Are You Future Ready?

By Dr Winnie Tang

About the author

Dr Winnie Tang, JP, is an Adjunct Professor in both the Faculty of Architecture and the Faculty of Engineering (Department of Computer Science) at the University of Hong Kong (HKU). She is a locally-bred IT entrepreneur from Hong Kong, and has over 20 years of experience in the information and communications technology (ICT) industry.

Dr Tang is the Founder and Chairman of Esri China (Hong Kong) Limited, which is an international office of Esri, specialising in geographic information system (GIS) technology. Esri is among the top 50 software companies in the world. She is also the Founder and Honorary President of the Smart City Consortium.

Over the years, she has been actively advocating the use of technology and sharing her views on the ICT industry, eHealth, environmental conservation, entrepreneurship and the smart city through her services in government and non-government organisations in Hong Kong.

As a renowned columnist and keynote speaker, she has been invited to share her views and promote technological and social developments at conferences, seminars and workshops organised by international organisations, such as the World Bank Group, International Telecommunication Union (ITU) and the Asian Productivity Organization (APO). She has published 11 Chinese and English books and over 600 research papers, newspaper articles and journals.

Dr Tang's Chinese book, *Surfing the IT World*, published in 2016, won the publishing award (the category of Commerce and Management) in the first Hong Kong Publishing Biennial Awards 2017.

In recognition of Dr Tang's works, she has been awarded the Distinguished Alumni by the Faculty of Science, HKU in 2009, the Ten Outstanding Young Persons in 2006, the Women of Influence – Young Achiever of the Year Award by the American Chamber of Commerce in 2004 and the Ten Outstanding Young Digi Persons Selection in 2001.

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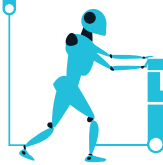

Dedicated to the University of Hong Kong

I would like to dedicate this book to my alma mater, the University of Hong Kong (HKU), in celebration of the Faculty of Science Oak. I am grateful to the Faculty of Science for nurturing STEM talents in Hong Kong throughout the years. As one of the beneficiaries, I am most grateful to them and want to express my utmost gratitude to the University. With this book, I hope I can achieve HKU's vision of 3 + 1* Is, namely, 'Internationalisation', 'Innovation', 'Interdisciplinarity', and transform them into a positive impact on society.

* Vision of '3+1' : https://www.sppoweb.hku.hk/vision2016-2025/our-3-1-is.html

Preface 1

Achieve, Connect, Educate – Are you future ready?

The present is simply an instant in time between that which has been — the past, and that which has yet to come — the future. In that instant hopefully we are informed by the past and are anticipating the future. In other words we should be prepared to learn from the past, and be ready for the future. For me science works in a way that is rather like this, a discipline is where it is today because of the work that has gone on in the past. We accept the synthesis of a field, the experiments and observations that have been made, we do not all start again from scratch. For example, few individuals working in modern genomics feel the need to establish the helical structure of DNA for themselves, they accept that this has been established and move on from that point. As Isaac Newton famously wrote to Robert Hooke: 'If I have seen further it is by standing on ye shoulders of giants.' Science would not have made such impressive progress in understanding the world around us if it was forever reinventing the wheel.

To be ready for the future we need to understand where we are today, and what is the current state of play. This can be harder than it seems, science and technology are changing very fast and keeping abreast of developments can feel exhausting. When I was a child in the 1970s a telephone was a large device usually placed on a shelf or a table, it was connected to the wall by a curly wire. Now I carry a small rectangular object in my pocket, which weighs just a few grams. I can use it for taking photographs, storing those pictures, storing and listening to music, researching almost any question that occurs to me, checking my location, watching movies, reading my email, learning a new language, and many other functions, in addition to talking to people anywhere in the world. It can be tempting for us as individuals, for organisations, and for society to allow this pace of change to overwhelm us. But, properly harnessed these changes can be used to help and support us. This I see is part of Dr Tang's thesis in this book, a call to embrace the current state of technology and to fully utilise its capacity in helping us function as individuals and as a society.

Science progresses, technology advances, and we in

our lives need to be open to the applications that are available. This does not mean unthinkingly adopting every new technology, there are some technologies (including some developed in Hong Kong) which are being put to uses which are ethically dubious. This does mean that we have the ability to assess for ourselves the way to use technology, a consequence of this is that society needs a degree of scientific literacy. To me one of the mysteries of the modern world is that while it is regarded as culturally unacceptable for an educated person to not know something about: da Vinci's Mona Lisa, Beethoven's Fifth, Wordsworth's odes, or Shakespeare's sonnets; it is acceptable to claim ignorance of: Newton's third law of motion, Boyle's law, or Darwin's theory of evolution by natural selection. This is the so-called 'two cultures debate' which has been going on for at least two centuries and this is not the place to reprise the discussion. Let me offer the opinion that to fail to have even the most basic understanding of science and technology is the modern equivalent of being illiterate. It is common in universities that basic language courses are compulsory – this is very desirable and to be encouraged. But I would say that basic numerical skills, and probably coding, should be regarded

in exactly the same way.

We need to rethink the place of scientific literacy and technological understanding in society. This knowledge should not be the private domain of a special elite, it should be expected of everyone. I do not mean that everybody should understand advanced theoretical physics, but if it is acceptable to have no knowledge of the standard model then how will people see theoretical physics as anything other than a towering academic edifice of no discernible value? This is often characterised as scientists hiding behind jargon-filled, complex arguments. In my experience this is rarely true, scientists are often rather good at demystifying their discipline if people want them to do so. Our children need to be inspired to learn science, to explore the world around them, to be curious, and to ask questions. Society needs to value science much more than it does now. Today it seems to me that scientists are regarded as simply another lobby group. This is far from the truth, science is a process of seeking understanding through a prescribed and rigorous method. Scientists have no more allegiance to one another than the fact that they practise this method. The fact that there

can be a scientific consensus about a certain question – climate change is real and man-made, vaccines do not cause autism – is not a sign of a sinister conspiracy. It is a sign that scientists working independently, and often competitively, have come to a common understanding of a problem. If there is such a consensus this should be regarded as of considerable value.

In my opinion to be future ready, means to be ready, willing and able to engage with the current state of science and technological advances. To do so means that we need to raise the levels of scientific literacy of society so that the average ten-year old knows: that forces come in pairs which are equal and opposite, that when you compress a gas its pressure increases, and that the diversity of life around us has come about through millions of random changes in genes each of which has slightly increased the chances of its possessor surviving to breed. We need to educate people, we need to connect with society in order to achieve what will be needed.

Professor Matthew R Evans
Dean of Science
The University of Hong Kong

Preface 2

We are living in a rapidly changing world. Every day, new technologies have been developed trying to improve the well-being of humankind. Engineering plays a pivotal role in contributing to positive societal impact and facilitating economic development. Here in Hong Kong, driving innovation and technology development is one of the highly prioritised endeavours of the Government. Together with the opportunities in mainland China, it is the best of times for engineering to play a more central role. It is our responsibility to provide solutions to global challenges and nurture leaders to embrace the advantages of technology advancement for the benefit of humankind and the planet.

One should understand the fact that "a boat sailing against the current must forge ahead or it will be driven back". In order to ride on the wave of economic development driven by technologies, many of our world-class researchers and innovators have been conducting impactful research projects in various interdisciplinary clusters, such as “Clean Energy and Environment”, “Smart Systems” and “Health

Technologies". We have taken steps to provide solutions to global challenges and nurture leaders in the use of technology for the benefit of mankind. As the general public or regular citizens, are we ready? Are we aware of how technologies change our daily lives? Have we equipped ourselves well for the fast-changing market?

Among different technologies, information technology (IT) is closely related to many of the emerging areas such as big data, artificial intelligence (AI), FinTech, advanced robotics and sustainable infrastructure. In this book, Dr Winnie Tang shows how IT has affected and will transform our lives, and encourages people in Hong Kong to embrace innovation and technology so as to co-create a leading smart city. As an outstanding entrepreneur in the IT industry, Dr Tang shares the success of living in a highly competitive internet world. The book starts with showing the role of IT in the past, present and future, followed by the global trend of IT applications. We will then know the usefulness of the geographic information system (GIS) in smart city development, and, most importantly, what our mindset should be for the future.

Professor Christopher Chao
Dean of Engineering and Chair Professor of Mechanical Engineering
The University of Hong Kong

Preface 3

‘Are you Future Ready?’ The question could be asked of any technology domain, but author Winnie Tang asks specifically in the context of spatial data technologies and their application to cities. In this context, it is a loaded question, in the sense addressed by the last section of the book when juxtaposed with the previous three sections.

The ‘science and technology of where’ requires no less sophistication than other technologies but is peculiarly relatable. Everyone loves and can understand maps. But the digital technology underlying smart city tech is not quite the same as the digital technology that revolutionised cartography and GIS in the 1980s. The internet of things combined with advances in sensing technology, high resolution urban big data, AI and ultra-high speed processing, means that the technological future that is arriving is truly novel. In particular, it is novel in its ability to detect and predict patterns and model alternative

trajectories and outcomes.

CL Dodgson, the Oxford mathematician and author of 'Alice in Wonderland' (pen-name Lewis Carroll), famously once suggested that the best scale for a map of the world would be 1:1. A new metaphor has lately slipped into discussions of computational representation: the digital twin. A digital twin of a city suggests that our computational models have captured so much information and meaning from the real city that we can use it as a proxy complex system for monitoring, understanding and exploring the impacts of interventions. This takes us a long way from a map as a 2D representation of a city or a GIS as a multi-dimensional representation. One of my former post-docs is currently working with the Singapore government and a famous American university on the highest resolution model of transport and land-use interaction ever attempted for that city. It is not so dissimilar to Dodgson's 1:1 map of the world. Individual households modelled as autonomous interacting agents imbued with decision-making logic that maximises utility subject to costs and so on. The result is at one time awe-inspiringly complex, beautiful, fascinating and overwhelming.

It is also difficult to interpret analytically. As with the pixilation problem in remotes sensing technology, the finer the detail, the harder it can sometimes be to interpret. When the model is a large number of interacting multi-dimensional decision agents, sensors or social-media data points, what-if simulations are governed by many parameters, which make results unstable, highly dependent on starting conditions, interactions between parameters and so on. The attractiveness of the 1:1 model's complexity becomes a liability when it comes to modelling cause-effect and interpreting results. Historically, scientists and philosophers have abstracted for a good reason. It is difficult to understand the way the human mind thinks, for example, without a robust abstraction of the idea of morality or learning or human judgement. The multiplicity of 'raw' information in a digital twin model of a city leads us, ironically, backwards (or is it forwards?) towards black-box thinking, where we observe systemic behaviour without being sure of the contributions of individual variables and parameters.

Another sense in which more complexity leads to more black-box thinking is in the application of AI and advanced

data-science.

We try to more clearly explicate urban analytics by using more and finer scale data and in so doing need to make more use of pattern-based tools from AI, generative computing and data-mining, which take us further away from explicitly behavioural models. Behavioural analysis is pushed both backwards and forwards in the process of inquiry – in structuring data and inquiry and in interpretation of patterns.

What all this means is that the techniques and paradigms for understanding spatial dynamics driving city growth and change are going through a subtle shift from 20th century style urban social science towards a 21st style of urban science. The roles, weighting and sequencing of the various stages of scientific thought – abduction, deduction and induction – are shifting. Are you ready for the future? The question is a profound one for those working with, teaching and reflecting upon the spatial sciences and their application to society.

Should we dispense with formal theory-driven urban

analytics and go straight to pattern recognition? A complicated structural equation model, or hybrid utility-maximisation-discrete-choice-agent-based-model or a general equilibrium model may dig down towards a 1:1 model of the dimensions of human spatial calculus, for example in making home-buying or shopping-destination choices. But do they produce more insights than observing millions of cases of actual locational or route-choice behaviour? Should the later be used to calibrate the former? Or the former used to explain the latter?

The future of the urban digital twin is not quite with us but it almost is. It is not just new skills that are required; real-time urban data streams and massive systems of linked records registered to multiple geographies right down to the individual all force us to re-invent urban science.

Professor Chris Webster
Dean of Architecture
Chair Professor in Urban Planning and Development Economics
The University of Hong Kong
April 2019

Preface 4

As the title suggests, "Are You Future Ready?" challenges readers to consider how information technology such as artificial intelligence and big data, and developments in telecommunications such as the imminent roll out of 5G will transform our lives. The book urges people in Hong Kong to embrace innovation and technology and collaboratively re-invent Hong Kong as a smart city able to lead into the second quarter of the 21st Century.

The book consists of four chapters. Chapter 1 focuses on past, current and future technical change identifying ingenious inventions that have changed our lives and explaining how the nature of work itself will fundamentally change, becoming much more collaborative and reliant on technology. In Chapter 2 readers are introduced to best practice in Singapore, London, Shenzhen, New York City, Moscow, Seoul and Abu Dhabi. As I write, Seoul has switched on its 5G network, totally transforming the smart devise experience, and becoming the first city in the world

to do so. The book challenges us to consider 'are we ready?' here in Hong Kong. A characteristic of the smart cities identified above is that they spend wildly more on research and development than does Hong Kong. Devoting only about 0.8% of GDP to R&D (compared to 2-3% in our competitors) is a conscious choice. We need to ponder as a community why we do not value R&D. Only by investing substantially more than we do today can Hong Kong hope to achieve its smart city potential.

