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Hong Kong Institute of Economics and Business Strategy
香港經濟及商業策略研究所

Hong Kong AI Industry Development Study

Hong Kong Productivity Council (HKPC) and

Hong Kong Institute of Economics and Business Strategy at HKU Business School

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Editorial Team

Hong Kong Productivity Council

Mr Edmond Lai

Mr Francis Lai

Ms Yammie Yu

Dr Geoff Cheng

Ms Vivian Wong

Ms Ceci Fung

Mr Grayson Sun

Mr Hobert Liang

Hong Kong Institute of Economics and Business Strategy (HIEBS)

Professor Heiwai Tang

Mr Cyrus Cheung

Introduction to Productivity Council and AI Development

The Hong Kong Productivity Council (HKPC) is a multi-disciplinary organisation established by statute in 1967, to promote productivity excellence through relentless drive of world-class advanced technologies and innovative service offerings to support Hong Kong enterprises. Being a key enabler of Industry 4.0 and Enterprise 4.0, HKPC strives to facilitate new industrialisation in Hong Kong, as well as bolstering Hong Kong to be an international innovation and technology centre and a smart city. The Council offers comprehensive innovative solutions for Hong Kong industries and enterprises, enabling them to achieve resources and productivity utilisation, effectiveness and cost reduction, and enhance competitiveness in both local and overseas marketplace. The Council partners and collaborates with local industries and enterprises and world-class R&D institutes to develop applied technology solutions for value creation. It also benefits a variety of sectors through product innovation, technology transfer, and commercialisation, bringing enormous business opportunities ahead. HKPC's world-class R&D achievements have been widely recognised over the years, winning an array of local and overseas accolades.

In addition, HKPC offers SMEs and startups immediate and timely assistance in coping with the ever-changing business environment, and strengthens talent nurturing and Hong Kong's competitiveness with FutureSkills training for enterprises and academia to enhance digital capabilities and TechEd competencies.

As a scientific research organisation with strong AI applications and formidable capabilities in AI research and development, HKPC has been committed to promoting the AI industry, successfully developing AI technologies to aid enterprises in upgrading and transformation. HKPC has achieved significant results in the research and development of AI and the promotion of AI industry. The Hong Kong Industrial Artificial Intelligence & Robotics Centre (FLAIR) established by the Council at the Hong Kong Science Park is one of the members of AIR@InnoHK, a world-class innovative R&D platform developed by the HKSAR Government. FLAIR harnesses its strengths in technical expertise, networks, innovative R&D and patents to enhance productivity with AI. Through years of efforts, FLAIR has not only collaborated with international research institutes and leading enterprises, but also developed the Horizon OpenExplorer: Industrial AI Application Platform, which provides industry players with access to and use of domain-specific information through the functions of data storage, model storage and code generation to facilitate the training, development and use of various AI technologies, and to help enterprises implement AI applications, thereby practically supporting Hong Kong's development as an international technology innovation hub.

Mr Edmond Lai

Mr. Edmond Lai Shiao-bun joined HKPC in 2018 to lead the digital transformation, smart manufacturing and Mainland businesses of HKPC. Mr. Lai is an expert in Industry 4.0 (i4.0) and Enterprise 4.0 (e4.0) business transformation, as well as digital product development, with experience in local and overseas market development. He assumed the position of Member of the Board and Chief Executive Officer, Hong Kong Industrial Artificial Intelligence & Robotics Centre (FLAIR) in 2019.

Mr. Lai worked in General Electric (GE) for more than 20 years. He spearheaded his expertise across other business units including aviation, capital, healthcare, plastics, power, transportation among various regions including Greater China, Australia, Japan, Singapore, Switzerland, the United States. He also assumed regional and global responsibilities to drive the business growth for various industries, such as energy storage, mining, marine, rail, renewable energy, thermal power generation, and so on. Mr. Lai held the Bachelor of Engineering (Computer Engineering) and Master of Philosophy (Computer Science) degrees from the University of Hong Kong.

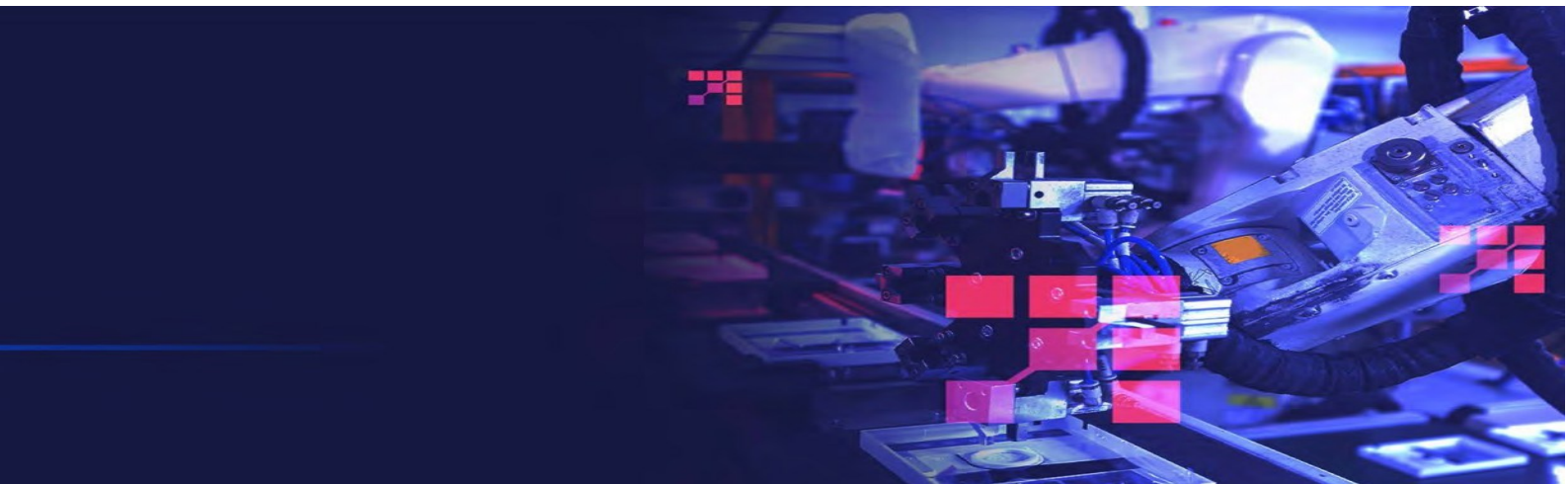
Profile of Hong Kong Institute of Economics and Business Strategy (HIEBS)

The Hong Kong Institute of Economics and Business Strategy (HIEBS) is a research centre affiliated with HKU Business School, focusing on the effects of Hong Kong's economic policies and business strategies on Mainland China and the Asia-Pacific region. Through the publication of independent and authoritative research, HIEBS aims to draw the attention of policymakers and stimulate public interest to build bridges between theory and practice and contribute to society's prosperity and sustainable development.

Professor Heiwai Tang

Heiwai Tang is Victor and William Fung Professor in Economics, Director of the Asia Global Institute, Associate Dean (External Relations) of the Business School at the University of Hong Kong (HKU), and Associate Director of the HIEBS. Prior to joining HKU, he was tenured Associate Professor of International Economics at the School of Advanced International Studies (SAIS) of Johns Hopkins University. He is also affiliated with the Center of Economic Studies and Ifo Institute (CESIfo, Germany), the Kiel Institute for the World Economy (Germany) and the Globalization and Economic Policy Center (U.K.) as a research fellow. He has been a consultant to the World Bank, the International Finance Corporation, the United Nations, and the Asian Development Bank; and held visiting positions at the IMF, Stanford, MIT, and Harvard. He is currently Managing Editor of Pacific Economic Review, and previously served as Associate Editor of *the Journal of International Economics*, *the Journal of Comparative Economics* and *the China Economic Review*. Since 2021, he has served on a number of public and regulatory bodies in Hong Kong SAR, including a member of the Currency Board Sub-Committee of the Hong Kong Monetary Authority's Exchange Fund Advisory Committee, Industry Advisory Committee of the Insurance Authority, Securities and Futures Appeals Tribunal, and the Minimum Wage Commission, among others.

Heiwai holds a Ph.D. in economics from MIT and a Bachelor of Science in mathematics from UCLA. His research interests span a wide range of theoretical and empirical topics in international trade, with a specific focus on production networks, global value chains, and China. His research has been published in leading journals in economics, including *American Economic Review* and *Journal of International Economics*. His research and opinions have been covered by BBC, Bloomberg, China Daily, CNA, CNN, Financial Times, New York Times, Al Jazeera, Foreign Policy, South China Morning Post, and various think tanks such as the Brookings Institution and the Peterson Institute for International Economics.



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Summary

In February 2023, Bill Gates noted that ChatGPT would change the world, which is no less important than the invention of the Internet. With the rise of OpenAI, artificial intelligence (AI) has been considered a key driver of global economic development. Computing power and data, the two core elements driving the development of the AI industry, have been compared to the oil and gold of the 21st century, while algorithmic talent, another core development element, is being fiercely competed for by international technology giants offering extremely favourable pay. Based on the development of advanced economies worldwide, the AI industry has become a field of strategic importance, and governments have introduced policies and measures to seize the technological dividends of the AI era for local economic prosperity.

How does the development of the AI industry in Hong Kong compare with that of other regions? How can the HKSAR Government enhance its support for the industry further? To delve deeper into these issues, HKPC New Industrialisation and the Hong Kong Institute of Economics and Business Strategy (HIEBS) of HKU Business School collaborated on the "Hong Kong AI Industry Development Study" conducted in mid-2023. The study aims to discuss the needs, challenges, and opportunities of the topic. Through case studies, the report examines the situation in six selected regions: Hong Kong, Singapore, New York, Switzerland, Shanghai, and Shenzhen. In addition, the report conducts interviews with 216 AI enterprises, 267 enterprises from various industries utilizing AI in Hong Kong, and nearly 30 representatives of AI suppliers and users through questionnaires, focus group interviews, and personal interviews. The key findings of the study are outlined as follows:

AI Industry Flourishes in Selected Regions and Hong Kong Is Striving to Catch up

The HKSAR Government has included "AI and Data Science" as one of the three major industries for new industrial development. It has set up the AIR@InnoHK research cluster, focusing on AI and robotics technologies research and applying the results to manufacturing, medical care, logistics, and construction industries. Currently, the primary strategies of the government in boosting the AI industry are still lagging behind leading regions but are endeavouring to catch up. The major efforts made by the government include nurturing the ecosystem, upgrading computing facilities, building a global data centre, and providing relevant guidelines. In addition to the above directions, the interviewed stakeholders also hoped the government could promote the industrial application of AI more intensively, develop the industry to retain talent from both home and abroad, adopt a more proactive supportive policy for small and medium enterprises (SMEs), and deepen the collaboration between Hong Kong and Guangdong.

Outside of Hong Kong, several regions have made significant progress in developing the AI industry. Referring to their experience is instructive for Hong Kong to formulate industrial policies:

Singapore launched its National AI Strategy in 2019, focusing on government-industry-academia-research interactions, talent, and data. It also concentrates resources on significant industries, including finance, government, healthcare, education, and logistics. Singapore's AI Apprenticeship Programme (AIAP) provides local talent with skills training and project practice opportunities. Supporting measures such as the AI Readiness Index assessment service, the "100 Experiments" funding matching project, the platform

engineering team, and the high-performance cloud cluster provide essential assistance for SMEs to apply AI.

As an international financial centre, New York provides a first-class financing environment for AI enterprises and has attracted many tech giants to set up AI R&D centres there. The government of New York City released the *New York City Artificial Intelligence Strategy* in 2021, striving to build a healthy AI ecosystem that protects citizens' digital rights while promoting the adoption of AI in the public sector.

The Swiss government has made significant investments in R&D and education, resulting in the establishment of several leading innovative universities worldwide, such as the Swiss Federal Institute of Technology Zurich and the Swiss Federal Institute of Technology Lausanne. Switzerland's exceptional innovation environment has fostered the emergence of local AI stars, such as MindMaze, and attracted top foreign technology enterprises, including Microsoft, to establish a business there. These leading public and private organisations are closely cooperating in AI technology research and the industrialisation of research findings to boost the Swiss economy.

Shanghai and Shenzhen have reached the world's first-class computing power level. Both places have promulgated laws, regulations, and policy measures to promote the development of the AI industry, covering all essential production factors, including talent, computing power, data, algorithms, primary research, product innovation, adoption scenarios, industry chains, industry clusters, service systems of industrial parks, fund clusters, and standardisation systems. One of the policy priorities of the two places is to promote the industrial application of AI. While Shanghai focuses on manufacturing, finance, and shipping industries, Shenzhen focuses on public services and urban governance. In addition, Shenzhen has proactively proposed to unite with Hong Kong to build an enterprise-level intelligent computing power platform and create a Shenzhen-Hong Kong AI computing power empowerment centre in the policy document.

Based on the information from the case studies, if we roughly classify the maturity of the development elements of the AI industry into three levels, namely ✓ under construction, ✓✓ established but to be perfected, and ✓✓✓ well-developed, the performance of each city can be outlined as follows:

	Computing Infrastructure	Data Infrastructure	AI Talent	AI Enterprise	Policy Planning	Industrial Application	Industry-academia Collaboration	Unique Advantages
Hong Kong	✓	✓ ✓	✓ ✓	✓ ✓	✓	✓	✓ ✓	Potential to pool data from the East and the West; broad prospects for regional cooperation
Singapore	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	Efficient utilisation of limited resources and high industry intensity
New York	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓	✓ ✓ ✓	✓ ✓ ✓	World financial and R&D centres
Switzerland	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓	✓ ✓	✓ ✓ ✓	World-class innovation environment
Shanghai	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	Integration of the best resources in China
Shenzhen	✓ ✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	A large number of AI enterprises focusing on industrial applications; broad prospects for regional cooperation

Quantitative Survey for Enterprises on Hong Kong's AI Services and Applications and Enlightenment

In the quantitative survey for AI enterprises, 216 AI-related enterprises in Hong Kong were successfully interviewed, and the overview and findings are as follows:

Industry overview:

- Among the AI enterprises interviewed, 75% were SMEs and 25% were large enterprises.
- 17% are developing AI at the basic, technology and application layers at the same time.

- 22% intend to extend their industry chain to other layers in the future.
- 55% are looking to expand their businesses into both international and local markets, 14% will choose to expand their businesses in Hong Kong and 11% will choose to develop their businesses in the Mainland.

Financial overview:

- 55% reported that they were profitable or broke even, while 31% of overall enterprises claimed to be profitable.
- Funding for enterprises come from various sources. 43% of the enterprises indicated that they received funding from the HKSAR Government, while 19% received funding from venture capital / angel investors, which shows that the HKSAR Government should consider setting up more types of exchange platforms and organizing more activities between funds and AI enterprises to push forward private investment.
- Cumulative investment amount: 49% invested less than HK$1 million, while 21% invested between HK$1 million and HK$5 million, 6% invested between HK$5 million and HK$10 million, 5% invested between HK$10 million and HK$100 million, and 4% invested over HK$100 million.

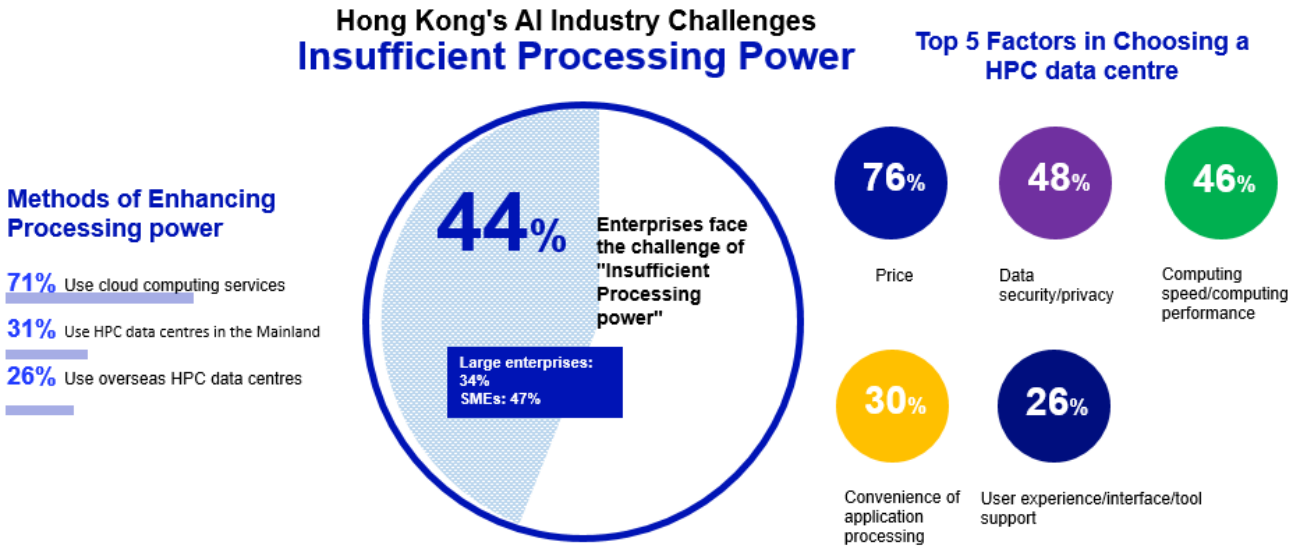
Overview of the industry market, personnel and income:

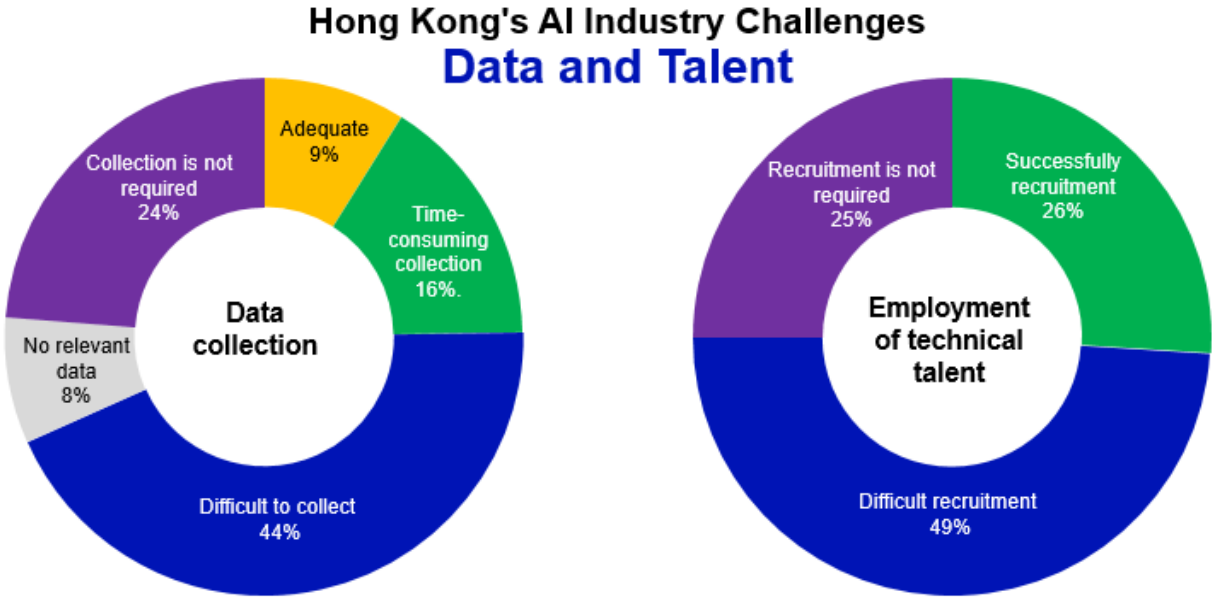
- 48% of companies solely focus on developing AI for one industry, while 16% target two industries and 15% target three industries at the same time, which shows that AI enterprises are more focused in market development
- Major industries targeting AI applications: Telecommunications and information technology services (29%), medical/ clinical and healthcare equipment, healthcare products and pharmaceuticals (24%), education, nurturing/ training (23%), manufacturing (22%), and government organisations (21%).
- Overall number of employees: 10-49 employees (31%), 1-10 employees (45%); showing that majority of AI enterprises in Hong Kong are SMEs
- Main sources of income: 63% from Hong Kong, 19% from the Mainland and 15% from overseas.

Major challenges in the industry - insufficient HPC processing power and data; difficulties in recruiting technical talent:

- **Insufficient processing power:** 44% of enterprises stated they are facing the challenge of “insufficient processing power”. To address the problem, 71% of them are using cloud computing services, 31% choose HPC data centres in the Mainland and 26% choose HPC data centres overseas. The top three factors for choosing supercomputing centres are price (76%), data security/ privacy (48%), and computing speed/ performance (46%).
- **Insufficient data:** 44% of enterprises are having difficulties in collecting data, and 16% said it took a long time to collect sufficient data, while 8% stated that they have no relevant data.

- **Recruitment difficulties:** 49% of enterprises are having difficulties in recruiting technical talent, and some enterprises even reduced their hires in Hong Kong and moved to overseas. 77% of enterprises attributed it to Hong Kong's high operating costs, while 41% indicated that Hong Kong lacks relevant technical talent. Nevertheless, 45% of enterprises intend to increase the hiring of Hong Kong technical talent in response to market needs, favourable tax regime and higher quality of personnel.





AI Research Findings by Industry

Application of AI by enterprises:

- In this study, 267 enterprises were interviewed, including 81% of SMEs and 19% of large enterprises

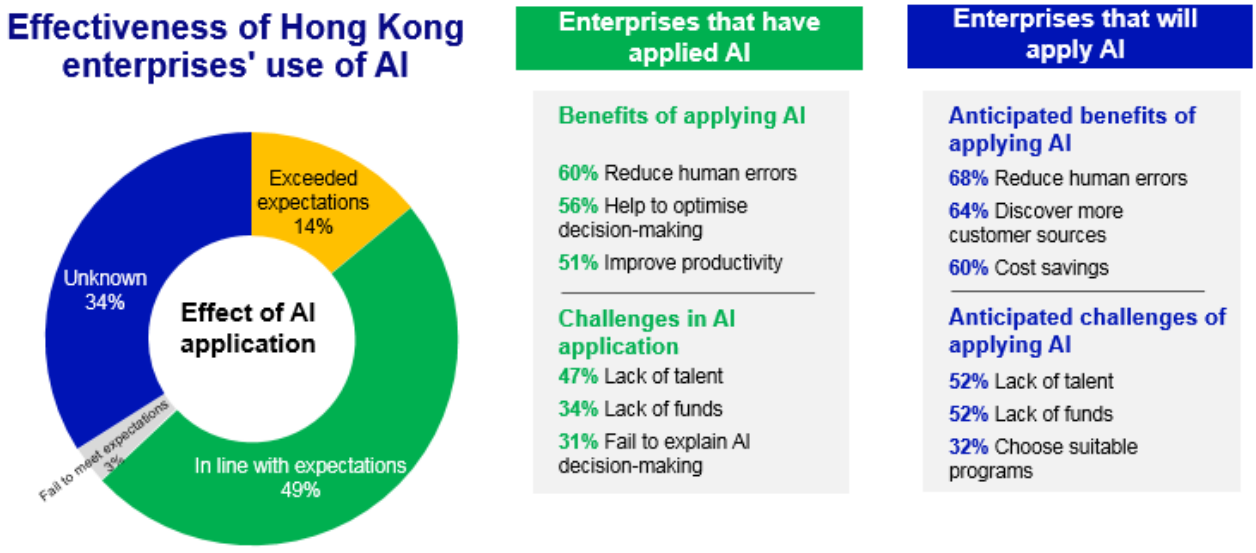
- The industries cover retail, catering, personal services, professional services, information and communications, finance and insurance, manufacturing, construction, logistics, real estate, etc.
- 41% of Hong Kong enterprises are or will be using AI
- 32% have applied AI to marketing (58%), operations (44%), internal management
- The average investment in AI is HK$830,000
- The average investment budget of enterprises preparing to apply AI (9%) is HK$140,000

Effect of application of AI by enterprises:

- 60% find AI can reduce human errors
- 56% find AI helps in decision making
- 51% find AI can improve productivity

Plan of enterprises for expanded application of AI:

- 59% adopt AI plans to further develop applications
- 61% expect to invest HK$300,000, with an average investment of HK$1.22 million
- 49% find that its effects were in line with their expectations
- 14% find that its effect exceeded their expectations



Conclusion

AI is a hot topic in the global technology field today, and its application has penetrated various industries and fields. As a modern metropolis, Hong Kong has always been committed to promoting technological innovation and digital transformation. In recent years, the HKSAR Government has actively advanced the development of AI by establishing 14 cross-sectoral

AI research laboratories, with goal to support quality economic growth and enhance competitiveness. These initiatives will drive Hong Kong to become an “International AI and Data Industry Development Hub”.

Advantages of Hong Kong

Hong Kong has an excellent geographical location and an international business environment, which attracts many international enterprises and innovative technology companies to set up their business and R&D centres here. With the support of the motherland and global outlook, Hong Kong holds strong manufacturing capability, a solid scientific research foundation and a robust market that can help develop the AI industry. In addition, the excellent education system and high-quality research institutions have cultivated many technology professionals. Hong Kong’s long-established position as an international financial centre can also effectively and quickly contribute to the financing and development of AI enterprises.

Challenges for Hong Kong

There is still room for Hong Kong to improve its computing infrastructure and standardise data sharing. At present, the main market for AI enterprises is in Hong Kong. To expand the market, Hong Kong needs to strengthen cooperation and communication with the international community and the Mainland China, complementing each other’s strengths in terms of manufacturing, application and R&D. As general enterprises and citizens in Hong Kong are not yet well aware of the application scenarios and benefits brought by AI, and the number of overseas AI enterprises with branches in Hong Kong is still limited, the HKSAR Government needs to enhance publicity and education. In addition, the society demands talent with AI knowledge and skills in other industries, such as finance and manufacturing. Therefore, Hong Kong should nurture professionals with broad skill sets to respond to the exuberant demand for talent.

Initiatives to Promote Hong Kong as a Key Global Hub for AI and Data Industries

Based on Hong Kong’s regional strengths and challenges, three core initiatives are proposed to support the development of local AI enterprises:

Improve infrastructure

Hong Kong should establish a leading supercomputing centre in Asia, build an “international hub of big data”, formulate policies and guidelines for the development and application of AI technology, and enhance collaboration with other cities in the Greater Bay Area and international cooperation to improve the AI industry chain.

Accelerate industrialisation

The HKSAR Government should take the lead in promoting large-scale AI applications, enhancing enterprises’ and citizens’ understanding of the AI application scenarios, and actively publicizing or providing support funds for AI application and training to empower

industrial upgrade and transformation in Hong Kong with AI. In addition, Hong Kong should be promoted as an international financing centre for AI enterprises through external publicity and policy improvements.

Expand talent pool

The HKSAR Government should popularise AI education in universities, secondary schools, primary schools and professionals, and nurture professionals with broader skill sets in cross-disciplinary expertise and AI. At the same time, Hong Kong should further optimise the policies for AI professionals from Mainland China and the world to work and live in Hong Kong, so as to attract global AI talent to Hong Kong.

Recommendations on Nine Major Development Paths

Improve infrastructure

1. Establish a leading supercomputing centre in Asia

The establishment of a leading supercomputing centre is an important initiative for Hong Kong to become an international technology innovation hub. Nowadays, with the continuous development of new technologies such as AI, supercomputing capability is becoming increasingly important to support the computing of various advanced research projects and promote the advancement of related technological fields. On the other hand, Hong Kong should deepen its cooperation with the Mainland and international universities and research institutes in this field by means such as setting up joint laboratories and competing for multinational enterprises with plans for computing centres in the Asia-Pacific region to establish relevant R&D bases in Hong Kong. Attracting the participation of Chinese and global resources through different channels will be conducive to the development of the Hong Kong supercomputing centre. In addition, the HKSAR Government needs to continuously optimise supporting policies to lead Hong Kong to be a great power in science and technology. The HKSAR Government can invest in the establishment of a public supercomputing centre,

which connects with other public supercomputing resources (e.g., universities), while introducing preferential policies to attract local and overseas enterprises to Hong Kong to build private supercomputing centres and conduct AI research and development.

2. Build an international hub of big data:

Building an international hub of big data is an important path for Hong Kong's future development. The HKSAR Government should prefect the relevant legal and regulatory frameworks, and formulate sound regulations and policies with personal privacy and information security as the core. At the same time, the HKSAR Government should also set up a dedicated organisation to develop standards and regulations that are suitable for Hong Kong. For example, the Digital Policy Office can formulate a data policy, including data "de-privatisation" requirements, to facilitate the flow of big data involving personal privacy (e.g., medical care), promote the provision of "de-privatised" big data and application programming interfaces (APIs) by government departments, public corporations, and public utilities, and negotiate and implement data flow with Mainland China and overseas cities. In addition, Hong Kong should strengthen cooperation with the Mainland China and other overseas cities in the field of big data, and jointly explore the development of cross-border data interconnection programmes. The HKSAR Government should also focus on attracting more multinational enterprises to set up data centres or R&D bases in Hong Kong. Overall, improving regulations, deepening cooperation and continuously improving infrastructure are all crucial for Hong Kong to develop into an international hub of big data.

