



2022  
Taiwan **AI**-Readiness  
Assessment Report

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**Assessment Report**

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## Foreword

Artificial intelligence (AI) technology is shaping the future of products and services across nearly every industry and sector. In view of the great impact of AI on the economy and society, an increasing number of countries see AI as a strategic priority to enhance their national competitiveness by formulating and promoting AI-related policies.

With the availability of high-quality research institutes and exceptional software and hardware talent, Taiwan has a world-class ICT industry, a full-fledged semiconductor supply chain, and integrated applications and services to undertake innovations across industries. Hence, Taiwan possesses the ability to develop smart solutions and foster an innovative smart application ecosystem. This has put Taiwan at an advantage when it comes to the development of AI.

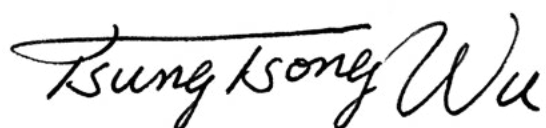
To explore the opportunity of AI and align with President Tsai's national policy directive of "Digital Nation, Smart Island", the government launched the "Taiwan AI Action Plan" in 2018. The Plan aims to propel Taiwan into one of the leading smart nations by cultivating AI talent, promoting Taiwan's lead role in AI, building Taiwan into an AI innovative hub, liberalizing laws and opening test grounds, and transforming industry with AI, both in the public and private sectors.

Since its implementation, the Plan has succeeded in developing AI core technologies for use in smart healthcare, smart manufacturing, and smart services. Thanks to strong financial support and resources from the government and private sectors, Taiwan is producing a growing number of new startups every year. Through the cooperation between universities, research institutions, new startups, and leading brands, Taiwan has been able to develop various AI use cases and applications to facilitate industrial transformation. With a favorable environment for AI in place, Big Tech like Google and Microsoft have cooperated with Taiwanese companies to set up local R&D centers and startup accelerators, making Taiwan an important AI innovation hub in the Asia-Pacific region.

COVID-19 has accelerated the development of digital technology applications over the years. As the core of digital technology, AI has an increasing influence on society and the economy.

However, it not only delivers more innovative products or services to users but also brings some considerable risks and negative effects that cannot be overlooked. Taiwan as one of the democratic countries has continuously advocated the value of human-oriented AI and that means respecting freedom and human rights while using AI to enhance human well-being. Therefore, the follow-up AI-related policies of Taiwan have also focused on promoting data governance and AI ethics to build and implement a trustworthy AI development environment, in addition to developing AI talent and technology to help industrial transformation.

In this report, readers can get the general idea of the government and the private sectors' efforts to accumulate AI development resources across industries over the years. By assessing talent cultivation, infrastructure and operating environment fulfillment, research and development, service applications, and commercialization of AI, this report can utilize statistical data and actual use cases to help the reader understand Taiwan's national AI readiness in compare with other countries. This report is not only a review of what has been accomplished in Taiwan but also is designed to set a foundation for all industry sectors at home and abroad to get a full picture of AI development in Taiwan and pave the road for all of us to reach our shared AI future. In closing, I sincerely hope this report will promote exchanges and cooperation between Taiwan and international partners while encouraging more Taiwanese companies to make more contributions to the development of ethically oriented and trustworthy AI technologies and ultimately benefit all in the world.



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Minister without Portfolio of the Executive Yuan and  
Minister of National Science and Technology Council

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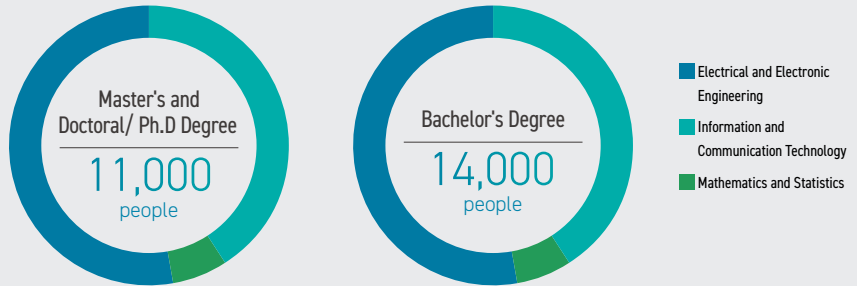
# 01 Talent

AI is regarded as one of the topmost national strategic technologies and is reshaping industrial ecosystems and business models worldwide. Against this backdrop, cultivating talent is key to Taiwan's efforts to maintain its long-term competitiveness in the world. Taiwan, like most countries, has to meet the growing transformation and upgrade demand in the industry with a limited AI talent pool to draw from. For this reason, Taiwan government has poured hefty resources into AI since 2018, especially into educational and vocational training systems, while the private sector also has a number of AI vocational training courses and classes available to the public. The essence of the public-private cooperation has always been to cultivate a new generation of tech-savvy AI talent to meet future needs.

## Government's Efforts

### Education in Schools

Annual Number of AI-Related Bachelor's, Master's, and Doctoral/Ph.D Graduates in the Academic Year 2018-2020



AI Courses at Colleges and Universities in the Academic Year 2019-2021



A total of **34** public and private universities



Provide **305** AI-related courses

### Training AI Talent Capable of Solving Industrial Problems

2018-2021 totals



Over **200** companies provided challenges to be solved



more than **1,200** people participated in problem-solving competitions

## Private Sector Training

### Physical Institution

Example: Taiwan AI Academy (AIA)

More than **8,000** individuals graduated 2018-2021



### Online Learning

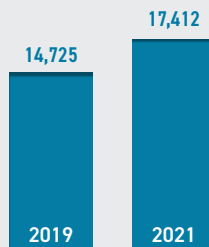
Example: TibaMe

The platform trained **700** AI engineers from 2019-2020

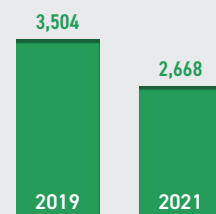
**40,000** individuals have enrolled in AI courses

## AI Talent of Businesses

### Growing AI Talent Supply



### Narrowing the Talent Gap



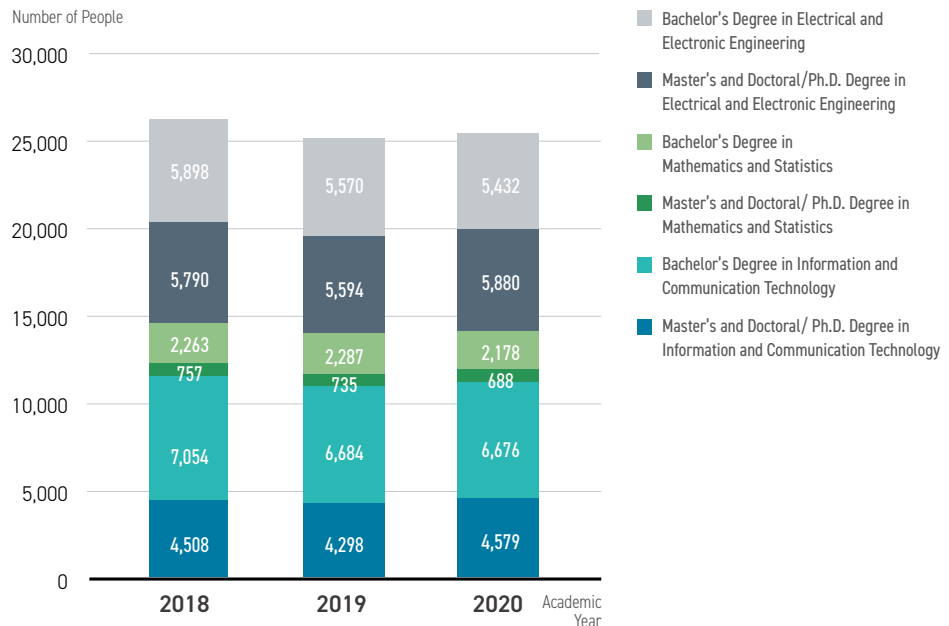
# 1-1 Government's Efforts

## 1-1-1 School Education

According to the academic disciplines published by Taiwan's Ministry of Education (MOE), AI-related academic fields include "Information and Communication Technology," "Mathematics and Statistics" and "Electrical and Electronic Engineering." Graduates with these majors are seen as potential AI talent. Statistics for the period 2018-2020 show that the average number of master's and Ph.D. graduates in information and communication technology was 4,500; mathematics and statistics graduates was 700; electrical and electronic engineering graduates was 5,800. During the 2018-2020 period, the number of graduates totaled 11,000. The average number of graduates with bachelor's degrees in the abovementioned fields was 6,800, 2,200, and 5,600, respectively, and totaled 14,000.

To tap the growing demand for AI talent, the MOE has gradually expanded the number of AI students in colleges and universities over the years. Since 2019, a total of 20 colleges and universities have offered bachelor's or master's degrees for cultivating AI talent. These include but are not limited to National Taiwan University's Master Program in Artificial Intelligence offered by the Computer Science & Information Engineering Department, National Chengchi University's Department of Computer Science Artificial Intelligence Group, National Cheng Kung University's Graduate Program of Artificial Intelligence, and In-Service Master Program

**Figure 1-1** ▶  
Number of AI-Related Bachelor's, Master's, and Ph.D. Graduates in the Academic Year 2018-2020

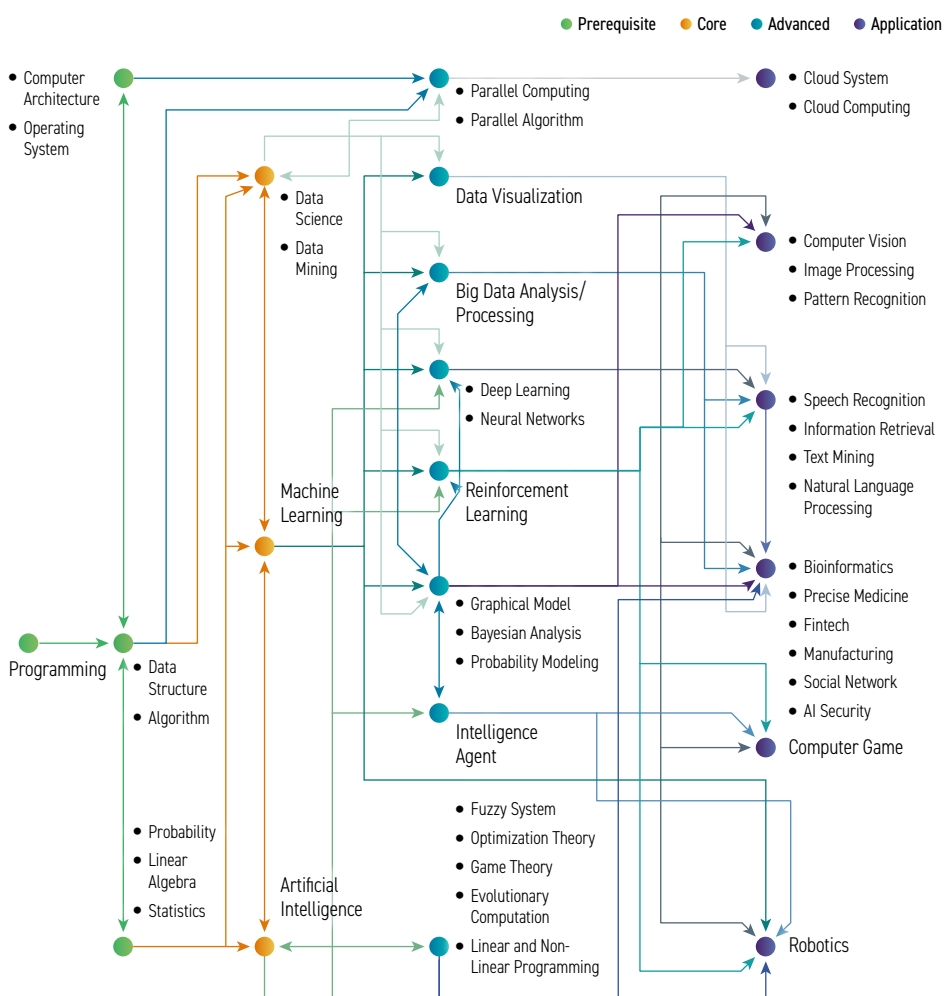


Source: MOE, compiled by III, October 2022

of Artificial Intelligence. The programs aim to use the formal education system to empower students with AI-readiness skills and alleviate the shortage of AI workforce in the market.

Meanwhile, the MOE has also published an AI Courses Roadmap and designed six major programs associated with AI System Platforms, Computer Vision, Natural Language Processing (NLP), AI Applications, Computer Games, and Robotics. This has provided a practical reference for colleges and universities to design a series of AI courses. From the academic year 2019-2021, the MOE subsidized a total of 34 public and private universities to provide 305 AI-related courses. These courses cover interdisciplinary AI applications in several industries such as medical imaging, high-tech manufacturing, financial technology, bioinformatics, elder care, social media, agriculture, environment, virtual reality gaming, and music & literature creation. The cumulative number of students taking these elective courses exceeded 12,000, of which 3,284 were crossing disciplines during 2019 and 2021.

**Figure 1-2** ▶  
AI Courses  
Roadmap of MOE



Source: MOE, compiled by III, October 2022

In recently years, the Ministry of Science and Technology<sup>1</sup> (MOST) has subsidized four universities, namely National Taiwan University, National Cheng Kung University, National Tsing Hua University, and National Yang Ming Chiao Tung University, to set up their own AI innovation research centers in a bid to cultivate AI talent. These four centers focus on the development of AI core technologies, smart healthcare, smart manufacturing, and smart services. They also provide world-class experimental fields and innovative research environments to inspire young scholars and experts to conduct AI R&D. Between 2018 and 2021, more than 390 experts and scholars participated in these research centers' projects with more than 3,300 master's and Ph.D. graduates.

To empower Taiwanese students with an international perspective to understand the pulse and needs of the industry, these four centers have cooperated with leading domestic and foreign academic research institutions and brands such as Stanford University, the University of Toronto, Siemens, Qualcomm, the AIDC and Aerospace A+ Alliance, and TSMC. In the meantime, they have also signed memorandums of understanding (MOUs) with leading brands such as Nvidia, IBM, and Intel Research to create opportunities for students in the form of ex-situ research, internships, and exchanges abroad.

## 1-1-2 Vocational Training

Both the Ministry of Economy Affairs<sup>2</sup> (MOEA) and the Ministry of Labor provide subsidies for private training courses. Initially, they planned training courses to meet the needs of the industry in order to stay ahead of AI trends while bringing together professional AI training centers in northern, central, and southern Taiwan. After being reviewed by AI experts in the industry and academia sectors, these courses have been provided to students. Students whose attendance rate and learning assessment meet the criteria set by the ministries are eligible to receive subsidies. Companies are also encouraged to develop their own AI courses to upskill their employees. Following approval by the ministries, employees can also apply for subsidies. Between 2018 and 2021, more than 10,000 individuals obtained ministerial subsidies.

