台植物病蟲害防治資料庫撐腰　累積空噴參數

和目前國內代噴業者不同，聯航科技工作團隊十分仰賴聯利植物連鎖醫院多年來建立的植物病蟲害防治大型資料庫，當農民有植物栽種的問題，聯利植物連鎖醫院除了會派出專業人員到現場進行診斷、提供解決辦法外，近年來更發展出「聯利農管家服務平台」—農民可以將現場作物透過拍照或攝影上傳至農作物小幫手 APP，透過雲端串連各種服務，提供必要診斷和用藥建議，並引導農民至聯利植物連鎖醫院購買相關產品，或委託代噴投藥。

接受委託的聯航團隊來到田間地形勘查與病蟲害診斷，執行代噴前先與技術部再次確認作物病蟲害種類，正確診斷後，對症下藥，再配合聯利所屬福爾摩沙實驗室針對該作物推薦的藥劑種類，研發篩選出不會藥害、效果又好的無人機專用防治藥劑；施藥結束後，聯航代理店與技術部人員會持續追蹤防治效果。

「每一種肥料或營養資材，都有不同的特性，只有充分了解才能達到精準用藥的目的，每一塊農田、每一種作物、每一次施肥、噴藥及效果評估，

to meet the requirement of precise pesticide application, so we will have to do it on another day."

Establishment of Air Spraying Parameters with the Support of Plant Pest and Disease Control Database

Unlike other spray operators in Taiwan, the LanHang Science team heavily relies on the large plant pest and disease control database established by Lanlix's plant chain retailers. When the farmers have questions about planting, the Lanlix Plant Chain Retailer will send professionals to the site for diagnosis and provide solutions. In addition, Lanlix has developed the "Lanlix Agricultural Steward Service Platform," and farmers can upload photos or videos of field crops to the agricultural helper app. The platform will provide necessary diagnosis and pesticide recommendation through cloud service, and guide the farmers to purchase relevant products in the Lanlix Plant Retailer or order commissioned pesticide spraying.

The commissioned LanHang Science team came to the field for terrain survey and pest and disease diagnosis. It confirmed the type of pest and disease with the Technology Department again before performing the spraying. After correct diagnosis, correct pesticide will be applied. The non-phytotoxic and effective drone-exclusive pesticide for the particular crop is researched, developed and recommended by Lanlix's Formosa Laboratory. After the pesticide application is over, the LanHang Science agent and the Technology Department will continue to track the effectiveness of the pest control.

"Every fertilizer or nutrient material has different characteristics. Only by fully understanding them can the purpose of precise pesticide application be achieved. Every piece of farmland, every type of crops, every fertilization, spraying and effect evaluation is a process of parameters accumulation. Without this process, we can only rely on the rule of thumb. This is what differentiates the service provided by the LanHang Science from other service providers." Ji-Chang Chen said that the entry barrier is not high for small and medium-sized farms or service providers as long as they can purchase relevant equipment. However, they might not be able to provide professional and differentiated services.

Good Effect with Labor-saving and Time-saving Approach is an Opportunity for Fine Agriculture

Ji-Chang Chen said agriculture is a sunset industry. To promote agricultural development and good harvest, reasonable and safe use of pesticides is necessary evil. However, overdoing and underdoing

◀ 聯航工作團隊每次出任務，都得遵循一套嚴謹的 SOP，確保安全用 藥。Every time the LanHang Science team is on a task, it follows a rigorous SOP to ensure safe pesticide application.

都是參數累積的過程，缺少這一塊，就只能憑經驗法則，這也是聯航科技提供服務的最大差異。」陳吉昌不諱言，中、小型農場，或業者購入器材代噴，門檻並不是太高，但卻未必能提供更專業的差異性服務。

省工省時效果佳 精緻農業契機

陳吉昌形容農業是一種日不落夕陽產業，但為促進農業發展、保證豐收，合理安全的使用農藥是必要之惡，但過與不足都會造成危害，適當使用是關鍵要素之一。無人機精準農噴能貼近農民需求，解決農業缺工及施藥暴露風險問題，以科技的方法精準施藥，提升用藥效率，減少農藥使用量，達到省時、省工又安全的效果。

過去噴灑農藥幾乎都是以人力為主每一分田大概得花費 1 小時的時間才能噴灑完畢，而且人力噴灑受限於體力，面積愈大效率愈差。同樣面積使用無人機噴灑，一分田可以縮短為 3 分鐘完成任務，藥劑的分佈也更均勻。

陳吉昌更預言，無人機噴藥加上安全用藥的推動，可望擴大台灣有機栽種的面積。他指出，台灣有機農業最大的困境之一，就是仰賴大量的人力除草及防治病蟲害，因此耕種面積都不大。但如果將無人機運用在植物病蟲害防治上，做到提早發現，在蟲害擴大之前提早用藥，有機栽種就不再只是仰賴人力做田間管理，就有可能擴大種植面積，對高值化有機栽種無疑是一大契機。

不僅縮短時間、增加效率，在同樣的面積之下，使用無人機噴灑所需要的農藥量也可以大幅減少，

can cause harm. Proper use is one of the keys. Precise drone spraying meets the needs of farmers, and can solve agricultural labor shortage and risk of pesticide exposure. Using technological method to precisely apply pesticide can improve the efficiency of pesticide use, reduce pesticide usage and achieve time-saving, labor-saving and safe effect.

In the past, pesticide spraying is a labor intensive work because it takes about one hour to complete the spraying of 1000 m2 of farmland. In addition, manual spraying is restricted by physical strength. The larger the area is, the less the efficiency is. On the contrary, for the same area, using drone spraying can reduce the time to three minutes, and the pesticide distribution is more uniformly.

Ji-Chang Chen also predicted that drone spraying and the promotion of safe pesticide use are expected to expand the area of organic cultivation in Taiwan. One of the biggest plights of organic agriculture in Taiwan is the reliance on manual weeding and manual pest and disease control, so the cultivation area is not large. However, if we apply drones to plant pests and diseases control, with early detection and early pesticide use before the situation worsens, organic cultivation will no longer solely rely on manpower for field management, and then it is possible to expand the planting area. This is no doubt a great opportunity for high value organic cultivation.