3. Formulate regulatory policies and guidelines on the development and application of AI technologies

To further ensure public rights and interests, regulatory authorities may consider formulating a comprehensive set of privacy protection guidelines. These guidelines can focus on AI systems and applications in the process of collecting, storing, processing and using personal data, and clearly regulate the privacy protection requirements and standards that must be complied with. Meanwhile, these guidelines should consider the needs and interests of enterprises and secure a certain degree of freedom of development for them, so as to encourage innovative research and development. Regulatory authorities should provide the necessary resources to help enterprises overcome the difficulties in the R&D and application process, thereby boosting the healthy development of the AI industry. With the development and implementation of appropriate regulation, confidence of the industry and the public in AI application will be enhanced. In formulating relevant laws and regulations, the HKSAR Government should give due consideration to international standards and refer to the relevant regulations and policies of other regions, such as the European Union, the United States and the Mainland China, to ensure that its policies can stay in line with the laws and regulations of the Mainland China and the world.

4. Strengthen cooperation with the Greater Bay Area and the international community to perfect the AI industry chain, and focus on the development of advantageous areas

To further promote the development of the AI industry, Hong Kong's cooperation with other cities in the Greater Bay Area and internationally renowned research institutes needs to be further enhanced. The cooperation should not be limited to close research exchanges, but also include the sharing of AI talent, algorithms and data resources. In this way, Hong Kong can build a cross-border AI R&D platform to gather global wisdom and jointly promote the innovation and development of AI technology. In addition, the platform facilitates the further expansion of cross-border projects on AI applications in various fields, including but not limited to medical care and smart city. Through the implementation of these cross-border projects, technologies and resources across the region can be complemented and shared to jointly promote the application of AI in these fields and optimize the related products and services. In-depth cooperation with international partners should be maintained in the research and development of cutting-edge technologies. Different countries and cities can conduct joint research and development in fields such as AI microelectronics technology to explore and advance the innovation and development of these technologies.

Accelerate industrialisation

5. The Government takes the lead in promoting large-scale application of AI

In line with the development vision of the Smart City Blueprint for Hong Kong in the six areas, namely "Smart Mobility", "Smart Living", "Smart Environment", "Smart People", "Smart Government" and "Smart Economy", the Hong Kong SAR Government can take the lead in launching exemplary AI application scenarios and applying AI in public service sectors such as transportation, medical care, finance and education. This will enable the public to perceive the benefits of a smart city and technology innovation to their daily lives, popularise high-end technologies, enhance the quality of citizen's life and economic benefits, and lead the development of the AI industry. For example, in terms of smart mobility, the HKSAR Government can adopt AI technology to monitor road conditions in real time and make corresponding adjustments to improve traffic efficiency, and make use of real-time traffic

information to optimise route planning and provide more accurate forecasts of arrival time, which can facilitate the journey planning of the public. In terms of medical care, the HKSAR Government can step up the promotion of the application of AI in medical diagnosis, treatment and drug research and development. It can also consider the extensive application of local-developed AI smart medical care technology solutions in public medical care services. Furthermore, a sharing platform for AI technologies and data can be established to facilitate cross-departmental and cross-institutional cooperation and improve the application effectiveness and social benefits of AI technologies.

6. Empower the upgrade and transformation of industries in Hong Kong with AI

The HKSAR Government should strengthen cooperation with industries, encourage enterprises to proceed with technology innovations for public services, and promote the industrialisation and commercialisation of AI technologies. Besides, funding and support can be provided to encourage enterprises to invest in AI-related research and development and innovation projects, and facilitate the popularisation and application of the projects at a reasonable price. The HKSAR Government can also encourage chambers of commerce to enhance cooperation with the AI industry, initiate exchanges on technology development and application, share successful cases and explore new application scenarios. Meanwhile, enterprises should make good use of the subsidies provided by the Government. For example, the New Industrialisation and Technology Training Programme (NITTP) under the Innovation and Technology Fund of the Innovation and Technology Commission (ITC) provides subsidies to local enterprises on high-end technology training for their employees, which can provide AI-related training and education to employees in traditional industries, and help to enhance their relevant skills and application capabilities. In addition to improving efficiency, the application of AI can optimise work processes and enhance occupational safety. For example, the HKPC and the construction industry have jointly developed a real-time safety monitoring system equipped with the deep network algorithms and IP cameras. When a construction worker mistakenly enters a dangerous area or fails to put on reflective clothing or safety helmet, the system will instantly record and issue a warning to enhance the alertness of the worker, which facilitates the management to take the relevant follow-up measures or actions, thereby enhancing management efficiency.

7. Develop an international financing centre for AI enterprises

Financing is an important means of support for the development and innovation of AI enterprises. In order to attract more overseas AI enterprises to develop in Hong Kong, the HKSAR Government can strengthen cooperation with relevant public and private institutions to publicise the listing mechanism of the Hong Kong Exchanges and Clearing Limited (HKEX) for specialised technology companies that took effect in 2023, including allowing the listing of specialised technology companies with no revenue and no profit in Hong Kong, as well as the reforms of the listing rules of the Growth Enterprises Market in the future, with a view to attracting more AI enterprises to list in Hong Kong and bringing more venture capital funds to Hong Kong. At the same time, the HKEX's international reputation and favourable regulatory environment also provide investors with greater confidence and protection, in addition to ensuring that the listing rules keep pace with the times and are in line with international best practice. The HKSAR Government can offer corresponding support measures, including providing financing resources, streamlining listing procedures, improving the regulatory environment, etc., to attract more AI enterprises to list in Hong Kong and promote Hong Kong to become an international financing centre for AI enterprises.

Expand talent pool

8. Popularise AI education and accelerate the cultivation of cross-disciplinary "AI+ talent"

Universities and professional institutes should incorporate AI into the compulsory curriculum of more different departments, providing more comprehensive basic education on AI. They should also establish an effective assessment mechanism to ensure that students use AI with responsibility, so as to nurture cross-disciplinary "AI+ talent" to meet the needs of the AI industry for talent in different fields, and promote Hong Kong to become an international AI development centre with a competitive edge in terms of talent. Technology innovation elements can be incorporated into primary and secondary school curriculum to help teachers integrate technology innovation into class learning in a more systematically, so that students can have early exposure to innovative technologies and cultivate their interest and skills in AI. This can not only lay the foundation for their future academic and career development, but also identify more potential young talent to enter the AI field. The HKSAR Government, educational institutions and the industry should collaborate to provide more training and educational resources, and offer learning and development opportunities for students and professionals to cope with the challenges and seize the opportunities brought about by the booming AI technology.

9. Toward the most internationally livable city for AI talent

The HKSAR Government can enhance external publicity on Hong Kong's long-term plans for the development of the AI industry, optimise the existing talent admission programmes to benefit Hong Kong's advantages as an international city, and attract global AI talent to Hong Kong for development. As an international financial centre and an innovation and technology hub, Hong Kong has an excellent geographical location and abundant resources. The HKSAR Government can make good use of these advantages to actively promote Hong Kong as an ideal place for the development of the AI industry. At the same time, policies should be formulated to encourage AI enterprises to relocate non-local AI technical staff to Hong Kong and promote the building of an international AI talent team. This will help to attract more leading AI professionals to come to Hong Kong for development and enhance Hong Kong's attractiveness as "The Most Internationally Livable City for AI Talent".

Chapter I: Brief Introduction

1.1 Preface

The AI industry has grown rapidly over the past decade, with global corporate AI investments totaling USD 189.6 billion in 2022, a 13-fold increase from USD 14.57 billion in 2013 (Stanford University Institute for Human-Centered AI, 2023).[1] In addition, a survey by McKinsey (2022) found that the number of surveyed organisations adopting AI more than doubled from 20% in 2017 to 50% in 2022.[2] Since the launch of ChatGPT at the end of 2022, generative AI has entered a phase of rapid development. Coupled with the advances made in areas such as the Metaverse and voice cloning, 2023 can be characterised as an important year for the development of the AI industry.

Moreover, governments around the world have taken positive actions to promote the development of AI. According to OECD.AI (2023), 69 countries or regions have initiated more than 1,000 AI policies or initiatives to enhance AI readiness and improve regulatory policies.[3] Obviously, Hong Kong does not want to be left behind. On 22 December 2022, the HKSAR Government released the *Hong Kong Innovation and Technology Development Blueprint*, which listed "enhance the I&T ecosystem and promote 'new industrialisation' in Hong Kong" as one of the four broad development directions and "AI and data science" as one of the three key industries for development. The government wishes to leverage Hong Kong's strengths to attract Mainland and overseas technology enterprises to set up business in Hong Kong.

However, the policy objectives and development strategies of the AI industry in Hong Kong have not yet been clearly defined, and a series of issues remain to be resolved. Against this background, the HKPC collaborated with the HIEBS of HKU Business School to conduct the "Hong Kong AI Industry Development Study" from mid-2022 to mid-2023. Over a year, we conducted case studies on five cities, Singapore, Shanghai, Shenzhen, New York, and Switzerland, to review the development of their AI industry and related policy experience. In order to gain a deeper understanding of the current development of the AI industry in Hong Kong, we also conducted a questionnaire survey of 216 AI enterprises and focus group interviews with nearly 30 industry representatives.

In this report, we draw on case studies, questionnaire surveys, and focus group interviews to discuss how Hong Kong can accelerate the development of the AI industry. In Chapter II, AI is briefly introduced from an industry perspective, focusing mainly on its role in industrial upgrading. In Chapter III, we review the development of the AI industry in Hong Kong and examine the valuable experience of the selected cities. In Chapters IV to V, we present the key findings of the questionnaire survey, particularly the current situation of suppliers and users in Hong Kong's AI industry

[1] Stanford University Institute for Human-Centered AI (2023). *The AI Index 2023 Annual Report*. Retrieved from https://aiindex.stanford.edu/wp-content/uploads/2023/04/HAI_AI-Index-Report_2023.pdf
[2] McKinsey (2022). *The state of AI in 2022—and a half decade in review*. Retrieved from https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2022-and-a-half-decade-in-review#/
[3] OECD.AI (2023). *OECD's Live Repository of AI policies & strategies*. Accessed on 20/11/2023. Retrieved from https://oecd.ai/en/dashboards/overview

and their expectations towards the HKSAR Government. In the final section, we will provide a series of policy recommendations to promote the development of the AI industry in Hong Kong.

1.2 Study Objectives and Methodologies

This report combines qualitative and quantitative research methods, aiming to analyse the current status of Hong Kong and the development experience of other selected regions, and ultimately formulate a series of policy recommendations with empirical support to promote the development of the AI industry in Hong Kong.

The following research methods are used in this report:

(1) Desk Research and Case Study. By collecting, screening and analysing secondary information from academic journals, research reports, policy papers, databases, official websites, etc., this report endeavours to ensure the reliability of the information sources and to present to the readers the development environment of Hong Kong's AI industry, as well as the experience of the five leading regions or countries, namely Singapore, Shanghai, Guangzhou, New York and Switzerland.

(2) Individual Interview and Focus Group Interview. A total of five rounds of individual interviews and three rounds of focus group interviews were conducted, involving nearly 30 representatives of AI suppliers and enterprises in the AI application from a wide range of sectors, including leading companies, small and medium-sized enterprises (SMEs), academia, and industry associations. By analysing the interview data, this report presents the industry's views on the development of the AI industry in Hong Kong and their expectations of the HKSAR Government.

(3) Surveys. In this study, a questionnaire survey was conducted on 216 Hong Kong AI suppliers to show readers the operation of Hong Kong AI companies from the perspectives of industry chain, computing power, data, talents, investment and operation. In addition, a questionnaire survey was also conducted on 267 Hong Kong enterprises in the AI application, covering a wide range of sectors, including retail and catering, personal services, professional services, information and communications, finance and insurance, manufacturing, construction, logistics, and real estate.

Chapter II: Overview of Artificial Intelligence

2.1 Definition of Artificial Intelligence

According to IBM, "Data science combines math and statistics, specialised programming, advanced analytics, artificial intelligence (AI), and machine learning with specific subject matter expertise to uncover actionable insights hidden in an organisation's data."[4] In the simplest terms, AI is a field that combines computer science and robust datasets to enable problem-solving.[5]

Stuart Russell and Peter Norvig (1995) proposed the most widely cited definition of AI: "the designing and building of intelligent agents that receive percepts from the environment and take actions that affect that environment."[6] With the technological advances of the last few decades, AI has become increasingly complex and difficult to define. Nevertheless, some industry experts have tried to define AI from an industry perspective in recent years.

In the context of Industry 4.0, the Institute of Electrical and Electronics Engineers (2020)[7] defines Industrial Artificial Intelligence (IAI) as a systematic discipline focusing on the development, validation, deployment and maintenance of AI solutions (in their varied forms) for industrial applications with sustainable performance. The research areas of IAI include machine learning, natural language processing, and robotics, which can be regarded as enablers for systems to perceive their environment, process acquired data, solve complex problems, and learn from experience to solve specific tasks. IAI can also be seen as a core technology to enhance the automation of industrial systems, which aims to enhance human productivity rather than replace humans.

Considering the vast amount of digital information in manufacturing, IAI differs from Artificial General Intelligence (AGI) in five aspects (IEEE, 2020)[8]:

- Hardware and software: Emphasis is placed on real-time processing capabilities, which are critical to ensuring industrial-grade reliability, high-security standards, and seamless interconnectivity.
- Data: A large volume of data from different units and products is required, and the velocity of data is highly varied.

[4] IBM. *What is data science?* Retrieved from https://www.ibm.com/topics/data-science
[5] IBM. *What is artificial intelligence?* Retrieved from https://www.ibm.com/topics/artificial-intelligence
[6] Russell, S., & Norvig, P. (1995). *Artificial Intelligence: A Modern Approach*. Retrieved from http://aima.cs.berkeley.edu/index.html
[7] Institute of Electrical and Electronics Engineers (2020). *Industrial Artificial Intelligence in Industry 4.0 - Systematic Review, Challenges and Outlook*. Retrieved from https://ieeexplore.ieee.org/abstract/document/9285283
[8] Institute of Electrical and Electronics Engineers (2020). *Industrial Artificial Intelligence in Industry 4.0 - Systematic Review, Challenges and Outlook*. Retrieved from https://ieeexplore.ieee.org/abstract/document/9285283

- Algorithms: The integration of physical, digital, and heuristic knowledge is required to handle highly complex model management and deployment.
- Decision-making: Tolerance for error is generally low, and efficiency is critical for large-scale optimisation problems.
- Objective: To create value by reducing scrap, improving quality, enhancing operational efficiency, and speeding up the ramp-up times.

2.2 Artificial Intelligence: An Emerging Industry

AI research was once equally divided between academia and industry, but today, industry is taking control of the AI field. Ahmed & Thompson & Wahed (2023)[9] found that only 21% of Ph.D. graduates majoring in AI from North American universities were employed by private companies in 2004, while this proportion increased significantly to approximately 70% in 2020. From an output perspective, the industry's share of the top 10 AI models soared from 11% in 2010 to 96% in 2021.

AI has been increasingly recognised as an industry. From a supply chain perspective, AI can be broadly categorised into the base layer (upstream), the technology layer (midstream), and the application layer (downstream). Business at the base layer involves computing power chips (e.g., graphics processing units), devices that collect information (e.g., sensors and cameras), servers, high-performance computing power centres, cloud-based platforms, and data services (e.g., data storage and retrieval systems).

Business at the technology layer involves deep learning algorithms (e.g., convolutional neural networks and recurrent neural networks), AI technologies (e.g., computer vision, speech recognition, natural language processing, and knowledge graphs), and software that supports machine learning and other AI technologies (e.g., PyTorch, TensorFlow, and Caffe).

The business at the application layer includes AI products (e.g., visual products, voice assistants, autonomous driving, and robots) and AI solutions (e.g., text and video creation, face and voice recognition, object detection, predictive analytics, and automation and personalised services). These AI products and solutions can be applied in areas such as smart manufacturing, healthcare, finance and logistics.

With the resurgence of AI, there is growing interest in investing in AI companies. Today, many of the world's top companies are considered AI companies because of their significant investments and R&D in AI technology, including Apple, Microsoft, Google, Amazon, Tesla, NVIDIA, TSMC, and Meta.

[9] Ahmed, N., Thompson, N., Wahed, M., (2023). *The growing influence of industry in AI research*. Science. Retrieved from https://www.science.org/doi/10.1126/science.ade2420

2.3 Artificial Intelligence: A Game Changer for Business

The economic significance of AI will be even greater if we think of it as a game changer for all industries rather than just an ordinary industry. In view of AI's outstanding capability to provide personalised, automated detection and real-time data analysis services to various industries, its role as a tool to facilitate industrial upgrading is obvious, and there are numerous relevant cases.

In finance, for example, JPMorgan Chase built a specialised team of more than 900 data scientists, 600 machine learning engineers, 200 top AI researchers, and about 1,000 data managers. The team aims to realise USD 1.5 billion in business value by the end of 2023 through 300 AI use cases in risk management, marketing, customer experience, fraud prevention, and more.[10] A more concrete example is Capital One's Eno application, which uses natural language processing to provide customers with a ready-to-use messaging assistant. Eno can send messages to customers to answer questions and help them protect their accounts and monitor their daily spending.[11]

In healthcare, AI is revolutionizing the process of disease diagnosis, drug development, pharmaceutical manufacturing, and personalised treatment. For example, Novartis, an international healthcare company, has become one of the pioneers in utilizing AI to drive healthcare innovation. In the area of research, Novartis has partnered with Microsoft to develop an AI-powered diagnostic tool that helps detect leprosy early.[12] In addition, Novartis has also established an artificial intelligence innovation laboratory, focusing on research areas such as intelligent molecular design, clinical effect optimisation, and personalised intelligent drug dispensing.[13] In the area of operations, Novartis has partnered with Amazon Web Services to improve the efficiency of pharmaceutical production procedures and supply chain management by utilizing machine learning and artificial intelligence technologies to predict machine failures, develop Digital Twin, and build demand forecasting models.[14] In healthcare services, Novartis has partnered with Tencent to launch the "Heart Care AI" smart platform (AI Nurse), a digital platform that supports Chinese patients in managing heart disease by focusing on patient needs, effectively improving prognosis and reducing the need for hospitalisation.[15]

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[10] JP Morgan Chase & Co (May 2023). *Investor Day – Global Technology, Transcript*. Retrieved from https://www.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/investor-relations/documents/events/2023/jpmc-investor-day-2023/JPM-Investor-Day-2023-Final-Transcript_Global-Technology.pdf

[11] More information on: https://www.capitalone.com/digital/eno/

[12] More information on Novartis (2020a). *AI-powered Diagnostic Tool to Aid in the Early Detection of Leprosy*. Retrieved from https://www.novartisfoundation.org/news/ai-powered-diagnostic-tool-aid-early-detection-leprosy

[13] More information on: https://www.novartis.com/about/strategy/data-and-digital/artificial-intelligence/ai-innovation-lab

[14] More information on Novartis (2019). *Amazon Web Services (AWS) announces strategic collaboration with Novartis to accelerate digital transformation of its business operations*. Retrieved from https://www.novartis.com/news/amazon-web-services-aws-announces-strategic-collaboration-novartis-accelerate-digital-transformation-its-business-operations

[15] More information on Novartis (2020b). *AI Nurse set to transform standards of care for heart failure patients in China*. Retrieved from https://www.novartis.com/news/ai-nurse-set-transform-standards-care-heart-failure-patients-china; Novartis (2021). *AI Nurse evolving for heart failure patients in China*. Retrieved from https://www.novartis.com/stories/ai-nurse-evolving-heart-failure-patients-china

AI is also receiving increasing attention in the green industry for its capability to provide solutions to reduce carbon emissions. The Directorate-General for Internal Policies of the Union (2021) conducted a study on AI solutions, stating that they could help reduce energy consumption in various sectors.[16] For example, AI can be used to anticipate the power demand of a building during its use and to detect malfunctioning appliances, thereby reducing unnecessary energy consumption. AI can also improve transportation efficiency by optimizing route planning and designing energy-efficient batteries and vehicles. According to Mortier[17] (2020) and IEEE Transmitter[18] (2023), one of the biggest challenges in adopting renewable energy is the difficulty in predicting supply, which reduces grid stability. AI may be the key to solving this problem, as it has the superior computing power to digest the massive amounts of real-time data generated by renewable energy to achieve more accurate predictions and optimal decisions. For generation companies and energy traders, more accurate forecasts of renewable energy supply in a shorter time mean more efficient adjustment of their market position and better financial returns.

AI is playing an increasingly important role in the development of smart cities around the world. Smart devices that collect and transmit data in real-time, such as sensors and surveillance cameras, are more commonly deployed in every corner of cities than ever before. By leveraging machine learning, algorithms, and predictive analytics, the government can analyse large amounts of data to optimise city services and improve governance effectiveness.

Considering that smart factories need to digest large amounts of data[19], the adoption of AI is indispensable. According to the research of the Institute of Electrical and Electronics Engineers (IEEE), the application of AI in the manufacturing industry focuses on the following four areas (IEEE, 2020)[20]:

- **Process optimisation:** IAI provides valuable insights for predicting energy consumption, predicting demand, and solving optimisation problems[21]. It can help factories make smarter data-driven decisions and improve profitability, sustainability and efficiency in the manufacturing process.
- **Quality control:** The complex multi-stage manufacturing process, such as assembly and processing, coupled with unforeseen interfering factors, creates challenges in

[16] Directorate-General for Internal Policies of the Union, Herold, A., Gailhofer, P., Urrutia, C. (2021). *The role of artificial intelligence in the European Green Deal*, European Parliament. https://data.europa.eu/doi/10.2861/882830
[17] Mortier, T. (2020). *Why artificial intelligence is a game-changer for renewable energy*. Ernst & Young. Retrieved from https://www.ey.com/en_gl/power-utilities/why-artificial-intelligence-is-a-game-changer-for-renewable-energy
[18] IEEE Transmitter (2023). *Why Edge Computing and AI May Be Key To Renewable Energy Adoption*. Retrieved from https://transmitter.ieee.org/why-edge-computing-and-ai-may-be-key-to-renewable-energy-adoption/
[19] According to GP. Bullhound (2019), manufacturing generates enormous data at about 1,812 petabytes (PB) every year.
[20] Institute of Electrical and Electronics Engineers (IEEE, 2020). *Industrial Artificial Intelligence in Industry 4.0 - Systematic Review, Challenges and Outlook*. Retrieved from https://ieeexplore.ieee.org/abstract/document/9285283
[21] An optimisation problem refers to finding the best solution out of all feasible solutions.

ensuring product quality. IAI can ensure product quality by utilizing real-time data to detect potential defects automatically and early in the production process.

- **Predictive maintenance:** Unplanned downtime is costly in the manufacturing industry. IAI can be used to detect potential problems and increase machine uptime. It does this by processing data from multiple heterogeneous sources and modelling the severity of degradation in the performance of the manufacturing machine.
- **Human-machine collaboration and ergonomics:** IAI builds collaborative environments between humans and robots to support human-centred work tasks on the shop floor, making their tasks easier and more efficient while improving operator well-being and safety.

It has become increasingly common for factories to use AI technology. Technologies such as machine vision, 3D photocopying, Industrial Internet of Things, edge computing, cloud data, machine learning, and robots are often used to automate factory operations and create a "lights out" production environment.

A case study of AI application in manufacturing industry

Athena 3D Manufacturing is an additive manufacturing service provider founded in 2019. Prior to the successful automation of the factory using AI, Athena's printers were always idle after completing work at night until the operator replaced the print bed the next morning before it could resume operation. Today, Athena uses a one-stop system featuring the FANUC CRX-10iA cobot to enable the printers to operate according to programming specifications. When the printer job is complete (usually at 3 a.m.), the cobot automatically removes the print bed, places it on a shelf, and puts the clean print bed on the printer. The printer then starts the next job through the application programming interface. This automation allows Athena's employees to leave the factory at 5 p.m. while keeping the factory in production 24/7.[22]

This chapter provides a brief overview of AI from an industry perspective. In the subsequent chapters, we focus on the situation in Hong Kong and other cities with a view to gaining policy experience in promoting the development of the AI industry.

[22] Fanuc (2023). *ATHENA Achieves Lights-Out Production*. Retrieved from https://www.fanucamerica.com/news-resources/articles/athena-achieves-lights-out-production

Chapter III: Development of the AI Industry in Hong Kong and Selected Regions

3.1 Hong Kong

3.1.1 International Rankings

Hong Kong needs to catch up in AI development. In the Global AI Index prepared by Tortoise in 2023, Hong Kong merely ranked 32nd out of 62 countries or regions. Although Hong Kong fared well in its commercial and infrastructure performance, ranking 6th and 10th, respectively, it simply ranked 35th to 52nd in other pillars, including talent, operating environment, research and government strategy. Concerning scale and intensity, Hong Kong achieved a modest performance, ranking 27th and 30th.[23]

In terms of the best locations for AI offices, Hong Kong's competitiveness scored[24] 52.14/100, lagging behind Shanghai, Tokyo, Singapore, and other Asian cities (fDi Intelligence,2022a).[25] While regarding the best locations for data centres, Hong Kong's competitiveness scored[26] 48.47/100, falling behind Beijing, Shanghai, Tokyo, Shenzhen, Chongqing, Singapore, Mumbai and other cities (fDi Intelligence, 2022b).[27]

3.1.2 Challenges and Opportunities

The global race for the development of the AI industry has just kicked off. For Hong Kong, challenges and opportunities are concurrent in this race. Data, algorithms and computing power are the basic elements of developing AI. Data is considered the gold of the 21st century. However, due to political factors, it is not easy to find somewhere collecting data from both the East and the West. Nevertheless, the world does need such a place to create numerous commercial opportunities. Over the past decades, Hong Kong has been acting as a "super-connector" between Mainland China and other regions worldwide. After its return to China, Hong Kong has enjoyed the unique advantage of "one country, two systems" and can be considered a popular option in aggregating global data. Suppose Hong Kong can be transformed into a global data centre. In that case, it is no surprise that Hong Kong will become an ideal location for international AI giants to expand their business and may even gain the discourse power to establish AI standards and norms.

Algorithms are critical to AI training, especially in identifying patterns, optimising performance, improving efficiency, generalising applications, providing analytical insights, and other aspects. Talent is the key to algorithm development, and Hong Kong has a significant

[23] Tortoise (2023). *The Global AI Index*. Retrieved from https://www.tortoisemedia.com/intelligence/global-ai/#further_reading
[24] Competitiveness is calculated as a function between cost and quality of setting up a 900 square metre office with a team of 70 people focused on AI.
[25] fDI Intelligence (2022a). *India and China stand out as world's best places for AI labs.* Retrieved from https://www.fdiintelligence.com/content/data-trends/india-and-china-stand-out-as-worlds-best-places-for-ai-labs-80947
[26] Competitiveness is calculated as a function between cost and quality of setting up a 465 square metres data centre with a team of 30 people
[27] fDI Intelligence (2022b). *Global cities fight for data centre supremacy*. Retrieved from https://www.fdiintelligence.com/content/locations/global/global-cities-fight-for-data-centre-supremacy-81428

advantage in higher education. The Chinese University of Hong Kong, City University of Hong Kong, and Hong Kong Polytechnic University were among the top 30 Best Global Universities for Artificial Intelligence (U.S. News, 2023)[28], ranking 3rd, 25th and 28th, respectively. The Hong Kong University of Science and Technology has also incubated many well-known AI enterprises, such as DJI and Googol Technology. However, from an industry perspective, Hong Kong still lacks world-leading AI companies, quality AI-related work opportunities, and an advanced manufacturing industry, which obstructs the advancement of AI-related talents and companies and affects their desire to stay in Hong Kong for development. Fortunately, the situation above seems to be improving. Specifically, there is a sign that Hong Kong reported a relative growth ratio of 1.37 in the relative AI hiring index in 2022, the highest of all the regions in the survey, more elevated than Spain (1.19), Italy (1.19), and other areas. (Stanford University Human-Centered Artificial Intelligence, 2023).[29]

Computing power is considered the petroleum of the 21st century, and the lack of it may be the biggest challenge facing Hong Kong. From the supply side perspective, at present, Hong Kong still fails to mass-produce high-quality AI chips to meet the demand of its market. Therefore, importing AI chips from other regions may be a reasonable option, but the stability of imported chips is also decreasing due to the China-United States tech war. On the other hand, Hong Kong's market size needs to be further expanded so as to support the substantial investment required to develop computing power. Many regions establish supercomputing centres to provide computing resources. Hong Kong needs to step up in this respect.

3.1.3 Direction of Government Initiatives

The HKSAR Government has shown its commitment to boosting the development of the AI industry. Since 2018, the HKSAR Government has invested more than HKD150 billion to support the progress of the innovation and technology industry. One of the major initiatives is to provide over HKD20 billion for the InnoHK Clusters in funding to promote the advancement of life sciences, AI and robotics.[30] Currently, there are 14 laboratories under the AIR@InnoHK research cluster focusing on research and development in AI, big data analytics, advanced materials and robotics for applications in various fields such as manufacturing, healthcare, logistics and construction.[31]

Nurturing the Ecosystem

On the upstream front, the 2023-24 *Budget* announced an appropriation of HKD3 billion to further enhance basic research in frontier technological areas including AI and quantum technology. The relevant appropriation will be leveraged to attract outstanding technology professionals, research teams and enterprises in the Mainland and overseas to Hong Kong, thereby boosting Hong Kong's international research collaboration.[32]

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[28] U.S. News (2023). *Best Global Universities for Artificial Intelligence*. Retrieved from https://www.usnews.com/education/best-global-universities/artificial-intelligence
[29] Stanford University Human-Centered Artificial Intelligence (2023). *Artificial Intelligence Index Report 2023*. P.180. Retrieved from https://aiindex.stanford.edu/wp-content/uploads/2023/04/HAI_AI-Index-Report_2023.pdf
[30] InnoHK. *Why HK- Strong government support*. Retrieved from https://www.innohk.gov.hk/en/why-hk/#where- your-work-is-trusted-and-respected
[31] InnoHK. *AIR@InnoHK*. Retrieved from https://www.innohk.gov.hk/en/r-d-centres/air-innohk/
[32] *The 2023-24 Budget*. Paragraph 76.

