Innovation and Technology Training Board

Manpower Update Report
Innovation and Technology Sector
2021

ACKNOWLEDGEMENT

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ITTB is also grateful to the Federation of Hong Kong Industries, Hong Kong Applied Science and Technology Research Institute Company Limited, Hong Kong Computer Society, Hong Kong Cyberport Management Company Limited, Hong Kong General Insurance Affairs Association Limited, Hong Kong Science & Technology Parks Corporation, Hong Kong Wireless Technology Industry Association Limited, Hongkong Association of Freight Forwarding and Logistics Limited, Hospital Authority, The Hong Kong Association of Banks, The Hong Kong Institution of Engineers, and The Hong Kong Retail Management Association for inviting industry experts to join the focus group.

Special thanks go to CPJobs and CTgoodjobs who have shared with us their database of job vacancies. The views of focus group members and information from major recruitment websites formed an integral part of this report.

Contents

Introduction

Background

The Innovation and Technology Training Board (ITTB) of the Vocational Training Council (VTC) is appointed by the Government of the HKSAR. According to its Terms of Reference, the ITTB is responsible for determining manpower demand of the sector, assessing whether the manpower supply matches manpower demand, and recommending to the VTC the development of Vocational and Professional Education and Training (VPET) facilities to meet the assessed training needs. A new approach for collecting manpower information is adopted to enhance the effectiveness and better reflect the dynamics of the manpower situation in the various industries. Under the new approach, one full manpower survey is conducted every four years, and this is supplemented by two manpower updates. The ITTB completed its latest manpower survey in 2018. Two manpower updates were conducted in 2020 and 2021.

The 2021 manpower information update comprises:

(a) focus group meetings and interviews getting the views of industry experts on the latest developments in the sector, manpower and training needs, recruitment difficulties, and measures to tackle the challenges the sector faces; and

(b) desk research analysing job advisements including qualifications, experience and skills required by the principal jobs in the Innovation and Technology sector.

Objectives

The objectives of the manpower update are to understand the following issues of the sector:

(i) to examine the latest trends and developments of the sector;
(ii) to explore the job market situation and training needs;
(iii) to identify the recruitment challenges; and
(iv) to recommend measures to meet the training needs and to ease the problem of manpower shortage.

Methodology

Overview

With reference to the 2018 full manpower survey of the innovation and technology sector, this update report aims to provide qualitative descriptions of the recent development of the sector through focus group meetings and interviews, supplemented by making reference to some quantitative data of recruitment advertisements from desk research.

Focus Group Meeting

The focus group was formed through engagement of industry experts to understand the latest trend and development of the manpower, training needs and recruitment difficulties in the sector. Members participating in the focus groups are representatives from the innovation and technology sector, including:

(i) community, social and personal services or medical and health care services;
(ii) electricity, gas, water or construction;
(iii) financing, insurance, real estate and business services;
(iv) manufacturing;
(v) transport and storage services;
(vi) cloud technology services;
(vii) communication services;
(viii) digital creative or innovation products and services;
(ix) IT products and services suppliers;
(x) research centres;
(xi) start-up companies;
(xii) systems integrator suppliers;
(xiii) wholesale, retail and import/export trades of computer products and software packages; and
(xiv) wholesale, retail and import/export trades, catering and hotels.

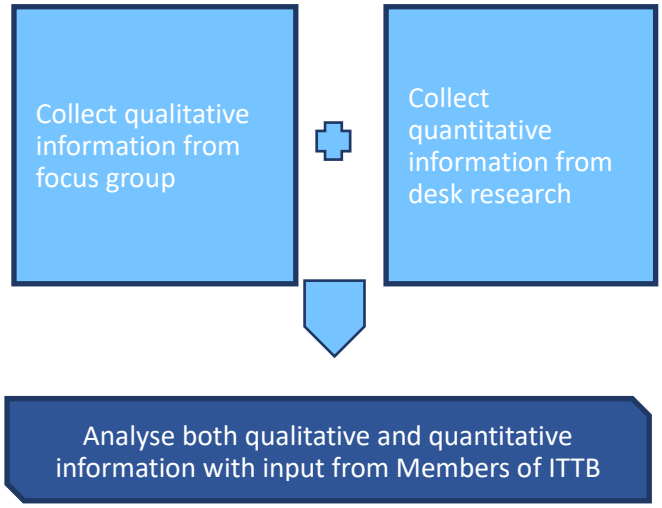
Two focus group meetings in hybrid mode, i.e. face-to-face and online, were conducted on 20 and 26 August 2021 with discussion on topics selected by the Working Party on Manpower Survey of the ITTB. The discussions at the meetings were recorded and transcribed to facilitate analysis. In addition, one online interview was conducted on 2 September 2021 with an industry expert who was not able to join the above focus group meetings.

Desk Research

Manpower information covering the period between 1 July 2020 and 30 June 2021 was collected through desk research. The information includes the number of job advertisements, required competency, qualification and experience, market remuneration, etc. An integrated database was being developed to capture the relevant recruitment data from the major online recruitment portals. Over 60,000 recruitment records were collected during the research period. Mapping was made with the list of related companies under the Hong Kong Standard Industrial Classification for removal of any duplicated records.

Data Analysis

The analysis consists of the following three steps:



Limitations

As this is not a full manpower survey, the findings and recommendations of the focus group meeting are more qualitative in nature and the report focuses mainly on the manpower trends. The information of job advertisements was collected from major recruitment websites and the Labour Department. Other channels, such as head hunting for managerial positions, were not covered. Since the data collected is a snapshot of a particular period without reference to any historical data, this can serve as reference information supplementary to the findings of focus group meeting.