Chapter 3 focuses on how geospatial data and location technology transform our world and urban management. Consider Hong Kong's future as a completely driverless city, a future that is certain to come although exactly when we cannot say. GIS and similar technologies will enable us to realise the efficiencies of this change. We will know where public transport is and when we can expect it to arrive. Completely driverless and shared transportation will improve productivity, safety, and the experience of moving around our city. To maximise the benefits of these developments we need open data and legislating on this is the role of government. Many of the cities discussed in Chapter 2 are making huge strides in this area. Are we prepared for this?

Chapter 4 advocates for public-private-people partnerships (4P) indicating key collaborative roles for government, business, and civil society. To develop our AI talent, for example, we need to realign our educational priorities, teaching STEM and coding much more widely in schools. Influential voices in the community are already demanding this. The chapter also points out that we should leverage a source of incredible often wasted, talent in our midst: women. Breaking down stereotypes that keep girls largely out of engineering and the development of technology, would bring enormous benefits. These changes indicate the need for substantially increased investment in reforming our system of education.

Readers should ponder the important messages of this book. Are we ready for Hong Kong's destiny as a smart city? Are we doing what is needed? Are we leading? Are you?

John P Burns
Emeritus Professor
Honorary Professor, Department of Politics and Public Administration
The University of Hong Kong
April 5, 2019

Preface 5

Collaboration is shaping our future

It seems just yesterday that I started working in a lab at Harvard University looking at spatial analysis and digitised geography to make maps from the information. I had a "wow, I've found Candyland" reaction as I realised it was possible to connect the science of geography with decision-making. That's when I founded the Environmental Systems Research Institute (Esri) 50 years ago.

Some 25 years ago, I met Winnie. I had a "great, I've found the right buddy" reaction as we share the same passion for geographic information system (GIS), the same enthusiasm as an entrepreneur, and the same vision to drive the world to be smarter and more intelligent through realising the potential of GIS in Hong Kong and worldwide. These similarities draw us to become close friends with mutual admiration though we are coming from different generations.

GIS, a digital geography tool, enables us to spot patterns, trends and insights that previously would remain buried.

As communities grow with a larger and larger population, they face more and more challenges. City authorities use the GIS tool to monitor air quality, plan urban development, track disease outbreaks, guide business expansions, manage forests and plan marine protections, and support peacekeeping and humanitarian missions.

What's next? That can be a new kind of unstructured data that will enable geocoding text; integration of BIM and our GIS tool ArcGIS is another excellent innovation with multiple benefits. Integrating artificial intelligence into ArcGIS platforms also makes GIS more prepared for the next level applications.

But the most important of all is to shape the future through collaboration.

Winnie, being one of the most energetic, passionate, and visionary leaders I have known, has spared no effort in

collaborating with numerous parties.

To promote GIS and find the best solutions for Hong Kong to become a smart city, she has reached out to countless people in Hong Kong and across the globe. In the last few years, her messages copied to me could relate to China, the United States, Russia, the Middle East, Japan, South Korea, Taiwan, as well as major conferences in Hong Kong where she meets government agencies, chambers of commerce, business and academic elites in architecture, surveying, transportation, and civil engineering industries on urban planning and smart city trends.

At the same time, Winnie has devoted much of her time grooming the next generation of IT talents in the University of Hong Kong (HKU). She also represents the Computer Science Department of HKU to write columns for a number of local and international media in her free time.

She has not forgotten the younger generation that are most in need of nurturing. That's why in the last few years, she has driven hard to offer all primary and secondary schools

in Hong Kong free use of our GIS software. She even works with the local education bureau to co-organise inter-school cross-curricular project competitions to encourage students to apply GIS and STEM (science, technology, engineering, mathematics) in project-based learning.

She is keen to raise the awareness of the community and the government on how to better prepare for the digital future by applying geospatial technology. She aims to get the community to be more conscious in using geography as a common framework for doing data integration and applying it to deal with issues that affect us all, whether that be dealing with housing issues or tackling traffic problems. I'm really proud of her.

Winnie's recent efforts can be seen in her new book *Are You Future Ready?* which is the third of a trilogy.

The first one in her trilogy, *Surfing the IT World* published in 2016, is about her startup story and has gained great success. Her story telling is so appealing that the book won the Publishing Award (Commerce and Management

Category) in the first Hong Kong Publishing Biennial Award 2017 hosted by the Hong Kong Publishing Association.

The second one *Smart City 3.0* provides a comprehensive review on the concept of a smart city with lots of vivid examples and stories. It is a valuable reference book on the topic for young people planning to study a master course on the subject, and for the general public to grasp new ideas.

With Industrialisation 4.0, the new book *Are You Future Ready?* explores how information technology and GIS have and will transform our lives, and encourage people in Hong Kong to embrace science and technology so as to co-create a leading smart city. The book also serves to commemorate the Science Faculty of HKU for nurturing STEM talents for Hong Kong in the past 80 years.

In conjunction with Winnie's continuous effort, I would love to see the Hong Kong authority take advantage of its investments in the common spatial data infrastructure to create a more integrated approach in its smart society

initiatives, and to further implement the smart technology programme by leaps and bounds.

When it comes to what we can create with GIS, the sky is the limit. So let's co-create a more sustainable and smarter future together!

Jack Dangermond
Founder & President
Esri
Redlands
2019

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Chapter Two – Right Timing

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Chapter One To Know the Present Through the Past

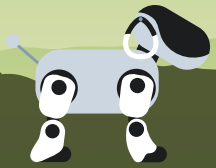
Throughout history, technology and innovation have been changing our lifestyle.

What kind of new problems will arise when humans become increasingly dependent on robots and new technologies?

What kind of talents does society need in the future?

What kind of skills are most promising?

Are you future ready?



1.1 Talent 1: Millennials

Today

The word "millennials" generally refers to the generation born between 1980 and 2000. They account for 40% of the workforce in Hong Kong and a quarter of the workforce in the United States. By 2020, they will constitute half of the global workforce. Millennials emphasise work-life balance and personal development, they are very much different from the post-war baby boomers who put contribution to the country, society and organisation as their top priority.

According to PwC, a consultancy company, the key to the success of a company in the future will be to find effective ways to attract and manage the millennial generation; allowing them to realise their potential. A basic difference between the millennials and the baby boomers lies in the mastery of digital technology. Millennials grew up in

the era of the internet, broadband, and social networks with massive information readily available. They prefer to communicate via mobile phone messages, face-to-face communications are not as common.

However, the millennial generation also experienced the global economic downturn. In Hong Kong, the financial turmoil in 1997, the SARS attack in 2003, and the global financial tsunami in 2008 have had a great impact on them.

According to the Hong Kong Government's statistics, the actual income of full-time employees aged 39 or below only increased by 10-12% from 2013 to 2017, while inflation was higher during the period; not to mention the surging property prices.

Millennials experienced the economic downturn and learnt how to compromise, some of them are ambitious, they want to be promoted quickly within an organisation. On the other hand, most of them believe that a work-life balance is as important as financial rewards. The millennial generation's demand for quality of life often contradicts the

expectations of many employers who require employees to work hard.

Having said that, companies also need talented young people to create the new economy, such as Google and Apple. Therefore, managers today are thinking about how to absorb, retain and nurture millennials.

Future

Apart from the newly emerged "gig work" in recent years, working from home or flexible working hours has become popular, I believe that this is also related to the millennial generation.

According to a survey in the United Kingdom in 2018, nearly 60% of adults do not like working nine to five, 37% of them prefer working from 8 am to 4 pm, more than 40% wish to have flexible working hours, such as compressing their working hours to balance family commitments or further study.

In the U.S., nearly 4 million people or 4% of the workforce spent half of their time working from home in 2017, an increase of more than double when compared to 2005; Most of them are also over the age of 35.

In 2007, Cisco Systems, with 70,000 employees in 70 countries around the world, started to allow employees to work from home for 30% of their office time, that is, working from home 1.5 days every week. The company said that it is a win-win solution: it not only reduces the number of employees commuting to work, but also reduces the company's costs. It is reported that Cisco has reduced office space by 5 million sq. ft. in the past five years.

The Wall Street Journal reported that some employees have two jobs at a time, which could be inspiring.

During the daytime, the interviewees work in high-pay jobs with large organisations, they may be a software engineer or a technical consultant, etc. However, at nighttime or on the weekend, they pursue personal interests by working as a disc jockey, singer, or actor.

Current Situation & Expectations of Millennials

Hong Kong	U.K.	U.S.
• 2013 to 2017: Actual income increased by ~10%, far behind the surging property prices • Stress work-life balance and personal development	• 60% dislike working 9 - 5 • 37% prefer working 8 am - 4 pm • >40% wish to have flexible hours for family commitments or further study	• ~4 million people work from home 1/2 time, increased by more than double compared to 2005

(Millennials = Generation born between 1980 and 2000)

Although they have stable work and attractive income in large organisations, they have to manage competing time demands from their own interests. Fortunately, their bosses understand their aspirations, some even agree to compress the working hours to four and a half days, so that the employee can freely use Friday afternoons.

It is of course satisfying to get everything as wished for, through this obtainment, the employee becomes more loyal to the organisation.

Sideline

/ Generation Z /

Based on data from the United Nations, Bloomberg estimated that Generation Z born in or after 2001 will account for 32% of the world's 7.7 billion population in 2019, surpassing the millennial generation (31.5%) for the first time.

Generation Z is genuinely digital aboriginal. When smartphones were launched in 2009, they were less than ten years old. After 2019, they will be turning 18. How do their preferences affect the world, we will have to wait and see.

Sideline

/ China has a "millennial generation" long time ago? /

Traditionally, Chinese scholars have been taught to take "cultivating oneself, managing the family, governing the country, and bringing peace to the world" as a lifetime mission. However, in the time of chaos (AD 365-427), when the Eastern Jin Dynasty was falling, and there were frequent power struggles among land owners, there was Tao Yuan Ming, the noble and virtuous writer and poet who "did not compromise his integrity just to earn a living"; or Feng Zikai (1898-1975), an artist who was devoted to the pursuit of goodness and beauty in human nature even when experiencing political and socio-economic turmoil during the birth of modern China. His famous work *Paintings for the Preservation of Life* breathed fresh air into society at the time, and is widely known amongst later generations.

Sideline

/ Collaborative robots /

Previously, when I was at the laboratory for the Faculty of Engineering at the University of Hong Kong, I saw two robotic arms of adult height working flexibly and gently. The entire robotic arm was wrapped with soft materials, so that people next to it need not be afraid of being hit.

These robots, collaborating with people, called cobots (collaborative + robot), are expected to become popular in the next few years. In 2018, these collaborative robots accounted for only 3% of global robot sales, but by 2025, the proportion is expected to increase to 34% since they are inexpensive and versatile.

Compared with the robot equipment priced USD100,000 (about HK$780,000), cobots are under USD45,000 (about HK$350,000), they can be used for various tasks, such as packaging, quality inspection, operating machines, assembly, welding, etc. Cobots operate 24 hours a day, thus, they are popular in small and medium-sized factories. How to collaborate with cobots instead of being replaced is a question for the millennials to ponder.

1.2

Talent II: A fresh start at mid age

The founders of digital giants like Microsoft, Apple, and Facebook, were in their twenties when they started their businesses and they were not even graduates from a university. Therefore, a common understanding is that "Young People" equals “Entrepreneurship”. However, a recent study by several American scholars completely overthrows this conventional thinking.

Researchers, from the National Bureau of Economic Research (NBER), Massachusetts Institute of Technology, and the U.S. Census Bureau, studied 2.7 million entrepreneurs who started a business between 2007 and 2014. It was found that the average age of entrepreneurs who continue to employ at least one staff member is 42. Among the 0.1% highest-performing startups, the average age at which they started their companies is even higher: 45.

This study covers startups in all industries, including high-tech companies; in the case of the petroleum or the biotechnology industry, the average age of the entrepreneurs when founding the businesses is closer to 47.

The highest-performing companies have significant increases in the number of employees, excellent sales growth, or the ability to exit through listing or acquisition in the first five years of business.

At the same time, when comparing the success rate of entrepreneurs of different age groups, it is found that middle-aged people from 41 to 50 have an 80% higher success rate than those aged 21 to 30. There are very few of the highest-performing companies whose founders were in their 20s when starting the business.

If we further compare the entrepreneur population of each age group with the "successful" population, that is, using the 1% of companies with the highest growth as a success indicator, it is clear that age 35 is the watershed. The

startups with founders aged below 25 performed poorly, while the startups with founders aged 35-45 performed very well, such high performance continues till the age of 60.

Therefore, if there are two entrepreneurs asking for funding, and you know nothing about them except their age, the researchers of this study made a joke that you should choose the older one as they are more assured.

The above findings are due to education, work experience and savings. Young people may be creative, but they lack industrial experience and the financial foundation to succeed. On the contrary, if entrepreneurs have accumulated at least three years of experience in the relevant industry, it is found that their success rate is 85% when starting a business.

