



Artificial Intelligence and Big Data in the Financial Services Industry

A Regional Perspective and Strategies for Talent Development

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Foreword

The financial services industry contributes to the economy by allocating capital and enabling risk sharing between individuals and businesses. To deal with a rapidly changing and evolving market environment, financial institutions have adopted technologies based on artificial intelligence (AI) and big data (BD) to enhance their business models and create new ways to provide financial services with a view towards transforming the industry and generating new value for customers. Talent development is essential for AI/BD adoption to succeed, as talent with proper training and experience is necessary to bridge the gap between finance and technology functions and to incorporate a financial context into technology development and deployment. In anticipation of the new skills and qualifications needed today, market participants and policy makers have begun to encourage the development of relevant talent. Amid the rapid evolution of the financial services industry in the Asia-Pacific region with AI/BD technologies, it is important for stakeholders in the region to better understand the demand and supply of relevant talent and the talent gap to support suitable policy initiatives towards sustainable talent development and the healthy growth of the industry.

This report provides an overview of the recent international transformation of the financial services industry using AI/BD technologies, highlighting talent as an essential consideration for their adoption. It also discusses a framework that emphasises the finance–technology integration needed in the different stages of AI/BD adoption to provide guidance and a roadmap

towards the healthy development of a financial services industry that embraces AI/BD technologies. The report then draws a picture of the current state of AI/BD adoption and the demand and supply of AI/BD professionals in six major Asia-Pacific financial centres (Hong Kong, Shanghai, Shenzhen, Singapore, Sydney and Tokyo) across four major financial services sectors. It presents and discusses the results of a survey commissioned by the Hong Kong Institute for Monetary and Financial Research (HKIMR) that gathered market participants' views on the status, benefits, challenges and risks of AI/BD adoption and, more importantly, on the demand for talent. Furthermore, this report explores the supply of talent and provides some preliminary estimates of the talent gaps in the Asia-Pacific region. The report then presents market views on talent development and reviews the initiatives implemented internationally and in Hong Kong. It concludes by offering suggestions to enrich Hong Kong's pool of talent.

We hope that this study sheds light on the talent needs and development of financial institutions adopting AI/BD technologies and thus helps support the healthy growth of the financial services industry in Hong Kong and the Asia-Pacific region.

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Executive Summary

Increasing digitalisation, together with the emergence of alternative and unstructured data and advancements in computational algorithms, have led financial institutions to adopt artificial intelligence (AI) and big data (BD) technologies in their provision of financial services. AI refers to intelligent computer systems that are able to learn and adapt to dynamic and uncertain environments. BD refers to very large and complex digital data collections that can potentially provide useful information for creating social and economic value. As the combination of AI ability and BD analytics can generate synergy, the **adoption of AI/BD technologies can transform the financial services industry by enhancing existing offerings, provisions and business models and by creating value propositions through innovative products and services. AI/BD technologies are likely to become essential business drivers of the industry going forward. However, access to talent is a key consideration for financial institutions embracing AI/BD technologies.**

This report focuses on AI/BD adoption in six major financial centres in the Asia-Pacific region (Hong Kong, Shanghai, Shenzhen, Singapore, Sydney and Tokyo) across four main financial services sectors (asset management, banking, insurance and securities trading). We incorporate the views of market participants on the current status of AI/BD adoption, its benefits and challenges, and the talent needs of financial firms together into a statistical analysis to provide a better understanding of the supply of talent and a preliminary estimation of the talent gap in Hong Kong and the Asia-Pacific region. We then present the views of market participants on initiatives geared towards the development of suitable talent for AI/BD adoption and review initiatives that have been implemented internationally and in Hong Kong. The report concludes by offering suggestions to enrich Hong Kong's pool of talent for AI/BD adoption.

To successfully transform financial services with AI/BD technologies, it is essential to identify business opportunities, determine technical solutions and achieve business–technology integration. Suitable talent development is necessary for AI/BD adoption to advance, as talent must have the training and experience to bridge the gap between finance and technology functions. By establishing a close link and productive communication through a shared team space and shared language between the two areas, **professionals versed in both finance and AI/BD technologies who possess an understanding of and perspectives on financial institutions regarding AI/BD adoption ('finance–technology innovators')** can help integrate finance and technology functions and incorporate the financial context into technology development and deployment. A conceptual framework labelled **'T-shaped teams'**, which is designed to describe the roles and operational importance of finance and technology professionals in a collaborative fashion, **can provide guidance and a roadmap across different stages of AI/BD adoption, leading to the healthy development of a financial services industry that embraces AI/BD technologies.**

The results of the HKIMR AI/BD survey conducted from April to July 2021 show that **71% of the survey respondents in the Asia-Pacific region, across financial centres and industry sectors, indicated that their firms have either adopted or planned to adopt AI/BD technologies in the next 12 months. The market participants highlighted that AI/BD adoption has brought them various benefits, but they were also concerned about talent shortages, data issues, business–technology integration and adoption costs.** The market participants also indicated that **these challenges are likely to persist over the next 5 years.** Financial firms in the region are seeking

professionals versed in both finance and AI/BD technologies, suggesting that most sectors of the financial services industry are moving towards a higher level of integration between business and technology functions. **The market participants highlighted that monetary compensation, career growth and training opportunities were the most important aspects for attracting and retaining talent to advance their AI/BD adoption.**

The analysis of the supply of talent in the region based on the LinkedIn profiles shows that **the majority of AI/BD professionals engaging in the financial services industry were employed in the banking and insurance sectors and that of all of the financial centres in the region, Hong Kong exhibited the highest rate of AI/BD professionals participating in the financial services industry.** However, in the region, there is still a large pool of talent with AI/BD skills (85% of the total) employed in non-financial sectors (mostly academia and the technology and telecommunication sectors), with propensity to switch to roles in financial services. There is evidence of talent mobility across sectors within each financial centre, and during the 12-month period ending July 2021, **about 6,800 AI/BD professionals moved between major Asia-Pacific financial centres and other parts of the world with net inflows of talent for all financial centres in the region. However, only 800 professionals moved across centres within the region,** denoting a relatively low intra-regional mobility, likely due to restrictions related to the ongoing COVID-19 pandemic.

Our preliminary annual estimates of talent gaps indicate that between 2,000 and 6,600 professionals with both finance and AI/BD skills are required across the region. The talent gap

in Hong Kong is estimated at 2,000 such professionals. Financial centres in the region may need to expand their pool of finance–technology innovators by 23% per year to narrow this gap and therefore progress with a healthy development of the financial services industry.

International financial centres embracing AI/BD technologies in their financial services have highlighted talent development as a key goal. To this end, they have undertaken initiatives to build domestic talent pipelines, cultivate a AI/BD ecosystem to facilitate knowledge transfer and attract international talent. **Hong Kong has introduced multiple talent initiatives to provide fintech training programmes, career acceleration schemes, technology education, institutional facilitation for financial innovation and incentives to attract overseas talent.**

Combining the market views expressed by the survey respondents and the experience of other international financial centres, this report proposes suggestions to develop talent for the further development and application of AI/BD technologies in Hong Kong's financial services industry. These include **strategies to narrow the talent gap, such as developing suitable AI/BD qualifications for finance-related jobs, creating a critical mass of high-quality and technically trained AI/BD professionals, providing incentives for obtaining suitable qualifications and supporting the training and promoting the career development of professionals versed in both finance and AI/BD technologies.** The suggestions also consider the **support to talent recruitment, including strategies to help the financial services industry identify sectoral talent gaps and measures to attract relevant talent from overseas.**

Chapter 1

Artificial Intelligence and Big Data in Financial Services: The International Experience

Industry transformation, applications and emerging challenges

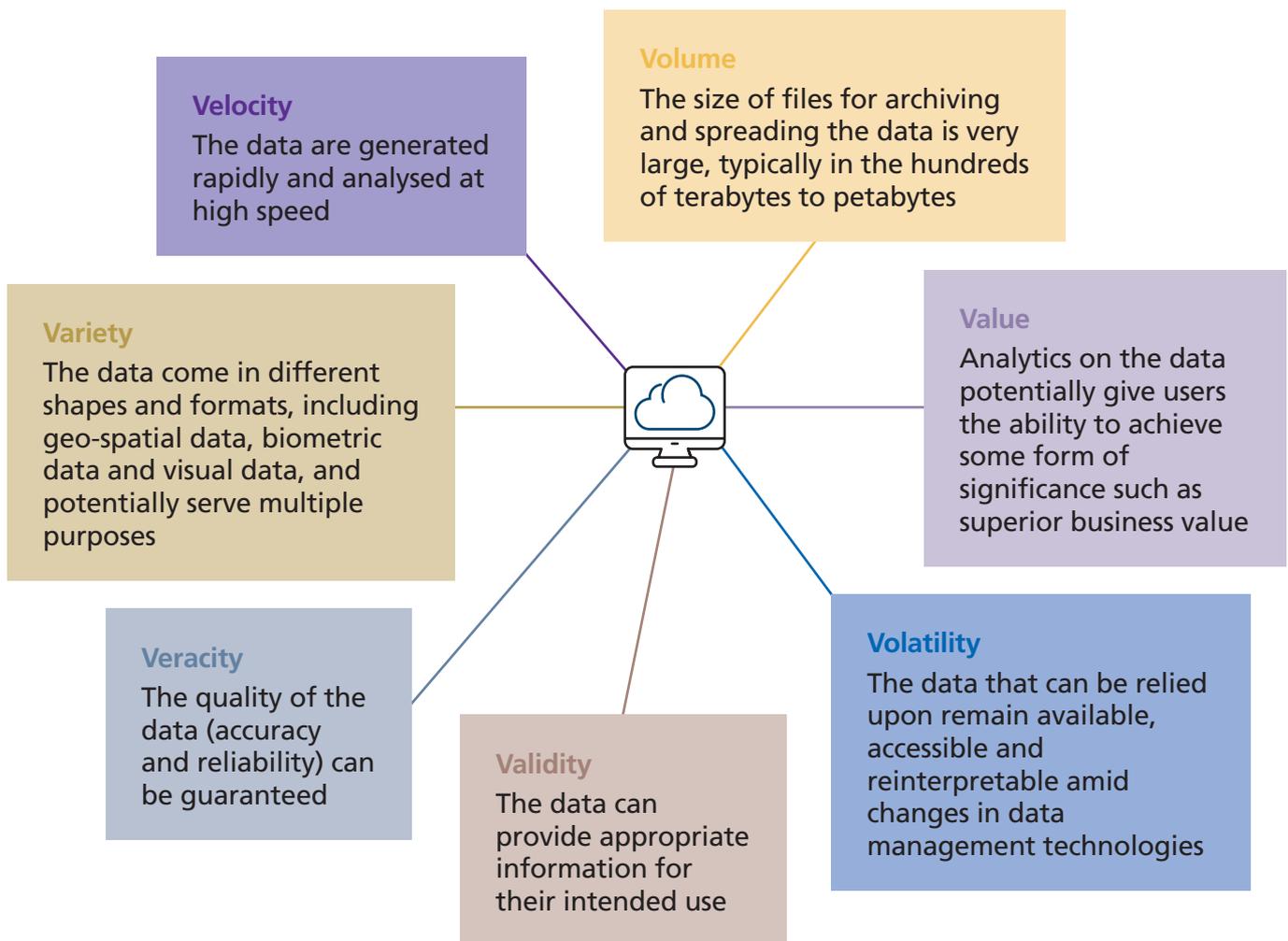
HIGHLIGHTS:

- The adoption of AI/BD technologies can transform financial services by enhancing existing offerings, provisions and business models and by creating value propositions by innovating new products and services.
- The financial services industry has adopted various AI/BD applications, and AI/BD technologies are likely to become its essential business driver.
- Access to talent is among the main challenges for the financial services industry in adopting AI/BD technologies.

Big data (BD) are very large data collections in digital formats that are associated with high levels of seven ontological characteristics: volume, velocity, variety, veracity, validity, volatility and value (7 Vs). Such data are thus huge in size, appropriately informative, of good quality, generated and analysed at high speed and valuable for gaining business insights (Chart 1.1). In addition, they have various forms and formats and remain available despite changes in data management technologies. BD can include traditional proprietary and third-party data in structured formats as well as alternative and unstructured data collected from websites, social media, mobile smartphones/tablets, Internet of Things (IoT) devices and other scientific

instruments. The detailed analytics derived from these granular, high-dimensional data can provide businesses with a deeper understanding of customer preferences, needs and pain points and enable firms to gather new insights into a variety of market behaviours, habits and incidents. Thus, access to BD opens up opportunities for firms to gain a competitive advantage by providing their customers with more tailored experiences. However, the heterogeneity and complexity of BD can make it difficult for humans and traditional database systems to collect BD and learn from all of the relevant information to enhance business decision making and operations.

Chart 1.1: The 7 Vs of BD (Characteristic and Implication)



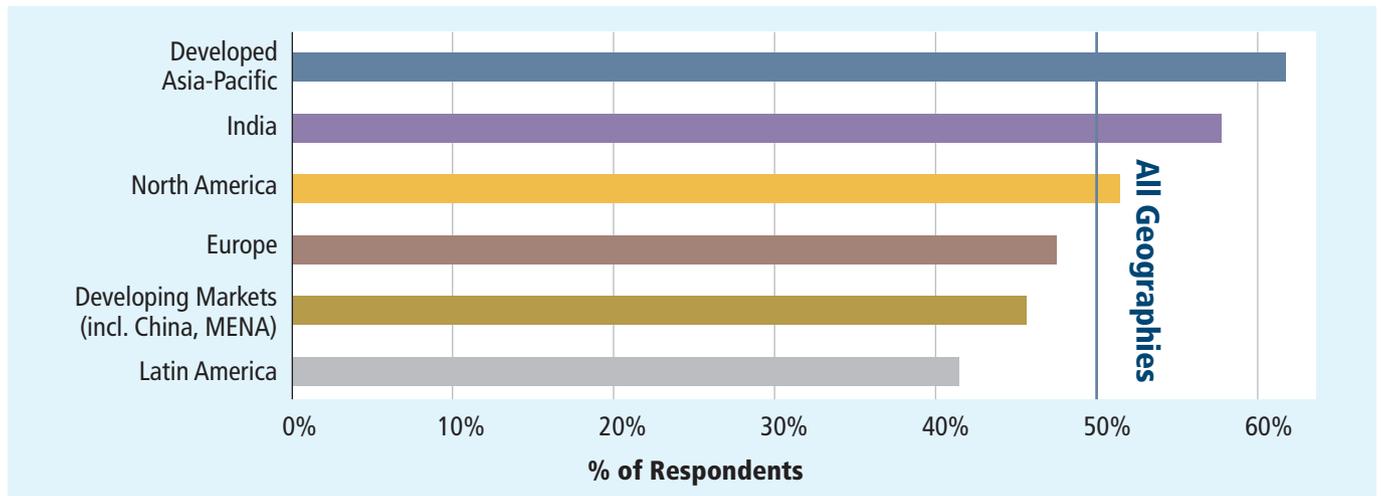
Note: One terabyte is 1,000 gigabytes and 1,000 terabytes are one petabyte.
Source: Leonelli (2020) and HKIMR staff compilation.

Artificial intelligence (AI) encompasses intelligent computer systems that are able to learn, adapt and operate in dynamic and uncertain environments.¹ AI facilitates the acquisition and process of BD. AI systems can scan documents and digitise paper records to identify historical information that is useful farther up the analytics chain. Scrapping tools and natural language processing (NLP), computer vision and voice recognition technologies can automate the extraction of data from Internet websites, social media posts, satellite images and IoT devices. AI systems can also autonomously verify and validate data to maintain high data quality and to cross-reference new data with existing data to sort out inconsistencies and inadequacies in real time. Chatbots and AI-supported online surveys can react to context and solicit relevant information from the customers that they interact with. Furthermore, as a subfield of AI, machine learning, especially deep learning, has become a

viable technology for businesses to help process and analyse data, support decision making and manage risk to reap the potential benefits from accessing BD. AI learning algorithms, which allow systems to be coded with data rather than merely logical rules, help to automate the enormous tasks of deriving insights from BD to generate new implications and rules for ongoing and future business operations.

AI's ability to work well with BD analytics is one reason why BD and AI have become inextricably linked as well as technologies of choice for firms to provide better customer experiences and more efficient operational processes. In a global survey conducted in June 2020 among 2,395 organisations, over 50% of the respondents stated that their organisations had adopted AI/BD in at least one business function (Chart 1.2).² As the developed Asia-Pacific region leads the world in AI/BD adoption, it merits particular attention.

Chart 1.2: Global AI/BD adoption rate in 2020



Source: McKinsey Analytics (2020); Zhang et al. (2021).

A recent research study shows that the United States and China led the world in private investment in AI/BD technologies and applications between 2015 and 2020 (Chart 1.3). China also has strong public investment in the AI/BD space, as both its central and

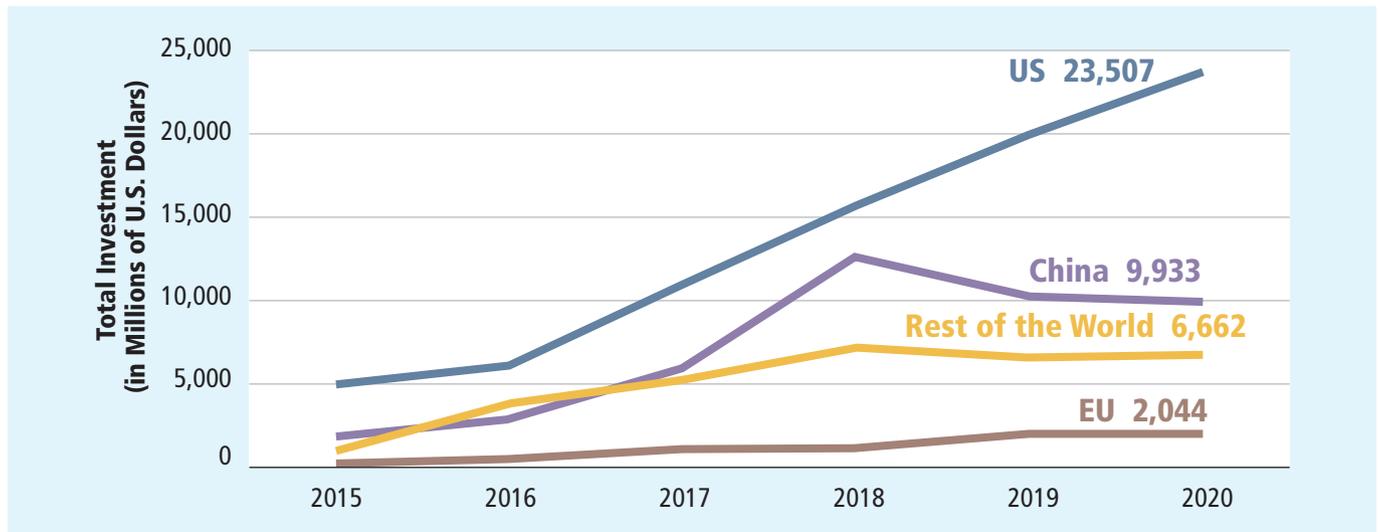
local governments have spent heavily on AI/BD-related research and development. As AI/BD technologies are predicted to drive global gross domestic product gains of up to USD15.7 trillion by 2030, AI/BD adoption is expected to grow very rapidly in the near future.³

¹ See, for example, Mialhe (2018).

² McKinsey Analytics (2020); Zhang et al. (2021).

³ Zhang et al. (2021); Colvin, Liu, Babou, and Wong (2020); PricewaterhouseCoopers (2018).

Chart 1.3: Rising trends of private investment in AI/BD



Source: Zhang et al. (2021).

This introductory chapter reviews the adoption of AI/BD technologies by the financial services industry, covering the potential transformation of this industry as these technologies have been adopted, key AI/BD use cases to provide financial services and the greatest challenges encountered by firms adopting AI/BD technologies, highlighting talent development as a key consideration.

1.1. TRANSFORMING THE FINANCIAL SERVICES INDUSTRY THROUGH AI/BD ADOPTION

The financial services industry is now operating in a rapidly changing market environment. However, incumbent firms are typically accustomed to traditional business models that rely on physical locations and large amounts of fixed assets to achieve economies of scale, mass-producing a small set of standardised products with rigid provisions to maintain their cost advantage. Therefore, not only do customers face high costs in searching for and comparing financial products but the services that they receive are not adequately customised to their preferences and needs. In such a case, customer engagement is rather

limited, and financial services are usually not integrated with non-financial markets. In addition, firms' internal risk assessments regarding fraud and money laundering are heavily dependent on human wisdom and experience, which typically slows responses to customer enquiries and increases deal processing time.

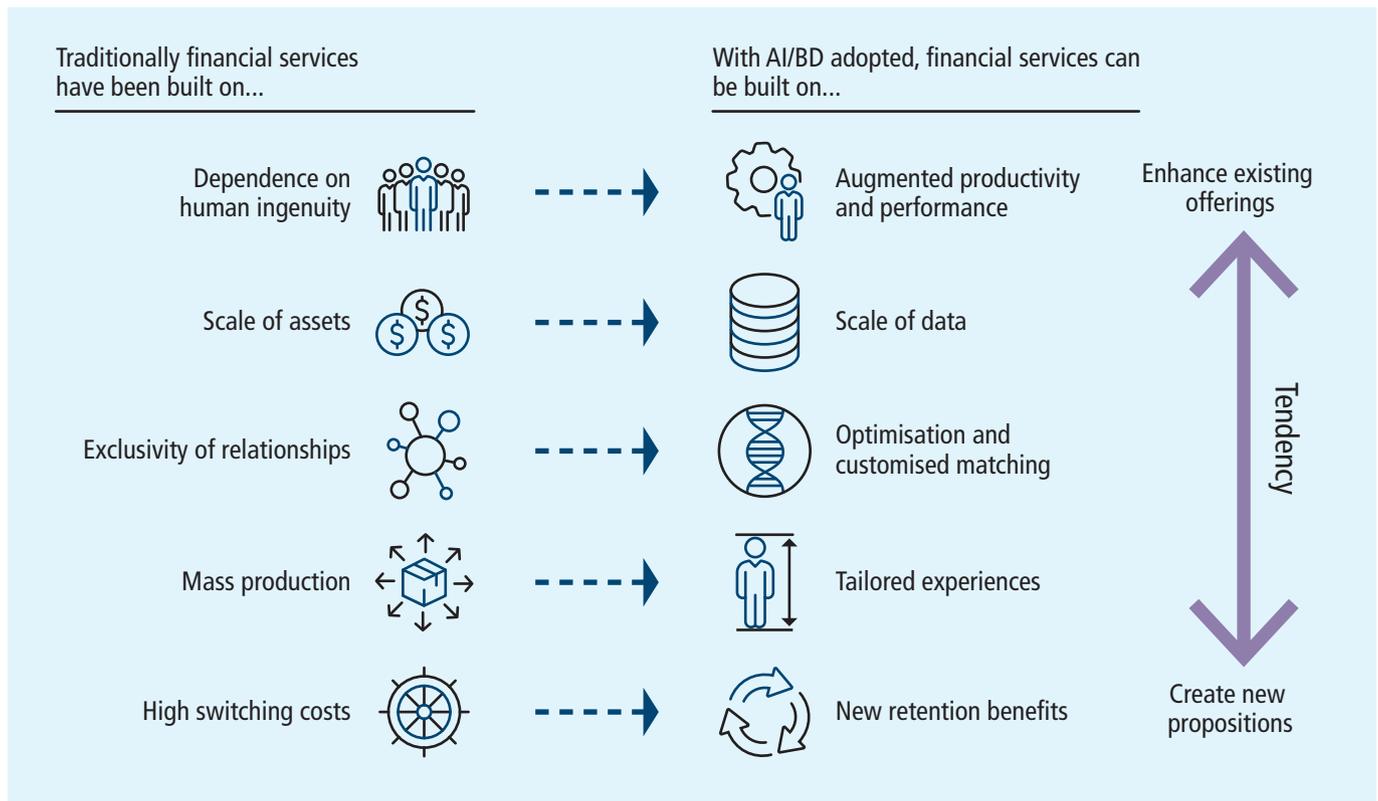
The adoption of AI/BD technologies can potentially transform the financial services industry by two distinct but combinable approaches: (1) enhancing existing products, services, provisions and business models and (2) creating value propositions by innovating new offerings. By adopting AI/BD technologies, firms can enrich financial models, deepen market analytics, improve decision making, reduce costs and streamline and automate operating procedures in the middle to back office. They can thus enhance their ongoing business models, develop more effective and flexible solutions to well-known financial problems and respond faster to customer inquiries and regulatory changes. In addition, firms can provide a more customised client experience and advance financial inclusion by innovating diverse, tailored products and services using AI/BD technologies, navigate uncharted waters in different markets and satisfy new demands.