Drone spraying not only reduces time and increases efficiency but also greatly reduces the amount of pesticide needed under the same area. The key is that the atomizing nozzles used by agricultural drones can make pesticide particle finer and thus the pesticide can be absorbed by the crops more easily. Moreover, the downdraft generated by the drone during flight can effectively and evenly spray pesticide on the crops, allowing the crops to be fully sprayed, which reduces large-scale pesticide dissipation.

Professional Management for Commissioned Spraying Business and Extended Disaster Relief

Lanlix established its fleet more than two years ago. It

其中的關鍵是農用無人機採用的霧化噴頭可將農藥噴灑的顆粒變得更加細微，使作物更容易吸收。再加上無人機飛行時所產生的下沉氣流，可使農藥有效且均勻的噴灑在作物上，使作物能夠整株完整授藥，也不容易產生大幅度的農藥逸散問題。

代噴專業納管 延伸防疫救災

聯利在兩年多前就成立機隊，以前訓練飛手要半年才能上線，但隨著科技的進步，人員一個禮拜也能起飛。在政府具體納管之前，執行代噴業務仍有許多模糊地帶。隨著今年度農委會農業藥物毒物試驗所、動植物防疫檢疫局及交通部民用航空局共同規劃農藥代噴技術人員訓練班課程，開辦無人機農噴專業課程班後，聯航也在最短的時間內協助隊員在今年取得無人機農噴專業證照，讓無人機應用可以合法上路。

「台灣農民，尤其年紀大的農民，向來勤撿持家，加上台灣農業土地切分過小，不像歐美有大面積農地，每人持有一、兩分地，種植不同作物，都會對無人機噴藥形成門檻。」但陳吉昌認為，隨著農村人力的老化，農噴服務已是大勢所趨，未來無人機勢必會進一步擴充到農地的管理監控與救災。

回應政府的智慧農業綱要計畫，他指出台灣農業已經進入新科技時代，無人機搭載光譜儀，透過整合影像技術，可以有效監控這片農田有無病蟲害發生，水份夠不夠、肥料夠不夠？也可以對疫情做有效的防治，跳脫傳統農業只能人工質性調查之框架，以更科學化的方式進行農業資料的偵蒐。

他認為，台灣要推動無人機代噴的普及，不應單純的補助農民或業者購置設備，而是應該鼓勵、補助農民委託專業廠商代噴，回歸安全用藥的思惟，才是發展智慧農業正確的方向。透過專業業者，針對不同地區、不同主要作物，透過資訊、經驗交流找出最好的解決方式，避免市場惡性競爭，透過產品差異化及合理化的利潤把市場穩定下來，讓人工智慧、物聯網、大數據等智慧科技真正翻轉台灣的農業。

used to take six months to train the drone operators before they are qualified to operate the drones. However, with the advancement of technology, the operators can operate the drones after one-week training. Prior to the government's specific management, there were still many ambiguities in the commissioned spraying business. After the Taiwan Agricultural Chemicals and Toxic Substances Research Institute, Council of Agriculture, Executive Yuan, the Bureau of Animal and Plant Health Inspection and Quarantine, and the Civil Aeronautics Administration, Ministry of Transportation and Communications organized the training program for pesticide spraying technicians and started the professional program for drone spraying, the LanHang Science also assisted the team members to acquire the drone spraying certificate so that the application of drones can be legitimate.

"Taiwanese farmers, especially older farmers, have always been industrious and thrifty. Moreover, unlike the US and Europe where farmers have large area of farmland, Taiwan's farmland is relatively small. Each farmer typically owns 1000 or 2000 m2 of farmland with various crops grown on it. These are barriers to drone pesticide spraying." However, Ji-Chang Chen believes that with the aging of rural manpower, agricultural spraying service has be a trend. In the future, drones will be extended to farmland management monitoring and disaster relief.

In response to the government's smart agriculture outline plan, he pointed out that Taiwan's agriculture has entered an era of new technology. Through integrating imaging technology, drones with spectrometers can effectively monitor whether pests and diseases present in farmland and whether water and fertilizer is enough. It can also effectively prevent and control epidemics. In this way, we can use a more scientific way to research agricultural data, as opposed to manual qualitative investigation in traditional agriculture.

He believes that to promote the prevalence of commissioned drone pesticide spraying in Taiwan, mere subsidies to farmers or service providers to purchase equipment is not the way. Instead, the government shall encourage and subsidize farmers to commission the spraying to professional service providers for safe pesticide application. This is the right direction for smart agriculture. The professional service providers will find the best solution for different regions and different main crops through information and experience exchange, avoid vicious market competition, and stabilize the market through product differentiation and reasonable profit so that smart technologies, such as artificial intelligence, Internet of Things and big data can actually flip Taiwan's agriculture.

台灣力拚循環經濟 台糖亮點計畫— 東海豐農業循環園區

Taiwan, Striving for Circular Economy Taiwan Sugar Highlight Project — Donghaifeng Circular Agriculture Park

影 音 報 導

政府推動「5+2」產業創新政策：「亞洲矽谷」、「智慧機械」、「綠能科技」、「生技醫藥」、「國防」，再加上「新農業」及「循環經濟」，其中透過能資源的再利用，讓資源生命週期延長或不斷循環的「循環經濟」，是政府期待能有效緩解廢棄物與污染問題，開啟「從搖籃到搖籃」的新經濟模式。

而以全新的概念養豬，從節水、沼氣發電到糞渣製成堆肥，零廢棄、低污染、無臭味畜養方式的「台糖東海豐農業循環園區」，正是循環經濟產業中的翹楚。

The government has promoted the 5+2 Industrial Innovation Program: Asia Silicon Valley Development Agency (ASVDA), Taiwan Smart Machinery, Green Energy Technology, Biotechnology and Medicine, National Defense and New Agriculture and Circular Economy. The circular economy that applies resources reuse to extend life cycle of resources or forever recycled resources is expected to effectively mitigate the problems of wastes and pollution and lead Taiwan to a new "cradle to cradle" economic model.

Raising pigs with a new concept, from water-saving, biogas power generation to manure compost, zero waste, low pollution and odorless animal husbandry, Taiwan Sugar's Donghaifeng Circular Agriculture Park is the leader in the industry of circular economy.