On the midstream front, the Chief Executive announced in the *2022 Policy Address* that HKD10 billion would be earmarked to launch the "Research, Academic and Industry Sectors One-plus Scheme", which would fund at least 100 research teams in universities that have good potential to become start-ups and promote the industrialisation of R&D outcomes.[33]

On the downstream front, the Innovation, Technology and Industry Bureau, in collaboration with the Office for Attracting Strategic Enterprises, will make use of the HKD30 billion Co-Investment Fund, the HKD5 billion Strategic Tech Fund, as well as the land provided in the Hong Kong-Shenzhen Innovation and Technology Park in the Lok Ma Chau Loop and around San Tin, to attract high-potential or representative enterprises in the Mainland China or overseas to Hong Kong, focusing on advantageous strategic technology industries, such as AI and data science.[34]

Upgrading Computing Facilities

In the 2023-24 *Budget*, the Financial Secretary announced a feasibility study on the development of an AI supercomputing centre. [35] The HKSAR Government aims to establish an AI supercomputing centre in Cyberport in phases from 2024 onwards, with a view to supporting the huge demand for computing power from R&D and relevant sectors and promoting industry development.[36]

Another initiative is to support the establishment of the Hong Kong Microelectronics Research and Development Institute, making it a leading organisation in the Asia-Pacific region. The institute's mission is to facilitate collaboration among universities, R&D centres and the industry to accelerate the "1 to N" transformation of R&D outcomes and further enhance the innovation and technology ecosystem. [37] In the 2023 *Policy Address*, it is stated that the institute's research direction includes the third-generation semiconductor core technology. The Microelectronics Centre will also be commissioned in 2024 to provide advanced infrastructure and hardware facilities designated for microelectronics.[38]

Building Hong Kong as a Global Data Centre

The HKSAR Government hopes to maintain the status quo of international data inflow into Hong Kong on the one hand and is committed to boosting the data flow between Hong Kong and Mainland China on the other hand.

A recent breakthrough is the signing of the *Memorandum of Understanding on Facilitating Cross-boundary Data Flow Within the Guangdong-Hong Kong-Macao Greater Bay Area* by the Innovation, Technology and Industry Bureau and the Cyberspace Administration of China

[33] *The Chief Executive's 2022 Policy Address*. Paragraph 39.
[34] Innovation, Technology and Industry Bureau (2022). *Hong Kong Innovation and Technology Development Blueprint*. pp.30-31.
[35] *The 2023-24 Budget*. Paragraph 50.
[36] *The Chief Executive's 2023 Policy Address*. Paragraph 61.
[37] *The 2023-24 Budget*. Paragraph 77.
[38] *The Chief Executive's 2023 Policy Address*. Paragraph 61.

in June 2023 in Beijing, with a view to facilitating the convenient and orderly flow of cross-boundary data from the Mainland to Hong Kong.[39]

Providing Guidelines on AI Development and Application

The public sector in Hong Kong has provided guidelines on AI development and application to address public concerns. In 2021, the Office of the Privacy Commissioner for Personal Data issued the *Guidance on the Ethical Development and Use of AI*[40] to assist organisations in complying with the relevant provisions under the *Personal Data (Privacy) Ordinance* (Cap. 486) in the development and use of AI. This guidance has been distributed to over 450 organisations, including government departments, statutory authorities, chambers of commerce, and professional bodies.[41]

In 2023, the Office of the Government Chief Information Officer formulated the *Ethical Artificial Intelligence Framework* to provide practice guidance to government bureaus and departments to help public servants better manage risks to privacy, data security and other aspects during the application of AI.[42]

3.1.4 Views of Focus Group Respondents

From the focus group interviews, we understand that the respondents generally hope that the Hong Kong Government can work more actively to accelerate the development of the AI and data science industry. Their views are summarised as follows:

Leveraging Hong Kong's Unique Strengths

Hong Kong is primarily advantageous in its excellent talent network, smooth information flow, sound protection for intellectual property rights, legal and commercial systems aligning with the international community, mature development of specific industries such as finance, and ability to break through the constraints of its small market size, enjoying strong support of the Mainland and being closely connected to the world. For example, China Unicom has shared its R&D costs in Hong Kong with its large Mainland market. It utilises overseas data and corpus for large-scale AI model training, and the output serves its approximately 320 million Mainland China customers and even global customers.

The development of the AI industry requires well-established hardware and software facilities. Thus, it is necessary to take the entire industry chain into account. Massive R&D investment means that the development of AI needs to be supported by commercialisation revenues in particular. Hong Kong must consider how to harness its distinctive strengths to help AI

[39] Office of the Government Chief Information Officer (2023a). *ITIB and CAC signed Memorandum of Understanding*. Retrieved from https://www.ogcio.gov.hk/en/news/press_releases/2023/06/pr_20230630.html
[40] Office of the Privacy Commissioner for Personal Data (2021). *Guidance on the Ethical Development and Use of Artificial Intelligence*. Retrieved from https://www.pcpd.org.hk/english/resources_centre/publications/files/guidance_ethical_e.pdf
[41] The Government of the HKSAR (2023). *LCQ10: Protecting personal data when developing and using artificial intelligence*. Retrieved from https://www.info.gov.hk/gia/general/202305/10/P2023051000271.htm?fontSize=1
[42] Office of the Government Chief Information Officer (2023b). *Ethical Artificial Intelligence Framework*. Retrieved from https://www.ogcio.gov.hk/en/our_work/infrastructure/methodology/ethical_ai_framework/

enterprises explore the Greater Bay Area and even the global market. It must also consolidate its advantages in areas such as intellectual property rights protection to create a favourable environment for the local commercialisation of AI.

Boosting Data Flow and Information Sharing

Due to inadequate information sharing, enterprises tend to repeatedly allocate resources in the same area, leading to a common wastage of resources. On the other hand, the stringent cross-border data transfer policy adopted by the Mainland has posed certain obstacles to its AI enterprises' collaboration with their counterparts in the United States and other regions. Hong Kong can strive to play an essential role in this situation, studying how to provide a convenient platform for domestic and even foreign enterprises to facilitate information sharing and data flow.

Data is considered a necessary condition for developing the AI industry. As an international city within China, Hong Kong should endeavour to import data from overseas and the Mainland. In addition, the government, universities, and enterprises possess a large amount of data. However, there is a significant data governance problem, making it difficult for all parties to exchange data with each other and effectively utilise the existing data resources. The Government can study and provide standards and guidelines to instruct the industry in regulating data governance so as to create favourable conditions for data connectivity.

Accelerating the Enhancement of Computing Power

Computing power is also necessary for the development of the AI industry, as insufficient computing power fails to process AI training. However, Hong Kong currently suffers from a severe lack of computing power. Even though the Hong Kong Government plans to build an AI data centre, it is estimated to be completed and put into operation by 2024 or 2025. The progress may fail to catch up with the rapid changes in the AI industry. Therefore, the government must expedite the data centre's construction progress in Hong Kong. With respect to the positioning of the data centre, considering that Shenzhen, Vietnam, Thailand, and other places have already established fairly large-scale computing centres, Hong Kong's computing centre should pool resources to develop business types with comparative advantages, avoiding cutthroat competition with neighbouring regions as far as possible.

Developing Industries to Retain Talent from Home and Abroad

The universities in Hong Kong nurture a wealth of talent in AI and data science every year. However, the talent often fails to find matching employment opportunities in Hong Kong after graduation and then flows to Shenzhen, Beijing, Shanghai, and other places for development. Instead of cultivating and attracting talent, Hong Kong's primary talent challenge is "how to retain talent". To tackle the problem at its root, industries should be promoted to attract more leading technology enterprises to develop in Hong Kong, thereby creating more quality employment opportunities.

The pool of talent in Hong Kong should comprise both local and foreign talent. The Government should not only issue preferential policies to attract foreign talent but also emphasise the nurturing of local talent. Cultivating talent in AI and data science should not

be limited to technical specialists but should also include application-oriented generalists, which is particularly important for promoting the upgrading and transformation of various industries using AI. In addition, Hong Kong should also proactively cooperate with other regions to enhance the international recognition of its local AI-related courses and certificates. For a relatively long period in the past, due to Hong Kong's shortage of supporting industries, it has lost a wealth of local talent to other regions for development, but at the same time, it has also accumulated a rich network of international talent. While promoting the development of the AI industry, Hong Kong might as well provide targeted facilitation policies for local talent with international experience to encourage them to return to Hong Kong for development.

As a high-tech industry, AI has become extremely sensitive in the general environment of tension between China and the United States. Some respondents who are U.S. citizens had worked in Mainland China but eventually chose to work in Hong Kong after their nationality hindered their career development. Under "one country, two systems", Hong Kong may, based on ensuring national security, consider providing more room for development for such talent to attract them to develop in Hong Kong. This can leverage Hong Kong's distinctive strengths as a Special Administrative Region in China and make a unique contribution to the country's attraction of international talent.

Promoting Industrial Applications of AI

AI is not only an industry but also an important tool to facilitate the development of other industries. In the development of AI in Hong Kong, the final phase of industrial application is crucial. However, despite abundant opportunities in Hong Kong, only a few have been successfully seized. For the financial and life sciences industries, on which Hong Kong relies for its survival, as well as other sectors such as advanced manufacturing, healthcare, and transportation, the Government should consider how to introduce policies to utilise AI to empower the advancement of these industries.

AI can create possibilities for solving social problems, leading to many business opportunities. There are several projects worthy of the Government's extended support. For example, the Hong Kong Polytechnic University has collaborated with the Jockey Club to launch a gerontechnology project, which uses AI technology to help the elderly diagnose the health conditions of their knees. Hong Kong may also consider encouraging the utilisation of AI models to develop surgical manipulators with real-time flexibility to remove doctors' manpower constraints. Applying AI technology in autonomous driving and smart manufacturing is also significant in preventing technical failures. Currently, some of the Government's outsourcing projects have already included additional requirements for the application of AI, but many private projects do not have such requirements. The Government can encourage outsourcing projects in different industries to introduce relevant requirements, creating an atmosphere for the industrial application of AI.

The recent rise of ChatGPT has stimulated a boom in large-scale AI models. However, since ChatGPT causes problems of disinformation and falsification, it can only be used for general purposes, not in specialised areas. Therefore, apart from developing large-scale AI models, Hong Kong should also develop "small-scale models" specialised for application in specific sectors and formulate norms for the application of AI in various industries.

Data sharing may be difficult for some industries due to commercial interests or other considerations. Hong Kong may consider encouraging the application of federated learning to train AI models, as this method ensures an effect of "sharing models while maintaining data security", offering maximum protection for privacy while training AI models.

Adopting More Proactive Supportive Policies

AI and data science are highly innovative industries that require adventurous start-ups to participate. However, even start-ups with development potential may not be able to afford the enormous and uncertain upfront investment cost for training AI on their own. For example, the leap from tens of billions to hundreds of billions of AI model parameters requires a large number of expensive high-performance GPUs. Therefore, the application scope of the relevant funding policies in Hong Kong should consider including upfront R&D investment rather than limiting them to enterprises that have successfully developed AI technology. Additionally, the Government should also allocate resources to boost collaboration between start-ups and large enterprises. In terms of resource utilisation, Hong Kong has to consider the revenue conversion of R&D expenditures, particularly whether the funding policies can effectively promote the commercial application of AI and whether the resource allocation can tie in with the development of key industries.

Another major challenge for AI start-ups in Hong Kong is the cutthroat competition. As Hong Kong has a relatively mature economy and a higher demand for market services, it is difficult for start-ups to meet the relevant requirements compared with large enterprises. For instance, some of the Government's outsourcing projects require a 24/7 service commitment, which is detrimental to start-ups with scarce human resources and often puts them at a disadvantage in competitive bidding. In order to maintain the vitality of AI development in Hong Kong, the Government should create a relatively level playing field for start-ups. Regarding specific grants, the Government should speed up the approval of funds and provide ample funding for start-ups with development potential, but it can set limitation clauses of funds to ensure that the projects and talent will ultimately stay in Hong Kong.

For application, compared with large enterprises, SMEs have a weaker grasp of market information and fewer available resources. The Government and relevant public organisations should introduce more supportive measures to help SMEs adapt to the era of AI and even use AI to boost business upgrading and transformation. Public organisations can also act as intermediaries by introducing specific cases of AI technologies and products to certain industries, matching suppliers with potential users. Moreover, as SMEs generally do not develop software for self-use and it is not easy to procure software bilingual in Chinese and English, the Government may shore up the development of AI software targeting the local market in Hong Kong and encourage the local industry to use the relevant products.

At present, the governments of Beijing and Shanghai invest a lot of money every year to promote the development of the AI industry. At the same time, Shenzhen's AI policies emphasise industrial application, but the policy support is still relatively passive. In order to play a significant role in developing the AI industry nationwide, Hong Kong, and even the entire Guangdong-Hong Kong-Macao Greater Bay Area, must issue more proactive supportive policies.

Deepening Guangdong-Hong Kong Cooperation

Notwithstanding the system differences between Guangdong and Hong Kong, there are still great prospects for cooperation between the two sides in AI and data science, which can be advanced in pilot projects. Overall, Hong Kong has an edge in technology R&D and internationalisation, while Guangdong possesses massive data and a large market size. Hong Kong should take the initiative to coordinate top-level policies with Guangdong to achieve a division of labour based on their respective comparative advantages in the AI industry chain and connect with the entire Mainland market through the platform in Shenzhen. At the implementation level, due to limitations such as technological interconnection and compliance policies, there are still computing and other barriers between Hong Kong and Guangdong, which need to be further resolved through cooperation between the governments of the two sides so as to ensure the cross-border flow of production factors, such as funds, data, computing power, talent, and information.

On the other hand, Guangdong and Hong Kong should focus on boosting the development of the AI industry. For example, Guangdong and Hong Kong can jointly reward the R&D of AI technology and products to encourage industrial application. So far, Beijing and Shanghai have already formed an “Academic Ceiling + Enterprise Ceiling” leading platform, and the governments of Guangdong and Hong Kong can explore the potential to foster related cooperation. Drawing on the successful experience of Microsoft’s collaboration with OpenAI, the HKSAR Government may encourage local university personnel to set up “small-sized but specialised” AI start-ups and carry out cooperation with large technology enterprises in Guangdong so that the local industry can receive support from the Mainland’s tech giants in terms of funds, data, and computing power.

Regulating and Managing AI

While AI has brought a lot of benefits to society, it has also given rise to multiple security and ethical concerns, such as disinformation and personal privacy exposure. In order to align AI development with the long-term interests of society, it is necessary for the Government to introduce policies and measures to regulate and manage the development of AI to ensure that it runs on the right track. This will also help stabilise citizens’ confidence and gain public support for advancing the AI industry. In any case, the era of AI is upon us and is irreversible. The Government should master the latest technology as soon as possible to cope with the malicious use of AI.

Summary

During the focus group interviews, respondents discussed the development of the AI and data science industry in Hong Kong. They raised several questions centring data, computing power, talent, start-up environment, industrial applications, Guangdong-Hong Kong cooperation, regulation and other aspects, generally holding that Hong Kong urgently needs to catch up with the progress it has already lagged behind. Looking at the policy of the HKSAR Government, the Government should have realized most of the problems and tried to introduce policies to solve them. However, it may take time for these policies to be implemented and settled before they can produce noticeable effects on the industry.

3.2 Singapore

As an international city in Asia, Singapore, whose economic, social, and cultural backgrounds are quite similar to those of Hong Kong and has consistently topped various AI lists, naturally serves as a key reference for Hong Kong.

3.2.1 AI Development Ranks Among the Top Worldwide

According to the Global AI Index prepared by Tortoise in 2023, Singapore ranked in the top three out of 62 regions, following the United States and China. With respect to the intensity, Singapore ranked first globally, reflecting its world-class efficiency in utilising its economic and demographic resources to drive the development of the AI industry.[43]

In terms of public services, Singapore excelled in the Government AI Readiness Index published by Oxford Insights in 2022, ranking second out of 181 regions and even leading the world in the Government pillar and the Data and Infrastructure pillar.[44]

In the realm of higher education, Nanyang Technological University and the National University of Singapore have been ranked by U.S. News as the second and fifth best global universities, respectively, in the field of AI from 2022 to 2023.[45] Singapore has also performed well in attracting foreign investment, securing 69 AI-related foreign direct investment projects between 2016 and 2021 and 138 data centre-related foreign direct investment projects between 2003 and June 2022[46], both of which rank first in the world.[47]

The industry in Singapore is proactive in applying AI, as well. According to the Global AI Adoption Index 2022 released by IBM, 39% of companies in Singapore have deployed AI and 46% are exploring AI, higher than the global average of 34% and 42%, respectively.[48]

Policy support is a key factor in Singapore's leadership in AI development. Compared with Hong Kong, Singapore has already demonstrated its determination to promote AI development several years ago and has taken steps ahead in platform infrastructure and policy planning and implementation.

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[43] Tortoise (2023). *The Global AI Index*. Retrieved from https://www.tortoisemedia.com/intelligence/global-ai/#further_reading
[44] Oxford Insights (2022). *Government AI Readiness Index 2022*. Retrieved from https://static1.squarespace.com/static/58b2e92c1e5b6c828058484e/t/639b495cc6b59c620c3ecde5/1671121299433/Government_AI_Readiness_2022_FV.pdf
[45] U.S. News (2023). *Best Global Universities for Artificial Intelligence*. Retrieved from https://www.usnews.com/education/best-global-universities/artificial-intelligence
[46] fDI Intelligence (2022a). *India and China stand out as world's best places for AI labs*. Retrieved from https://www.fdiintelligence.com/content/data-trends/india-and-china-stand-out-as-worlds-best-places-for-ai-labs-80947
[47] fDI Intelligence (2022b). *Global cities fight for data centre supremacy*. Retrieved from https://www.fdiintelligence.com/content/locations/global/global-cities-fight-for-data-centre-supremacy-81428
[48] International Business Machines Corporation (2022). *IBM Global AI Adoption Index 2022*. Retrieved from https://www.ibm.com/downloads/cas/GVAGA3JP

3.2.2 National Supercomputing Centre (NSCC) Singapore[49]

The NSCC Singapore was established in 2015 with the support of the Agency for Science, Technology and Research of Singapore (A*STAR), the National University of Singapore, Nanyang Technological University, and the Singapore University of Technology and Design. The centre manages two petascale supercomputers, ASPIRE1 and ASPIRE 2A[50], which are used to support public and private organisations in conducting research using high-performance computing so as to advance development in areas such as AI, advanced manufacturing, and healthcare. As of June 2023, ASPIRE 2A (GPU Partition) ranked 197 in the world, with a computing power of 3.33 PFlop/s (Rmax), and ASPIRE 2A (CPU Partition) ranked 314 globally, with a computing power of 2.58 PFlop/s (Rmax).[51]

In 2021, the NSCC Singapore and the National University Health System (NUHS) inked a collaborative agreement to build a petascale supercomputer called Prescience, specifically designed to support AI projects of public healthcare organisations. [52] Prescience has been fully operational since 31 July 2023 in National University Hospital, which can apply Large Language Models (LLMs) for deep learning on NUHS's large databases, and all data training is conducted without the Internet connection, effectively protecting patient privacy. Currently, Prescience is primarily used to support the RUSSELL-GPT product and the SMILE AI projects. The RUSSELL-GPT can help healthcare professionals perform administrative tasks, such as writing patient case notes and referral letters, and predict the severity and progression of a patient's disease by analysing historical data. The SMILE AI project provides dentists with a fast oral scanning tool that enhances the visualisation of the scanned image, reducing the time between collecting a patient's dental information and starting treatment to less than five minutes.[53]

In addition to building the supercomputers, the NSCC Singapore actively cooperates with foreign research institutes to seek access to overseas supercomputers for local researchers. In 2021, the NSCC Singapore signed an agreement with Japan's Research Organisation for Information Science and Technology (RIST) to allow researchers in Singapore to apply for access to Japan's supercomputer, Fugaku.[54]

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[49] For details, please refer to: https://www.nscc.sg/
[50] For details, please refer to: https://www.nscc.sg/wp-content/uploads/2022/07/NUS-NSCC-i4.0-DC-V1.0-2.pdf
[51] Source: *Top 500 List- JUNE 2023*. Retrieved from https://www.top500.org/lists/top500/list/2023/06/
[52] National University Health System & National Supercomputing Centre (2021). *National AI Healthcare Initiatives get boost from RIE funding with new national supercomputer resource built and sited at NUHS. Singtel and NUHS to set up a 5G Indoor Network, a first for a public healthcare institution.* Retrieved from https://www.nscc.sg/wp-content/uploads/2021/12/NUHS-NSCC-MEDIA-RELEASE.pdf
[53] National University Health System & National University Centre for Oral Health & National Supercomputing Centre (2023). *NUHS LEVERAGES SUPERCOMPUTER TO DRIVE AI IN HEALTHCARE*. Retrieved from https://www.nuhs.edu.sg/sites/nuhs/NUHS%20Assets/News%20Documents/NUHS%20Corp/Media%20Releases/2023/Media-release-NUHS-leverages-supercomputer-to-drive-AI-in-healthcare.pdf
[54] National Supercomputing Centre & Research Organization for Information Science and Technology (2021). *Singapore researchers granted regular access to reigning world's top supercomputer in first-of-its-kind arrangement with Japan*. Retrieved from https://www.nscc.sg/wp-content/uploads/2021/11/Media_Release_RIST-NSCC-MOU_Project-Calls-to-Fugaku-final.pdf

3.2.3 AI Singapore[55]

Regarding policy planning, Singapore launched a national programme called AI Singapore in May 2017, aiming to bring together stakeholders such as R&D institutions and enterprises to consolidate Singapore's profound strength in the AI field and take its place on the world map. The programme mobilises several government departments and universities, with coordinating organisations including the National Research Foundation, Economic Development Board, Infocomm Media Development Authority, and Integrated Health Information Systems, as well as research partners such as the National University of Singapore, Nanyang Technological University, Singapore Polytechnic University, A*STAR.

AI Singapore reflects the Singapore government's policy direction to boost AI development, with six pillars including Research, Governance, Technology, Innovation, Products and LearnAI. Moreover, there are a number of sub-targets and specific measures to facilitate the achievement of the targets under each pillar. Specifically, AI Innovation is one of the noteworthy pillars, primarily aiming to accelerate AI application across industries through industry-centric programmes and talent deployment. Singapore has launched several supporting measures on this target, including Platforms Engineering, AI Readiness Index, AI Apprenticeship Programme, Chartered AI Engineer and 100 Experiments.

Platforms Engineering

The Platforms Engineering of AI Singapore is equipped with a cloud cluster with a high-performance workload and a well-developed support team to shore up AI Innovation and other pillars, empowering enterprises to solve business problems with AI. The cloud cluster, powered by Google Cloud Platform and Microsoft Azure, has over 7,000 x86 CPUs, 32 NVIDIA V100 GPUs, 0.5 PB of storage, and 100 G of Infiniband networks. Four support teams, including InfraOps, DataOps, MLOps, and SecureAI, build, operate, and optimise the internal software platforms to enable users to create AI solutions.

AI Readiness Index

In order to help enterprises assess their AI readiness and accelerate their AI adoption, AI Singapore has developed an assessment framework called the AI Readiness Index, which allows enterprises to obtain assessment results and corresponding recommendations by completing an electronic questionnaire on AI Singapore's official website. As shown in Figure 3-1, Singapore's AI Readiness Index results are generally categorised into four levels: AI Unaware, AI Aware, AI Ready and AI Competent. Enterprises can accelerate their AI adoption by participating in suitable development programmes on AI Singapore's platform based on their respective assessment results.

[55] For details, please refer to: https://aisingapore.org/

Figure 3-1 Explanation on the Classification of AI Readiness Index for Singapore and Corresponding Government Support Measures

	AI Unaware	AI Aware	AI Ready	AI Competent
Average Score	Less than 2.5	2.5 to 3.4	3.5 to 4.5	Greater than 4.5
Interpretation	Organisation might hear about AI, but is unaware of AI applications.	Organisation is aware of AI applications and could identify potential use cases.	Organisation has the capabilities to integrate pre-trained AI models into products or business processes.	Organisation has the capabilities to develop customised AI models and solutions for specific business needs.
Characteristics	Wait for vendors to convince with use cases and business value of AI and consume ready-made AI solutions.	Actively seek AI solutions to address business needs. Able to identify potential use cases for AI applications, and consume ready-made AI solutions.	Evaluate and seek AI APIs, SDKs and pre-trained AI models for use within business.	Have strategy and roadmap of AI deployment for organisation.
Recommendation	Increase AI literacy of organisation.	Consume ready-made, end-to-end COST AI solutions.	Prepare organisation to adopt and integrate AI solution. Broaden the organisation's understanding of AI Broaden understanding of AI to whole of organisation.	Deepen organisational AI capabilities. Broaden the organisation's understanding of AI Broaden understanding of AI to whole of organisation.
AI Singapore				
Advisory and Roadmaps			AI Advisory Programmes: Discovery Workshops, AI Ready Clinics for Leaders	
Skills and Training	AI For Everyone (AI4E), Data Analytics For Everyone			
		LearnAI: AI For Industry (AI4I), AIAP Field Guide		
				AI Certification
Capabilities			AI Apprenticeship Programme	
Innovation			100 Experiments	
Data and Tools		Makerspace Bricks		

Data source: AI Singapore (2023b)

In addition, AI Singapore also works with third parties to provide programme recommendations to enterprises using the AI Readiness Index for self-assessment, apart from recommendations from AI Singapore. For example, Figure 3-2 shows Google's recommended programmes:

Figure 3-2 Ratings of AI Readiness Index for Singapore and Corresponding Google Recommended Projects

	AI Unaware	AI Aware	AI Ready	AI Competent
Skills and Training	Kickstart Program with Pluralsight, Google Skills Ignition SG, Grow with Google		Google Cloud Professional ML Engineer Certification	
Capabilities		Google Colab	Google Cloud Research Credits, Google Colab, Google Partner/ Employer Consortium	
Innovation			Google for Startups	
Data and Tools		Google Public Data, Google Dataset Search		

Data source: AI Singapore (2023b)

AI Apprenticeship Programme and Chartered AI Engineer

Recognising the importance of nurturing Singaporean AI talent, Singapore has launched the AI Apprenticeship Programme, which requires that candidates must have technical competency with Python and AI/ML. Apprentices successfully admitted will receive a monthly training allowance of SGD3,500 to SGD5,500, depending on their qualifications, and will be required to work full-time for nine months, including two months of deepskilling and seven months of on-the-job training.[56]

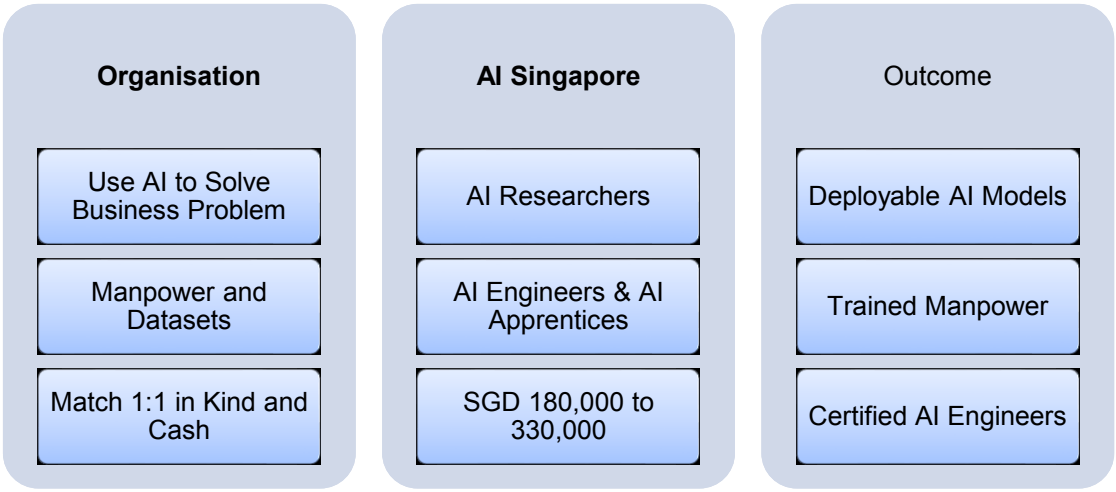
Furthermore, AI Singapore pioneered the AI Certified Engineer programme in 2019. The programme was subsequently taken over by the newly formed AI Professionals Association in 2020 and renamed the Chartered AI Engineer (CAIE) programme.[57] CAIE now has professional qualifications for Associate AI Engineer, Chartered AI Engineer Level 1, and Chartered AI Engineer Level 2, and has granted 151, 44, and four certifications, respectively.[58]

100 Experiments[59]

100 Experiments is AI Singapore's flagship programme dedicated to helping the industry solve business problems without an off-the-shelf AI solution. AI Singapore provides support for each approved project, including assigning engineers and AI apprentices to work on the programme for 9 to 18 months, as well as matching the 1:1 funding of SDG180,000 to 330,000 in kind and cash for the Principal Investigators from universities, A*STAR research institutes or other partners. Starting from 2020, the number of 100 Experiments projects has increased from 100 to 200. As of September 2023, the official website shows that a total of 110 projects have been approved, of which 73 have been completed and 37 are in progress.