The adoption of AI/BD technologies can transform financial services by enhancing existing offerings, provisions and business models and by creating value propositions by innovating new products and services.

According to the nature of the business and financial problems to be solved and the AI/BD strategies adopted by the firms, new approaches can be used to engineer potential solutions and transform the financial services industry in the following ways (Chart 1.4):

1. **From dependence on human ingenuity to augmented productivity and performance:** Instead of scaling up business operations by increasing labour and functional training, financial institutions can use AI/BD technologies to strengthen human talent and amplify outcome performance. The automation of repetitive activities can enable staff to use their time more productively. For example, AI/BD-enabled operational process optimisation can improve firms' efficiency and productivity by reducing manual work that is mundane and creates little value added.
2. **From scale of assets to scale of data:** Instead of only using economies of scale in terms of physical assets to sustain cost advantages, financial institutions can also use AI/BD technologies to drive operational efficiency. For example, AI/BD can be used to build automated information systems that process service applications, distribute financial products and manage customer enquiries in higher volumes without adding substantial numbers of physical locations.
3. **From exclusivity of relationships to optimisation and customised matching:** Instead of relying on direct access to markets and connections to customers, financial institutions can leverage digitalisation and use AI/BD technologies to optimise the fit between different parties. Improved client profiling and customer targeting can lead to increased sales and better marketing. For example, AI/BD-enabled financial software and mobile applications can identify and engage customers more effectively and quickly anywhere and at any time.
4. **From mass production to tailored experiences:** Rather than relying on physical footprints and standardised products to deliver revenue growth, financial institutions can use AI/BD technologies to distribute customised interactions and products on a large scale. For example, robo-advisers can collect customers' financial status and goals and provide on-demand customised advice and product recommendations in real time.
5. **From high switching costs to new retention benefits:** Rather than relying on barriers to switching service providers to retain customers, financial institutions can use AI/BD to continuously improve product performance and service outcomes and create new value to keep customers engaged. For example, AI/BD algorithms can be used to analyse and predict customer preferences and to recommend marketing campaigns and retention programmes to reduce churn risk.

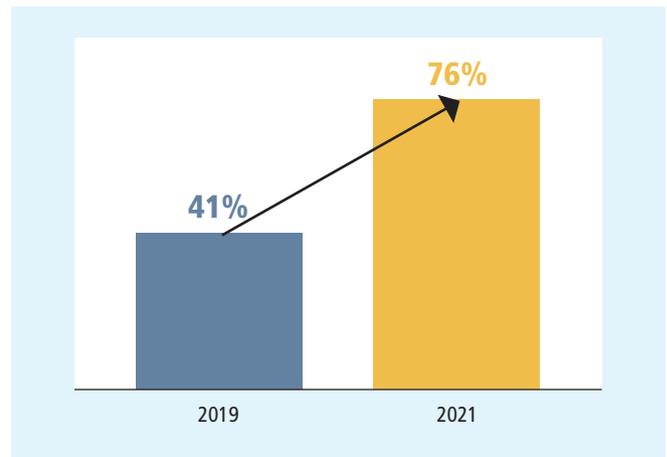
Chart 1.4: Ways that AI/BD can transform financial services



Source: World Economic Forum (2018) and HKIMR staff compilation.

In a global survey conducted in June 2019 to collect the views of 151 organisations in the financial services industry across 33 jurisdictions on the adoption of AI/BD technologies, 85% of the respondents stated that they had already deployed AI/BD applications, with fintech companies slightly ahead of incumbent firms in terms of the level of AI/BD adoption. The respondents also stated that AI/BD technologies had been adopted for enhancement and innovation. Furthermore, the survey revealed that AI/BD technologies were expected to quickly become an essential business driver across the financial services industry. While 41% of the respondents perceived the adoption of AI/BD technologies to be strategically important for 2019, this percentage was 76% for 2021 (Chart 1.5).⁴

Chart 1.5: Perceived strategic importance of AI/BD adoption in the financial services industry worldwide



Source: Cambridge Centre for Alternative Finance and World Economic Forum (2020) and HKIMR staff compilation.

⁴ Cambridge Centre for Alternative Finance and World Economic Forum (2020).

Responses to the COVID-19 pandemic, including lockdowns, social distancing, work-from-home arrangements and remote online meetings, have substantially changed customers' behaviour and increased their appetite for online and mobile financial products enabled by AI/BD and other cutting-edge technologies (see Box 1.1 for an example).⁵ It is likely that customers will continue to prefer flexibility, speed and customisation in financial products and such preferences will become the new normal. AI/BD adoption and data-driven decisions will remain important factors for the future development of the financial services industry in the rapidly changing socio-economic environment, and widespread adoption to provide more offerings and satisfy market demand is expected to continue.

Box 1.1: A global bank has launched chatbots to respond to customer needs arising from the COVID-19 pandemic.

The COVID-19 pandemic accelerated one large bank's efforts to bring together customer service data from online and offline interactions to provide more prompt and targeted service to corporate customers during the pandemic, particularly regarding government grants provided to relieve the economic strain that companies were experiencing. The bank combined the datasets and launched an AI/BD-powered chatbot to respond to customer queries. This initiative not only helped customers but also demonstrated to bank employees what AI/BD could do, and other AI/BD initiatives were subsequently accelerated.

Source: McKinsey Analytics (2020).

1.2. AI/BD USE CASES IN FINANCIAL SERVICES

The financial services industry contributes to the economy by allocating capital and enabling risk sharing between individuals and businesses. AI/BD technologies have penetrated every sphere of this industry, but the way and the extent to which they influence each sector is contingent on the ease and effectiveness with which the core business of a sector can benefit from AI/BD adoption. In addition to Regtech, an AI/BD application commonly adopted across financial services sectors to enhance risk management and regulatory compliance, a number of sector-specific categories of AI/BD use cases have been observed in the recent literature (Chart 1.6 to 1.9). While AI/BD technologies have applications that cut across several sectors of the financial services industry, for the sake of clarity in what follows we provide a description of AI/BD use cases classified by financial sectors.

⁵ See, for example, Ruddenklau (2020) and McKinsey Analytics (2020).

Chart 1.6: Key categories of AI/BD use cases in the asset management sector

Categories	Enhancing Existing Offerings	Create New Propositions
Asset Management 	Automated Customer Service Enhanced Asset Allocation	New Market Analytics Digitalised Verifiable Impact Investing

1.2.1. Asset management

The asset management sector actively embraces AI/BD adoption. Asset management firms can use AI/BD technologies to automate clients' risk profiling, portfolio monitoring and investment performance reporting. Its core businesses, which include asset allocation and management of portfolios and market exposure, involve the analysis of complex dynamic capital market relationships and the prediction of market movements, where AI/BD techniques in combination with human expertise can provide an advantage over human intelligence alone. AI/BD technologies can also help asset managers overcome new challenges emerging from new investment trends. The main use cases observed in the asset management space and their potential benefits include the following.

- **Automated customer service:** In terms of enhancement, AI/BD-enabled collection and analysis of survey and alternative data can be used to better profile the risk tolerance of clients and determine their appropriate investment risks more efficiently. Cross-product analysis can then be performed to monitor a customer's investment portfolio and automatically detect areas of improvement (e.g., suboptimal risk allocation). Automated performance reporting systems can provide customers timely updates on these analyses in addition to profit-and-loss statements and description of asset positions.
- **Enhanced asset allocation:** Data analytics capabilities enhanced by AI/BD algorithms can improve the assessment and prediction of corporate performance and firm distress. AI/BD models can

also provide superior forecast macroeconomic events and policy development than traditional methods can. With these informational advantages, AI/BD technologies can more accurately estimate expected returns and covariances and construct investment portfolios with potentially better performance.

- **New market analytics:** In terms of innovation, AI/BD technologies can be used to identify previously unexplored patterns and correlations in traditional and alternative datasets. Parsing unstructured data (e.g., voice, text and images) at scale using NLP and computer vision techniques can create new data sources that lead to novel measures that track market news, sentiment and other variables that are useful for providing new investment guidance.
- **Digitalised verifiable impact investing:** Amid the growing demand for environmental, social and corporate governance (ESG) investing, difficulties in collecting quality data on investment opportunities and a lack of liquidity in the secondary market are the main challenges hindering asset managers from verifiable impact investing. ESG financial instruments can be structured as security token offerings (STOs). These tokenised digital securities, which are traded on digital asset exchange built on distributed ledger technology (DLT) and cloud platforms, not only provide proof of ownership and creditor claims but are also linked to real-time information sources such as IoT devices, satellites and accounting systems that keep track of the underlying business projects funded. Investors can deploy AI/BD algorithms to retrieve relevant data encrypted in the tokens using 5G networks and analyse them to inform their decisions and monitor performance.

Chart 1.7: Key categories of AI/BD use cases in the banking sector

Categories	Enhancing Existing Offerings	Create New Propositions
Banking 	Streamlined Compliance Enhanced Credit Risk Management	Customised Marketing and Advisory Monitoring of CBDC transactions

Note: CBDC refers to central bank digital currency.

Sources: Bartram, Branke, and Motahari (2020), Cambridge Centre for Alternative Finance and World Economic Forum (2020), Cao (2019), Hong Kong Institute for Monetary and Financial Research (2020), Hong Kong Monetary Authority (2019), Organisation for Economic and Co-operation Development (2020), Swiss Re Institute (2020), World Economic Forum (2018), World Economic Forum (2020) and HKIMR staff compilation.

1.2.2. Banking

The fundamental business model of a bank is to obtain a profit from the positive difference between the interest it earns from borrowers and the interest it pays to depositors. The provision of non-traditional fee-based services, such as credit cards, merchant payment, foreign exchange, open banking, merchant banking and treasury services, has also become an important part of a bank's operations. Banks can adopt AI/BD technologies to streamline internal processes and reduce operational costs, to better attract and retain customers and to provide quality services in an innovative manner. Banks can also play a role in digitalised global money transfer by adopting AI/BD technologies. The main use cases observed in the banking space and their potential benefits include the following.

- **Streamlined compliance:** AI/BD techniques can be used to source, sort, generate and store compliance requirements to maintain audit trails and risk logs and automate and streamline the compliance process. On-boarding of customers can be made more efficient using NLP and computer vision algorithms. AI/BD-driven predictive analytics can be used to detect suspicious transactions and misconduct, which reduces human intervention and increases the tasks involved in fraud detection and anti-money laundering.
- **Enhanced credit risk management:** Alternative data sources can be used in place of traditional credit scores to evaluate creditworthiness in areas for

which data are not readily available. A credit system improved with AI/BD technologies can provide more accurate loan rates and customer classifications in an automated way.

- **Customised marketing and advisory:** In terms of innovation, AI/BD technologies can create more accurate customer segments, which allows for more segment-specific marketing strategies, tailored advertising and customised outreach, enabling cross-selling to target customers. Insights generated from third-party data (e.g., social media and mobile applications) can connect banks to the day-to-day reality of retail and corporate customers and help them discover new client opportunities. Furthermore, predictive algorithms can assess and anticipate client needs in real time, allowing banks to dynamically generate offers and extend funding and services seamlessly.
- **Monitoring of CBDC transactions:** The rapid growth of cross-border transactions and payments has motivated central banks around the world to collaborate on proofs of concept for the development of an integrated global money transfer system with networks enabled by DLT and cloud computing to transfer funds transparently. For example, central bank digital currencies (CBDCs) have been tested in some jurisdictions for cross-border payments. Banks participating in the system as governance operators can use AI/BD models to monitor transactions in real time to determine whether they comply with regulatory requirements.

Chart 1.8: Key categories of AI/BD use cases in the insurance sector

Categories	Enhancing Existing Offerings	Create New Propositions
Insurance 	Automated Claims Processing Enhanced Pricing and Operation	Tailored Customer Acquisition Customer-centric Digital Insurance

1.2.3. Insurance

The insurance sector offers risk-sharing services in the form of insurance contracts. The insurance provider guarantees payment to the insured or the policyholder for an uncertain future event, and the policyholder pays a premium to the insurer in exchange for protection on that future uncertainty. The adoption of AI/BD technologies allows insurance firms to efficiently verify documents and automate claim processing while maintaining adequate due diligence. Insurers can also use AI/BD technologies to upsell clients and acquire new customers to maintain and enlarge their clientele. The risks faced by clients can be better identified, and underwriters can provide timely solutions to help customers manage these risks at competitive prices. The main use cases observed in the insurance space and their potential benefits include the following.

- **Automated claims processing:** In terms of enhancement, AI/BD-enabled systems can be used to handle standard insurance claims with well-specified items. For complex claims, AI/BD technologies can also be adopted to streamline administrative procedures and reduce manual workloads. After the initial screening of applications by automated systems, computer vision and NLP can be used to read and pre-process receipts, medical and surveillance reports and supporting documents and to provide inputs for further human review and verification.
- **Enhanced pricing and operations:** Insurance underwriters can use AI/BD-powered data analytics to better evaluate actuarial risk and operational risk and improve their overall business operations. Large quantities of data from multiple sources can be

efficiently processed and used to enrich insurance policy pricing models and fine-tune anomaly detection and fraud prediction systems to improve their performance and accuracy. AI/BD technologies can help insurance firms detect fraud by identifying abnormalities in claims data and discerning false information used to obtain a lower premium or higher claim payout. By reducing the potential for human error and bias in underwriting, AI/BD technologies can also improve the quality of underwriting.

- **Tailored customer acquisition:** In terms of innovation, AI/BD algorithms can be used to discover new opportunities among existing customers for cross-selling, such as in the case of property and casualty insurance, travel insurance and life and health insurance. Customised product promotion and advertisement potential can also be identified to recruit new clients.
- **Customer-centric digital insurance:** Customers can update data automatically to designated cloud platforms using IoT devices powered by 5G, such as smart phones and watches, while engaging in daily activities such as shopping on a grocery app, monitoring their exercise on a fitness tracker and travelling and navigating with a map app. Insurance companies can deploy AI/BD models to the cloud platform to draw meaningful insights about their customers' behaviours to provide personalised health risk analyses and incentive rewards. Automated decision-making systems can dynamically blend and even customise insurance products, and virtual assistants such as chatbots can provide offerings and quotes in real time. Individualised updates can also be easily made as clients' profiles and risk change.

Chart 1.9: Key categories of AI/BD use cases in the securities trading sector

Categories	Enhancing Existing Offerings	Create New Propositions
Securities Trading 	Automated Position Monitoring Enhanced Trading Algorithms	Advanced Trade Execution Corporate Actions Analytics

1.2.4. Securities trading

The securities trading sector provides brokerage services to retail and institutional investors, executing their intended orders for transacting equities, bonds, mutual funds and other financial instruments. Many securities trading firms also actively embrace AI/BD technologies, which can help streamline trade monitoring and reporting. For their core business, namely formulating and implementing trading strategies, AI/BD models can provide a deeper understanding of the complex relationships in capital markets and enable the automation of trading activities. They can also help securities trading firms efficiently survey markets and respond effectively to market stress. AI/BD technologies can also allow traders to better cope with complex, fragmented corporate action information. The main use cases observed in the securities trading space and their potential benefits include the following.

- Automated position monitoring:** In terms of enhancement, the workflow of marking to market and the fair value accounting of trade positions can be streamlined by collecting trade data using document recognition and managing records at scale with AI/BD-enabled databases. Securities traders can then generate and analyse inventory reports more efficiently.
- Enhanced trading algorithms:** AI/BD models can be used to learn from historical market information with the goal of predicting future market events and asset price movements in real time. AI/BD-powered trading systems can make decisions in response to fast-changing markets, and AI/BD technologies can
- Advanced trade execution:** In terms of innovation, sophisticated trade execution techniques using AI/BD technologies can dynamically divide a large order into smaller ones and place them at different price limits over a suitable time horizon. This can help traders mitigate the price impacts of their trades and execute their strategies at better prices and desirable speeds. Furthermore, predictive surveillance models using AI/BD algorithms can anticipate adverse market effects, such as those generated by predatory trading. Early warning systems can prompt traders to modify outstanding orders and protect their positions.
- Corporate actions analytics:** Information on corporate actions is valuable to securities traders. However, the relevant publications are complex, fragmented and often duplicated and hence difficult to process, especially for traders operating on markets across multiple jurisdictions. Reporting agencies, after using NLP and relevant AI/BD technologies to detect exceptions for standardised action documents and pre-process unstructured action documents, can share the cleaned data in machine-readable format on a global DLT hosted by a cloud platform. This DLT can serve as a consolidated source of information that allows traders to use a straight-through to process corporate actions and update their securities analytics.

be used to model and estimate transaction costs, such as in terms of liquidity and market impact, and can be used to ascertain whether trading strategies may generate profits net of the trading expenses in a given environment.

The financial services industry has adopted various AI/BD applications, and AI/BD technologies are likely to become its essential business driver.

1.3. CHALLENGES IN AI/BD ADOPTION: THE CASE FOR TALENT DEVELOPMENT

Although AI/BD adoption can transform and improve the provision of financial services, financial institutions view the integration of data from multiple sources to create high-quality BD as challenging. Managing BD in compliance with data privacy, intellectual property rights and other relevant regulations amid potential development in the legal and regulatory environment is also important. Firms adopting AI/BD technologies face governance issues, such as the transparency of the AI/BD models adopted and the accuracy, interpretations and fairness of outcomes produced by the AI/BD applications. Furthermore, most AI/BD algorithms and models are technically demanding, and a vast number of techniques are available, which may deter financial institutions from formulating and implementing strategies to adequately adopt AI/BD technologies.⁶ It is not surprising that firms operating in the financial services industry consider data quality and data access as some of the main challenges of AI/BD adoption.

In addition to the challenges related to data acquisition and management, another clear theme that has

emerged from anecdotal and hard evidence on AI/BD adoption in the financial services industry is the shortage of talent across sectors and jurisdictions.⁷ Attracting and retaining talent is vital for firms seeking to engage in AI/BD development. Talent development is not only key to the implementation of suitable and new strategies but also adds value to the firm's adoption of AI/BD technologies. Studies show that firms that are able to generate earnings from their AI/BD adoption place a strong emphasis on talent development.⁸ These studies also highlight that the balance between optimising current activities and developing talent is necessary for supporting future industry developments.⁹

Evidence suggests that the potential supply of talent with AI/BD capabilities has increased in recent years, as has the potential demand for it.¹⁰ Without suitable talent initiatives and collaboration between all stakeholders (i.e., universities, policymakers and financial institutions), this persistent talent gap may jeopardise the health of industry growth and hamper financial innovation. Given the importance of these issues, the following chapters of this report explore the current state of the demand and supply of relevant talent in various financial centres across the Asia-Pacific region to provide an understanding of the drivers of both forces and the potential gaps. Against this backdrop, we highlight the potential implications for talent development in Hong Kong.

Access to talent is among the main challenges for the financial services industry in adopting AI/BD technologies.

⁶ Cambridge Centre for Alternative Finance and World Economic Forum (2020); Doerr, Gambacorta, and Serena (2021); Irving Fisher Committee (2021).

⁷ See, for example, Cambridge Centre for Alternative Finance and World Economic Forum (2020). The European Commission (2020) also suggests that skills needs can limit businesses from adequately adopting AI/BD technologies.

⁸ See, for example, McKinsey Analytics (2020).

⁹ World Economic Forum (2018).

¹⁰ Gagne, Hudson, and Mantha (2020); Tencent Research Institute (2017); Zhang et al. (2021).

Chapter 2

A Talent Framework for Adopting Artificial Intelligence and Big Data in Financial Institutions

Production workflow, finance–technology innovators and T-shaped teams

HIGHLIGHTS:

- The adoption of AI/BD technologies and the integration of finance and technology in the financial services industry can be fostered by professionals with both finance and AI/BD expertise.
- In order to successfully lead financial services teams, finance–technology innovators can bridge the gap between finance and technology functions and integrate the financial context into technology development and deployment.
- By incorporating the roles and capabilities of professionals with different talents and expertise, the T-shaped team framework can provide guidance and a roadmap for the healthy development of a financial services industry that embraces AI/BD technologies.



This chapter presents how a financial services firm may operate when adopting AI/BD technologies to provide an understanding of the main tasks involved in the process and facilitate further discussion. We then discuss a conceptual framework called ‘T-shaped teams’ that can shed light on potential talent needs and the management of talent by financial services firms for AI/BD adoption and development.

2.1. PRODUCTION FLOW OF FIRMS ADOPTING AI/BD TECHNOLOGIES

The development of business applications and financial products powered by AI/BD technologies is a complex process that requires the interaction of various stakeholders with a wide range of expertise. An organisation includes finance professionals carrying out functions related to the provision of financial services and technology professionals performing technical functions. Some professionals may have a background in both finance and technology: their main role is to bridge the expertise of finance professionals and technology professionals. These professionals may take positions at various levels and serve different functions in the organisation, and their number and involvement are expected to increase as the firm’s AI/BD adoption matures.¹¹ Firms conduct research studies and internal reviews to identify customer needs or business pain points to transform financial services in the ways discussed in Chapter 1. They then initiate the workflow for the development of AI/BD-enabled applications for marketing to financial customers or for internal

business use, market research and internal audit functions in combination with other business and supporting functions.

Once customer needs or business pain points are clearly identified, the application development workflow can be initiated. This workflow typically involves the following six key phases.

1. **Identify value proposition:** In this step, finance professionals study customer needs and business pain points and determine whether and how they can solve these issues and improve well-being. Professionals who understand the financial or business issues and are versed in AI/BD technologies can assess whether and how AI/BD technologies can be used to shape potential financial and business solutions.
2. **Determine the appropriate technologies to use:** The finance problem statement and business requirements are translated into technical terms and communicated to technology professionals. In the discussion, the design plan for a viable solution enabled by AI/BD technologies is mapped into technology functions with facilitation by professionals versed in both finance and AI/BD technologies. Finance professionals also use their expertise and market knowledge to recommend information sources that can be useful for engineering technical solutions. Technology professionals then specify the candidate AI/BD models, data structures and learning algorithms and formalise the corresponding technical requirements.

¹¹ The integration of finance professionals and technology professionals linked by professionals with a background in both finance and technology can be expanded to multiple teams when the firm scales up its AI/BD adoption in project size and in scope to cover various business and supporting functions. Refer to Chart 2.2 for the life cycle of these organisational dynamics.

3. **Develop AI/BD architecture:** This step usually involves two tasks.
 - i. **Data preparation:** In this task, technology professionals extract, transform and load appropriate information from multiple data sources into a destination system to construct databases to train candidate AI/BD models. Because training accurate and insightful AI/BD models involves enormous quantities of data, automation is critical for cleaning, labelling, augmenting and managing BD. Appropriate data structures can ensure efficiency throughout the data wrangling process. Finance experts can help refine the informativeness of the data by having professionals with a background in both finance and technology explain their ideas to the technology professionals.
 - ii. **Model training:** The goal of this task is to train robust intelligent models that address the finance problem subject to the business requirements determined at the outset. This can be accomplished using an open ecosystem of optimised AI frameworks and application programming interfaces. Complex computation and learning algorithms can be accelerated by using graphics processing units, tensor processing units, parallel computing and distributed computing on local and cloud servers. Changes and training iterations should be tracked to help explain the hyperparameters selected and to create reproducible results.
4. **System integration and testing:** The developed AI/BD architecture is typically incorporated into a wider firm-level system. Testing for efficacy is therefore necessary, not only to validate that the AI/BD-based solution addresses the stated finance problem and business requirements but also to ensure that it can function with the other system components. To this end, professionals from the finance side and the technology side should work together under the facilitation of professionals with a background in both areas to verify that the solution performs as expected in each historical and simulated scenario and properly responds to special cases that may occur at extreme operating parameters.
5. **Compliance review and risk management:** The developed AI/BD architecture is audited by relevant professionals to ensure that it meets the proper standards and produces outcomes that are transparent, fair and ethical. The corresponding documentation is reviewed for completeness and whether it adequately covers the risks inherent in AI/BD adoption to ensure robust internal control.
6. **Deployment into production:** Firms package implementation-ready AI/BD-based solutions into marketable financial products or internal business applications, and computer programmes are fitted to the target environment (e.g., the Internet, desktop and laptop computers and smart phones and watches) using a combination of embedded

or edge devices, enterprise systems, cloud servers and other operational technologies. Market outreach functions can leverage their expertise to make recommendations on dissemination style and format to optimise customer engagement. Relevant business functions can be used to identify the target environment that optimises the internal user experience. User experience can also be enhanced by fine-tuning the software and using hardware-optimised computational libraries to cater to the technical profile of the target environment.