Some people may argue that Steve Jobs was only 21 when he started his business. However, the company's stock price continued to be sluggish since listing it in his 20s. The stock price started to rise only when he was 48. When

he launched the epoch-making iPhone, he was already 52. The stock price of Microsoft and Amazon was also at their peaks when Bill Gates and Jeff Bezos were in their 40s. The two Google founders, Larry Page and Sergey Brin, both born in 1973, also made a significant breakthrough in their company stock price after the age of 35.

It is believed that this study has significant implications for university resource allocation.

At present, there are 64 entrepreneurship bachelor degrees and 106 entrepreneurship master degrees in the United Kingdom. The universities also offer numerous support services to the students, such as providing co-working spaces, or helping students from foreign countries (outside U.K. and E.U.) to gain a Graduate Entrepreneur visa, allowing them to stay in the U.K. for at least another year after graduation.

The researchers of this paper suggested that instead of targeting young people, universities' entrepreneurship courses and government venture funds should focus on the experienced middle-aged, so they do not need to put their life savings or mortgages at risk to start a business. In return, the government funds can be used more effectively.

Sideline

/ Ultramarathon /

Ultramarathon is long-distance run in any footrace longer than the traditional marathon length of 42 kilometers. Ultramarathons are divided into two types: one has a fixed race distance, such as 50 km or 100 km, the latter is a world record recognised by the International Association of Athletics Federation. The other type is competing in a double marathon, a 24-hour run, or a 1,000-km run, etc. It may take a day or more to complete the race.

A study in *Research in Sports Medicine* surveyed the participants of the two largest 161-km ultramarathons held in North America.

The study found that most runners are well-educated, health-conscious men: 80% male, 70% married, half of them university degree holders (compared to the norm of less than 30% of adults in the U.S.), and over 75% have the habit of taking vitamins or nutrition supplements. What about the average age? It is 44.5.

Sideline

/ Solution to midlife crisis? /

Hong Kong people's average life expectancy is 81 for men and 87 for women; it also continues to rise every year. However, the retirement age of our civil servants is still 60, and 55 for the disciplined services such as the police. With the post-war baby boomers approaching retirement, planning for the latter half of life has become a 'hot' topic.

I do not have the age distribution of participants in the Hong Kong Marathon. However, since the event was first held in 1997, the number of participants increased from over 1,000 to more than 70,000 in 20 years. As for the 100-km Oxfam Trailwalker within 48 hours, the number of participants also increases every year with a large proportion of senior participants over the age of 50.

At the cross road of life, challenging their physical ability may be the answer for some of the middle-aged.

1.3 The best job

Hong Kong has developed from a small fishing village to a metropolis. In the last few decades, the three most sought after occupations are doctor, lawyer, and accountant, as their income and social status are high. For example, a famous doctor can earn as much as one million Hong Kong dollars in a week. Other professions, such as engineering and architecture, are also desired fields,

However, with the rise of new technologies such as innovative technology, big data and 3D printing, today's high income groups have started to shift towards artificial intelligence related fields, one of the latest "hot" jobs is "data scientist".

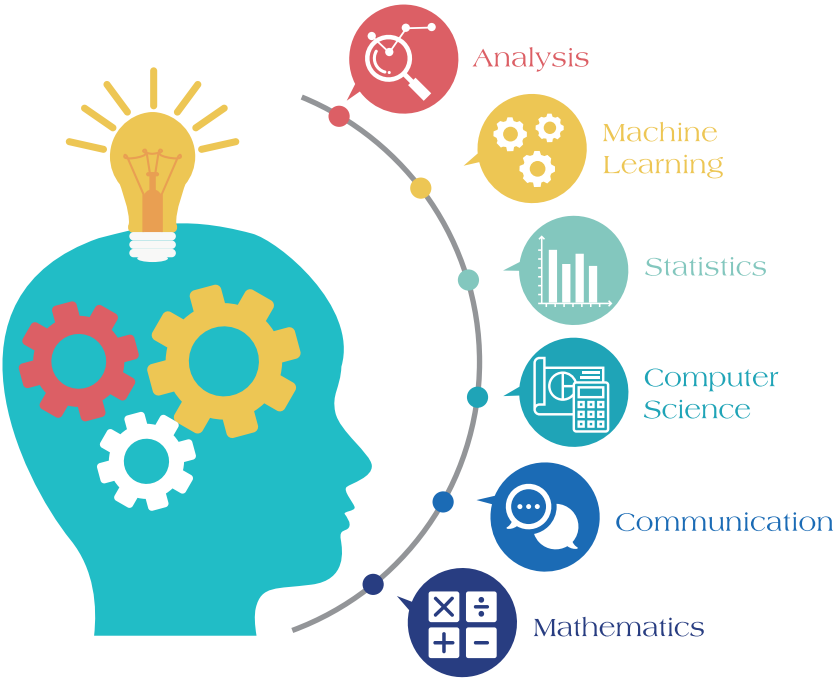
In the past, data scientists were called "data analysts". When big data on customer behaviour collected via online interaction becomes more and more useful, there is much

room for data analysis, the importance of the analyst will increase significantly. Today, there is an increasing demand from many enterprises for such professionals. So what skills are most in demand for a data scientist? A recent analysis based on the relevant job advertisements on the five largest job listing websites in the United States, such as LinkedIn, reveals interesting findings.

The analysis was based on job descriptions for 20,000 vacancies of "data scientists" posted on five job listing websites on a certain day in October, 2018. It was found that in the "general skills" aspect, the first and second most in demand skills were "analysis" and "machine learning", more than 60% of the job postings required the two skills. Processing data means finding out the meaning behind things, this requires analytical ability. While machine learning is to create systems to predict future performance.

The third and fourth most in demand skills were "statistics" and "computer science". Again, no surprise. Even the sixth most in demand skill, “mathematics”, is a relevant subject in the field.

Six Most in Demand Skills in Data Scientist Job Listings



The most interesting finding is that the fifth in demand skill was "communication", which was raised by nearly 50% of employers. That means data scientists have to explain the analysis results to others and work with teams so as to make full use of the insights in problem solving.

The head of a data analytics company who hires data

scientists pointed out that the core requirements of a data scientist are: how to interpret the data models and make recommendations to the business. Therefore, a quarter of the data scientist's time should be spent on this aspect.

This is because the ultimate task of a data scientist is to solve business problems, not just analyse data or building models. Therefore, analysts must first be able to understand the customer's problems from a business perspective, and then find a way to solve the problems with the tools at hand.

For example, he said that many companies want to know why they cannot retain their customers. The first thing a data scientist needs to do is to understand why the customers chose the company's services in the first place, as well as their needs and expectations, and their feedback on the services, etc.

The essence of communication includes talking, listening, empathising, and cooperating with others. Is communication not also a requirement for the workplace in the past, the present and the future?

Sideline

/ Jobs with a six-figure USD starting salary /

The position of data scientist is one of the fashionable jobs, another is software engineer. They share similar backgrounds and training; their salary has also skyrocketed.

According to a survey by a U.S. software engineer, the starting annual salary of a computer science graduate is USD120,000 (about HK$936,000) in a listed tech company; students can also earn a six-figure salary even in a startup company. This is only the basic salary, if a stock bonus is included, their annual compensation could be doubled, as in the case of the author herself who works in San Francisco.

In her survey, the basic salary plus bonus of software engineers in other U.S. cities, ranging from university graduates to those with four years of work experience, only represented 60% to 70% of the Bay Area. However, do not forget that Silicon Valley and the Bay Area are famous for their high living costs, so employees have a higher income and higher expenses at the same time.

Sideline

/ Pay transparency /

Salary has always been a matter of personal privacy, but recently, in order to promote pay equality, an Asian-American female software engineer working in a San Francisco listed technology company not only disclosed her salary, but also hundreds of peers' salary information collected anonymously. By increasing transparency, she wants to reduce pay inequality. At the same time, according to a survey by an American hiring firm, male employees can earn 63% more than female counterparts for the same tech post in the same company, while 54% of female employees in the tech world also pointed out that their income is less than their male counterparts.

Sideline

/ A splendid job in ancient China /

In ancient China, to be a government official was the most popular and admired profession, it was the best job at the time.

How can one be a government official? There is an old saying "the top grade does not have impoverishment; the low grade does not have aristocracy". Before the Sui and Tang Dynasties, officials mainly held positions through family succession, that is, if the grandfather was an official, their descendants could also assume the same position. It was not until the Sui Dynasty (AD 587) that officials were selected by imperial examinations. The new system enabled anyone to take the examinations regardless of their family background, wealth, and age. It broadened the talent pool for the government to select talent and increased the upward mobility of scholars from the lower and middle classes.

The scholars who achieved high results in the imperial examinations, namely, “Zhuangyuan” (first place), “Bangyan” (second place) and “Tanhua” (third place) were honoured directly by the emperor.

Sideline

/ Talent selection in ancient China /

The Chinese imperial examination system was abolished in the late Qing Dynasty (1905). During the 1,300 years it existed, there were many revisions to perfect the system more and more. For example, in order to be fair, since the Song Dynasty, the space on the exam paper for recording the candidate's name was covered with a paper (called "sealing"), and a clean copy would be made by another person to prevent the examiner from recognising the handwriting of the candidate, thereby minimising fraudulence. There is a story that when Ouyang Xiu, the chief examiner, saw an article titled "An argument on the most gracious penalties and rewards" which he appreciated very much, his first thought was to rank it as first, but he suspected it might be the work of his student, Zeng Gong. In order to avoid suspicion, he ranked it second place. It subsequently turned out that the candidate was Su Shi (Su Dongpo), who was one of the most accomplished figures in classical Chinese literature and was highly regarded in his time and later generations.

Sideline

/ 1 in 6,000 /

Prof. Benjamin Elman, an American historian pointed out that the imperial examinations have cultivated and identified a large number of talents in the Chinese dynasties, but the competition was very keen. Taking the situation of the middle and late Qing Dynasty (1850) as an example:

- 1st round: county examination – held two times every three years with about two million candidates participating. The passing rate was only 1.5%, or 30,000 people;
- 2nd round: provincial examination - held every three years. The passing rate was 5% of those who passed the county examination or 1,500 people;
- 3rd round: examination in the capital. Passing rate: about 20% or 300 people. In other words, there was about a 1 in 6,000 chance of winning the game.

This kind of examination and selection of officials is exactly the same as the Hong Kong civil service system.

1.4 The best assistant

Today

There are many maids from Southeast Asia outside the kindergartens and primary schools, they carry schoolbags, violins, snacks for their little masters who travel between tutorial schools and interest classes. At home, they take care of the daily chores of washing, ironing, cooking, and cleaning, etc.

The Hong Kong Government began allowing foreign domestic helpers into Hong Kong from 1973. In 1975, there were only 1,350 foreign domestic workers in Hong Kong, while in 1982, there were 20,000. However, with the rapid increase of middle-class families, as well as rapid economic growth, the number of foreign domestic helpers continued to rise, from 260,000 in 2009 to over 386,000 in 2018. Of these more than half came from the Philippines,

43% came from Indonesia, and 98% of them are women. In the past 20 years, their share of the overall labour force in Hong Kong has increased substantially from 5.3% to 9.3%, they have become an indispensable part of the local community.

They are mainly responsible for household chores, taking care of the children and the elderly, thereby releasing the duties of home-bound women, enabling more than half of the women in Hong Kong to go out to work. However, some people have criticised that the large number of foreign domestic helpers reduced the development momentum of Hong Kong's childcare and elderly services.

As the economy of Southeast Asian countries has improved in recent years, it has been reported from time to time that these countries will stop exporting domestic helpers. For example, in 2016, Indonesia said that women would no longer be approved to work as foreign domestic helpers by 2019, for those who are working in Hong Kong, they can choose to continue or not.

If one day, we do not have these needed helpers, what shall we do?

Future

Dan Brown, author of the popular novel *The Da Vinci Code*, depicts a perfect assistant Winston in his 2017 fiction *Origin*. Winston is both knowledgeable (acting as a museum guide for the main character, Robert Langdon, a Harvard professor, and has a fluent conversation with the professor), considerate (catering to the needs of the guests, his voice is pleasant and with a British accent that Langdon loves), witty (pretending to be a security guard to distract the guards), loyal and calm (planning the escape route, arranging various transportations methods for his master's friend even after his master's death, etc.), enjoying being praised and possessing a sense of humor. Yes, Winston is just a computer with an artificial intelligence (AI).

In the future, smart small butlers with AI will be combined with the internet of things, big data, robotics and 5G mobile communication technology to greatly enhance the convenience and comfort of future homes.

Currently, robots can sweep the floor, perform laundry

folding, cooking, and, most helpfully, cleaning up bathrooms. At the World Robot Summit held in Japan in 2018, Team Homer of the University of Koblenz-Landau, Germany, showcased a robot that could remove trash from the floor and clean water from around a toilet, the cleaning result is over 80% satisfactory.

In addition, other devices like the Smart Mirror can detect blood pressure and heart rate; the Smart Assistant can tell you the time, temperature, brief you on the daily news, remind you of your schedule. But the problem is that these services are not connected seamlessly. In other words, we just have a best-of-breed range of products but lack an end-to-end solution. To address the issue, we need:

1. To connect different facilities and devices, eg. once the refrigerator has only two eggs left, it is best to notify us of the need to refill and connect to the supermarket's website to place an order.