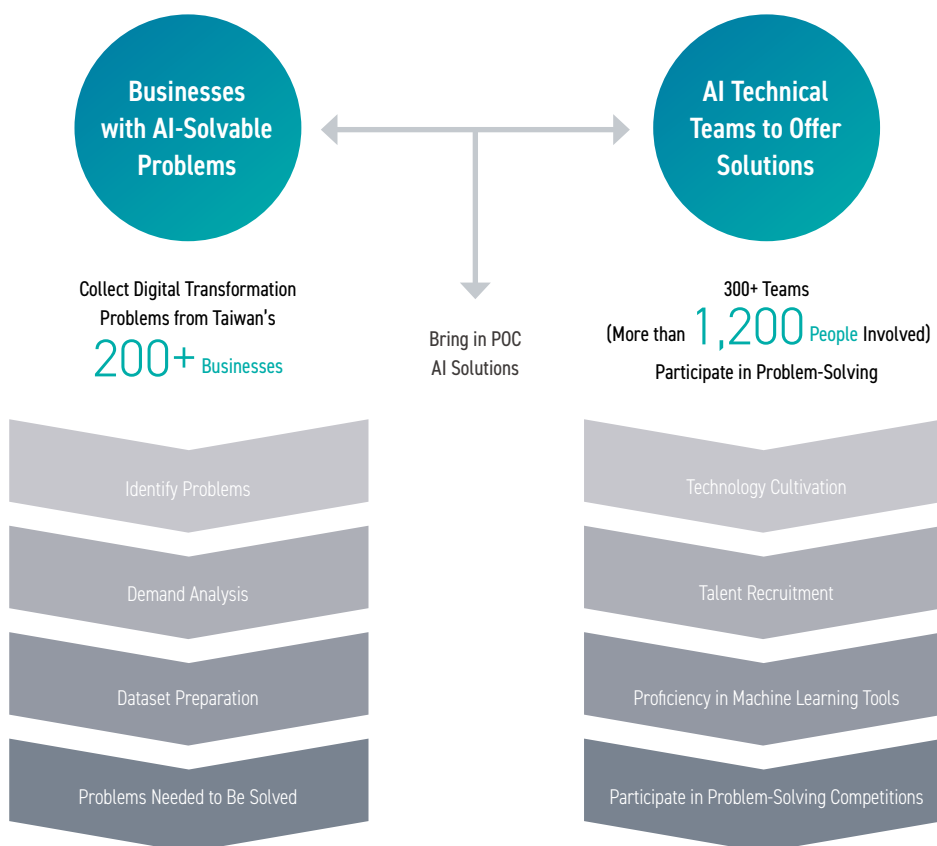
Over the years, the MOEA has adopted a "Challenges from the Industry and Solutions from Talents" model to train AI talent capable of solving industrial problems. The "Challenges from the Industry" refers to a series of real problems collected from the business and public sectors. Through guidance and optimization, these problems

1 MOST is to be reorganized as a ministry-level council named National Science and Technology Council starting 27 July 2022. However, the MOST will continue to be mentioned in this report as this report covers mainly content for the period 2018-2021.

2 Some AI businesses of the MOEA have been transferred to the Ministry of Digital Affairs on August 27, 2022. However, the MOEA will continue to be mentioned in this report as this report covers mainly content for the period 2018-2021.

become AI solvable. "Solutions from Talents" refer to a group of tech-savvy people from new startups, academia, and research institutes to offer solutions. They are grouped into teams to be engaged in problem-solving competitions to solve real business problems and generate "Proof of Concept" (POC) solutions using AI technology. Companies have been able to build up their ability to implement AI solutions at the same time. With this model in mind, more than 200 companies and 300 teams (with more than 1,200 individuals involved) already participated in problem-solving competitions between 2018 and 2021.

**Figure 1-3** ▶  
"Challenges from the Industry and Solutions from Talents"



Source: MOEA, compiled by III, October 2022

# 1-2 Private Sector Training

Private training institutions in Taiwan, both physical and online, are dedicated to customizing AI courses to help businesses foster AI talent and/or upskill their employees. Physical institutions refer to organizations such as the Taiwan AI Academy (AIA), the Artificial Intelligence Technology Foundation, and the Digital Talent Cultivation Center. Online learning platforms including TibaMe, Hahow and Udemy provide apprentices with more flexible learning programs to upskill with AI. The description of physical and online training institutions is as follows with an example given for each.

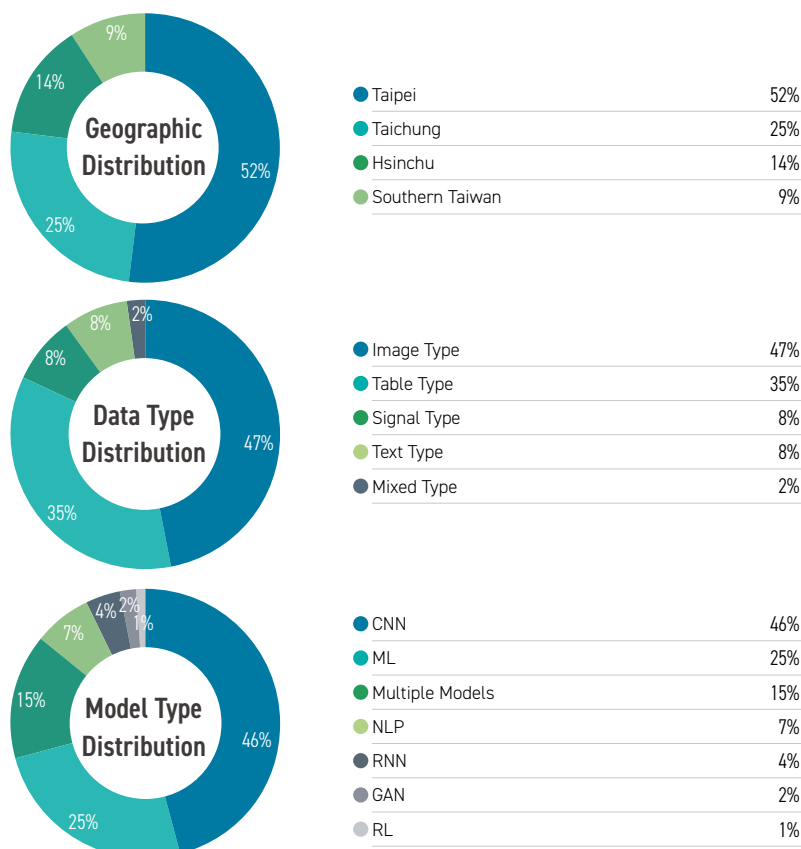
## 1-2-1 Physical Institutions

In the face of challenges in Taiwan's industries resulting from the rise of emerging technologies such as AI, companies urgently need more professionals and concrete measures to maintain and enhance competitiveness. Founded at the 2017 Artificial Intelligence Annual Conference, the AIA initiated by Academia Sinica's Dean James C. Liao and Academician Hsiang-Tsung Kung has begun operations in January 2018. With the support of several local leading businesses, the AIA has been able to spawn the next generation of talent to inject new growth momentum into Taiwan's technological innovation ecosystem.

To this end, the AIA offers different types of training courses for businesses to upskill and reskill their employees, such as top management classes, technical classes, smart healthcare classes, smart manufacturing classes, and edge AI classes. These classes provide intensive, fast, and systematic training. Between 2018 and 2021, more than 8,000 individuals graduated from the Taipei Main Campus, Hsinchu Campus, Taichung Campus, and Tainan Campus. These graduates have been able to facilitate the industrial adoption of AI while driving industrial upgrading and transformation in Taiwan.

The AIA also attaches great importance to practical training. For example, during the 4-month technical course, students from different industries must pass a midterm exam and complete a POC project before graduation. In addition to helping individuals from different industries improve problem-solving skills for problems facing today's businesses, POC projects can be further developed and deployed in businesses, and the graduates can become the seeds for businesses to introduce more AI into their operations.

**Figure 1-4** ▶  
POC Projects Analysis  
of Technical Classes  
Organized by the AIA



Note: The scope of analysis covers 563 POC projects in technical classes from January 2018 to September 2021.

Source: AIA, compiled by III, October 2022

## 1-2-2 Online Learning

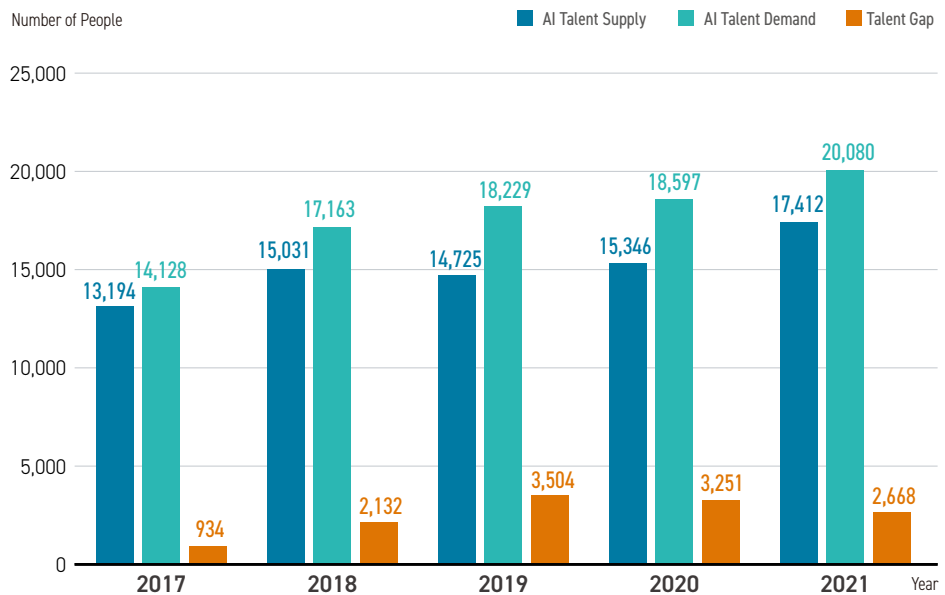
Established in 2015, Wistron Group's TibaMe is a leading cloud education service provider for online learners in Taiwan to develop digital talent for the workplace. It is derived from the pronunciation of "promote" in Mandarin (*tiba*) plus the English word "me." The company's online learning platform has three major interdisciplinary courses, including AI, information & communication management, and foreign languages to tap the increasing demand for high-tech talent. Consequently, TibaMe is designed to pursue international market expansion in the hope of becoming one of the leading Chinese-language cloud education service suppliers.

Since its establishment, TibaMe has assisted more than 6,000 students to land jobs after graduation and has provided on-job online training for apprentices of over 1,300 businesses dedicated to digital transformation. When it comes to cultivating AI talent, the data shows that the platform has trained 700 AI engineers with over 40,000 individuals enrolled in AI courses in the past two years.

# 1-3 Summary

Thanks to the joint effort of the government and private sectors, the number of skilled AI professionals in Taiwan has increased steadily to close the tech skills gap. According to statistics from 104 Job Bank, the largest job bank in Taiwan, the number of job seekers with AI-related skills increased from 13,194 in 2017 to 17,412 in 2021 and the talent gap decreased from a peak of 3,504 in 2019 to 2,668 in 2021. However, the AI workforce shortage remains the most acute challenge facing the industry in Taiwan. To help Taiwan's industry drive digital transformation and play a key role in the new global digital economy, the government should keep collaborating with the private sector. Universities, research institutions, and industries should also foster more AI talent to meet the practical needs of the industry in the future.

**Figure 1-5** ▶  
AI Talent Demand  
and Supply  
of Taiwanese  
Businesses



Note: The AI talent supply was calculated based on resumes collected via 104 Job Bank that contain keywords such as Machine Learning, Deep Learning, NLP, and Data Science.

Source: 104 Job Bank, compiled by III, October 2022

## ▶ AI Education Takes Root

With the arrival of the AI era, several major countries have introduced AI-related courses into their national education curriculums, including Taiwan. For primary and secondary school students to get a better understanding of AI, the MOE has compiled a textbook called “Making Friends with AI,” along with teaching materials, to translate complex AI concepts into easy-to-understand content. The MOE also has conducted online and offline teacher training workshops to adequately empower, support, improve, and motivate teachers for the improvement of educational quality in AI courses and classes.

“Making Friends with AI” is designed for elementary school and secondary school students with different levels of teaching materials for each school level. The elementary school textbooks focus on introducing AI technology and arousing students’ interest in AI with stories and easy-to-operate algorithms. For junior high school students, “logic and computational thinking in machine learning” is the core feature of their AI textbooks, which not only convey the basic computational thinking of AI but also allow students to develop a simulation-based machine learning model. Senior high school textbooks deliver an in-depth introduction to supervised learning, unsupervised learning, reinforcement learning, and deep learning. Adopting this gradual tiered approach, AI-related education is necessary for students of all ages in Taiwan. Since the second semester of the 2019 academic year, 8,618 students from 62 schools have participated in AI-related courses and classes.

The MOEA provides high school and vocational students an opportunity to learn and experience AI through a series of activities. The purpose of these activities is to stimulate students’ interest in AI learning, help them recognize the importance of AI, and build up their innovative abilities. Students in all fields – not limited to science, technology, engineering, and mathematics (STEM) – are encouraged to involve in three stages of these activities with the support of several well-known international and domestic AI brands. The first stage is to ask participants to do self-study online AI courses in their spare time. Signing up for the AI workshop after completing the online courses is the second stage. And the last stage is to provide excellent-grade students an opportunity to visit those AI brands. These taking-root programs, which started in 2019, have been held for the fourth time in 2022 with more than 7,000 students participating thus far.

**Figure 1-6** ▶  
The AI Workshop  
for High School and  
Vocational School  
Students



Source: AIGO Project, compiled by III, October 2022

# 02

## Infrastructure

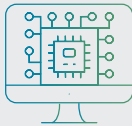
Infrastructure refers to the basic requirements for AI operations, comprising mainly networks, computing power, and data. In addition to its complete network architecture with high-performance computing (HPC) resources, Taiwan has been committed to establishing data-sharing practices and realizing the full value of data. This has empowered Taiwan with greater strength to build a sound foundation for AI development.

## Connectivity



Economist Intelligence Unit (EIU) Inclusive Internet Index -  
Taiwan ranks **9<sup>th</sup>** overall globally and secures **4<sup>th</sup>** place in  
network quality

## Computing Power



Taiwan ranks **20<sup>th</sup>** in the global supercomputer Top500 list  
Ranked **10<sup>th</sup>** in the Green500 list

## Data Provisioning

### Open Data



**Government Open Data Platform** ranked **1<sup>st</sup>**  
in the world in the Global Open Data Index

**Civil IoT Taiwan Platform** has approximately  
**1,000,000** users

### Data Co-ops





#### AI Medical Image Annotation Database

improved diagnosis accuracy to over **98%**

### Data Market



**Companies** help create business  transportation 

#### Data Market

### Data Trust



More than **30** Companies including financial institutes and TSPs  
have participated in **Open Banking**

## 2-1 Connectivity

The Internet today is a widespread information infrastructure in Taiwan as 86% of Taiwanese people have access to the Internet. According to the findings of the National Development Council (NDC) in 2021, approximately 90%, or 6.34 million, of Taiwanese households had access to fixed broadband networks, 4.03 million of which received Fiber to the x (FTTx) services. In terms of mobile communications, 84.4%, or 29.6 million, of Taiwanese people had access to mobile Internet services in 2021.

Most recently, Economist Intelligence Unit (EIU), the research and analysis division of The Economist Group, updated the Inclusive Internet Index 2022 list. The list includes 100 countries of the world and measures them based on the factors of the availability, affordability, relevance, and readiness. In 2022, Taiwan ranks 9<sup>th</sup> in the overall rankings and secures 4<sup>th</sup> place in the “quality” sub-category of the “Availability” category that measures the quality of experience the connected population receives while using the Internet. Taiwan’s rankings are detailed below.