It is instructive to note that this production workflow can be iterative. Each individual step may be repeated before the next one begins to enhance the intermediate outputs. At any step, the development process can roll back to a previous step for revisions to improve the final results. Finally, the deployed applications are used internally by the relevant business functions of the organisation or are marketed to financial customers through the sales and market outreach functions in collaboration with other supporting functions.

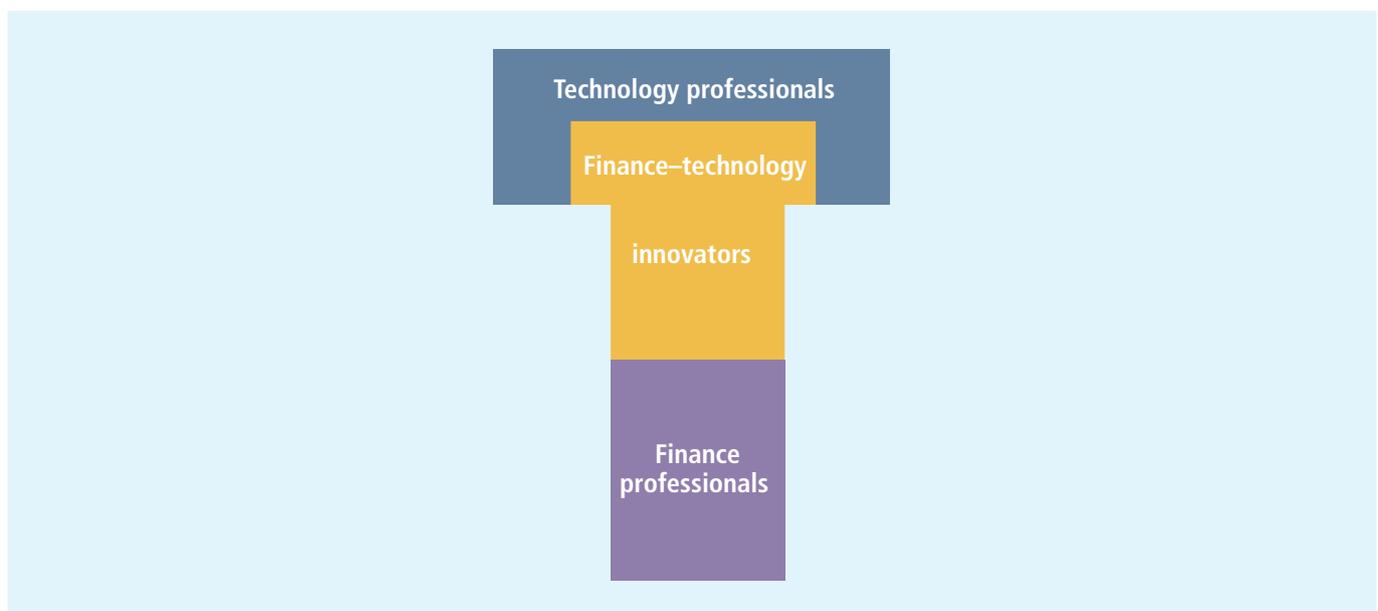
The adoption of AI/BD technologies and the integration of finance and technology in the financial services industry can be fostered by professionals with both finance and AI/BD expertise.

2.2. A FRAMEWORK FOR UNDERSTANDING TALENT NEEDS WITHIN FINANCIAL INSTITUTIONS ADOPTING AI/BD TECHNOLOGIES: T-SHAPED TEAMS

Successful transformation of financial services with AI/BD technologies requires simultaneous identification of opportunities from the business perspective, determination of technical solutions from the technology perspective and achievement of business–technology integration. Skills in data analytics, computer science, technologies and engineering techniques (i.e., technology professionals) is essential for handling the technical aspects in the overall production flow of financial institutions' adoption of AI/BD technologies. In addition, the skills of finance professionals are important for the production flow, as customer and business needs, value propositions, information sources and business requirements must be clearly identified at the outset. In addition, the quality of outputs must be established prior to product deployment, and developed products must be used by the business itself or marketed to customers.

Establishing a close link and productive communication between the two areas through a shared team space and shared language is essential. An organisational structure and culture that emphasises collaboration, transparency and accountability can contribute to the success of AI/BD adoption in financial services. However, AI/BD technologies are sufficiently distinct from financial services that an additional function is needed to combine them into a cohesive AI/BD-age financial services team. This additional function can be fulfilled by professionals who have training and work experience in both finance and AI/BD technologies. With the support of senior management, they can bridge the gap between finance and technology functions. Specialists who have domain-specific knowledge and who possess an understanding of and perspectives on financial institutions regarding the adoption of AI/BD technologies can communicate effectively with both finance professionals and technology professionals and act as a conduit between them to incorporate the financial context into technology development and deployment. These finance–technology innovators can combine deep knowledge in one discipline or part of the ecosystem and broader knowledge in the other discipline or other parts of the ecosystem and competencies (Chart 2.1).

Chart 2.1: A T-shaped team



Source: Cao (2019) and HKIMR staff compilation.

Finance–technology innovators are not only at ease with technology but can connect finance and technology functions, work well with other people and understand the wider systems in which their firms function.¹² They often carry titles such as product manager or business analyst (in a technology department). In the workflow of building AI/BD-enabled financial applications, finance–technology innovators can specify which data are useful, the decisions that AI models should be built towards making, the market scenarios and special business cases needed for adequate testing and validation and the format and environment suitable for deploying AI models for financial products that are marketable to customers. Furthermore, finance–technology innovators can draw on their financial knowledge to help business leaders identify and prioritise their problems. They can then tap into their working knowledge of AI/BD technologies to communicate these business goals to technology

professionals and help determine the appropriate technology solution. They can also ensure that the technology solutions produce insights that the business can interpret and execute, and, ultimately, convey the benefits of these insights to customers and senior executives.¹³

In order to successfully lead financial services teams, finance–technology innovators can bridge the gap between finance and technology functions and integrate the financial context into technology development and deployment.

¹² CFA Institute (2019).

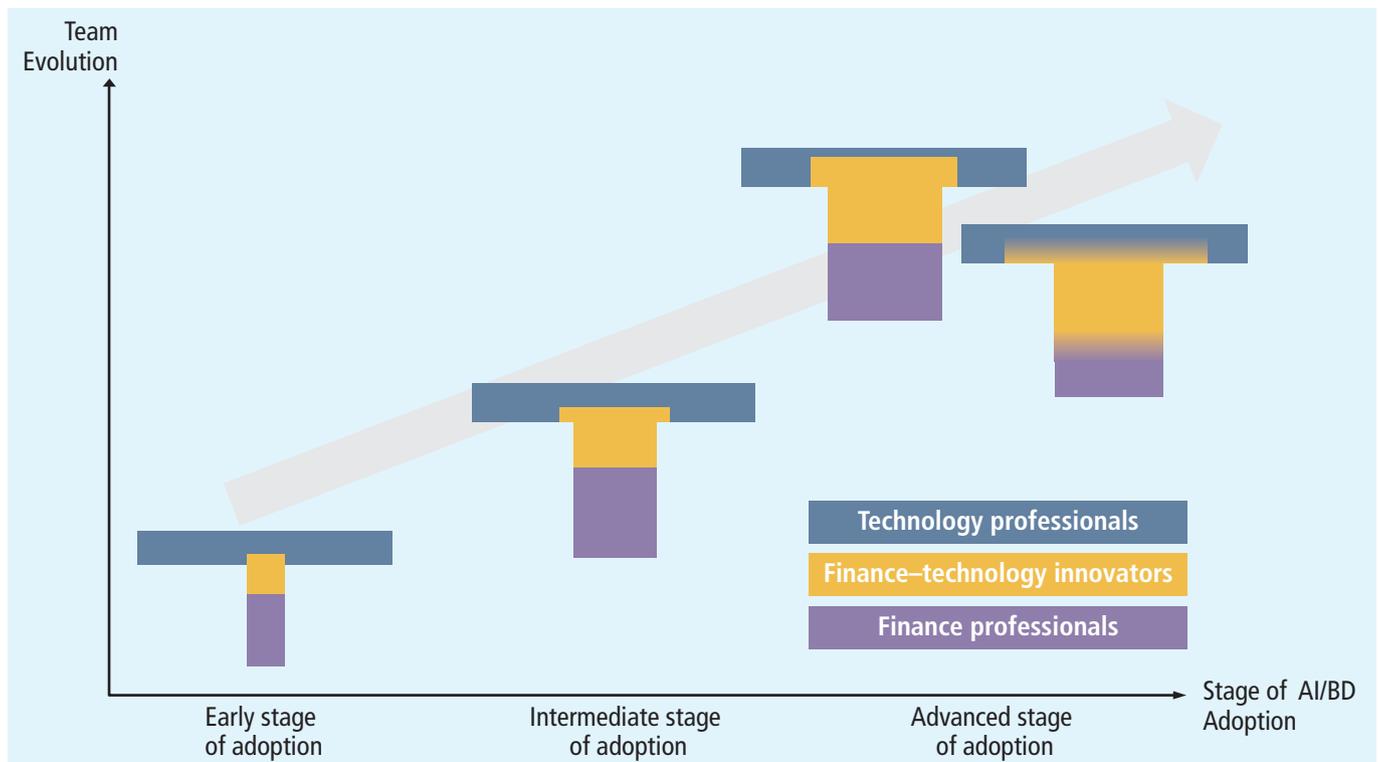
¹³ See, for example, Henke, Levine, and McInerney (2018).

2.2.1. Evolution of T-shaped teams

For the adoption of AI/BD technologies for financial services, an integrated and collaborative group of finance professionals, technology professionals and finance–technology innovators can be strategically organised as T-shaped teams that benefit from broad and deep collective intelligence and skills that operate under a diverse knowledge background and in a collaborative culture. This framework also emphasises the critical role of finance–technology innovators in enhancing communications across functions and facilitating a collaborative environment in which finance professionals and technology professionals can closely work in a shared team space and foster team skills^{14,15}.

The roles of the different functions in a T-shaped team evolves through the early, intermediate and advanced stages of AI/BD adoption, which require different focuses. Chart 2.2 depicts the general dynamics of how firms might develop T-shaped teams. Firms that plan to engage with AI/BD technologies can develop generic solutions or individual applications for some of their business units although such efforts may have only limited coordination and penetration within their firms (i.e., early stage of adoption). Early-stage T-shaped teams can be small in scale and may exist only on an informal, project-specific basis, supported by technology professionals such as data scientists, computer/IT engineers and finance–technology innovators. Firms can then coordinate efforts, involving more finance–technology innovators and possibly more data scientists and data engineers, to produce applications across their firms (i.e., intermediate stage of adoption).

Chart 2.2: Evolution of T-shaped teams



Source: Cao (2021) and HKIMR staff compilation.

¹⁴ See, for example, Cao (2019).

¹⁵ The idea of T-shaped teams as an effective tool to describe talent with interdisciplinary expertise or the structure of teams with cross-practice functions has attracted broad interest from professionals and academics over the past 20 years. See, for example, Saviano et al. (2016).

Advancing further with more finance–technology innovators facilitating integration and collaboration, firms may use AI/BD technologies more extensively in core business areas and supporting functions (i.e., advanced stage of adoption). T-shaped teams are not one-size-fits-all; financial institutions can develop their own T-shaped team structures that best meet their needs and capabilities, especially firms in the intermediate and advanced stages of AI adoption.¹⁶

In the early and intermediate stages of adoption, the roles of finance professionals may not be substantially different from those observed in the current financial services industry, although the focus of technology professionals can evolve. Their most significant challenge is to deliver a solution in the early stage of adoption that can solve real business problems with little input from the finance function. This can also be the easiest way to earn the trust of finance professionals. In the advanced stage of adoption, some finance professionals and technology professionals may develop themselves into finance–technology innovators. When firms develop their talent structure in this manner, they seek more finance–technology innovators as they increase their AI/BD adoption. As this adoption advances, T-shaped teams can become more common and may become permanent elements of the organisational structure

of firms providing financial services. Firms tackling a number of complex issues with AI/BD technologies can thus develop and support multiple T-shaped teams.

By incorporating the roles and capabilities of professionals with different talents and expertise, the T-shaped team framework can provide guidance and a roadmap for the healthy development of a financial services industry that embraces AI/BD technologies.

It is important to understand the views of market participants and the potential talent shortage regarding the adoption of AI/BD technologies in the financial services industry. The next chapter of this report discusses the results of a survey commissioned by the HKIMR to gather the views of market participants regarding the benefits, challenges and risks of AI/BD adoption and the demand for talent. Chapter 4 of this report presents the results of an empirical study commissioned by the HKIMR to measure the supply of relevant manpower and the talent gaps in the region.

¹⁶ For further information and details about the T-shaped-team framework for AI/BD technologies in financial services firms and how roles change throughout the stages of adoption, refer to Cao (2021).

Chapter 3

Artificial Intelligence and Big Data Adoption in the Asia-Pacific Region

Market views on the benefits, challenges and risks of adoption and the demand for talent

HIGHLIGHTS:

- 71% of the survey respondents across financial centres and industry sectors indicated that their firms have either adopted or planned to adopt AI/BD technologies in the next 12 months.
- Financial institutions in Hong Kong and the Asia-Pacific region that have adopted AI/BD technologies gained insights leading to better products and services, made better decisions thanks to enhanced modelling and automated repetitive activities to enable staff to use their time more productively.
- The market participants were concerned about talent shortages, data issues, business–technology integration and adoption costs. They also viewed limitations in the organisational culture on AI/BD adoption and rapid technological changes as relevant challenges in the next 5 years.
- Professionals versed in both finance and AI/BD technologies are in demand across major Asia-Pacific financial centres, suggesting that most sectors of the financial services industry in Hong Kong and the region are advancing their AI/BD adoption and achieving greater integration between business and technology functions.
- The market participants in Hong Kong and in the Asia-Pacific region highlighted that monetary compensation, career growth and training opportunities are the most important factors in attracting and retaining talent.

To obtain a clear picture of the benefits, challenges and risks of AI/BD adoption in the financial services industry in the region and to understand the demand side of talent development from the perspective of market participants, the HKIMR commissioned the CFA Institute to conduct a survey entitled *Artificial Intelligence and Big Data in the Financial Services Industry: A Regional Perspective and Strategies for Talent Development* (hereinafter 'AI/BD Survey') from April to July 2021. The AI/BD Survey invited a wide range of financial market participants from four main financial services sectors (asset management, banking, insurance and securities trading) in six major Asia-Pacific financial centres (Hong Kong, Shanghai, Shenzhen, Singapore, Sydney and Tokyo) to share their views on AI/BD adoption and talent development concerning this adoption. Executives in financial institutions were invited to participate in panel interviews to share their first-hand experience with AI/BD applications and talent acquisition.¹⁷

According to the results of the AI/BD Survey, firms in the financial services industry in the region have

adopted AI/BD technologies to a large extent (Chart 3.1). In fact, 71% of the survey respondents indicated that their firms have either adopted or planned to adopt AI/BD technologies in the next 12 months. Firms with no adoption plans were considering the pros and cons of adopting AI/BD technologies and assessing the associated challenges and risks.¹⁸ In addition, 36% of the respondents indicated that their firms were in the early adoption stage. These firms have either developed their own individual applications for use by their business units or acquired generic solutions externally. Although these efforts may lack coordination and penetration across business functions, these firms can test AI/BD adoption and are in the process of formulating strategies for more extensive engagement with these technologies. One quarter of the respondents indicated that their firms have already reached the intermediate or advanced stage of adoption, and some of them have already developed applications for use across their firms. Others extensively used AI/BD technologies in their core business areas and supporting functions.

Chart 3.1: Stages of AI/BD adoption

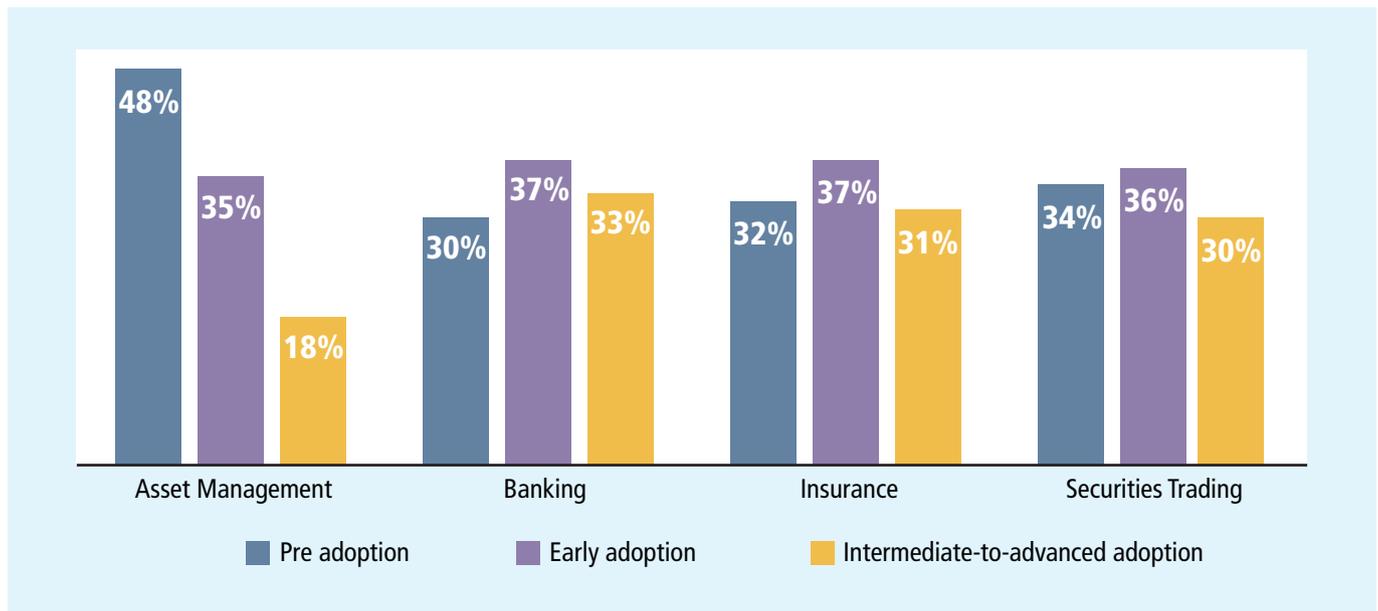


Source: HKIMR staff compilation.

¹⁷ Full details of the AI/BD Survey can be found in Appendix A.

¹⁸ See, for example, *Artificial intelligence in banking: The changing landscape in compliance and supervision*. HKIMR Applied Research Report No. 2/2020.

Chart 3.2: Stages of AI/BD adoption across financial services sectors



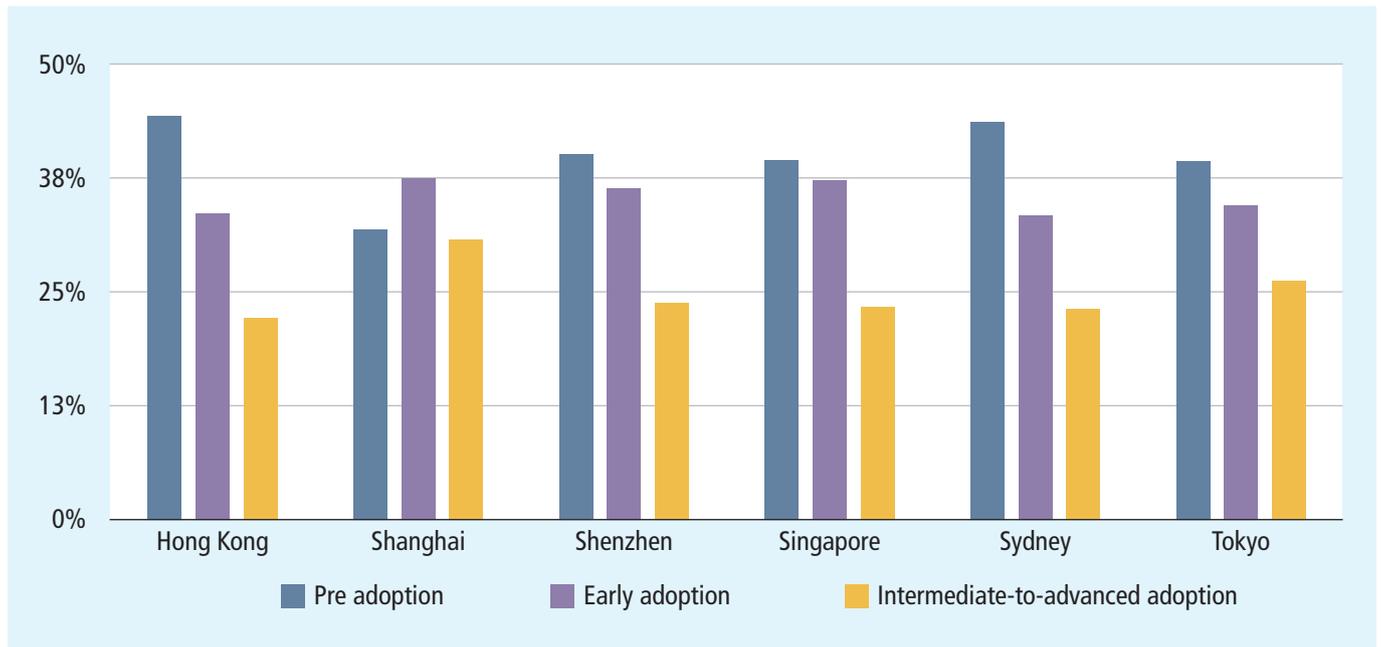
Note: The results are based on all six major financial centres in the region.
Source: HKIMR staff compilation.

In addition to an aggregate point of view, the AI/BD Survey provides a sectoral perspective that offers further insights. Chart 3.2 reports the adoption stages for each of the main sectors of the financial services industry for the full sample. The banking sector leads in the intermediate and advanced stages of adoption with 33% of the respondents, followed by the insurance sector, the securities trading sector and the asset management sector. The finding for the asset management sector can be understood on the grounds that firms in the Asia-Pacific region tend to be relatively small operations, and portfolio managers often adhere to the fundamental discipline of investment analysis. They may have limited resources with which to explore AI/BD techniques for investing. Nonetheless, the large proportion of responses for the pre-adoption stage in the asset management sector suggests the potential for growth.¹⁹

As Chart 3.3 shows, the financial centres exhibit a similar pecking order in terms of stages of AI/BD adoption. The exception is Shanghai, where more respondents reported that they had reached the intermediate or advanced stage of adoption compared with other financial centres. This finding could be due to a higher portion of respondents from the banking and insurance sectors that have already extensively used AI/BD technologies in their core business areas and supporting functions and developed applications for use across their firms.

¹⁹ However, if the AI/BD adoption rate is mostly the result of the industry structure, this situation may persist in the near future.

Chart 3.3: Stages of AI/BD adoption across financial centres



Source: HKIMR staff compilation.