「在循環經濟這個名詞出現之前，糖業一直以來就是循環經濟的標竿！過去我們稱作『多角化經營』，從甘蔗的採收、榨汁製糖到蔗渣做成蔗板、有機堆肥到牛飼料！」「榨出來的蔗汁有 75％是水，水蒸氣可以變成設備的動能，糖蜜還可以製成酒精和酵母，就連最後剩下的一點沉澱物，也會變成濾泥回到農地裡，從甘蔗到所有副產品的利用、開發，可一點都不浪費，也是最典型的！」台糖總經理管道一

"The sugar industry has been the benchmark of circular economy long before the term circular economy emerges. We called it "multi-dimension management, from sugarcane collection, sugar juice extraction and sugar production to transforming wastes to byproducts, such as bagasse board, organic compost and cattle feed!" "75% of the sugarcane juice is water. The water vapor can power for the equipment. The molasses can be made into alcohol and yeast. Even the remaining precipitate returns to the farmland as sludge. Nothing is wasted from sugarcane to all byproducts. This is a typical model." Mr. Tao-I Kwan, the President of Taiwan Sugar

開門見山，用糖的製程詮釋台糖與現階段政院推動循環經濟的淵源。

提及台糖養豬的起源，管道一說，當時因為蔗田地力培養需要及利用多餘的空地，因此民國 41 年時任台糖總經理楊繼曾邀請全台畜牧專家，共同商討發展畜牧事業。迄今已有 60 餘年歷史，且近年來，國際上大力推動循環經濟，部分國家甚至立法實施循環經濟；台糖公司具有國營企業的使命「配合中央政策，貢獻國家發展，投入前瞻性未來產業」、「建設一個安居樂業的永續循環台灣」並以「亞太地區健康及綠色產業標竿」為願景，因此，協助政府推動政策必是不遺餘力。為改善國內養豬環保問題，台糖公司配合「我國養豬場綠能發電規劃」政策及新農業之推動，於是著手推動豬場改建計畫，包括目前的東海豐畜殖場的改建。

▲ 東海豐農業循環園區耗資近 7 億元興建完成的畜產業循環生態園區，把過去被視為廢棄物的豬糞尿和農業廢棄物，轉變為可利用資源，落實農業資源循環利用。It costs about NT$700 million to build the livestock circular ecological park in the Donghaifeng Circular Agriculture Park. The pig manure and agricultural wastes, which were considered wastes, are transformed into usable resources as the implementation of circular use of agricultural resources.

從糖業循環經濟到零廢棄畜殖場

今年 9 月，台糖全台首座綠色畜殖場示範園區正式啟用，這由行政院整合農委會、經濟部、環保署、工研院及台糖公司等單位，分別就技術面（國產沼氣設備開發）、產業面（廠房改建與設計實踐）及機制面（多源料源）共同推動，歷時約兩

used the process of sugar production to explain the relationship between Taiwan Sugar and the circular economy currently promoted by the Executive Yuan.

As to why Taiwan Sugar started the pig farming business, Tao-I Kwan explained that for sugarcane field fertility and utilization of excess vacant land, Mr. Ji-Tseng Yang, the President of Taiwan Sugar back in 1952, invited all livestock experts in Taiwan to discuss the development of animal husbandry. It has been more than 60 years, and in recent years, circular economy has been widely promoted by the international community. Some countries even have regulations for the implementation of circular economy. As a state-owned enterprise, Taiwan Sugar Cooperation has taken on the missions of "following the policies of the central government to contribute to national development and invest in forward-looking future industry," and " building a sustainable Taiwan where people live safely and happily" with the vision of "being the benchmark for health and green industry in Asia-Pacific region." Therefore, Taiwan Sugar has spared no effort to assist the government in promoting the policies. In order to improve the environmental problem of pig farming in Taiwan, Taiwan Sugar Cooperation has started the pig farm reconstruction plan following the policy of "Green Energy Power Generation Planning for Pig Farms" and promotion of new agriculture, including the current reconstruction of the Donghaifeng Livestock Farm.

From Circular Economy in the Sugar Industry to the Zero-waste Livestock Farm

In September this year, the Taiwan Sugar's first green livestock demonstration farm was officially opened. This farm is a collaborative work among the Executive Yuan, Council of Agriculture, Ministry of Economic Affairs, Environmental Protection Administration, Industrial Technology Research Institute, and Taiwan Sugar Cooperation from the technology aspect (domestic biogas equipment development), industry aspect (factory rebuilding and design realization) and the mechanism aspect (multi-source materials). It took about two years, including several times of Executive Yuan-level discussion. Taiwan Sugar's Donghaifeng Circular Agriculture Park located in Changzhi Town, Pingtung County is one of the achievements (highlights) of the implementation of circular economy policy. Taiwan Sugars' Donghaifeng Circular Agriculture Park is the first livestock circular ecological park in Taiwan that was designed based on the concept of circular economy. It costs about NT$700 million. The park includes ten modern green energy buildings for pig farming, a biogas center and old-style fan-shaped pig houses, an ecological detention pond and an

年多（包含多次的院層級會議討論）的努力，以台糖位於屏東長治鄉東海豐農業循環園區，做為落實循環經濟推動政策之成果（亮點）之一。東海豐農業循環園區是台糖公司在台灣第一座以循環經濟的理念規劃設計，耗資近 7 億元興建完成的畜產業循環生態園區，區內包括十棟現代化綠能養豬場、沼氣中心以及舊式的扇形豬舍、生態滯洪池及環境教育中心，結合豬隻的畜養、發電及環境教育的展示，把過去被視為廢棄物的豬糞尿和農業廢棄物，轉變為可利用資源，落實農業資源循環利用，也改變民眾對養豬業污染負面的印象。

管道一指出，台灣氣候濕熱，為了降低傳統開放式豬舍內的溫度，往往需要大量灑水，一方面也同時清洗地面上的排泄物，根據統計，一頭豬平均一天要用掉 30 公升的水，相當浪費水資源；另一方面，農委會過去也推動過用豬的排泄做沼氣發電，但因為經過水的稀釋，效率也相當低，嚴格講起來並不符合成本效益，並不成功。

「糞尿即時導入沼氣發電成功的關鍵在豬隻排泄物的濃度，濃度高，水分少，發電效率就好。因此台糖在東海豐現代化豬舍設計之初，不僅要重新思考養殖環境的改善，對於創造循環經濟的每一道流程都要思考到。」管道一表示，園區的傳統老舊豬舍改建為負壓水簾式畜舍後，即使室外

▲ 沼氣發電是東海豐農業循環園區推動再生能源發展的主軸之一。
Biogas power generation is one of the themes of renewable energy development in the Donghaifeng Circular Agriculture Park.

environmental education center. It is a demonstration park that combines animal husbandry, power generation and environmental education. The pig manure and agricultural wastes, which were considered wastes, are transformed into usable resources as an implementation of circular use of agricultural resources. This has also changed the public's negative perception of the pig industry.