**Table 2-1** ▶  
The Inclusive Internet Index 2022 of the EIU – Taiwan’s Rankings in the “Quality” Sub-category of the “Availability” Category

Evaluation Item	Measured Value	Global Ranking
Average fixed broadband upload speed	155.14 Mbps	6 <sup>th</sup>
Average fixed broadband download speed	180.16 Mbps	13 <sup>th</sup>
Average fixed broadband latency	9 ms	3 <sup>rd</sup>
Average mobile upload speed	16.49 Mbps	18 <sup>th</sup>
Average mobile download speed	81.14 Mbps	17 <sup>th</sup>
Average mobile latency	24 ms	6 <sup>th</sup>
Bandwidth capacity	2,385,504 Bits per person	2 <sup>nd</sup>

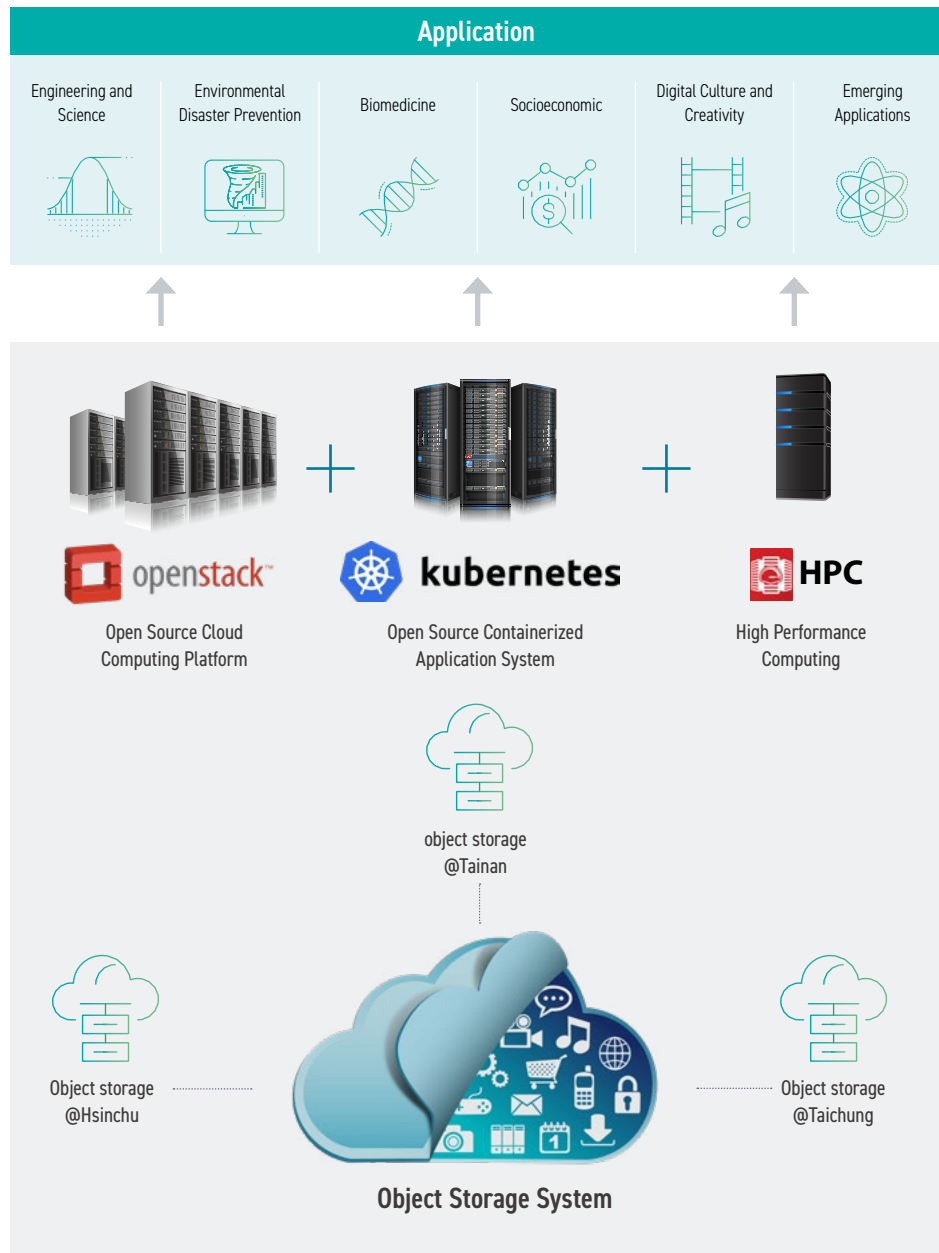
Source: *The Economist*, compiled by III, October 2022

## 2-2 Computing Power

Built by the National Center for High-Performance Computing (NCHC), Quanta Computer, Taiwan Mobile, and ASUS, Taiwan 2 was Taiwan’s first homegrown supercomputer that can perform 9 petaFLOPS (PFLOPS, peta floating-point operations per second). In 2018, Taiwan 2 ranked 20<sup>th</sup> in the global supercomputer Top500 list and ranked 10<sup>th</sup> in the Green500 list. It has set an important milestone in the development of supercomputers in Taiwan.

Building on the initial success of Taiwania 2, the NCHC, Quanta, Taiwan Mobile, and ASUS jointly launched a new computation service called the Taiwan Computing Cloud (TWCC) in October 2019. Since then, TWCC has played a key role in supporting AI research and has shared half of its computing resources for industry use, making it Taiwan's first cloud service provider to provide classified and sensitive data protection, national data management, and forward-looking AI application services. TWCC has served more than 200 companies, more than half of which are startups, and has made a significant contribution to the development of AI products and services in Taiwan.

**Figure 2-1** ▶  
Illustration of  
TWCC Frameworks



Source: NCHC, compiled by III, October 2022

To promote the application of AI in biomedicine, Taiwan's National Institutes of Health announced in March 2022 that it would cooperate with ASUS and Nvidia to build Taiwan's first AI supercomputer for biomedicine. This allows developers and/or data scientists to develop, deploy, and test AI applications while high-speed computing can significantly reduce the processing time and costs to process massive amounts of data. The platform can accelerate research on genetics and multi-somatic data computation, precision medical models, medical image recognition, and drug/vaccine development, and ultimately help promote precision health in Taiwan.

## 2-3 Data Provisioning

Based on how data has been provided and accessed, data governance can be classified into four models: open data, data co-ops, data market, and data trust. Over the years, these four models have made significant progress in Taiwan and their representative cases are listed below.

**Table 2-2** ▶  
Four Data  
Governance  
Models and  
Use Cases

	Open Data	Data Co-ops	Data Market	Data Trust
<b>Definition</b>	The data holder provides the data in a format that is open, modifiable, and free from technical restrictions; allow anyone to access data in a non-exclusive, irrevocable, and royalty-free manner, unrestricted by time or space.	Most data holders share or contribute data for the purpose of analysis and processing based on a collective goal, with an aim to jointly enhance data value or create collective influence.	The data holder will upload data to a common platform and specify the authorization fee, usage fee, or quid pro quo for others to access.	The data subject or the original data holder entrusts a specific person to manage their data, and the entrusted one provides the data for others to access within a scope and purpose defined by the data subject or the original data holder.
<b>Taiwan's Use Cases</b>	Government Open Data Platform promoted by the NDC Civil IoT Taiwan Platform promoted by the Ministry of Science and Technology (MOST)	The establishment of the AI Medical Image Annotation Database subsidized by the MOST	Enterprise Business Information Platform of <i>Taiwan Economic Journal</i> (TEJ) DataBAR Trading Platform of TMS Technologies	Open Banking promoted by the Financial Supervisory Commission (FSC)

Source: Individual institutions, compiled by III, October 2022

### 2-3-1 Open Data

Taiwan aggressively launched and promoted a government open data platform in 2012. The data disclosed on the platform has been in line with three key requirements of the Open Definition: an open license, open access, and an open format. The platform is designed to utilize the private sector's creativity and develop convenient cross-organizational services, allowing individuals, schools, groups, businesses, and/or government agencies

to access, use, modify, and share data freely. Since its official launch in 2013, this government-run open data platform has accumulated more than 70,000 datasets, half of which have come from the central and local governments. In 2015, the platform ranked first in the Global Open Data Index published by UK's Open Knowledge Foundation.

Meanwhile, the MOST, the Ministry of Economic Affairs (MOEA), the Ministry of Transportation and Communications, and the Ministry of the Interior, along with the Environmental Protection Administration and the Council of Agriculture of the Executive Yuan, have jointly rolled out a new data service platform, called the Civil IoT Taiwan. The platform connects up to 77 national monitoring stations and 8,600 micro-sensors from which data is collected every hour or every 3 to 10 minutes from four key areas: air quality & weather, earthquakes, water resources, and disaster alert. It can then be uploaded to an open data service platform, which contains more than 20 types of IoT service datasets. By using the Open Geospatial Consortium (OGC) SensorThings API to build a data model, this data service platform can reduce the interfacing cost of each application service. In addition, the platform can also help an earthquake early warning system reduce the average alerting time and an air pollution control system to expand coverage to cover 44 industrial parks across Taiwan. The platform has an official Line account to broadcast disaster warning notices and currently has approximately one million users.

**Figure 2-2** ▶  
Dataset Types of  
the Civil IoT  
Taiwan Data  
Service Platform



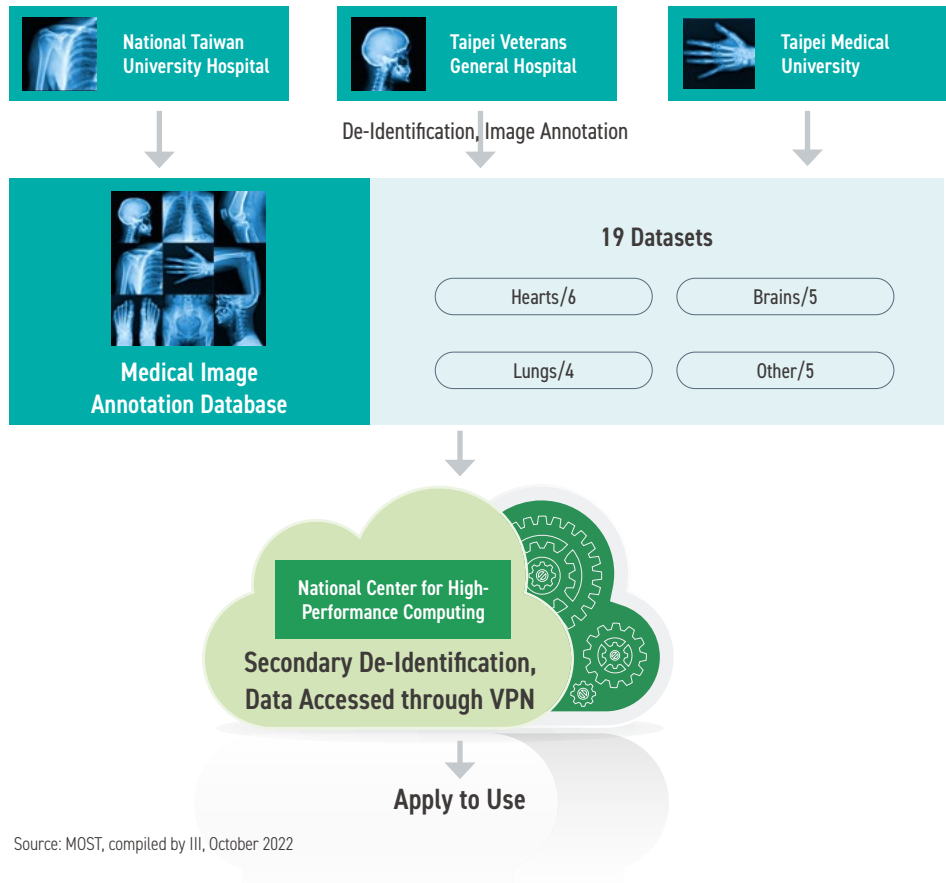
Source: MOST, compiled by III, October 2022

## 2-3-2 Data Co-ops

The MOST has assembled three hospitals, including the National Taiwan University Hospital (NTUH), Taipei Veterans General Hospital, and Taipei Medical University (TMU), to build Taiwan's first cross-institutional homegrown AI Medical Image Annotation Database. With the technical support of the NCHC, the database provides a medical imaging data platform for medical and academic institutions, making it an iconic Data Cooperatives case in Taiwan. Taking the legality of data sources and the security of data utilization into account, the platform can also enhance the trust of stakeholders through supporting measures such as the rights protection mechanism and de-identification of subject data.

As of July 2022, the platform accumulated 19 datasets, including about 59,000 high-quality annotated medical images of hearts, brains, and lungs, and about 29,000 instances of clinical and semantic annotated data. This platform has become one of the key pieces of infrastructure for medical and academic research institutions to carry out AI medical research in Taiwan. For example, the NTUH uses the platform data to develop an AI analysis model for cardiac aortic calcification/fat. It only takes 0.4 seconds to analyze a single case and the accuracy of cardiac segmentation is up to 94.2%. The TMU used nearly 6,000 labeled lung CTs while developing the Deep-Lung, an AI diagnostic system for lungs. The Deep-Lung can detect multiple pulmonary nodules with an accuracy of 86.9% and the classification accuracy of benign and malignant tumors is also as high as 98%.

**Figure 2-3** ▶  
Illustration of the Data Processing Flow of the AI Medical Image Annotation Database



## **2-3-3 Data Market**

TEJ combines internal data with public information from the market and government sectors to launch the TEJ Enterprise Business Information Platform, which is a one-stop service platform for data query and retrieval. The platform provides both free and paid datasets. After users register as members, they can access different dataset types and scales through a menu of subscription plans. The platform provides API tools to help improve data access efficiency. In addition, companies may apply to become data suppliers to increase market data coverage. At present, the platform covers more than 700,000 SMEs and publicly owned companies in Taiwan, and nearly 10,000 listed companies in China, Japan, and Malaysia. The platform is mainly used for customer services, supply chain management, accounts receivable analysis, money laundering prevention, group account transfer, and business annual reports.

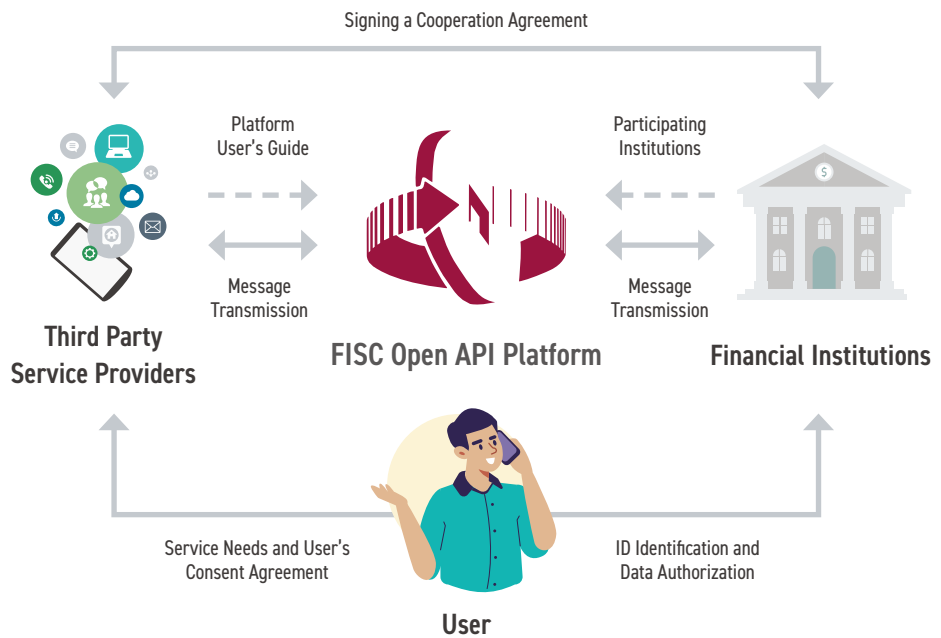
TMS Technologies has built a new transportation-centric, open data platform called the DataBAR Trading Platform. The platform consolidates public and private data to develop standardized data, which can be accessed by traffic information service providers and carmakers. When it comes to its business model, DataBAR allows users to download the standardized data on the platform as many as 50,000 times for free per user every month but will charge additional downloads after that. In addition, DataBAR also provides API services for data updates and tracking. Its current partners include the Institute for Information Industry, Papago, Goyourlife, and GSTech. DataBAR's database has more than 10,000 datasets and 100 APIs for customers like several international traffic information service suppliers and Taiwan's local companies such as HAITEC Automotive and Supergeo Technologies.