[56] AI Singapore (2023c). *AI Apprenticeship Programme (AIAP®)*. Retrieved from https://aisingapore.org/innovation/aiap/
[57] AI Singapore (2023d). *Chartered AI Engineer (CAIE)*. Retrieved from https://aisingapore.org/innovation/caie/
[58] AI Professionals Association (2023). *CAIE Registry*. Retrieved from https://www.aip.org.sg/caie-registry/
[59] For details, please refer to: AI Singapore (2023e). *100 Experiments*. Retrieved from https://aisingapore.org/innovation/100e/

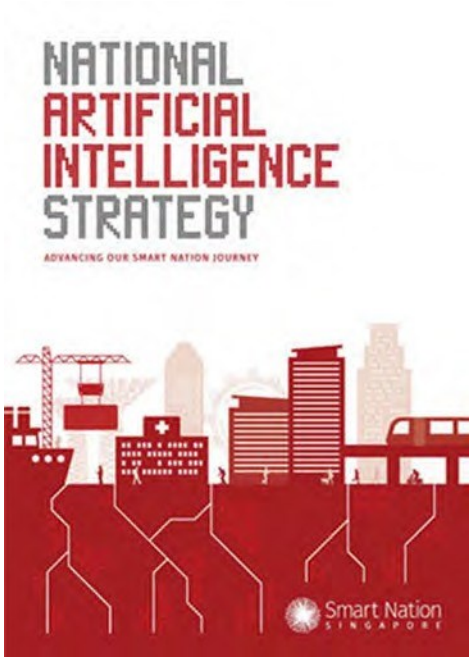
Figure 3-3 100 Experiments Programme Structure



Data source: AI Singapore (2023e)

3.2.4 National Artificial Intelligence Strategy [60]

Based on AI Singapore's efforts to drive AI research, innovation and commercialisation, Singapore's Smart Nation and Digital Government Office (SNDGO) launched a National Artificial Intelligence Strategy in 2019 with the goal of becoming a leader in developing and deploying AI solutions by 2030, creating new areas of economic growth for Singaporeans. Compared to AI Singapore, the National Artificial Intelligence Strategy focuses more on utilising AI to solve social concerns and achieve economic rise.



Source: SNDGO (2019)

[60] For details, please refer to: SNDGO (2019). *National Artificial Intelligence Strategy*. Retrieved from https://www.smartnation.gov.sg/initiatives/artificial-intelligence/

To promote the sustainable development of the AI industry, the National Artificial Intelligence Strategy is committed to building a vibrant ecosystem that includes five enablers, that is, triple helix partnership (research community, industry, and government), talent and education, data architecture, progressive and trusted environment, and international collaboration. In addition, the strategy also concentrates public resources on seven national AI projects in healthcare, smart cities and estate, education, border security, logistics, finance, and government to address major challenges facing Singapore society.

In terms of funding, Singapore has invested SDG500 million in AI-related activities under the *Research, Innovation Enterprise 2020 Plan* and an additional SDG180 million under the *Research, Innovation Enterprise 2025 Plan* to promote AI research and industry-academia-research cooperation. [61]

Singapore's National Artificial Intelligence Strategy has made some progress. For example, in the healthcare sector, the Singapore Eye Research Institute (SERI) and the National University of Singapore have developed the SELENA+, an AI tool used to analyse retinal photographs and increase the efficiency of detecting diabetic retinopathy disease, attaining accuracy levels of more than 90%. Since July 2021, SELENA+ has been deployed to all 22 polyclinics across Singapore and is projected to screen an estimated 120,000 patients annually.[62]

It is worth mentioning that in recent years, the Singapore government has been actively partnered with Google Cloud to promote the implementation of the National Artificial Intelligence Strategy. In 2022, the SNDGO led the Government Technology Agency and Google Cloud to sign a Memorandum of Understanding to deepen AI cooperation, establishing the first public-private partnership with an international technology company. [63] In May 2023, the SNDGO and Google Cloud announced the launch of the Artificial Intelligence Government Cloud Cluster (AGCC) to support the adoption of AI across Singapore's public sector. The Government Technology Agency is the first public sector organisation in Singapore to leverage the AGCC. It has developed a large language model-powered office software called Pair, which civil servants can use to boost their productivity, with security safeguards in place to maintain the confidentiality of government information. [64] In July 2023, the Ministry of Communications and Information, Digital Industry Singapore, the SNDGO, and Google Cloud announced the launch of AI Trailblazers. Upon the AI Trailblazers initiative, two Innovation Sandboxes have been established to provide more than 100 public and private organisations in Singapore with seamless access to high-performance GPUs, Vertex AI platform, pre-trained generative AI models, and low-code developer tools, further shoring up the developing of generative AI solutions.[65]

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[61] SNDGO (2021). *Two New National AI Programmes Launched; Additional $180 Million Investment For AI Research*. Retrieved from https://www.smartnation.gov.sg/media-hub/press-releases/new-ai-programmes-2021

[62] Refer to footnote 61.

[63] SNDGO (2022a). *SNDGG Partners with Google Cloud to Enhance AI Innovation in Singapore*. Retrieved from https://www.smartnation.gov.sg/media-hub/press-releases/23082022/

[64] SNDGO (2023b). *Launch of the Artificial Intelligence Government Cloud Cluster*. Retrieved from https://www.smartnation.gov.sg/media-hub/press-releases/31052023/

[65] SNDGO (2023c). *Launch of the AI Trailblazers Initiative*. Retrieved from https://www.smartnation.gov.sg/media-hub/press-releases/24072023/

3.2.5 Summary

Singapore started earlier in boosting the development of the AI industry and has ranked high on various international lists, whose policy experience is a worthy reference for Hong Kong. The Singapore government plays a leading role in promoting the development of the AI industry, not only by providing computing support to the industry through the NSCC, but also by implementing the AI Singapore programme to strengthen local AI research, innovation and commercialisation capabilities. Additionally, the Singapore government has constructed an ecosystem for the progress of the AI industry through the *National Artificial Intelligence Strategy* and has concentrated public resources on key areas for industrial application.

The main lessons of Singapore's AI policy that Hong Kong can learn from include:

1. Collaborate with international technology enterprises to enhance infrastructure such as data, algorithms, and computing power platforms;

2. Focus resources on promoting the AI industrial application in key industries, such as healthcare, finance and logistics, to satisfy the needs of social development;

3. Promote AI basic research and industry-academia-research cooperation through targeted financial support;

4. Support SMEs to adopt AI through programmes including AI Readiness Index, Platforms Engineering and 100 Experiments; and

5. Nurture local talent by employing the AI Apprenticeship Programme and Charter AI Engineer.

3.3 Shanghai

In recent years, Shanghai has witnessed rapid growth in its AI industry, with a size rising from RMB134 billion in 2018 to over RMB380 billion in 2022.[66] Shanghai hosted the World Artificial Intelligence Conference for six consecutive years, from 2018 to 2023. The recently held 2023 World Artificial Intelligence Conference was a large-scale event with an exhibition area of more than 50,000 square meters. The conference facilitated connections with 210 upstream and downstream enterprises, resulting in an intention-to-purchase amount of RMB11 billion and the signing of 32 major industrial projects with a total investment of RMB28.8 billion.[67]

3.3.1 Shanghai Supercomputer Centre

In terms of the construction of the public computing power platform, the Shanghai Municipal Government invested in the building of the Shanghai Supercomputer Centre in 2000, and the centre currently has supercomputers such as the Magic Cube II and Magic Cube III.[68] As of

[66] Shanghai Municipal People's Government (2023a). *Build an Innovation Highland for Three Pilot Industries: The Second Meeting of the Standing Committee of the 16th Municipal People's Congress Is Held (Chinese)*. Retrieved from https://www.shanghai.gov.cn/nw4411/20230426/b6697d596dbd4eb49db7b5783bfce514.html
[67] Shanghai Municipal Commission of Economy and Informatization (2023a). *2023 World Conference on Artificial Intelligence Successfully Concludes Today, with New Initiatives Launched, New Policies Introduced and New Projects Contracted to Create a New Ecology (Chinese)*. Retrieved from https://app.sheitc.sh.gov.cn/zxxx/695334.htm
[68] For details, please refer to: https://www.ssc.net.cn/

June 2023, the Magic Cube III ranked 426th in the world, with a computing power of 2.11 PFlop/s (Rmax).[69] In addition, the Shanghai Supercomputer Centre is also responsible for constructing and operating the Shanghai Artificial Intelligence Public Computing Service Platform, which offers computing power to research institutes and SMEs in an inclusive manner. The platform, officially launched in April 2023, uses the domestic self-developed Da Vinci architecture AI computing power, with a peak computing power of 100 PFLOPS (FP16).[70]

Source: Shanghai Supercomputer Centre (SSC)

3.3.2 Progressive AI Policies

As China's leading city for AI industry development, Shanghai has progressive top-level policy planning, covering almost all development elements, including basic research, data, algorithms, computing power, industry clusters, industry chains, industrial applications, and ecosystems. Similar to Singapore, Shanghai's AI policy planning kicked off earlier. It issued the *Implementation Opinions on Promoting the Development of the New Generation of Artificial Intelligence in Shanghai* in November 2017, in response to the *Next Generation Artificial Intelligence Development Plan* released by China's State Council in July of the same year. Subsequently, Shanghai has further released a series of policy documents, aiming to create a "Shanghai Highland" of AI and develop into a country-leading and even a world-leading city.

The AI policies issued in Shanghai can be generally divided into two categories: Comprehensive overall planning and policies targeting specific elements such as data, computing power, algorithms and standards.

3.3.3 Overall Planning

Shanghai's overall planning for developing the AI industry has evolved rapidly over the past five years and now "attains to the broad and great while addressing the delicate and minute". The *Implementation Opinions on Promoting the Development of the New Generation of*

[69] Data source: *Top 500 List- JUNE 2023*. Retrieved from https://www.top500.org/lists/top500/list/2023/06/
[70] Shanghai Supercomputer Centre (SSC) (2023): *AI Computing Power Platform*. Retrieved from https://www.ssc.net.cn/resource-ai.html

Artificial Intelligence in Shanghai , which was initially released in November 2017, promotes the development of the AI industry merely by creating a diversified and innovative ecosystem, strengthening the forward-looking layout of scientific research, promoting the development of industrial clustering, and expanding the scenarios of integrated applications. [71] Later, Shanghai released the *Implementation Measures for Accelerating the High-quality Development of Artificial Intelligence* at the World Artificial Intelligence Conference in September 2018, which proposes 22 specific measures regarding five development elements, including talent development, data resources, industrial collaboration, industrial layout and financing support. In June 2021, the *14th Five-Year Plan for the Development of Shanghai's Strategic Emerging Industries and Pilot Industries* formally listed AI as one of the three core industries, with a focus on the development of smart chips, smart software, autonomous driving, and smart robotics.[72]

14th Five-Year Plan for the Development of Artificial Intelligence in Shanghai Municipality[73]

After four years of policy exploration, the *14th Five-Year Plan for the Development of Artificial Intelligence in Shanghai Municipality* was formally launched in December 2021, which demonstrates a more comprehensive policy planning, with the goal of moving faster to build the "Shanghai Highland" with more international influence and creating a world-class AI industry cluster. The Plan proposes six major tasks, which are summarised as follows:

Face the Frontier Arena: Shaping A New Advantage in Innovation	It refers to ensuring Shanghai's leading position in the AI sector at the technological level by strengthening basic research. Its policy direction is to accelerate the building of the innovation system, including: • Build national innovation platforms with advanced international standards, such as the Shanghai AI Laboratory; • Accelerate the construction of functional innovation platforms with influence across the industry, such as the AI Industry Empowerment Centre; • Improve the industrial innovation platform in which enterprises are the main actors.
Focus on core production factors, continuously consolidating a new foundation for industry development	It refers to boosting the integration of algorithms, computing power and data to support the development of the AI industry in Shanghai. Policy directions include: • Enhance algorithmic innovation and build transformation and application ecosystems; • Advance the construction of computing power infrastructure and optimise the layout of platforms;

[71] General Office of Shanghai Municipal People's Government (2017). *Implementation Opinions on Promoting the Development of the New Generation of Artificial Intelligence in Shanghai (Chinese)*. Retrieved from https://www.shanghai.gov.cn/nw43400/20200824/0001-43400_54186.html
[72] General Office of Shanghai Municipal People's Government (2021a). *14th Five-Year Plan for the Development of Shanghai's Strategic Emerging Industries and Pilot Industries (Chinese)*. Retrieved from https://www.shanghai.gov.cn/202115bgtwj/20210805/da6588220d144f9abef953d29b2d906a.html
[73] Shanghai Municipal Commission of Economy and Informatization (2021b). *14th Five-Year Plan for the Development of Shanghai's Artificial Intelligence Industry (Chinese)*. Retrieved from https://www.shanghai.gov.cn/gwk/search/content/29259791c2fd46a2aff8b0dc09d4f8e6

	• Improve the supporting system for data infrastructure, including developing a data element market, speeding up the opening of public data, building a joint innovation laboratory for big data, perfecting data ecological standards, and promoting research and development of data technologies.
Enhance enterprise agglomeration and constantly increase new momentum of core industries	It refers to strengthening the AI industry chain in Shanghai. Policy directions include: • Actively attract leading enterprises at home and abroad and accelerate the cultivation of innovation-oriented enterprises; • Perfect basic hardware and make comprehensive breakthroughs in AI chips, enhanced intelligent sensing, and other key technologies; • Develop key software, support AI framework software research and development applications, and accelerate the development of AI system software; • Promote product innovation and develop a new generation of intelligent terminal products, smart driving and smart robotics.
Comprehensively enable the digital transformation of cities as a leader	It refers to generating socio-economic benefits by promoting the industrial application of AI. Policy directions include: • Promote the application of AI in industries such as manufacturing, retail, finance, shipping, energy, and corporate services; • Promote the application of AI in urban governance, including developing terminal facilities such as intelligent education and enhancing operational efficiency in key areas such as government services and traffic management.
Improve spatial layout and expand the functions as a carrier for industry development.	It refers to building industry clusters by creating space and supporting conditions to attract AI enterprises. Policy directions include: • Promote the innovative development of the four major advantageous industrial agglomeration areas of Zhangjiang of Pudong, Binjiang of Xuhui, Maqiao of Minhang and Lin-gang Special Area; • Build an intelligent service and operation management system for parks, for example, providing integrated innovation services such as R&D and design, data training, computing power sharing, pilot-scale application and technology finance, as well as perfecting the whole procedure of services for the implementation of key investment promotion projects.
Optimise the overall environment to create a vibrant industrial ecology	It refers to creating a friendly ecological environment for AI development in Shanghai. Policy directions include: • Accelerate the improvement of the workforce system; • Improve AI standards and intellectual property layout; • Develop an agile governance system; • Enhance support and protection for the capital market; • Boost the coordinated and integrated development of the Yangtze River Delta.

上海市经济和信息化委员会文件

沪经信智〔2021〕1195号

上海市经济和信息化委员会关于印发
《上海市人工智能产业发展“十四五”规划》的通知

各有关单位：

为进一步发挥人工智能的“头雁效应”，深化人工智能在城市数字化转型中的重要驱动和赋能作用，加快建设更具国际影响力的人工智能“上海高地”，打造世界级产业集群，我委编制了《上海市人工智能产业发展“十四五”规划》，现印发给你们，请认真贯彻落实。

上海市经济和信息化委员会
2021年12月27日

— 1 —

Source: Shanghai Municipal Commission of Economy and Informatization (2021b)

Regulations of Shanghai Municipality on Promoting the Development of the Artificial Intelligence Sector[74]

In addition to formulating the 14th Five-Year Plan for the development of the AI industry, Shanghai has also formulated specific regulations to define the responsibilities of public authorities to shore up the AI industry's progress in a clear legal manner. The *Regulations of Shanghai Municipality on Promoting the Development of the Artificial Intelligence Sector* came into effect on 1 October 2022 and consists of six chapters and 72 articles, including:

(1) Fundamentals and Technological Innovation

- Article 13 provides that the municipal department of economy and informatisation shall, in conjunction with the municipal department of development and reform, the department of science and technology and other departments, develop measures for the supply of public computing resources, to ensure that SMEs obtain inclusive public computing power;
- Article 21 stipulates that institutions of higher education, research institutes and enterprises may establish new R&D institutions, use market mechanisms to integrate advanced AI technology and high-quality resources, and carry out research and development, training of innovative talents, application and promotion of achievements and other activities.

[74] Shanghai Municipal People's Government (2022). *Regulations of Shanghai Municipality on Promoting the Development of the Artificial Intelligence Industry (Chinese)*. Retrieved from https://www.shanghai.gov.cn/hqcyfz2/20230627/3a1fcfeff9234e8e9e6623eb12b49522.html

(2) Industrial Development and Application Empowerment

- Articles 40 to 44 set out the support for the development of five major industries, namely, smart chips, AI framework software and system software, smart robotics, intelligent connected vehicles, and unmanned aerial vehicles and unmanned ships;
- Article 52 provides support for enterprises to use special policies to promote high-quality industry development to carry out technological transformation and upgrading and to promote the digital and intelligent transformation of the manufacturing industry.

(3) Industrial Governance and Security

- Article 65 stipulates that the relevant departments of Shanghai may develop a list of minor illegal acts not subject to administrative penalties in accordance with the law during the process of development of the AI industry;
- Article 66 provides for the establishment of an Expert Committee for AI Ethics.

3.3.4 Targeted Policies

In addition to overall planning, Shanghai has also formulated guidelines, action plans, and even regulations for specific elements required for developing the AI industry.

Innovation Ecology

Shanghai released the *Action Plan for Building the Shanghai AI Highland and Constructing a First-class Innovation Ecology (2019-2021)* in 2019, in which seven special actions are proposed:[75]

(1) Build 4 + X Integrated Innovation Vehicles

- Arrange four key agglomeration areas for AI industry innovation, including Zhangjiang of Pudong, Binjiang of Xuhui, Maqiao of Minhang and Lin-gang Special Area, and build characteristic innovation brand vehicles in other districts according to the local conditions.

(2) Build Pivot-like Innovation Platforms

- Promote industry-academia-research cooperation and establish joint laboratories;
- Implement the construction plan for open-source and open communities and form developer communities integrating “algorithms, data, and scenarios”;
- Build municipal functional platforms for the R&D and transformation of AI and AI innovation centres;
- Support emerging chip enterprises in participating in computing power platform construction projects and create a first-class AI chip highland.

[75] Shanghai Municipal Commission of Economy and Informatization (2019). *Action Plan for Building the Shanghai AI Highland and Constructing a First-class Innovation Ecology (2019-2021) (Chinese)*. Retrieved from https://www.sheitc.sh.gov.cn/xxfw/20190923/0020-683713.html

(3) Construct Big Data Joint Innovation Laboratories

- With a focus on healthcare, steel, high-end equipment and other fields, build 15 big data joint innovation laboratories;
- Build a tag system for industry data and research data standards and specifications;
- Provide a training ground for AI elements gathering with "data resources + industry experts + application scenarios".

(4) Build a Talent Team

- Implement the young talent support action and the echelons of talents training action;
- Launch the AI "Wise Craftsman" and "Leading Pioneers" selection campaigns.

(5) Create a Pilot Application Scenarios

- Focus on the application of AI in key areas such as healthcare, education, urban management, and manufacturing;
- For a major special project listed in the Shanghai Pilot Application Scenarios of Artificial Intelligence, give support according to 30% of the investment in the project, to the extent of RMB20 million.

(6) Establish an Industrial Investment Fund

- Establish an AI industry investment fund with an initial size of HKD10 billion to drive larger-scale social capital investment and ultimately to successfully incubate and nurture ten leading innovative enterprises, 100 benchmark innovative enterprises, and to form a cluster of funds worth RMB100 billion.

(7) Build a Governance System

- Develop guidelines for the application of AI technology in healthcare, finance, transportation and other areas, and boost the formation of several enterprise standards or industry standards. Research and propose the general standards for AI governance and release the *Blue Book on the Rule of Law for Artificial Intelligence*.

Algorithms

The Shanghai Municipal People's Government has put forward five major goals and tasks in the *Action Plan of Shanghai for New Generation AI Computing Innovation (2021-2023)*, aiming to provide a solid technological foundation for Shanghai's digital transformation:[76]

[76] Shanghai Municipal Commission of Economy and Informatization & Shanghai Municipal Development & Reform Commission & Shanghai Municipal Education Commission & Science and Technology Commission of Shanghai Municipality (2021). *Action Plan of Shanghai for New Generation AI Algorithmic Innovation (2021-2023) (Chinese)*. Retrieved from https://stcsm.sh.gov.cn/zwgk/ghjh/20210817/deb2d6e5c0cd41e09de6d840da56d074.html

Figure 3-4 Main Objectives and Tasks of the Action Plan of Shanghai for New Generation AI Algorithmic Innovation

Main Objectives	Main Tasks
•Create about ten leading achievements and form clusters of innovation platforms; •Create 100 typical cases for algorithmic products and algorithmic applications each; •Formulate an intellectual property circulation market based on the AI algorithmic trading bazaar as a carrier; •Introduce and cultivate around 50 international algorithmic leaders and outstanding young scientists, and cultivate and select about 100 chief algorithmists in the industry and enterprises; •Form an open community of algorithms represented by the Baiyulan Open AI Platform and cultivate a 100,000-person algorithm application developer community.	•Promote AI basic theory research and core technology breakthroughs by building an algorithmic innovation platform system; •Promote the innovation of algorithm application by strengthening the supply of algorithms for industrial application, building a system for transforming algorithms into applications, and increasing the strength of promotion; •Cultivate the algorithmic ecosystem by building an algorithmic trading bazaar, establishing algorithmic standards and evaluation systems, and strengthening algorithmic resource support; •Increase the gathering of algorithmic talent by building a core team of chief algorithmists, increasing support for the introduction of algorithmic talent, and building a cultivation system; •Build an open community of algorithms by creating the Baiyulan Open AI Platform, promoting mutual recognition of national rules on open source software, formulating relevant standards and protocols in the open source field, and organising various algorithmic cooperation and exchange activities.

Data source: Shanghai Municipal Commission of Economy and Informatization, Shanghai Municipal Development & Reform Commission, Shanghai Municipal Education Commission, and Science and Technology Commission of Shanghai Municipality (2021).

Data

The *Shanghai Data Regulations*, which came into effect on 1 January 2022, consists of ten chapters and ninety-one articles covering data rights and interests protection, public data, data element market, development and application of data resources, data reform in the Pudong New Area, data cooperation in the Yangtze River Delta region, data security, and legal liabilities. Of which, Article 67 provides for the establishment of a data exchange in the Pudong New Area in accordance with the national requirements. Article 68 provides for the

focus of the Lin-gang Special Area to build a global data convergence and transfer hub platform in accordance with the national deployment.[77]

On 31 December 2022, the Shanghai Municipal Government implemented the *Implementation Rules of Shanghai Municipality on Open Public Data*, which provides detailed regulations in four areas: Open data, data access, information systems and open platforms, and data utilisation. Specifically, Article 38 states that the municipal department of economy and informatisation may entrust a third-party professional organisation to evaluate the effectiveness of public data opening work and data utilisation. The evaluation results are used as a reference for decision-making and are included in the management appraisal of public data and Government Online-Offline Shanghai.[78]

Computing Power

On 19 April 2023, *the Guidelines on Promoting the Unified Scheduling of Computing Resources in Shanghai*[79] was formally issued, in which it was proposed:

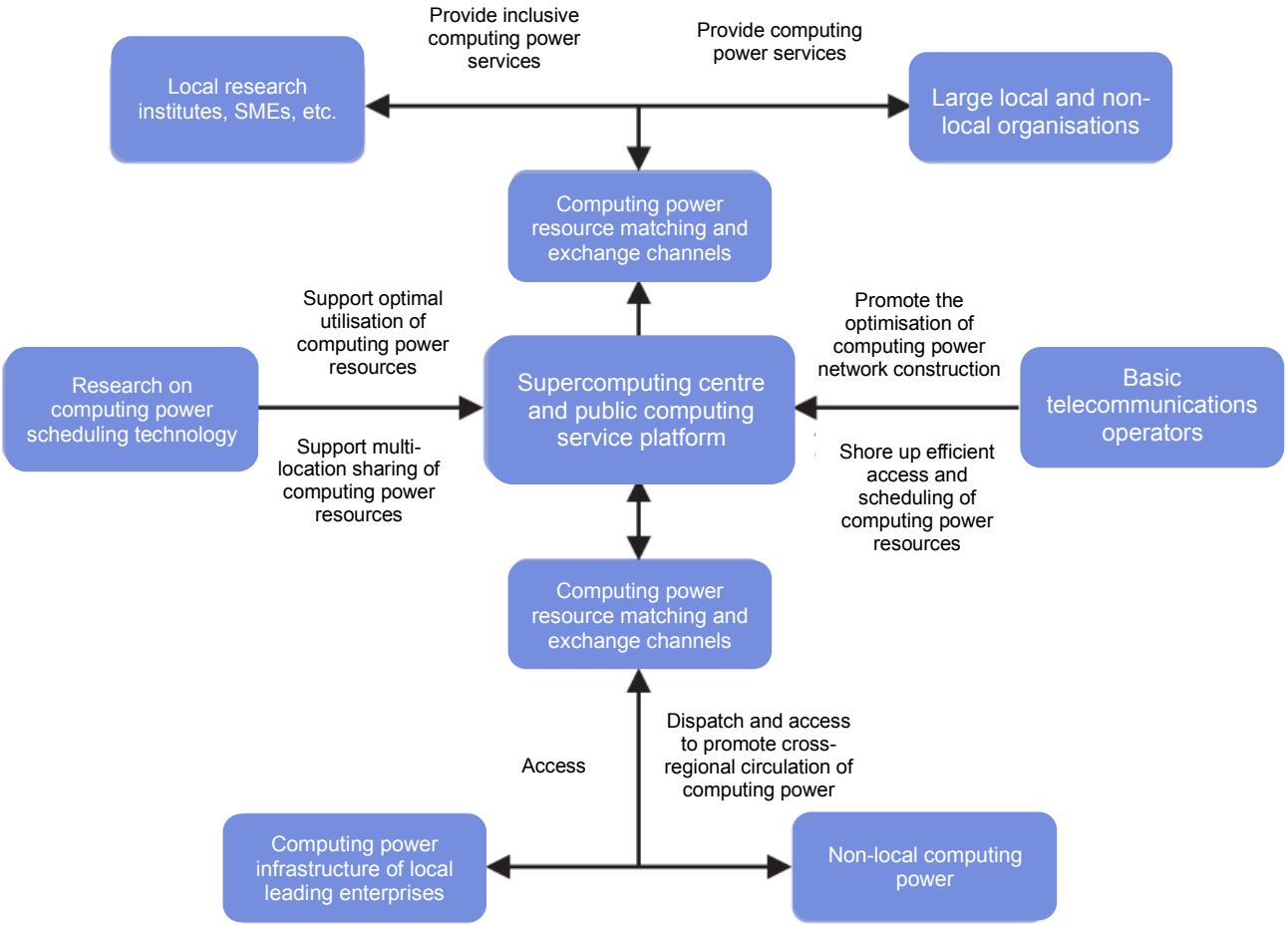
• By the end of 2023, rely on Shanghai's AI public computing service platform and access and dispatch more than four arithmetic infrastructures, with dispatchable smart computing power reaching more than 1,000 PFLOPS (FP16);

• By 2025, Shanghai's AI public computing service platform will be upgraded, the computing exchange mechanism will be perfected, cross-regional intelligent dispatching of computing power will be realised, and efficient computing power dispatching will be used to promote the equalisation of computing power supply and demand, and the role of driving industrial development will be significantly strengthened. The municipal data centre will reach a computing power of over 18,000 PFLOPS (FP32).

The Guiding Opinions puts forward nine key tasks, including (1) Constructing new computing power facilities for scientific innovation; (2) coordinating the layout of computing power infrastructure; (3) promoting the optimisation of computing power network building; (4) accelerating the R&D of computing power dispatching technology; (5) improving the computing power exchange mechanism; (6) launching the integration of computing power and different industries for demonstration of innovation; (7) building the computing power network safety and security system; (8) developing research on industrial standardisation of computing power network; and (9) increasing cooperation at different levels of the "municipality, Yangtze River Delta region and the country".