Tao-I Kwan pointed that Taiwan is hot and humid. To reduce the temperature in traditional open pig houses, a large amount of water is often needed. The water also washed away the pig manure on the ground. According to statistics, on average, a big consumes 30 liters of water a day, which is quite a waste of water resources. On the other hand, the Council of Agriculture had promoted biogas power generation using pig manure. However, the diluted pig manure makes the power generation efficiency very low. Strictly speaking, it was not cost-effective, and thus unsuccessful.

"For the instant introduction of manure to biogas power generation, the key to the success is the concentration of pig manure. High concentration and low water content results in good power generation efficiency. Therefore, at the beginning of the design of Donghaifeng's modern pig houses, Taiwan Sugar has to not only rethink the improvement on the breeding environment but also consider every process for creating a circular economy." Tao-I Kwan said that after the traditional old pig houses in the park are converted to negative pressure water curtain type, the pig houses can still be maintained at a comfortable temperature of 24° C to 28° C even when the outdoor temperature exceeds 30° C. This not only increases the pigs' growing speed and production efficiency but also reduces dust and spread of disease. Without the need of water cooling, the daily water consumption of each pig can be reduced to five liters or less.

Power Generation by Biogas and Solar Energy

The interior of the pig houses is elevated, and with reduced flushing, the pig manure is no longer watery. Moreover, with the wastewater treatment and recovery system and rain water reclamation facility, the water consumption can be reduced by 83%, and through the closed pipelines in the park, the pig manure is transported to the anaerobic treatment facility to produce biogas. The more the solid, the higher the efficiency of biogas fermentation and power generation. It is estimated that 9,000 kWh power can be generated every day. In addition, the process of power generation is order-free. The value at the air outlet is far lower than the standards set by the Environmental Protection Administration. The remaining sludge and slurry will

溫度超過 30 度，畜舍內仍然可以維持在 24 ～ 28 度的舒適溫度，不但可以提高豬隻發育速度及生產效率，同時還能減少粉塵，降低疾病的傳播，也不必因為要降溫而頻頻沖水，豬隻每日的用水量可降低到 5 公升以下。

沼氣和太陽能都能發電

畜舍內部改良成高架床面，減少大量沖水，豬隻排泄物不再「湯湯水水」，再加上廢污水處理暨回收系統，以及雨水回收再利用等設施的挹注，除了用水量可比原本節省 83% 外，也透過園區內設置的密閉式管線，將豬糞尿輸送到厭氧處理設備中產生沼氣，固形物越多，沼氣發酵、發電的效率也跟著提高，估計未來每天將可產生 9,000 度的發電量。而沼氣發電過程不會產生臭味，出風口數值更遠低於環保排放標準，剩餘的沼渣、沼液將循環利用回歸大地，做為農地施肥養分。

「沼氣發電需要氮與碳，東海豐作為農委會實驗計畫的場域，我們也結合了園區周邊鳳梨皮、檸檬皮等農業廢棄物，作為共醱酵之料源，不僅解決了農廢處理問題，又產生能源，預估運轉後每日有 100 公噸的需求。」管道一表示，台糖公司藉由東海豐農業循環園區推動三大主軸再生能源發展，第一個是沼氣發電，透過東海豐豬舍之改建和沼氣中心的配置來達成；第二個是太陽能光電，在豬舍屋頂設置太陽能發電；第三個則是未來的農電共享，台糖與各地政府合作，解決廚餘、過剩農業廢棄物問題，創造獲利的機會。也就是說，成立一個能源服務公司，與彰化、雲林、嘉義、屏東等農業大縣洽談合作，這些惱人的農業廢棄物可以拿來發電、賣電或多元利用。

循環經濟從台糖做起

完工後的「東海豐農業循環園區」共分為 10 棟 20 區的畜舍、多功能展示中心、日處理量 200 噸 的沼氣處理中心、日生產 20 公噸的堆肥處理中心以及環境教育場所，豬隻飼養流程以長約 22 公尺玻璃參觀廊道的方式呈現。因此這裡將不僅僅只是一處環保、潔淨的綠能畜殖場，更是一處

return to the farmland as fertilizer.

"Biogas power generation requires nitrogen and carbon. Donghaifeng, as a site of the Council of Agriculture's experimental plan, we also use pineapple peel, lemon peel and other agricultural waste around the park for co-fermentation. This not only solves the problems of agricultural waste but also generates energy. It is estimated that there will be a demand of 100 metric tons of agricultural waste per day once the biogas power generation facility is running." Tao-I Kwan said, Taiwan Sugar Cooperation promotes the development of three main renewable energy models through the Donghaifeng Circular Agriculture Park. The first is biogas power generation, which is achieved through the reconstruction of Donghaifeng pig farm and biogas center. The second is solar power through the installation of photovoltaic panels on the pig house roofs. The third is sharing of agricultural power in the future. Taiwan Sugar will cooperate with local governments to solve the problem of food scraps and excessive agricultural waste and create opportunities for profit. In other words, Taiwan Sugar will set up an energy service company and discuss with big agricultural counties, such as Changhua, Yunlin, Chiayi, and Pingtung to turn the annoying agricultural waste into power or other profitable byproducts.

Circular Economy Starts with Taiwan Sugar

The completed Donghaifeng Circular Agriculture Park has 20 blocks of pig houses spread in 10 buildings, a multi-purpose exhibition center, a biogas treatment center with a daily processing capacity of 200 tons, a compost processing center with a daily processing capacity of 200 metric tons, and an environmental education site. The pig raising and breeding process is presented in a 22-meter long glass corridor. Therefore, this place is not only an environmentally-friendly and clean green energy livestock farm but also a park that can provide environmental education for people. We will apply for an environmental education site for the agricultural circular economy. With the pig house area, biogas center, organic compost house, crop planting area, ecological pond and green belt, the park combines AR/VR virtual reality technology and food and farming education to take the public to explore the process of pig farming and understand the life of a pig as well as the way to recycle agricultural waste, from expanding vision and knowledge to actual participation, promoting the concept of agricultural circular economy in depth.