## **2-3-4 Data Trust**

Taiwan has been implementing Open Banking in three stages based on data collected. The first stage is mainly to open "product information inquiries" for the public to use an API provided by a third-party service provider (TSP). The second stage is to open "consumer information inquiries." With the consent of the consumer, a TSP provides account integration services such that the consumer does not have to fill in the same information repeatedly across different financial institutions. The third stage is mainly to open "transaction information inquiries." With the consent of the consumer, after the account integration is done by the TSP, the account can be deducted through the app link and the payment can be made directly. During the second and third stages, the consumer is given more control over the use of their own financial information. This helps promote cross-bank data exchanges to create more diversified and innovative financial service opportunities. This Open Banking initiative can be regarded as a Data Trust prototype.

To date, the “transaction information inquiries” function has opened to more than 25 financial institutions and seven TSPs. Seven financial institutions and two TSPs have access to the “consumer information inquiries.” The development of “transaction information inquiries” is next on the agenda. Since the transaction information inquiries involve customer information, customer personal information protection, customer rights protection, dispute resolution mechanisms, and TSP management, stricter regulations are required. For this reason, the Bankers Association and Financial Information Service Co., Ltd. (FISC) have respectively accomplished the revision of system and technical specifications for banks and TSPs to follow under the supervision of the FISC.

**Figure 2-4** ▶  
Illustration of the  
Open Banking  
Open APIs



Note: According to regulations of the Bankers Association, financial institutions must obtain the prior consent of the consumer before they provide consumer information to a TSP and relevant records must be kept.

Source: FISC, compiled by III, October 2022

## 2-4 Summary

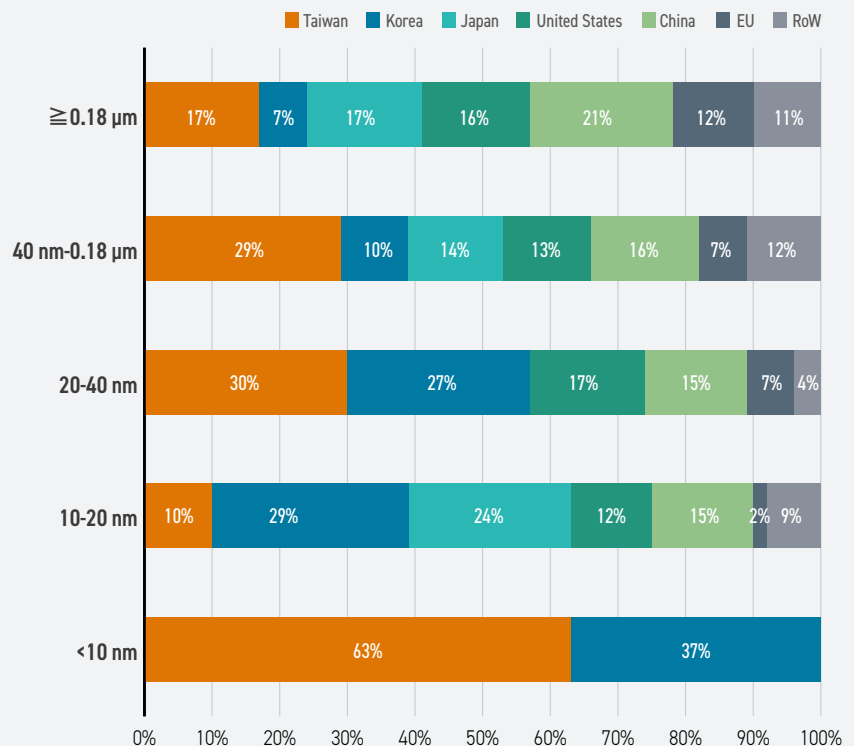
Taiwan has the ability to make highly inclusive and universal communication services thanks to its complete fixed and mobile network infrastructure. This has encouraged more people living in Taiwan to embrace and experience AI. In terms of computing power, HPC resources like TWCC have served as a solid foundation for Taiwanese academic institutions and startups to develop AI technologies and innovative applications. To tap data sensitivity and different application needs, Taiwan has promoted progressively the circulation and utilization of data leveraging different data governance models to ensure the diversity in AI.

## Taiwan's Semiconductor Industry Drives Global AI Computing Power

With the continuous evolution of semiconductor technology, computing power has significantly improved to keep pace with the rapid development of AI in recent years. The importance of Taiwan's semiconductor industry to global AI computing power has been widely recognized. For example, Taiwan can provide high-end process nodes (<10nm) to fabricate AI chips featuring high computing power and low power consumption for cloud data centers, high performance computers, smartphones, self-driving cars, and robotics. Taiwan's leading foundry TSMC alone accounts for 63% of the global high-end chip production capacity. Therefore, leading data center chipmakers such as Nvidia, Intel, and AMD, and smartphone chipmakers such as Qualcomm and MediaTek are all TSMC's customers.

In addition to its outstanding performance in semiconductor manufacturing, Taiwan's semiconductor industry has also extended its reach to AI chip design, targeting lucrative opportunities for AI computing on-device and on-edge. With the full support of the Executive Yuan and the MOEA, the AI on Chip Taiwan Alliance (AITA) was established in 2019. It has gathered more than 80 local leading semiconductor and ICT companies, universities, and R&D institutions such as the Industrial Technology Research Institute. The AITA sets up an ecosystem connecting the AI semiconductor supply chain and downstream applications. One of the AITA members, Egis Technology, has invested in analog AI chips, which were used in large-area under-display optical fingerprint recognition systems in March 2022.

**Figure 2-5** ▶  
Distribution of Global Wafer Production Capacity by Country



Source: IC Insight (2021), compiled by III, October 2022

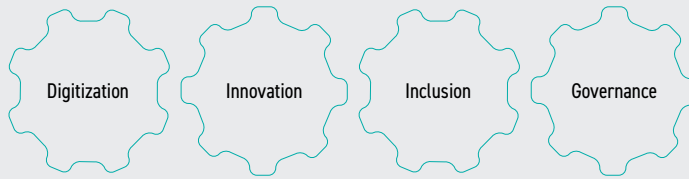
# 03

## Operating Environment

Government policies and a comprehensive legal framework facilitate in fostering the AI operating environment in Taiwan. By consolidating best practices for data governance and innovation activities in the industry, government, academia, and research sectors, Taiwan can develop an innovation-friendly trustworthy AI application environment.

## Government Policies

### Smart Nation 2030



### Taiwan AI Action Plan



### Establishing the Ministry of Digital Affairs

By integrating information, telecoms, communications, information, cyber security, and the internet industries, the Ministry aims to facilitate digital governance and digital infrastructure to drive digital transformation of both public and private sectors

## Regulation Environment



### Accelerating Data Sharing and Democratic Participation

#### Key Regulation

The Freedom of Government Information Law

#### Key Impact

Six cities adopted the **Open Data Charter**, the first cities to do so in Asia.



### Enhancing Security, Safety, and Risk Management

#### Key Regulation

Personal Data Protection Act

#### Key Impact

Joined the **APEC Cross-border Privacy Rules System** in 2018



### Supporting Innovation and Talent Inflow

#### Key Regulation

Financial Technology Development and Innovative Experimentation Act

Unmanned Vehicles Technology Innovative Experimentation Act

#### Key Impact

**9 financial technology innovation experiments** approved

**11 self-driving vehicle on-road experiments** approved



### Promoting Equality, Diversity, and Inclusion

#### Key Regulation

AI Technology R&D Guidelines

#### Key Impact

Incorporate humanistic, social, and legal concerns into AI research projects

# 3-1 Government Policies

## 3-1-1 The Digital Nation & Innovative Economic Development Program and the Smart Taiwan 2030

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Aligning with President Tsai's national policy directory "Digital Nation, Smart Island" and pursuing a sustainable new economic model, the Executive Yuan officially launched the Digital Nation & Innovative Economic Development Program (2017-2025) (DIGI<sup>+</sup> Program) in October 2017. The program aims to use digital technology as the foundation for national development, build broadband networks in Taiwan, enhance the government's digital governance, develop an active online society, foster a digital innovation economy, improve national digital readiness, and drive transformation across various industries.

Taiwan's "DIGI<sup>+</sup>" program has identified AI as one of the key enabling technologies for national science and technology development. It has contained specific plans such as AI talent cultivation, the establishment of national-level AI R&D and cloud service infrastructures, the development of forward-looking AI application software and hardware technologies and services, and the bridging of the AI ecosystem and industry applications.

The first phase of the DIGI<sup>+</sup> program was completed four years later in 2020 following the launch. The Executive Yuan then upgraded the program in May 2021 and renamed the program Smart Taiwan 2030 to keep pace with global geopolitical and economic trends, and the government's vision of becoming a smart nation. To achieve the "Taiwan 2030 – Innovation, Inclusion, and Sustainability" vision, the Smart Taiwan 2030 Program has four pillars: Digitization, Innovation, Governance, and Inclusion. In addition, the Smart Taiwan Steering Committee has been set up to formulate and promote corresponding policies for four pillars.

## 3-1-2 Taiwan AI Action Plan

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In face of the ever-changing development of intelligent technology and its wide impact on the economic, social, and technological spheres, the Office of Science and Technology of the Executive Yuan<sup>3</sup> held the Strategic Review Board Meeting (SRB) for the intelligent systems and chip industry in July 2017. The meeting aimed to reach a consensus on the development of intelligent technology in Taiwan across the industry, government, and academic sectors. Following the SRB, the Executive Yuan launched the Taiwan AI

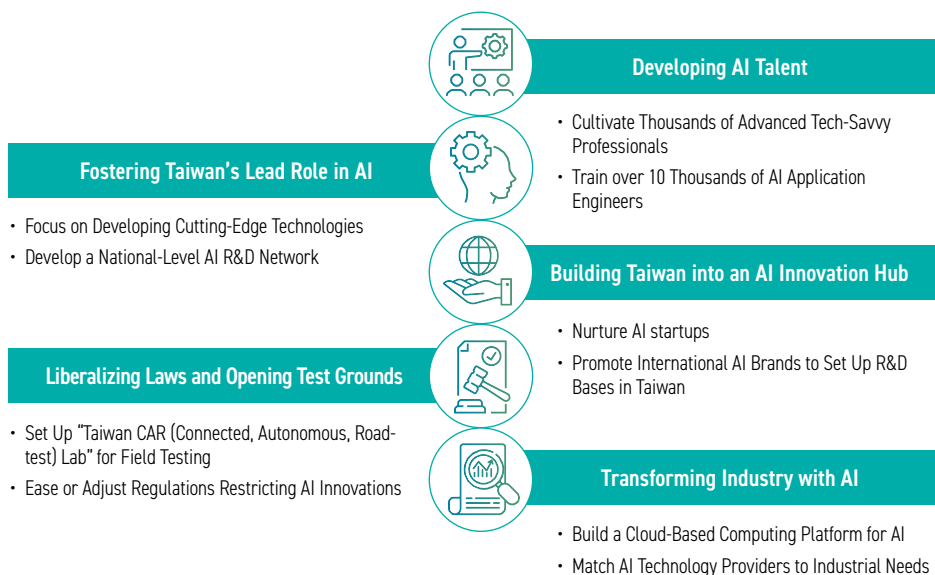
<sup>3</sup> Pursuant to the Act for Adjustment of Functions and Organizations of the Executive Yuan, the Office of Science and Technology, Executive Yuan is to be reorganized as the Office of Science and Technology Policy, National Science and Technology Council starting 27 July 2022.

Action Plan (2018-2021) and encouraged cross-ministerial collaboration on the DIGI\* coordination platform to promote AI development.

The purpose of the Taiwan AI Action Plan is to take advantage of the country's comprehensive talent, ICT, and semiconductor clusters to integrate with open test grounds and data resources to unveil a new chapter for economic development in Taiwan. The vision of the plan is to sharpen Taiwan's advantages, prioritize innovation and real-world implementation, and develop software and hardware in tandem, thereby injecting greater momentum into Taiwan's industries. To achieve this vision, the Taiwan AI Action Plan focuses on five themes, including "developing AI talent," "fostering Taiwan's lead role in AI," "building Taiwan into an AI innovation hub," "liberalizing laws and opening test grounds," and "transforming industry with AI." By combining the resources of all relevant government projects and collaborating with international partners, the plan strives to reshape Taiwan into one of the global innovation hubs.

As the Taiwan AI Action Plan came to an end in 2021, the Office of Science and Technology has planned a second stage in step with the latest AI development trends. Other than continuously developing and fostering talent, technologies, and industries, the Taiwan AI Action Plan 2.0 is intended to (1) attach importance to data governance and AI ethics while building a sound legal environment for the implementation of trustworthy AI, (2) make good use of Taiwan's successful experiences and advantages to actively cooperate with international partners so as to enhance Taiwan's contribution in AI, (3) pay attention to the negative impact of AI on society to develop countermeasures while using AI to help solve the challenges faced by the country and society to benefit all.

**Figure 3-1** ►  
Five Themes and  
Key Tasks of the  
Taiwan AI Action  
Plan

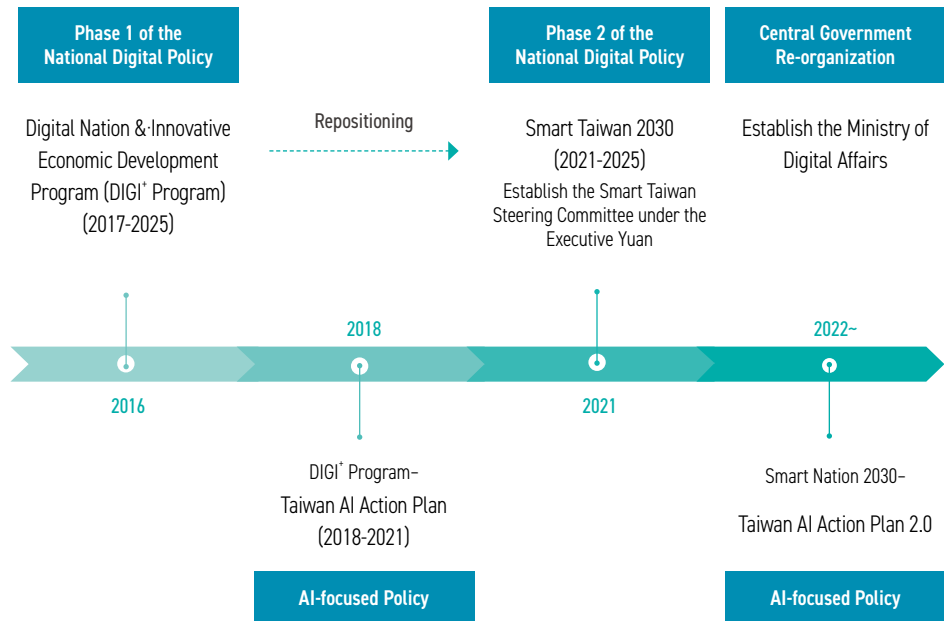


Source: Executive Yuan, compiled by III, October 2022

### 3-1-3 Establish the Ministry of Digital Affairs

To accelerate digital transformation and develop an innovative economy in Taiwan, President Tsai attended the “Future Technology Expo” in December 2019 and stated an urgent need to set up a competent authority in charge of promoting digital development. The Legislative Yuan then approved the establishment of the Ministry of Digital Affairs (MODA) by passing an amendment to the National Communications Commission Organization Act and approving the Organization Act of the MODA in December 2021. The MODA was inaugurated on 27 August 2022. The new ministry is responsible for promoting Taiwan’s overall digital policy innovation and reform. By consolidating the resources of five major fields of telecommunications, information, cyber security, internet, and communications, the MODA plans digital policies and coordinates infrastructure, environment preparation, and resource management to ensure national cyber security.