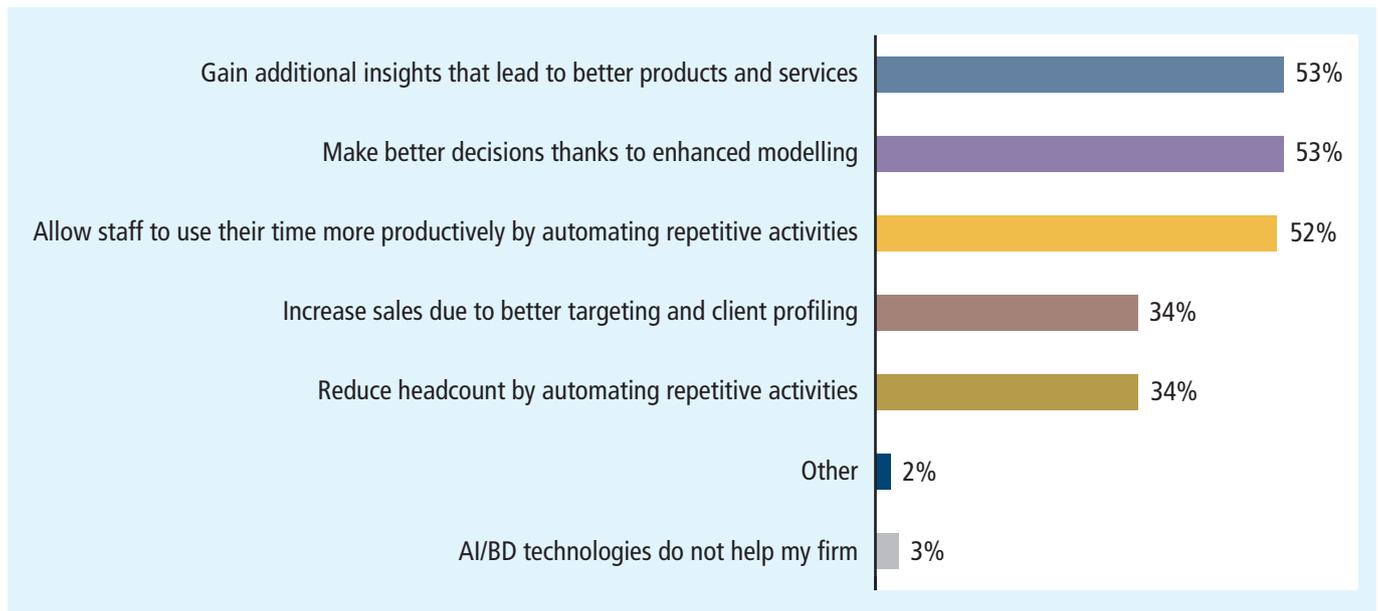
71% of the survey respondents across financial centres and industry sectors indicated that their firms have either adopted or planned to adopt AI/BD technologies in the next 12 months.

3.1. BENEFITS, CHALLENGES AND RISKS OF AI/BD ADOPTION

The benefits of AI/BD adoption have been widely recognised throughout the financial services industry in major financial centres in the Asia-Pacific region, and the patterns are similar across financial centres. About 53% of the survey respondents stated that their firms have gained additional insights, produced better products and services, made better decisions thanks to enhanced modelling and enabled staff to use their time more productively by automating repetitive activities (Chart 3.4). These findings support

the notion that AI/BD adoption can help strengthen human talent, amplify outcome performance and enable staff to reduce their manual work and focus on efforts to increase value added. In addition, 34% of the respondents indicated that their firms have increased sales through better targeting and client profiling and reduced headcount by automating repetitive activities. Only 3% of the survey respondents stated that the use of AI/BD technologies have not helped their firms.

Chart 3.4: Benefits of AI/BD adoption



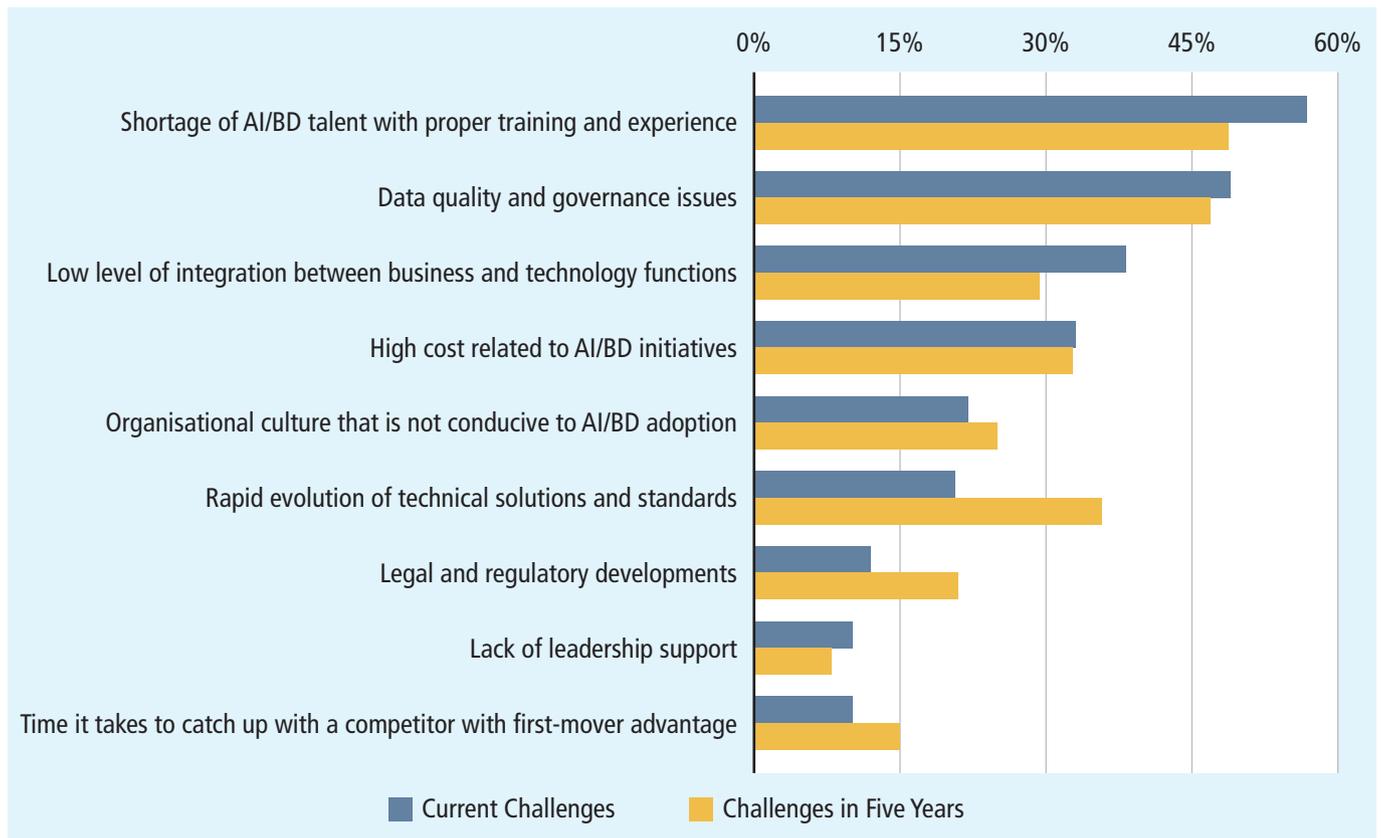
Note: As the respondents could choose more than one option, the percentages in the graph do not add up to 100.
 Source: HKIMR staff compilation.

The above survey evidence was supplemented with insights obtained from panel interviews. The head of data analytics at a traditional bank stated that the bank’s team of data scientists and analysts supported projects to analyse customer data to identify the products most appealing to customers and to improve risk management and operational efficiency. The chief architect at an Internet bank stated that they applied AI/BD technologies in a wide range of scenarios, such as remote account opening, customer service, risk management and economic forecasting, to lower costs and improve efficiency.

The survey respondents also highlighted that when adopting AI/BD technologies, their firms faced challenges that may affect current and future business decisions. As Chart 3.5 shows, the shortage of AI/BD talent with proper training and experience was the challenge identified by the most respondents (57% of the respondents), which suggests that it is also a relevant concern for the major financial centres in the Asia-Pacific region. The interviewees also expressed concern about the talent shortage. This is understandable, as successful AI/BD adoption requires talent who master the relevant technologies and possess the skills to put them into practice and generate business value.

Financial institutions in Hong Kong and the Asia-Pacific region that have adopted AI/BD technologies gained insights leading to better products and services, made better decisions thanks to enhanced modelling and automated repetitive activities to enable staff to use their time more productively.

Chart 3.5: Challenges of AI/BD adoption



Note: As the respondents could choose more than one option, the percentages for current challenges and challenges in 5 years do not add up to 100.
Source: HKIMR staff compilation.

Data quality and governance issues were also identified as major current challenges by 49% of the survey respondents, and insights obtained from the panel interviews validated this survey evidence. For example, the CIO of the robo-advice arm of a financial institution suggested that the limited amount of data available in financial markets and the fact that many AI/BD algorithms are difficult to explain were additional obstacles to AI/BD adoption. The survey respondents also highlighted a low level of integration between business and technology functions, which suggests that some financial services firms may be able to advance their AI/BD adoption by improving the translation of technology functions into business activities. Other notable current challenges included the high costs of AI/BD initiatives and organisational culture, which are not conducive to AI/BD adoption.

Anecdotal evidence gathered during the interviews also pointed to these two hurdles. For instance, the country head of Active Equity at a global asset management firm expressed that senior management had to make budget decisions, but they often had insufficient expertise with AI/BD.²⁰ The relative importance of the current challenges was similar across financial services sectors except for insurance and securities trading, where the rapid evolution of technical solutions and standards was identified as the key challenge.

The survey respondents expected most of the current challenges to persist into the near future, as they predicted that the shortage of talent, data issues, low level of business–technology integration and high costs of AI/BD initiatives would persist over the next 5 years.

²⁰ In addition, in general, C-level executives believed that functional integration and cost were more prominent issues than the general sample did.

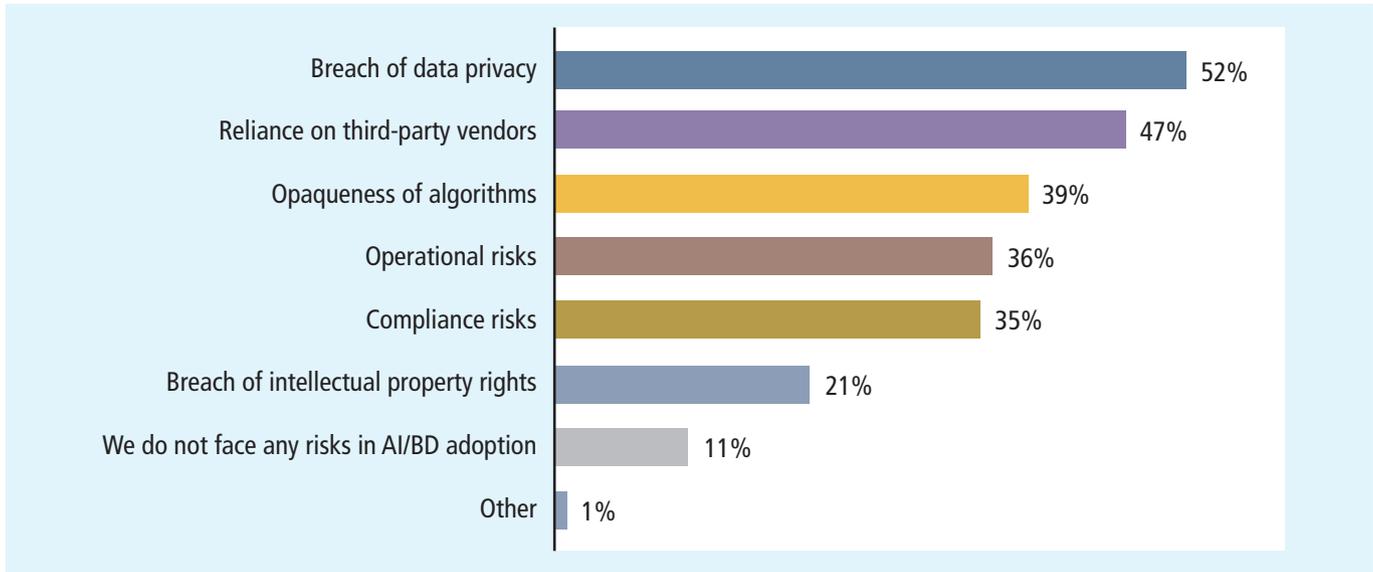
The limitations of organisational culture on AI/BD adoption and the rapid evolution of technical solutions and standards were also important concerns for the next 5 years. Although technological innovation may bring better and more advanced solutions to the market, it could potentially lead to stronger competition between market participants. In addition, firms whose organisational culture is not conducive to AI/BD adoption may have greater difficulty adapting to these changes.

The application of AI/BD technologies poses new risks that must be properly managed, and the survey respondents demonstrated a clear awareness of these risks in their responses. As Chart 3.6 shows, 52% of the respondents viewed data privacy breach as the main risk in AI/BD adoption, as businesses must maintain high data privacy standards to earn customers' trust. In addition, 47% of the survey respondents identified reliance on third-party vendors as a risk in AI/BD adoption. Collaboration with unregulated third parties can subject financial services firms to greater uncertainty. Other risks included the opaqueness of algorithms, operational risks, compliance risks and breach of intellectual property rights. These concerns are also important for the implementation of AI/BD technologies in an ethical and responsible manner. The relative importance of these risks is not specific to a financial centre but can be seen in all of the major centres in the Asia-Pacific region surveyed.

The market participants were concerned about talent shortages, data issues, business–technology integration and adoption cost, and they also viewed limitations in organisational culture and rapid technological changes as relevant challenges in the next 5 years.

Chapter 3

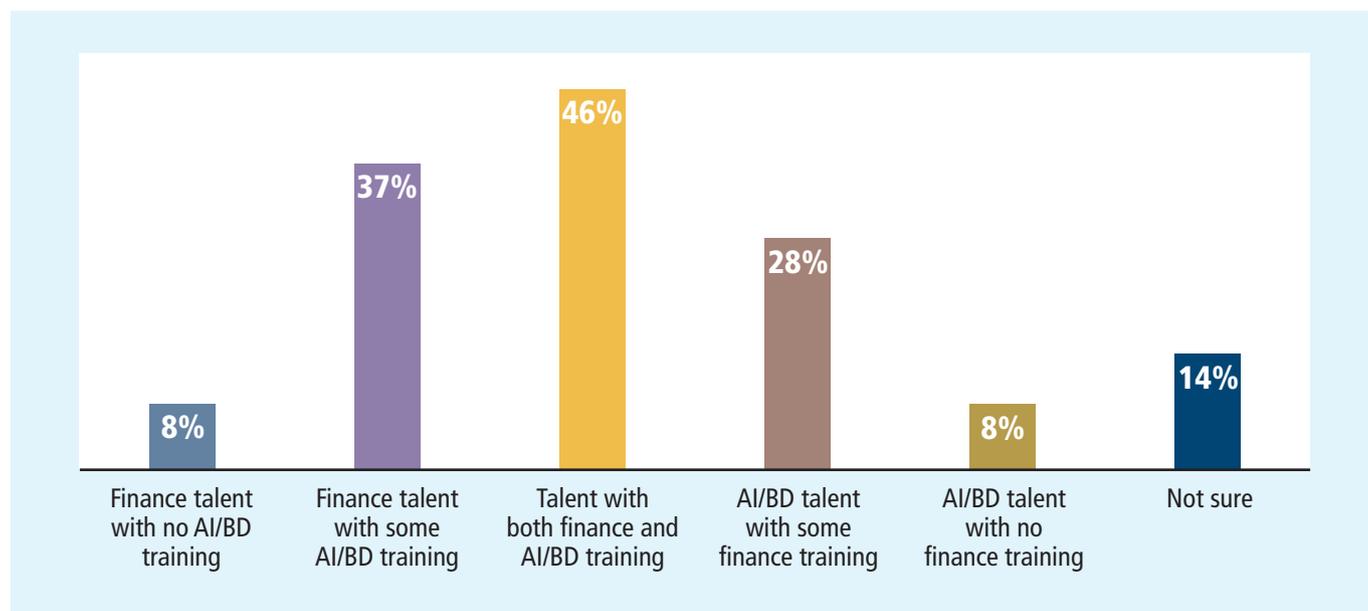
Chart 3.6: Risks of AI/BD adoption



Note: As the respondents could choose more than one option, the percentages in the graph do not add up to 100.
Source: HKIMR staff compilation.

3.2. THE DEMAND FOR TALENT: VIEWS FROM THE MARKET

Chart 3.7: Talent demand over the next 2 years



Note: As the respondents could choose more than one option, the percentages in the graph do not add up to 100.
Source: HKIMR staff compilation.

The AI/BD Survey also explored aspects related to the demand for talent for AI/BD adoption across sectors of the financial services industry. The respondents' views (summarised in Chart 3.7) showed that over the next 2 years, their firms will aim to recruit professionals with both finance and AI/BD training (46% of the respondents). A smaller percentage of respondents suggested the need to recruit professionals with either AI/BD or finance knowledge. These findings highlight that market participants give higher priority to professionals who have training to develop AI/BD technologies into financial products. This is also consistent with an early stage of adoption of AI/BD technologies, as discussed in Chapter 2.

Financial services firms in the early stage of AI/BD adoption tend to hire finance–technology innovators (i.e., professionals with both finance and AI/BD skills) to connect professionals with a finance background with professionals with a technology background. Firms moving from the early stage to the intermediate stage of AI/BD adoption are likely to recruit more finance–technology innovators to improve collaboration between finance professionals and technology professionals to consolidate their T-shaped teams. Firms reaching the advanced stage of AI/BD adoption would seek more finance–technology innovators to strengthen integration within their T-shaped teams and support more T-shaped teams to scale up the size and number of AI/BD projects.

Anecdotal evidence from the interviews supported this pattern. A senior director of technology innovation at the asset management arm of a financial institution stated that it was valuable to have a high percentage of technologists on the team who understood finance and business and business professionals with hands-on experience with programming, data analysis and machine learning. Similarly, the AI R&D product head at the insurance arm of a financial institution suggested that technology talent can benefit from having financial and business knowledge. Although business professionals may have to invest a great deal of effort to become tech savvy, upskilling oneself can still be viable. For example, a Senior Investment Manager at a sovereign wealth fund with an actuarial background who had obtained a Master's degree in data science after working for 10 years stated that this technology knowledge enabled better collaboration with technology colleagues and smoother translation of technology proposals into business actions.

Professionals versed in both finance and AI/BD technologies are in demand across the Asia-Pacific's major financial centres, suggesting that most sectors of the financial services industry in Hong Kong and the region are advancing their AI/BD adoption and achieving greater integration between business and technology functions.

3.2.1. Talent acquisition plans

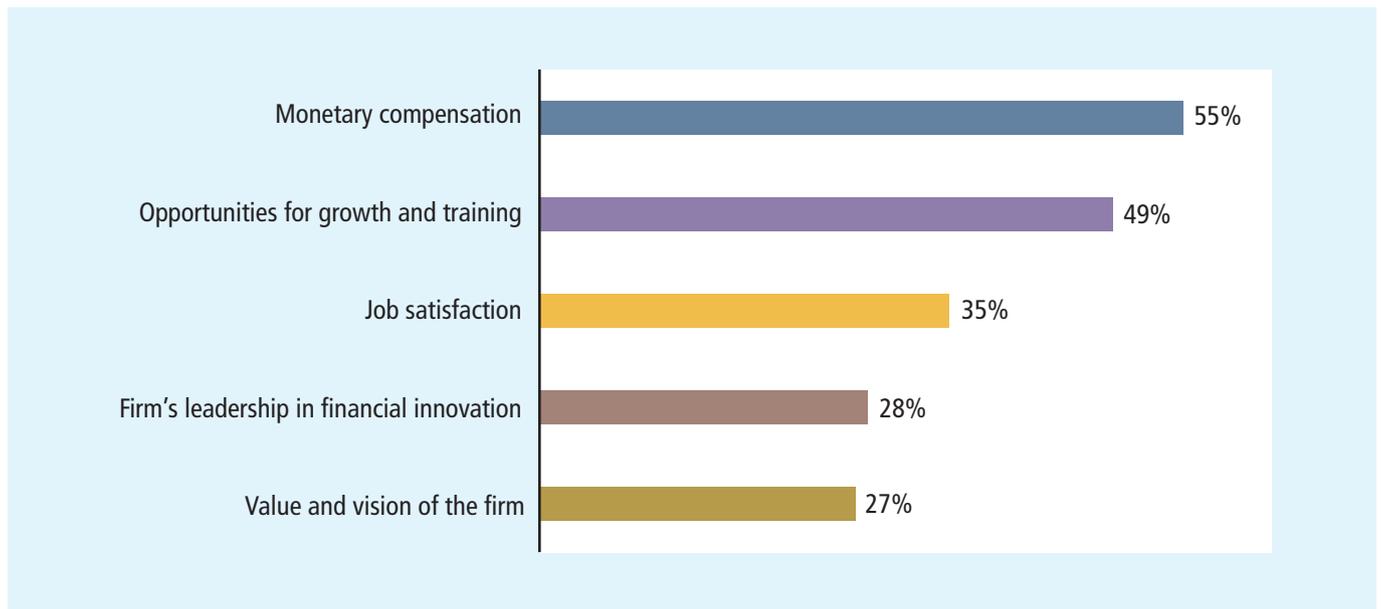
After indicating the talent needs required over the next 2 years, the survey respondents were asked how they planned to implement this talent expansion. Financial services firms in the region acquired talent to develop AI/BD technologies by hiring experienced professionals, retraining current staff and hiring fresh graduates. The survey results showed that hiring experienced professionals was slightly preferred over the other two channels but that their overall importance was very similar. This finding was consistent across the financial services sectors and financial centres surveyed. Insights obtained from the panel interviews indicated similar understandings. For example, the CEO of the subsidiary of a global insurance firm stated that the firm had hired fresh graduates and retrained its current staff but preferred hiring experienced professionals when transferable skills and knowledge were needed. The co-head of active equities at a regional asset management firm added that they had recently filled a junior position with an experienced professional for a similar reason. In addition, a number of interviewees stated that they had recruited talent through various channels and often filled junior positions with fresh graduates.

As effectively attracting and retaining talent is crucial for the healthy development of the financial services industry, the survey respondents were also invited to rate the factors that are considered important in this respect. As Chart 3.8 shows, 55% of the respondents indicated that monetary compensation was an important consideration in attracting and retaining talent. This may reflect the competitiveness of the labour market for talent with technology skills, as large technology firms have to pay high salaries to attract such talent.²¹ Many respondents also stated that career growth, training opportunities and job satisfaction were important. Taken together, these findings suggest that many professionals seek jobs with good future prospects and prefer jobs that are interesting and fulfilling.²²

²¹ See, for example, Metz (2017).

²² See, for example, Roesch, Sivak, Porter, and Stancroff (2021).

Chart 3.8: Important factors for attracting and retaining talent



Note: As the respondents could choose more than one option, the percentages in the graph do not add up to 100.
Source: HKIMR staff compilation.

The discussions in the panel interviews provided further insights. For instance, the chief architect at an Internet bank concurred that a competitive monetary compensation package may not be sufficient to retain talent and that professional growth opportunities were also important. In addition, an AI Research Scientist at a global brokerage firm stated that it is important to connect with talent through multiple channels and to communicate the firm's mission and values to them so that they can find purpose in their work.

In addition to developing AI/BD applications internally, financial services firms in the region may rely on collaboration with external parties. External collaboration can be a viable short-term solution when exploring new ideas and for firms that are not yet ready to fully invest in AI/BD technologies. The Survey results concerning how the respondents

viewed different forms of external collaborations showed that collaborations through hiring external vendors and consulting firms and strategic partnerships with established AI/BD vendors were slightly preferred to strategic partnerships with AI/BD and fintech start-ups. It is worthwhile noting that the tendency to hire external vendors and consulting firms may lead to concentration risk and over-reliance on a small number of specialised service providers. Collaboration with unregulated third parties can subject financial services firms to greater uncertainty. In fact, the survey respondents rated reliance on third-party vendors as the second most important risk arising from AI/BD adoption. The lower preference for strategic partnerships with start-ups may reflect firms' aim to avoid uncertainty. Developments in these areas are worth exploring in the near future in the interest of a more diverse and vibrant fintech ecosystem.