Findings

Factors Affecting the Development of the Innovation and Technology Sector

New Normal

Amid the COVID-19 pandemic, Hong Kong's employers need to rethink the strategy to sustain their businesses. The new normal has altered how organisations perform businesses, and how businesses and customers deal with each other. It shifted organisations to a work-from-home model and remote operations. In the context of the new normal, organisations are responding with alternative initiatives and solutions to interact with their customers more effectively. This triggered innovation and accelerated the existing need for a digital transformation, particularly for Small and Medium Enterprises (SMEs), which have been constituting the major business establishments in Hong Kong. Start-ups technologies do help SMEs streamline communication and workflow and that is one of the reasons why the number of Hong Kong start-ups continue to grow rapidly.

Digital Transformation

Digital transformation is of crucial importance to the development of the new economy under the new normal. Retailers are striving for better online shopping experience by adopting digital tools to boost up sales and customer engagement. E-commerce has been entering a new wave of revolution to live commerce by linking up the online store with a livestream broadcast to allow customers to watch and shop at the same time. Manufacturing is also going through a fourth Industrial Revolution (Industry 4.0) driven by innovative technological solutions such as drones, Automatic Guided Vehicle (AGV)s, and robots to build more automated production operations to complete online and custom made products. Shipping and maritime logistics industry is also increasingly digitalised and data-driven. Customers are demand to know the real-time positioning of the vessels while in open sea and also in congested harbours to ensure the vessels reach their destinations. In addition, implementations of emerging technologies, including Artificial Intelligence (AI), blockchain, social media, data analytics tools and Internet of Things (IoT) devices, provoke high demand for digital innovation and technology expertise. In order to get through the digital transformation process, Agile software development and data science are the way forward to drive

performance and productivity as data is an underpinning key to digitalisation.

Greater Bay Area

The digital transformation of the world economy has brought business opportunities to the development of the Greater Bay Area (GBA). Talent is crucial to the success of the innovation and technology development, and talent pool in GBA is highly skilled and experienced in emerging technologies, particularly for positions like AI architects, blockchain specialists and data scientists. Not only the business opportunities brought forth by the GBA, the talent integration within the GBA could further support Hong Kong as an international innovation and technology hub. The "Outline of the 14th Five-Year Plan for the National Economic and Social Development of the People's Republic of China and the Long-Range Objectives Through the Year 2035" also mapped out the strategic directions for Hong Kong to collaborate with other GBA cities in technology development and exchange of talents. Hong Kong, with its sound science and technology foundation, is able to seize opportunities brought forth by the development of the GBA to create more room for the sector to grow in the long term.

New Digital Economy

In the era of new digital economy, emerging technologies including AI, big data, blockchain, cloud computing and cybersecurity have brought new vitality to business. The Government of the Hong Kong Special Administrative Region has taken initiatives to promote the development of digital economy, such as the launch of the Hong Kong Monetary Authority Banking Open Application Programming Interface (API) Framework. The open API technology has created promising opportunities for banks in Hong Kong to collaborate with non-financial companies to develop digital products and extend the promotion channels to new digital interfaces. Hong Kong also has a well-developed and mature electronic payment ecosystem, and the use of mobile payment tools is also increasingly popular in recent years, particularly under the e-voucher scheme, which favoured to the development of financial technology. With the robust technological infrastructure, internet access capabilities and support from the Government, Hong Kong is able to take lead in the digital economy to provoke innovative financial technologies and technology investment.

Manpower Demand

Focus Group

With reference to the trends and development of the sector, views of the focus group on the anticipated changes in manpower demand were collected. Principal jobs related to data analytics, cybersecurity, user interface and programming, and project management, are considered to be in high demand. Relevant job titles are Data Scientist, Business Analyst, Cybersecurity Engineer, UI/UX Designer, Programmer, Software Engineer and Project Manager. In addition, employees possessed both domain and technical knowledge are very difficult to be recruited. Particularly, sustainable finance is growing globally, talents with expertise in Financial Technology (Fintech) and environmental, social and governance are in significant shortage.

Desk Research

Out of the relevant recruitment advertisements captured in desk research, the following top five principal jobs with the highest number of vacancies were identified:

1) Programmer / Analyst Programmer / Software Engineer (24%)
2) User Support / User Co-ordinator (9%)
3) Sales Representative / Marketing Representative / Account Manager / Product Promotion Representative (7%)
4) IT Architect / Business Analyst (6%)
5) System Analyst (6%)

Comparison with previous manpower survey / update

According to the 2020 manpower update, the top five principal jobs with highest number of vacancies were as follows:

1) Programmer / Analyst Programmer / Software Engineer (27%)
2) User Support / User Co-ordinator (10%)
3) Sales Representative / Marketing Representative / Account Manager / Product Promotion Representative (8%)
4) Web Designer / Web Developer (7%)
5) IT Architect / Business Analyst (7%)

With regards to the 2018 full manpower survey, the top five principal jobs with highest number of vacancies were as follows:

1) Programmer / Analyst Programmer / Software Engineer (32%)
2) User Support / Co-ordinator (16%)
3) Sales Representative / Marketing Representative / Account Manager / Product Promotion Representative (7%)
4) Field Technician (6%)
5) R&D Technician (5%)

Over the years, programmers and software engineers have been ranked as the most in-demand positions. The rapid growth of technology results in increasing need for these two posts to assist in the design, development and maintenance of innovative software. In addition, the lifespan of code in applications is of only a few years where ongoing enhancement or revamp are always needed.