Illustration: We will apply for an environmental education site for the agricultural circular economy, and promote the agricultural circular economy in depth by combining

可提供民眾環境教育的園區，未來將申請做為農業循環經濟「環境教育場址」。藉由園區裡豬舍區、沼氣中心、有機堆肥舍、作物種植區、生態池及園區綠帶等元素，結合 AR/VR 實境科技與食農教育理念，帶領民眾窺探養豬流程與瞭解豬的一生，以及農業廢棄物資源化利用的方式，從視野與知識的增長到實際參與的體驗，深度推廣農業循環經濟之理念。

除了「東海豐農業循環園區」外，台糖亦規劃的全台灣第一個智慧綠能循環住宅園區也即將在 108 年底誕生。「只租不賣，可以改變人們已經習慣用過即丟的觀念，也可以從源頭改變設計，讓商品可以修理，再利用。」管總經理表示，位於台南沙崙高鐵特定區的循環住宅所有的建材、設備都要符合可拆解、回收再製成或重新組裝再利用的特性，且有完整的使用歷程，傢俱也可以採租用模式，由建商或設備商負責管理維護。

另外，台糖也相中將台灣西部沿岸養殖業丟棄大量廢牡蠣殼，尋找轉化為循環經濟商機的可能性。「邁向循環經濟不是選項，是必然要走的路，投資循環經濟就是投資台灣的未來。」管道一指出，台糖斥資 2 億元，在台南永康打造全台首座牡蠣殼碳酸鈣生技材料廠，第一階段將提煉出碳酸鈣，從工業用、肥料、飼料與建築材料，隨著精煉度的提升，再擴及食品級的鈣片、制酸劑，面膜等，預計每年收進 5 萬噸廢牡蠣殼，生產出 4 萬噸碳酸鈣原料，為台糖推動循環經濟再開創出一條的生產線。

台糖農畜學院
培育未來經營發展人才

提及國內農畜產業的經營發展人才，管道一也不諱言指出，農畜領域涉及的專業知識非常廣泛，以「東海豐農業循環園區」來說，與東海豐綠能豬場直接相關的就是畜牧相關學程，但是，豬舍相關設計則與建築及機械設計等密切結合，廢水處理又是環境工程與化學工程相關學程，厭氧醱酵則與微生物有關，沼渣沼液利用則屬於農業應用，沼氣利用則與機電工程相關，目前國內相關

AR/VR virtual reality technology and food and farming education.

In addition to the Donghaifeng Circular Agriculture Park, Taiwan Sugar has also planned Taiwan's first smart green energy circular residential park, which will be launched at the end of 2019. "The 'leasing only' practice will change people's behavior of treating goods as disposable and can change the design from the source so that the goods can be repaired and reused." President Kwan said that all building materials and equipment of the circular dwellings located in the Tainan Shalun High Speed Rail area must be able to be disassembled, recycled, reassembled or reused, and shall have a complete use history. When adopting the lease mode, the builder or equipment supplier will manage and maintain the furniture.

In addition, Taiwan Sugar is also looking for the possibility of turning a large number of oyster shells from the aquaculture in the western coast of Taiwan to business opportunities of a circular economy. "Moving towards a circular economy is not an option, but the way to go. Investing circular economy is investing the future of Taiwan." Tao-I Kwan pointed out that Taiwan Sugar invested NT$200 million in building Taiwan's first oyster shell calcium carbonate biotech material plant in Yongkang District, Tainan City. The first stage is to extract calcium carbonate from oyster shells for industrial use, fertilizer, feed and building materials, and next for food-grade calcium tablets, antacid, and facial masks. Fifty thousand tons of oyster shells are expected to be collected every year to produce 40,000 tons of calcium carbonate raw materials. This will be a new production line for Taiwan Sugar to promote circular economy.

Taiwan Sugar Cooperation Agriculture and Livestock Academy, a Cradle to Nurture Future Talent for Business Development

When it comes to the agricultural and livestock industry's management and development talent, Tao-I Kwan pointed out that the professional knowledge involved in the agricultural and livestock field is very extensive. Take Donghaifeng Circular Agriculture Park for example, animal husbandry programs are directly related to the Donghaifeng green energy pig farm, but the design of pig houses requires architecture and machinery design. Wastewater treatment is related to environmental engineering and chemical engineering. Anaerobic fermentation is related to microbiology. Sludge and slurry are agricultural application, and biogas utilization is related to electromechanical

▲ 台糖公司於 107 年成立農畜學院，設立畜牧系及農經系，培育國內農畜產業未來經營發展所需人才。Taiwan Sugar Cooperation established the TSC Agriculture and Livestock Academy, Department of Animal Husbandry and Department of Agricultural Economy to train future talent for the management and development of the agriculture and animal husbandry industry in Taiwan.

學門大多各自努力推動，產學結合部分仍有部分不足之處，仍待培育具國際觀、國際鏈結與移動力及最新綠能材料技術的各階研發人才，透過與產業鏈的連結以系統整合規劃、產品優化設計及產業外溢規劃等方式，同時盤點學界擅長的主軸專長訓練及廠商合作需求，以媒合、講訓、試驗、聯盟籌組等多面向手段，提高技術產業運用效益。針對此部分，台糖公司於 107 年 2 月正式成立農畜學院，設立畜牧系及農經系，培育國內農畜產業未來經營發展所需人才。農畜學院係以循環經濟理念做為課程設計之架構，並於畜牧系辦理「養豬基礎訓練班」，課程中導入豬糞尿回收再利用及永續農業等綠能養豬相關議題，截至目前為止已培訓畜殖產業青農共 99 位。農畜學院除了是技術培訓機構外，更是提供農畜產業網絡交流互動之平台，對於提升產業未來發展及循環經濟推動更加有助益，並配合政府推動六級產業規劃，可創造產業附加價值。