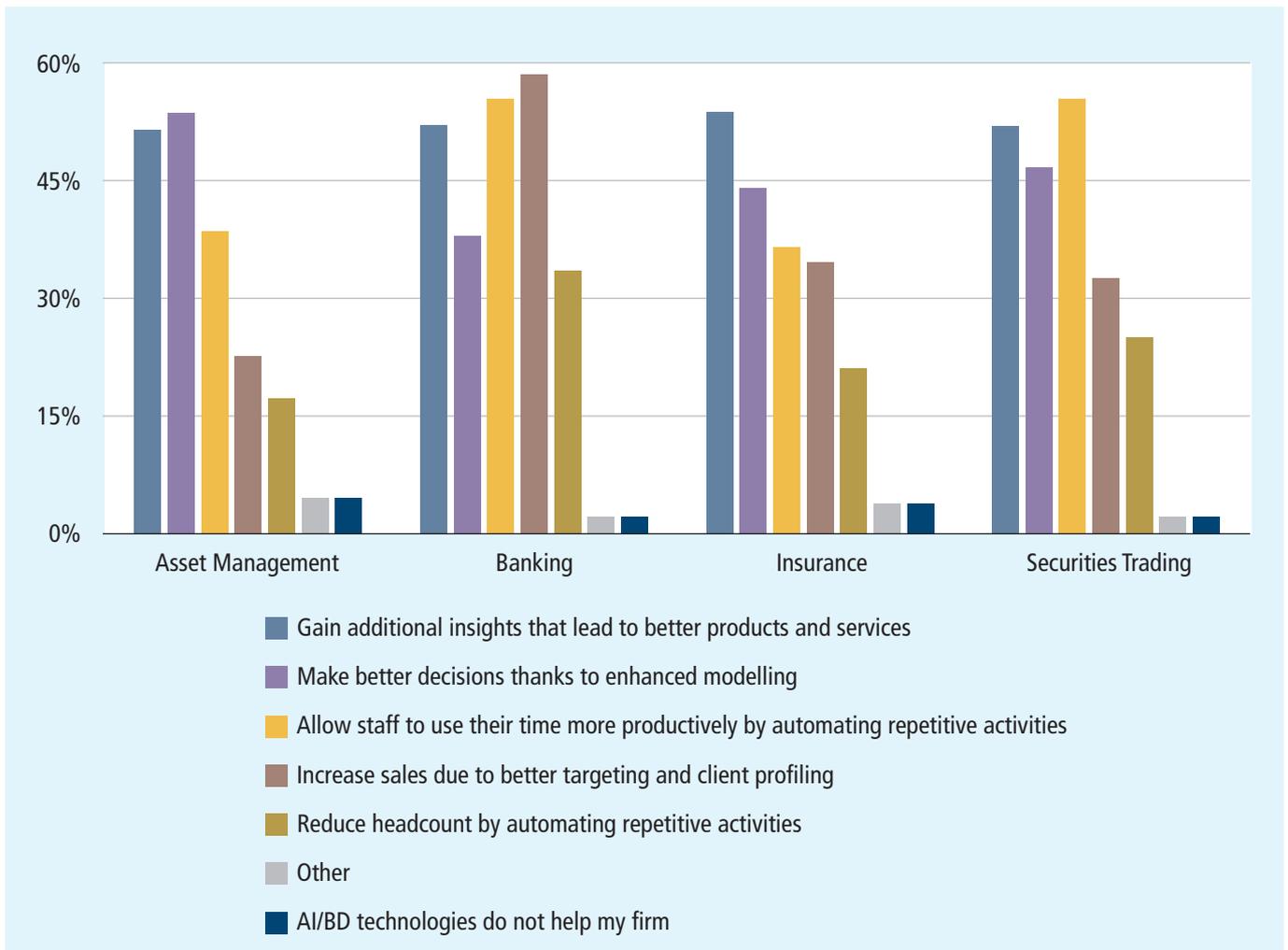
3.3. FURTHER INSIGHTS INTO HONG KONG

This section discusses the findings for Hong Kong to understand the specificities of AI/BD adoption there and the local demand for talent.

The survey evidence shows that financial institutions in Hong Kong that have adopted AI/BD technologies have experienced various benefits. Market participants, across all financial sectors, believed that AI/BD technologies brought additional insights that

led to better products and services (Chart 3.9). Some of these benefits are sector-specific, as the market participants in the asset management, securities trading and insurance sectors suggested that AI/BD adoption led to better decision making because of the enhanced modelling that AI/BD technologies enabled. In addition, the market participants in the banking and securities trading sectors viewed benefit from increased staff productivity resulting from the automation of repetitive activities. The market participants in the banking sector also highlighted increased sales because of better client profiling.

Chart 3.9: Benefits recognised from AI/BD adoption in Hong Kong

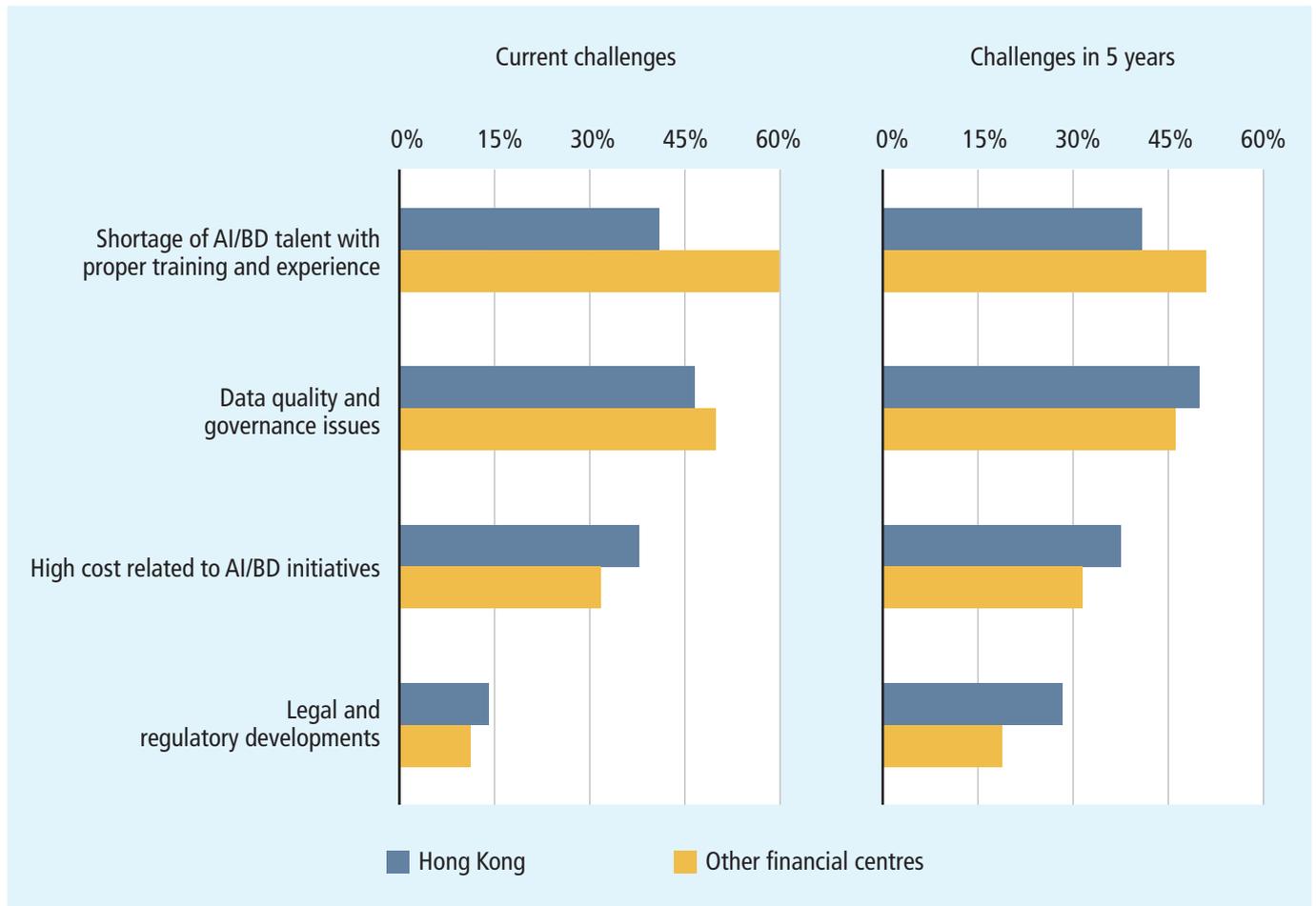


Note: As the respondents could choose more than one option, the percentages for each financial services sector in the graph do not add up to 100.
Source: HKIMR staff compilation.

The survey respondents in Hong Kong emphasised a set of key challenges for AI/BD adoption similar to those of their peers in other financial centres, with data quality and talent shortage high on the list (Chart 3.10). However, different from other financial centres, Hong Kong’s survey respondents placed slightly greater emphasis on data quality than talent shortage, although both were regarded as main

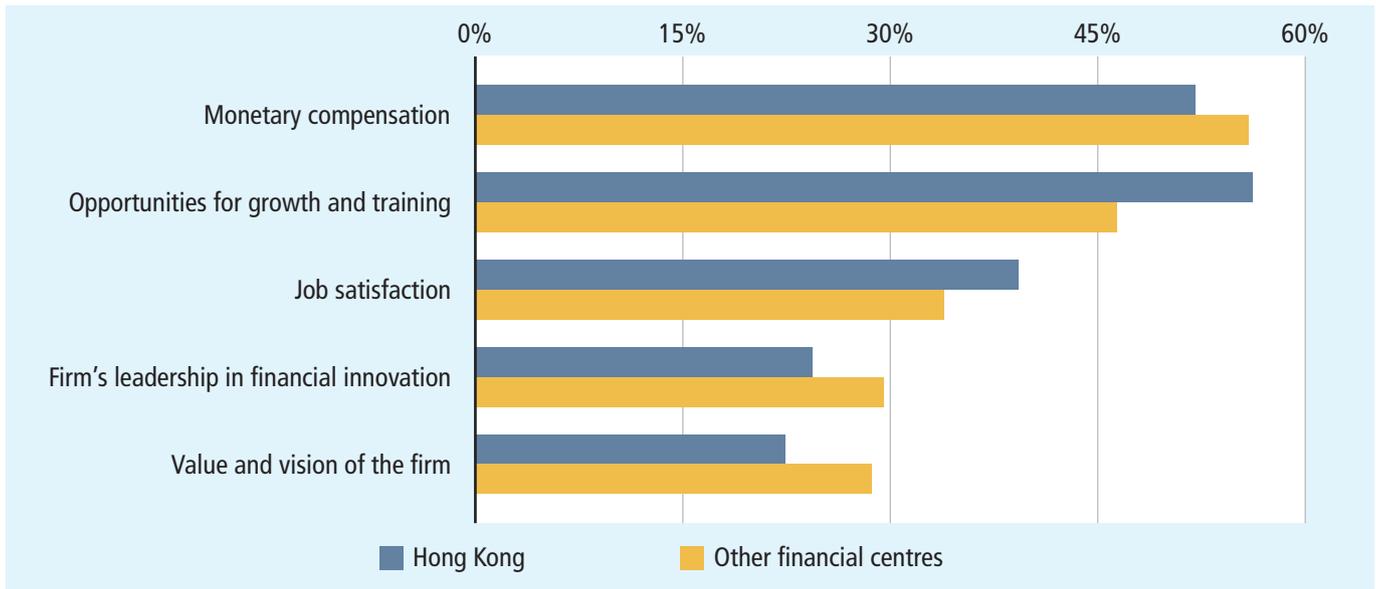
challenges and were expected to persist (or even increase) over the next 5 years. In addition, more than their peers in other financial centres, the Hong Kong market participants emphasised the high costs related to AI/BD adoption and viewed developments in the legal and regulatory landscapes as more prominent challenges in the next 5 years.

Chart 3.10: Challenges of AI/BD adoption in Hong Kong



Note: As the respondents could choose more than one option, the percentages for current challenges and for challenges in 5 years for Hong Kong and other financial centres do not add up to 100.
 Source: HKIMR staff compilation.

Chart 3.11: Important factors for attracting and retaining talent in Hong Kong



Note: As the respondents could choose more than one option, the percentages for Hong Kong and other financial centres in the graph do not add up to 100.

Source: HKIMR staff compilation.

When asked about talent expansion, the survey respondents in Hong Kong expressed a slightly greater preference for hiring experienced professionals than for building an internal talent pool. Although they valued transferable skills and previous knowledge, the respondents highlighted the importance of building their own talent pool internally by upskilling existing employees who understand the business and nurturing inexperienced new hires. These findings echo those from the other financial centres in the region.

In rating the factors that they considered important for attracting and retaining talent, the Hong Kong respondents had a slightly different view. As Chart 3.11 shows, the majority of the respondents in Hong Kong indicated that career growth and training opportunities were the key considerations, followed by monetary compensation and job satisfaction.

The market participants in Hong Kong and in the Asia-Pacific region highlighted that monetary compensation, career growth and training opportunities were the most important factors in attracting and retaining talent.

Chapter 4

A Panoramic View of Talent Supply in the Asia-Pacific Region

Understanding the supply of professionals with artificial intelligence and big data skills and the talent gaps

HIGHLIGHTS:

- AI/BD professionals working in the financial services industry were mainly employed in the banking and insurance sectors, and Hong Kong exhibited the highest rate of AI/BD professionals participating in the financial services industry among the financial centres surveyed.
- For the Asia-Pacific region, 85% of the AI/BD professionals were employed in non-financial sectors (mostly academia and the technology and telecommunication sectors), and this group exhibited a propensity to switch to roles in the financial services industry.
- During the 12-month period ending in July 2021, about 6,800 AI/BD professionals working moved between major Asia-Pacific financial centres and other parts of the world, with net inflows of talent for all financial centres in the region. Only 800 professionals moved across centres within the region.
- Our preliminary annual estimates of the regional talent gaps range between 2,000 and 6,600 professionals with both finance and AI/BD skills, with the talent gap in Hong Kong estimated at 2,000 such professionals.

To supplement the market views gathered from the AI/BD Survey and panel interviews, this chapter presents the results of a study commissioned by the HKIMR to understand the characteristics of the supply of talent relevant to AI/BD adoption in six Asia-Pacific financial centres and across the four main financial services sectors studied. The latter part of this chapter presents and discusses the results of a preliminary estimation of the talent gaps in the region.

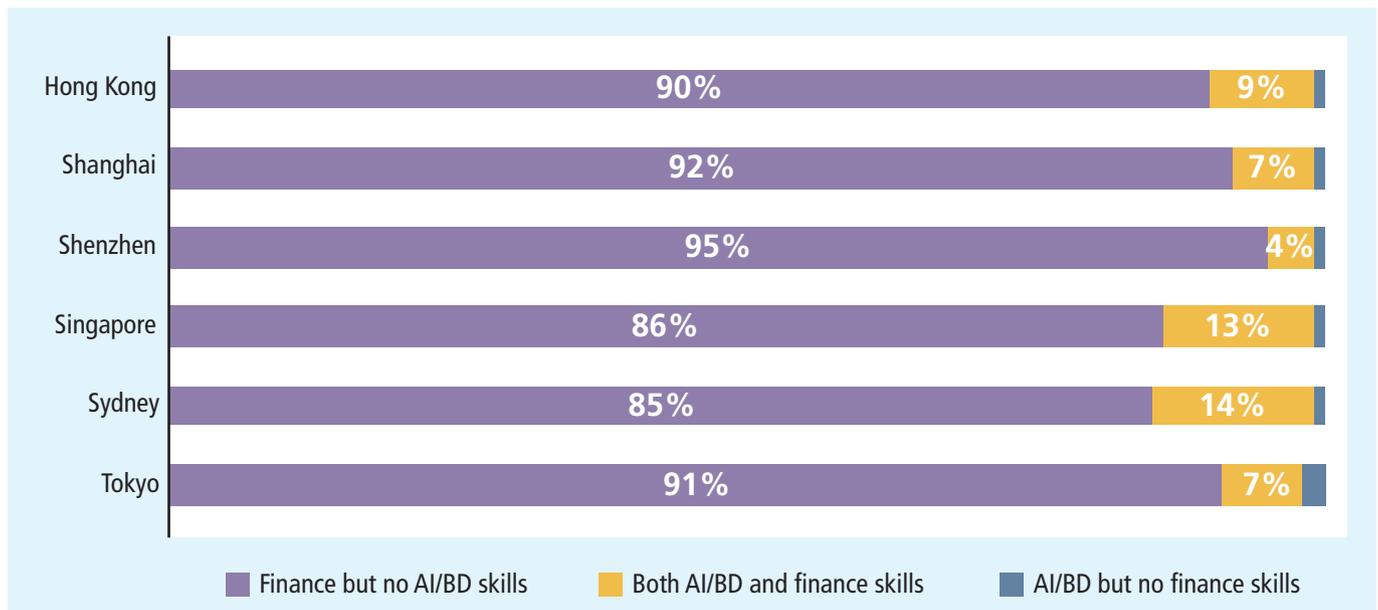
4.1. THE EXISTING POOL OF TALENT

The study examined the characteristics of the pool of talent in the financial services industry in the region, based on statistics derived from member profiles extracted from talent reports provided by LinkedIn in July 2021.²³ The data collected include about 933,000 individuals who were identified as professionals associated with the financial services industry in the six financial centres.²⁴ According to the locations stated in the member profiles, Hong

Kong, Shanghai, Singapore and Sydney each accounted for about 20% of these profiles, and the remaining 20% worked in Shenzhen and Tokyo.

Chart 4.1 presents the distribution of skills of professionals working in the financial services industry of each financial centre. The majority of these professionals had finance but no AI/BD skills (i.e., finance professionals), and those who had AI/BD but no finance skills (i.e., technology professionals) were few (about 1% of the sample). This distribution of skills was similar across the six financial centres. The percentage of professionals who had both finance and AI/BD skills ranged from 4% to 14%. These findings support the predictions made concerning the T-shaped team framework discussed in Chapter 2 and indicate that, especially for earlier stages of AI/BD adoption, only a small fraction of professionals in the financial services industry had both skills and more of them are needed for firms to advance in AI/BD adoption.

Chart 4.1: Skills possessed by professionals working in the financial services industry



Note: For each financial centre, about 1% of the professionals working in the financial services industry have AI/BD but no finance skills.

Source: Tam (2021) and HKIMR staff compilation.

²³ Full details of the sample and methodology used in the study can be found in Tam (2021).

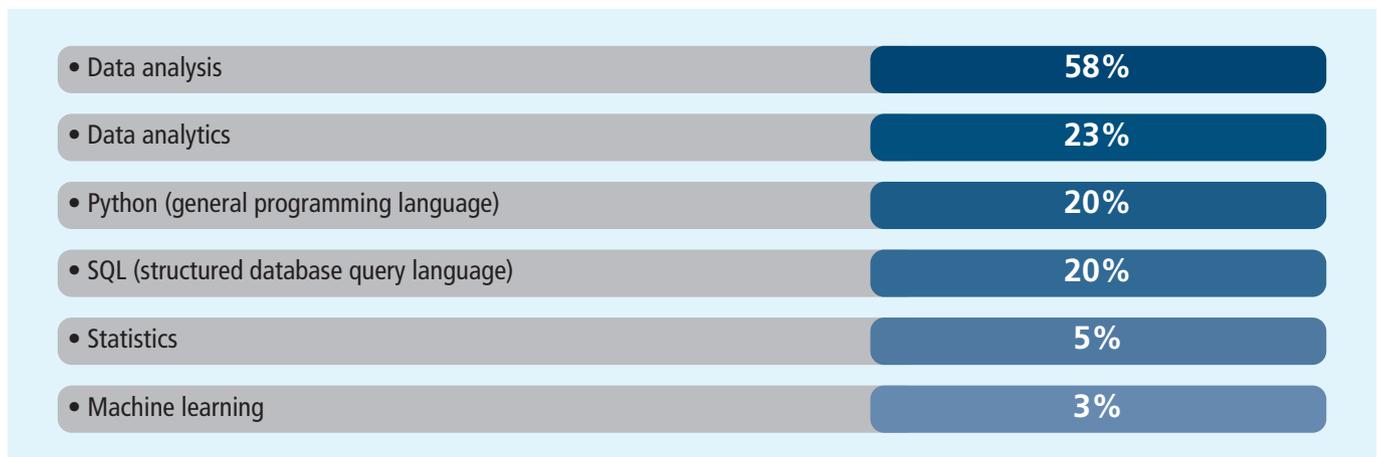
²⁴ It is important to note that the actual size of talent in each financial centre may differ from the number of relevant LinkedIn members that are used in the study. Nonetheless, the analysis can still offer a useful perspective on the characteristics of the talent pool available in Asia-Pacific financial centres.

To gain further insights into the AI/BD skills possessed by talent in the financial services industry in the region, a list of AI/BD-related skills was compiled to identify the top 10 skills extracted from the members' profiles. Chart 4.2 presents these skills in descending order of occurrence.

Data analysis, which involves specific actions to study data, was the top AI/BD-related skill possessed by talent in the financial services industry, followed by data analytics, a broad field in which advanced data science techniques and tools are used to make business decisions. These findings are understandable, as data analysis is an important basic skill and AI/BD adoption is driven by computational algorithms and data.

The majority of the AI/BD professionals (i.e., technology professionals and finance–technology innovators) were graduates from local universities.²⁵ Local universities, education institutions and professional bodies can be major drivers in nurturing domestic talent for several reasons. First, because of geographical proximity, they can better understand the practices, policies and development of the relevant finance services industries. Second, local universities are also able to offer courses and education programmes in line with market needs to train students and upskill in-practice professionals with knowledge and techniques suitable for adopting AI/BD technologies. Third, students and graduates of local universities can acquire information and guidance regarding internships, career opportunities and networking through these local entities.

Chart 4.2: AI/BD-related skills possessed by talent in the financial services industry in the Asia-Pacific region

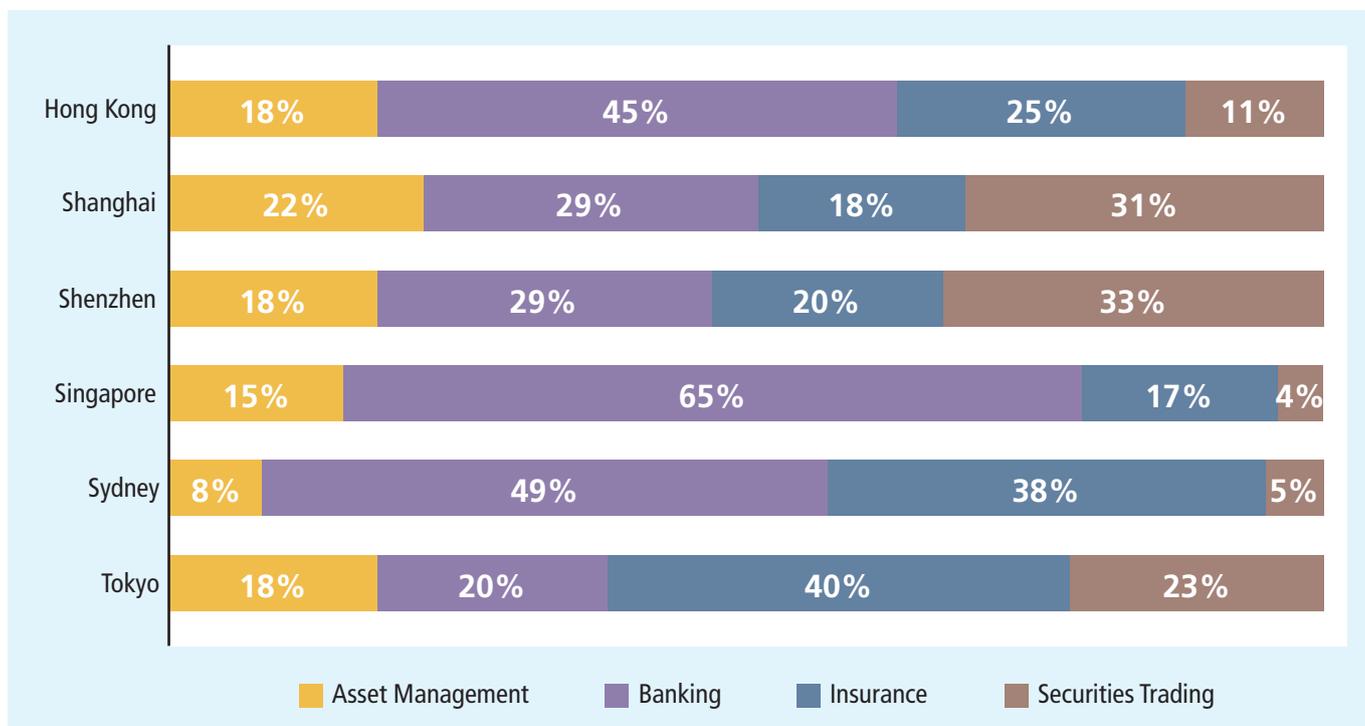


Note: As an individual can possess multiple relevant skills, the percentages in the chart do not add up to 100.

Source: Tam (2021) and HKIMR staff compilation.