Training Needs

Focus Group

The following skills are essential for employees in the innovation and technology sector:

Technical Skills

- Artificial Intelligence
- Blockchain
- Cybersecurity
- Extended Reality
- Database
- Data Science and Data Analytics
- Digital Marketing and E-commerce
- Internet of Things
- Robotic Process Automation
- UI/UX
- Virtualisation and Cloud Computing
- Solid foundation of programming skills
- Methodology and Approach involving Agile, DevOps, Docker and Containers

Soft-skills

- Design Thinking
- Project Management
- Problem Solving Skills
- Research Methodology

Desk Research

In addition, the advanced technology, related job titles, and emerging skills and knowledge identified from the advertisements are summarised in the following table:

Advanced Technology	Related Job Titles	Emerging Skills and Knowledge
5G	● 5G Network Engineer ● 5G Solution Engineer	● Radio network algorithm development for cellular network

Advanced Technology	Related Job Titles	Emerging Skills and Knowledge
		● Radio Resource Management / Message Authentication Code / SON (Savasere, Omiecinski, Navathe) algorithm ● Internet of Things ● 5G positioning
Agile	● Scrum Master ● Agile Coach ● Agile Transformation Manager ● Agile Project Manager	● Scrum Master certification such as Certified Scrum Master, Professional Scrum Master, and Scaled Agile Framework ● Experience with Agile practices, patterns and techniques ● Experience with Agile techniques such as User Stories, Acceptance Test-Driven Development, Test-Driven Development, and Behavior-Driven Development ● Business Process Management
Artificial Intelligence (AI)	● AI Architect ● AI Developer ● AI Engineer ● AI Algorithm Engineer ● NLP Algorithm Engineer ● Machine Learning Engineer ● AI Ethics Officer	● Machine learning algorithms and deep learning frameworks ● Visualisation tools ● Knowledge of popular programming languages such as Python, Java, R and C++ ● Analytical thinking and creative vision for future ● Neural network architectures
Blockchain	● Blockchain Architect ● Blockchain Developer ● Blockchain Engineer ● Blockchain Analyst ● Crypto Analyst ● Cryptocurrency Trader	● Blockchain framework, such as Ethereum, Hyperledger, R3, Ripple and EOS ● Smart contract development ● Concepts of cryptography ● Knowledge of popular programming languages such as Rust, C++, Java, JavaScript, and Python ● Data Structures ● Practical experience in designing blockchain solutions
Cloud Computing	● Cloud Architect ● Cloud Network Engineer ● Cloud DevOps Engineer ● Cloud Infrastructure Engineer	● Knowledge on different cloud service providers ● Development and Operations (DevOps) ● Knowledge of virtual machine ● Cloud security and recovery mechanisms ● Major Certifications:

Advanced Technology	Related Job Titles	Emerging Skills and Knowledge
		➢ Alibaba Cloud Professional Certification ➢ Amazon Web Services Certification ➢ Azure Certification ➢ EMC Cloud Architect ➢ Google Cloud Associate and Professional Certifications ➢ HP ExpertOne Cloud Certification ➢ Huawei Cloud Service Solutions Architect ➢ IBM Certified Solution Architect ➢ VMware Cloud Certification
Cybersecurity	● Cybersecurity Analyst ● Cybersecurity Engineer ● Cybersecurity Architect ● Cybersecurity Consultant ● Cloud Security Engineer	● Knowledge on cryptography ● Professionally certified (e.g. Certificate of Cloud Security Knowledge (CCSK), Certified Cloud Security Professional (CCSP), Certified Ethical Hacker (CEH), Certified Information Systems Auditor (CISA), Certified Information Security Manager (CISM), Certified Information Systems Security Professional (CISSP), Certified in Risk and Information Systems Control (CRISC), Huawei Certified ICT Professional-Security, Offensive Security Certified Professional (OSCP), etc.) ● Strong documentation skills on requirements, process, procedures, reports, plans and analysis ● Knowledge on IT security infrastructures and cloud computing
Data Science	● Data Scientist ● Data Engineer ● Data Analyst ● Chief Data Officer ● Business Intelligence Developer	● Data analysis algorithms such as data mining, machine learning, and natural language processing ● Data integration tools ● Data governance ● Advanced analytic capabilities ● Business Intelligence (BI) tools such as Tableau, Power BI, AWS QuickSight, etc.
Digital Entertainment	● Augmented Reality Developer ● Virtual Reality Developer ● Mixed Reality Developer ● Technical Artist ● Digital Producer	● 3D animation ● 3D modeling ● 3D scanning ● 3D games engines ● Visualisation tools ● Virtual production

Advanced Technology	Related Job Titles	Emerging Skills and Knowledge
	● Multimedia Producer	● Knowledge of site functionality, interaction, site architecture, user interfaces, and navigation
Financial Technology	● FinTech & Innovation Manager ● Software Engineer - FinTech ● FinTech Developer	● Financial technology applications such as Electronic Know Your Customer, Big Data, Cloud, AI, Mobile Application, and Stored Value Facilities ● Project management skills in financial services ● Knowledge of FinTech market trends
Internet of Things (IoT)	● IoT Architect ● IoT Engineer	● Embedded software development ● Data management solutions ● High-performing user-friendly web and Mobile User Apps
Quantum Technology	● Quantum Research Scientist ● Quantum Computer Engineer	● Quantum Algorithms ● Quantum Computation ● Quantum Machine Learning ● Quantum Optimisation ● Design and Simulation
Robots	● Robotics and Mechatronics Engineer ● Robotics and Mechatronics Architect ● Robotics Scientist	● Robotics systems using a robotics middleware and existing libraries and tools ● Knowledge of robotics and surrounding systems
Robotic Process Automation (RPA)	● RPA Developer ● RPA Architect ● RPA Analyst	● RPA tools like Automation Anywhere / UiPath / BluePrism ● Project management skills ● As a change agent to communicate complex solutions to service users
Video Analytics	● Video Analytics Consultant ● Video Analytics Engineer	● Computer Vision algorithm design and development ● Video technologies such as image/audio capture, compression and broadcast streaming ● Deep Learning algorithm and frameworks
Others	● Microservices Developer ● Microservices Engineer	● Microservices architecture ● Domain Modelling ● DevOps and Containers

In light of the wide adoption of emerging technologies in Hong Kong, the following key emerging technologies are recommended for employees training in the innovation and technology sector:

Artificial Intelligence (AI)

Artificial Intelligence is the hottest emerging technology because it is impacting on how we work and live. AI applications are widely adopted and many products with AI capabilities are developed. AI applications are implemented in many industries in Hong Kong, including finance, healthcare, marketing, retail, and logistics. The future of work involves automation and the rise of AI in the commercial world will create many job opportunities in various industries. It is therefore necessary to acquire the AI knowledge for career advancement.

Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR)

In response to the dynamic growth of e-commerce and significant changes in consumer behaviour worldwide, many retailers have accelerated their efforts to leverage digital technology in AR, VR and MR applications. The rise in demand for digitally enriched shopping experience has led to e-commerce to "v-commerce" (viz. virtual commerce). Apart from the applications in gaming and entertainment industry, AR, VR and MR technology now helps Hong Kong business provide better customer experience and offer three dimensional models of products and information to customers. Industries are deploying AR, VR and MR technology for different purposes, for example, education, marketing events, property development and entertainments.

Blockchain

Blockchain technology is gaining popularity in Hong Kong and is important in the FinTech development in Hong Kong. Apart from developing blockchain solutions for FinTech, blockchain startups in Hong Kong also initiate projects for other industries such as transportation and logistics, real estate and smart contracting, etc. New models are erupting day by day around blockchain technology. One of its biggest disruptors is asset tokenisation, which is how any real-world asset, tangible and intangible becomes digitised, and then broken down into smaller parts which take the form of tokens.

Cloud Computing

Cloud computing could not be missed in today's digital transformation. AI-based predictions supported by cloud resources are now the prevailing solutions in handling critical business decisions by reducing operational costs and human error. Most of the traditional IT operations are now being migrated into the Cloud. Companies are demanding for cloud solutions and services and now even non-technical positions would require to have basic knowledge on Cloud Platform.

Cybersecurity and Compliance

In today's digital world, knowledge of cybersecurity is important because it is the basis to prevent from a cyber-attack. Employees in cybersecurity profession should be able to develop solutions that can detect data breaches, network attacks and ransomware threats. For non-technical employees, cybersecurity awareness training is needed to enhance the fundamental cybersecurity competencies to reduce the risk and keep companies secure from possible cyber threats. In addition, compliance training is also important to ensure employees understand the relevant laws and regulations as well as internal policies that govern the operation of the companies. For regulated industries like banking and finance, the knowledge on regulations for information technology stipulated by the Hong Kong Monetary Authority and the Securities and Futures Commission are essential to ensure the safety and standardisation of the systems. In light of the diversified online businesses and e-commerce, businesses in Hong Kong may also applicable to the data and privacy laws in other countries such as European Union General Data Protection Regulation, Personal Information Protection Law of the Chinese Mainland, etc. Employees should keep up with the latest developments in data governance and related areas of the countries concerned.

Data Science

Data is referred as new oil in today's digital world. It is a valuable business asset because it serves as fuel to perform artificial intelligence and business analytics. Apart from conducting in-depth analysis on big sets of data, data scientists or related positions in the innovation and technology sector are required to understand the business strategies and address to them with intellectual analytical solutions.

Internet of Things (IoT)

Internet of Things has disrupted how traditional businesses operate. Devices and sensors are now interconnected to improve performance and customer experience. China is playing a significant role in IoT development driven by the growing capacity of Chinese businesses to deploy Industrial Internet of Things solutions and high level of automated operations. Hong Kong should keep pace with the times and keep abreast of the latest development to help companies to progress to more advanced IoT applications in enhancing the customer service.

Methodology and Approach involving Agile, DevOps, Docker and Containers

Agile methodology is transforming project management across different industries and businesses. The methodology allows companies to response swiftly and accurately to the imminent changes in today's competitive business environment. It encourages better adaptability and flexibility as well as higher profits and faster return on investments. Agile focuses on software development while docker

approach focuses on how to deploy the created software applications effectively on the number of servers with containers. The integration of Agile methodology and docker approach allows employees to perform rapid deployments without hardware barriers. There is also a trend that team of developers are connecting with the operations staff to make sure that the software has run smoothly and such latest trend are commonly referred as DevOps. The concept of DevOps helps in building communication and collaboration in software development, services and operations. For DevOps execution, developers learn how to use containers for automation and on-demand deployment to reduce risk and expedite the process. Containers actually support Agile and DevOps to accelerate development, test, and production cycles. Microservice architecture is also growing in popularity which requires DevOps in order to be successful, it is therefore crucial for employees to get familiar with the new methodology and approach.

Recruitment Challenges

Due to the keen competition of the market, some of the employers have experienced difficulties in the recruitment process. The difficulties might be summarised and related to some of the following factors:

Rapid Technological Change

The rapid technological change is affecting not only Hong Kong but also every country in the world. Emerging technologies like AI, big data, IoT, 3D printing, machine learning, robotics, nanotechnology, renewable energy technologies, and satellite and drone technologies require high-calibre employees, where the local labour force is unable to cope with such demand.

International Mobility of Workforce

Accompanying the intense worldwide demand for highly-skilled labour in particular to innovation and technology sector, such as information technology experts, engineers and scientists, international mobility of these workforce is a crucial issue as countries increasingly compete to attract and retain talents by imposing more favourable migration policies. The global competition for talents affects the talent acquisition and retention of Hong Kong employees.