**Figure 3-2** ▶  
The Timeline of Taiwan’s AI Programs



Source: Executive Yuan, compiled by III, October 2022

## 3-2 Regulation Environment

To create an environment conducive to trustworthy AI development, Taiwan has taken international trends into account to implement relevant legislation and regulations that span four dimensions, namely, “accelerate data sharing and democratic participation,” “enhance security, safety, and risk management,” “support innovation and talent inflow,” and “promote equality, diversity, and inclusion.”

### 3-2-1 Accelerate Data Sharing and Democratic Participation

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To lay a legal foundation for open data in central and local government organizations at all levels, Taiwan formulated the Freedom of Government Information Law in 2005. The law lays out relevant operating principles and specifications to facilitate people to share and fairly utilize government information, protect people’s right to know, further people’s understanding, trust and overseeing of public affairs, and encourage public participation in democracy. With the assistance of the National Development Council (NDC), six cities including Taipei, New Taipei, Taoyuan, Taichung, Tainan, and Kaohsiung signed the Open Data Charter (ODC) in 2018. Promoted by international organizations such as the United Nations, the Group of Eight, and subsequently Group of 7 (G7) and the Open Government Partnership, these cities were the first in Asia to adopt the ODC.

### 3-2-2 Enhance Security, Safety, and Risk Management

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Long before AI was in the picture, the Taiwanese government has already known the importance of privacy, personal data protection, and cybersecurity and formulated relevant laws and regulations. Laws such as the Personal Data Protection Act, the Cyber Security Management Act, and related laws have helped lay a good foundation and legal environment for creating trustworthy AI.

In response to the rapid evolution of AI medical applications, the Ministry of Health and Welfare (MOHW) has formulated guidelines for the inspection and registration of AI medical device software to ensure their safety when used in patients. The MOHW has also announced guidelines, including Artificial Intelligence/Machine Learning-Based Software as a Medical Device (AI/ML-based SaMD) and Technical Guidance on Registration and Market Approval of AI/ML-based Computer-Aided Detection (CADe) SaMD.

**Table 3-1** ►  
Regulations  
on Enhancing  
Safety and Risk  
Management and  
Their Impact

Regulation (year passed)	Impact
Personal Data Protection Act and Related Law (2015)	<ol style="list-style-type: none"> <li>1. Government agencies have introduced personal data security management systems while non-government agencies have measures in place for securing personal data. The central competent authority should formulate these measures for the relevant industries and supervise the implementation of these measures.</li> <li>2. Taiwan, under the name Chinese Taipei, joined the Asia-Pacific Economic Cooperation (APEC) Cross-border Privacy Rules System (CBPRs) in 2018.</li> <li>3. The NDC has established MyData, a service platform established by the government for the autonomous use of personal data. Data subjects have the right to obtain a copy of personal data stored on the platform that can be provided to government agencies and/or trusted enterprises for one-time use. As of 2021, MyData already provided 100 connected information services, and 200 over-the-counter and online services.</li> </ol>
Cyber Security Management Act and Related Laws (2018)	Government agencies, critical infrastructure providers, government-owned enterprises, and government-endowed foundations should stipulate cybersecurity maintenance plans and set up reporting and response mechanisms based on cybersecurity responsibility levels. In addition, they should strengthen cybersecurity management systems through an impartial third-party certification body.
Guidance for Industry to Register Artificial Intelligence/ Machine Learning-Based Software as Medical Device (AI/ML-Based SaMD) (2021) and Technical Guidance on Registration and Market Approval of AI/ML-Based CAde SaMD (2021)	In May 2021, the Food and Drug Administration of the MOHW established the Smart Medical Device Office. The Office helps provide guidance and consulting services to more than 10 domestic ICT manufacturers, hospitals, and research institutions. They file applications for their AI/ML-based medical devices to obtain registration and business licenses.

Source: Compiled by IRI, October 2022

### 3-2-3 Support Innovation and Talent Inflow

Over the years, Taiwan has formulated the Financial Technology Development and Innovative Experimentation Act, Unmanned Vehicles Technology Innovative Experimentation Act, and related Acts for several important AI-related applications such as Fintech and unmanned vehicles. In addition, Taiwan has built regulatory sandboxes and/or testing mechanisms to encourage industry players to develop innovative services. To attract foreign AI professionals, Taiwan stipulated the Act for the Recruitment and Employment of Foreign Professionals in 2018. Amendments to the law were officially enacted in 2021.

**Table 3-2 ▶**  
Regulations  
on Supporting  
Innovation and  
Talent Inflow and  
Their Impact

Regulation (year passed)	Impact
<p><b>Financial Technology Development and Innovative Experimentation Act (2018)</b></p>	<p>The purpose of the Act is to encourage the financial industry, technology industry, and startups to develop innovative financial products and services. By June 2021, nine financial technology innovation experiments had been approved, including "Telecom Mobile Identity Authentication for Inclusive Financial Services."</p>
<p><b>Unmanned Vehicles Technology Innovative Experimentation Act (2018)</b></p>	<p>The purpose of this Act is to create a smart testing field that integrates information and communication technology and unmanned vehicle technology to satisfy local needs. As of March 2022, there were 11 on-road experiments approved, including sightseeing connections, last-mile connections, urban transportation, and self-driving logistics.</p>
<p><b>The Act for the Recruitment and Employment of Foreign Professionals (2018)</b></p>	<ol style="list-style-type: none"> <li>1. The purpose of the Act is to attract foreign AI professionals to work in Taiwan, targeting nine major fields: technology (including AI), economics, education, arts &amp; culture, sports, finance, laws, architecture, and national defense. The Act aims to help domestic industries accelerate transformation and upgrading.</li> <li>2. Amendments were implemented in 2021 to relax the rules on work permits, residence permits, and eligibility requirements for family members of workers. For example, the amendments allow visa-exempt entry, and workers can directly apply for a residence permit without applying for a visa. Foreign professionals and their family members who possess permanent residency no longer need to apply for a work permit.</li> </ol>

Source: Compiled by IIL, October 2022

### 3-2-4 Promote Equality, Diversity, and Inclusion

Trustworthy AI stresses the importance of equality and inclusion. In addition to the existing legal framework concerning gender equality, Taiwanese government agencies have formulated regulations to promote inclusion, fairness, and non-discrimination in compliance with international initiatives on AI ethics and reduce AI risks such as bias in algorithms. For example, the Ministry of Science and Technology (MOST) issued the AI Technology R&D Guidelines in 2019 based on three core values: human-centric, sustainable development, and diversity and inclusion. There are eight guidelines derived from the abovementioned three core values, including (1) common good & well-being, (2) fairness & non-discrimination, (3) autonomy & control, (4) safety, (5) privacy & data governance, (6) transparency & traceability, (7) explainability, and (8) and accountability & communication.

**Table 3-3 ▶**

Regulations on Promoting Equality, Diversity, and Inclusion and Their Impact

Regulation (year passed)	Impact
<p><b>Act of Gender Equality in Employment (2002) and the Gender Equity Education Act (2004)</b></p>	<p>These two Acts help to change employment stereotypes and raise the public's awareness of gender diversity and equality. According to statistics from the Ministry of Education, the proportion of women studying in the field of science and technology increased from 32% in 2009 to 36.4% in 2019. According to Taiwan's 104 Job Bank, the proportion of female senior executives in the electronic information industry increased from 11% in 2009 to 18% in 2019.</p>
<p><b>AI Technology R&amp;D Guidelines (2019)</b></p>	<p>The purpose of the Guidelines is to incorporate humanistic, social, and legal concerns into AI research projects subsidized by the MOST. In 2021, the MOST's "AI Thematic Research Program Coping with National Grand Challenges" addressed topics including trustworthy AI and social, ethical, and legal issues.</p>

Source: Compiled by III, October 2022

## 3-3 Summary

Inclusive policies and a sound legal framework are expected to help promote AI applications while enhancing society's trust in AI. For this reason, the Taiwanese government has enacted policies to support the development of game-changing technologies for AI. Under the influence of the international trustworthy AI initiative, the government's policies have also concentrated on developing innovative, inclusive, and sustainable AI. To accelerate the domestic digital transformation and make the AI industry more prosperous, the government has set up the MODA this year as a specialized agency to help Taiwan transform into a digital nation and smart island.

For years, Taiwan has taken a holistic and comprehensive approach to developing a legal environment for AI such as open government data, personal data protection, information security management, financial and unmanned vehicle technological innovation experiments, the recruitment of foreign AI professionals, and AI R&D guidelines. In the future, the government will keep strengthening international communication and collaboration in both public and private sectors to ensure AI policies and legal systems comply with global trends and keep pace with changing times.

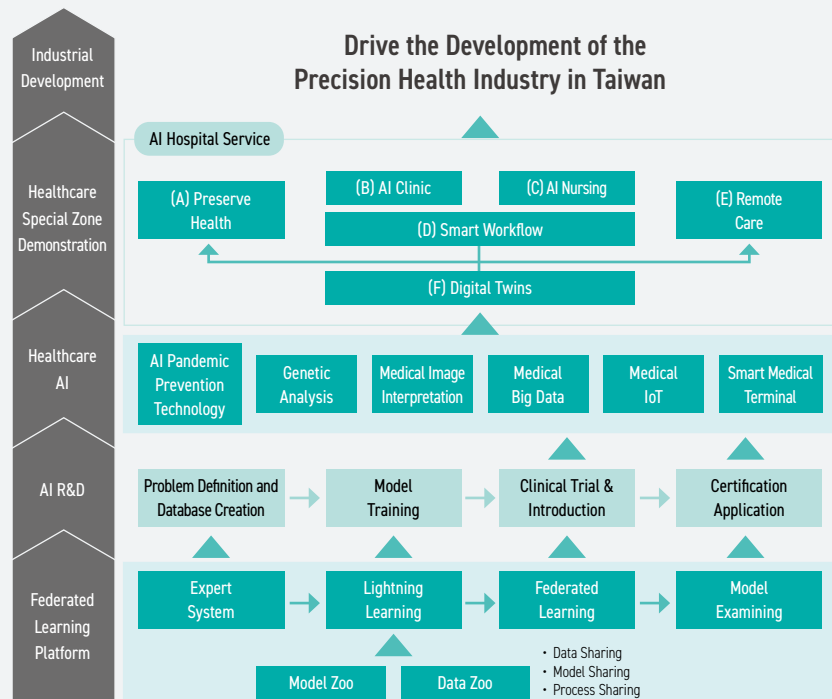
# Taiwan AI Federated Learning Alliance

Federated Learning technology brings disruption to the traditional centralized Machine Learning method. Replacing sharing data with sharing models, Federate Learning is an important trend in AI development to prevent personal data from unauthorized access while achieving the purpose of refining AI models. Organized by Taiwan AI Labs and initiated by the NDC, the Taiwan AI Federated Learning Alliance (TAIFA) was officially launched in January 2021 and has been supported by the MOST, the MOHW, the Ministry of Communications, the Ministry of Economic Affairs, and the Ministry of Culture.

The purposes of the TAIFA are: (1) to promote federated learning for accelerating AI application development to boost cross-domain application, drive industrial innovation, foster talent, and enable international collaboration; (2) to encourage the industry, academia, and government sectors to invest in federated learning research and provide qualified federated learning service for each domain, and provide suggestions for policy-making; (3) to consolidate alliance members to build trustworthy data sharing policy and regulations; (4) to promote formulation of federated learning and operation mechanism in Taiwan.

Members include enterprises, private institutions, government agencies, and public associations, which have been categorized into the medical alliance, urban-rural & transportation alliance, financial alliance, manufacturing alliance, and business & cultural alliance. The medical alliance, for instance, has developed a variety of medical AI solutions, such as Deepmets®-Plus, an AI-assisted diagnosis system for brain metastases, the Wuhan pneumonia chest X-ray automatic detection system, and intelligent selection of the optimal phase of coronary arteries in heart computer tomography. During the early stage of the pandemic (January-March 2020), the Wuhan pneumonia chest X-ray automatic detection system helped detect early symptoms in 27 of the 109 chest X-ray cases, earlier than nucleic acid tests, making the system an effective tool for pandemic surveillance and prevention of spreading infection.

**Figure 3-3** ▶  
Federated Learning Is a Key Approach to Precision Health



Source: TAIFA, compiled by III, October 2022

# 04

## Research and Development

Like other fields, AI technology development can be roughly divided into two categories: fundamental research for academic institutions and technology research for industrial applications. The deliverables of fundamental research are mainly published papers while technology research is measured by the number of patents granted. In recent years, both fundamental research and technology research for AI in Taiwan has been developing rapidly and both types of research are elaborated below.

## Fundamental Research

### Achievements of AI Innovation Research Centers

AINTU



Federated learning for predicting clinical outcomes in patients with COVID-19 EMR CXR AI Model (EXAM), results published in *Nature Medicine*

AIBMRC



Intelligent Neurofeedback Training and Sleep Quality Assessment System for sleep enhancement can improve symptoms of insomnia

AIMS



Energy Saving and Chiller Configuration Optimization have been introduced to Taiwan's semiconductor fabs

PAIR



Automatic labeling tool "ezLabel" can quickly create customized deep learning datasets for Advanced Driver Assistance Systems (ADAS) applications

### Publication Performance

AI Papers Published in Top Conferences



## Industrial R&D

### Achievements of R&D Organizations



Deep Learning Technologies for Defect Classification



Smart Manufacturing Scheduling System



Diabetic Retinopathy Diagnosis - Auxiliary Analysis Technology



AI Customer Service Dialogue System



8 bits Compute-in-Memory Chip



1.5 bits Compute-in-Memory Chip

### Patent Performance

Number of AI-Related Patents Filed by Taiwan's Enterprises and Granted by the USPTO between 2008 and 2018

Cumulative Number of Patents: Taiwan ranked **11<sup>th</sup>** in the world and ranked **5<sup>th</sup>** when normalized with GDP

# 4-1 Fundamental Research

## 4-1-1 AI Innovation Research Center

To strengthen Taiwan's AI R&D capability, the Ministry of Science and Technology (MOST) launched the "AI Innovation Research Center Program" in 2018 to promote R&D in AI core technology, smart healthcare, smart manufacturing, and smart services. Since then, the Ministry has subsidized four universities to establish their own research centers, namely the Research Center for AI technology and All Vista Healthcare at National Taiwan University (AINTU), the Artificial Intelligence Biotechnology Research Center (AIBMRC) at National Cheng Kung University, the Artificial Intelligence for Intelligent Manufacturing Systems Research Center (AIMS) at National Tsing Hua University (NTHU), and the Pervasive Artificial Intelligence Research Center (PAIR) at National Yang Ming Chiao Tung University (NYCU). These four centers have made considerable achievements and some highlights are listed below.

The AINTU, the National Health Insurance Administration of the Ministry of Health and Welfare (MOHW), and Nvidia have also adopted a Federated Learning (FL) model, called Electronic Medical Record (EMR) Chest X-ray AI Model (EXAM). The model used data from 20 institutes across the globe to train the FL model, which is a method used for training AI models. The EXAM not only is trusted by medical staff but also can be effectively used in the clinical field. It can predict the oxygen requirements of patients with COVID-19 using inputs of vital signs, laboratory data, and chest X-rays. The research results were published in the leading biomedical research journal *Nature Medicine* in September 2021.