訪談最後，管道一真誠的表示，台糖身為國營企業，責無旁貸落實政府發展綠能與循環經濟的政策目標，由於相對於民間產業有更暢通的向上溝通管道，台糖公司在全力配合政府政策的同時，亦感受到政府單位給予的大力支援，從計畫預算的成立至園區竣工後的運作皆受到相關單位不遺餘力的協助，不管是農委會、環保署及經濟部與其轄下相關機構與地方單位均提供相當多的指導與建議，甚至民間的環保團體、大專院校或研究機構也都支持並提供建言，在大家有志一同的努力下，期能扭轉大眾認為畜牧業易造成污染的負面印象，使新興畜牧業蛻變成新的「清潔養豬，循環經濟產業」。

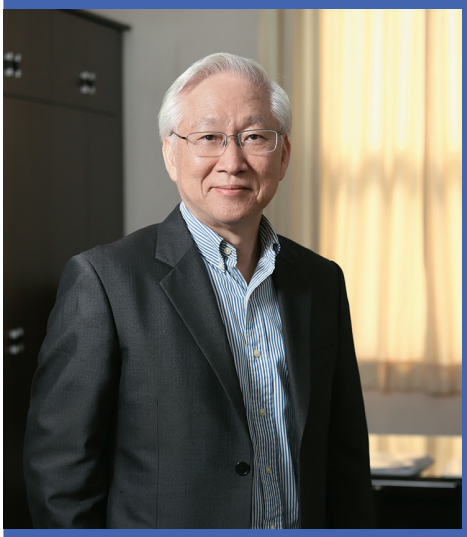
engineering. So far, most of the relevant disciplines in Taiwan only focus on their own field. Industry-academia collaboration is still inadequate. R&D talent with international perspective, international linkage and mobility and knowledge of the latest green energy materials are still lacking at all levels. The TSC Agriculture and Livestock Academy plans to improve the application efficiency of high-tech industry through system integration with industrial chain, product optimization design and spill-over effect as well as matchmaking, training, trial and alliance to match the expertise in the academia with the needs of companies. To bridging the gap, Taiwan Sugar officially established the TSC Agriculture and Livestock Academy as well as Department of Animal Husbandry and Department of Agricultural Economy in February 2018 to train future talent for the management and development of the agriculture and animal husbandry industry in Taiwan. The TSC Agriculture and Livestock Academy adopts the concept of circular economy as the framework for curriculum design, and organized "basic pig farming training program," which introduced pig manure recycle and reuse, sustainable agriculture and green energy for pig farming to students. So far, this program has trained 99 young farmers in the livestock industry. In addition to being a technical training institution, the TSC Agriculture and Livestock Academy is also a platform for the agriculture and livestock industry to exchange information and interact. This is very helpful for improving future development of the industry and promoting circular economy. It also cooperates with the government to promote the six-grade industrial planning to create industrial added value.

At the end of the interview, Tao-I Kwan sincerely said that as a state-owned enterprise, Taiwan Sugar has obligation to implement the government's policy goal of green energy and circular economy. Compared with private industries, Taiwan Sugar has a smoother upward communication channel, so Taiwan Sugar is fully supported by the government when following the government's policy. From budgeting to operation after completion, Taiwan Sugar has received an abundant assistance, including the advice and suggestions from Council of Agriculture, Environmental Protection Administration and Ministry of Economic Affairs, and their related agencies and local departments. Even private environmental protection groups, colleges or research institutions were very supportive. With the efforts of everyone, we hope to change the public's negative perception that the animal husbandry industry is prone to pollution, and transform the emerging livestock industry into a new circular economy.

國家級人體生物資料庫整合平台 開創台灣精準醫療新里程

National Integrated Platform for Biobanks A New Milestone for Precision Medicine in Taiwan

影 音 報 導



台灣地區人口結構漸趨老化，平均壽命延長，健康促進及慢性病預防逐漸成為目前公共衛生重要的議題。然而台灣具備規劃完整、行之已久之全民健康保險與其資料庫，同時也擁有具世界級的資訊科技產業，是發展「精準醫療（Precision Medicine）」絕佳的地點。在數位科技、基因檢測與定序技術的快速進展下，「精準醫療」將為生技醫療產業帶來前所未有的轉變，不僅能有效地分析健康資訊， 同時還能給予精準且高品質的醫療照護，更可降低不必要的醫療支出 ，因此成為廣受全球矚目的焦點。

An aging population and an increasing average lifespan have made health promotion and prevention of chronic illness two of the most important health issues in Taiwan. Fortunately, having a time-tested National Health Insurance scheme, a comprehensive health database, and a world-class IT industry makes Taiwan an ideal location to experiment and develop "precision medicine" as a solution to the above problems. As digital, genetic testing, and genome sequencing technologies progress, they make "precision medicine" possible that will bring unprecedented changes to the biomedicine industry. The concept of "Precision medicine" has caught the world's attention not only for its ability to analyze health information with great efficiency, but also for its potential to direct high-quality healthcare precisely where it is needed, and thereby reducing redundant medical expenditure.

行政院政務委員 吳政忠 Tsung-Tsong Wu, Minister without Portfolio of the Executive Yuan

隨著 AI 人工智慧在醫療現場應用，近年的精準醫療及新興療法進展神速，而兼具一致性與品質的人體生物資料庫（Biobank）及衍生數據，對於生醫創新技術與產品的開發占有關鍵地位，也是奠定台灣精準醫療發展的重要基礎。台灣現有 31 家人體生物資料庫，各有不同的收案來源和收案數，如果能串接、整合所有的人體生物資料庫，藉

Precision medicine and new treatments have progressed rapidly in recent years thanks to the incorporation of AI into medical applications; however, having a biobank that supplies biological data of consistent quality is just as critical to biotechnology innovations resulting in the great advantage that Taiwan possesses in the development of precision medicine going forward. There are currently 31 biobanks in Taiwan; each collects data from different

此擴增訓練 AI 模組所需要的大數據，就能加速台灣精準醫療的發展。

三支利箭推升台灣的精準醫療

衛福部指出，台灣在精準醫療所射的第一支箭是 99 年通過《人體生物資料管理條例》，第二支箭是 101 年中研院成立台灣人體生物資料庫（Taiwan Biobank）。台灣人體生物資料庫依據不同遺傳氏族在臺灣地區居住分佈的特性，並針對本土常見疾病（如高血壓、糖尿病、癌症等）進行長期追蹤研究。在研究設計上採取世代研究、病例對照研究與藥物基因體研究等多重方法。世代研究將募集 20 萬名一般民眾及 10 萬名常見的 10 ～ 15 種疾病患者一同參與，收集參與者的健康情形、醫藥史、生活環境資訊與生物檢體、健康變化情形與治療狀況。截至 108 年 10 月底，台灣人體生物資料庫累計的參與總數超過 12 萬，透過這些參與總數幫助我們提升醫療品質。