Work Preference of Young Generation

It has become more challenging for employers to engage millennials and generation Z. These young generations are tech-savvy as they are growing up with technologies and social media who are more likely to run their own businesses and are less loyalty to long term employment.

Employers considered that it is difficult to recruit new blood and nurture them to possess both hands-on technical skills and strong business knowledge.

Lacking of Young Employees with Educational Background in Science and Technology

Hong Kong students are focusing on equipping themselves as business talents rather than pursuing technological advancement. The supply of young technology employees falls short of demand. The higher the level of local labour workforce in technological ability, the more advanced products and services Hong Kong will innovate.

Diversity in Technology

Technology companies are mostly male employees particularly for infrastructure related job opportunities. The lack of diversity is not a recent phenomenon and women should be more encouraged and prepared for careers in the innovation and technology sector.

Recommendations

To meet the future development of the innovation and technology sector, it is considered essential for the Government, education institutions and employers to provide suitable training opportunities to the employees and students in the following areas:

Government

Arouse Students Interest in STEM

STEM stands for the fields of science, technology, engineering and mathematics. The Government has been making substantial efforts to promote STEM education over the years. Continuous promotion and support of STEM education could stimulate students' interest in innovation and technology in order to ensure a steady supply of new blood for the sector. Innovation is important to new products and process that sustain Hong Kong's long term economic development and STEM education could develop the foundation for critical thinking and science literacy which enable the young generation to be innovators. It is undeniable that most jobs of the future will require a strong understanding of mathematics and science.

Promote Exchange of Talents with other GBA Cities

Facilitation measures have been implemented by the Government with a view to fostering the flow of people, goods, capital and information to enhance the overall connectivity of Hong Kong and other GBA cities. The Government could further collaborate with other GBA cities to encourage the exchange of talents to enhance sharing of expertise and raise technological development. The trend for Hong Kong entrepreneurs to set up innovation and technology related businesses in GBA cities will become more pronounced and the need for talents with strong understanding in GBA economic development and business model viability would be on the rise. Likewise, other GBA cities will need Hong Kong's talents and investments to expedite its reform and development.

Attract More Investments in Research and Development

The Government has been launching different funding schemes related to the promotion of technological adoption. To boost up the research and development activities in Hong Kong, the Government could consider providing more incentives for companies to invest in research and development through collaboration with education institutions and experts in the technological field. With the support from the Government, companies could focus more on the development of advanced technologies without emphasis on only the financial gains and the returns on

investment. It will steer close collaboration between commercials and institutions to embark on new technological initiatives.

Encourage Commercial Enterprises to Adopt the Innovations from Start-ups

The Government is committed to promote Hong Kong as a leading start-up destination for innovation and entrepreneurship. The Government could further bridge the collaboration between commercial enterprises and start-ups to expand the innovation and technology market in Hong Kong. The partnership is mutual beneficial to both parties that start-ups can benefit from funding sources and customer access while enterprises could innovate to stay competitive and access new technology. Technological innovations can sustain the development of innovation and technology in Hong Kong.

Education Institutions

Enrich Project-based Learning

Education and training institutions should enrich the learning outcome by bringing real-life context and technology to the curriculum through project-based learning. Project-based learning help students to master the new knowledge base and become lifelong learners who are encouraged to take responsibility for their own learning and support creativity to generate new ideas. The wide adoption of project-based learning will assist the new generation to acquire the digital skills needed in the digital economy.

Extend Industrial Attachment to Supply of Graduates to Companies

It has been a well-established practice for education institutions to include industrial attachment opportunities to provide students with real-life workplace experience, and enhance their skills and knowledge to meet the needs of the employers. However, in most contexts, industrial attachment has no connection with graduate employment. Education institutions should take further steps to create seamless transitions for students from industrial attachment to graduate employment. Education institution should work with companies to secure an offer of employment to students before graduation where positive benefits accrued to both companies and students. Companies could build the backbone of their talent pool without putting in extra recruitment efforts and students could develop promising careers in companies connected to their study interests. Students could continue their study in parallel with work to take benefits from experience and academia. Early employment could help the sector to bring in new blood.

Provide Training on Understanding of Digital Ecosystem in the Chinese Mainland

In order to strengthen Hong Kong's roles and functions as a springboard between the Chinese Mainland and the

international markets, Hong Kong workforce should enrich its understanding on the development of the digital ecosystem in the Mainland. The digital ecosystem built in the Mainland is self-reliant and advanced in nature, it is therefore instrumental for education institutions to provide training to get familiar with the technology platform adopted there. Western dominance is no longer the sole influence of the innovations as the software industry in the Mainland has been highly competitive with a number of tech giants like, Alibaba, Baidu, Huawei, Tencent, Xiaomi, the requisition of knowledge in the ecosystem built in there could help Hong Kong better integrate into the opportunities brought forth in GBA cities. To enhance communication and integration with talents in GBA cities, education institutions could enhance both the working adults and students on the understanding of different information technology terminologies used in the other GBA cities and Hong Kong.

Engage Industry for Partnership

In light of the volatile and demanding global economic environment, education institutions should forge collaboration with industries to train up students with trade-specific knowledge and skills. Education institutions should play a more proactive role in commercialisation of research achievements. Companies would be encouraged to establish and sustain collaboration if education institutions could demonstrate the applicability of the research products or solutions. In doing so, education institutions should have an in-depth understanding of business and user requirements to align research objectives for greater business impact.

Offer Short Courses on Upskilling and Reskilling

Many practitioners in innovation and technology are now looking for ways to enhance their skills and knowledge by upskilling or bring in new knowledge and ideas by reskilling. Education institutions should offer courses to help working adults to gain the relevant technological skills needed for their new career paths in a highly effective manner and in a shorter timeframe. Short courses are therefore more preferred by working adults.