2. To standardise, integrate, and store the different data formats from various household appliances, then

use the predictive model for a need analysis, and transform the results into instructions. For example, when there are only two eggs left in the refrigerator, if your recent blood pressure and heart rate suggested less cholesterol, you would be reminded not to refill eggs for the time being.

3. Smart home services cover energy conservation, security, entertainment, health care, taking care of daily living, improving comfortability, etc. Although the estimates of various research institutes are quite different, they all agree that this is a huge market with many business opportunities.

Sideline

/ AI is the new driver for economic growth /

McKinsey, a consulting firm, estimated that AI could contribute unprecedented value to the global economy. Its 2018 report compared the economic value and productivity gains from various technological innovations, including steam engines in the 18th century which increased productivity by 0.3% a year; while robots in the 19th century increased productivity by 0.4% a year; and in 2000, the rate rose to 0.6% due to information technology. What about AI? It is expected to increase productivity by 1.2% per year and increase global GDP by USD13 trillion by 2030. It is estimated that 70% of the world's companies will use at least one AI function, and large companies will fully embrace this technology.

At the same time, the report said that countries which were pioneers in AI would enjoy an extra 25% of economic growth, while the late comers could only have half of the extra economic growth. Therefore, China and the United States have been working hard on this area in recent years.

Sideline

/ Prejudiced assistant? /

Data diversity in artificial intelligence analysis has aroused a lot of attention.

For example, a research on cancer deaths over the past 20 years in the U.S. drew an unreasonable conclusion that black Americans had significantly higher cancer mortality. It is due to its data samples being highly concentrated on white males.

A startup in Toronto applied AI to a hearing assessment for neurological diseases, such as Parkinson's disease, they found that the technology is only applicable to people who speak native English and have a Canadian accent. Others may be misdiagnosed as having a symptom due to a slow response or unclear answer.

Behind the biased data, there is a biased researcher and his biased value. A startup which developed an AI medical device to diagnose eye disease approved by the U.S. Food and Drug Administration (FDA) for the first time, promised to pay close attention to the data diversity. The widespread concerns of academia, political parties, businesses and the community is expected to bring order out of chaos.

Sideline

/ The extraordinary retainers in China /

The rich families in ancient China always had servants and retainers, they acted as guards or porters when the masters were away from home, and they worked as domestic workers to take care of the daily living needs of their masters when they were home; they were indispensable helpers.

The most famous Chinese retainers that appeal to the masses are Hua An and Qiu xiang. They are the characters in a popular folk comedy *Three Smiles*, and Stephen Chow Sing Chi's blockbuster movie *Flirting Scholar* in 1993. The story focuses around Lady Hua's maid Qiu Xiang, a beautiful and intelligent girl who attracted Tang Yin (Bohu), one of the four famous scholars in the Jiangnan region. Tang Yin pretended to be a servant boy and served in Lady Hua's family to get close to Qiu Xiang.

The servant boy called Xinyan in Jin Yong (Louis Cha)'s novel *The Book and the Sword* may be the most loyal assistant. Xinyan followed the main character Chen Jialuo and learnt martial arts from his master since he was little. There is a scene in the book where he implored Huo Qingtong who held the military power to rescue his master Chen and other fellows of the Red Flower Society. He knelt down for the sake of his master. Readers are often impressed by his loyalty.

Sideline

/ Amahs' golden days /

In the 1930s and 1940s, most of Hong Kong's rich families or foreign executives in the political and business community hired servants, known as "amahs". They usually came from Shunde, Zhongshan and other places in Guangdong. Many of them used to spin silk to make a living, but as the industry shrank in the 1930s, many of them went to Singapore, Malaysia, Hong Kong and Macao to work as domestic helpers. They earned their own living and stayed single for their whole life, they are called "comb sisters". Their typical image was a long braid hairstyle with a white top and black trousers.

Unlike ancient China, the British Hong Kong Government banned human trafficking. Therefore, the amahs became free labour, they could switch jobs whenever they wished. Although the amahs had to live in an employer's house and standby for 24 hours, their monthly salary was said to be quite attractive, ranging from HK$30 to HK$50, comparable to the salary of a white-collar worker. They earned more than enough to support themselves, so they were also able to send money home.

Sideline

/ Hong Kong's famous amah /

Released in 2012, the film *A Simple Life* starring Andy Lau and Deanie Ip is based on a true story of Lee Yan Lam, the film's producer: The main character Ah Tao was brought to Hong Kong to be an amah at age 13 and served the Lee family for three generations till Ah Tao had a stroke in her late years.

1.5

Education changes fate

Today

Knowledge changes fate, and schools have always been the key place to impart knowledge. Research proves that whether a country is rich or poor depends on the education level of the people - for example, in Senegal, West Africa, where people over the age of 25 only attended school for 2.4 years on average, the country's per capita income is USD1,000; Turkey's average education period is 6.6 years, its per capita income is USD10,900; while Americans receive an average of 13.4 years of education, its per capita income is USD53,000.

A traditional teaching of the Chinese says that: nothing is more important than learning.

However, Jack Ma of Alibaba said that if we do not reform

our education system within the next 30 years, the world will face a great crisis. The consulting firm, McKinsey estimated that by 2030, 800 million people's jobs around the world will be replaced by robots. If we still adhere to the current hundreds of years old education approach, it will be difficult for us to compete with machines.

Jack Ma advocates that children should learn soft skills, such as independent thinking, and team-work that machines cannot pick up.

In recent years, many educators and even countries have advocated for reforms in education. Three professors at the school of computer science in Carnegie Mellon University, United States, which is outstanding for artificial intelligence (AI) development, jointly wrote an article in the *Harvard Business Review*, pointing out that people must reform education and prepare young people for the future AI era.

In addition to learning coding and strengthening STEM (science, technology, engineering, and mathematics)

education, there should be specific educational priorities at different stages of primary and secondary education to meet future challenges:

1. Kindergarten to primary school: Problem solving and collaboration skills. When designing an AI system, it is necessary to separate a big problem into many smaller units and then integrate solutions of the smaller units. Therefore, we have to cultivate the cooperation and problem-solving abilities of students as early as possible.

2. Middle and high school: In addition to traditional core subjects, robotics and computational art should be added to broaden students' knowledge and interest in computers.

3. High school: Strengthen the connection between mathematics and computer science, such as statistics, probability, logic, etc., they are useful for data-oriented work in the future, while the proportion of calculus in traditional courses can be adjusted.

More importantly, the education authorities should set up academic requirements for computer science courses and STEM in primary and secondary schools to determine textbooks and serve as the basis for training professional teachers.

At the same time, Finland, consistently ranked top in global education systems, has also carried out pedagogical innovations. This Nordic country does not stress examination (there is only one mandatory test at age 16) and students have relatively little homework. The World Economic Forum (WEF) pointed out that the gap between the weakest and the strongest Finnish students is the smallest in the world, their academic performance is outstanding. Finnish 15-year-old students have repeatedly performed well in the Programme for International Student Assessment (PISA) covering reading, mathematics and science.

In 2016, Finland boldly tried two educational reforms:

1. Increase the application of e-learning tools: The education ministry allocated an extra EUR50 million

(about HK$450 million) to train teachers to teach using electronic devices;

2. Implement phenomenon-based learning: Encourage students to become more active in their studies and collaborate in group projects, it is totally different from traditional learning in subject specific mode.

But two years later, in 2018, research from the University of Helsinki indicated that these two new policies are not satisfactory:

1. The more digital tools, such as tablets, are used in lessons, the more easily students' attention is distracted, which is why Finland's performance in all aspects of PISA has seen declines in recent years;

2. Phenomenon-based learning can only work for students with high grades, family support and self-discipline. Researchers indentified several "risk factors" of students, such as being boys, less talented, absent from time to time, coming from a single parent or

new immigrant family, or they are particularly weak in mathematics.

The research confirms that the Finnish old education methods are better, researchers understand that things have changed over time, people cannot return to the era without digital devices. As for where to go, it is a topic to be explored in the future.

Future

According to *The Economist*, parents in emerging economies are more willing to spend money on their children's education – compared with 1% of household income spent on education expenses in European countries, 2.5% in the U.S., 4% in India, and 5% in China.

This has created a flourishing establishment of private schools, which is conducive to improving the education quality. However, another problem arises: the widening gap between the rich and the poor.

Therefore, online free education may play an important

role in the future. When talking about this, I must mention the Khan Academy.

The founder of the Academy is an Indian, Salman Khan, who was born in the U.S. and obtained a bachelor's degree from the Massachusetts Institute of Technology (MIT) and an MBA from Harvard University. He was initially engaged in fund management. By chance, his YouTube video tutorial on mathematics received a great response, and then he founded the Khan Academy. Since 2009, he has been working full-time producing educational videos and uploading them to YouTube. The number of views for these videos in his first year exceeded 450 million.

This non-profit online learning platform encourages people of all ages to receive education free of charge anytime and anywhere. The platform contains 6,500 videos, including on mathematics, science, computer programmes, history, economics, etc., and they have been translated into at least 36 languages.

For education in the future, Khan also put forward many

inspiring ideas to challenge the current school system. In his book *The One World Schoolhouse: Education Reimagined*, he shared several ideas, including:

- Student-oriented: Let children learn at their own pace regardless of their age, they can also study at home or at any time that they think appropriate, then bring the questions and homework to the classroom to discuss with teachers and classmates.
- Floating summer vacation: Summer vacation "robs students of momentum and causes unlearning," according to Khan. Instead, saving vacations for later use (like adults take annual leave). Since students work on their own pace, taking vacation at different times will not disrupt their learning.
- Learning from work: To learn in real life is an important part of learning. Schools should work with different organisations to seek these internship opportunities.

However, the Finnish education reform provides a lesson. To realise this ideal of independent learning, we need the effective coordination of resources, supporting facilities, families, and schools, it is an arduous challenge.

Sideline

/ Interdisciplinary learning /

Many universities have responded to the changing demands on talents; they introduced interdisciplinary curriculums. For example, the Faculty of Science in the University of Hong Kong (HKU) has launched a Bachelor of Arts and Sciences (Applied AI) in the 2019/20 school year. The programme aims to train students in designing and constructing AI systems in different fields. It also discusses moral and ethical considerations when applying AI.

There are many new interdisciplinary programmes at HKU, including the Bachelor of Arts (Financial Technology) in the School of Engineering, which combines computing, finance, policy, and regulatory requirements to nurture financial and technical experts; Bachelor of Arts and Sciences (Design +) in the School of Architecture integrates architecture, history, and aesthetics to train students in solving problems using innovative design concepts.

Sideline

/ To broaden students' horizon /

In order to train young people to cope with future challenges, and to establish an international network and broaden their horizons, the Chinese University of Hong Kong (CUHK) and HKU have launched cross-regional programmes in cooperation with universities in other locations. At the end of 2018, HKU and Tsinghua University announced that a co-organised Dual Bachelor's Degree Programme in Computer Science and Technology will be launched in 2020. In March 2019, CUHK also announced its cooperation with five internationally renowned institutions, namely: Peking University, Tsinghua University and Waseda University, the IE Business School in Spain, and the Sir John Cass Business School, City University of London. These collaborations offer a dual bachelor's degree programme, opening a gateway for students to access the international community.

Sideline

/ Blockchain /

Cryptocurrency and blockchain technology are seen as drivers for revolutionising many industries. A survey in 2018 indicated that many universities in the world had started to launch related courses, including Stanford University; MIT; Cornell University; Harvard University; University of California, Berkeley; Princeton University; National University of Singapore; and Swiss Federal Institute of Technology Zurich. Although most courses are related to mathematics and science, some of the courses span across business, finance, law, and even combine with anthropology, history, and politics.

1.6 Wearables

Today

People want to carry useful things with them, combining a timepiece with a computer is definitely a worthy idea.

The first digital calculator watch was introduced by Pulsar in 1975, it supported the calculation of 12 digits. As the LED screen consumed much electric power, the screen turned blank when idle to save power, one could press "Pulsar" to see the time. A few years later, this LED watch was replaced by a watch with a low-power LCD screen, and the LED version was then put aside as a collector's item.

Today's most popular wearable device is the smart bracelet. Health bracelets from Xiaomi, Fitbit, and Apple have broad functions: measuring stride, distance, quantity, speed, and calories burned. They can also detect heart

rate, body temperature, sleep quality and pattern.

There are many other wearable products, such as a device attached to the head for detecting brain damage or emotional changes; a monitor that can be swallowed to closely inspect the alimentary canal to replace invasive examinations such as gastroscopy, but these are not as popular as the smart bracelet at the moment.

Future

According to an estimate from Research And Markets, the annual sales of the global wearable device market will be over 200 million pieces (USD45 billion or about HK$350 billion) by 2021. As for the major customers, another survey agency, Global Web Index pointed out that more than 70% of young people aged 16-24 expressed their desire for wearable technology.

Some people say that future wearable devices will be implanted in the body, I have reservations about this.