The AIBMRC has launched a new system for sleep enhancement, called the Intelligent Neurofeedback Training and Sleep Quality Assessment System. Combined with wearable iSleepBetter products, the system can monitor the sleeping quality of patients with insomnia and assist doctors in making diagnoses. Using the repeated brain-computer interface, users can gauge their current brain training state from the visual stimulation, adjust their training strategy, and achieve long-term improvements in symptoms of insomnia. This research achievement won the 17<sup>th</sup> National Innovation Award of the Taiwan Government and was exhibited at the 2020 Consumer Electronics Show (CES).

The AIMS has developed a new solution, called Industry 3.5 for optimizing chiller configuration for energy saving. By using big data analytics and AI technologies, the solution can instantly monitor, predict, and fulfill the cooling load demand via the operating chillers employed in the facilities given the existing infrastructure. Chillers are designed to remove the heat via the absorption refrigeration cycles to maintain the desired conditions. In addition, the solution also integrates a chiller health evaluation model to optimize the combination of operating chillers. When a facility is at risk of operational failure, the solution can also provide early warnings and appropriate countermeasures. This solution has been applied in several of Taiwan's semiconductor fabs to further improve the operational performance of the chillers for energy saving.

The automatic labeling tool “ezLabel” developed by PAIR can quickly create customized deep learning datasets for Advanced Driver Assistance Systems (ADAS) applications. This tool significantly reduces the labeling time by 10-15 times compared to the manual process, while ensuring the quality of the samples. Combining with the team’s real-time software algorithms, ezLabel can help reduce the cost of AI computer vision through computing platforms. This idea won third place at the Audi Innovation Award and the team was invited to the Audi headquarters to discuss the adoption of ezLabel.

## 4-1-2 Publication Performance

In the past ten years, research in the field of AI has progressed rapidly. According to the Artificial Intelligence Index Report 2022 released by Stanford University, global AI publications have grown from 162,444 in 2010 to 334,497 in 2021.

The number of AI publications, particularly top conference papers, reflects the fundamental research strength of individual countries and is the best way to demonstrate each country’s fundamental research capacity. With the abovementioned four AI research centers dedicated their resources to AI, Taiwan has published at least 215 papers at top AI conferences such as CVPR, AAAI, ICRA, SIGIR, and ACL during the period 2019-2021. The number of AI publications in Taiwan, though not as high as other developed countries, enjoyed explosive growth of 136.3% comparing to the period 2016-2018, the highest among the Four Asian Tigers. This indicates Taiwan is catching up fast in this arena.

**Table 4-1** ▶  
The Number of  
Top AI Conference  
Papers Published  
in the United  
States and Major  
Asian Countries

Country/ Area	Number of Publications in 2016-2018	Number of Publications in 2019-2021	Growth in Publications 2019-2021 vs. 2016-2018	Number of Publications in Proportion to Global Total, 2016-2018	Number of Publications in Proportion to Global Total, 2019-2021
Worldwide	14,095	18,244	29.4%		
United States	5,792	7,479	29.1%	41.1%	41.0%
China	3,596	5,980	66.3%	25.5%	32.8%
Japan	525	635	21.0%	3.7%	3.5%
Hong Kong	522	920	76.2%	3.7%	5.0%
Singapore	577	687	19.1%	4.1%	3.8%
South Korea	314	654	108.3%	2.2%	3.6%
Taiwan	91	215	136.3%	0.6%	1.2%

Note 1: The data consolidates top AI conferences based on CSRankings, including AAAI, IJCAI, CVPR, ECCV, ICCV, ICML, KDDI, NeurIPS (NIPS), ACL, EMNLP, NAACL, SIGIR, WWW. Note that EMNLP and NAACL are not listed in Web of Science Core Collection and thus are not included.

Note 2: The number of articles published in China consolidates published paper in Hong Kong.

Source: MOST, Web of Science (July 2022), compiled by III, October 2022

When it comes to Taiwan's performance in sub-fields such as AI, Computer Vision, Machine Learning & Data Mining, NLP, the Web & Information Retrieval, Robotics and Human-Computer Interaction, the number of papers published in Taiwan as a portion of global total conference papers indicates Taiwan has more research capacity in sub-fields such as Computer Vision, Human-Computer Interaction, and the Web & Information Retrieval. In addition, the number of published papers in the NLP sub-field witnessed the highest growth rate as well.

**Table 4-2** ▶  
The Number of  
Publications in  
AI Sub-fields in  
Taiwan

Sub-field	Number of Publications in 2016-2018	Number of Publications in 2019-2021	Growth in Publications 2019-2021 vs. 2016-2018	Number of Publications in Proportion to Global Total, 2016-2018	Number of Publications in Proportion to Global Total, 2019-2021
AI	30	55	83.3%	0.69%	1.06%
Computer Vision	48	108	125.0%	0.73%	1.28%
Machine Learning & Data Mining	29	15	-48.3%	0.96%	0.58%
NLP	7	20	185.7%	0.62%	1.01%
The Web & Information Retrieval	31	61	96.8%	1.26%	1.51%
Robotics	16	19	18.8%	0.57%	0.61%
Human-Computer Interaction	37	59	59.5%	1.21%	1.62%

Note: The Data Consolidates Top AI Conferences Based on CSRankings and the Equivalent.

Source: MOST, Web of Science (July 2022), compiled by III, October 2022

## 4-2 Industrial Technology Development

### 4-2-1 R&D Organizations

With the support of the Ministry of Economic Affairs (MOEA), R&D organizations such as the Industrial Technology Research Institute (ITRI) and the Institute for Information Industry (III) have developed AI software and chip technology to facilitate the application needs of the industry. The deliverables have benefited a wide range of industries such as manufacturing and service industries. Examples are given below.

In response to the increasing needs of the manufacturing industry for AI, these R&D organizations have developed three AI software technologies, "Deep Learning Technologies for Defect Classification," "Intelligent Collaborative Process Analysis and Parameter Optimization Technique," and "Intelligent Scheduling System." Deep Learning Technologies for Defect Classification help inspect product defects with high accuracy rates and speeds. For instance, Deep Learning can automatically filter out half of the false defects in the printed circuit board (PCB) industry. Intelligent Collaborative Process Analysis and Parameter Optimization Techniques can be applied to the bond rupture process at large petrochemical plants, leading to 2.5% increase in the average yield. After the Intelligent Scheduling System is implemented in a panel factory, the system can help increase the capacity of the entire production lines by 1.76% and the utilization of human resources by 10%.

In addition, diagnostic retinopathy detection technology has been transferred to industry players to develop an AI Decision-Making Research (AI-DR) handheld ophthalmoscopes, the first computer-aided detection (CADe) AI medical device approved by the Taiwan Food and Drug Administration (TFDA). The new invention has increased the price of ophthalmoscopes by 31%. Meanwhile, a multi-round dialogue platform has been established after collecting more than 100,000 question-and-answer corpora to develop the Chinese-language knowledge graph, inference system and question-and-answer technology. The platform uses a text-based virtual agent application to provide customer services and dialogue solutions, which have been transferred to IT service providers in the e-commerce, logistics, and public sectors.

**Figure 4-1** ▶  
Achievements  
of Taiwan's R&D  
Organizations in  
the AI Field



Source: ITRI, III, compiled by III, October 2022

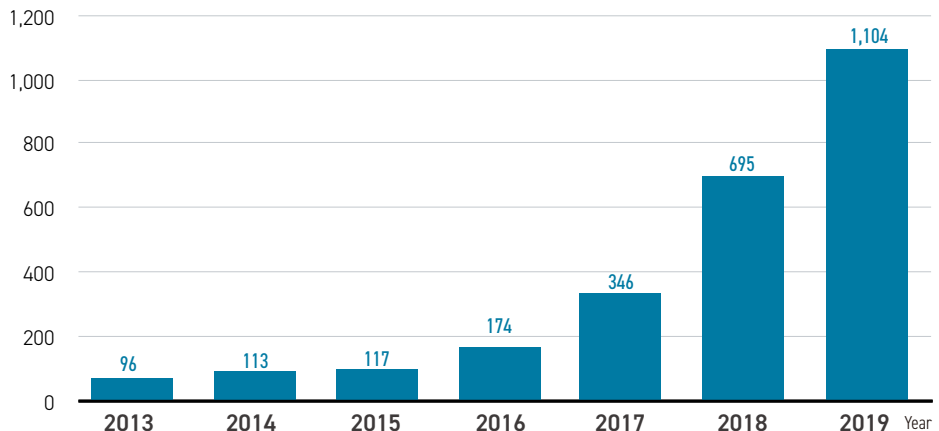
As for the development of AI chips, the focus is on four key on-device AI technologies: domain-specific AI chips, heterogeneous AI chip integration, emerging computing architecture, and an AI system software development environment. Through collaboration with the industry, the development of solutions with “module sizes reduced by 40%-60%,” “computing power consumption reduced by 25%-40%,” and “computing speed increased by 20%-35%” becomes possible. All of these efforts have delivered significant benefits for the implementation of AI computing in various devices. Working with Synopsys, an AI chip design platform was built utilizing AI architecture design, AI compilers, and AI software & hardware integration technologies. Specifically, the platform has helped Taiwanese chip designers reduce R&D timelines by more than 30%.

As for the development of emerging computing architectures, in cooperation with the NTHU, a static random access memory (SRAM) based computing in memory (CIM) technology was jointly released at the 2021 International Solid-State Circuits Conference (ISSCC). The 8-bits CIM chip has an energy efficiency of 22.75 TOPS/W, 6 times higher than the preceding version. The purpose of the collaboration with NYCU was to unveil an accelerator chip with a low-precision CIM architecture at the 2021 IEEE Asian Solid State Circuits Conference (IEEE A-SSCC). It can perform more than 20,000 trillion AI operations per second (20943 TOPS/W), which is 3.7 times higher than state-of-the-art chips and the area efficiency is also increased by 4.5 times, setting a new record for in-memory computing.

## 4-2-2 Patent Performance

Countries in the world are racing for global AI dominance. Hence, Taiwanese businesses and academic & research institutions have been ramping up their patent licensing over the years. According to statistics from the Taiwan Intellectual Property Office (TIPO) of the MOEA, the number of AI-related patents filed by Taiwanese applicants at the TIPO has grown significantly since 2016 to over 1,100 applicants in 2019.

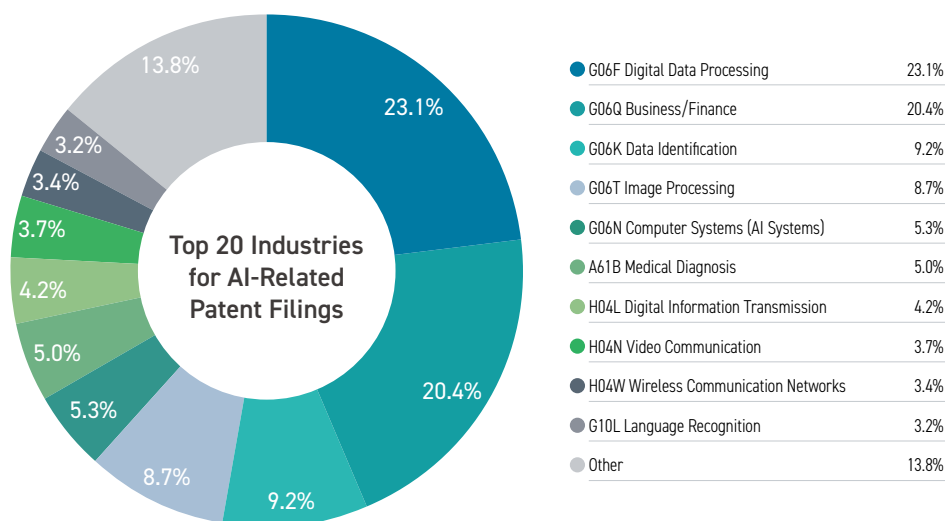
**Figure 4-2** ▶  
The Number of AI-Related Patents Filed by Taiwanese Applicants at the TIPO



Source: TIPO (2021), compiled by III, October 2022

The top-3 applicants in Taiwan are the ITRI, Chunghwa Telecom, and the III. The number of patent filings from ICT companies has accounted for the largest share in the manufacturing sector while telecommunications and financial applicants have dominated the service industry. Meanwhile, academic institutions (universities) also account for nearly one-third of the total patent filings in Taiwan. The analysis of patent filings from the top 20 patent applicants shows that nearly 70% are related to core technologies such as G06F, G06K, G06T, G06N, H04L, H04N, G10L, and H04W. Patent filings aiming to apply in business/finance, healthcare, and semiconductor fields account for more than 25% of the total patent filings. With more and more companies adopting AI, the percentage of application-oriented patents in total patent filings at the TIPO is expected to increase in the future.

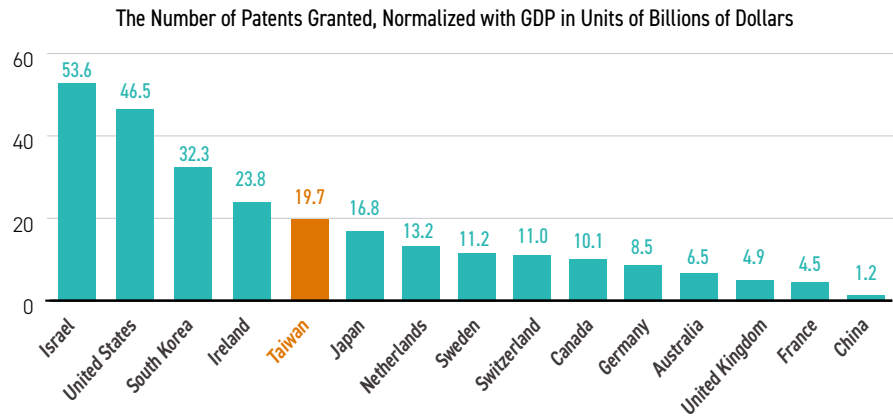
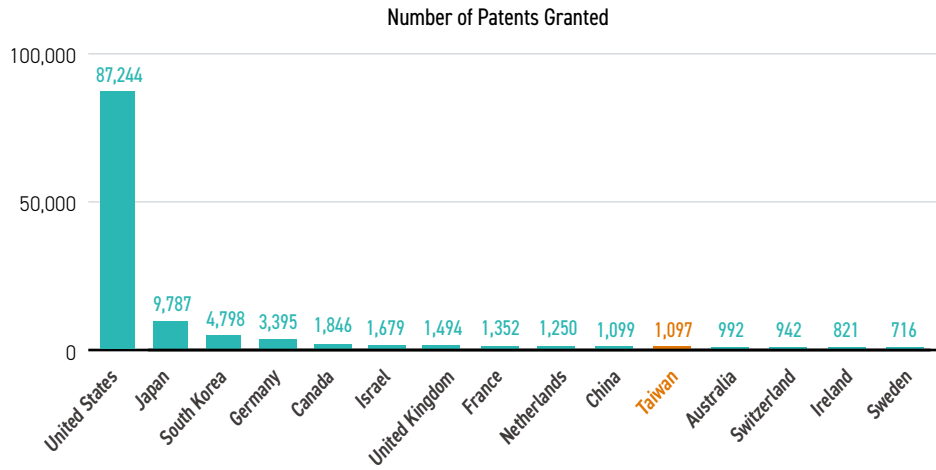
**Figure 4-3** ▶  
The Type of AI-Related Patents Filed by Taiwanese Applicants at the TIPO



Note: The analysis covers only the top 20 patent applicants.  
Source: TIPO public & announcement database, compiled by III, October 2022

Taiwanese businesses, academic, and research institutions have been actively applying for overseas patents. For example, Taiwanese applicants were granted 1,097 AI-related patents from the U.S. Patent and Trademark Office (USPTO) between 2008 and 2018, ranking 11<sup>th</sup> in the world. This reflects the strong ambition of Taiwanese businesses to deepen their presence in the U.S. market. However, it is difficult to objectively assess the innovation ability across different countries based on their patent counts, due to the differences in population, R&D investment, and gross domestic product (GDP). Hence, normalization with GDP, which is the number of patent applications divided by GDP, is useful in this case. Using the normalization method, the top-3 countries are Israel, the United States, and South Korea, and Taiwan ranks fifth. This demonstrates that Taiwan's performance in AI patents has kept pace with the world's leading countries.