Employers

Invest in Employee Development

Employee development could help companies outperform themselves by building up a trained workforce to bring increased efficiency and prosperity. Companies should invest more in employee development such as training the workforce on new technologies and strategies or provide skill-based training to improve work performance. In addition, employers, particularly from Small and Medium Sized Enterprises, are urged to maximise the Government funding to enhance their competitiveness in talent and innovation development. With the funding from the Reindustrialisation and

Technology Training Programme, staff of local companies are funded to receive advanced technology training and assist them in upgrading their technological level and implementing more technological applications for their businesses. Other Government funding schemes such as Innovation and Technology Fund and Continuing Education Fund could also help employers to invest in employee development.

Innovate to Stay Competitive

The ability of companies to innovate and absorb new technologies is crucial to sustain its competitiveness. Inventive solutions and products could keep companies ahead of their competitors but innovation is not only about digitalisation of existing business models, it also involves decision of future technologies which enable constantly innovating to provide better experience for customers.

Modernise IT Infrastructure to Support Digitalisation

Apart from focusing on transformative innovation, IT infrastructure is building a company foundation for digital capabilities. IT infrastructure consisting network resources, hardware, software, security, and end-user technology services which forms the technology foundation to support company's business strategies and ability to adopt technological applications. Company should not neglect the importance of a robust infrastructure to improve technology-driven performance and security strategy.

Embrace Mobile Workforce

Mobile workforce has become more prevalent under the new normal. Employers should develop human resources strategies to support a versatile, high performing and mobile workforce without being bound by a physical work location. Companies successfully incorporate a mobile workforce could remove geographic barriers to recruit and retain a larger talent pool.

Co-create Partnership with Education Institutions

Employers are looking for skilled employees to adapt quickly and effectively to change, especially in high technology areas. On-the-job training keeps employees up-to-date with advanced technologies and best practices. Employers should contribute to the curriculum development to ensure that the skills taught in school connected to those needed in real-life work environment. Upskilling and retraining programmes are seen as an effective way to increase the mobility and adaptability of workforce towards knowledge-intensive and higher value-added activities. Employers should actively participate in the partnership with education institutions to co-create talent development for the innovation and technology sector.

Employees

Become Lifelong Learners

It is no doubt that lifelong learning is important for employees to maintain a competitive edge in new technologies and grow through continuous application of knowledge and experience. In fact, lifelong learning requires embracing opportunities to learn and put into practice. There are different ways to achieve lifelong learning such as self-motivated learning through online learning platforms, books and training. It could be in another form of professional learning through networking and industry news, and pursuing professional certification and qualifications.

Maintain Personal Qualities for Proactive and Adaptive Agility

Agility is a crucial trait to increase employability under the rapid technological evolution and to meet the demanding customer expectations. Employees need to adapt to the new way of working by using digital tools made available by the employers. Apart from training to get used to those new tools, employees should transform the skills learnt from training into capabilities to carry out duties and deliver swift outcomes with the increased use of technologies.

Gain a Deeper Understanding on the Development of GBA Cities

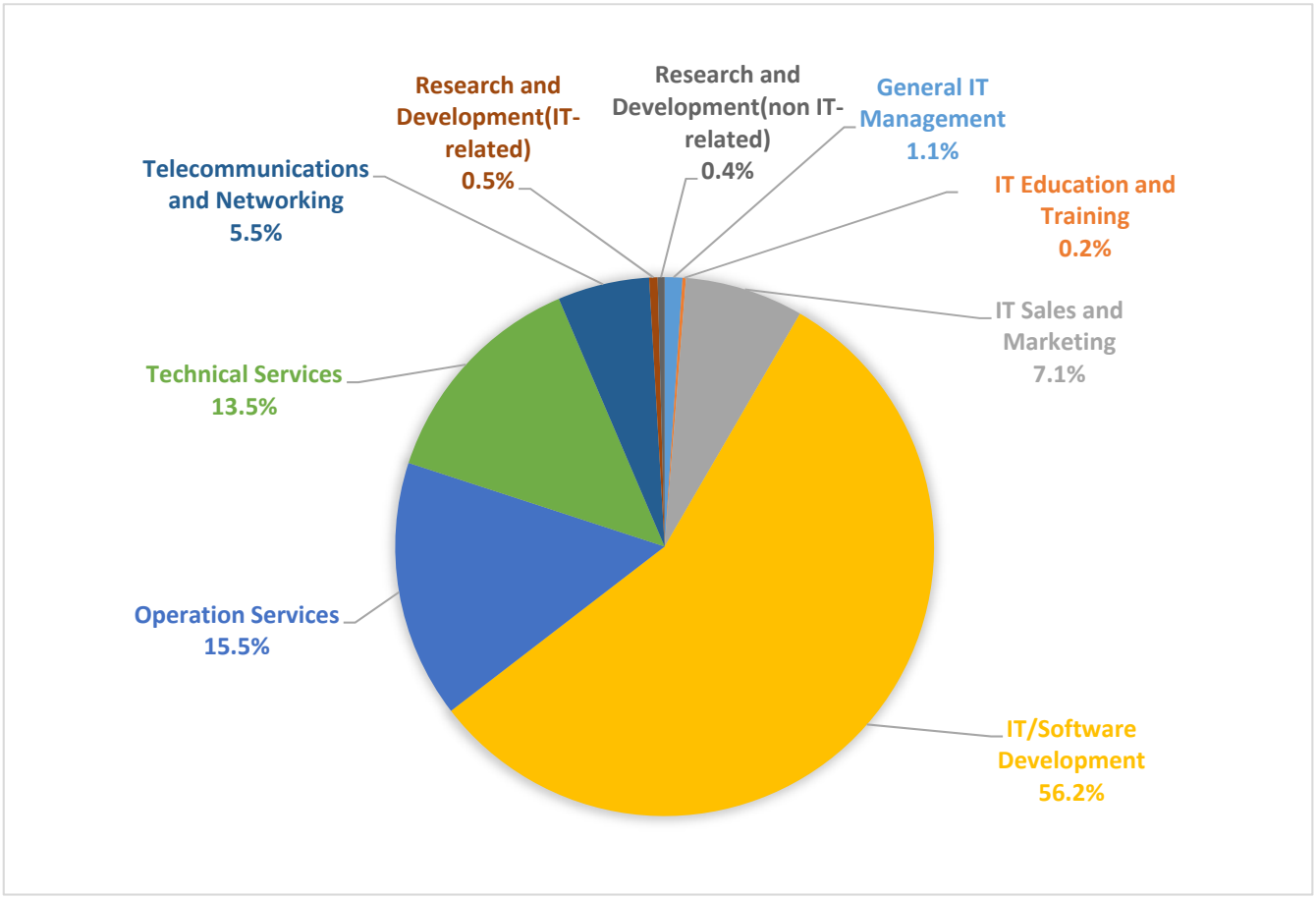
To better seize employment opportunities arising from GBA cities, employees should develop new strategic career plans by gaining a deeper understanding of the labour market, work culture and career prospects in the Chinese Mainland. Graduates who are making continuous efforts to keep abreast of new skills and knowledge in GBA cities are able to outperform their peers by cultivating relevant professional knowledge, exposures and skills.