²⁵ Tam (2021) identifies the top 5 educational affiliations for each financial centre as follows: Hong Kong: the University of Hong Kong, the Chinese University of Hong Kong, the Hong Kong University of Science and Technology, City University of Hong Kong and Hong Kong Polytechnic University; Shanghai: Fudan University, Shanghai Jiao Tong University, Shanghai University of Finance and Economics, Tongji University and Shanghai University; Shenzhen: Shenzhen University, Sun Yat-sen University, Peking University, Wuhan University and Chinese University of Hong Kong, Shenzhen campus; Singapore: National University of Singapore, Nanyang Technological University, Singapore Management University, Temasek Polytechnic and the University of London, Singapore campus; Sydney: the University of New South Wales, the University of Sydney, the University of Technology Sydney, Macquarie University and Western Sydney University; Tokyo: the University of Tokyo, Waseda University, Keio University, Kyoto University and Sophia University.

Chart 4.3: Distribution of AI/BD professionals across financial services sectors



Source: Tam (2021) and HKIMR staff compilation.

4.1.1. Top employers and employment status

Most of the top 10 employers of AI/BD professionals in Hong Kong, Shanghai, Singapore and Tokyo were global financial institutions, whilst most of those in Shenzhen and Sydney are leading regional and national financial institutions. These findings may reflect the different business strategies emphasised by the financial centres. Chart 4.3 presents the distribution of these AI/BD professionals across the four main financial services sectors for each of the six financial centres.

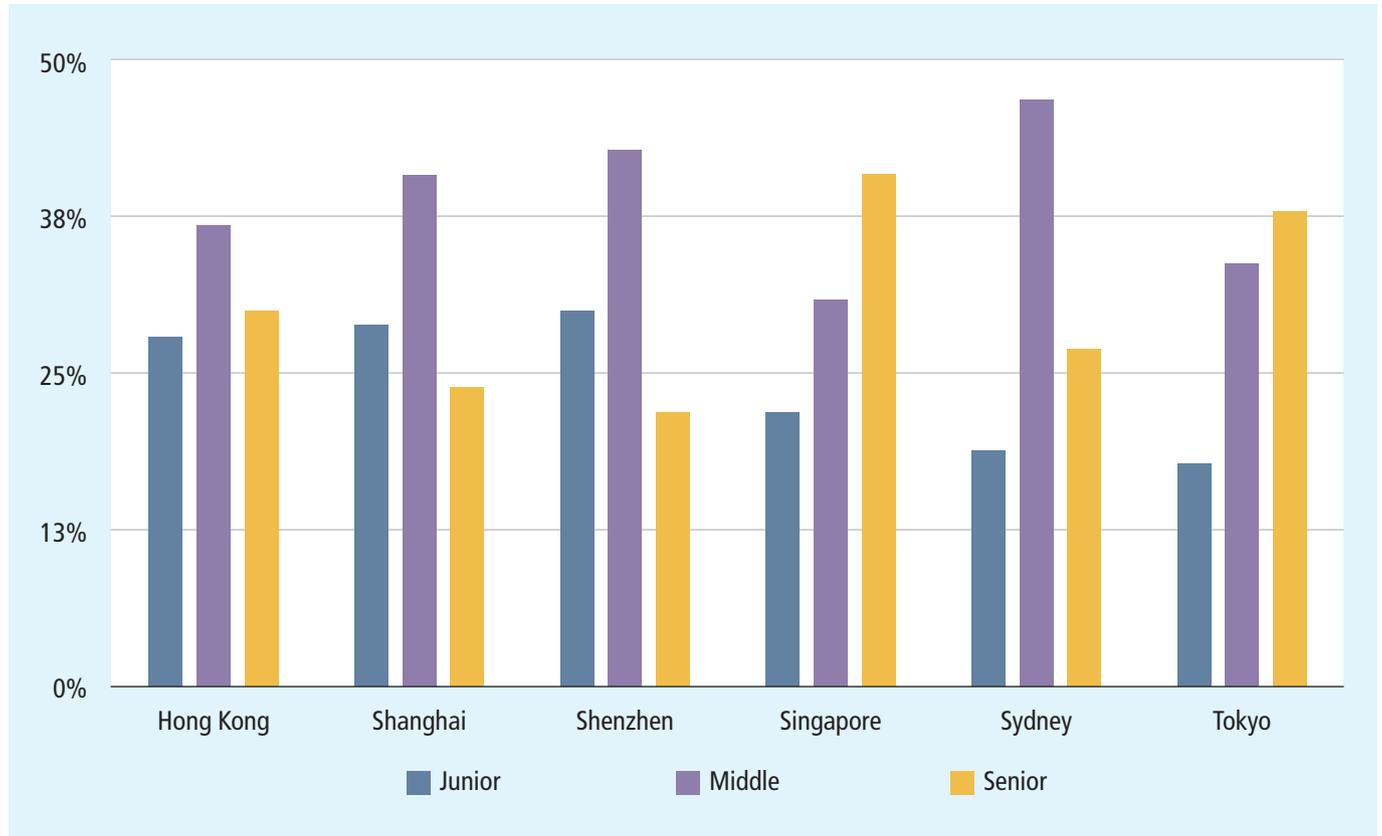
AI/BD professionals working in the financial services industry were mainly employed in the banking and insurance sectors. This finding is consistent with the fact that the banking and insurance sectors have progressed faster in adopting AI/BD technologies than the other sectors (see Chart 3.2 in Chapter 3 of this report). For Shanghai and Shenzhen, the securities trading sector also actively engages AI/BD professionals, as more of its firms have reached the intermediate and advanced stages of adoption, as observed in Chapter 3 of this report.

AI/BD professionals working in the financial services industry were mainly employed in the banking and insurance sectors, reflecting that these sectors have progressed faster in adopting AI/BD technologies than other sectors.

To obtain further insights into the job levels associated with AI/BD professionals in the financial services industry in the region, the LinkedIn members’ profiles were grouped according to three job seniority levels – junior, middle and senior – based on a broad classification of the position titles stated in the members’ profiles. As Chart 4.4 highlights, the AI/BD

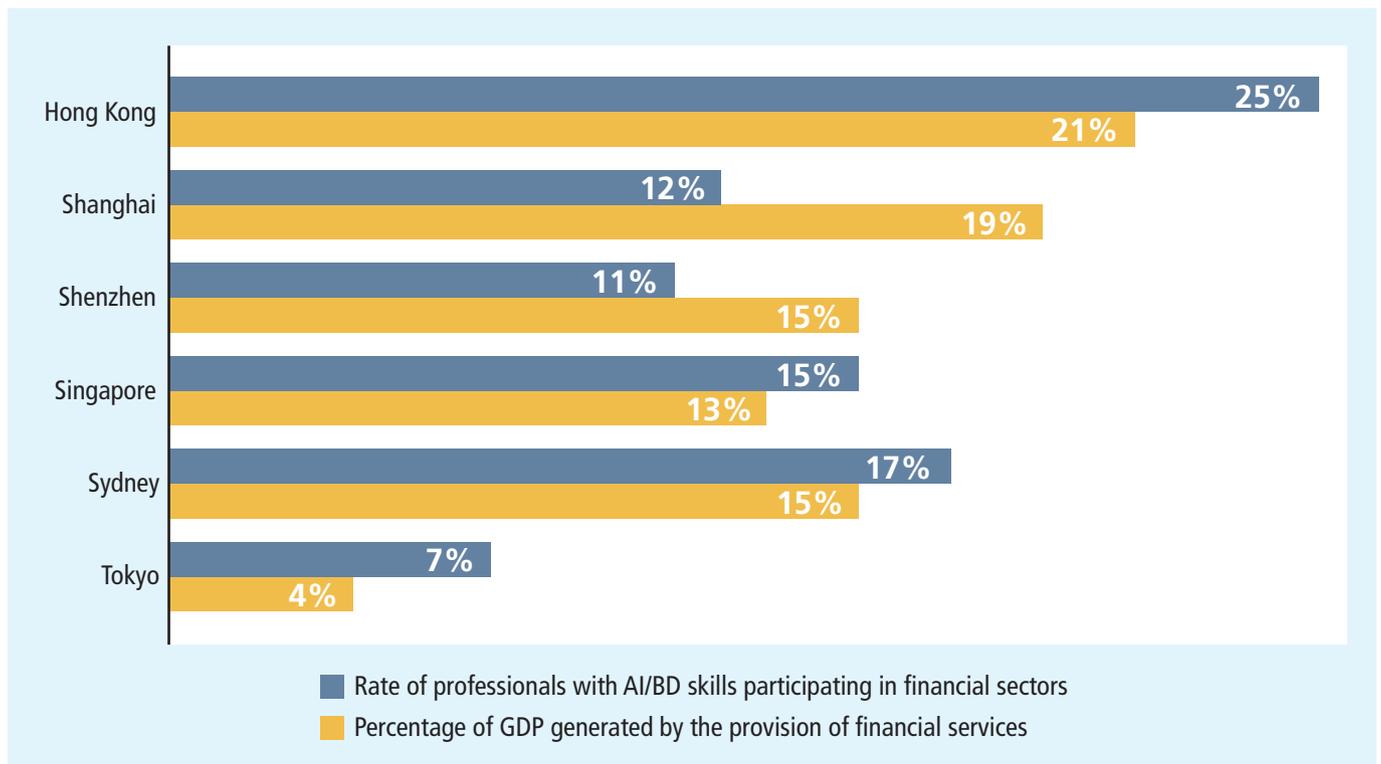
professionals participated in the provision of financial services in the region at various levels. The pool of AI/BD professionals in the financial services industry in Hong Kong had high percentages of middle and senior jobs in comparison with junior jobs; however, the distribution across seniority levels was more even in Hong Kong than in other financial centres.

Chart 4.4: Job rank of AI/BD professionals in the financial services industry



Note: As the results are based on the top 100 job titles, the percentages for each centre in the graph do not add up to 100.
 Source: Tam (2021) and HKIMR staff compilation.

Chart 4.5: AI/BD professionals participating in financial sectors



Sources: Hong Kong Census and Statistics Department (2021) for Hong Kong in 2019; 2020上海市统计局 (2021) for Shanghai 2020; 深圳金融业2020年运行数据 (2021) for Shenzhen in 2020; Statista for Singapore in 2020 and Japan in 2019; SGS Economics and Planning (2018) for Australia in 2018; Tam (2021); HKIMR staff compilation

4.1.2. AI/BD talent mobility

To understand the mobility of AI/BD professionals between the financial and non-financial sectors, Chart 4.5 presents the rate of these professionals participating in financial sectors for each financial centre along with the percentage of GDP generated by the provision of financial services.²⁶

Hong Kong exhibited the highest rate of AI/BD professionals participating in financial sectors (25%), followed by Sydney and Singapore. The chart also suggests a positive correlation between the participation rate and the percentage of GDP generated by the provisions of financial services in a financial centre.²⁷

Hong Kong exhibited the highest rate of AI/BD professionals participating in the financial services industry among the financial centres surveyed.

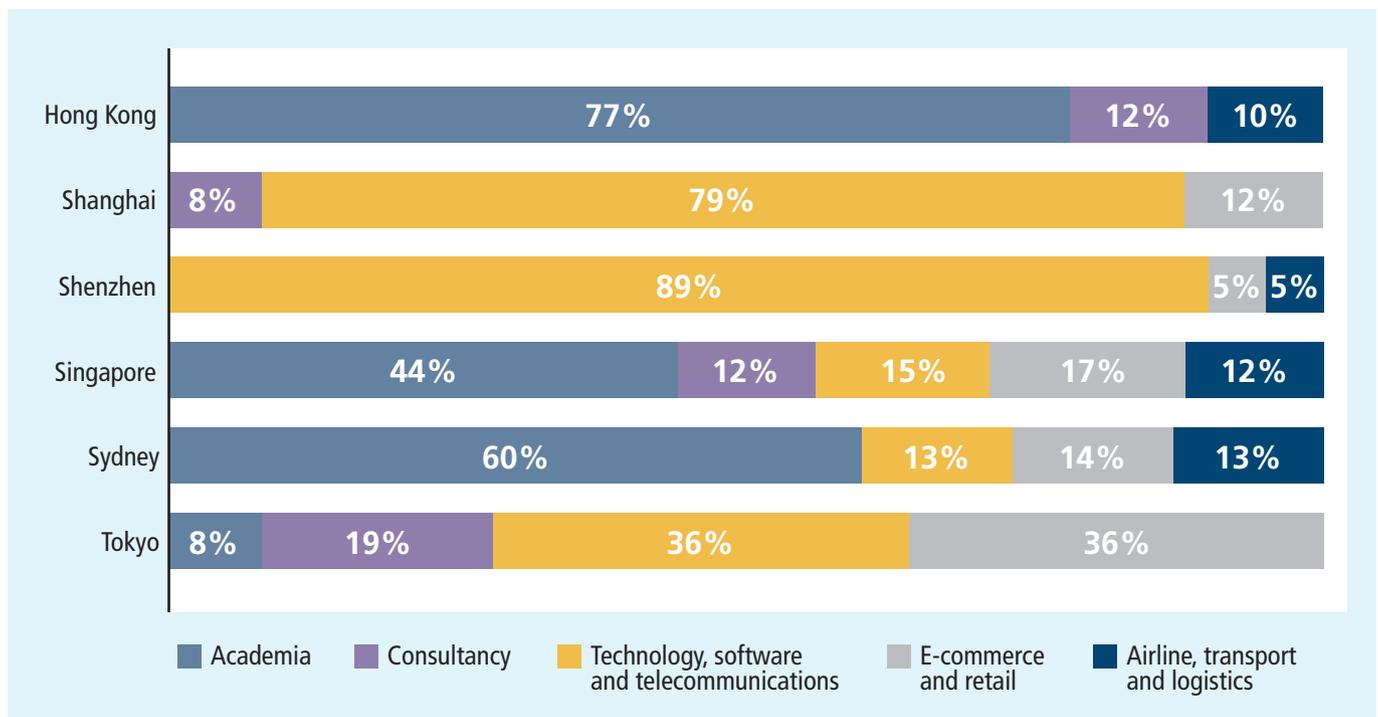
²⁶ Using LinkedIn records over the 12 month ending in July 2021, 664,000 AI/BD professionals were identified to be working in all industries across all financial centres under investigation. Of these, about 100,000 (or 15% of the sample) currently worked in the financial services industry. For further details, see Tam (2021).

²⁷ This finding is indicative and should be taken with caution, as several factors other than the participation of AI/BD professionals in the financial services industry may affect the percentage of GDP generated by financial services.

As only 15% of the AI/BD professionals in the region were employed in the financial services industry, a larger number of professionals with suitable skills may provide the much needed expertise to accelerate the adoption of AI/BD technologies in the financial services industry. It is therefore worthwhile to gather more information regarding the characteristics of this untapped pool of talent. Chart 4.6 presents the participation of AI/BD professionals in non-financial sectors. These professionals were mainly associated with the academia and consultancy sectors in Hong Kong, Singapore and Sydney and with the technology, software and communications sectors in Shanghai

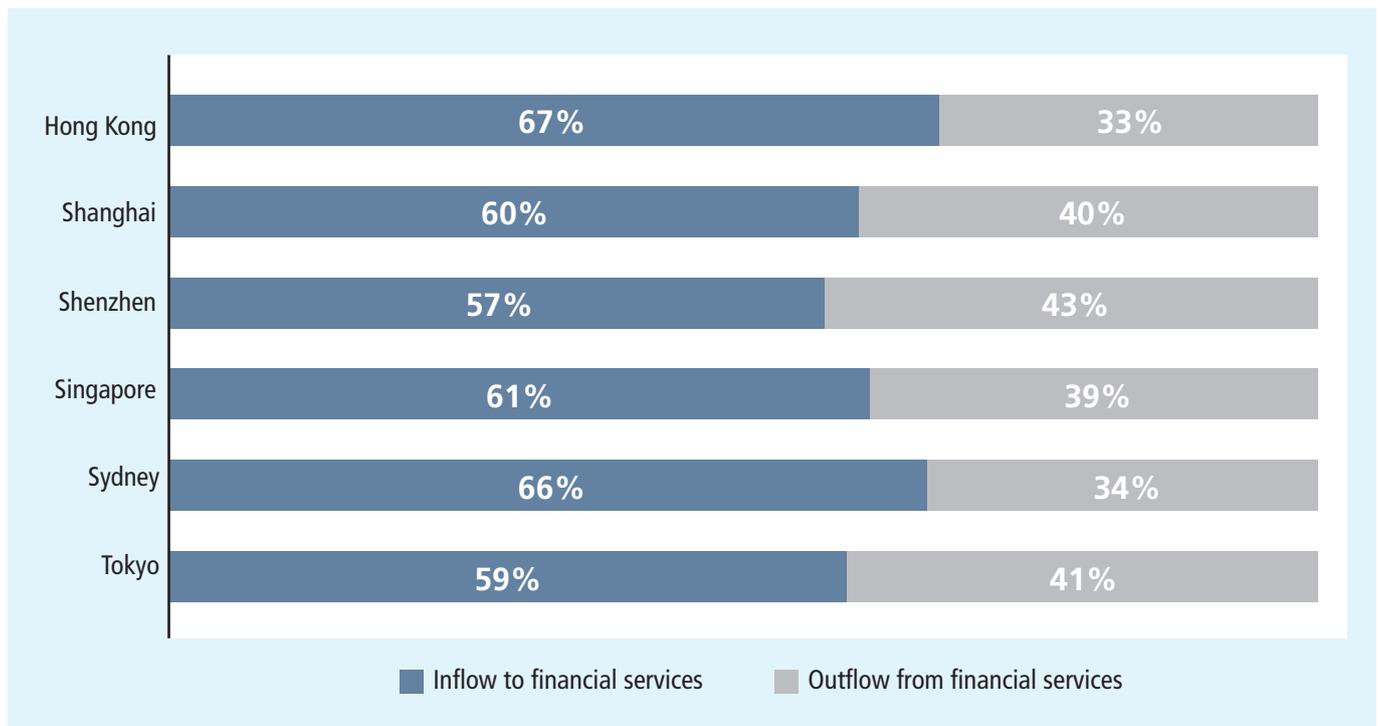
and Shenzhen. The high percentage of AI/BD professionals working in universities in Hong Kong suggests that there are opportunities for the financial services industry to enrich the talent pool by engaging AI/BD researchers and academics working at the universities. In Tokyo, AI/BD professionals not engaged in financial services tended to participate in the technology, software, communications, e-commerce and retail sectors. These findings highlight that financial services firms may face competition from big tech firms when attracting and retaining AI/BD professionals.

Chart 4.6: AI/BD professionals’ participation in non-financial sectors



Source: Tam (2021) and HKIMR staff compilation.

Chart 4.7: Flow of AI/BD professionals between financial and non-financial sectors



Note: The white numbers indicate the estimated numbers of professionals who changed industry groups.
 Source: Tam (2021) and HKIMR staff compilation.

Upon adequately upskilling their finance knowledge, AI/BD professionals working outside the financial services industry can join the industry and contribute to its AI/BD adoption. However, AI/BD professionals engaged in financial services may switch careers and leave for non-finance industries. Chart 4.7 presents the flow of talent between these two industry groups that occurred during the sample period.

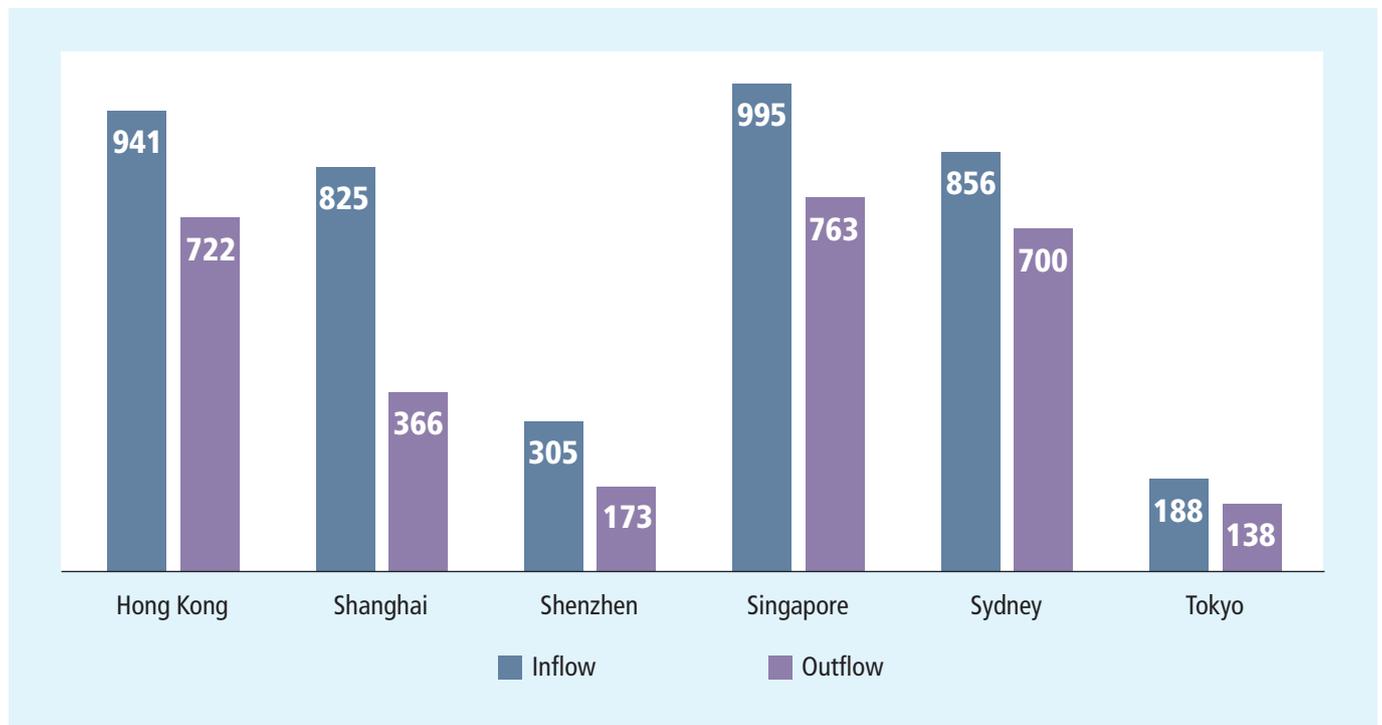
For all six financial centres, the flow of AI/BD professionals into the financial services industry from other industries was larger than the flow of AI/BD professionals from the financial services industry to other industries. That is, AI/BD professionals showed a greater propensity to switch to a finance career than move away from one. Hong Kong and Sydney had the highest estimated inflow-to-outflow ratios, about 2 to 1, suggesting that the financial services industry in Hong Kong may be positioned to attract AI/BD professionals from outside the financial services industry than those in other financial centres.

For the Asia-Pacific region, 85% of the AI/BD professionals were employed in non-financial sectors (mostly academia and the technology and telecommunication sectors), and this group exhibited a propensity to switch to roles in the financial services industry.

To understand the geographical mobility of talent with AI/BD skills across financial centres, a flow analysis was conducted, based on the LinkedIn data during the 12-month period ending July 2021. During this period around 6,800 AI/BD professionals moved between major Asia-Pacific financial centres and other parts of the world.²⁸ Chart 4.8 also shows that for all financial centres in the region there was a net inflow

of AI/BD talent from other parts of the world. When the analysis was limited to the flow within the major financial centres in the Asia-Pacific region, only about 800 AI/BD professionals moved over the 12-month period. This result is not surprising, and is likely due to restrictions related to the ongoing COVID-19 pandemic, which have substantially reduced talent mobility.²⁹

Chart 4.8: AI/BD international talent mobility



Note: the figure is based on data between August 2020 and July 2021. Inflow (outflow) denotes the flow of talent to (from) major Asia-Pacific financial centres from (to) other international financial centres.

Source: Tam (2021) and HKIMR staff compilation.

During the 12-month period ending in July 2021, about 6,800 AI/BD professionals moved between major Asia-Pacific financial centres and other parts of the world, with net inflows of talent for all financial centres in the region. Only 800 professionals moved across centres within the region.

²⁸ The other international financial centres include, among others, London and New York. See, Tam (2021).