[77] Shanghai Municipal People's Government (2021). *Shanghai Data Regulations (Chinese)*. Retrieved from https://www.shanghai.gov.cn/nw12344/20211129/a1a38c3dfe8b4f8f8fcba5e79fbe9251.html
[78] Shanghai Municipal Commission of Economy and Informatization & Information Office of Shanghai Municipality (2022). *Implementing Rules for Openness of Public Data in Shanghai (Chinese)*. Retrieved from https://app.sheitc.sh.gov.cn/sjxwxgwj/694243.htm
[79] Shanghai Municipal Commission of Economy and Informatization (2023b). *Guidelines on Promoting the Unified Scheduling of Computing Resources in Shanghai (Chinese)*. Retrieved from https://www.shanghai.gov.cn/hqcyfz2/20230626/09e05ec545384533a84b7e404e1252d1.html

Figure 3-5 Conceptual Diagram for Building a Supercomputing Centre and a Public Computing Service Platform



Source: Research team

It is worth mentioning that the Shanghai Municipal Government released on 17 May 2023 the *Several Measures for Shanghai to Help Micro, Small and Medium-sized Enterprises Stabilise Growth, Adjust Structure, and Strengthen Capabilities*, in which it proposed to issue "AI computing power coupons" and "smart evaluation coupons" to help SMEs in their digital transformation. The "AI computing power coupons" focus on supporting enterprises that rent the city's intelligent computing power for core algorithm innovation and model research and development, with a maximum support of 20% of the contract cost; while the "smart evaluation coupons" with municipal-level funding of RMB50 million, supports enterprises to purchase assessment and evaluation services for smart manufacturing maturity and capability, and encourages all districts to carry out policy support.[80]

Standards

In 2021, Shanghai released the *Guiding Opinions on Promoting the Construction of a New Generation of Artificial Intelligence Standard System in Shanghai,* proposing that by 2023, it will lead or participate in more than 20 international and national standards, more than 50

[80] Shanghai Municipal People's Government (2023b). *The Phased Policy of Issuing "AI Computing Coupons", "Intelligent Evaluation Coupons" and Reserving a Share for Government Procurement Projects Continues until the End of the Year: Shanghai Has Launched 28 Measures to Support SMEs (Chinese)*. Retrieved from https://www.shanghai.gov.cn/nw4411/20230518/a4d128797dd04572b6ed934bb5b737b4.html

industry, local and group standards, and more than three unified standards for the Yangtze River Delta. In addition, it will cultivate about 10 AI standardised benchmark enterprises and form a batch of advanced achievements for replication and promotion. By 2030, Shanghai's new generation of AI standard system must basically reach the international leading level. The key tasks set out in the *Guiding Opinions* include:[81]

Figure 3-6 Main Work of Development of a New Generation AI Standard System in Shanghai

Coordinate the AI Standardisation	Areas Accelerate the Research and Preparation of Standards in Key
•Establish a new generation AI standard system covering basic commonalities, key technologies, core industries, industrial applications, and security theories; •Promote the research, preparation and revision of AI standards at national, industrial, local, organisational, regional, and enterprise levels; •Accelerate the building of a comprehensive and credible AI test and assessment system for intelligent connected vehicles, medical image diagnostic aids, visual image identification, smart sensors, and other tracks; •Use pilot demonstration projects to promote the implementation and promotion of AI standards.	•AI-related terminology, reference structure, test and assessment, and other basic common standards; •Key technology standards for machine learning, knowledge mapping, biometric identification, natural language processing, etc. •Core industry standards, including supporting technologies and products (e.g., big data, secure computing, and smart sensors), basic software and hardware platforms (e.g., smart chips, system software, machine learning frameworks, and open-source open platforms), and smart products and services (e.g., smart robotics, smart driving, and smart terminals); •Application standards for manufacturing, finance, commerce and trade, healthcare, urban governance and other industries; •Security and ethical standards

Data source: Shanghai Municipal Commission of Economy and Informatization, and Shanghai Municipal Administration for Market Regulation (2021)

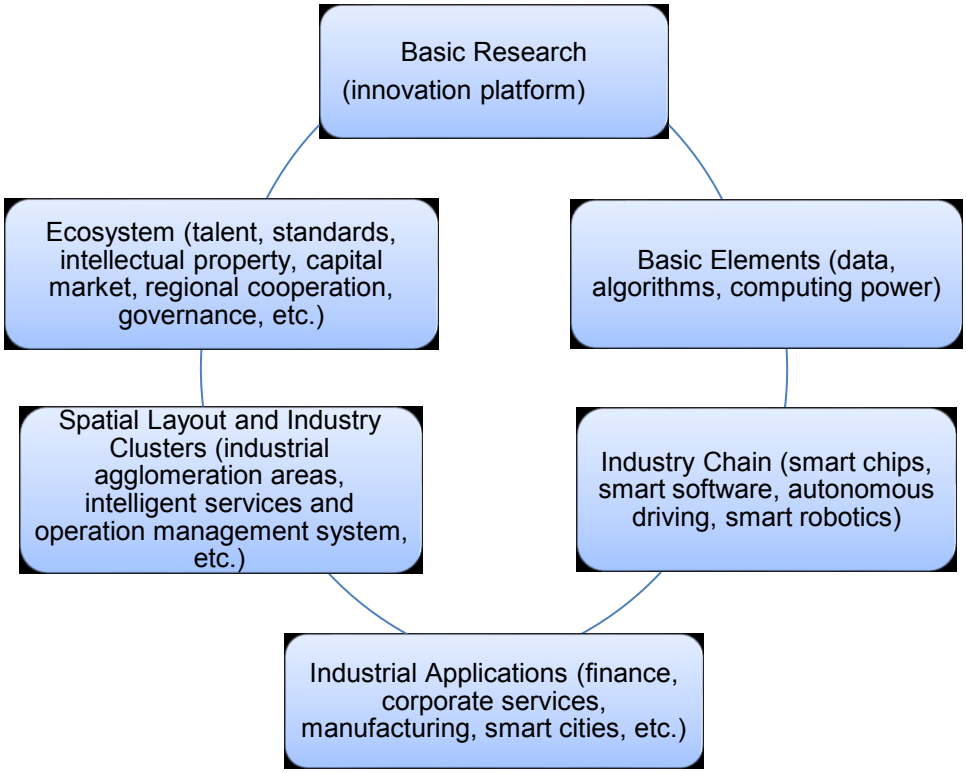
3.3.5 Summary

Shanghai's AI policy is comprehensive and targeted for progress. On the basis of national policies, the Shanghai Municipal Government has not only made a detailed overall plan for

[81] Shanghai Municipal Commission of Economy and Informatization & Shanghai Municipal Administration for Market Regulation (2021). *Guidelines on Promoting the Development of a New Generation AI Standard System in Shanghai (Chinese)*. Retrieved from https://www.shanghai.gov.cn/hqcyfz2/20230626/6a112553f9834a6eaf9e630729f04cc6.html

the development of the AI industry but also introduced targeted policies and measures for key development elements such as data, computing power, algorithms, and standards. The main lessons of Shanghai's AI policy that Hong Kong can learn from include:

1. The government needs to consider the following six aspects in promoting the development of the AI industry:



2. Build supercomputing centres and public computing service platforms to access the computing power infrastructure of leading local enterprises and non-local computing power dispatching resources so as to provide inclusive computing power for scientific research institutes and SMEs. In addition, it is necessary to optimise the construction of computing power networks, speed up the R&D of computing resource dispatching technologies, and build channels for matching, accessing and exchanging computing resources. These measures will facilitate the circulation of computing resources across regions and enhance the efficient utilization of resources.

3. Issue "AI computing power coupons" and "smart evaluation coupons" to support SMEs in purchasing assessment and evaluation services for smart manufacturing maturity and help SMEs in their digital transformation;

4. Formulate data policies to protect data rights and establish a data market to facilitate the development and application of data resources. Additionally, it is necessary to enhance the public data opening and expedite the promotion of data flow with the Mainland and overseas cities;

5. Shore up various algorithmic cooperation and exchange activities to promote the application of local open source and the innovative advancement of algorithms;

6. Focus on key areas such as healthcare and manufacturing, set up AI application pilot schemes, and provide financial subsidies;

7. Establish an AI industry investment fund to drive social capital investment in local AI enterprises;

8. Build an intelligent service and operation management system for parks and provide integrated innovation services such as R&D, design, data training, computing power sharing, pilot-scale application, technology, and finance. It is also essential to perfect the whole procedure of services for the key business projects;

9. Participate actively in the formulation of international, national, and regional AI standards.

3.4 Shenzhen

According to a study by the Shenzhen Artificial Intelligence Industry Association, the scale of the AI industry in Shenzhen reached RMB248.8 billion in 2022, with a core industry of RMB30.8 billion. There are 1,920 AI enterprises in Shenzhen, of which nearly 75% are in the application layer, while those in the base layer and the technology layer account for only 8% and 17%, respectively.[82] At present, Shenzhen has already gathered Huawei, Tencent, Ping An Group, ZTE and other integrated AI leading enterprises, as well as XtalPi, Orbbec, DJI, Intellifusion, Pudu Technology and other sub-track leaders and unicorns, forming a development pattern in which the leading enterprises are leading the way, and the unicorns and SMEs are "flying along with them".[83]

3.4.1 Computing Power Construction

The National Supercomputing Centre in Shenzhen was established in 2009, and its high-performance computing platform, Dawning 6,000, performs a peak of 1,271 trillion calculations per second (1.27 PFLOPS/s, Rpeak).[84] In recent years, the Central Government has approved the establishment of the Peng Cheng Laboratory in Shenzhen, which has achieved remarkable results:

- The main construction of the AI computing power platform "Pengcheng Cloud Brain II" has been completed, which can provide no less than 1,000 Pops of AI computing power and 64PB of high-speed parallel extensible storage, and has a 100 GB-class network transmission rate. [85] "Pengcheng Cloud Brain II" has provided services to enterprises, universities, research institutes and other organisations, supporting nearly 1,000 domestic AI model training tasks and the release of AI algorithms;[86]
- It leads the development and construction of the China Computing NET, with the vision of "building a national computing power network like the electric power grid, operating the computing power network like the Internet, and allowing users to use computing power as

[82] Shenzhen Artificial Intelligence Industry Association (2023). *2023 White Paper of the Development of the Artificial Intelligence Industry in Shenzhen - Premiered at the "Shenzhen Bay - World Conference on General Artificial Intelligence" (Chinese)*. Retrieved from https://www.szaicx.com/page00181?article_id=13626
[83] Shenzhen Special Zone Daily (2023). *Shenzhen Develops "Four-one" Policy System for High-quality Development of Artificial Intelligence (Chinese)*. Retrieved from http://www.sz.gov.cn/cn/ydmh/zwdt/content/post_10645400.html
[84] National Supercomputing Shenzhen Centre: *High Performance Computing Platform*. Retrieved from https://www.nsccsz.cn/nsccsz/zxzy/202008/ff5af45d80844e6f a5bbe3608733ce1f.shtml
[85] Peng Cheng Laboratory (2023a). *Major Science and Technology Infrastructure: Peng Cheng Cloud Brain (Chinese)*. Retrieved from https://www.pcl.ac.cn/html/1030/2022-11-17/content-3876.html
[86] 21 jingji (2023). *Academician Wen Gao: Peng Cheng Cloud Brain Has Supported the Training of Nearly 1,000 Domestic AI Models, and Its Performance Is World Leading (Chinese)*. Retrieved from https://www.21jingji.com/article/20230522/herald/5ec77d5ee5a91785cd6f92d48a8afd91.html

conveniently as electricity". The project's first phase, the "Intelligent Computing Network", was launched in June 2022. With the "Pengcheng Cloud Brain" as the hub and node, the network incorporates more than 20 heterogeneous computing centres across different regions, with a convergence of computing power of more than 3E Flops. At present, it has completed the national intelligent computing power interconnection system and the AI open source platform, which realises the opening of computing power and AI open source services to users nationwide;[87]

- On 21 September 2023, the Peng Cheng Laboratory released the PengCheng Mind large-scale AI general model, which is jointly supported by the Chinese Foreign Language Publishing Administration, Huawei, Tencent, and other strategic partners and covers corpus datasets and data quality assessment toolsets with Chinese, English and more than 50 languages of countries and regions along the "Belt and Road Initiative". Peng Cheng Laboratory will take the lead in establishing the "Peng Cheng - Brain Sea" open source consortium, uniting enterprises, universities and research institutes to accelerate the development of AI-empowered industries.[88]

Source: Official website of Peng Cheng Laboratory & Pengcheng Cloud Brain

3.4.2 Policy Systems

Compared to Singapore and Shanghai, Shenzhen's AI policy planning did not start that early. Shenzhen implemented the Regulation of the *Shenzhen Special Economic Zone on the Promotion of Artificial Intelligence Industries* (the "Regulation") and the *Action Plan for Accelerating the Promotion of High-Quality Development and High-Level Application of Artificial Intelligence in Shenzhen* (2023-2024) (the "Action Plan") on 1 November 2022 and 31 May 2023, respectively. In the *Action Plan*, Shenzhen released the first batch of "City + AI" application scenario lists. It proposed to form an AI fund cluster with a scale of RMB100 billion, thus constructing an AI policy system of "one regulation, one programme, one list, and one fund cluster".

Shenzhen Special Economic Zone on the Promotion of AI Industries

The *Regulation* consists of seven chapters and seventy-three articles to regulate the development of the AI industry in Shenzhen. With reference to the interpretation of the

[87] Peng Cheng Laboratory (2023b). *China Computing NET (C²NET) (Chinese)*. Retrieved from https://www.pcl.ac.cn/html/1030/2023-09-07/content-4292.html
[88] Peng Cheng Laboratory (2023c). *"PengCheng-Mind": Official Launch of Large-scale Innovation of General AI (Chinese)*. Retrieved from https://www.pcl.ac.cn/html/943/2023-09-21/content-4299.html

Standing Committee of the Shenzhen Municipal People's Congress[89], the main contents of the *Regulation* are as follows:

(1) Establish AI Industry Statistics and Monitoring System

Article 9 stipulates that it is necessary to establish and improve the standards for the statistical classification of AI industries, formulate and improve the statistical classification catalogue of AI industries, and statistically investigate, monitor, and analyse AI industries in an orderly manner.

(2) Support Weak Spots in AI Basic Research

- Article 14 provides that a system of supportive policies that cover the entire cycle of research on key core AI technologies shall be established;
- Articles 15 to 17 regulate that the construction of national, provincial and municipal research platforms shall be accelerated; innovation vehicles such as key laboratories and manufacturing innovation centres shall be built; and new research and development institutions shall be cultivated and built, featuring diversified investors, modernised management systems, market-oriented operating mechanisms and flexible employment methods;

  Articles 21 to 23 stipulate that AI projects shall be managed in an innovative manner, and support shall be given to science and technology innovation achievements publicly collected by means of non-periodic project funding or other means; a quality, performance, and contribution-oriented project evaluation system shall be established; and an incentive mechanism conducive to promoting the commercialisation of scientific and technological achievements shall be established.

(3) Strengthen AI Industry Infrastructure Construction

- Article 31 provides that a public data open platform shall be constructed, public data sharing catalogues and sharing rules for AI application areas shall be established, and the orderly opening of public data shall be promoted by classification and by grade;
- Article 34 stipulates that colleges and universities, research institutes, enterprises and other organisations shall be encouraged and supported to build AI computing power infrastructure, open source development platforms and open source communities; computing platforms, such as the National Supercomputing Centre in Shenzhen, Pengcheng Cloud Brain, shall be used to make computing power resources available to the public, reduce development cost for enterprises and shorten development cycles;
- Articles 35 to 36 require that the construction of public service platforms for the AI industry shall be strengthened, including supporting enterprises to build open AI innovation platforms and making key common AI technologies accessible to upstream and downstream enterprises in the industry. Besides, the building of AI testing and certification platforms shall be promoted.

[89] Standing Committee of Shenzhen Municipal People's Congress (2022). *Regulations for the Promotion of the Artificial Intelligence Industry in Shenzhen Special Economic Zone (Chinese)*. Retrieved from http://www.szrd.gov.cn/szrd_zlda/szrd_zlda_flfg/flfg_szfg/content/post_834707.html

(4) Fully Utilise Application Scenario Drivers

- Article 38 stipulates that public enterprises and institutions shall take the lead in using AI products and services;
- Article 43 provides that the municipal competent department for the industry shall establish a system for releasing AI application scenarios, regularly formulate and publish an AI scenario demand list, publicly solicit solutions to application scenarios, and attract high-level AI product and service suppliers at home and abroad;
- Article 44 stipulates that low-risk AI products and services for which national or local standards have not been formulated and that meet international advanced product standards or norms shall be allowed to be pioneered by test, experiment, pilot programme, and other means.

Action Plan for Accelerating the Promotion of High-Quality Development and High-Level Application of Artificial Intelligence in Shenzhen (2023-2024)[90]

The *Action Plan* focuses on six areas, namely, intelligent computing power, key core technology and product innovation, industry clustering, scenario application, data and talent elements, and safeguard measures, and proposes 18 initiatives to be implemented by all relevant authorities within the government to promote the development of the AI industry. The main contents are as follows:

(1) Strengthen the Supply of Intelligent Computing Power Clusters

- Shenzhen's computing power resources shall be integrated to build a city-level computing power coordination and dispatching platform to realise "one-network computing power, integrated coordination and one-stop dispatching". It is also planned to start the construction of the Pengcheng Cloud Brain III supercomputing project by the end of 2023;
- The implementation of the "Research and Validation of Key Technology Systems for Intelligent Computing Power Networks" project shall be accelerated, cooperation with neighbouring cities on intelligent computing power shall be strengthened, and the establishment of a platform for coordinating the dispatching of intelligent computing power in the Guangdong-Hong Kong-Macao Greater Bay Area shall be planned;
- The enterprise-level intelligent computing power platform shall be built in combination with Hong Kong enterprises, research institutes, and universities to create a Shenzhen-Hong Kong AI computing power empowerment centre. In addition, the Software Cloud Service Application Demonstration Support Scheme shall be carried out to encourage relevant organisations to purchase intelligent computing power cloud services.

(2) Enhance Key Core Technologies and Product Innovation Capabilities

- Strengthen R&D in science and technology, including:

[90]General Office of the CPC Shenzhen Municipal Committee and General Office of the Shenzhen Municipal People's Government (2023): Action Plan for Shenzhen Municipality to Accelerate the Promotion of High-quality Development and High-level Application of Artificial Intelligence (2023-2024), https://mp.weixin.qq.com/s/JC1yJf6gzmOWxxUdotXxFw

1. Attention shall be given to areas such as large-scale general models, smart computing power chips, smart sensors, smart robotics, and intelligent connected vehicles, and a major project support plan for AI science and technology shall be implemented;

2. The core technology tackling carrier support programme shall be implemented, research institutes shall be supported to build more than five AI joint laboratories with enterprises, and the establishment of the Guangdong Provincial Humanoid Robot Manufacturing Innovation Centre shall be sped up.

- Support innovative product development, including:

1. Enterprises with large models shall be encouraged to join hands with ecological partners to strengthen the research and development of large model plug-ins and related software and hardware;

2. Enterprises shall be encouraged to rely on the Hetao Shenzhen-Hong Kong Science and Technology Innovation Cooperation Zone, the Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone, or overseas R&D centres to research and develop innovative products based on the major international large-scale models, and to actively expand into the international market;

3. A programme to support the upgrading of key processes in the industrial chain shall be promoted, and an approach of "opening bidding for selecting the best candidates" shall be adopted to encourage the R&D and industrialisation of common and general technology products;[91]

4. Qualified AI products shall be selected to be included in the first edition of the software and the first set of major technological equipment catalogue, and support shall be provided for products included in the catalogue;

5. The advantages of the manufacturing of the Guangdong-Hong Kong-Macao Greater Bay Area shall be leveraged to promote the application of humanoid robots on a large scale. Enterprises shall be encouraged to proactively arrange their business in vertical industries and actively expand their application scenarios. The post-project subsidy and support scheme for the industrialisation of strategic emerging industries shall be implemented to encourage enterprises to carry out industrialisation projects using AI.

(3) Enhance Industry Clustering

- AI industrial agglomeration areas shall be planned and constructed. A number of municipal software parks in the AI industry shall be recognised relying on the Hetao Shenzhen-Hong Kong Science and Technology Innovation Cooperation Zone, the Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone to connect with Hong Kong and international resources;
- AI investment from local leading enterprises shall be supported to push domestic and foreign leading enterprises to establish AI subsidiaries in Shenzhen. A batch of innovation-based leading enterprises shall be nurtured with core competitiveness. Leading enterprises with hundreds of billions of dollars shall be incubated. SMEs shall be

[91] "Open bidding for selecting the best candidates" is similar to a technology reward system, where the government lists the critical core technologies needed, and those who have the capability can obtain research funds by delivering relevant research results.

promoted for development and expansion to build up a batch of specialised, special, new, single-champion, and unicorn AI enterprises.

- Support in low-cost intelligent computing power, algorithms, toolsets, model libraries, and adaptive certification shall be offered to SMEs relying on Pengcheng Cloud Brain. Ecological partners shall be empowered to carry out joint innovation projects. Moreover, the support scheme shall be implemented to cultivate a number of characteristic AI public technology service platforms.

(4) Create Full-range and Full-time Scenario Applications

- The first batch of "City + AI" application scenario lists shall be launched, including 26 application scenarios, mainly in the areas of public services and urban governance, which also include smart healthcare, smart manufacturing and low-altitude areas. The application scenarios of smart manufacturing include equipment failure detection and diagnosis, surface defect detection and intelligent sorting;
- The collection, utilisation and development of manufacturing data shall be strengthened to explore the building of a closed-loop mechanism for enterprise data "marking + training". High-quality datasets are reserved to incubate highly intelligent production robots;
- A platform for matching AI supply and demand shall be built to solicit and publicly announce AI innovative products, marketable project demands and application scenarios from the whole society, relying on the "Shen i Qi" platform to build an AI service zone.

(5) Strengthen the Supply of Data and Talent Elements

- A high-quality data element market shall be fostered:

1. By the end of 2023, an open public data management measures and resource catalogue shall be released, and an open public data plan shall be formulated; a citywide open public data operation platform shall be built, a high-quality Chinese language corpus shall be created, and technologies such as privacy-preserving computation shall be utilised to integrate and use data from education, healthcare, and other industries with corporate information;

2. Policies and measures for the cultivation of the data element market shall be researched and issued. The exchange scale of the Shenzhen Data Exchange shall be further expanded. Industry-leading enterprises and platform-based enterprises shall be encouraged to provide high-quality data products and specialised data services. Enterprises shall be guided in exploring data assets, making data resources accessible to the public, and participating in data exchange so as to build a number of enterprise data brands;

3. The research of technologies for storage and utilisation separation, quantitative trading, and secure circulation shall be sped up, and diversified entities such as data source vendors, data developers, data service providers, and platform service providers shall be nurtured specifically to boost the comprehensive development of data-related business.

- A hub for gathering high-calibre talent shall be created:

1. AI general education shall be enhanced by forming the Shenzhen AI Education Alliance and AI Lecturers Group. AI discipline building in colleges and universities shall be strengthened to support colleges and universities and enterprises to jointly cultivate AI talent around areas such as large-scale general models;

2. An enterprise talent aggregation programme shall be explored and launched to promote gathering talent in the AI industry. Colleges and universities shall be supported to cooperate to build AI talent training bases in clothing, jewellery and other fashion and creative industry sectors to develop practical training for AI application positions;

3. Organise high-level competitions to gather and introduce excellent AI teams and talent.

(6) Strengthen Organisational Leadership and Financial Protection

- The government investment fund shall be utilised to coordinate and integrate fund resources to form an AI fund cluster worthy of RMB100 billion;
- AI enterprises shall be encouraged to launch equity financing in the capital market. Venture capital and venture capital organisations shall be supported to strengthen investment in AI start-ups and mergers and acquisitions. Special AI sessions shall be set up at the Venture Capital Day of Shenzhen, held on the 8th of each month;
- A municipal special work group and a coordination mechanism shall be established for the AI industry. A municipal AI strategic consulting committee shall be set up to carry out forward-looking and strategic research on major issues. A municipal AI industry alliance shall be built to integrate resources from all sectors of society.

3.4.3 Summary

Shenzhen has an AI policy system of “one regulation, one programme, one list, and one fund cluster”, with special emphasis on the government’s leading role and the promotion of AI industrial applications. Shenzhen also proposes strengthening cooperation with Hong Kong and other neighbouring cities. The main lessons of Shenzhen’s AI policy that Hong Kong can learn from include:

1. Utilise government investment funds to guide the development of the AI fund cluster;

2. Release the AI application scenario lists and make governments and other public departments take the lead in applying AI in areas such as public services and smart cities, as well as promoting the application of AI in smart manufacturing in the context of new industrialisation.

3. Set up a special work group and advisory committee on AI industry development to promote the formulation and implementation of AI policies;

4. Develop R&D institutes for computing power services and cooperate with large technology enterprises and neighbouring cities to enhance computing power infrastructure;

5. Strengthen the supply of data, including optimising the public data system, improving the R&D of data technologies, such as privacy-preserving computation, and cultivating a high-quality data market;

6. Enhance AI general education, university discipline building, internship training, and organise high-level competitions to gather and introduce AI talent;

7. Boost innovation in key AI technology and product by providing financial support and optimising the incentive mechanism for the commercialisation of scientific and technological achievements;

8. Plan to build an AI industrial agglomeration area, which provides computing power, generic technologies, testing, certification and other related supporting services to cultivate local AI enterprises and attract non-local AI enterprises;

9. Establish AI industry statistics and monitoring systems to provide a reference for policy formulation.

Mention must be made that, in the wave of AI industry development in China, Beijing and Shanghai have steadily ranked in the first echelon. Although Hong Kong and Shenzhen have shortcomings in AI industrialisation and basic research, they can still complement each other through cooperation and strive to assume a vital responsibility in the whole country and even the world. Furthermore, both Shenzhen and Shanghai have enacted laws to demonstrate their determination to promote the development of the AI industry. They have defined the responsibilities of government departments and have showcased the orientation of AI policies by expressing provisions. It is instructive to Hong Kong.

3.5 New York

New York is ahead of Hong Kong in terms of its overall development, but it still shares many similarities with Hong Kong, such as a similar population size, a thriving financial industry, a high degree of internationalisation, and a high cost of living. In terms of the AI industry, New York's development is largely driven by the private market, and the city government is primarily engaged in boosting the AI industry in a healthy direction.

3.5.1 Private Market Leads AI Industry Development

Supported by the private market, the AI industry in New York is booming. Google, Microsoft, IBM and other tech giants have all set up AI R&D centres in New York. [92] In terms of computing power, as of June 2023, the AiMOS supercomputer at the Rensselaer Polytechnic Institute, a private university, ranked 76th in the world, with a computing power of 8.34 PFlop/s (Rmax). The Henri supercomputer operated by the Flatiron Institute ranked 255th in the world, with a computing power of 2.88 PFlop/s (Rmax). New York University's Greene supercomputer ranked 429th in the world, with a computing power of 2.09 PFlop/s (Rmax).[93]

Case: UiPath [94]

UiPath is an automation company headquartered in New York. The company's AI-powered business automation platform enables significant time and cost savings for enterprises, with applications in finance, healthcare, insurance, manufacturing, retail, telecommunications, public sector and other industries.

[92] For details, please refer to: https://www.microsoft.com/en-us/research/theme/machine-learning-ai-nyc/, https://research.ibm.com/labs/watson/; https://research.ibm.com/collaborate/ai-hardware-center, https://research.google/locations/new-york/
[93] Source: *Top 500 List- JUNE 2023*. Retrieved from https://www.top500.org/lists/top500/list/2023/06/
[94] For more information, please refer to: https://www.uipath.com/

Case: Runway [95]

Founded in 2018, Runway is an AI start-up based in New York. The company utilises software developed by general AI technologies to generate short videos from everything from text to images, and its clients include industry giants such as Google, Microsoft, Ogilvy, New Balance, and the Columbia Broadcasting System Corporation.

Case: Taboola [96]

Taboola is a content platform company headquartered in New York that uses AI algorithms to connect users with content they may be interested in. Taboola has more than 500 million active users, 9,000 publisher partners, and 15,000 advertiser partners. Its exclusive partners include Bloomberg, USA Today, Insider, NBC News, Yahoo and other well-known publishers, and it processes 100 terabytes of data per day.

Case: Similarweb [97]

Similarweb is an Israeli business research company with offices in New York and other regions. Its AI-powered intelligence platform can monitor the traffic of web and mobile applications to provide business intelligence to the market. The company collects tens of billions of digital information, analyses 2 TB of data, and generates 10,000 traffic reports every day. It has more than 200 data scientists responsible for perfecting AI algorithms and has clients in consulting, finance, logistics, retail and FMCG, and travel industries.

3.5.2 Supporting Role of City Government

With the private sector boosting the booming AI industry, the role of the government of New York City is more about driving the AI industry in a healthy direction consistent with society's well-being. In October 2021, the *New York City Artificial Intelligence Strategy* was officially released, which suggests that New York City should focus on five areas, including data infrastructure, applications within the city, city governance, partnerships, and business, education, and the workforce, in order to build a robust AI ecosystem:[98]

Data infrastructure	• Improve open data programme to make it easier for users to access more accurate data; • Establish citywide applicable data strategies and guidelines to harmonise government organisations and enhance the efficiency of data processing within the government; • Develop more data engineers and experts within government organisations.