Equip with Proactive Problem Solving Skills

While companies are looking forward to building up their independent research and development capabilities, employees are expected to possess proactive problem solving skills to find solutions independently. In this connection, the employees should be more proactive in using data to analyse the root cause to problem and seek a favourable solution for business prosperity.

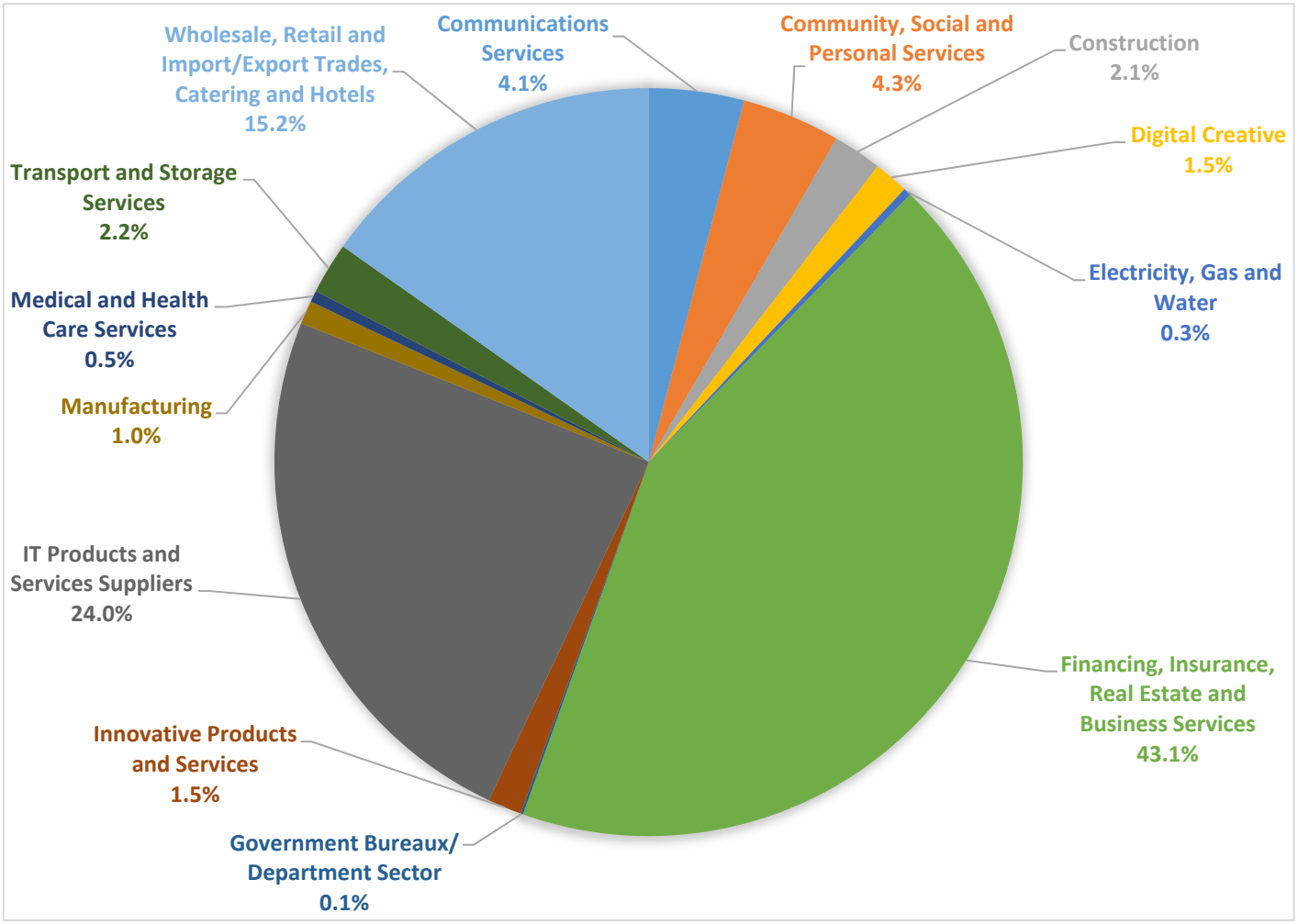
Appendix (a)