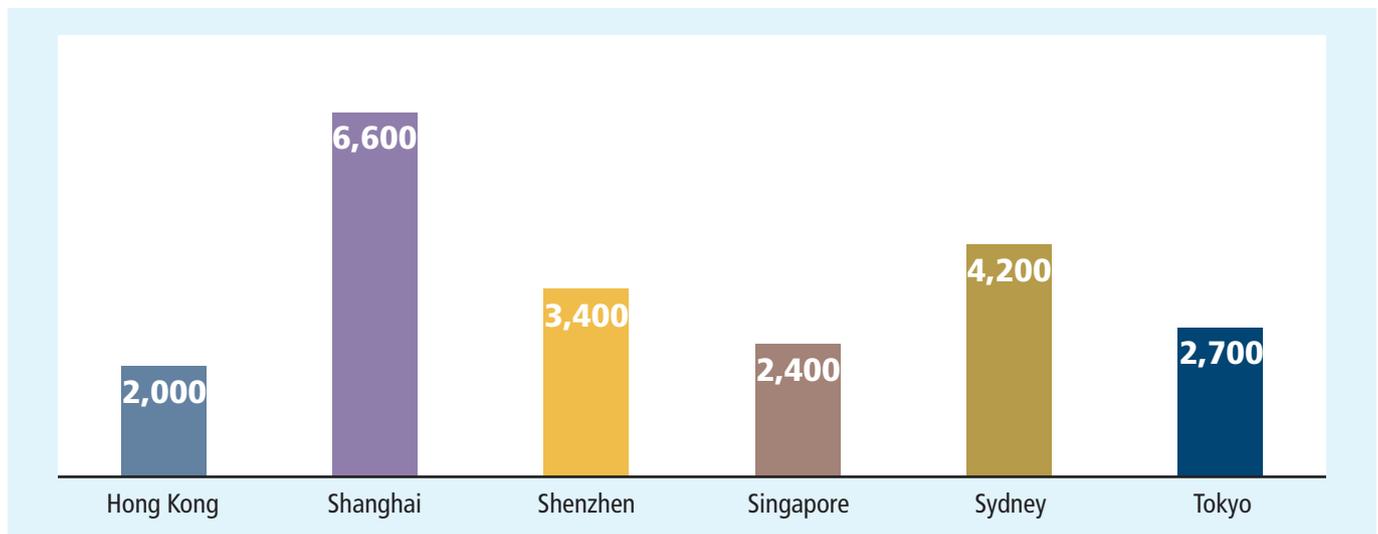
²⁹ These should be considered as preliminary but useful results. Further research is needed to better understand AI/BD talent mobility during normal times, especially when restrictions due to the ongoing pandemic are not in place.

4.2. THE TALENT GAPS

The previous sections of this report have highlighted the characteristics and potential opportunities associated with the supply of talent with AI/BD skills. Taken together with the current stages of AI/BD adoption observed and market participants' views of talent demands, these findings indicate a pervasive talent gap in terms of professionals with both finance and AI/BD skills (i.e., finance–technology innovators) in the financial services industry in the Asia-Pacific region. However, because of the interwoven and evolving nature of different market development initiatives and data limitations, measures of the talent gap are difficult to construct. In order to show some preliminary evidence, Chart 4.9 presents a set of

annual estimates that represent the number of professionals with both finance and AI/BD skills in shortage for each of the six financial centres in the region.³⁰ The estimated talent gaps presented here refer to a very specific group of professionals, who have expertise in both finance and AI/BD technologies (i.e., the finance–technology innovators discussed in Chapter 2). Hence, these estimations only reflect a fraction of the overall demand of talent with technology expertise in the region. It is also worthwhile noting that these talent gap figures are subject to uncertainty and they are intended as back-of-the-envelope calculations, therefore they should be interpreted with caution.

Chart 4.9: Estimated annual talent gaps of finance–technology innovators across Asia-Pacific financial centres



Source: HKIMR staff compilation.

³⁰ The estimation are based on publicly available information and the survey results discussed in Chapter 3 of this report. Full details of the talent gap measure construction and the data sources can be found in Appendix B.

Our preliminary estimates of the sizes of the talent gaps in financial centres in the region range between 2,000 and 6,600 professionals with both finance and AI/BD skills per year. With a total gap of about 21,300 professionals versed in both finance and AI/BD technologies and a pool of around 92,000 such professionals³¹, major Asia-Pacific financial centres may have to expand their pool of finance–technology innovators by 23% per year over the next 3 years to narrow the talent gaps and progress with a healthy development of the financial services industry embracing AI/BD technologies.

The next chapter discusses the market participants' views on talent development and then reviews the relevant initiatives implemented internationally and in Hong Kong aimed at narrowing the talent gaps. We also propose a set of suggestions to enrich Hong Kong's pool of talent with finance and AI/BD skills.

Our preliminary annual estimates of the regional talent gaps range between 2,000 and 6,600 professionals with both finance and AI/BD skills, with the talent gap in Hong Kong estimated at 2,000 such professionals.

³¹ The size of the existing pool of professionals versed in both finance and AI/BD technologies was obtained by counting LinkedIn members with both AI/BD and finance skills. Further details are reported in Tam (2021).

Chapter 5

Talent Development: International Initiatives and Local Insights

Market views, talent initiatives and ways forward for Hong Kong

HIGHLIGHTS:

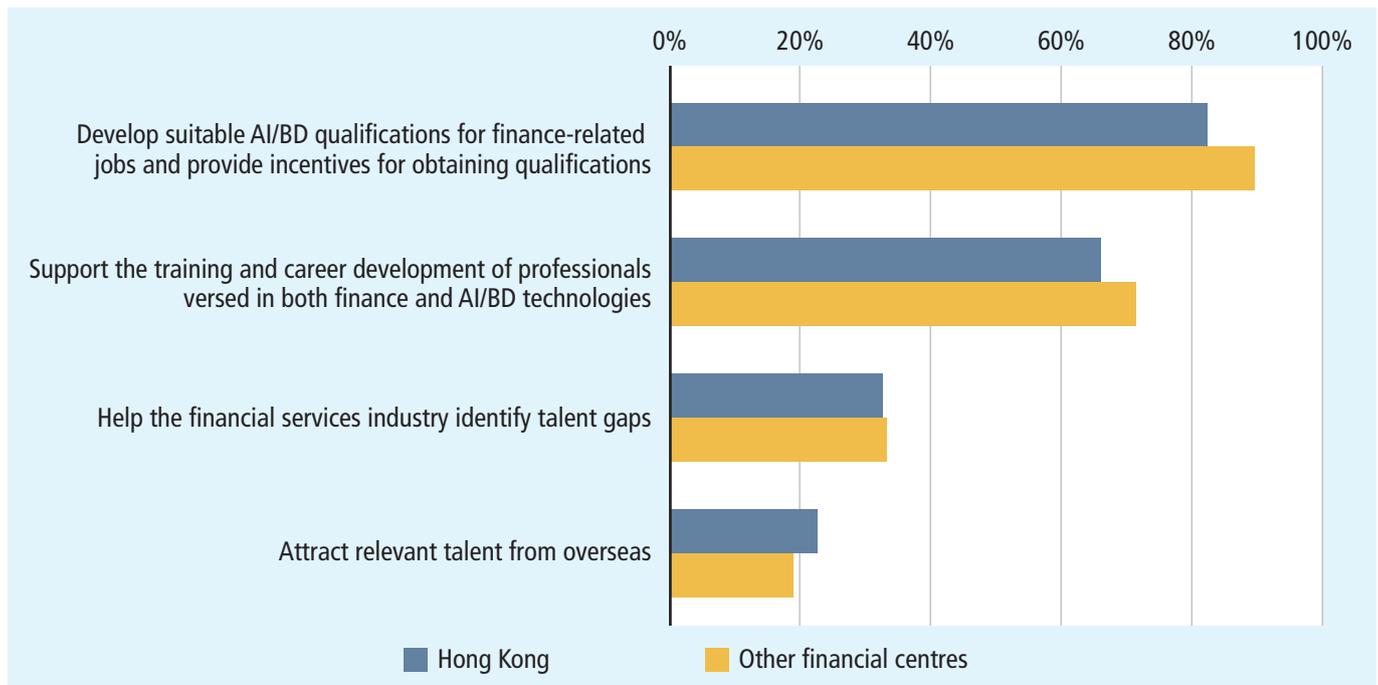
- Talent development is a key goal for all international financial centres embracing AI/BD technologies. Initiatives have been undertaken to build domestic talent pipelines, develop AI/BD ecosystems, facilitate knowledge transfer and attract international talent.
- Hong Kong has introduced multiple talent initiatives to provide fintech training programmes, career acceleration schemes and technology education, in addition to institutional facilitation for financial innovation and incentives and streamlined procedures for overseas talent recruitment.
- Based on our survey results and the experience of other international financial centres, AI/BD talent can be further developed with strategies that aim to narrow the talent gap and support talent recruitment.

During the AI/BD Survey, we invited the market participants to express their views on talent development initiatives to foster the growth of AI/BD technologies in the financial services industry. Chart 5.1 reports the results of this exercise for respondents in Hong Kong and from the other major financial centres studied. The majority of the survey respondents viewed the development of suitable AI/BD qualifications for finance-related roles and the provision of incentives to obtain these qualifications as desirable. To a lesser extent, the survey respondents deemed support for the training and career development of professionals versed in both finance and AI/BD technologies as a relevant initiative. These views confirm that financial firms in the region seek professionals versed in both finance and AI/BD and that market participants support initiatives aimed to develop talent that can contribute to a higher level of integration between business and technology functions.

The survey respondents also stated that initiatives to help the industry identify talent gaps were useful. As technical solutions and standards can rapidly evolve over time, it is useful for firms adopting AIBD technologies to keep abreast of the new skills required to maintain proper adoption and promptly fill emerging talent gaps. The survey respondents also viewed initiatives to attract talent from overseas as valuable but less relevant than other initiatives.

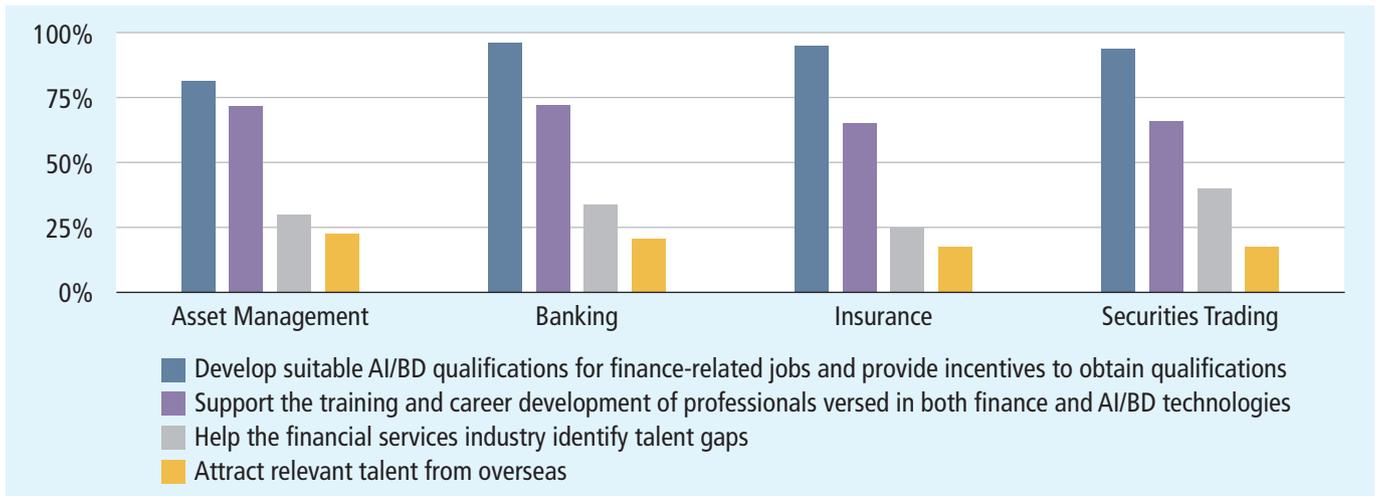
The market participants' views on initiatives to develop AI/BD professionals were mostly consistent across the sectors of the financial services industry. They indicated that the development of suitable AI/BD qualifications, the provision of incentives for professionals to obtain these qualifications and support for professionals' training and career development were the most desirable options (Chart 5.2).

Chart 5.1: Market views on talent initiatives



Note: As the respondents could choose more than one option, the percentages in the graph do not add up to 100.
Source: HKIMR staff compilation.

Chart 5.2: Market views on talent initiatives across financial services sectors in the Asia-Pacific region

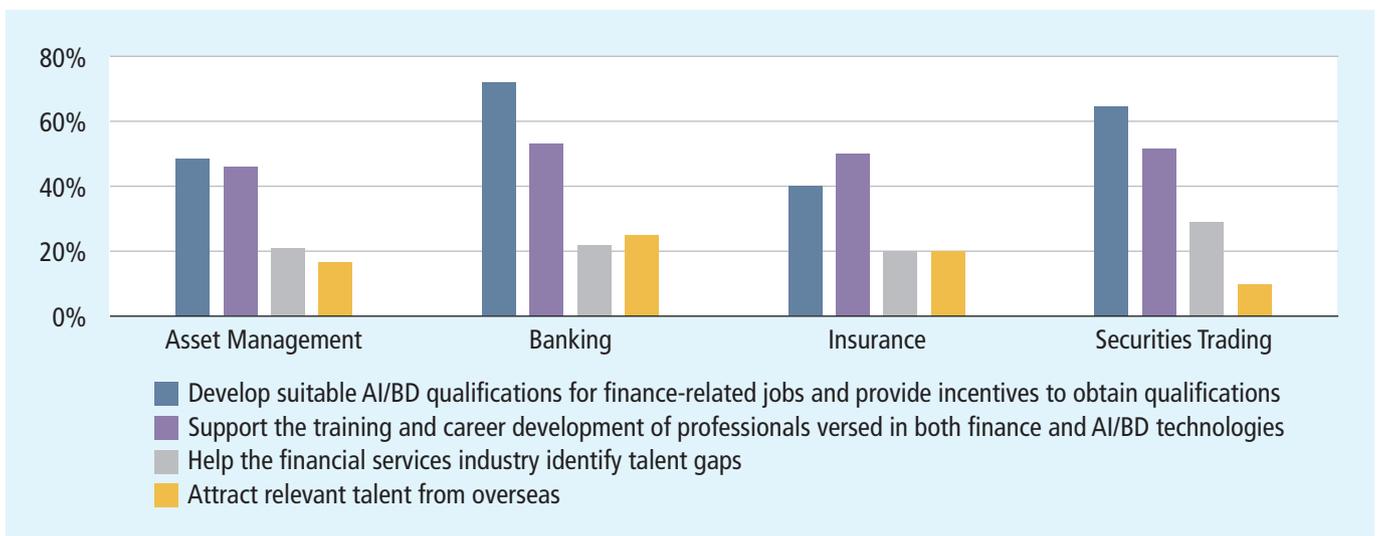


Note: As the respondents could choose more than one option, the percentages for each sector do not add up to 100.
Source: HKIMR staff compilation.

The views of the market participants in Hong Kong mostly aligned with those of the market participants in the other financial centres (Chart 5.3). However, the

respondents in the insurance sector emphasised the need for training and career development of professionals above the other options.

Chart 5.3: Market views on talent initiatives across financial services sectors in Hong Kong



Note: As the respondents could choose more than one option, the percentages for each sector do not add up to 100.
Source: HKIMR staff compilation.

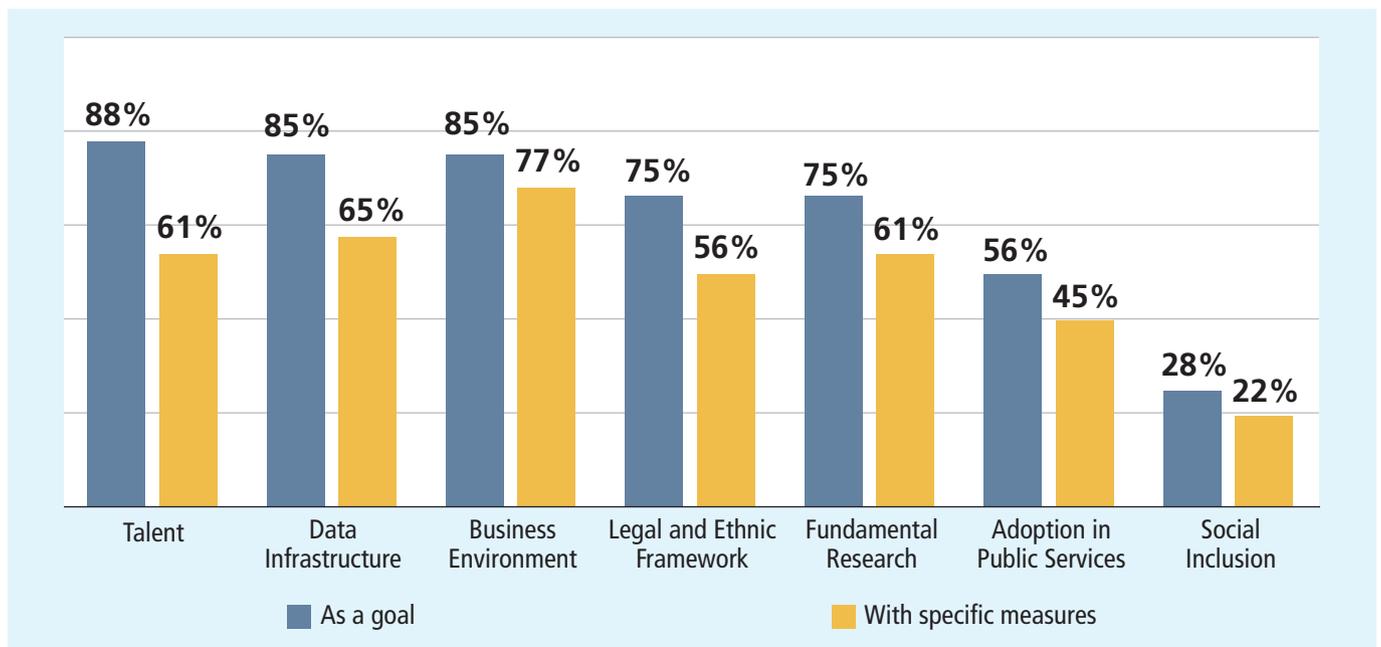
The market participants viewed the development of suitable AI/BD qualifications for finance-related jobs, the provision of incentives to obtain these qualifications and support for the training and career development of AI/BD professionals as key talent initiatives.

5.1. TALENT INITIATIVES: THE INTERNATIONAL EXPERIENCE

International financial centres have actively pursued initiatives to promote and facilitate AI/BD adoption in the pursuit of competitive advantages and economic growth. Numerous jurisdictions, including the G7 countries, China, the European Union, Australia and Singapore, have developed national AI/BD strategies. Overall, they have focused on seven main aspects:

developing talent, creating data infrastructure, cultivating the business environment, establishing legal and ethical frameworks, promoting fundamental research, piloting adoption in public services and enabling social inclusion (Chart 5.4). More than 80% of these jurisdictions reported developing talent, creating data infrastructure and cultivating the business environment as their goals. In addition, 61% of these jurisdictions have formulated initiatives to facilitate talent development for AI/BD adoption in their economies.³²

Chart 5.4: The seven main aspects of national AI/BD strategies



Sources: Canadian Institute for Advanced Research (2020), Organisation for Economic and Co-operation Development (2020) and HKIMR staff compilation.

Talent development is a key goal for all international financial centres embracing AI/BD technologies. Initiatives have been undertaken to build domestic talent pipelines, develop AI/BD ecosystems, facilitate knowledge transfer and attract international talent.

³² For further details, refer to Canadian Institute for Advanced Research (2020) and Organisation for Economic and Co-operation Development (2020).

Most of the AI/BD strategies highlighting talent development as a main goal have acknowledged the shortage of relevant talent as a key challenge to AI/BD adoption in various financial services industries. To facilitate talent development, numerous initiatives have been undertaken in the various financial centres. These can be categorised into three major groups, as follows.

1. Initiatives aimed at building domestic talent pipelines:

These initiatives are intended to upskill incumbent practitioners, with incentives provided for in-service practitioners to reskill themselves with techniques essential for AI/BD adoption through online courses, boot camps and thematic training programmes. To nurture upcoming talent, the education sector in the region has begun to revamp education curricula. For the short to medium term, more tertiary programmes and courses related to AI/BD technologies are being provided to students along with vocational training and internships to develop graduates viable for upcoming AI/BD job roles. For the long term, education on science, technology, engineering and mathematics at the primary and secondary levels are being strengthened to provide future generations with a foundation for acquiring specialised AI/BD skills.

2. Initiatives aimed at building AI/BD ecosystems and facilitating knowledge transfer:

Innovation centres and centres of excellence have helped coordinate best practices, research funding, networking opportunities and other measures to cultivate local talent. An AI/BD ecosystem that includes technology hubs, AI/BD labs and infrastructure provides an environment conducive to aspiring talent to collaborate and accelerate AI/BD start-ups and business growth. To facilitate the transfer of AI/BD know-how, organisations rolling out new technology functions have formulated plans to transfer practical AI/BD knowledge from technology staff to non-technology staff and to promote the cross-fertilisation of domestic and international AI/BD talent.

3. Initiatives aimed at attracting international talent:

Tax incentives, subsidies, expedited visa applications, immigration facilitation and streamlining of procedures for overseas talent recruitment have been used to help financial institutions attract overseas AI/BD professionals, entrepreneurs and business owners. Multilingual serviced apartments, medical care and international schools have been provided to ensure a quality living environment for relocated talent and their family members.

A summary of the key initiatives implemented in the major Asia-Pacific financial centres is provided in Appendix C.

5.2. TALENT INITIATIVES IN HONG KONG

Hong Kong has implemented numerous talent initiatives to promote the development of its financial services industry. In the following, we review and discuss the major initiatives using the taxonomy introduced earlier in this chapter.

5.2.1. Build domestic talent pipelines

To grow the domestic innovation and technology talent pool, the Hong Kong Science and Technology Parks Corporation (HKSTP) has rolled out projects aimed at nurturing relevant talent in collaboration with the Hong Kong Applied Science and Technology Research Institute, the largest publicly funded applied R&D institute in Hong Kong, as well as with other partners. Since 2021, HKSTP InnoAcademy's DeepTech Talent Training programme has offered courses, projects and internships to train tertiary students and university graduates from all disciplines in basic data science skills and AI/BD techniques.³³ The HKMA has upgraded the Fintech Career Accelerator Scheme (FCAS) to FCAS 2.0 and now offers talent development programmes.³⁴ In response to the 2019 Chief Executive's Policy Address, the Cyberport, a digital technology community in Hong Kong with over 1,650 digital and technology

³³ For further details, refer to <https://innoacademy.hkstp.org/dtt.html>

³⁴ See <https://www.hkma.gov.hk/eng/key-functions/international-financial-centre/fintech/talent-development/>

companies, has operated the FinTech Training Programme, providing seminars, workshops, conferences and network opportunities to in-service financial practitioners.³⁵ The Financial Services and Treasury Bureau, in collaboration with the Cyberport, has launched the FinTech Anti-Epidemic Scheme for Talent Development (FAST) under Hong Kong Government's Anti-Epidemic Fund to enrich the city's fintech talent pool. The FAST helps create job opportunities by providing financial assistance to local fintech firms across multiple sectors, including asset management, banking, insurance and securities trading.³⁶ The Hong Kong Institute of Bankers (HKIB) has introduced the BEST Certificate Programme to help practitioners to reskill and widen their technology and data skills and knowledge useful for supporting the development of the Hong Kong banking sector.³⁷

The STEM Internship Scheme offers opportunities for STEM graduates to apply their skills and knowledge in areas related to innovation and technology.³⁸ Allowances are provided to undergraduate and postgraduate students participating in full-time university STEM programmes funded by the University Grants Committee to enrol in short-term internships. The Greater Bay Area Youth Employment Scheme has been rolled out to provide local university graduates with innovation and technology posts in Hong Kong and other GBA cities.³⁹ Six publicly funded local universities in Hong Kong have rolled out Bachelor's or Master's degree programmes related to fintech, and other related programmes are being developed. Since the 2019–20 Budget, the Hong Kong SAR government has provided funding to improve domestic universities' campus facilities and provide students, researchers and teachers with better learning

and research environments.⁴⁰ Since the 2018–19 academic year, the Study Subsidy Scheme for Designated Professions/Sectors (SSSDP) has increased the number of subsidised study quotas,⁴¹ and five computer science programmes and four fintech programmes have been subsidised under the SSSDP.⁴²

The Hong Kong government has facilitated STEM education at the primary and secondary school levels and has provided funding to local secondary schools to organise the IT Innovation Lab programme. Funding has also been granted to each secondary school to procure IT technology equipment and services to enhance computer hardware and to organise IT-related extracurricular activities for students, thus strengthening their IT foundation and skills.⁴³ According to the 2021–22 Budget plan, funding will be provided to primary schools to organise an IT Innovation Lab programme similar to that implemented in secondary schools. In addition, the 'Knowing More About IT' programme will be launched in subsidised primary schools with support from public funding.⁴⁴ The government has organised major initiatives to position the city as a world-class research cluster. The Researcher Programme and the Postdoctoral Hub under the Innovation and Technology Fund (ITF), administered by the Innovation and Technology Commission, support eligible organisations and companies in recruiting local university graduates and postdoctoral researchers in undertaking research and development, thus providing opportunities for professionals to pursue research careers in innovation and technology.^{45,46} Furthermore, employees from various companies have received on-the-job training on innovation and technology under the Re-industrialisation and Technology Training

³⁵ Cyberport launches FinTech training," 2019.