However, a smart lens with a glucose-sensing function for detecting changes in glucose levels without pricking a

finger; an accommodating contact lens for people with astigmia or presbyopia; and a lens used in virtual reality or augmented reality games, helping people to see things in the dark, where each blink charges the lens, these are all coming to the stage. I am eager to see such kinds of products in the future.

It is even better to combine the lens with the mind-reading headset of the Massachusetts Institute of Technology (MIT). In 2018, MIT released a wearable device that attaches to the head to read the brainwaves of the user who can send and receive messages without making a sound. For example, when you want to know the current time or the name of the object in front of you, the device will pass the answer to you silently after sensing it. Ten people had participated in testing the headset and the average accuracy is over 90%.

If the mind-reading function is combined with a smart contact lens, then perhaps we could communicate by using brainwaves via cloud computing, and ask for videos or information to be projected in front of us; when replying to messages, the user only needs to think about it, then the smart glasses could convert the reply into text that

is shown in front of the user, and once the user blinks, indicating a “yes”, the message would be sent out.

That people can monitor health through wearable devices may also be used for the caring of pets. Many pets are left home alone most of the time, The British *Daily Mail* reported that a quarter of dogs are anxious and frustrated because of loneliness, and some of them became destructive as a result.

While people cannot stay with their pets all the time, they can use a computer device to monitor the situation. There is a video recorder product from a Ukrainian startup: when the owner is not at home, the recorder will record a live video of the pet’s activity, the pre-set pet snacks in the video recorder can be activated, it can also interact with the pet. The owner can even add a wearable device that detects the pet’s blood pressure, heartbeat and mood to better understand the pet's physical and mental health. Besides this, comparing the data collected from the owner’s device and the device used by the pet may provide a deeper understanding of the health of both parties.

Sideline

/ Big data on sleep /

Fitbit announced last year that it had collected 6 billion nights of anonymous sleeping data from users, accompanied by their gender, age, weight, height, location and weekday activity, to understand the lives of Americans, including:

Male vs. Female

Women sleep an average of 6 hours and 50 minutes per night, 25 minutes more than men. However, women are 40% more likely to have trouble falling asleep.

Old vs. Young

Many elderly people have insomnia, and Fitbit's data shows that when people are 20, they are getting half an hour more deep sleep a night than when they are 70.

Weekday vs. Weekend

Many city dwellers go to bed late on weekends. The Americans go to bed 64 minutes later on weekends, that is, one may go to bed at 11p.m. on weekdays, and go to bed after midnight on Saturdays and Sundays. The researchers call it "social jetlag".

Sideline

/ Risk of weekend cravings /

Weekend cravings and staying up late during Saturday and Sunday have negative consequences. Some data showed that when a person has a two-hour difference in the time of going to bed every week, compared to a person who has only half an hour difference, then it is equivalent to sleeping 30 minutes less every night.

Why does this happen? This is similar to jetlag when we travel. When the physical clock of the body is different from the actual time, we have difficulty falling asleep at night and feel sleepy during the day. This is why many people have Monday blues. Dr Till Roenneberg, professor of the Institute of Medical Psychology at the University of Munich estimated that every hour of social jetlag increases the likelihood of being overweight or obese by about 33%.

Sideline

/ Fatal evidence /

Since people wear smart bracelets all the time, these devices may help reveal the truth in the event of an accident.

In March 2018, an Australian woman Caroline Nilsson was charged with murdering her mother-in-law. The case happened two years ago, when Caroline's 57-year-old mother-in-law was found dead in the laundry room. Caroline originally told the police that someone had broken into the house at night, and her mother-in-law and the gangster had struggled, while she was tied in the kitchen and did not know the situation. It was only by 10 o'clock that she managed to break free and rushed to the neighbour for help. Although the police suspected Caroline, there was no evidence. Later, the police found the heartbeat and activity record in the deceased's smart bracelet. It was confirmed that the time of the assault actually happened around 6:30 p.m. on the day of the incident, so they concluded that Caroline lied.

Sideline

/ Wearables in the old days /

Wearable devices like spectacles have a long history. There are different versions of its origins. Nearly 2,000 years ago, the ancient Roman Emperor Nero (AD 37-68) used a concave lens made of emerald, he is the first person on record to wear sunglasses. In the 13th century, over one thousand years later, the Italian priest Salvino D'Armato degli Armati was authorised to produce glasses, then the product started to become popular.

It is also said that in the same period of time, there was a book *Dongtian Qinglu* in the Southern Song Dynasty in China, talking about jade, porcelain and other antiques, the "ai dai" recorded here is actually a pair of glasses: "The old man cannot distinguish the fine prints, when he covers his eyes with 'ai dai', the vision becomes clear." It is said that the "ai dai" were as big as two copper coins; they were probably glasses for reading. At that time, the Arabs who had access to the most advanced technology were said to have studied the manufacture of glasses in the 10th century.

Sideline

/ China's unique wearable /

A ring abacus is a unique wearable device in China. It was invented in the Qing Dynasty. There is a small Chinese abacus on the front of the ring. As the beads are too small, the abacus cannot be operated directly using fingers. When there was a transaction, the merchant would take a needle to do the simple calculations using the ring abacus, and women could also use a hairpin to operate the abacus.

1.7 Chatbot

Today

If you want to find the price of a product or the address of a company, you can talk directly to a chatbot instead of searching on the website.

The chatbot is an emerging product in recent years. It is a computer programme that interacts with people using words or in conversation. It is commonly used either in customer service or as a personal assistant:

1. Customer service - For specific products or services, such as tracking online shopping, booking airline tickets, checking bank accounts, etc.
2. Personal assistant - Such as iPhone's Siri or Amazon's Alexa which answers questions on the weather, traffic conditions, or adjusts the room temperature, or even briefly describes the calendar event for the day.

The customer service chatbot, in particular, has developed rapidly in recent years.

Harvard Business Review found that nearly a quarter of companies were unable to respond to inquiries within 24 hours, and another quarter could not respond in time due to inadequate manpower; these companies might miss business opportunities as a result. IBM estimated that the world's corporations received up to 265 billion customer inquiries each year and the processing cost could be as much as USD1.3 trillion. Chatbots can significantly reduce the response time by 99%, the time for solving each basic question is reduced from 38 hours to 5.4 minutes; a market research company, HubSpot, also said that chatbots can reduce a company's customer service expenses by 30%.

Since Facebook opened the Messenger bot on the instant messaging software Messenger to application developers, the number of chatbots available on Messenger has increased from 10,000 in 2016 to 30,000 in 2018.

You may think that this new technology is only welcomed

by young people, but the *2018 State of Chatbots Report* found that middle-aged people (over 55 years old) are also very receptive. More than 60% of the respondents appreciate the chatbot's instant reply; 58% of them appreciate its 24-hour un-disrupted service.

It is because chatbots with artificial intelligence and natural language processing can quickly respond to customers by finding answers from the Frequently Asked Questions (FAQs) and a database.

Chatbots are widely used in business, apart from customer service, recruitment companies also use it for screening job seekers and checking backgrounds. It is also effective and accurate in responding to executives' business inquiries, such as the latest market trend, competitor information, customer behavioural data, etc.

However, it is interesting to note from various surveys that most people actually prefer talking to a real person if the option is available.

Future

According to the consulting company Gartner's estimate, more than 50% of medium-sized and large companies will use chatbots by 2020. As more and more companies use chatbots, Gartner even predicts that we will talk to chatbots more often than to our partners in the future!

In addition to business applications and as a personal assistant, chatbots will likely shine in everyday life:

- Fortune telling - A website has cooperated with Taipei Xiahai City God Temple to create a chatbot which can perform the drawing of Chinese fortune sticks (or "Kau Cim" in Cantonese) online. After a series of questions and answers via Messenger, you can ask for a sign by drawing a stick from the chatbot. After that, it is also necessary to cast moon blocks to confirm the sign. Finally, there is an interpretation service for the predictions. The whole process is handled by the chatbot.

It can apply not only to fortune telling but also feng shui,

all you need to do is upload your date and time of birth and your floor plan to the chatbot, advice can be obtained anytime, anywhere.

- Bond between the dead and future generation – Many people cannot let go of their dead relatives and friends. A U.S. data scientist wanted to mourn his father who died a few years ago, and let his children know more about their grandfather that they do not have a chance to meet, he created a griefbot by collecting his father's pictures, audio and videos, texts, and letters, then he imitated his father with artificial intelligence. The following is his simulation of a conversation with his father, can you feel the warmth?

Father: Son, how are you?
Son: I am fine. Dad, how is your health?
Father: I am fine also. How is your mother?
Son: She is doing good, and she has good health.
Father: How do you do today?
Son: Working on finishing a research paper.
Father: Don't stay up too late for it.

Son: I will have to. The deadline is near.

Father: Be sure to walk and take some rest.

The daily conversation between parents and children always concentrates on dining, dressing, health, etc. The future griefbots should have advances to include current events, as well as the current situation of friends and relatives.

Sideline

/ The Turing Test /

In 1950, Alan Turing, a British scientist, published a famous article "Computing Machinery and Intelligence", which proposed the Turing Test as a criterion for artificial intelligence. A machine can be considered "intelligent" if it is difficult to distinguish whether its response is from a human or a computer programme. This has formed a standard for chatbots.

According to Boris Katz, an MIT chief scientific researcher who developed a virtual assistant 40 years ago, today's chatbots (such as iPhone's Siri) are not that smart because they just retrieve preset answers to questions matching yours from their database. It can answer the preset questions, but lacks common sense and cannot understand the motive behind the behaviour. Therefore, it is difficult for chatbots to truly interact with human beings at the moment.

Sideline

/ The first chatbot /

ELIZA, an early natural language processing programme launched in 1966, was developed by Professor Joseph Weizenbaum of the Massachusetts Institute of Technology (MIT). It acted as a practitioner in Rogerian psychotherapy. It could communicate with people in an empathic and respectful attitude, many people who spoke to ELIZA, including the secretary of Weizenbaum, were convinced of ELIZA's intelligence and perceptive ability. However, Weizenbaum insisted that ELIZA did not really understand the content of a conversation.

Sideline

/ Chatbots made in Hong Kong /

Recently, I read an article “Why do chatbots made in Hong Kong give irrelevant answers?" in a local Chinese media written by a writer with the byline “working woman in the tech industry”. She shared the three major difficulties in developing local chatbots in the first person:

1: Cantonese is complicated

Compared to English, Cantonese causes the computer to be "unable to make any sense of the matter". The author cited an example: “The English response to ‘Do you want to continue to inquire?’ could be ‘YES’, ‘YA’, ‘YUP’ as confirmation, and ‘NO’, ‘NOPE’, ‘NAH’ as negative response, most of the confirmed answers start with ‘Y’, and the negative answers start with ‘N’. As for Cantonese, the confirmation could be ‘hou2’ (好); ‘hai6 ’(係); ‘jiu3’ (要), you need to teach the chatbot one by one. It is also easy to confuse them with the negative words, like ‘m4 hai6’ (唔係) or ‘m4 hou2’(唔好). The confirmation words appear clearly (‘hai6’, ‘jiu3’), but you have to teach the chatbot that these are negative answers.”

2: Hong Kong-style language: a mixture of English and Chinese, and typos

Many Hong Kong people loosely use a mixture of Chinese and English in conversation. There are also many typos and homophonic words. For example: "A customer typed 'gum loi?', we understand that this is the meaning of 'having been waiting for a long time'... 'ho2 fau2 heoi3 branch gaau2' (可 否 去branch搞?), it means 'Can we handle at the branch?'. This is a simple question, which contains written language, English, and Cantonese. 'bin6 D dak1 m4 dak1?' (便 D 得唔得?) I did not miss any words. This is another example of a customer who wanted to negotiate a lower price by typing 'bin6 ji4 dim2' (便 宜 點) but missing one word can cause the computer to be unable to understand.

3: There are relatively few artificial intelligence resources based on Cantonese

The Hong Kong market is small, so there are limited artificial intelligence resources based on Cantonese. If you want to develop on your own, you need to invest a lot of money and time. It is not cost-effective.

1.8 The value of maps

Today

I started loving maps since my childhood. Over the years, I have collected countless maps and related items. In my office, there is a Chinese version of the world map from the Ming Dynasty, the map of vampires, Hong Kong's first vegetation map, and a magnetic levitation floating globe, as well as many others.

According to scientists' research, the brains of mammals have a very sophisticated tracking system that leads us through the geospatial space. However, only human beings are able to make physical maps from information in their mental map, this is the biggest intellectual difference between humans and apes, according to the British author Simon Garfield's book *On the Map: Why the World Looks the Way It Does*. After human beings produced physical maps, they were considered as intelligent, and it marked

the era of civilisation.

Knowing our location and relative location to the outside world (such as buildings, cars, rivers or other landmarks) is a very important ability, it is the key to survival and reproduction. Today, the importance of geospatial knowledge is increasing.

Since 80% of information is linked to location, it is logical to attach location information to data. Nowadays, many advanced cities focus on spatial locations and place a variety of public data on a central platform, called common spatial data infrastructure (CSDI), for use by the government, public and private organisations, startups and citizens.