Number of Advertisements from Popular Recruitment Media (1 July 2020 to 30 June 2021) by Job Category



Appendix (b)

Number of Advertisements from Popular Recruitment Media (1 July 2020 to 30 June 2021) by Sector



Appendix (c)

Number of Advertisements from Popular Recruitment Media (1 July 2020 to 30 June 2021) by Principal Jobs

Job Title	Percentage
Programmer / Analyst Programmer / Software Engineer	24.1%
User Support / User Co-ordinator	8.7%
Sales Representative / Marketing Representative / Account Manager / Product Promotion Representative	6.8%
IT Architect / Business Analyst	6.4%
System Analyst	6.4%
Web Designer / Web Developer	5.2%
Systems Programmer (in-house) / Systems Programmer (vendor) / Systems Engineer	4.8%
Computer Operator / Systems Operator	3.7%
Project Manager / Project Leader	3.6%
IT Security Specialist / Information Security Specialist / Information Security Officer	3.3%
Database Administrator / Data Warehouse Administrator / Database Designer	3.2%
Systems Development Manager	2.8%
Cloud Engineer / Cloud Architect	2.5%
Data Scientist / Engineer	2.3%
Customer Service Engineer / Field Engineer	1.8%
Computer Operations Supervisor / Operations Support Supervisor	1.8%
Telecommunications Engineer / Network Engineer	1.6%
UX Designer	1.4%
Computer Game Designer / Computer Game Artist / Computer Game Developer / Computer Graphic Designer / Computer Graphic Artist / Computer Animator / Web Graphic Designer / Visual Effects Designer	1.3%
Help Desk Representative / Customer Service Officer / Customer Service Representative	1.1%
Network Administrator / Network Officer	1.0%
IT Director / MIS Director / Head of IT / CIO	0.9%
Quality Assurance Specialist / Software Assurance Specialist / Software Assurance Engineer / IT Systems Auditor	0.7%
R&D Researcher / R&D Scientist / R&D Engineer	0.6%
DevOps Engineer/ DevOps Architect	0.5%
Software Product Designer / Firmware Product Designer / Product Analyst / Product Developer / Software Product Manager	0.5%
Field Technician	0.4%
Software Product Engineer	0.4%
Sales Director / Marketing Director / Account Director / Sales Manager / Marketing Manager	0.3%

Job Title	Percentage
Telecommunications Manager / Networking Manager	0.2%
Robotics Software Engineer/Robotics Software Architect	0.2%
Lecturer / Professor / Training Officer	0.2%
R&D Technician	0.2%
Technical Writer	0.2%
Telecommunications Consultant / Network Consultant	0.2%
CTO	0.1%
Computer Operations Manager	0.1%
RPA Developer / RPA Architect / RPA Analyst	0.1%
R&D Supporting Staff	0.1%
Help Desk Supervisor	0.1%
IoT Engineer/ IoT Architect	0.1%
Customer Engineering Manager / Services Support Manager	<0.1%
IT Trainer / IT Instructor	<0.1%
Total	**100%**

Appendix (d)

Number of Advertisements from Popular Recruitment Media (1 July 2020 to 30 June 2021) by Qualification Requirements

Job Category	Postgraduate	First Degree	Sub-degree	Senior Secondary and below	Unspecified
General IT Management	4.5%	75.0%	8.0%	0.8%	11.7%
IT / Software Development	2.9%	53.1%	25.0%	1.3%	17.7%
Telecommunications and Networking	2.7%	50.3%	27.3%	3.3%	16.4%
Technical Services	2.3%	47.6%	30.4%	3.6%	16.2%
Operation Services	1.4%	27.8%	42.6%	10.7%	17.6%
IT Education and Training	36.4%	26.4%	8.3%	0.8%	28.1%
IT Sales and Marketing	1.1%	50.0%	24.4%	6.8%	17.7%
R&D (IT related)	28.2%	45.8%	12.3%	0.3%	13.3%
R&D (Non-IT related)	24.4%	42.9%	12.6%	2.4%	17.7%

Apart from the academic qualifications, the percentage of advertisements that included different types of IT certifications is shown as follows:

Job Category	IT Certifications*
General IT Management	20.6%
IT Education and Training	1.7%
IT Sales and Marketing	1.0%
IT/Software Development	5.0%
Operation Services	15.8%
Technical Services	31.6%
Telecommunications and Networking	42.7%
Research and Development(IT-related)	1.0%
Research and Development(non IT-related)	2.4%

*Examples of the IT certifications: Alibaba Cloud Professional Certification, Amazon Web Services (AWS) Certification, Azure Solutions Architect, Certificate of Cloud Security Knowledge (CCSK), Certified Cloud Security Professional (CCSP), Certified Ethical Hacker (CEH), Certified Information Security Manager (CISM), Certified Information Systems Auditor (CISA), Certified Information Systems Security Professional (CISSP), Citrix Certified Associate (CCA), Cisco Certified Network Associate (CCNA), Cisco Certified Network Professional Enterprise (CCNP), EMC Cloud Architect, Google Cloud Associate and Professional Certifications, HP ExpertOne Cloud Certification, Huawei Certified ICT Professional-Security, Huawei Cloud Service Solutions Architect, IBM Certified Solution Architect, Information Technology Infrastructure Library (ITIL) Certificates, Linux Professional Certifications, Microsoft Certified Educator (MCE), Microsoft Certified IT Professional (MCITP), Microsoft Certified Solutions Expert (MCSE), Offensive Security Certified Professional (OSCP), Oracle Database Certifications, Oracle Java Certifications, Project Management Professional (PMP), Red Hat Certified Engineer (RHCE), Scrum Master, VMware Cloud Certification.