**Figure 4-4 ▶**  
The Number of AI-Related Patents Granted by Major Countries to USPTO between 2008 and 2018



Note: GDP is in units of 100 billion USD.

Source: Hamidreza Habibollahi Najaf Abadi and Michael Pecht (2020), compiled by III, October 2022

## 4-3 Summary

With government financial support, the four AI innovation research centers in Taiwan have demonstrated extraordinary academic and research capabilities, and the number of top conference papers in Taiwan has also grown exponentially in recent years. The MOST has combined four of them into one center, named the Taiwan AI Center of Excellence (Taiwan AICoE). Other than enhancing AI academic and research capabilities, the Taiwan AICoE aims to strengthen international cooperation and expand application versatility.

AI software and hardware technology developed by the R&D organizations has been deployed by businesses in a wide range of industries, including e-commerce, manufacturing, medical equipment, and IC design to enhance competitiveness. On top of that, Taiwanese businesses, academic, and research institutions have all spared no effort to apply for AI-related patents and have succeeded in proving their competence with numbers. This has helped them build a solid ground for overseas market expansion.

## Taiwan's Open-Source Software Making Contribution to the Globe

GitHub is a software repository platform for software development, which allows version control of projects through a tool known as Git. The platform allows developers to work on projects hosted in the cloud to promote software innovation. According to GitHub's 2021 Octoverse Report, the platform currently has more than 73 million developers worldwide, and 84% of Fortune 100 companies use GitHub.

The number of GitHub users in Taiwan has increased by nearly 30% from 483,359 in 2020 to 626,405 in 2021. In addition to scaling up the user base, Taiwanese developers have been able to make an essential contribution to this software community. For example, a library for multi-label text classification developed by ASUS Intelligent Cloud Services (AICS) was released for free on GitHub in 2021. It can categorize large amounts of text documents into a given set of labels using NLP and graphics recognition technologies and, therefore, can be applied to internet articles, legal documents, and electronic medical records. The library not only helps other developers reduce the difficulty of development and avoids repetitive work but also accelerates the use of prototype frameworks to expand applications.

Another well-known case is called the Taiwan Social Distancing App, which was co-developed by Taiwan AI Labs and the Taiwan Centers for Disease Control of the MOHW during COVID-19. Taiwan AI Labs released source code for developers in 2021. Having an open-source community to allow users to participate and give feedback, the app has earned the public's trust. Furthermore, it can be updated over time for the optimization of app functions to reduce further spread of infectious diseases.

Figure 4-5 ▶  
Examples of AI Open Source Projects in Taiwan



- Alert users if they have been exposed to confirmed COVID-19 cases.
- Traces user's social interaction with confirmed cases using smartphone Bluetooth; information is collected in an anonymous way to protect personal privacy.



- Categorizes large amounts of text documents into a given set of labels by natural language processing and graphics recognition technologies.
- Provides developers classic cases and models for preprocessing text data.



# 05

## Application and Commercialization

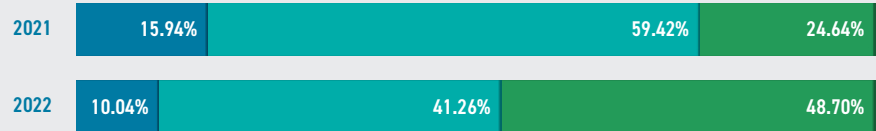
AI application and commercialization can be described in two areas: “AI Adoption in Industries” and “Industrialization of AI.” AI Adoption in Industries is how the industry can implement AI technology in the daily operations of businesses for the optimization and transformation of internal processes/products/services. During COVID-19, Taiwanese companies have dedicated themselves to deepening digitalization and AI development, and thus their AI maturity has skyrocketed. Industrialization of AI is about applying AI technology to develop products or services, engendering new startups to form a new industry. AI has been the raging buzzword globally, including in Taiwan. Taiwanese AI startups are flourishing to facilitate industrialization thanks to the increasing government support and private sector resources.

## AI Adoption in Industries

### Enterprise AI Maturity Level

Whole Enterprise AI Maturity Distribution

■ LV 0-1 Preparation Stage ■ LV 2-3 Introduction Stage ■ LV 4-6 Growth Stage



Enterprise AI Maturity Levels by Industry



Banking and Finance

3.70



Internet & Media

3.69



Healthcare

3.59



Telecommunications

3.50



Manufacturing

3.45

## Industrialization of AI

### Government Resources



Foster  
New Ideas



Kick Off a  
New Business



Enter the  
Growth Stage



GO public  
Listing

### Examples of Taiwan AI Startups across Industries

Appier

Retail

Gorilla

Computer Vision

PERFECT

Fashion

iKala

Retail

CYCARRIER  
興義智慧科技

Security

aetherAI

Healthcare

Jubo

Healthcare

oToBrite

Automobile

InfuseAI

Manufacturing

NEUCHIPS

AI Chip

# 5-1 AI Adoption in Industries

This section examines the state of enterprise AI in Taiwan based on the “State of Taiwan Enterprise AI 2022” released by Hive Ventures in March 2022. The report employed online questionnaire to evaluate the maturity and state of enterprise AI adoption in Taiwan. All respondents were scored according to their data, team, and operational readiness to assess their overall maturity levels. The enterprise AI maturity cycle can be divided into 7 levels (see the table below for the definitions of each level). The survey was conducted from January 14, 2022, to February 22, 2022, and responses by 270 respondents were collected from different business units of companies of all sizes across various industries.

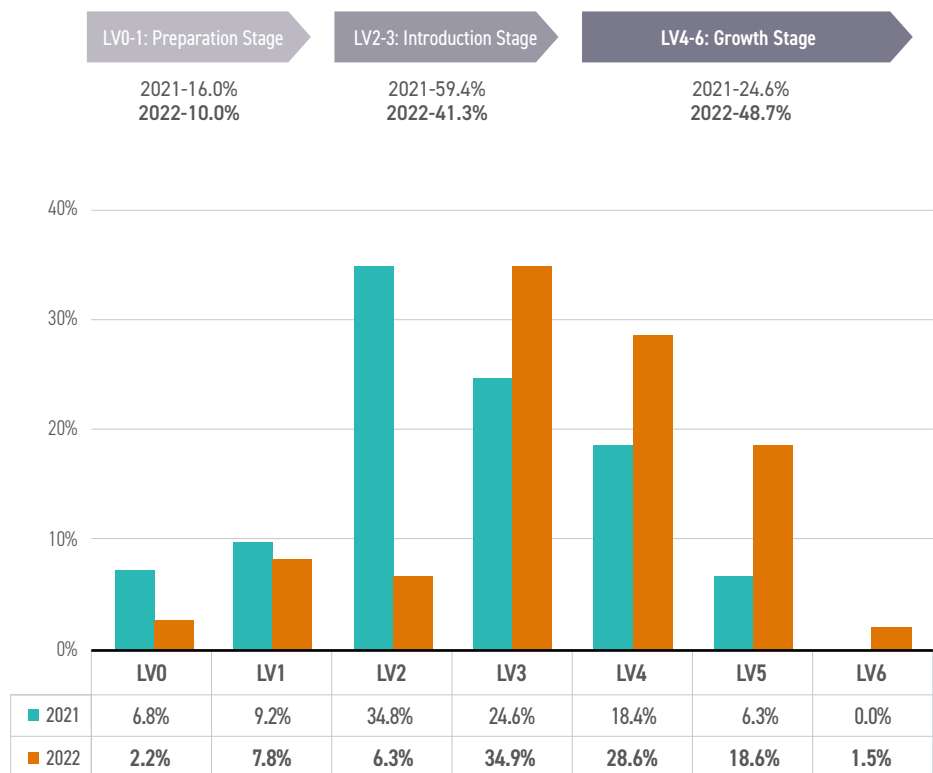
**Table 5-1** ▶  
Enterprise AI  
Maturity Cycle  
and Definitions

Stage	AI Maturity Levels and Definitions	
	Level	Definition
Preparation Stage	Level 0	Aware: Initial interest of adopting AI into the enterprise. Aligning enterprise towards a unified vision.
	Level 1	Infra: Establishing the data infrastructure to ensure access to required data for AI visions and objectives.
Introduction Stage	Level 2	Define: Identifying use cases and establishing business cases. Experimenting with data to achieve POC on use cases.
	Level 3	R&D: Affirmation of investment into the vision. Identifying tools, solutions, and partners to complement organizational capabilities in implementation.
Growth Stage	Level 4	Operate: AI is operationalized, with deployments and showing business value.
	Level 5	Infuse: AI is becoming infused into a wider scope of operations. More development, more deployments, and more involvement in wider teams.
	Level 6	Democratize: AI is within the enterprise DNA. AI may no longer be an independent initiative, but rather, an integral component of most operations.

Source: State of Taiwan Enterprise AI 2022, compiled by III, October 2022

Taiwan's enterprise AI maturity in 2022 has profoundly improved compared to 2021, presumably due to the COVID-19, which has somewhat accelerated the pace of enterprise digitization. The proportion of enterprises in the AI growth stage is estimated to have reached 48.7% in 2022, up from only 24.6% in 2021. This indicates that nearly half of the surveyed enterprises have AI projects that are operationalized, verified, deployed, and demonstrated business value (Level 4), or are expanding AI adoption (Level 5), or perhaps already have AI within the enterprise DNA (Level 6). The findings also show that enterprises in the early adoption stage have also grown significantly. In 2021, about 34.8% of the surveyed enterprises were still in the second level. The proportion of enterprises moving to the third level is estimated at 34.9% in 2022, indicating that more enterprises have completed AI infrastructure construction, heading toward the next level(s).

**Figure 5-1** ▶  
The Enterprise AI Maturity Distribution, 2021-2022

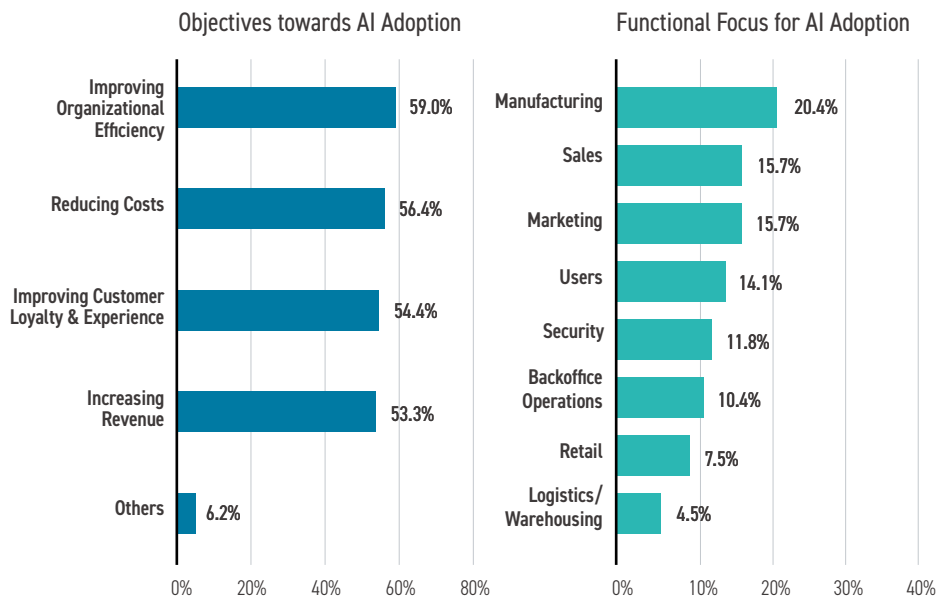


Source: State of Taiwan Enterprise AI 2022, compiled by III, October 2022

When it comes to organizational objectives towards AI adoption in 2022, “improving organizational efficiency” remains the underlying objective. However, the pandemic and economic uncertainty have changed corporate management’s views on AI adoption. The survey found that companies have been strongly concerned about costs, making

“reducing costs” the second-largest goal when adopting AI. The second-largest goal in 2021, “increasing revenue,” slipped to fourth place this year. With regards to the functional teams that have the earliest adoption of AI within the organization in 2022, Taiwanese companies still give priority to the Manufacturing, Sales, and Marketing units, consistent with the rankings in 2021. This year they have paid more attention to the Manufacturing unit while ramping up investments in the Security unit in light of the increasing importance of operational security and data governance in the world of AI. The Security unit is to become another main area of focus for AI adoption over the next one to two years, in addition to Manufacturing, Sales, and Marketing units.

**Figure 5-2** ►  
Objectives and Key  
Functional Focus  
of Taiwanese  
Companies for AI  
Adoption in 2022



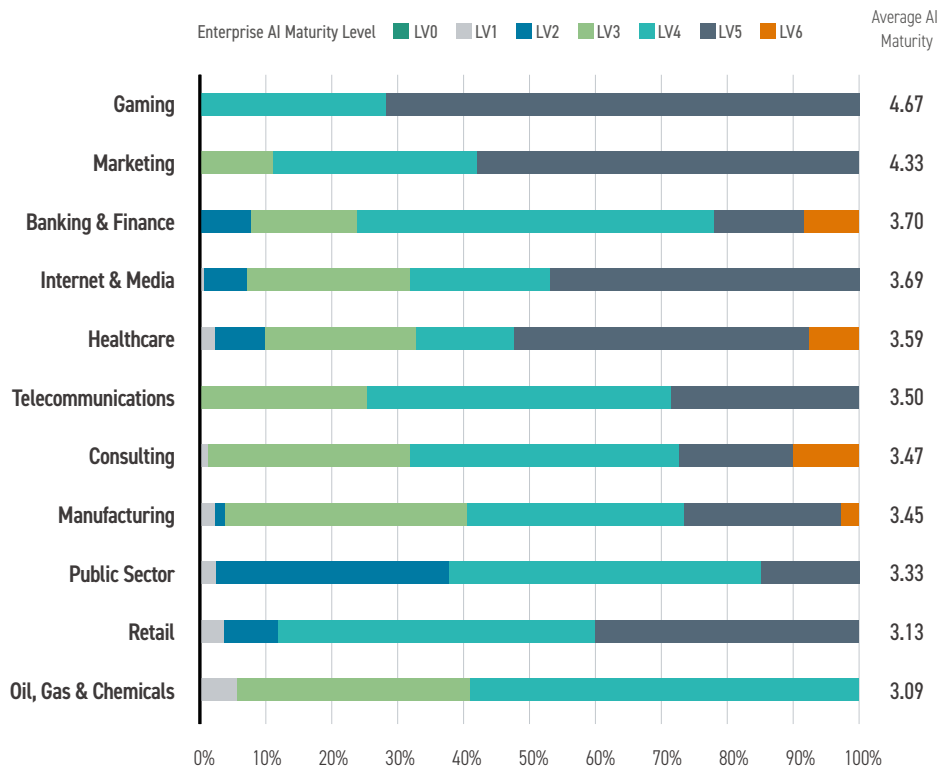
Source: State of Taiwan Enterprise AI 2022, compiled by III, October 2022

The enterprise AI maturity levels across industries can be categorized into three groups. The industries with a higher level of maturity (where the average maturity level is above a score of 4.0) are Gaming (4.67) and Marketing (4.33). The high maturity level is mainly due to a significant jump in data completeness of the two industries this year compared to 2021 and compared to other industries. The findings indicate all the surveyed companies in the Gaming industry have entered the growth stage, equivalent to level 4 and level 5 of the enterprise AI maturity cycle.