Hong Kong is also very advanced in this respect. Over 20 years ago, the geographic information system (GIS) was introduced for city planning and management. In 2018, the Lands Department took the lead in linking data of various government departments to spatial information and presented the information on a map. The new website of the Hong Kong Geographic Data (HK GeoData Store) is said

to be the prototype of a CSDI. However, Thomas Chan Chung-Ching, Director of Lands said, “in terms of size, the current datasets in Hong Kong are just like a local grocery store, not comparable to a large supermarket.”

Therefore, the government's main task in the future is to continue to expand data stations, digitise more land-related information, and collect more information related to urban infrastructures and facilities, and public services through cooperation with different departments, public and private organisations, and to gradually open the data. Resulting in the enrichment of the scope and content of datasets; it is expected to complete the work by the end of 2022.

Future

With the emergence of the internet of things (IoT), the GIS has become the most enabling medium. The IoT is huge, and the connected objects are far more numerous than humans. It is estimated that from 2015 to 2025, the electronic devices which are installed with sensors will grow fivefold to more than 75 billion. Combining these fragmented real-time data by spatial location and artificial

intelligence, we could discover the patterns of things, turning data into useful information, helping us to solve problems in real time.

How does it shape our future life? Imagine that with the help of robots and driverless technology, everyone has a personal assistant, they take care of our daily chores so that the elderly are able to live alone comfortably and independently. The key to success would be whether the public and private organisations and the entire community can work together. It is easier said than done, as private corporations like car parks and bus companies may not want to open their data, and the public also has privacy concerns.

Some people advocate that one's data should be controlled by themselves, that is, sharing private personal data should first be agreed by the individuals, like what information can be shared, and the targets, duration and the conditions of sharing should be regulated, and there should be a right to be forgotten. Data should also be uploaded to a blockchain where the record cannot be tampered with and privacy is assured by legislation, so as to allay the public's worries.

Sideline

/ United Nations emblem /

A famous drawing by Urbano Monte, the 16th century Italian cartographer, is a world map drawn on 60 sheets of paper. In 2017, the Stanford University library connected them with digital technology. The octagonal image is 3 meters in diameter and is believed to be the largest world map from the 16th century. In addition to the large size, Urbano Monte did not use the common Mercator projection that uses the equator as the midline, with the north pole and south pole at the upper and lower end. Instead, Monte used the North Pole as the centre, an unusual approach in map making. The drawing's perspective is looking down from the top of the earth, the ocean and continents are more stereoscopic this way.

The emblem designed by the United Nations in 1945 contains a world map that emulates Monte's map, "representing an azimuthal equidistant projection centred on the North Pole."

Sideline

/ China's oldest map /

There is no evidence of when the first map appeared in China, because most of the materials used for painting such as cloth were non-durable. The three maps unearthed from the Mawangdui Tomb in Hunan are some of the oldest maps that we can see today. It is believed that the maps were drawn in the Year 168 BC, the Western Han Dynasty, and were used during wars.

When fighting wars, even in the ancient period, it is important for a map to be accurate in scale and for it to be clear and easy to understand. For example, the Yellow Emperor, the leader of the ancient Chinese tribe who defeated Chiyou (born in the Year 2717 BC), must have used a map to guide his chariots to capitalise on advantages in the war; and Emperor Yu who tamed the floods (estimated to be near the Year 2200 BC) was equipped with the so-called "marking-line on the left, and the compass and square on the right" ("marking-line", "compass and square" are the measurement standard) to explore the geographical environment around the Yellow River before taking measures to mitigate the floods.

Sideline

/ China's ancient law of mapping /

Pei Xiu of the Western Jin Dynasty (AD 201-300) created a mapping method called "six principles for creating a map", including the measurement rules for uneven terrain, the distance of the road between two places, the area and the ratio of length to width. It established the rules of Chinese ancient map drawing.

Sideline

/ Yin & Yang /

The Chinese book *Declassification of the Great Universal Geographic Map: The World of Surveying and Mapping in Ming Dynasty* pointed out that China is an agricultural country, and sunshine is the lifeblood of agriculture. As there is no sunshine to the north of a mountain, it is difficult to have a productive harvest. Therefore, the south of a mountain should be chosen. At the same time, the Yellow River and the Yangtze River run from the west to east, with mountains on both sides and sunshine on the north side of the river, thus, it is called Hanyang or Huaiyang. The south side is blocked by mountains and lacks sunlight. Therefore, if using the mountain as the standard, the north of the mountain is "Yin"; if using the river as the standard, the south of the river is "Yin". This understanding affects land use and planning, that is, using the places with plentiful sunshine for farming, and the place without sunshine for tombs. For example, the north of Luoyang City and the south of the Yellow River are places for famous cemeteries; the imperial tombs of the Song Dynasty were also built in Gongyi, the mountain of "Yin".

Sideline

/ Infectious disease map /

In recent centuries, the western world has made great progress in producing maps and applications, the United Kingdom is one the greatest.

- Infectious Disease Map – during a cholera outbreak in the 19th century, Dr John Snow questioned the mainstream opinion of an airborne virus, he mapped the homes of the cholera deceased and found that the deceased used the same street public water pump, so he persuaded the authorities to cut off the water supply and successfully stopped the epidemic.

- The world's largest map producer – The original work of the Ordnance Survey, which was established more than 200 years ago, was military mapping. During the First World War (1914-1918), more than 300 million maps were produced by the Ordinance Survey for military use.

  Today, the Ordnance Survey is one of the world's largest map producers, it updates 7 local maps per minute for British MasterMap and undertakes over 10,000 updates per day to ensure map accuracy.

1.9 Mobile communication

Past

The world's first mobile phone communication took place on April 3, 1973. Martin Cooper, an engineer at Motorola, United States, used a cellphone prototype to call Joel Engel, an engineer at the Bell System (competitor of Motorola) in front of a reporter. The model used was a DynaTAC. "DynaTAC" is the abbreviation of Dynamic Adaptive Total Area Coverage. Cooper became the "inventor of the cellphone".

However, in order to mass-produce mobile phones, it was necessary to seek government approval and build a corresponding network. As a result, the mobile phone was officially launched in 1983, 10 years after the first call. The first-generation mobile phone had to be charged for 10 hours for a half an hour conversation, what about the

price? It is said that it was nearly USD4,000, equivalent to about USD10,000 in 2018. Some of us may recall the “big brother” mobile phone in the 1980s, where a "big brother" artist brought a large kettle-like mobile phone to the stage at an award ceremony. Since then, the most popular Motorola mobile phone has been nicknamed "Big Brother".

In the U.S., people call a mobile phone a "cellphone", which is an abbreviation for "cellular phone". The wireless communication network divides the coverage of the service into six hexagonal cells, each cell has a transmitting base station for transmitting signals to the user.

The world's first generation of cellular phone (1G) was introduced by Japan’s Nippon Telegraph and Telephone (NTT) in 1979, it was used as a car phone at the time, using an analogue system.

Today

Regarding the second generation of mobile communication (2G), although it was still mainly for voice calls, it used a digital system, which meant that the message was turned into "0" and "1", supporting data such as short message transmissions, and fixing the deficiency of being easily eavesdropped on in an analogue phone. Hong Kong uses the European GSM technical specification, which is different from Japan and the U.S. Therefore, Hong Kong users had to switch their handsets to keep in contact when they were in these countries.

Ten years ago, the mobile internet and social networks became popular with smartphones, enabling third generation (3G) and fourth generation (4G) mobile communication technologies to take off.

The fifth generation (5G) of mobile technology is the communication between people and people, people and machines (or objects), and among things (that is, the internet of things). The 5G network is fast and reliable for

data transmission. Its goal is to transmit data at speeds of up to 10GB per second (for example, when downloading an 8GB movie, 3G takes about 26 hours, 4G 6 minutes, 5G 4 seconds), and message delay is only 1/1000 second (for a driverless car traveling at 100 km/hr, if you want to stop in an emergency, a 4G network car will travel 60 cm before it can begin to stop, whereas 5G only takes 7 cm), it is very reliable (99.999%), and can serve users travelling at high-speed (upto 500 km/hr).

The application potential of 5G is unlimited. After connecting all objects via the internet, and combining them with big data and artificial intelligence, 5G can provide everything from smart home security, remote patient monitoring, and autonomous driving, to virtual reality (VR) and augmented reality (AR) entertainment.

Future

Cooper, the former Motorola engineer who publicly launched the world's first mobile phone more than 40 years ago, predicted the future of wireless communications

to be an invisible supercomputer built into the human body, a human-machine integration, just like the earrings that many women wear.

Apart from communication, a supercomputer can record trivial things and manage data storage, so that you can free your mind for thinking. When you need to use data, you can easily extract it, then everyone can make full use of their brains, and the waste heat produced by the human body can also charge this supercomputer.

Sideline

/ 5G: First year of commercialisation /

2019 should be named as the first year of 5G commercialisation.

This year, the world's 5G network services were launched in quick-fire succession. The first one was in South Korea. In April 2019, SK Telecom and KT announced the launch of the services; Verizon of the U.S. followed suit. The British telecom company EE launched their services at the end of May. By June, the Ministry of Industry and Information Technology in China also officially issued 5G commercial licences, six months ahead of market expectations.

Sideline

/ 5G: Money talk /

Why have so many countries competed to launch 5G? It is expected that 5G will drive China's total economic output to RMB10 trillion (about HK$11 trillion) for the period of 2020-2025, and the total indirect economic output will reach RMB24 trillion (about HK$27 trillion), creating over 3 million jobs by 2025. A British research institute IHS Markit estimated that by 2035, the global economic benefits created by 5G will reach USD12 trillion (about HK$93 trillion), exceeding the combined consumption of China, Japan, Germany, the U.K. and France in 2016, and will create up to 22 million jobs.

Investment for 5G is huge, operators need to increase the number of existing base stations by nearly 10 times to build a high-speed and well-covered network. According to *The Economist*, the telecom industry organisation GSMA interviewed the top management of 750 telecom companies regarding "the biggest obstacle to 5G". More than half of the respondents said that 5G lacked a clear business model for earning profit. GSMA therefore expected that 62% of Asia's mobile traffic will remain as 4G by 2025, only 14% will be 5G.

Sideline

/ 5G: Street test /

According to a reporter's test on the streets of London, it is found that 5G is indeed 10 times or even 40 times faster than 4G (the transmission speed is about 1GB per second). However, the current fee package (such as the British EE) still uses the 4G approach, so the 10GB capacity with a monthly fee of £54 (nearly HK$540) can be exhausted in seconds. There was a "joke" when the BBC used 5G for a live broadcast, the video was disconnected in less than a minute as the capacity was used up. To increase the capacity, 120GB is a choice but it will cost £74 (nearly HK$740) and will still only last for a few hours.

To achieve unlimited internet access, it is necessary to greatly increase the number of base stations; it takes time and huge investment. Mainland analysts estimated that by Q4 2020, when 5G technology is more mature, network coverage is much better, and 5G mobile phones are more affordable, the number of users is expected to reach another breaking point.

Summary

- The biggest difference between the millennial and the baby boomer generation lies in mastering digital technology. How to effectively realise the millennial's talent has become the key to the future success of a company.

- The success rate of middle-aged entrepreneurs is higher, university entrepreneurship programmes should therefore focus more on the middle-aged group. Furthermore, the government's venture capital fund should also adjust accordingly, so that public funds can be used more efficiently.

- Data scientists used to be equivalent to "data analysts". Since big data is becoming more elaborate and complicated, many companies are increasingly seeking such professionals.


UPDATE
UPDATE

Chapter Two Right Timing

Hong Kong's R&D spending has been at a low percentage of its GDP. Europe, the Middle East, Singapore, and Shenzhen have invested resources into developing technology, and using 5G and the internet of things as the backbone to build a smart city; what can we learn from them when Hong Kong is moving comparatively slow? This chapter also explores the preparation of different countries for future readiness.

2.1

Are you future ready?

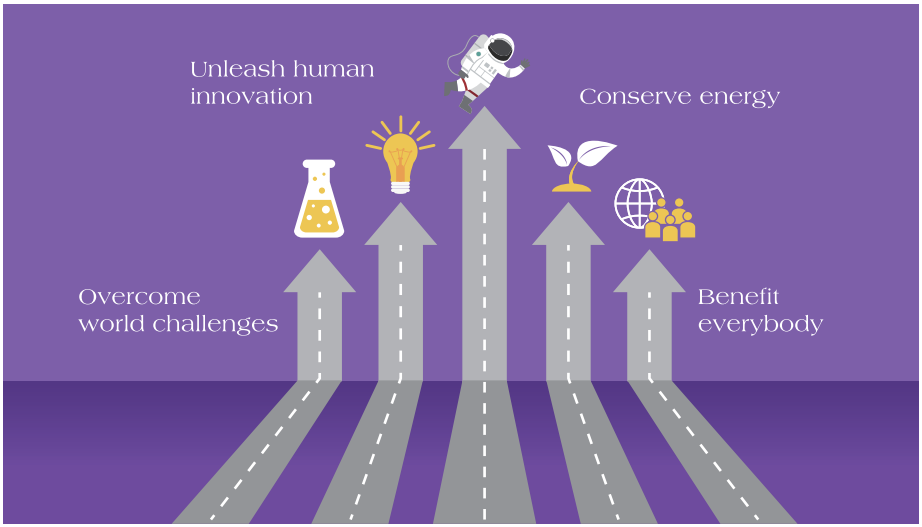
The World Economic Forum (WEF) has repeatedly reminded the world that the Fourth Industrial Revolution, driven by artificial intelligence and big data, will bring tremendous changes to the world. To survive this chaotic transition, individuals, governments and enterprises must plan ahead and work together.