舉例來說，在 104 年時，曾透過資料庫篩選出台灣人特有的 65 萬個基因，從中比對出 41 個與糖尿病相關的基因，未來若能連結健保資料庫，讓民眾透過抽血檢測這 41 個基因位置，就能提高預測未來罹患糖尿病的機率。其他台灣常見的慢性疾病，如高血壓、心臟病等，則需要分析數以千計的基因，再加上飲食和環境因子才能做出判斷。幸運的是，台灣擁有良好的臨床診斷和公共衛生水準，還有全民健保可以協助長期追蹤參與世代研究之一般民眾的檢體與資料，長期觀察了解疾病發生的原因；而參與世代研究之病患的檢體與資料則幫助我們了解疾病發展以及治療情況。

各大醫院紛紛設立人體生物資料庫

推升我國精準醫療發展的第三支箭是各醫院成立人體生物資料庫。各醫院中，三軍總醫院 (三總) 率先於 103 年成立人體生物資料庫。三總病理部主任趙載光指出，三軍總醫院人體生物資料庫針對肺癌、胃癌、乳癌、大腸直腸癌、腦腫瘤、頭頸癌、

sources. By linking and integrating these biobanks, researchers will have the big data needed to train AI models more efficiently and hasten the development of precision medicine in Taiwan.

Three Measures to Support Precision Medicine in Taiwan

According to the Ministry of Health and Welfare (MOHW), Taiwan has taken several measures to support precision medicine, including passing the Human Biobank Management Act in 2010 and the creation of the Taiwan Biobank by Academia Sinica in 2012. Taiwan Biobank conducts long-term research on common diseases (such as hypertension, diabetes, cancer, etc.) after taking into consideration the distribution of different gene families in Taiwan. Taiwan Biobank adopts a multitude of approaches in its research, including cohort study, case-control study, and pharmacogenomics. For the cohort study, Taiwan Biobank will be gathering information such as health condition, medical history, lifestyle, environment, biological samples, health changes, and treatments from 200,000 ordinary subjects and 100,000 patients diagnosed with 10~15 of the common diseases. By the end of October 2019, Taiwan Biobank had accumulated more than 120,000 participants, whose contribution has helped improve the quality of our healthcare system.

For example, Taiwan Biobank was able to compare 650,000 distinctive genes of the Taiwanese people to identify 41 that were related to diabetes back in 2015. If the biobank could somehow be linked to the National Health Insurance database in the future, people will be able to check the loci of these 41 genes through a blood test and predict the risk of diabetes with greater precision. As for other common diseases such as hypertension and heart disease, further conclusions can be reached only after analyzing thousands of genes and taking into account dietary and environmental factors. Fortunately, with the support of strong clinical diagnosis, a robust health system, and the National Health Insurance scheme, Taiwan Biobank can analyze biological samples and conduct long-term observations on cohort study participants to determine the underlying causes and the development patterns and treatments of various diseases.

Biobanks in Major Hospitals

The third measure supporting precision medicine has

▲ 三軍總醫院病理部主任趙載光指出，三總的人體生物資料庫針對了肺癌、肝炎、心血管疾病、糖尿病、阿茲海默氏症等 15 種疾病，收集個案檢體與相關資料。Tai-Kuang Chao, Chief of Pathology of TSGH, said that TSGH has been gathering biological samples and information on 15 diseases such as lung cancer, hepatitis, cardiovascular disease, diabetes, and Alzheimer's through its biobank.

肝炎、心血管疾病、糖尿病、腎臟病、腦中風、腦外傷、阿茲海默氏症、子宮內膜異位、氣喘等 15 種疾病，收集個案檢體與相關資料。近 5 年來的努力，讓三總在預防醫學、標靶藥物研發等有了顯著的成長。有了三總打頭陣，爾後如中國醫藥大學附設醫院、彰化基督教醫院、中山醫學大學附設醫院等 27 家中大型教學醫院及區域醫院，便如雨後春筍般紛紛設立人體生物資料庫，群體群力為台灣醫療研究貢獻一份心力。

集合眾人力量
Biobank 共享時代來臨

目前台灣已核准成立 31 家人體生物資料庫，檢體總建置數高達 450 萬件，但受限規模大小不一，且申請程序繁複，缺乏統合，導致運用效益有限。為突破此困境，行政院政務委員吳政忠邀集中央研究院、衛福部、國衛院等部會，共同研商規劃建立「國家級人體生物資料庫整合平台」，整合國內現有人體生物資料庫，並於今年 10 月 30 日成立 Biobank

been the establishment of biobanks in major hospitals. The Tri-Service General Hospital (TSGH) was the first among local hospitals to establish a proprietary biobank. Tai-Kuang Chao, Chief of Pathology of TSGH, mentioned that TSGH has been gathering biological samples and information on lung cancer, stomach cancer, breast cancer, colorectal cancer, brain tumor, head and neck cancer, hepatitis, cardiovascular disease, diabetes, kidney disease, cerebral stroke, brain injury, Alzheimer's, endometriosis and asthma through its biobank. For the last five years, the additional data has enabled TSGH to make prominent breakthroughs in terms of preventive medicine and target drug development. With TSGH leading the charge, 27 educational and regional hospitals such as China Medical University Hospital, Changhua Christian Hospital, and Chung Shan Medical University Hospital soon followed creating biobanks of their own and contributing to medical research in Taiwan.