Industries with a medium level of maturity (average maturity level of 3.4-4.0) are Banking & Finance (3.70), Internet & Media (3.69), Healthcare (3.59), Telecommunications (3.50), Consulting (3.47), and Manufacturing (3.45). The adjustment of regulations around cloud adoption for the Banking & Finance industry and the advancement of data governance software has unleashed the capability of the sector in adopting AI within their organization in terms of customer services, product design, product offerings, and marketing. The maturity level of some high-tech manufacturers in the Manufacturing industry has outperformed others in AI adoption with maturity levels reaching level 5 or 6.

Industries with relatively low maturity levels are the Public Sector (3.33), Retail (3.13), and Oil, Gas & Chemicals (3.09). The average maturity scores of these three industries are all below 3.4. The Retail industry also has relatively polarized maturity levels. Meanwhile, about 40% of companies in the Public Sector and the Oil, Gas & Chemicals industry are at the introduction stage of the enterprise AI maturity cycle.

**Figure 5-3** ▶  
Enterprise AI  
Maturity Levels in  
2022 - by Industry



Source: State of Taiwan Enterprise AI 2022, compiled by III, October 2022

In addition, the survey shows that model deployment rates (number of models deployed / number of models developed) of Taiwanese companies are between 50%-75%, higher than 20%-50% in 2021, and the global average (about 20%). This indicates that Taiwanese companies have sufficient AI technical teams and partners with the domain expertise to select, experiment, and test models for higher success rates.

## 5-2 Industrialization of AI

To accelerate the development of innovations and proliferation of startups in Taiwan, the Taiwanese government integrates resources of the Ministry of Science and Technology (MOST), the Ministry of Education, the Ministry of Economic Affairs, the National Development Council and the Financial Supervisory Commission to support startups with one-stop services. The services help startups when they have new ideas (the preparation stage after a new idea pops up), kick off a new business (the beginning stage of business operations), enter the growth stage (startups are registered and operate well), and reach the mature stage (startups get listed). The government is ready to provide corresponding assistance at each stage of startup development.

The resources provided by the government include financial assistance (including investment, subsidies, and loans) and non-financial assistance (such as guidance, incubators, courses, marketing channels, international networking, and competitions). In addition, new startup bases such as Startup Terrace A6 have been set up to provide new startups office, accommodation, collaboration, and exhibition spaces. Startup Terrace A6 also offers international-level accelerators and incubators, making it an ideal environment for innovative research and development, both domestically and internationally.

There are also considerable AI investments from private venture capital firms and incubators. More prestigious venture capital firms in the AI field include AppWorks Accelerator, CDIB Capital Group, and Cathay Venture. Furthermore, AppWorks Accelerator and CDIB Capital Group also have accelerators to provide entrepreneurial guidance, along with capital investment. In addition, major IT brands such as Quanta, MediaTek, and Wistron all have actively invested in potential AI startups. Show Chwan Memorial Hospital and BE Capital have co-established a new accelerator, called BE Accelerator, to invest in and provide guidance in the field of biomedicine (including AI). This has helped Show Chwan Memorial Hospital diversify its operations while taking advantage of AI technology.

**Figure 5-4** ▶  
Taiwan AI Startup  
Ecosystem -  
Incubation and  
Acceleration

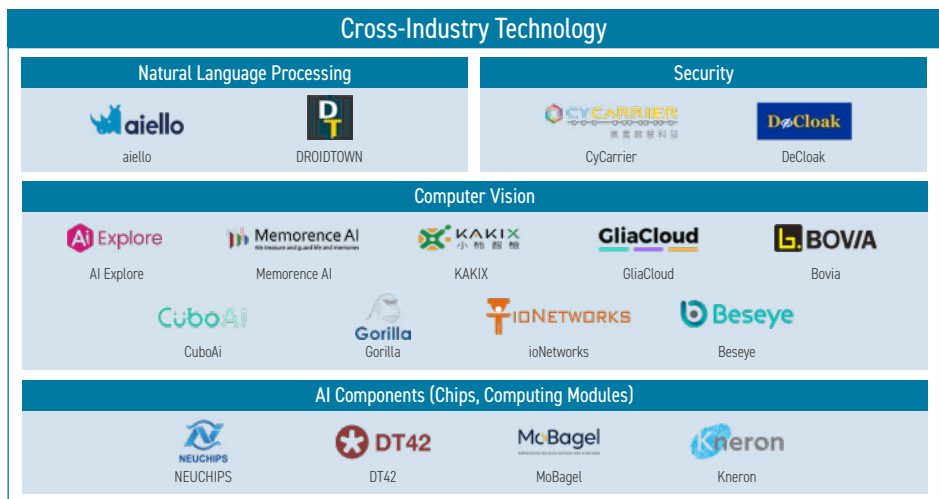


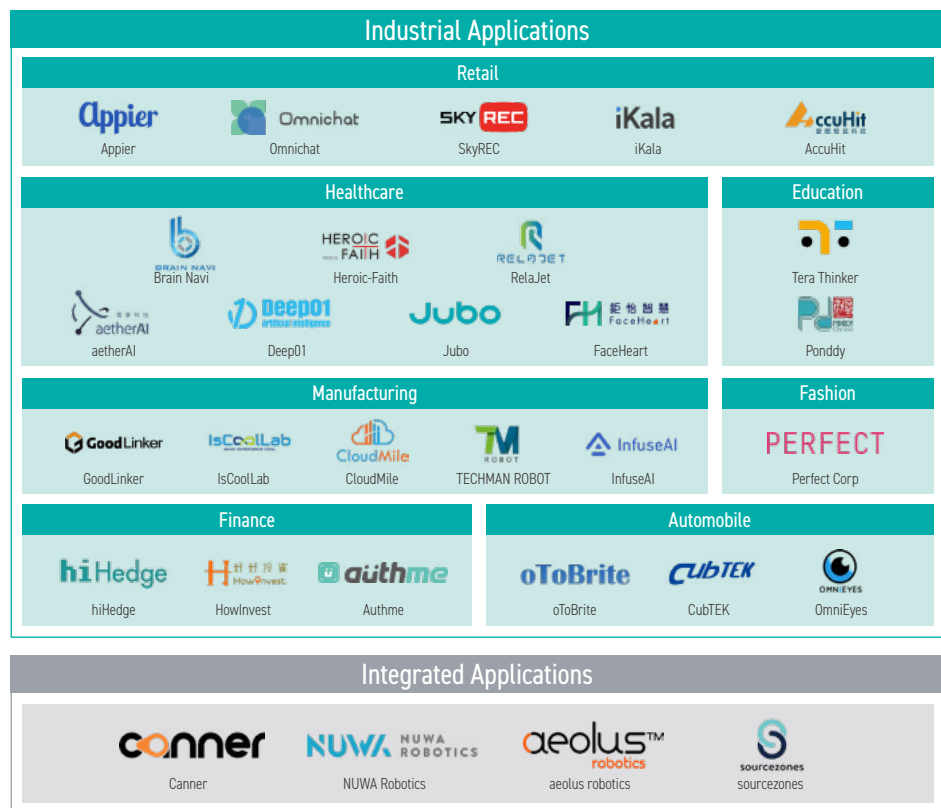
Source: Artificial Intelligence Foundation (AIF), AppWorks Accelerator, compiled by III, October 2022

Taiwan’s AI startups have flourished in recent years with the joint efforts of the government and private sectors. From a technical standpoint, Taiwan’s AI startups provide services covering NLP, computer vision, security, AI components such as chips and computing modules, and integrated service applications. Several representative companies include Aiello (NLP), Beseye (computer vision), CyCraft (security), Neuchips (AI chips), and Aeolus robotics (integrated applications). The solutions of Taiwan AI startups cover various application fields such as healthcare, retail, manufacturing, finance, education, and automobiles. Among them, the number of investments in the healthcare field is higher than in other fields. Healthcare is expected to continue receiving a great deal of attention owing to the growing demand for precision medicine. Leading startups include aetherAI, Heroic-Faith Medical Science, Jubo Health and RelaJet. The contactless service opportunities spurred on by COVID-19 have led to the proliferation of new startups in the retail sector such as Appier, iKala Interactive Media, and SkyREC, and in the autonomous-driving sector like oToBrite Electronics and OmniEyes.

AI startups in Taiwan have also lured several international venture capital firms. Several have obtained international funding while some have been listed overseas. For example, Appier has secured funding from well-known venture capital firms, including Sequoia Capital and Softbank, and has got listed in Japan in March 2021. Gorilla Technology Group, which specializes in computer vision and IoT security, was listed on NASDAQ as a Special Purpose Acquisition Company (SPAC) in July 2022. Other renowned Taiwanese AI startups with mature products/services and more successful fundraising include PERFECT, which provides AR and AI solutions to the beauty and fashion industry (IPO registration statement was declared effective by the U.S. Securities and Exchange Commission in September 2022), iKala Interactive Media, which provides AI-based software as a service (SaaS) (completed a series B round of fundraising in 2020), and CyCraft, which provides AI-enabled cybersecurity solutions (completed a series B round of fundraising in 2019).

**Figure 5-5** ▶  
Taiwan AI Startup  
Ecosystem –  
Representative  
Startups





Source: AIF, AppWorks Accelerator, compiled by III, October 2022

## 5-3 Summary

When it comes to enterprise AI adoption across industries, the pandemic has created the urgency to speed up digitization and has significantly increased the AI maturity levels of Taiwanese companies in 2022. Meanwhile, nearly 50% have reached the growth stage of the enterprise AI maturity cycle, demonstrating the commercial value of AI. With the increasing importance of operational security and data governance in the world of AI, security will be another area of focus for AI adoption over the next one to two years, in addition to Manufacturing, Sales, and Marketing units.

As regards to the industrialization of AI, the government's one-stop services can assist startups, in addition to financial support from private sector companies and venture capital firms. As a result, Taiwan has been able to cultivate AI startups across a variety of technology and application areas. The relevant government agencies are to continue to foster new startups, assist them in connecting with international venture capital firms for global market expansion, and help more startups get listed overseas.

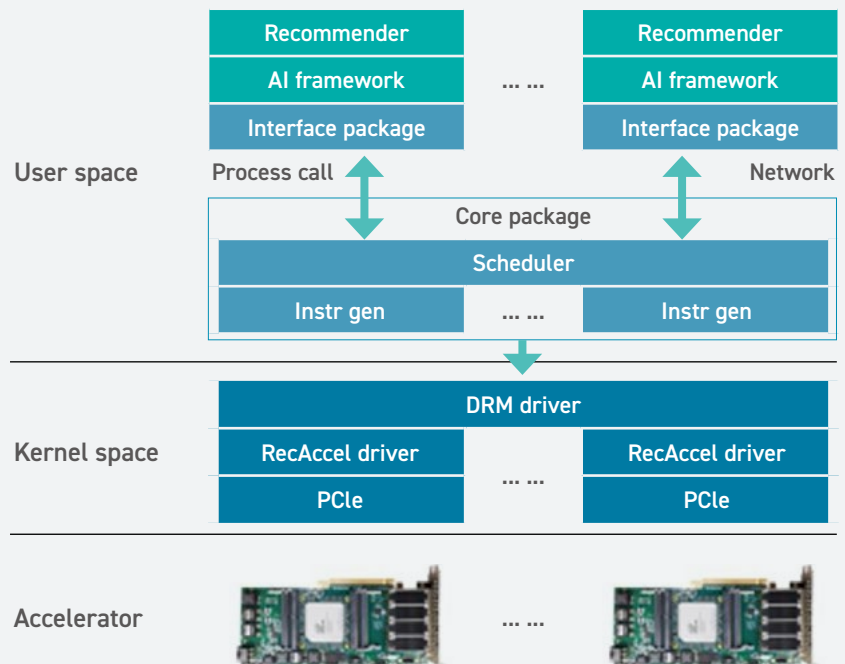
## ▶ AI Chip Startup - Neuchips Inc

Neuchips was founded in 2019 based on the “Semiconductor Moon Shot” project of the MOST. It was Taiwan’s first IC design startup dedicated to the 7nm fab process. The founder, Chairman Youn-Long Lin, is the chair professor of Computer Science at National Tsing Hua University. He has organized an innovative and experienced team by recruiting team members from top universities and listed Taiwanese companies.

Equipped with a high accuracy AI computation engine, Neuchips has been able to extend its reach to edge- and cloud-based environments. The company is an AI ASIC solution provider to develop purpose-built data center AI solutions. For instance, the company released an RNN deep learning accelerator, called RNNAccel, which supports long short-term memory (LSTM) networks, and HarDNet, which is an open-source convolutional neural network (CNN) architecture. On May 31, 2022, the company announced its first ASIC using TSMC’s 7nm process, called RecAccel N3000, which is specifically designed for accelerating deep learning recommendation models (DLRM).

Neuchips received funding worth US\$14 million from several international venture capital firms and leading IT brands as of April 2021. Investors include JAFCO Asia, Powerchip, Sunplus Technology and Wistron. In terms of business development, the company has succeeded in licensing IP to U.S. IC design houses. Neuchips plans to deliver its RecAccel N3000 AI inference platform on Dual M.2 modules for Open Computing Project (OCP) compliant servers during 2H 2022.

Figure 5-6 ▶ Illustration of Neuchips’ RecAccel Solution



Source: Neuchips, compiled by III, October 2022

## ▶ AI Healthcare Startup - aetherAI

aetherAI, founded by Dr. Joe Yeh in 2015, is a leading medical image AI solution provider in Asia and focuses on digital pathology systems and AI-powered diagnostic support solutions. The company seeks to leverage deep neural networks' superior ability to improve clinical diagnosis. aetherAI has developed a wide array of AI-assistance for lung cancer, gastric cancer, nasopharyngeal carcinoma, and breast cancer used in screening, quantification, and other AI applications. aetherAI aims to ease the burden on healthcare professionals and further accelerate the realization of precision medicine.

The company has cooperated with hospitals and universities. Many of the research results have been published in peer-reviewed journals. For example, co-authored with Taipei Medical University, "An annotation-free whole-slide training approach to pathological classification of lung cancer types" was published in *Nature Communications*. This research achieved an accuracy of over 95%. Another collaboration with Chi Mei Medical Center presented a machine learning approach to support the diagnosis of primary intestinal T-cell lymphomas. The findings were published in the medical journal *Cancers*.

aetherAI partners with top medical centers, including Cedars-Sinai Medical Center in Los Angeles, University of Pittsburgh Medical Center, National Taiwan University Hospital (NTUH), Chang Gung Memorial Hospital, and Cathay General Hospital. A number of aetherAI medical image AI solutions have been approved and introduced to markets for commercial use. One such solution is aetherAI Hema, which is co-developed with NTUH to automate the procedure of bone marrow smear differential counting. This solution has received a Conformité Européenne (CE) certification and has been approved by Taiwan Food and Drug Administration (TFDA) for commercial use. On top of that, it will be promoted in blood labs around the world. aetherAI Endo – another solution co-developed with NTUH and Cathay General Hospital and approved by the TFDA – has been able to detect colorectal polyps and adenomas in real-time. Ultimately, more AI applications are expected to be commercialized in the near future.

**Figure 5-7** ▶  
Illustration of aetherAI  
AI Digital Pathology  
System



aetherAI has developed a cutting edge full-slide pathological image recognition system with embedded AI to assist physicians in diagnosis (the red area in the above figure indicates AI-predicted areas with cancer). This solution shortens the diagnosis and interpretation time of physicians by 30%. The results have been published in internationally renowned journals.

Source: aetherAI, compiled by III, October 2022

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