While people have much interest in the ranking of different countries in WEF's *Global Competitiveness Report 2018*, the theme of the report is even more thought-provoking – it is how to prepare for future productivity, which is coined as "future readiness".

The term "future readiness" means:

(1) Overcoming the challenges of the world with technology;

"Future Readiness" Means:



(2) Unleashing human innovation and creating opportunities through new ways;

(3) Conserving energy and optimising natural resources to minimise the impact on the environment;

(4) The transformation of production systems through science and technology driven by this industrial revolution can benefit all people in society.

Singapore is the most "future ready" country, according to the Report.

To make the public's day-to-day living more convenient with digital infrastructure, the Singaporean government announced its digital plan in mid 2018. Under the new plan, the payment of fees, signing of documents, and applying for public housing can all be completed on the government's online platform. In addition, most government data will be open to the public on an application programming interface (APl) format as required by the application developers to promote the new economy. This is exactly what the WEF highlighted!

Countries around the world have also geared up to better prepare for the future. For example, Germany proposed "Industry 4.0", which is based on large-scale customisation; Japan advocated "Society 5.0", after the hunting era (Society 1.0), the agricultural society (2.0), industrial society (3.0) and information-led society (4.0). The problem with "Society 4.0" is that information is voluminous and scattered making it difficult to be used for creating value.

The latest "Society 5.0" enables a close connection between the virtual and reality through the internet of

things (IoT), a variety of knowledge and information is shared to create new value through the analysis of data. Facing the dual pressures of a declining birth rate and an ageing population, Japan's Society 5.0 is considered to be a strategy to turn the crisis into an opportunity and become a new engine to drive the country's economic growth.

However, the problems encountered in the IoT, such as system standardisation, network security, personal privacy and so on are complicated. The government cannot solve it alone. Therefore, the WEF suggested collaborations among public and private organisations as well as people from all walks of life.

2.2

Singapore: Open data accelerates innovation

In June 2018, Singapore took a strategic step in the direction of innovation and development. Its Smart Nation and Digital Government Office (SNDGO) announced a blueprint for a digital government with a five-year plan. The blueprint targets citizens, businesses and public officers, and lists the goals to be achieved by 2023.

First of all, in terms of daily activities, citizens will be able to pay bills, sign documents, apply for public housing, as well as buy and sell real estate or vehicles through the government's online platform. Meanwhile, civil servants must upgrade their digital competency, 14% or 20,000, will have to go through training in data science and analytics; departments will have to try to adopt artificial intelligence in their decision making.

Concurrently, in order to promote the innovation industries, the government will establish an open and easy-to-use information platform, that is a common spatial data infrastructure (CSDI), to provide data linked to geospatial locations in a machine readable format or application programming interface (API) for the convenience of application developers, and to facilitate the better accessibility and utilisation of data with the business sector.

Singapore's ambition is shown on the success indicators listed in the blueprint. By 2023, at least 75-80% of its citizens and the business community shall be "very satisfied" with the government's digital services. This figure represents almost the whole country. At the same time, 90-100% of the core data fields have to be available in an API format.

Geospatial information is particularly valuable. Navigant Research estimated that the value of the global market for core geographic information in 2016 was about USD1.6 billion (approximately HK$12.5 billion), and it will double

to over USD3.2 billion (HK$25 billion) by 2025. Many countries also see the potential of geospatial data, such as the United States, Canada, Japan, India, and Australia. They have set up comprehensive legislation, standards, and specialised departments to collect and manage these intangible assets, and share them with the public to optimise the potential of the data.

In Hong Kong, we have many world leading infrastructure projects. In addition to advanced technology, there are dedicated departments, such as the Hong Kong Observatory for collecting weather data, the Environmental Protection Department for creating an air pollution index and doing analysis, the Electrical and Mechanical Services Department for electrical installation, the Highways Department for road works. However, for geospatial data and location information, we lack a dedicated department to formulate relevant laws and policies for implementation by the relevant bureaux and departments. Furthermore, if the data can be shared with the public in an API format, Hong Kong's spatial information usage will be enhanced, it will also inject more fuel into the development of our innovation industries!

2.3 U.K.: Effective way to attract talent

Though the United Kingdom has remained at the top of global financial market as confirmed by various surveys, including the *Global Financial Centres Index* released in March 2018, it is still working hard to advance further. One of the initiatives involves setting up a global sandbox which can attract and converge financial technology (FinTech) professionals.

As early as 2015, the Financial Conduct Authority (FCA) in the U.K. announced that it would establish a regulatory

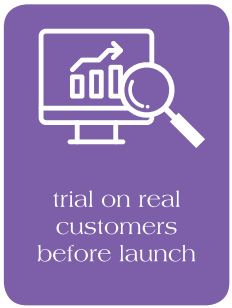
3 requirements of a sandbox:

1. Genuinely innovative
2. With identifiable consumer benefits (e.g. saving transaction fees)
3. Measures of risk management and consumer protection

sandbox. After the British official launch, Hong Kong, Singapore, Australia, Switzerland, Dubai, the United States, and Canada also established their own versions.

The "sandbox" is a metaphor, drawing the example of children playing with sand to imply that any creative idea is harmless and welcome. The sandbox products are required to be genuinely innovative, and have identifiable consumer benefits (e.g. saving transaction fees). The applicant is also required to have put in place appropriate safeguards to manage risks and protect consumers.

What is “Regulatory Sandbox”?



The establishment of a regulatory sandbox allows creative financial products to be tested in a controlled environment with real customers before they are officially launched. While participants can learn from the experience, the regulatory authorities can also explore measures required to regulate them.

According to the FCA's review, its sandbox has done a positive job in these areas: 80% of the participants in the first year were startups. At least 40% of the firms with complete testing in the first cohort received investment during or following their sandbox tests. A further 90% of the participating companies launched their tried services in a wider market.

At the same time, Britain planned the next step: to enter the global financial market arena. At the time the sandbox was launched in 2016, cooperation with various regulatory bodies in different countries and economies including Hong Kong was discussed. A blueprint for a cross-border sandbox with some regulatory bodies around the world was also raised.

The U.K. has been innovative in not only the FinTech area but also open data.

Also announced in mid 2018, geospatial data by the 227-year-old Ordnance Survey, an official map agency, would be made freely available to citizens and businesses. Small and medium enterprises (SMEs) and startups are expected to benefit the most from this opening up. The scheme is expected to produce £130 million (about HK$1.2 billion) of revenue per year for the British economy.

The new schemes are crucial to the nation's future. Firstly, about 80% of the data are related to geolocation. Secondly, geospatial data plays a key role in planning road trip routes, locating missing elderly, tracking cargo shipments, developing autonomous vehicles and deploying 5G mobile services. Moreover, the data on daily life linked with geospatial information can accurately respond to citizens' needs.

By merging the geospatial data with other data, startups

and SMEs can generate new information to develop more innovative solutions to relevant issues. Given the knock-on effects, the U.K. government estimated that the value of the British digital economy can reach £11 billion (about HK$104 billion) per year.

These geospatial data, which contain details of terrain, building heights, land use, green space, as well as the network of highways, water courses and foot / cycle paths, will certainly be made available for public access via an API. Ordnance Survey indicated that the real estate sector can make good use of open geospatial data to identify undeveloped land.

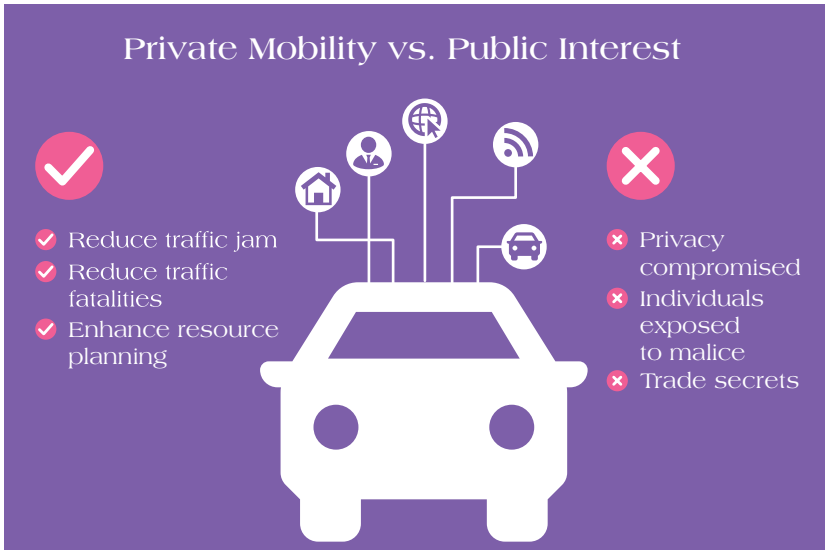
Once again, the U.K. has cemented its position as the global innovation hub which will undoubtedly become a magnet for talent. In Hong Kong, we have financial strength, resources and experience, together with the open data initiatives from the government. Therefore, we must take action proactively and as soon as possible to spot and grasp the opportunities.

2.4

New York City: How to resolve data privacy controversies

In an era of the smart city, the improvement of a city's operation is heavily data driven. That is the reason why data collection and sharing have become the key tactic for solving traffic congestion in the latest smart city blueprint released by the Hong Kong government in December 2017.

Today, connected devices are everywhere, some mobile applications have been updating their users with real-time traffic information, eg. road accidents, congestion and dangerous situations. The information may be piecemeal though, as it is limited by submissions from service subscribers. We can only have a comprehensive picture of the traffic situation with public data being open and shared among private and public organisations.



NYC's Open Data Law

Rather than just a technical policy or an executive order, which is the case in many other cities in the U.S., open data in New York City is a law. In 2012, NYC mandated that "all public data be made available on a single web portal by the end of 2018".

According to Dr Amen Ra Mashariki, the former director

of the Mayor's Office of Data Analytics in NYC, one of the major issues they needed to tackle was privacy concerns which is also a key concern of the people in Hong Kong.

In early 2017, NYC authority's requested data of pickup and drop-off times and their associated locations for every journey undertaken by for-hire-vehicles (FHV) such as Uber, for analysis and release onto the open data portal; this triggered a public outcry.

Official: Data helps reduce traffic fatalities

According to the *Driver Fatigue Rules*, a FHV driver is allowed to transport passengers for no more than 10 hours in any 24-hour session, nor can they exceed 60 hours weekly. The information collected could help monitor drivers' working hours, thus help reduce the risk of fatigue driving, in support of the city's Vision Zero initiative to reduce traffic fatalities.

At the same time, the number of FHV vehicles and trips has grown rapidly in the City with Uber and Lyft

together completing 240,000 daily trips in January 2017. In comparison 340,000 trips were undertaken by yellow taxis in the same period, so the ride-hailing trip data, eg. distances travelled during and between trips, routes and traffic conditions, is incredibly valuable to city transportation planners.

A clearer picture about pick-up time and destination data from ride-hail companies could enable public officials to better understand the companies' effect on the transportation network – whether a neighbourhood needs more frequent transport links, a commuter-friendly bus service, a new transport line or a bike-share station. Furthermore, they can see where these ridesharing companies seldom serve, who is being denied services, and how often that is happening may signal how the city needs other options.

Informed decisions on how to regulate traffic and provide transit services can then be made.

Advocate: Anxiety about data collection

Worried advocates and the public have privacy concerns that if a comprehensive log of an individual's specific travel movements was made public or accessible, the privacy of New Yorkers could be significantly compromised. In an era of heightened surveillance, this data could be used to negatively target certain groups or individuals.

People having no trust in the government is an underlying issue. According to Letitia James of New York City Public Advocate, the move came amid anxiety over the Trump Administration's stances on civil liberties and the city struggling to prevent data from being shared with the federal government.

Other concerns: Data security, trade secret

Data security is yet another concern, particularly after a flaw in the data anonymisation process by NYC officials

in 2014. As a result, software developers were able to re-identify all 173 million entries of taxi drivers' licence numbers in less than two hours, revealing which driver drove each trip in the dataset.

The data also contains trade secrets which make rideshare companies reluctant to release it - how these companies build their competitive edges in the endlessly-honed algorithms that connect their drivers to the closest riders, then route them to their destinations and onto the next trip in the most efficient manner.

Data to serve every citizen

To resolve the controversy, a formal hearing was held for citizens to engage with public officials on their concerns. As a result, instead of getting the exact location of drop-off and pickup times in the open data portal, the location is now substituted with a neighbourhood code.

As Dr Mashariki said, policy development and the implementation of Open Data in NYC was a partnership

between the agency leadership, city politicians, the civic technology leadership, government oversight groups and everyday ordinary citizens. Though a really tough task, the government has continuously engaged these different stakeholders to ensure that the open data law remains relevant and is serving the needs of everyone in NYC.

I think the NYC experience is a strong reference for people in Hong Kong; all parties in society should keep an open mind, and be willing to share and discuss everyone's concerns and aspirations with regards to the issue. This is the best way to move the city forward.