Prospects of Shared Biobank

4.5 million biological samples are estimated to have been collected through the 31 licensed biobanks in Taiwan to date, but due to the difference in sizes and the complex procedures involved, attempts to integrate data and use them in complement for greater benefits have been unsuccessful. To overcome this limitation, Tsung-Tsong Wu, Minister without Portfolio of the Executive Yuan, engaged Academia Sinica, MOHW, and the National Health Research Institutes in a series of discussions regarding the creation of a "National Integrated Platform for Biobanks" that consolidates resources from existing biobanks within the nation. Also, a Biobank Integration Alliance was formed on October 30 this year to realize the above goal. This alliance grants medical researchers access to all health and genetic data maintained on separate databases through a single point of contact without having to undergo a complex review procedure. This alliance has the potential to improve the accuracy of research outcomes. In addition to promoting more active use of biobank resources, the alliance also enables connection to the National Health Insurance database for data of high research value such as medical charts, and cancer and rare diseases information that can be provided with patients' consent. Overall, the National Integrated Platform for Biobanks provides biomedicine and precision medicine researchers with valuable resources needed for disease-related studies and new drug development, which in turn attracts investment from foreign pharmaceutical companies, improves the local healthcare system, and gives Taiwan the competitive

整合平台聯盟。現在透過單一窗口和簡便的審核程序，醫學研究人員、專家學者可以一次取得所有的資料，觀察到大量的基因，讓研究成果更準確。不僅活絡整體生物資料庫之運用，取得當事人同意後還可串接健保申報資料、電子病歷、癌症登錄、罕見疾病等資料庫，提供台灣醫藥生技研究與精準醫療發展所需之重要資料來源，加速疾病研究與新藥研發，並吸引國外藥廠來台投資，提升台灣醫療照護品質與水準，促進國民健康外，也藉此為台灣精準醫療立下國際發展的新利基。

人機協作 生醫產業數位加值

有關於未來生醫產業如何利用數位科技，國衛院病理核心實驗室主任黃秀芬以組織病理為例說明。過往癌症病患的腫瘤切片都是由病理科醫生用肉眼看顯微鏡來做判讀和診斷，包括良性、惡性、罹患哪一種疾病……等細節。但目前透過全玻片影像掃描等數位科技輔助，由病理醫生協助定義有哪些重要的異常判別特徵，再由程式設計師編寫在程式中，經由一系列分析衍生出數據與診斷。運用 AI 判讀的數位醫療，仍有醫生負責最後把關，做出正確診斷和處理。因此，人機協作輔助醫生進行診斷判讀，提升診斷速度與精準度，最大益處就是降低醫生的工作負擔。

目前國內的生醫產業與數位科技已經出現了不少結合的案例，例如國內規模最大的長庚醫療體系，在去年就成立了 AI 中心，正全面分析應用醫院數據，

edge in developing precision medicine in the future.

Human-robot Collaboration brings Value to Biomedicine

Shiu-Feng Huang, Supervisor of the Pathology Core Lab at the National Health Research Institutes, explained how digital technology could be incorporated into the biomedicine industry in the future using a histopathological example. In the past, biopsy samples taken from cancer patients had to be interpreted and evaluated by pathologists, which involved observing for signs of malignancy and disease through a microscope. Today, however, the observation part is being performed using digital scanners, which have been programmed with the help of pathologists to look for abnormal patterns and generate a series of data and diagnoses automatically. AI interpretations are still reviewed by real physicians to ensure the correctness of the final diagnosis. This level of human-robot collaboration helps physicians diagnose and interpret results at greater speed and precision, which ultimately reduces the workload for physicians.

Cross-industry Applications, Training, and Collaboration

There have already been several successful integrations of digital technology in biomedicine applications; Chang Gung Medical Foundation, Taiwan's largest medical group, for example, created an AI center last year that is now fully dedicated to analyzing hospital data and supporting the development of precision medicine and smart

◀ 國家級人體生物資料庫整合平台正式啟用，為台灣精準醫療奠定利基。National Integrated Platform for Biobanks provides the foundation for precision medicine development in Taiwan.

◀ 國衛院病理核心實驗室主任黃秀芬認為，預告基因分析、基因判讀等領域也將成為未來就業市場的熱門專業。According to Shiu-Feng Huang, Supervisor of the Pathology Core Lab at the National Health Research Institutes, genetic analysis and gene interpretation are expected to be two of the most popular professions in the future.

瞄準精準醫療與智慧醫療發展。另外，台中榮總透過導入醫療詢問系統與各式 APP，協助病患、家屬與醫師，在 2018 年醫策會國家醫療品質獎中獲得智慧醫療類智慧解決方案銀獎。

展望未來的生醫產業人才培育，需要跨領域的多元培育。黃秀芬強調，過往僅需要連結基礎研究與臨床醫學，未來的生醫產業人才不但要懂基礎研究與臨床醫學，還要了解生物技術（Biotech）相關科技，包括基因、大數據等，才有能力與醫生對話，解決醫生在臨床上的問題。黃秀芬也以美國的就業現況為例，預告基因分析、基因判讀等領域也將成為未來就業市場的熱門專業。

行政院政委吳政忠表示，生醫科技是我國政府的 5+2 科技產業政策之一，我國發展生醫科技具備眾多優勢，包括行之多年的健保制度與資料庫、ICT 產業創新先進、科技與醫療產業的人才資源，再加上人體生物資料庫若能做更有效的統整，將成為醫界、學界與產業界研究的最佳利基，可望進一步結合人工智慧、大數據、物聯網，實現精準醫療、智慧醫療、遠距醫療與預防醫學。

healthcare. Meanwhile, Taichung Veterans General Hospital introduced a medical consultation system along with a variety of APPs aimed at helping patients, patients' families, and physicians, for which it won the Silver Award in Smart Healthcare Solutions during the 2018 Healthcare Quality Improvement Campaign.

Training of future biomedicine talents will require contributions of multiple expertise. Shiu-Feng Huang explained that the biomedicine industry used to expect nothing more from employees than knowledge of fundamental research and clinical medicine. In the future, however, employees will have to possess knowledge on topics such as biotech, genetics, and big data to communicate with physicians on solving clinical issues. Shiu-Feng Huang considers the genetic analysis and gene interpretation to be two of the most popular professions in the future, given the current state of the U.S. job market.

Tsung-tsong Wu said that being a part of the government's 5+2 Industry Project, Taiwan possesses many advantages to succeed in biotech development, from its time-tested National Health Insurance system, comprehensive database, advanced ICT industry to the abundant supply of technological and medical talents. Effective integration of biobanks would provide the medical world, academia and the industry with valuable resources needed to elevate research to a whole new level, and explore the incorporation of new technologies such as AI, big data and IoT to realize the vision of precision medicine, smart healthcare, remote healthcare, and preventive medicine.

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