[95] For more information, please refer to: https://runwayml.com/
[96] For more information, please refer to: https://www.taboola.com/
[97] For more information, please refer to: https://www.similarweb.com/
[98] New York City Mayor's Office of the Chief Technology Officer (2021). *The New York City Artificial Intelligence Strategy*. Retrieved from https://www.nyc.gov/assets/cto/downloads/ai-strategy/nyc_ai_strategy.pdf

Applications within the city	· Tap into opportunities for government organisations to apply AI and improve application efficiency; · Support various governmental organisations in machine learning and other AI activities from the software and hardware perspective.
City governance	· Set up internal working groups to support the formulation of AI policies; · Conduct constant and regular reviews of the AI systems deployed by government organisations to ensure that each government organisation is in control of the AI systems it uses; · Collaborate with social organisations to promote public participation in AI systems' design, use, governance, and administration.
Partnership	· Establish a centralised team to facilitate cooperation among stakeholders such as academic institutions; · Create more opportunities to partner with external experts; · Create gathering opportunities for different groups in the AI ecosystem.
Business, education and workforce	· Continuously monitor the impact of AI on employment; · Support programmes that train the workforce in AI skills; · Increase minority participation in AI; · Enhance the capacity of civil servants to deal with AI issues; · Protect the digital rights of citizens.

Source: New York City Mayor's Office of the Chief Technology Officer (2021)

As can be seen from the New York City Artificial Intelligence Strategy, the government of *New York City's AI* policy mainly emphasises promoting the development of the AI industry in a healthy manner rather than expanding its scale, which is quite different from cities such as Singapore, Shanghai and Shenzhen. Many reasons contribute to this phenomenon, which

may include the following: First, most of the U.S. policies to promote the expansion of the AI industry are national policies, such as the *Executive Order on Maintaining American Leadership in Artificial Intelligence*; second, the U.S. AI industry is leading the world driven by the private market. Instead of boosting the development of the AI industry, the city government needs to respond to social concerns about AI and lead society to adapt to the new era of AI.

Particularly, the regulatory policies on AI can potentially affect the market adversely and even trigger social controversies. For example, the *Automated Employment Decision Tool*, a law that goes into effect in New York City on 5 July 2023, has been criticised for being difficult to enforce and burdensome on enterprises. The law encompasses provisions that regulate employers' use of AI for recruitment activities, including the requirement that employers submit annual independent audit reports to certify that the AI systems used for recruitment do not discriminate based on race or sex.[99]

3.5.3 Summary

New York possesses a private market-driven AI industry with excellent performance in technology R&D, corporate finance, and industrial applications. Instead of actively promoting the growth of the AI industry, the role of the New York City government primarily focuses on building a healthy ecosystem to ensure that AI development is consistent with the well-being of society. The experience of New York's AI policies, which is worthy of Hong Kong's reference, mainly includes:

1. Optimise open data programme and establish general data strategies and guidelines to enhance the data process efficiency for the public sector;

2. Enhance the prevalence of AI use in the public sector and conduct regular reviews of deployed AI systems in terms of efficiency and safety;

3. Create gathering and cooperation opportunities for different groups in the AI ecosystem;

4. Collaborate with social organisations to promote public participation in the design, use, governance, and administration of AI systems, continuously monitor the impact of AI on employment, guarantee citizens' digital rights, and assist the minority in adapting to the new era of AI.

3.6 Switzerland

Switzerland is an interesting case. As a small economy in Europe, its development of the AI industry still stands out even though it has yet to formulate relevant promotion policies. With reference to the Global AI Index prepared by Tortoise in 2023, Switzerland only ranked 56th out of 62 regions worldwide in terms of government strategy but still achieved an excellent overall ranking of 9th thanks to its superb performance in intensity (3), research (4), talent (9), and commercial (9) aspects.[100]

[99] Tate Ryan-Mosley (2023). *Why everyone is mad about New York's AI hiring law. MIT Technology Review*. Retrieved from https://www.technologyreview.com/2023/07/10/1076013/new-york-ai-hiring-law/
[100] Tortoise (2023). *The Global AI Index*. Retrieved from https://www.tortoisemedia.com/intelligence/global-ai/#further_reading

Switzerland also performed well in the Government AI Readiness Index prepared by Oxford Insights in 2022, with a relatively mediocre performance in the Government pillar but a strong performance in the Data and Infrastructure pillar and the Technology Sector pillar (ranked 5th and 7th globally, respectively), resulting in 23rd place out of 181 regions globally.[101]

3.6.1 First-class Innovation Environment Provides Quality Conditions for AI Development

Compared to Singapore, Shanghai and Shenzhen, which are committed to boosting the development of the AI industry, the Swiss government is not as active and has not yet formulated a comprehensive AI development strategy. The Swiss Federal Council made AI a vital theme of the Digital Switzerland Strategy in 2018 and set up an interdepartmental working group to focus on AI-related matters. However, the working group only aimed to "facilitate the exchange of knowledge and ideas and to coordinate Switzerland's positioning in international organisations," [102] and it only published a report on AI challenges and a guide to the federal government's use of AI between 2019 and 2020[103], and has not contributed to the Swiss government's policy to promote the development of the AI industry.

Nevertheless, the Swiss government has been quite successful in nurturing an innovation ecology, which, in combination with the stable political and economic environment, has provided excellent conditions for AI development in Switzerland:

- Since 2011, Switzerland has been ranked by the World Intellectual Property Organization as the most innovative region globally;[104]
- In 2022, Switzerland took first place in the INSEAD Global Talent Competitiveness Index;[105]
- According to the World Bank, Switzerland ranks eighth in the world in terms of R&D expenditures, accounting for approximately 3.15% of GDP[106], and second globally with respect to 66% of medium- and high-tech manufacturing value-added;[107]

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[101] Oxford Insights (2022). *Government AI Readiness Index 2022*. Retrieved from https://static1.squarespace.com/static/58b2e92c1e5b6c828058484e/t/639b495cc6b59c620c3ecde5/1671121299433/Government_AI_Readiness_2022_FV.pdf

[102] The Federal Council (2018). *New guidelines for digital Switzerland*. Retrieved from https://www.bakom.admin.ch/bakom/en/homepage/ofcom/ofcom-s-information/press-releases-nsb.msg-id-72053.html

[103] State Secretariat for Education, Research and Innovation. *Federal Education, Research and Innovation Policy - Artificial Intelligence*. Retrieved from https://www.sbfi.admin.ch/sbfi/en/home/eri-policy/eri-21-24/cross-cutting-themes/digitalisation-eri/artificial-intelligence.html

[104] WIPO (2022). *Global Innovation Index 2022*. Retrieved from https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-en-main-report-global-innovation-index-2022-15th-edition.pdf

[105] INSEAD & Portulans Institute & Human Capital Leadership Institute (2022). *The Global Talent Competitiveness Index 2022*. Retrieved from https://www.insead.edu/sites/insead/files/assets/dept/fr/gtci/GTCI-2022-report.pdf

[106] World Bank Data (2023a). *Research and development expenditure (% of GDP)*. Retrieved from https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?most_recent_value_desc=true

[107] World Bank Data (2023b). *Medium and high-tech manufacturing value added (% manufacturing value added)*. Retrieved from https://data.worldbank.org/indicator/NV.MNF.TECH.ZS.UN?most_recent_value_desc=true

- In 2021, Switzerland's R&D expenditures reached CHF24.6 billion, of which the private sector accounted for 68% and higher education institutions for 28%, reflecting the mature advancement of the Swiss innovation and technology industry.[108]

3.6.2 Active AI Ecosystem

With a world-class innovation environment, Switzerland has successfully attracted foreign technology giants such as Microsoft, Google, IBM, Disney and Sony to establish AI laboratories in the country. These foreign enterprises have brought in huge R&D investment from the private sector to Switzerland and have also worked closely with local universities and research institutes, such as the Federal Institute of Technology Zurich and the École polytechnique fédérale de Lausanne (EPFL), playing a crucial role in promoting the transfer and industrialisation of AI research results.[109]

Source: Disney Research Studios

On the other hand, Switzerland's thriving innovation ecology has spawned several AI enterprises. With reference to Deep Knowledge Analytics' report, as of the fourth quarter of 2021, there were about 500 AI enterprises in Switzerland, of which about 54% have one to ten employees, 35.4% have 251 to 500 employees, and 2.4% have more than 500 employees. In terms of business distribution, taking the top 100 AI enterprises as samples, industries such as recruitment and human resources, health and life sciences, cybersecurity, market

[108] Federal Statistical Office (2023). *Research and development in Switzerland in 2021*. Retrieved from https://www.bfs.admin.ch/news/en/2023-0281
[109] For more information, please refer to: https://www.microsoft.com/en-us/research/lab/mixed-reality-ai-zurich/collaborations/; https://research.google/locations/zurich/; https://www.zurich.ibm.com/; https://studios.disneyresearch.com/; https://ai.sony/

analysis, retail solutions, and logistics and transportation have attracted considerable funds.[110]

Case: MindMaze[111]

MindMaze is a medical technology company headquartered in Lausanne, Switzerland. It was founded in 2012 by a research team from the École polytechnique fédérale de Lausanne. It utilises neuroscience, biosensing, engineering, mixed reality and AI to deliver digital therapies and exercise assessment products that can enhance the recovery potential of patients with neurological disorders.

Case: Scandit[112]

Scandit is a data collection company headquartered in Zurich, Switzerland, founded in 2009 by three researchers from the Massachusetts Institute of Technology, the Federal Institute of Technology Zurich and IBM Research. It utilises computer vision to build an intelligent data collection platform that empowers smart devices such as smartphones, unmanned aerial vehicles, digital glasses, and robots to efficiently scan data from barcodes, text, ID cards, and other objects, with applications in retail, logistics, shipping, manufacturing, and healthcare industries.

Case: SOPHiA GENETICS[113]

SOPHiA GENETICS is a medical company in Rolle, Switzerland, founded in 2011 with an initial public offering in 2021. The company has a cloud-based software-as-a-service platform called SOPHiA DDM ™ that leverages AI capabilities to standardise and computationally analyse complex health data, enabling healthcare organisations to generate insights from the data quickly.

Case: WISeKey[114]

WISeKey is a cybersecurity company headquartered in Geneva, Switzerland. It was founded in 1999 and had an initial public offering in 2019. The company utilises blockchain, AI, and IoT technologies to provide integrated security solutions for the digital identity ecosystem and has installed more than 1.5 billion microchips in various IoT areas, such as connected cars, smart cities, anti-counterfeiting, smartphones, and cryptocurrency. In addition, the semiconductors produced by WISeKey can generate considerable data that can be used for AI analysis and predictive maintenance of equipment.

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[110] Deep Knowledge Analytics (2021). *Artificial Intelligence Industry in Switzerland Landscape Overview 2021 Q4*. Retrieved from https://analytics.dkv.global/AI-in-Switzerland-2021-Q4/Report.pdf
[111]For more information, please refer to: https://mindmaze.com/
[112]For more information, please refer to: https://www.scandit.com/
[113] For more information, please refer to: https://www.sophiagenetics.com/
[114] For more information, please refer to: https://www.wisekey.com/

Case: Yokoy[115]

Founded in 2019, Yokoy is an AI start-up based in Zurich, Switzerland. It utilises automation technology to enable enterprises to manage their expenses in an efficient and compliant manner so as to save money, with applications in finance, manufacturing, business services, and technology industries.

Case: ANYbotics[116]

ANYbotics is an industrial robot start-up based in Zurich, Switzerland. Founded in 2016, it specialises in developing legged robots for industrial inspection. Its flagship product, ANYmal, uses AI to analyse sensing data and detect anomalies. Besides, it has industrial applications across the construction industry and heavy industries such as power, oil, petroleum, mining, and chemicals.

3.6.3 Government Investment in Innovation and the Development of AI

In terms of government investment, Switzerland's investment in innovation R&D is crucial in promoting the development of the AI industry. For example, the Swiss federal government has invested in supercomputing centres since 1985 to provide computing power support for scientific research.[117]

So far, the Swiss National Supercomputing Centre has set up a number of supercomputers with different models, which has become a significant infrastructure to boost the industrial development of AI. Specifically, Alps, a supercomputer built by the Centre in collaboration with Hewlett Packard and NVIDIA, is planned to come online in 2023 and replace Piz Daint, which currently (as of June 2023) ranked 28th in the world with a computing power of 21.23 PFlop/s (Rmax)[118].[119]

In addition, the Federal Assembly of Switzerland has decided to invest a total of approximately CHF28.1 billion in education, research and innovation from 2021 to 2024, of which around CHF10.8 billion will be invested in the ETH Domain[120], CHF5.8 billion in public universities and universities of applied sciences, CHF4.8 billion in the Swiss National Science Foundation and the Swiss Academies of Arts and Sciences, CHF4.1 billion in vocational and professional education and training, and CHF1.2 billion in the Swiss innovation agency

[115] For more information, please refer to: https://yokoy.io/
[116] For more information, please refer to: https://www.anybotics.com/company/
[117] Swiss National Supercomputing Centre (2023). *History*. Retrieved from https://www.cscs.ch/about/history
[118] Source: *Top 500 List- JUNE 2023*. Retrieved from https://www.top500.org/lists/top500/list/2023/06/
[119] Swiss National Supercomputing Centre (2021). *CSCS, Hewlett Packard Enterprise and NVIDIA Announce World's Most Powerful AI-Capable Supercomputer*. Retrieved from https://www.cscs.ch/science/computer-science-hpc/2021/cscs-hewlett-packard-enterprise-and-nvidia-announce-worlds-most-powerful-ai-capable-supercomputer
[120] The ETH domain consists of the Swiss Federal Institutes of Technology in Zurich and Lausanne, the Swiss Federal Institute of Aquatic Science and Technology, the Swiss Federal Institute for Forest, Snow, and Landscape Research, the Swiss Federal Laboratories for Materials Science and Technology, and the Paul Scherrer Institute.

Innosuisse. [121] These funds provide crucial financial support to Switzerland's higher education and research sectors, part of which is used to support AI R&D.

For example, the teaching and research team of the ETH AI Centre[122] at the Federal Institute of Technology Zurich consists of more than 100 professors from 16 departments and offers doctoral and post-doctoral programmes to train top professionals in AI scientific research. In addition, the Centre has a multi-disciplinary team of 10 to 30 members in each research area to study the AI industrial applications and associated impacts. These research areas cover AI theory, healthcare, law, fintech, manufacturing, science and engineering, education and future work, robotics and automation, sustainability, augmented reality, retail, and smart cities. On the other hand, the Centre has partnered with enterprises such as Ernst & Young, Viseca, Meta, Kaiko, Lakestar and YData to advance AI R&D and application in various sectors. The Centre also has some start-ups dedicated to introducing cutting-edge AI technology to multiple industries. For example, EthonAI develops software applications using AI technology to help manufacturers manage quality in root cause analysis, assembly validation, visual inspection, process monitoring, and other aspects.[123]

Another example is the Swiss Data Science Centre, a joint venture established by the École polytechnique fédérale de Lausanne and the Federal Institute of Technology Zurich, in collaboration with Swiss giants such as Swisscom, Lombard Odier, Richemont, the Adecco Group, Firmenich and Logitech to accelerate the application of data science and machine learning in academic and industrial fields. Furthermore, the Centre has established an open-source platform called Renku to provide data science researchers and learners with full-procedure tools to facilitate collaboration and R&D in data science projects.[124]

The Swiss National Science Foundation and the innovation agency Innosuisse also assume a vital responsibility in promoting AI in Switzerland. The Swiss National Science Foundation provides funding for AI-related and other research projects. For example, in 2018, it granted CHF1.02 million to shore up the research project *De novo molecular design by deep learning*. [125] The innovation agency Innosuisse offers a scaled-up mentoring programme for AI start-ups. Start-ups participating in the programme in 2023 include Lyfegen, FAIRTIQ, Signifikant, Smeetz, and Veezoo.[126]

The renowned Swiss AI Lab IDSIA and Idiap Research Institute have also received considerable funding from the Swiss National Science Foundation and Innosuisse to advance their AI research and related technology transfer projects. [127] IDSIA's Recurrent Neural Networks (RNNs) lay the groundwork for the development of deep learning, which has been

[121] State Secretariat for Education, Research and Innovation. *Federal Education, Research and Innovation Policy 2021-2024*. Retrieved from https://www.sbfi.admin.ch/sbfi/en/home/eri-policy/eri-21-24.html
[122] For more information, please refer to: https://ai.ethz.ch/
[123] For more information, please refer to: https://ethon.ai/#
[124] For more data, please refer to: https://datascience.ch/
[125] For more information, please refer to: https://data.snf.ch/grants?q=artificial%20intelligence
[126] For more information, please refer to: https://www.innosuisse.ch/inno/en/home/media-and-events/newsroom/scale-up-award.html
[127] For more information, please refer to: https://www.idsia.ch/idsia_en/applications.html & https://www.idiap.ch/en/scientific-research/projects

extensively used by tech giants such as Google, Facebook, Microsoft, and Apple[128], and Idiap's research has been used by Facebook to further develop the machine learning library PyTorch.[129]

Source: Switzerland Global Enterprise

3.6.4 Summary

Switzerland's experience reflects the importance of R&D investment and an innovation environment for the development of the AI industry. Switzerland spends over 3% of its GDP on R&D, with higher education institutions accounting for 28% and the private sector for 68%. Even though the Swiss government has not formulated specific policies to promote its AI industry development, its substantial public investment in R&D is still of great benefit. The government funds many top higher education and R&D institutions in Switzerland. They have invested heavily in AI, excelling in basic research and nurturing many start-ups and top talent, creating favourable conditions for the local development of the AI industry.

Compared with Hong Kong, Switzerland's AI industry chain is more established. It not only has a considerable number of local giants and AI start-ups but also has attracted numerous technology giants abroad to develop AI businesses in Switzerland. These enterprises have brought huge private R&D expenditures to Switzerland and actively participated in industry-academia-research cooperations, promoting the transformation and industrialisation of AI-related basic research outcomes.

The inspiration brought by Switzerland to Hong Kong mainly includes:

1. Provide more financial support for R&D activities in the public sector to foster an active innovation ecosystem;

[128] Jürgen Schmidhuber (2017). *Our Impact on the World's Most Valuable Public Companies (Google, Apple, Microsoft, Amazon, etc.)*. Retrieved from https://people.idsia.ch/~juergen/impact-on-most-valuable-companies.html
[129] Idiap Research Institute. *PYTORCH BECOMES PART OF THE LINUX FOUNDATION*. Retrieved from https://www.idiap.ch/en/allnews/pytorch-becomes-part-of-the-linux-foundation

2. Attract more leading technology enterprises to develop business in Hong Kong to promote the increase of R&D investment from the private sector; and

3. Collaborate with international technology giants to enhance the computing power infrastructure.

Chapter IV: Study Methodologies

We conducted a comprehensive survey on the development of the AI industry to gain insights into the current status and future trends of the sector. In addition to collecting basic information about the enterprises, such as the nature and scope of their business, we also explored a number of topics, including (1) the current development and application status of AI; (2) the existing challenges and difficulties; (3) the demand for talent; and (4) the prospects for future development and application in the AI field. Details are available in the detailed questionnaire in the Appendix. The survey, conducted in mid-2023, targeted two categories of companies, including:

(1) AI-related enterprises mainly engaged in AI-related businesses in Hong Kong

(2) Enterprises applying AI across nine major industries in Hong Kong

A total of 216 AI-related enterprises and 267 AI-enabled enterprises were interviewed by telephone.

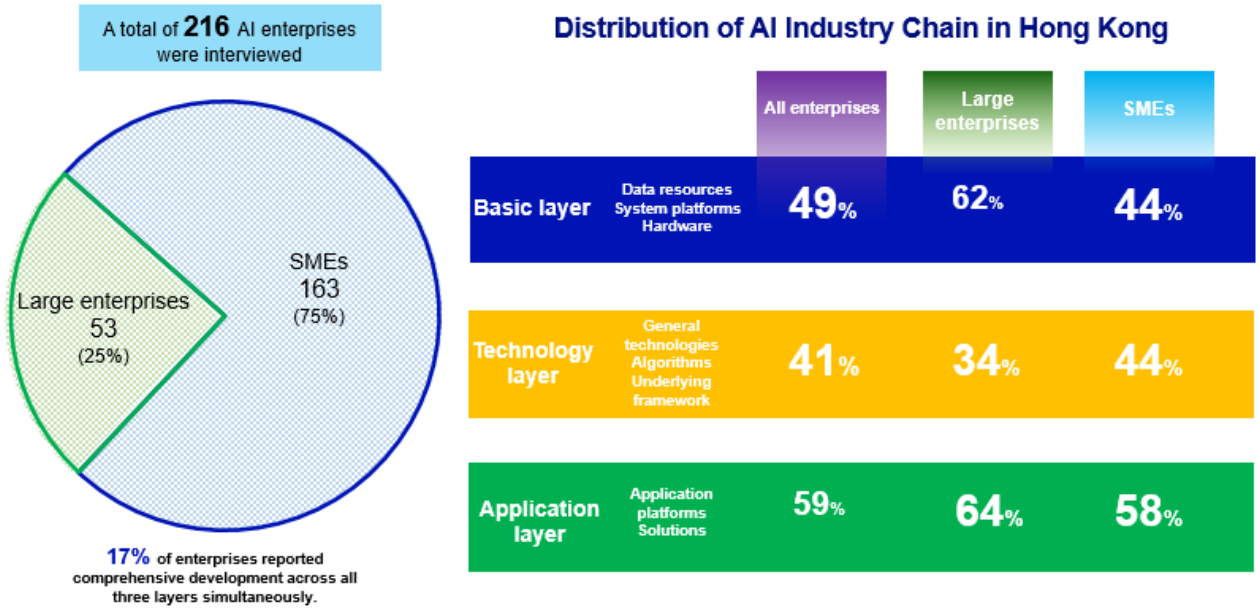
Chapter V: Study Results

5.1 Overview of the AI industry in Hong Kong

Of the AI-related enterprises surveyed, 25% were large enterprises, while 75% were SMEs.

We conducted an analysis of the AI industry chain in Hong Kong, which comprises three layers: the "basic layer", the "technology layer" and the "application layer". The survey found that 49% of AI-related enterprises are developing at the "basic layer", which involves data resources, system platforms and hardware facilities. 41% of enterprises are progressing at the "technology layer", which involves the development of general technology, algorithms and underlying frameworks. Finally, in terms of the "application layer", which includes developments such as application platforms and solutions, nearly six out of ten (59%) enterprises reported that they are developing at this layer.

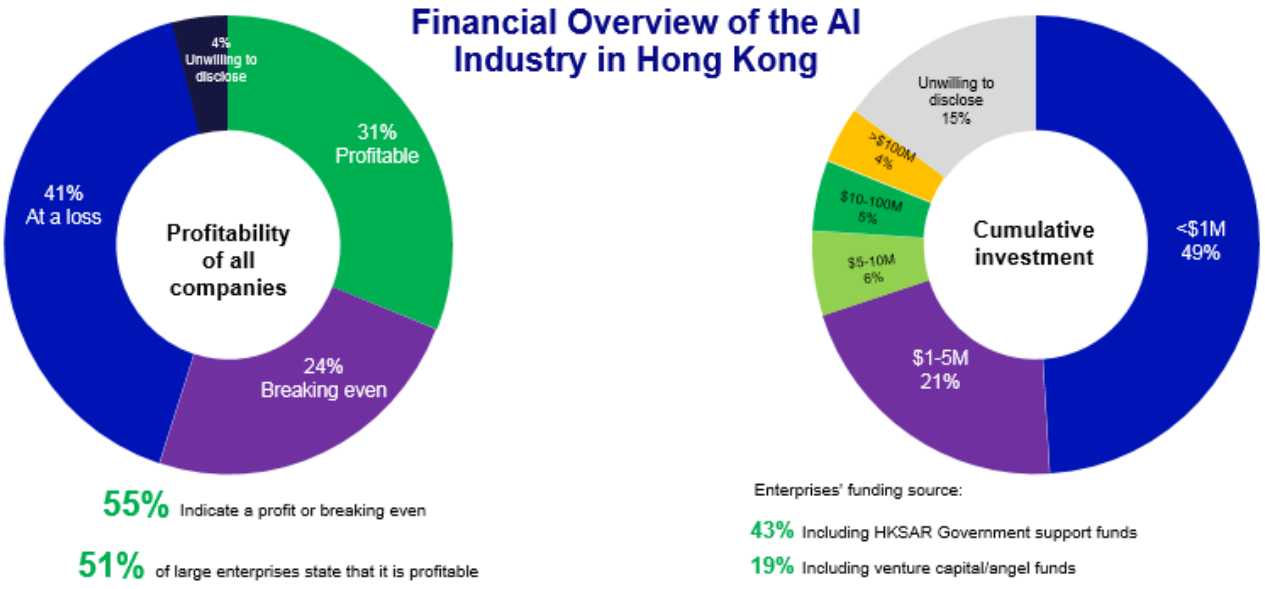
Upon further examining the situation of large enterprises and SMEs, we found that 62% of large enterprises reported that they are developing at the basic layer, while 64% are developing at the application layer. In contrast, SMEs are more focus on the application layer, with 58% of SMEs reporting that they were developing on that layer. Among them, 17% reported comprehensive development across all three layers of basic, technology and application layers simultaneously.



In terms of the financial status of AI-related enterprises in Hong Kong, overall, 31% of the surveyed enterprises reported profit, 24% were breaking even, and 41% were experiencing losses. Of the large enterprises, half (51%) reported profit.

In terms of the source of funding, 43% of the enterprises reported that part of their funding came from the HKSAR Government's support funds, while 19% reported that part of their funding came from venture capital or angel investors.

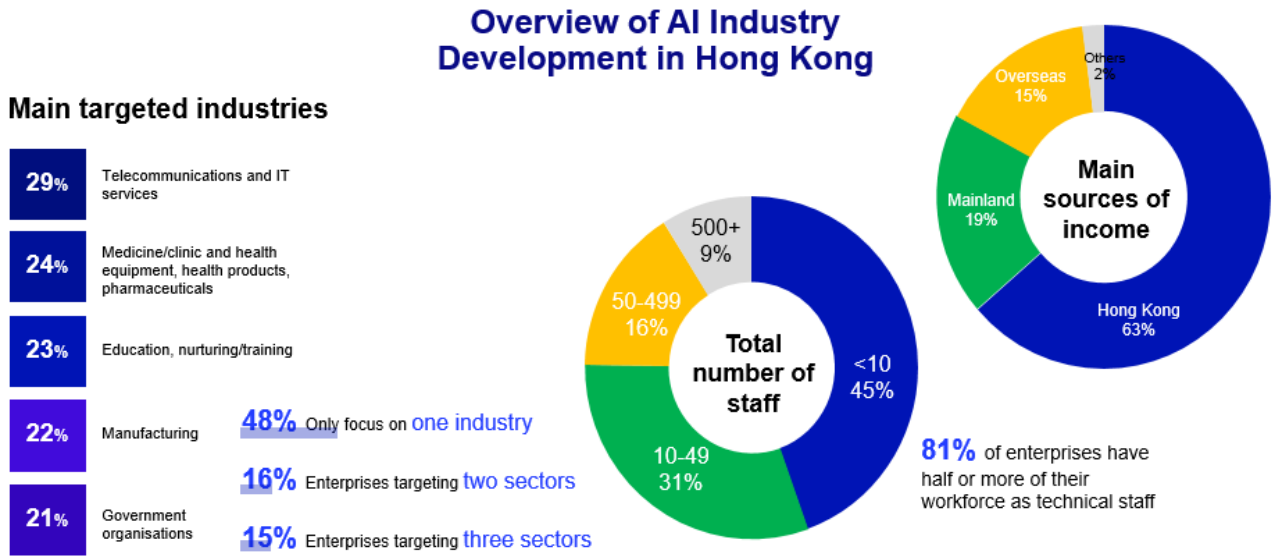
In cumulative investment amount, nearly half (49%) of the enterprises invested less than HK$1 million, about 20% (21%) invested between HK$1 million and HK$5 million, 6% invested between HK$5 million and HK$10 million, another 5% invested between HK$10 million and HK$100 million, and 4% invested over HK$100 million.



In terms of industry development, 48% of enterprises focused on AI development within a single industry, while 16% were expanding their AI endeavors across two industries, and another 15% were simultaneously developing AI in three different industries.

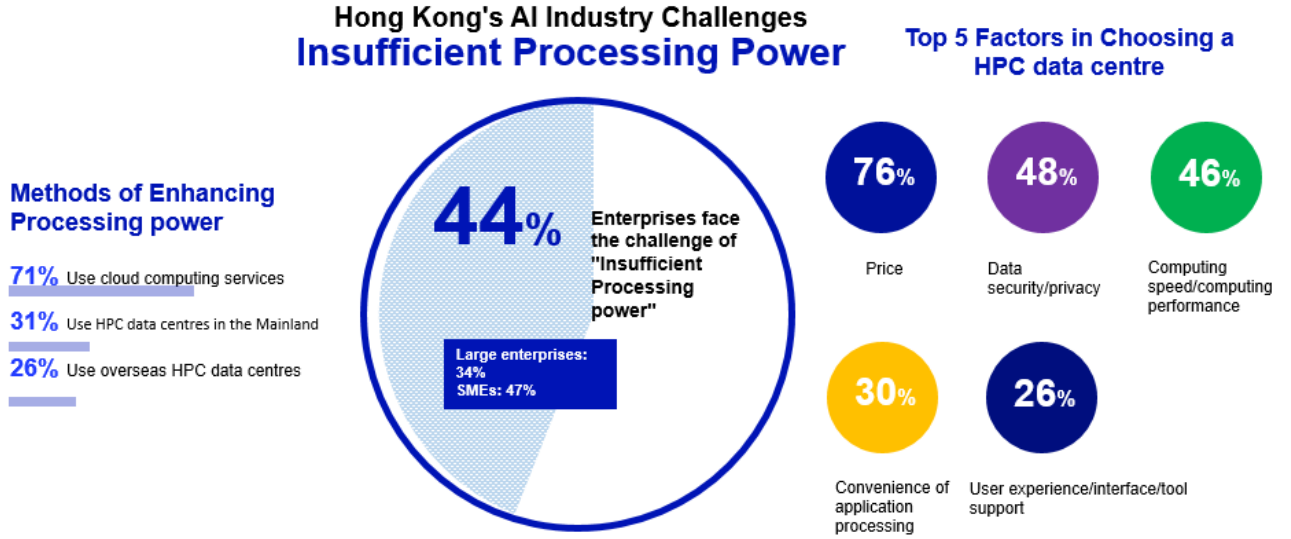
Upon further observation, the major industries targeted cover a wide range of sectors. Among them, 29% of the enterprises focused on telecommunications and IT services, 24% on the medical/clinical and health equipment, health products, pharmaceuticals sector, 23% on the education, nurturing/ training sector, 22% on the manufacturing industry, and 21% on government organisations.