³⁶ For further details, please refer to <https://fast.cyberport.hk/en/>

³⁷ See <https://www.hkib.org/page/121>

³⁸ STEM is a term used to group together the academic disciplines of Science, Technology, Engineering and Mathematics. See also <https://www.itf.gov.hk/en/funding-programmes/nurturing-talent/stem-internship-scheme/>

³⁹ <https://www.bayarea.gov.hk/en/opportunities/youth.html>

⁴⁰ Government of the Hong Kong Special Administrative Region (2019).

⁴¹ For further details, refer to <https://www.cspe.edu.hk/en/sssdp/sssdp.html>

⁴² "LCQ22," 2018.

⁴³ Yau (2019).

⁴⁴ Ho (2021).

⁴⁵ Innovation and Technology Commission (2020).

⁴⁶ See <https://www.itf.gov.hk/en/funding-programmes/nurturing-talent/research-talent-hub/>

Programme, a funding scheme under the ITF that subsidises local companies to train their staff in advanced technologies.⁴⁷

5.2.2. Build an AI/BD ecosystem and facilitate knowledge transfer

The HKMA has established the Fintech Facilitation Office to facilitate the healthy development of the fintech ecosystem in Hong Kong and to promote the city as a fintech hub in Asia.⁴⁸ The HKMA and the Bank for International Settlements (BIS) have collaborated on the BIS Innovation Hub Centre in Hong Kong to identify and develop insights into critical trends in technology that affect central banking such as CBDC, digitalisation of trade finance and topics potentially related to AI/BD adoption. On the regulatory front, the HKMA developed a two-year roadmap to promote Regtech adoption in the Hong Kong banking sector.⁴⁹ To further nurture the next generation of Regtech talent, one of the initiatives in the roadmap is to establish a Regtech Skills Framework.⁵⁰ The HKMA has also announced the Fintech 2025 strategy to increase the adoption of technology in the banking sector. To increase the workforce that can both use and develop fintech solutions, the HKMA began in September 2021 to collaborate with the industry and local universities to launch the Industry Project Masters Network (IPMN) scheme to help fresh graduates and existing practitioners gain knowledge and practical experience in AI/BD adoption and other areas of innovation and technology.⁵¹ The Enhanced Competency Framework (ECF) for Banking Practitioners, an industry-wide competency framework introduced by the HKMA together with the banking industry, will also be extended by the end of 2021 to cover both fintech and Regtech to develop professional practitioners in these areas.⁵²

5.2.3. Attract international talent

To attract overseas talent, the Talent List of Hong Kong, which contains 11 professions that can support Hong Kong's development as a high value-added and diversified economy, has provided immigration facilitation under the Quality Migrant Admission Scheme (QMAS) for experienced fintech professionals.⁵³ In addition, the Innovation and Technology Commission (ITC) has rolled out the Technology Talent Admission Scheme (TechTAS), which provides fast-track procedures for eligible companies to admit international talent to undertake research and development on fintech and other technology areas potentially related to AI/BD adoption.⁵⁴ The government has also initiated schemes to introduce top-tier international talent. The Global STEM Professorship Scheme was launched to attract world-renowned innovation and technology scholars and research teams to teach STEM-related courses and programmes and perform research on related topics in local universities.⁵⁵ The AIR@InnoHK focuses on attracting first-class domestic and overseas researchers to develop AI/BD technologies and related applications.⁵⁶

Hong Kong has introduced multiple talent initiatives to provide institutional facilitation for financial innovation, incentives and streamlined procedures for overseas talent recruitment, fintech training programmes, career acceleration schemes and technology education.

⁴⁷ For further details, refer to <https://rttp.vtc.edu.hk/>

⁴⁸ See <https://www.hkma.gov.hk/eng/key-functions/international-financial-centre/fintech/>

⁴⁹ "The HKMA developed a two-year roadmap," 2020.

⁵⁰ Hong Kong Monetary Authority (2020).

⁵¹ "The HKMA unveils "Fintech 2025"," 2021.

⁵² "LCQ17," 2021.

⁵³ See <https://www.talentlist.gov.hk/en/talentlist.html>

⁵⁴ For further details, refer to https://www.itc.gov.hk/en/fund_app/techtas/index.html

⁵⁵ Legislative Council Panel on Commerce and Industry (2021).

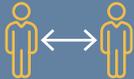
⁵⁶ See https://www.itc.gov.hk/en/technological_infrastructure/innohk_clusters.html

5.3. WAYS FORWARD FOR HONG KONG

Combining the market views expressed by the survey respondents, the specificities of AI/BD adoption and the local demand for talent in Hong Kong with

reference to the experience in other major financial centres in the region, we make the following suggestions, which may be helpful for narrowing the talent gap and fostering the growth and development of AI/BD technologies in Hong Kong's financial services industry (Table 5.1).

Table 5.1: Strategies to narrow the talent gap and support talent recruitment

To narrow the talent gap 	Develop suitable AI/BD qualifications for finance-related jobs	<ul style="list-style-type: none"> • Establish best practices to qualify relevant talent and skills • Professional standards can enable financial institutions to ensure that staff and new hires possess adequate capabilities • Private fintech enterprises can be encouraged to participate in curriculum development and application
	Create a critical mass of highly qualified and technically trained professionals to benefit all firms in the industry	<ul style="list-style-type: none"> • A coordinated effort between the government, regulators and universities may create a sufficient number of professionals with both finance and AI/BD skills to greatly strengthen Hong Kong as a global finance centre
	Provide incentives to obtain suitable qualifications	<ul style="list-style-type: none"> • Support qualifications by promoting public awareness to increase participation • Offer subsidies for relevant preparation courses and examinations
	Support the training of AI/BD professionals	<ul style="list-style-type: none"> • Encourage talent to stay up to date and remain relevant to their roles • Public bodies and stakeholders of the financial services industry can coordinate and evaluate internship and apprenticeship programmes
	Support the career development of AI/BD professionals	<ul style="list-style-type: none"> • Provide long-term career planning and demonstrate career growth, an important aspect for attracting and retaining talent in Hong Kong, to help maintain a healthy talent pool
To support talent recruitment 	Help the financial services industry identify talent gaps	<ul style="list-style-type: none"> • Keep abreast of the new skills required when AI/BD technical solutions and standards advance and promptly fill emerging talent gaps
	Attract relevant talent from overseas	<ul style="list-style-type: none"> • Widen the talent pool, improve diversity in the workplace and build an organisational culture conducive to AI/BD adoption

Source: HKIMR staff compilation.

- **Develop suitable AI/BD qualifications for finance-related jobs:** According to the findings of the survey and interviews discussed in previous chapters, the market participants in Hong Kong aimed to recruit finance professionals with AI/BD training. It is therefore helpful to establish best practices to qualify different professionals and skills relevant to the adoption of AI/BD technologies in various financial services sectors. The Fintech 2025 strategy, for example, has been used to develop fintech-specific qualifications. Professional standards can also enable financial institutions to ensure that staff and job candidates possess the capabilities to fulfil their roles in AI/BD adoption. This argument is echoed by the Financial Services Development Council, which also recommends that public bodies and stakeholders of the financial services industry develop and update the core competency map for different financial services sectors, and private fintech enterprises have been encouraged to participate in curriculum development and application.^{57,58}
- **Create a critical mass of highly qualified and technically trained AI/BD professionals:** As shown in Chapter 4 of this report, a large fraction of AI/BD professionals in Hong Kong are employed outside the financial services industry, proving an untapped source of talent. Local universities have the potential to play a key role by providing programmes that are able to train a sufficient pool of professionals with both finance and AI/BD skills, which are most needed by the industry. Creating a talent pool of relevant professionals can deliver immediate benefits to the financial services industry and create spillover effects within and

across industries. Such efforts can facilitate the establishment of an ecosystem in which the healthy exchange of ideas and practices can take place. In addition, talent with technical knowledge can be difficult to recruit, and the limited supply may drive up the remuneration of these professionals, which may increase costs for many resource-constrained small and medium-sized firms. An increase in the supply of these professionals in the short and medium term will help to moderate the talent gap facing firms at all levels. A coordinated effort by all stakeholders, including but not limited to regulators and universities, may create a sufficient number of professionals with both finance and AI/BD skills. Master's degree-level education and training are desirable, as acquiring AI/BD skills and mastering them in actual applications may take time. Short-term training and continuing professional development programmes can also help to raise awareness among industry members.

- **Provide incentives towards obtaining suitable qualifications:** Financial institutions adopting AI/BD technologies would clearly benefit from a larger pool of accredited professionals. The financial services industry and regulators can encourage suitable AI/BD qualifications for finance-related jobs by promoting public awareness and incentivising incumbent professionals and students to participate in qualifications suitable for their background. Public bodies and talent projects can consider offering subsidies on relevant preparation courses and examinations to create a friendly environment in which professionals can obtain qualifications.

⁵⁷ Financial Services Development Council (2021).

⁵⁸ Further initiative includes the development of professional qualification standards under the Qualifications Framework for the fintech sector, which are intended to provide a clearer and recognised professional development pathway for employers and practitioners in the financial services industry. See Government of the Hong Kong Special Administrative Region (2021).

- **Support the training of AI/BD professionals:** The survey respondents in Hong Kong highlighted the value of training opportunities for attracting and retaining talent. Continued education and training can encourage professionals to stay up to date in their finance and AI/BD skills and remain relevant in their roles. Public bodies and stakeholders of the financial services industry can also coordinate and evaluate internship and apprenticeship programmes.⁵⁹
- **Support the career development of AI/BD professionals:** Long-term career planning with a view towards ensuring career growth prospects is key to retain talent. As pointed out by the survey respondents in Hong Kong, career growth is a very important aspect when attracting and retaining talent in the financial services industry. Proper reskilling and redeployment of existing staff in ways that will help them acquire new expertise required is also a useful tool to continue empowering staff and promote retention.⁶⁰
- **Help the financial services industry identify talent gaps:** One challenge that concerns market participants in Hong Kong, especially over the next 5 years, is the potential rapid evolution of technical solutions and standards. To mitigate this concern, it would be useful to help the financial services industry keep abreast of the new skills required to maintain proper AI/BD adoption to support firm in promptly filling the emerging

talent gaps. In particular, the HKMA's Regtech Skills Framework is a useful reference material for the financial services industry in understanding the current Regtech skills gaps.

- **Attract relevant talent from overseas:** Despite the current limited geographical mobility of talent due to the ongoing COVID-19 pandemic, international recruitment should be regarded as an important priority, in addition to the development of the local pool of talent. In fact, it can widen the talent pool in the short-term, improve diversity in the workplace and build an organisational culture conducive to AI/BD adoption for financial institutions. In seeking to attract foreign talent, Hong Kong has already adopted measures to facilitate employment under the QMAS and fast-tracked the on-boarding of overseas hires through the TechTAS.^{61,62} The Air@InnoHK, a research cluster established with a focus on developing AI technologies, can also attract relevant talent from overseas.⁶³

Suggestions to foster talent development in Hong Kong include strategies to narrow the talent gap and support talent recruitment.

⁵⁹ Financial Services Development Council (2021).

⁶⁰ HKMA, HKAB, and HKIB (2020).

⁶¹ For further details, refer to <https://www.talentlist.gov.hk/en/talentlist.html>

⁶² See https://www.itc.gov.hk/en/fund_app/techtas/index.html

⁶³ See https://www.itc.gov.hk/en/technological_infrastructure/innohk_clusters.html

Conclusions

Financial institutions across various sectors of the financial services industry in six major financial centres in the Asia-Pacific region are seeking to advance their AI/BD adoption journey. **Moving forward, AI/BD technologies are likely to play an important role in driving the growth of the financial services industry in the region.** Financial institutions that have adopted AI/BD technologies benefit from better products, services and decisions and improved productivity, but they must also face challenges and manage risks associated with this adoption. In particular, the **market participants expressed concern about shortages of suitable talent to advance their AI/BD adoption.**

At the current stage of AI/BD adoption, professionals with both finance and AI/BD skills (i.e., finance–technology innovators) who can provide integration of finance and technology functions will contribute to advancements in the financial services industry in Hong Kong and the region. This relevance is also reflected in the survey evidence showing that professionals versed in both finance and AI/BD technologies will be particularly sought after over the next 2 years. By bridging the gap between the two areas, these professionals possess an understanding of and perspectives on financial institutions regarding AI/BD adoption and can help integrate the two areas seamlessly and integrate the financial context into technology development and deployment.

The market participants' views on the talent needs and the results of a statistical analysis of the existing supply of talent indicate the existence of a pervasive talent gap in Hong Kong and the region. Nonetheless, **future local developments can build on a position of strength, as Hong Kong exhibited the highest rate of AI/BD professionals participating in financial services in the region. In addition, the existing untapped pool of talent, currently employed outside the financial services industry can provide further support towards the healthy growth of an industry that embraces AI/BD technologies.**

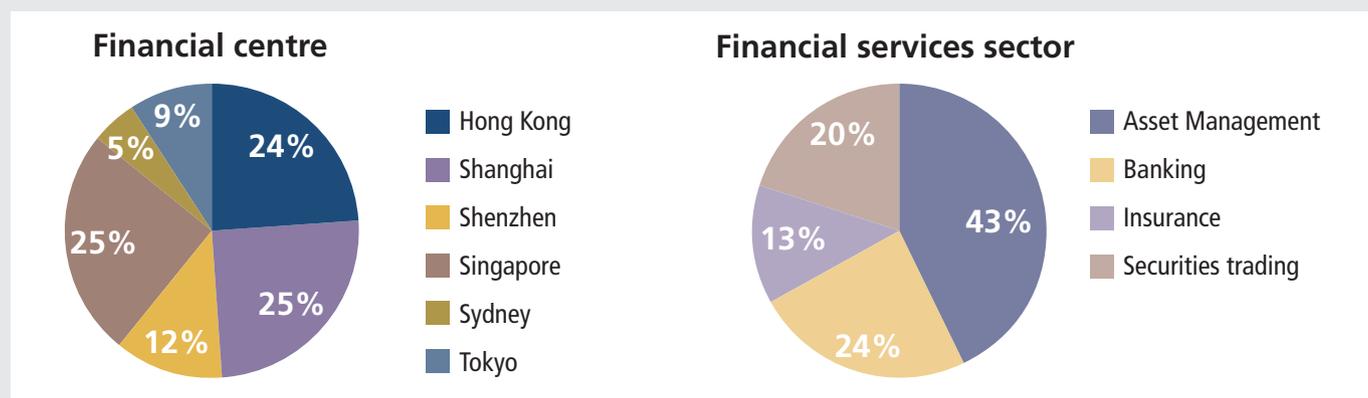
Timely talent development initiatives can help financial institutions meet their talent needs to advance their AI/BD adoption. The market participants viewed the development of suitable AI/BD qualifications for finance-related jobs, the provision of incentives to obtain these qualifications, and support for the training and career development of AI/BD professionals as key initiatives. They also suggest helping the financial services industry identify talent gaps and attracting relevant talent from overseas. The **measures that Hong Kong has introduced are steps in the right direction.**

Appendix A: Background of the Artificial Intelligence and Big Data in the Financial Services Industry Survey

The AI/BD Survey was designed to obtain data on current trends in AI/BD adoption in the financial services industry in the Asia-Pacific region, covering six financial centres – Hong, Kong, Shanghai, Shenzhen, Singapore, Sydney and Tokyo – and four financial services sectors – asset management, banking, insurance and securities trading. Commissioned by the HKIMR, the CFA Institute conducted a member survey in the region between 22 April 2021 and 5 July 2021 and obtained 840 responses. The survey respondents were engaged in a broad range of occupations and organisations, as follows.

Occupation	Organisation
C-level executives (CEO, CFO, CTO, etc.)	Asset Management / Investment Firm
Compliance Analyst / Officer	Brokerage
Corporate Financial Analyst	Business or Knowledge Process Outsourcing
Credit Analyst	Central Bank
Economist / Strategist	Commercial Bank
Financial Adviser / Planner / Wealth Manager	Consulting Firm
Information Technology	Endowment / Pension Fund / Sovereign Wealth Fund
Portfolio Manager	Information Technology or Software
Relationship Manager / Account Manager	Insurance
Research Analyst / Investment Analyst / Quantitative Analyst	Investment Bank
Risk Analyst / Manager	Private Wealth Management Firm / Family Office / Trusts
Sales Agent	Securities Exchange
Trader	Other
Other	

The following charts present the breakdowns of the responses that we received from the AI/BD Survey.



Because of the potential limitations associated with our sample of respondents, various focus group interviews were arranged to mitigate these issues. Six focus group interview sessions were held with executives from the financial services industry between 25 May 2021 and 10 June 2021, and 31 executives representing the six financial centres and four financial services sectors participated in these interviews.

Appendix B:

Estimation of the Annual Talent Gaps

This appendix details the methodology and the data sources used to estimate the talent gap (expressed in terms of the annual number of professionals with both finance and AI/BD skills, i.e. finance–technology innovators) in the financial services industry for each financial centre presented in Chapter 4 of this report. The following formula has been used for the calculations.

$$\text{Talent gap of finance–technology innovators} = S \times \alpha \times \beta \quad (*)$$

where

S is the annual number of AI/BD professionals in shortage in all sectors (financial and non-financial).

α is the percentage of AI/BD professionals participating in the financial services industry.

β is the percentage of AI/BD professionals working in the financial services industry who also have finance skills.

Table B.1 summarises the values of the inputs to the formula (*) and the corresponding results.

Table B.1: Inputs to estimate the annual talent gaps and the corresponding results

Financial Centres	Time period of data used	S	α	β	Annual talent gap of finance–technology innovators
Hong Kong	1 year (2020–2021)	8,900	25%	90%	2,000
Shanghai	1 year (2019–2020)	62,900	12%	88%	6,600
Shenzhen		34,400	11%	90%	3,400
Singapore	3 years (2020–2023)	17,200	15%	93%	2,400
Sydney	1 year (2019–2020)	26,600	17%	93%	4,200
Tokyo		44,000	7%	89%	2,700
All					21,300

The estimates of α and β are obtained from Charts 4.5 and 4.1 of this report. The data sources used to calculate the value of S for each financial centre reported in Table B.1 are described below.⁶⁴

⁶⁴ Full details regarding the calculations of the variables of interest are available upon request.

Hong Kong

The manpower requirement of the information technology (IT) and information services (IS) in 2017, the total number of IT workers required across all economic sectors in 2016, the manpower requirement of innovation and technology (I&T) in 2017 and the expected annual growth rate of I&T between 2017 and 2027 were obtained from Labour and Welfare Bureau (2019); Table 3.13 on page 51, Section 3.44 on page 51 and 3.45 on page 53; respectively. The number of individuals expected to graduate from local university programmes related to fintech, business analytics and artificial intelligence from 2020 to 2021 was obtained from Exhibit 24 on page 59 of HKUST Business School (2020). S is calculated as the difference between the annual number of professionals required by IT and IS, IT in all sectors and I&T projected on the basis of the I&T growth rates and the expected number of relevant graduates for the period 2020 to 2021.

Shanghai and Shenzhen

Shanghai and Shenzhen's shares of national demand and supply in AI/BD manpower for 2019 were obtained from 猎聘 (2019), page 8 and China's national AI/BD manpower shortage for 2020 were obtained from 工业和信息化部人才交流中心 (2020), Section 2.3.1, page 23. The midpoint of Shanghai and Shenzhen's shares of China's national demand and supply in AI/BD manpower are used to approximate for the share of national AI/BD manpower in shortage. S is then estimated as this midpoint times China's national AI/BD manpower in shortage.

Singapore

S is computed using the additional info-communications manpower needed less the number of new graduates expected for the period 2020 to 2023 discussed in Tham (2020). The figure reported over the three-year period was annualised by dividing it by 3.

Sydney

The required technology manpower and the actual new technology manpower required for the period 2019 to 2020 were obtained from Deloitte Access Economics (2020), page 1 and from Deloitte Access Economics (2021) Section 2.2, page 6, respectively. S is computed as the difference between required and actual number of new technology workers for the period 2019 to 2020.

Tokyo

S is proxied by the expected AI manpower in shortage for the period 2019 to 2020 using the average growth rate of the economic activities related to AI presented in 表5 of 経済産業省 (2019).

Appendix C:

Key Talent Initiatives in Major Asia-Pacific Financial Centres

This appendix provides a summary of the key talent initiatives implemented in Shanghai, Shenzhen, Singapore, Sydney and Tokyo to build domestic talent pipelines (I), provide institutional facilitation for financial innovation (II) and attract international talent (III).

	I	II	III
Shanghai	<ul style="list-style-type: none"> Implementation Plan for Expediting Promotion of Shanghai Fintech Centre 	<ul style="list-style-type: none"> People's Bank of China three-year fintech development plan Shanghai North High-tech Park three-year action plan 	<ul style="list-style-type: none"> More open policies to attract foreign talent with high-end scientific innovation skills⁶⁵
Shenzhen	<ul style="list-style-type: none"> Shenzhen–Hongkong–Macau FinTech Professional Programme 	<ul style="list-style-type: none"> People's Bank of China three-year fintech development plan Implementation Plan for the Innovation and Development of Shenzhen's Digital Economy Industry (2021–2023) Action Plan for the Development of New Generation Artificial Intelligence (2019–2023) 	<ul style="list-style-type: none"> New measures to attract overseas fintech talent⁶⁶
Singapore	<ul style="list-style-type: none"> AI Singapore SkillsFuture TechSkills Accelerator 	<ul style="list-style-type: none"> Financial Sector Technology and Innovation Scheme Smart Nation Singapore 	<ul style="list-style-type: none"> Tech@SG
Sydney	<ul style="list-style-type: none"> Digital Technologies (Industry 4.0) pilot Digital Technologies Hub Higher Level Apprenticeship Pilot Skill Finder 	<ul style="list-style-type: none"> An AI action plan for all Australians: A call for views Select Committee on Australia as a Technology and Financial Centre 	<ul style="list-style-type: none"> Global Business and Talent Attraction Taskforce Global Talent Visa Program
Tokyo	<ul style="list-style-type: none"> Society 5.0 	<ul style="list-style-type: none"> Society 5.0 	<ul style="list-style-type: none"> New measures to engage foreign fintech talent⁶⁷

Source: HKIMR staff compilation.

⁶⁵ <https://home.kpmg/cn/en/home/insights/2021/03/china-tax-alert-09.html>

⁶⁶ <https://www.scmp.com/news/china/politics/article/3106023/shenzhen-given-new-powers-attract-key-foreign-workers-and>

⁶⁷ <https://www.asianinvestor.net/article/tokyo-accelerates-reforms-to-advance-status-as-global-financial-city/468467>

Appendix D:

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The AoF is set up with full collaboration amongst the HKMA, the Securities and Futures Commission, the Insurance Authority and the Mandatory Provident Fund Schemes Authority. By bringing together the strengths of the industry, the regulatory community, professional bodies and the academia, it aims to serve as (i) a centre of excellence for developing financial leadership; and (ii) a repository of knowledge in monetary and financial research, including applied research.

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The HKIMR is the research arm of the AoF. Its main remit is to conduct research in the fields of monetary policy, banking and finance that are of strategic importance to Hong Kong and the Asia region. The Applied Research studies undertaken by the HKIMR are on topics that are highly relevant to the financial industry and regulators in Hong Kong, and they aim to provide insights on the long-term development strategy and direction of Hong Kong's financial industry.

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