In addition, we are also concerned about the primary sources of income for these enterprises. According to the survey findings, 63% of the enterprises generated their primary income from Hong Kong, 19% from the Mainland and 15% from overseas markets.



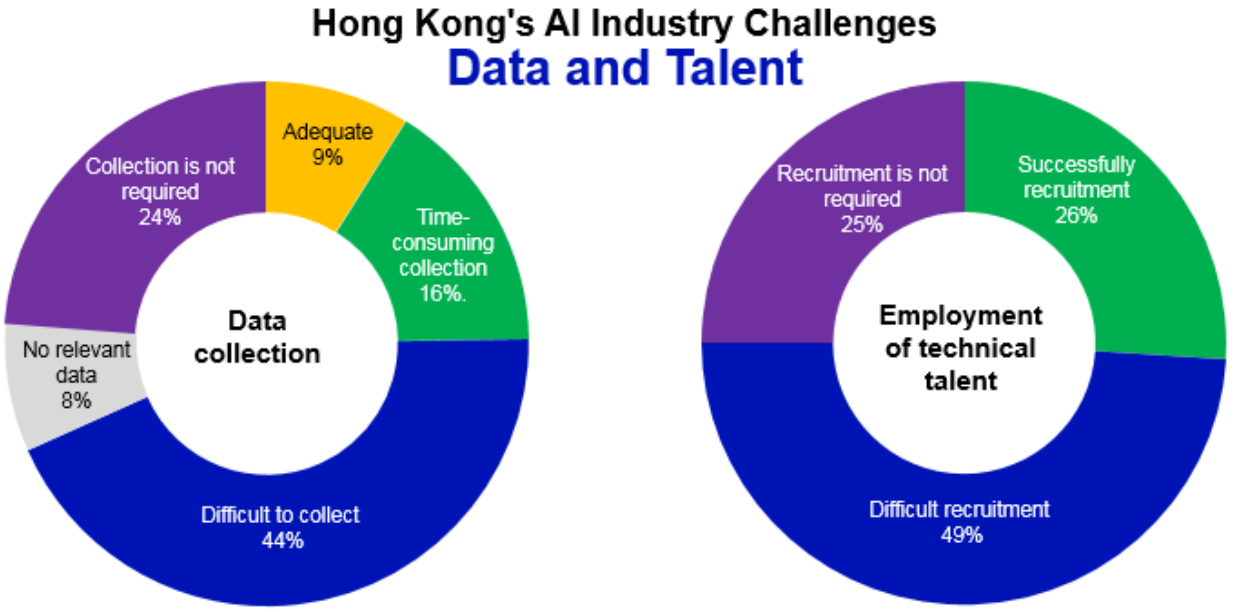
In the development of the industry, enterprises are facing significant challenges, including "insufficient processing power", "insufficient data" and "difficulties in recruiting technical talent".

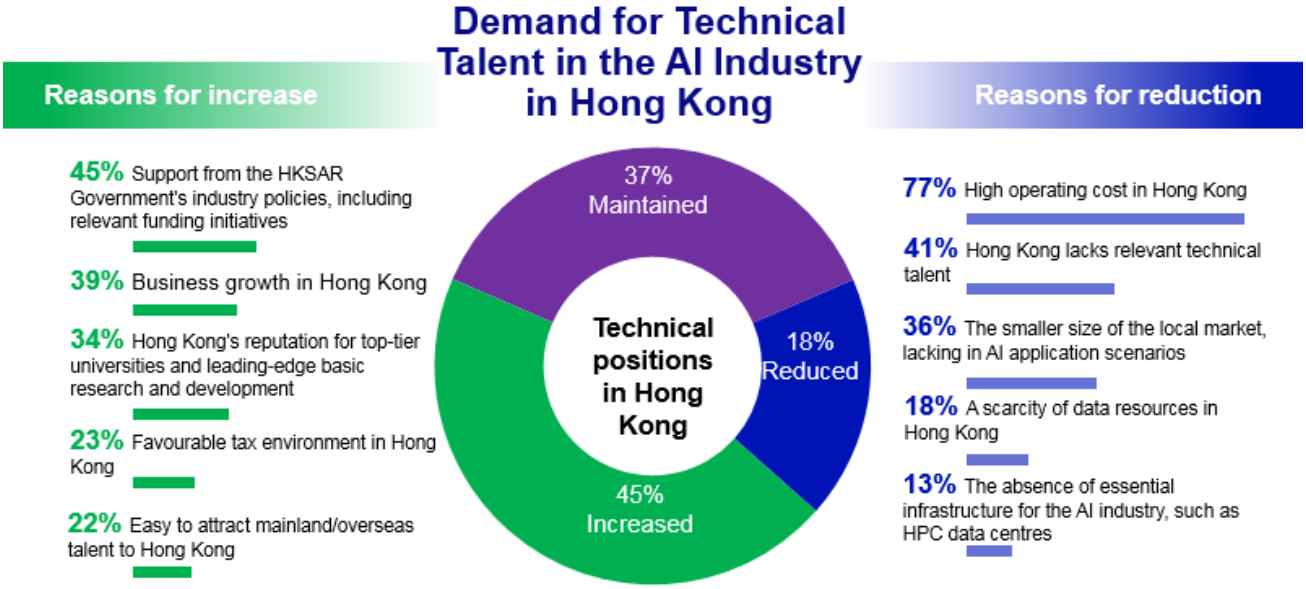
Firstly, the issue of "insufficient processing power" is widespread, with 44% of enterprises reporting that they are currently confronting this challenge. To address the challenge, enterprises have adopted a variety of countermeasures. Among them, 71% have turned to cloud computing services as a solution. In addition, 31% of enterprises are leveraging HPC data centres in the Mainland, while 26% are utilizing HPC data centres overseas.



Secondly, the issues of "insufficient data" poses another challenge, with two-thirds (67%) of enterprises reporting that they were facing this difficulty. Among these, 44% found data collection challenging, 16% reported that collecting sufficient data was time-consuming, and an additional 8% reported a scarcity of relevant data.

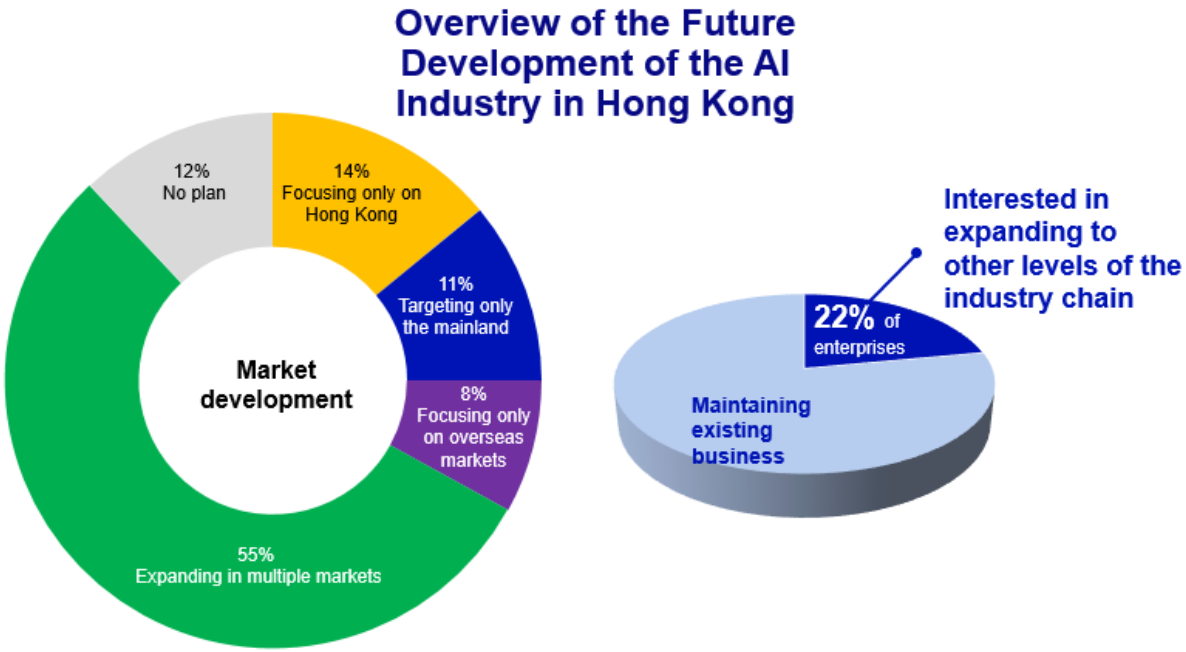
Another significant challenge is the “difficulties in recruiting technical talent”. According to the survey findings, 49% of the surveyed enterprises reported struggles in recruiting technical talent. In addition, 18% of enterprises reported that they were scaling down their technical roles in Hong Kong. Among them, the majority (77%) reported that the operational costs in Hong Kong were relatively high, while 41% pointed to a shortage of relevant technical talent within Hong Kong. Nevertheless, 45% of enterprises indicated that they plan to increase the number of positions for technical talent in Hong Kong. Among the enterprises planning to increase their technical positions in Hong Kong, 45% cited the support of the HKSAR Government’s industry policies as a contributing factor, 39% of these enterprises have observed growth in their Hong Kong operations, and 34% recognise Hong Kong as a leading hub for basic research and development.





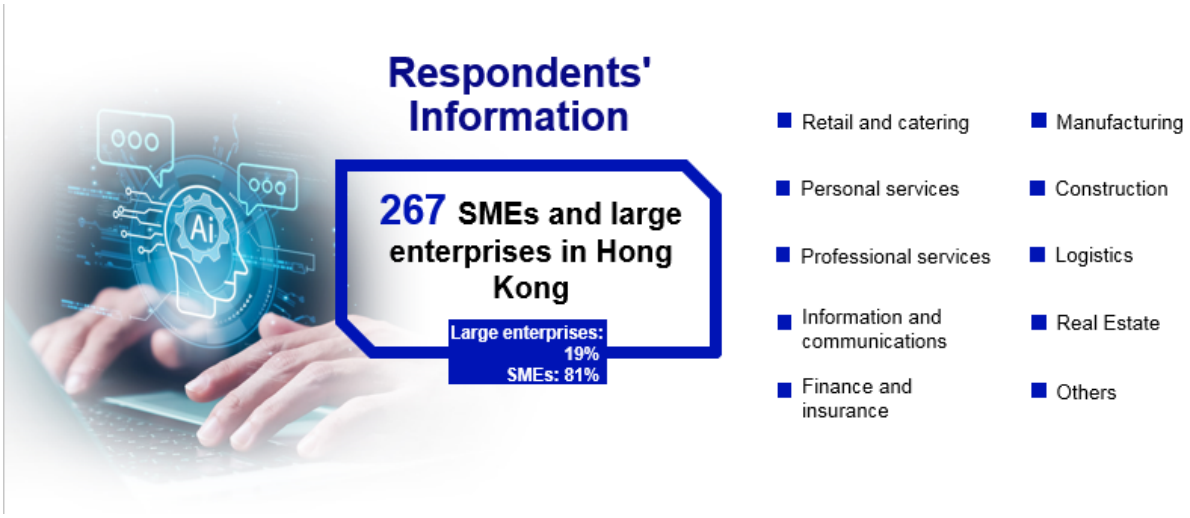
Regarding the future development of the AI industry in Hong Kong, the survey reveals that 22% of the AI-related enterprises in Hong Kong have reported their intention to expand their industry chain to other layers in the future.

In addition, 55% of enterprises expect to look for growth opportunities not only in the local market, but also to venture further into the international market. Meanwhile, 14% choose to continue to expand their businesses in Hong Kong, and 11% are looking towards business expansion in the Mainland.



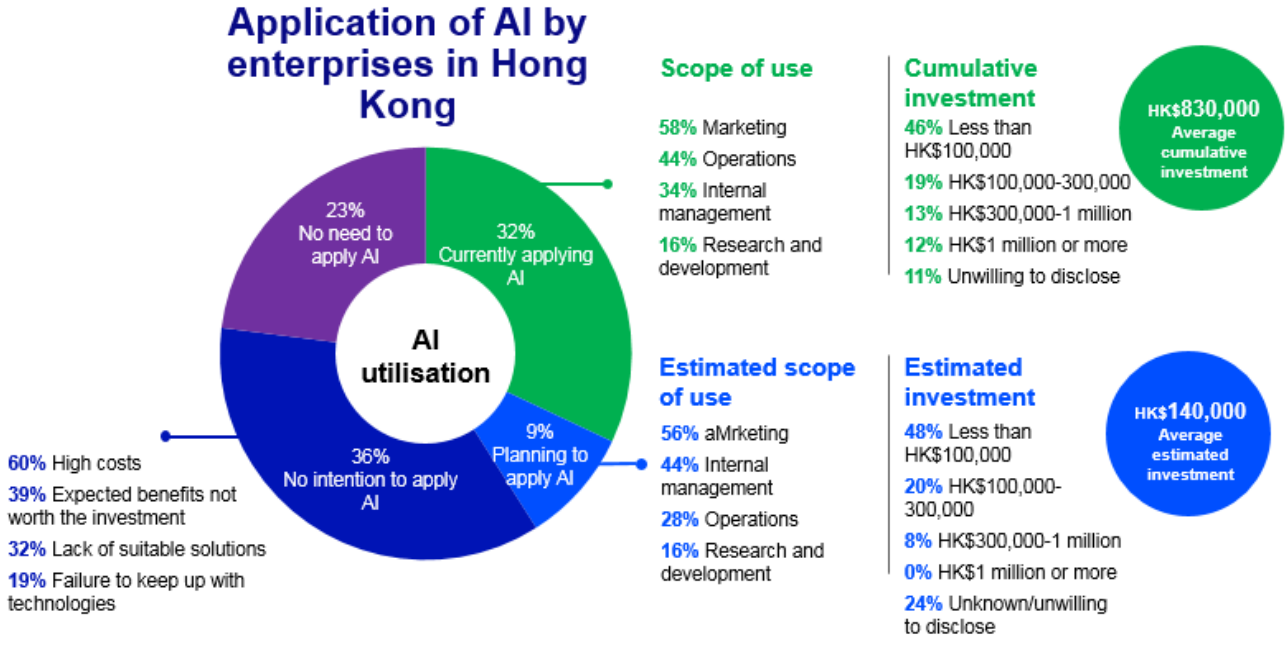
5.2 Overview of the Application of AI in Hong Kong

In addition to exploring the development of the AI industry, this study also examines the application of AI by enterprises in Hong Kong. The survey covered 267 Hong Kong enterprises, of which 81% were SMEs while 19% were large enterprises. These enterprises represent a wide range of sectors, including retail and catering, personal services, professional services, information and communications, finance and insurance, manufacturing, construction, logistics, and real estate.



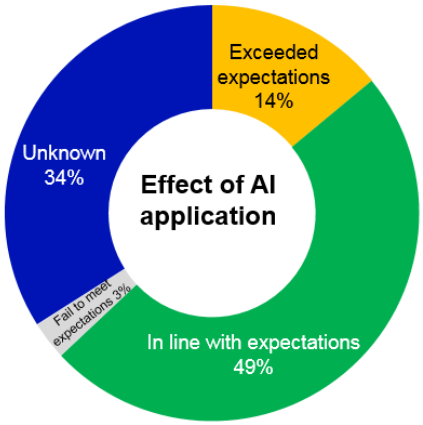
Of the Hong Kong enterprises surveyed, 41% are currently applying or planning to apply AI technologies. Among them, 32% have been already using AI at multiple levels, including marketing (58%), operations (44%) and internal management (34%). On average, these enterprises have invested a cumulative total of HK$830,000. A further 9% said they are preparing to put AI technology into their business operations, with these enterprises budgeting an average investment of about HK$140,000.

On the other hand, one-third (36%) of the enterprises said they had no intention to incorporate AI technology to their work flow, with “high costs” being one of the main reasons (60%), followed by expected benefits not worth the investment (39%) and lack of suitable solutions (32%).



Of those enterprises that are applying AI technology, 59% say they plan to further expand their AI applications. Among them, 61% expect to expand their investment by HK$300,000, with an average estimated investment of up to HK$1.22 million.

Effectiveness of Hong Kong enterprises' use of AI



Enterprises that have applied AI

Benefits of applying AI

- 60% Reduce human errors
- 56% Help to optimise decision-making
- 51% Improve productivity

Challenges in AI application

- 47% Lack of talent
- 34% Lack of funds
- 31% Fail to explain AI decision-making

Enterprises that will apply AI

Anticipated benefits of applying AI

- 68% Reduce human errors
- 64% Discover more customer sources
- 60% Cost savings

Anticipated challenges of applying AI

- 52% Lack of talent
- 52% Lack of funds
- 32% Choose suitable programs

According to the latest findings, 49% of the enterprises that have already applied AI technology believe that its effect are in line with their expectations, while 14% said that the outcomes even exceeded their expectations. However, a small percentage of enterprises also reported a need for enhancement in AI efficacy. This underscores the challenges and complexities inherent in AI technology deployment that require further improvement and optimisation.

Chapter VI: Conclusions and Recommendations

6.1 Conclusion

AI is a hot topic in the global technology field today, and its application has permeated various industries and fields. As a modern metropolis, Hong Kong has always been committed to promoting technological innovation and digital transformation. In recent years, the HKSAR Government has also been actively promoting the AI development to support high-quality economic growth and enhance competitiveness.

Hong Kong has an excellent geographical location and an international business environment, which attract numerous international enterprises and innovative technology companies to set up their business and R&D centres here. In addition, Hong Kong possesses an excellent education system and high-end research institutions that can cultivate professional talents in science and technology. These advantages have laid a solid foundation for Hong Kong to become an “International AI and Data Industry Development Hub”.

Despite Hong Kong's potential to become a hub for the global AI and data industries, there are still some challenges to overcome. For example, aspects such as the completeness of infrastructure and the standardisation of data sharing still need improvement. Recognising this, this report proposes the following recommendations, with the aim of propelling Hong Kong into a significant hub for global AI and data industries, and injecting new momentum into the economic development of Hong Kong.

Firstly, the HKSAR Government should increase investment and support for AI. Through providing funding and resources, the government can facilitate the research and application of AI technology, promoting innovation and technological transformation. Additionally, the government can formulate corresponding policies and regulations to create a favorable business environment, attracting more AI enterprises and professionals to develop in Hong Kong.

Secondly, the government can strengthen international promotion of Hong Kong’s long-term plans for the development of the AI industry, incentives, and the advantages of Hong Kong as an international city. This will help attract global AI talent to develop in Hong Kong, increase international cooperation and exchange, and enhance Hong Kong’s influence in the global field of AI.

Furthermore, the government can formulate policies that encourage AI enterprises to relocate non-local AI technical staff to Hong Kong, promoting the establishment of international AI talent teams by businesses. This will further enhance Hong Kong’s attractiveness as a most internationally livable city for AI talent, attracting more top-notch AI professionals to develop in Hong Kong and drive it to become a global leading AI centre.

Simultaneously, the government should strengthen collaboration with the academic and business sectors to promote the research and application of AI technology. By establishing more collaboration platforms and opportunities for exchange, knowledge and technology sharing can be facilitated, driving innovation and application of AI technology.

Finally, the government should enhance AI education in the education system, cultivating more professionals with AI knowledge and skills. This can be achieved by introducing relevant courses and training in primary and secondary schools as well as universities, providing opportunities for students and professionals to learn and develop, thus meeting the demand for professional talents in the AI industry.

As a modernised metropolis, Hong Kong possesses the advantages and potentials to boost the development of the AI industry. Through government support and initiatives, Hong Kong has the potential to become a crucial hub for global AI and data industries, injecting new vitality into Hong Kong's economic development. Additionally, this provides more employment and entrepreneurial opportunities for the youth in Hong Kong, promoting sustainable social and economic development.

6.2 Recommendations for Industry Development

Enhancing infrastructure:

1. **Strengthening collaboration with the Greater Bay Area and international partnerships to improve the AI and data industry chain:** Hong Kong should focus on developing its strengths and establish a leading supercomputing centre to become an international technology innovation hub. In today's continuous development of new technologies such as AI, the capability of supercomputing becomes increasingly crucial. It can support various advanced research computations and drive progress in related technological fields. If Hong Kong aims to establish a leading supercomputing centre in Asia, it needs to exert greater efforts in various aspects, including resource allocation, compared to other regions. According to some studies, there is still room for improvement in the proportion of the HKSAR Government's research budget to the GDP compared to some countries and regions in Asia. On the other hand, Hong Kong should deepen its cooperation with Mainland and international universities and research institutes in this

field by means such as setting up joint laboratories. Additionally, the HKSAR Government can also seek multinational enterprises with plans for computing centers in the Asia-Pacific region and encourage them to establish relevant research and development bases in Hong Kong. Attracting the participation of domestic and overseas resources through various channels will be conducive to the development of the Hong Kong supercomputing centre. Furthermore, government agencies need to continuously 80ptimizi supporting policies to guide Hong Kong towards the vision of becoming a great power in science and technology. The HKSAR Government can invest in the establishment of a public supercomputing centre, which connects with other public supercomputing resources (e.g., universities), while introducing preferential policies to attract local and overseas enterprises to Hong Kong to build private supercomputing centres and conduct AI research and development.

2. **Building an "International Hub of Big Data":** Constructing an "International Hub of Big Data" is a crucial development direction for Hong Kong's future. To achieve this goal, Hong Kong should improve relevant laws and regulatory frameworks, establish a comprehensive digital regulatory system with individual privacy and information security as core considerations. The government should also establish a dedicated agency to formulate standards and specifications suitable for Hong Kong. On the other hand, cultivating talent is equally important. Hong Kong should strengthen the training of professionals in relevant fields to meet the talent demand of the big data industry. Only with an adequate number of talents can Hong Kong truly establish an influential big data industry. In addition, Hong Kong should strengthen cooperation with the Mainland China and other international cities in the field of big data, and jointly explore the development of cross-border data-interconnection programs. The government should also focus on attracting more multinational enterprises to set up data centres or R&D bases in Hong Kong. The Digital Policy Office can formulate a data policy, including data "de-privatisation" requirements, to facilitate the flow of big data involving personal privacy (e.g., medical care), promote the provision of "de-privatized" big data and APIs by government departments, public corporations, and public utilities, and negotiate and implement data flow with Mainland China and overseas cities. Overall, improving regulations, deepening

cooperation and continuously improving infrastructure are all crucial for Hong Kong to develop into an international hub of big data.

3. **Formulating policies and guidelines for the development and application of AI technology:** To further ensure public rights and interests, regulatory framework may consider formulating a comprehensive set of privacy protection guidelines. These guidelines can focus on AI systems and applications in the process of collecting, storing, processing and using personal data, and clearly regulate the privacy protection requirements and standards that must be complied with. Simultaneously, the regulatory framework will take into account the needs and interests of enterprises. It will provide a certain degree of development freedom for enterprises to encourage innovative research and development, and provide the necessary resources to help enterprises overcome the difficulties in the R&D and application process, thereby boosting the healthy development of the AI industry. Through the formulation and implementation of the regulatory framework, the confidence of the industry and the public in the application of AI will be boosted. In formulating relevant laws regulations, we should give due consideration to international standards and make reference to the relevant regulations and policies of other regions, such as the European Union, the United States and the Mainland China, so as to ensure that our regulatory framework can stay in line with the laws and regulations of the Mainland China and the world.

4. **Strengthening collaboration with the Greater Bay Area and international partnerships to improve the AI and data industry chain:** Hong Kong should focus on developing its strengths. To further promote the development of the AI industry, Hong Kong's cooperation with other cities in the Greater Bay Area and internationally renowned research institutes will be further enhanced. This collaboration extends beyond close research exchanges to include the sharing of AI talents, algorithms, and data resources. In this way, we can build a cross-border AI R&D platform to gather global wisdom and jointly promote the innovation and development of AI technology. Moreover, the scope of cross-border projects in various fields of AI applications will be expanded. These fields include, but are not limited to, healthcare, smart cities, etc. By implementing these cross-border projects, we can complement and share technologies and resources across the region to jointly promote the application of AI in these fields and 82ptimizing the related products and services, so as to better meet the demands of users. In-depth cooperation with international partners should be maintained in the research and development of cutting-edge technologies. In areas such as AI microelectronics technology, joint research and development will be conducted to explore and advance the innovation and development of these technologies. This deep collaboration not only injects new momentum into the AI industry chain, enhancing its competitiveness but also helps us to secure a position in the global AI industry. Through these strategies and actions, our aim is to better advance the development of the AI industry, enhance international influence in AI research and development, and lay a solid foundation for future technological innovation and industrial development.

Accelerate industrialisation:

5. The Government takes the lead in promoting large-scale application of AI

In line with the development vision of the Smart City Blueprint for Hong Kong in the six areas, namely “Smart Mobility”, “Smart Living”, “Smart Environment”, “Smart People”, “Smart Government” and “Smart Economy”, the government can take the lead in launching exemplary AI application scenarios and applying AI in public service sectors such as transportation, medical care, finance and education. This will enable the public to perceive the benefits of a smart city and technology innovation to their daily lives, popularise high-end technologies, enhance the quality of citizen’s life and economic benefits, and lead the development of the AI industry.

In the realm of Smart Mobility, where public transport accommodates over 10.6 million passengers daily (in 2021), with railways as the backbone, the government can utilize AI technology to enhance traffic flow management and improve transportation quality. For example, through intelligent traffic monitoring systems and predictive models, the government can monitor road conditions in real-time and make corresponding adjustments to enhance traffic efficiency. Additionally, the government can use AI technology to improve public transportation systems, optimise route planning, and provide more accurate arrival time predictions based on real-time traffic information, facilitating citizens in planning their travels more effectively.

In the healthcare sector, following the COVID-19 pandemic, hospitals worldwide, including local ones, have introduced telemedicine services, and medical services such as prescription dispensing are gradually becoming electronic. The report suggests that the government can strengthen the promotion of AI applications in medical diagnosis, treatment, and drug development. In addition to existing medical and surgical robotic assistance to alleviate the pressure on healthcare teams, locally developed AI intelligent medical technology solutions can be widely applied in public healthcare services. For example, a team from the HKU has developed a novel “AI Virtual Patient” consultation application for medical students to simulate interactions with patients, significantly enhancing the professional skills and accuracy of medical students in gathering medical histories. This initiative provides medical students and interns with more opportunities for cross-regional and time-unrestricted clinical practice, reinforcing the quality of local healthcare and accelerating the development of smart hospitals.

Beyond promoting AI in specific application scenarios, the government can establish a platform for sharing AI technology and data to facilitate inter-departmental and cross-institutional collaboration, improving the application effectiveness and social benefits of AI technology. However, the report also points out that while AI brings positive momentum in various sectors, it is crucial to consider aspects such as network security, privacy rights, ethics, and morals. It is necessary to guide a correct understanding of the advantages and limitations of AI, strengthen regulation against issues such as deep fakes and fraud, and lead society in the ethical use of innovative technology.

6. Empower the upgrade and transformation of industries in Hong Kong with AI

Regarding the use of AI by Hong Kong businesses, 36% of surveyed enterprises indicated no plans to adopt AI. The main reasons cited were high costs and expected benefits not worth the investment, highlighting financial constraints as a widespread obstacle to the extensive application of AI. Therefore, the report suggests that the government should strengthen collaboration with the industry, encouraging companies to innovate and develop technologies for public services. The government can provide funding and support to incentivise enterprises to invest in AI-related research and innovation projects, promoting widespread application at reasonable prices. It also suggests that business associations can enhance cooperation with the AI industry, engaging in technological development and application-layer exchanges, sharing success stories, and jointly exploring new application scenarios.

Meanwhile, the report recommends enterprises make good use of the subsidies provided by the government. For example, the New Industrialisation and Technology Training Programme (NITTP) under the Innovation and Technology Fund of the Innovation and Technology Commission (ITC) provides subsidies to local enterprises on high-end technology training for their employees, which can provide AI-related training and education to employees in traditional industries, and help to enhance their relevant skills and application capabilities, enabling them to adapt to new work environments and requirements. Through training and education, employees in traditional industries can learn how to use AI technology to enhance productivity and efficiency, facilitating upgrades and transformations. This not only contributes to the development of businesses but also provides employees with better career development opportunities, strengthening the pool of innovation and technology talents.

In addition to improving efficiency, the application of AI can optimize work processes and enhance occupational safety. Let's take the construction industry as an example. 23 out of 25 (over 90%) fatal industrial accidents in 2021 were related to construction, and many of them involved outdoor and aerial work. In the construction industry, leveraging innovative technology can improve work environments and ensure worker safety. For instance, recognising that workers lack sufficient safety guidance and training, making it easy to overlook the importance of safety equipment, the HKPC and the construction industry have jointly developed a real-time safety monitoring system equipped with the deep network algorithms and IP cameras. When a construction worker mistakenly enters a dangerous area or fails to put on reflective clothing or safety helmet, the system will instantly record and issue a warning to enhance the alertness of the worker, which facilitates the management to take the relevant follow-up measures or actions, thereby enhancing management efficiency.

Empowering Hong Kong industries through AI for upgrading and transformation is an important development direction. The government should strengthen collaboration with the industry, encouraging businesses to undertake technological innovation and development for public services, thus promoting the industrialisation and commercialisation of AI technology. Simultaneously, industry chambers should enhance cooperation with the AI sector to

collectively explore new application scenarios. Enterprises should leverage government-provided funding programmes to offer AI-related training and education to employees, assisting traditional industries in achieving upgrading and transformation. The government should also concurrently support the development of emerging industries, especially in innovative fields related to AI, to create more business opportunities for the AI industry. This will contribute to propelling Hong Kong's industrial upgrading and transformation, enhancing overall economic competitiveness.

7. Develop an International Financing Centre for AI Enterprises

Financing is an important means of support for the development and innovation of AI enterprises. The report recommends that, in order to attract more overseas AI enterprises to develop in Hong Kong, the government can strengthen cooperation with relevant public and private institutions to publicise the listing mechanism of the Hong Kong Exchanges and Clearing Limited (HKEX) for specialised technology companies that took effect on March 31, 2023, including allowing the listing of specialized technology companies with no revenue and no profit in Hong Kong, as well as the reforms of the listing rules of the Growth Enterprises Market in the future, so as to attracting more AI enterprises to list in Hong Kong and bringing more venture capital funds to Hong Kong. This will support the fundraising needs of AI companies, and put innovative concepts into practice. It will attract more attention and funding from investors, supporting their development and innovation.

At the same time, the HKEX's international reputation and favourable regulatory environment also provide investors with greater confidence and protection, in addition to ensuring that the listing rules keep pace with the times and are in line with international best practice. Moreover, the government can offer corresponding support measures, including providing financing resources, streamlining listing procedures, improving the regulatory environment, etc., to attract more AI enterprises to list in Hong Kong and promote Hong Kong to become an international financing centre for AI enterprises, enhancing its international competitiveness.

Expand talent pool:

8. Popularise AI education and accelerate the cultivation of cross-disciplinary "AI+ talent"

According to data from the webpage of the Hong Kong Smart City Blueprint, in the 2019/20 academic year, 60% of high school students took at least one elective course related to STEM, and all students were required to study mathematics as a core (compulsory) course. Additionally, 30,580 students (35%) pursued STEM-related bachelor's degree programmes supported by the University Grants Committee, and among the 11,251 students pursuing research and postgraduate courses funded by the University Grants Committee, 48% were engaged in STEM-related research programmes.

The Education Bureau continues to incorporate elements of innovative technology into primary and secondary school curricula. In 2023, it introduced new "Enriched Module on Coding Education for Upper Primary Level" and "Module on Artificial Intelligence for Junior Secondary Level" to assist teachers in systematically integrating innovative technology elements into classroom learning. The report acknowledges the importance of exposing students to innovative technology early on, cultivating their interest and skills in AI. This not only lays the foundation for their future academic and career development but also attracts more potentially talented individuals to enter the field of AI.

In addition to early education in primary and secondary schools, the report suggests that universities and professional institutes should incorporate AI into the compulsory curriculum of more different departments, provide more comprehensive basic education on AI, and establish an effective assessment mechanism to ensure that students use AI with responsibility, so as to nurture cross-disciplinary "AI+ talent" to meet the needs of the AI industry for talent in different fields, and promote Hong Kong to become an international AI development centre with a competitive edge in terms of talent. The government, educational institutions and the industry should collaborate to provide more training and educational resources, and offer learning and development opportunities for students and professionals, so as to cope with the challenges and seize the opportunities brought about by the booming AI technology.

9. Toward the "Most internationally livable city for AI talent"

One of the key focuses of the Policy Address is "talent attraction". According to the report, among the surveyed AI enterprises, 49% indicated difficulties in recruiting AI talent.

Additionally, when planning for future technical positions, 41% of companies stated a reduction in job positions due to a lack of relevant technical talent in Hong Kong.

The report suggests that the government can enhance external publicity on Hong Kong's long-term plans for the development of the AI industry, optimize the existing talent admission programs to benefit Hong Kong's advantages as an international city, and attract global AI talent to Hong Kong for development. As an international financial centre and an innovation and technology hub, Hong Kong has an excellent geographical location and abundant resources. The HKSAR Government can make good use of these advantages to actively promote Hong Kong as an ideal place for the development of the AI industry. At the same time, the Government can formulate policies to encourage AI enterprises to relocate non-local AI technical staff to Hong Kong and promote the building of an international AI talent team. This will help to attract more leading AI professionals to come to Hong Kong for development and enhance Hong Kong's attractiveness as the most internationally livable city for AI talent.

Furthermore, collaboration between the government, businesses, academic institutions, and professional organisations is recommended to provide more training and networking opportunities. These activities can foster collaboration and communication among AI professionals, elevating their expertise and innovation capabilities. Such collaborations can also facilitate cooperation between academia and industry, promoting research and application of AI technology.

Becoming the "Most Internationally Livable City for AI Talent" is a crucial goal AI industry development in Hong Kong. The government should strengthen its external promotion efforts to attract global AI talent. Through the above measures, Hong Kong can become a leading global AI center, attracting more top-notch AI professionals to develop their careers in the city. This will bring more innovation and economic growth to Hong Kong while enhancing the city's international competitiveness.

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Appendix

Study on the Development of the AI and Data Science Industries - Provider Questionnaire

HKPC is conducting a Study on the Development of AI and Data Science Industries (hereinafter referred to as "the Study"), which aims to understand the needs of Hong Kong enterprises in the development of AI and data technology, as well as the challenges and opportunities faced by the industry in the introducing the new technologies. The collected data will be analysed to provide recommendations to the government, the Council, and local providers of AI and data science solutions, including software, hardware, system infrastructure, and platform service providers.

Your valuable opinions are crucial for the development of Hong Kong's AI and data science industry. We sincerely invite you to participate in this survey, and we hope you can spare approximately 10 minutes to complete the questionnaire. During the response process, please answer based on your operational situation in Hong Kong.

We appreciate your participation in this study, and rest assured that the data you submit will be treated with strict confidentiality.

(A) Company Overview	
1. Which of the following best describes the AI technology/ industry that your company is currently developing? Please choose all appropriate answers. [Multi-select]	
AI chips, such as GPU, FPGA, ASICs, chip IP, etc.	1
AI infrastructure, such as general servers, AI servers, cloud computing, mobile terminals, etc.	2
Big data, such as speech data, image data, text data, big data services, etc.	3
Deep learning algorithms, such as convolutional neural networks, recurrent neural networks, deep neural networks, etc.	4
AI software frameworks, such as TensorFlow, Caffe, Torch, domestic platforms, etc.	5
AI technologies, such as computer vision, speech recognition, natural language processing, knowledge graphs, etc.	6
AI products, such as visual products, voice assistants, autonomous driving, robots, etc.	7
Open software platforms, such as comprehensive, visual, speech, robot categories, etc.	8
Solutions, such as security, finance, transportation, etc.	9
Applying developed AI models to the company's sales/ operational processes	10
Others, please specify:	11
2. Which of the following best describes your company's current profitability? Please choose the most appropriate answer. [Single-select]	

Profitable	1
Breaking even	2
At a loss, but at least one product/ service has been launched in the market	3
At a loss, still in the development/ testing phase of the first product/ service, not yet launched in the market	4
Others, please specify:	5
3. In which industries does your products/ services related to AI primarily target? Please choose all appropriate answers. [Multi-select]	
Manufacturing	1
Electricity and gas supply	2
Water supply; sewage treatment, waste management, and pollution control activities	3
Construction/ civil engineering	4
Import/ export trade, wholesale, and retail	5
Logistics and transportation services, ports	6
Accommodation, hotels, and tourism	7
Food and beverage services	8
Telecommunications and IT services	9
Finance and insurance	10
Real estate	11
Professional services (such as legal, accounting, auditing, interior/fashion/graphic design, etc.)	12
Administrative and support services (such as equipment leasing, human resource management, security, cleaning services, etc.)	13
Public administration	14
Education, nurturing/ training	15
Medical/ clinical and health equipment, health products and pharmaceuticals	16
Care services (e.g., nursing homes) and social work (e.g., service centres for the elderly, youth, and children), non-profit organisations (NGOs)	17
Government organisations	18
Arts, culture, and creative industries	19
Others, please specify:	20

(B) Current Challenges and Difficulties	
4. According to the understanding, one of the challenges faced in developing AI in Hong Kong is the local "insufficient processing power". Is your company currently facing this challenge? Please choose the most appropriate answer. [Single-select]	
Yes	1

No	2
Not applicable	3
5. How are you currently addressing the issue of "insufficient processing power" in Hong Kong? Please choose all appropriate answers. [Multi-select]	
Use HPC data centres in the Mainland	1
Use HPC data centres overseas	2
Using cloud computing services	3
No corresponding method	4
Others, please specify:	5
6. How is your company's current processing power? Please choose the most appropriate answer. [Single-select]	
___ Nvidia V100 GPU model or equivalent	1
___ Nvidia P100 GPU model or equivalent	2
___ Nvidia A100 GPU model or equivalent	3
___ Nvidia A800 GPU model or equivalent	4
___ Nvidia H100 GPU model or equivalent	5
Others, please specify: _____	6
Uncertain about the current processing specifications	7
Not applicable	8
7. Considering your company's current development needs in AI, how much do you expect your company's processing power to increase within the next five years? Please choose the most appropriate answer. [Single-select]	
0% / No need for an increase	1
0.1% -< 20%	2
20% -< 50%	3
50% -< 100%	4
100% -< 200%	5
200% -< 300%	6
300% -< 500%	7
500% or above	8
Uncertain / don't know	9
8. Hong Kong is building a "supercomputing centre". Which of the following factors will affect whether you choose to use this supercomputing centre? Please select the three most important factors. [Multi-select]	
Computing speed/ computing performance	1
Data storage/ capacity	2
Data security/ privacy	3

User experience/ interface/ tool support (SDK/API)	4
Convenience of application processing	5
Documents required for application	6
After-sales technical support	7
Price	8
Others, please specify:	9
9. "Insufficient data" is also mentioned by many as another challenge in developing AI. Regarding your company's current development in the AI industry, which description best fits your data collection situation? Please choose the most appropriate answer. [Single-select]	
Started collecting data	1
Intend to collect data and know that relevant data are available in Hong Kong, but the relevant parties have not opened up data sharing	2
Intend to collect data, but don't know if the relevant data are available in Hong Kong and don't know how to start	3
Intend to collect data, but relevant data are not available in Hong Kong, and don't know how to start	4
No intention to collect data	5
Others, please specify:	6
10. Is the data collected by your company in Hong Kong sufficient? Please choose the most appropriate answer. [Single-select]	
Already collected enough / Expect to collect enough data in the short term	1
Just started collecting but expect it to take a long time to collect enough data	2
Difficult to collect enough data in Hong Kong	3
Others, please specify:	4
11. Is the format of the data collected by your company in Hong Kong complete? Please choose the most appropriate answer. [Single-select]	
Complete	1
Incomplete, with varying data structures/ formats	2
Others, please specify:	3

12. After collecting data, have you conducted any analysis? Please choose the most appropriate answer. [Single-select]	
Started analysis	1
Intend to conduct an analysis, but don't know how to start	2
Haven't conducted any analysis	3
Others, please specify:	4

(C) Talent Demand	
13. How many full-time employees do your company have in all offices combined (including employees of various functions and worldwide employees)? Please choose the most appropriate answer. [Single-select]	
1 – 5	1
6 – 9	2
10 - 19	3
20 - 49	4
50 - 99	5
100 - 199	6
200 - 499	7
500 or above	8

14. In terms of talent, how many full-time staff do your company have in the following areas currently (including staff from all over the world)? Please choose the most appropriate answer. [Single-select]

	a. AI-related technical talents (including algorithm developers, architects, engineers, operations and maintenance, etc.)	b. AI-related non-technical talent (including: management personnel, digital marketing personnel, etc.)
1 – 5	1	1
6 – 9	2	2
10 - 19	3	3
20 - 49	4	4
50 - 99	5	5
100 - 199	6	6
200 - 499	7	7
500 or above	8	8
No relevant employees	9	9

15. In terms of talent, how many full-time staff do your company have in the following areas currently (including staff from all over the world)? Please choose the most appropriate answer. [Single-select]

	a. Percentage of AI-related technical talents	b. Percentage of AI-related non-technical talent
Hong Kong		
Mainland		
Overseas		
Total	**100%**	**100%**

16. Compared to the past three years, which sentence best describes the situation of hiring AI-related technical talents in Hong Kong by your company? Please choose the most appropriate answer. [Single-select]	
Increasing vacancies, and successful recruitment	1
Increasing vacancies, but unsuccessful recruitment	2
Fill existing vacancies but fail to recruit	3
Fill existing vacancies and recruit successfully	4
Decreasing relevant positions in Hong Kong and recruiting in the Mainland/ overseas	5
Others, please specify:	6
17. Why are you increasing vacancies for AI-related technical talents in Hong Kong? Please choose all appropriate answers. [Multi-select]	
Hong Kong's reputation for top-tier universities and leading-edge basic research and development	1
Hong Kong has excellent and sufficient technical talents	2
Easy to collect data from different regions in Hong Kong	3
Business growth in Hong Kong requires increased manpower to meet local market demand	4
Favourable tax environment in Hong Kong	5
Support from the HKSAR Government's industry policies, including relevant funding initiatives	6
Easy to attract mainland/overseas talent to Hong Kong	7
Others, please specify:	8
18. Why would you relocate the positions for AI-related technical talents to the Mainland/ overseas? Please choose all appropriate answers. [Multi-select]	
Hong Kong lacks relevant technical talent	1
The operating cost in Hong Kong is high, including human resources cost, management cost, etc.	2
The smaller size of the local market, lacking in AI application scenarios	3
The absence of essential infrastructure for the AI industry, such as supercomputing centres	4
A scarcity of data resources in Hong Kong	5
Strict data regulations in Hong Kong	6
Others, please specify:	7
19. Compared to the past three years, which sentence best describes the situation of hiring non-technical talents related to AI in Hong Kong by your company? Please choose the most appropriate answer. [Single-select]	
Increasing vacancies, and successful recruitment	1
Increasing vacancies, but unsuccessful recruitment	2
Fill existing vacancies but fail to recruit	3

Fill existing vacancies and recruit successfully	4
Decreasing relevant positions in Hong Kong and recruiting in the Mainland/ overseas	5
Others, please specify:	6
20. Why are you increasing vacancies for non-technical talents related to AI in Hong Kong? Please choose all appropriate answers. [Multi-select]	
Business growth in Hong Kong requires increased manpower to meet local market demand	1
Hong Kong has a large pool of relevant non-technical talents	2
Favourable tax environment in Hong Kong	3
Support from the HKSAR Government's industry policies, including relevant funding initiatives	4
Easy to attract mainland/ overseas talent to Hong Kong	5
Others, please specify:	6
21. Why would you relocate the positions for non-technical talents related to AI to the Mainland/ overseas? Please choose all appropriate answers. [Multi-select]	
Hong Kong lacks relevant non-technical general talent	1
The operating cost in Hong Kong is high, including human resources cost, management cost, etc.	2
Bleak business prospects in Hong Kong, leading to a reduction in the local workforce	3
Others, please specify:	4

(D) Funding and Income Sources	
22. How much have you invested cumulatively in AI and data science? Please choose the most appropriate answer. [Single-select]	
Below HK$100,000	1
HK$100,000 to HK$300,000	2
HK$300,000 to HK$500,000	3
HK$500,000 to HK$1 million	4
HK$1 million to HK$2 million	5
HK$2 million to HK$5 million	6
HK$5 million to HK$10 million	7
HK$10 million to HK$50 million	8
HK$50 million to HK$100 million	9
HK$100 million or above	10
Don't know/ Unclear	11

23. Which of the following are your company's main sources of funds? Please choose all appropriate answers. [Multi-select]	
Company operational surplus, self-owned funds, personal savings	1
Bank and financial institution loans	2
Venture capital/ angel funds	3
Government-funded grants	
Hong Kong	4
Mainland	5
Overseas	6
Others, please specify:	7
24. Have you ever applied for any government funds (Enterprise Support Scheme (ESS), HKSTP Venture Fund, Strategic Tech Fund (STF), Innovation and Technology Venture Fund (ITVF), etc.) to support the development of AI? Which sentence best describes your situation? Please choose the most appropriate answer. [Single-select]	
Previously funded	1
Applied and currently under review	2
Applied for but didn't get the funding	3
Not applied. Know the relevant funds but the funding amount is too low	4
Not applied. Know the relevant funds but the application threshold is too high	5
Not applied. Know the relevant funds but the application procedures are too complex	6
Not applied. Know the relevant funds but don't know the relevant channels	7
Don't know related government funds	8
Others, please specify:	9
25. Have you received any non-government funds for the development of AI? Which sentence best describes your situation? Please choose the most appropriate answer. [Single-select]	
Applied for and received funding	1
Under discussion	2
Applied for but failed to get the funding	3
Not applied. Know the relevant funds and the application channels	4
Not applied. Know the relevant funds but don't know the relevant channels	5
Don't know related funds	6
Others, please specify:	7
26. Currently, what is your main source of income regionally? Please choose the most appropriate answer. [Single-select]	
Hong Kong	1
Mainland	2
Overseas	3

Others, please specify:	4

(E) Future Development in AI	
27. In which industry do you think Hong Kong can adopt more AI? Please choose all appropriate answers. [Multi-select]	
Manufacturing	1
Electricity and gas supply	2
Water supply; sewage treatment, waste management, and pollution control activities	3
Construction/civil engineering	4
Import/export trade, wholesale, and retail	5
Logistics and transportation services, ports	6
Accommodation, hotels, and tourism	7
Food and beverage services	8
Telecommunications and IT services	9
Finance and insurance	10
Real estate	11
Professional services (such as legal, accounting, auditing, interior/fashion/graphic design, etc.)	12
Administrative and support services (such as equipment leasing, human resource management, security, cleaning services, etc.)	13
Public administration	14
Education, nurturing/ training	15
Medical/ clinical and health equipment, health products and pharmaceuticals	16
Care services (e.g., nursing homes) and social work (e.g., service centres for the elderly, youth, and children), non-profit organisations (NGOs)	17
Government organisations	18
Arts, culture, and creative industries	19
Others, please specify:	20
28. Which of the following are your development directions in AI and data science for the next five years? Please choose all appropriate answers. [Multi-select]	
Expand the Hong Kong market	1
Expand the Mainland market	2
Expand overseas markets	3
Develop technology in the upstream (basic layer: provide computing power and data input support for upper-layer algorithms)	4
Develop technology in the middle stream (technology layer: use massive data for algorithm training and reasoning on software platforms)	5

Develop technology in the downstream (application layer: implement technology, including AI products and solutions integrating with traditional industries)	6
Others, please specify:	7

(F) Company Background	
29. Company name:	
30. Year of establishment (if less than a year, please enter "0.5"):	
31. Company type:	
Public company	1
Sole proprietorship	2
Partnership	3
Others, please specify:	4
32. Interviewee	
Interviewee's name:	
Interviewee's contact:	
Interviewee's email address:	

~ End of Survey ~

Study on the Development of the AI and Data Science Industry - User Questionnaire

HKPC is conducting a Study on the Development of AI and Data Science Industries (hereinafter referred to as "the Study"), which aims to understand the needs of Hong Kong enterprises in the development of AI and data technology, as well as the challenges and opportunities faced. The collected data will be analysed to provide recommendations to the government, the Council, and local providers of AI and data science solutions, including software, hardware, system infrastructure, and platform service providers.

Your valuable opinions are crucial for the development of Hong Kong's AI and data science industry. We sincerely invite you to participate in this survey, and we hope you can spare approximately 10 minutes to complete the questionnaire. During the response process, please answer based on your operational situation in Hong Kong.

We appreciate your participation in this study, and rest assured that the data you submit will be treated with strict confidentiality.

(A) Company Overview	
33. Which of the following best describes your main business scope? Please choose the most appropriate answer. [Single-select]	
Manufacturing	1
Electricity and gas supply	2
Water supply; sewage treatment, waste management, and pollution control activities	3
Construction/civil engineering	4
Import/export trade, wholesale, and retail	5
Logistics and transportation services, ports	6
Accommodation, hotels, and tourism	7
Food and beverage services	8
Telecommunications and IT services	9
Finance and insurance	10
Real estate	11
Professional services (such as legal, accounting, auditing, interior/fashion/graphic design, etc.)	12
Administrative and support services (such as equipment leasing, human resource management, security, cleaning services, etc.)	13
Public administration	14
Education, nurturing/ training	15

Medical/ clinical and health equipment, health products and pharmaceuticals	16
Care services (e.g., nursing homes) and social work (e.g., service centres for the elderly, youth, and children), non-profit organisations (NGOs)	17
Government organisations	18
Arts, culture, and creative industries	19
Others, please specify:	20
34. How many full-time employees do you have in all offices combined (including employees of various functions and worldwide employees)? Please choose the most appropriate answer. [Single-select]	
1 – 5	1
6 – 9	2
10 - 19	3
20 - 49	4
50 - 99	5
100 - 199	6
200 - 499	7
500 or above	8

(B) Current Application of AI and Data Science	
35. Currently, does your company apply AI and data science in the following categories? Please choose all appropriate answers. [Multi-select]	
R&D (including technical research, market research, and product development, etc.)	1
Operations (including procurement, inventory, production, quality testing, risk control, etc.)	2
Marketing (including market promotion, sales, etc.)	3
Customer service	4
Corporate communications	5
Administrative support	6
Human resources management	7
Finance	8
Legal affairs	9
Others, please specify:	10
Currently, no application of any AI and data science	11
36. How much have you invested cumulatively in applying AI and data science? Please choose the most appropriate answer. [Single-select]	
Below HK$100,000	1
HK$100,000 to HK$300,000	2
HK$300,000 to HK$500,000	3

HK$500,000 to HK$1 million	4
HK$1 million to HK$2 million	5
HK$2 million to HK$5 million	6
HK$5 million to HK$10 million	7
HK$10 million to HK$50 million	8
HK$50 million to HK$100 million	9
HK$100 million or above	10
Don't know/Unclear	11

37. When you applied AI and data science in the following categories, did the results match your expectations? Please choose one answer for each category. [Single-select]

	Exceeded expectations	In line with expectations	Fail to meet expectations	To be observed
a. R&D (including technical research, market research, and product development, etc.)	1	2	3	4
b. Operations (including procurement, inventory, production, quality testing, risk control, etc.)	1	2	3	4
c. Marketing (including market promotion, sales, etc.)	1	2	3	4
d. Customer service	1	2	3	4
e. Corporate communications	1	2	3	4
f. Administrative support	1	2	3	4
g. Human resources management	1	2	3	4
h. Finance	1	2	3	4
i. Legal affairs	1	2	3	4
j. Others, please specify:	1	2	3	4

38. Why do you think the effects of applying artificial intelligence and data science are worse than expected? Please choose all appropriate answers. [Multi-select]

Poor data quality (including but not limited to data accuracy, completeness, data format, etc.)	1
Data collected is insufficient to cover all customer segments	2
Employees did not effectively use the new technology	3
Insufficient resource allocation	4
Ethical and moral issues	5
Current technology limitations	6
Others, please specify:	7

39. After applying AI and data science in different areas, what benefits do you think it can bring to you? Please choose all appropriate answers. [Multi-select]

Discover more customer sources	1
Improve productivity	2
Enhance the quality of products and services	3
Reduce human errors	4
Cost savings	5
Efficiently and accurately understand the company's situation through data, assisting in optimizing decisions	6
Others, please specify: _____	7
No benefits	8

40. When you applied AI and data science in different areas, what difficulties did your company encounter? Please choose all appropriate answers. [Multi-select]	
Poor data quality (including but not limited to data accuracy, completeness, data format, etc.)	1
Data privacy (including some non-sensitive personal data or company data, etc.)	2
Selecting software solutions and models suitable for the most appropriate scenario	3
Inability to effectively analyse and express the results obtained from the used model	4
Limited computing speed and storage resources	5
Constraints in transitioning from experimentation to practical application	6
Legal and administrative regulatory constraints	7
Ethical issues	8
Lack of funds	9
Lack of technical specialists or generalists	10
Others, please specify:	11

(C) Future Application of AI and Data Science	
41. In the next 12 months, is your company considering expanding the application of AI and data science in the following areas? Please choose all appropriate answers. [Multi-select]	
R&D (including technical research, market research, and product development, etc.)	1
Operations (including procurement, inventory, production, quality testing, risk control, etc.)	2
Marketing (including market promotion, sales, etc.)	3
Customer service	4
Corporate communications	5
Administrative support	6
Human resources management	7
Finance	8
Legal affairs	9

Others, please specify:	10
Not consider expanding the application of any AI and data science in the next 12 months	11
42. How much is your estimated investment in expanding the application of AI and data science? Please choose the most appropriate answer. [Single-select]	
Below HK$100,000	1
HK$100,000 to HK$300,000	2
HK$300,000 to HK$500,000	3
HK$500,000 to HK$1 million	4
HK$1 million to HK$2 million	5
HK$2 million to HK$5 million	6
HK$5 million to HK$10 million	7
HK$10 million to HK$50 million	8
HK$50 million to HK$100 million	9
HK$100 million or above	10
Don't know/Unclear	11
43. Why don't you consider expanding the application of AI and data science in different operational and sales categories in the next 12 months? Please choose all appropriate answers. [Multi-select]	
Lack of suitable application solutions	1
Market not large enough, expected benefits not worth the investment	2
Excessive investment costs (including purchasing/choosing suitable models, training staff to use AI, etc.)	3
Fear of bearing patent or related legal risks	4
Rapid technological developments make it difficult to keep up	5
Previous application results were poor, believing there is no need to continue expanding application	6
Adapting to existing AI technology/solutions/models, no resources to expand application	7
Others, please specify:	8
44. In the next 12 months, are you considering applying AI and data science in the following areas? Please choose all appropriate answers. [Multi-select]	
R&D (including technical research, market research, and product development, etc.)	1
Operations (including procurement, inventory, production, quality testing, risk control, etc.)	2
Marketing (including market promotion, sales, etc.)	3
Customer service	4
Corporate communications	5

Administrative support	6
Human resources management	7
Finance	8
Legal affairs	9
Others, please specify:	10
Not consider the application of any AI and data science in the next 12 months	11
45. How much is your estimated investment in applying AI and data science? Please choose the most appropriate answer. [Single-select]	
Below HK$100,000	1
HK$100,000 to HK$300,000	2
HK$300,000 to HK$500,000	3
HK$500,000 to HK$1 million	4
HK$1 million to HK$2 million	5
HK$2 million to HK$5 million	6
HK$5 million to HK$10 million	7
HK$10 million to HK$50 million	8
HK$50 million to HK$100 million	9
HK$100 million or above	10
Don't know/Unclear	11
46. Assuming the application of AI and data science in different areas, what benefits do you think it can bring to you? Please choose all appropriate answers. [Multi-select]	
Discover more customer sources	1
Improve productivity	2
Enhance the quality of products and services	3
Reduce human errors	4
Cost savings	5
Efficiently and accurately understand the company's situation through data, assisting in optimizing decisions	6
Others, please specify:	7
No benefits	8
47. When applying AI and data science in different areas, what difficulties do you think your company will encounter? Please choose all appropriate answers. [Multi-select]	
Poor data quality (including but not limited to data accuracy, completeness, data format, etc.)	1
Data privacy (including some non-sensitive personal data or company data, etc.)	2
Selecting software solutions and models suitable for the most appropriate scenario	3

Inability to effectively analyse and express the results obtained from the used model	4
Limited computing speed and storage resources	5
Constraints in transitioning from experimentation to practical application	6
Legal and administrative regulatory constraints	7
Ethical issues	8
Lack of funds	9
Lack of technical specialists or generalists	10
Others, please specify:	11
48. Why don't you consider applying AI and data science in different operational and sales categories now and in the future? Please choose all appropriate answers. [Multi-select]	
Lack of suitable application solutions	1
Market not large enough, expected benefits not worth the investment	2
Excessive investment costs (including purchasing/choosing suitable models, training staff to use AI, etc.)	3
Fear of bearing patent or related legal risks	4
Rapid technological developments make it difficult to keep up	5
Others, please specify:	6
Believe there is no need to apply AI	7
49. Interviewee	
Interviewee's name:	
Interviewee's contact:	
Interviewee's email address:	

~ End of Survey ~

HKU Business School and HKPC

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HKU BUSINESS SCHOOL 港大經管學院

HIEBS
Hong Kong Institute of Economics and Business Strategy
香港經濟及商業策略研究所