2.5

Moscow: Open data for city transformation

McKinsey, a consulting company published its report *Smart Cities: Digital Solutions For A More Livable Future* in June 2018, it contained a survey of residents in major cities around the world regarding their acceptance of advanced technologies already in use. Moscow ranked first in Europe for Muscovites' awareness and satisfaction on online applications, showing that new technologies have been successfully integrated into people's daily lives .

Moscow is one of the fastest growing cities in the world. In 2000, there were only 9 million people, by 2017 the population reached 13 million. To serve the growing population, the city accelerated its smart city development. Smart City Moscow was launched in 2011 with the goal of setting up the IT infrastructure and implementing e-health, e-education and public services in the capital by 2019.

Encourage public participation

When the plan was launched, a principle was laid down: the project and the budget should be highly transparent to facilitate citizen participation. One example is the My Street project, which is claimed as the world's largest urban reconstruction project with a three-year investment of USD1.6 billion (around HK$13 billion).

At the same time, through the Active Citizen electronic voting platform, the Muscovites were encouraged to select the road sections which they wanted to restore. As a result, more than 500,000 citizens selected 233 locations, covering streets, plazas, riverbanks; and the preferred sequence and materials to be used. Suggested new bus routes were also voted on.

After restoration, the widths of many footpaths were doubled, while more than 2,000 historical buildings were renovated, more than 10,000 trees were planted and free public WiFi was set up with seamless continuity in the city centre; the newly built 20 km bicycle track and 400 modern bus stations with free WiFi and USB charging plugs were also created. No

wonder up to 87% of the residents were satisfied with the new look and functionality of the city.

Mobile app improves mobility

Traffic congestion was another issue that Moscow faced in the past. It was once named the most congested city out of the 400 cities surveyed by TomTom, a Dutch smart mobility service provider. How did Moscow tackle the problem through technology?

The city government together with Russian and international experts jointly developed an improvement plan, and launched a smart transportation system with the related infrastructure from 2012 to 2015 to solve the problem.

Many features of the smart transportation system may be familiar to us, that is, installing thousands of sensors, video surveillance cameras, and smart traffic lights on the streets, to monitor the road's conditions in real time; enabling the proactive relief of traffic. It replaced the

practice of passively waiting for Muscovites' complaints or reports from law enforcement officials before taking action. The system not only targets traffic flow problems, but also addresses the usage of parking spaces.

In addition, there were supporting measures, including the re-organisation of public transport routes, encouraging bicycle travel, etc., together with big data analyses to improve the road conditions.

For example, the government upgraded the bus fleet and train carriages to attract more people to take public transport. By the end of 2017, 90% of the buses had been in service for less than five years and almost 40% of the metro trains were brand new. The smart transportation system collected passengers' boarding and alighting patterns so as to introduce new bus routes to reduce the need for interchanges. One new route has benefited more than 900,000 commuters in the city.

At the same time, the increase of cycling tracks provides more choice to the Muscovites. Compared to 2015, the

number of cycling trips in the city doubled to 2.3 million in 2017.

As a result, travel via public transport each year has grown from 1.9 billion in 2010 to 2.8 billion in 2017. Moscow was once ranked No.1 in terms of congestion in 2010, this dropped to 13th in 2016. Although the number of private cars increased by one million during that time, the average speed of travelling increased by 13%. At the same time, there was a time save of 65% when searching for a parking space. No wonder people in Moscow were proud of these achievements.

In addition, a mobile phone application has been set up to help people plan their journeys, find parking spaces, process payments, and rent bicycles. This popular application has 3.5 million downloads so far. The government has also developed online and mobile versions for more than 220 public services, up to 75% of the public has used these applications. These mobile applications together with the privately-developed ones, have gained wide acceptance and popularity in Moscow.

One of the most important elements of open information is a computer readable format, API, which could be used by application developers. This leads to a variety of applications for the convenience of the public in Moscow, such as traffic violation notices, or the payment of utilities. In this regard, Hong Kong really has to work harder.

2.6

South Korea: Behind the success in innovative technology

South Korea has achieved renown as one of the top three innovative countries in the world and in the Asia Pacific region by Bloomberg and the World Intellectual Property Organization respectively. In late 2018, I was invited to visit Seoul to study the secret behind its success.

One of the highlights was to visit South Korea's Silicon Valley, the Pangyo Techno Valley (PTV) which is an important information technology town. It is a miniature of the innovation and technology (innotech) development in Korea today.

South Korea was once drowned by the financial turmoil of 1997. However, the country rebounded over the last two decades and has created an amazing economic miracle in the same time its GDP per capita has doubled. Its K-Pop

and innotech are popular all over the world, together with cosmetics and skin care products, home appliances, mobile phones, food, and from clothing to automobiles, all have driven exports by more than five fold during the period.

Silicon Valley in Seongnam style

PTV was developed at the end of 2004, it is located in Seongnam of Gyeonggi-do province, only 30 km from Seoul. The government has invested over ₩100 billion (over HK$700 million) to build the 66-hectare Pangyo New Town (three times the size of the Hong Kong Science Park), with subways and highways connecting to Seoul and Incheon International Airport. The development of PTV was undertaken in three phases and it is currently in the second phase of development.

Its convenient transportation network has attracted high-tech departments from large Korean enterprises such as Samsung, SK, and LG to set up office there. In fact, 8 of the top 10 corporations in Korea, as well as 1,306 IT companies have offices located in the valley.

As of 2016, there were about 75,000 employees working in the valley, generating the largest number of job opportunities in the province and contributing 22% of its GDP.

One of the success factors of Pangyo is the government's strong support for innovation, including the allocation of more than one quarter of the land in PTV to research institutions.

In addition to nurturing startups, it also tests new technologies, such as autonomous vehicles – there will be two driverless bus services travelling between Pangyo railway station and the valley for a trial period of 12 months starting from the beginning of 2019.

Key success factors

Actually, the success of PTV is founded on the aggregate efforts of Korea over the past 20 years.

Firstly, the Korean people have been working very hard for it.

Secondly, they begin learning computer coding at kindergarten, which in turn provides ample talent for the technology industry.

Thirdly, they are very patriotic and proud of their country, they support their home culture, art and products wholeheartedly - our exchange tour had a lot of local college students acting as tour guides, where they took us sight-seeing to the old market, night market, as well as various monuments and museums. Their keen approach to learning and humble attitude is very impressive. What is more, they all have the same wish, that their country's economy can catch up with China one day.

However, as for Hong Kong, young people seem to be complacent and obstinate. As said by Professor Charles Kuen Kao, it is normal for young people to be rebellious though.

I still remember seeing a job advertisement from a hotel reservation website posted at Pangyo subway station

in Seoul. The starting salary was ₩50 million (about HK$340,000) a year. It also offered "Monday start work at 1pm" and "3 free meals a day" which both sound really attractive to young people. With the help of a number of favourable science and technology policies and an increasingly healthy environment for innotech in Hong Kong, I hope there are opportunities for our young people to develop their potential. Then one day, we could see job advertisements everywhere competing for local talent similar to Pangyo today.

2.7

Middle East: Using data to enhance competitiveness

My trip to the United States to participate in the Esri User Conference in July 2018 was very rewarding. The five-day intensive conference showcased new geographic information system (GIS) applications to 18,000 users around the world. Some countries are racing to take advantage of information technology and overtake others via a gap jump, which is very impressive.

For example, when we talk about the Middle East, we only think of oil and desert in the past. However, when we saw the female custodian of Dubai's IT policy at the 2017 Esri conference, she talked about how to shape Smart Dubai, which massively subverted people's previous deep impressions of the region. This is not an individual case. I met another outstanding Middle Eastern woman at the conference in 2018 – H.E. Dr Rauda Saeed Al Saadi

from Abu Dhabi. She is the Director General of the Smart Solutions and Services Authority (ADSSSA) and she gave me the same positive impression.

Abu Dhabi: Advanced geospatial contact centre

Abu Dhabi is the capital of the United Arab Emirates, the second largest city in this rich country. It has a population of nearly three million.

The ADSSSA is responsible for assisting various governmental departments to upgrade their services through information technology. The Authority drafts policies, formulates strategies, and provides operational support to achieve the government integration of information and communication technologies. Its recent major project is to build a Smart Geospatial Contact Centre. It is the world's first full-service platform that gathers all government big data, geographic information, machine learning and artificial intelligence to provide quality, fast, and people-oriented services. For example, when a citizen

has an urgent need and calls for help, the contact centre can quickly locate the citizen, and make the support service more readily available.

The Abu Dhabi government greatly appreciates the importance of geospatial data. The implementation of the My Address (Onwani) project which facilitates mobility and emergency rescue is a showcase. Having no formal address at the previous local street system, the new project added a formal address and QR code to more than 200,000 street signs, lampposts or buildings, while the exact location could be obtained with a scan from a smart phone. Currently, local schools in Abu Dhabi from kindergarten to middle school have added GIS to their regular courses. In Hong Kong, students can only access GIS subjects at the university level, we are lagging behind Abu Dhabi.

Qatar: Towards online government

When we talk about the Middle East, we have to mention Qatar too. As the first Middle East country to host the

World Cup, Qatar has also taken the opportunity to use information technology to promote its national image.

Qatar is about 10 times Hong Kong's size, it has a population of over two million, but the natural resources bring it a GDP per capita of USD125,006 (nearly HK$1 million). Its information technology policy in recent years is worthy of attention. In 2014, the Ministry of Information and Communications Technology published the *Qatar Digital Government 2020 Strategy*, with the target of establishing a more open and advanced government within five years. This includes putting all government services online so that people can complete transactions at home; most importantly, the government will open data to encourage people to participate in policy making which, in turn stimulates innovation and promotes economic diversification.

Back to Hong Kong, we have always been proud of our advanced infrastructure and comprehensive systems. However, others have caught up and even overtaken us today.

The full implementation of an IT strategy is a great opportunity for us to "overtake by jumping the gap" – riding on comprehensive legislation, standards and dedicated departments to collect and manage various government data, especially geospatial information. More critical is that the relevant department should immediately commit to an exact timetable and implement a common spatial data infrastructure (CSDI) which is open to the public so that we can fully reap the potential of the data.

If we delay further, Hong Kong will miss the great opportunity to catch up with her peers.

2.8 Israel: Learning from the Startup Nation

Israel has more than 80 technology companies listed on NASDAQ in the United States, which is two-thirds that of China, though it has a small population of less than nine million and encounters constant military clashes with its neighbours. No wonder why in the past 20 years, two of Hong Kong's chief executives: Tung Chee-hwa and Leung Chun-ying visited the country, not to mention numerous official and private groups have also; everyone wants to learn how this tiny nation excels in innovation and technology.

In late 2018, I accompanied the Financial Secretary to Tel Aviv and Jerusalem for an exchange visit to its business sector, innotech companies and research institutions. For me, this was an eye-opening tour.

A few big ticket acquisitions have once again cemented the country's position as the world's Startup Nation. These include: Waze, a traffic and navigation startup acquired by Google for USD1.3 billion; and Mobileye, an autonomous-driving mobile phone startup acquired by Intel for USD15.3 billion while its home-grown taxi app Gett was valued at USD1.4 billion. The country has also achieved outstanding results in network security and financial technology (FinTech).

For example, The Floor, a FinTech matching platform established in 2016, has been very impressive. The company employs less than 10 people and specialises in identifying innovative solutions for financial organisations. In addition to cooperating with the world's six major financial organisations, it also acts as an intermediary to connect investors and startups. Its business has developed rapidly, with a branch recently established in Hong Kong.

Orcam, another tech company we visited, displayed spectacles that speak Mandarin. A small chip that is

installed in the frame has a face recognition function, it can also convert text into speech and read the content of a book through a miniature speaker. This thoughtful design is expected to be popular among the elderly and the visually impaired.

The representatives of Science Park and Cyberport pointed out that the startups in Hong Kong are also world class. Our development of biomedical science such as blood tests for cancer is comparable to that of Israel.

Having said that, Hong Kong had less than 3,000 startups in 2018, while Israel had nearly 7,000, and has the largest number of startups per capita in the world.

I think we could learn the following from Israel to boost our startup establishment:

Israeli Advantages

1. Go global —

- Israel is a tiny country with a small population, so going global is the only way to survive. As a result, startups there can successfully attract foreign investors.

- More than two-thirds of funding deals with local startups consist of foreign investment of which Europe and the United States account for more than 70%.
- There are more than 300 multinational companies to attract local talent and acquire scientific research results through the establishment of R&D centres or the acquisition of startups.

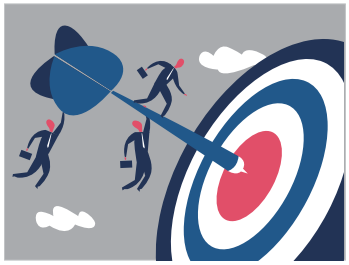
➜ **Therefore, Hong Kong's startups should also think global and go global.**

2. Dare to take risks

- 27% of Israeli startup founders are repeated entrepreneurs, this means they may have sold their former business and started another one. As they are experienced, it is easier for them to pick up the operation of a new business.
- The Israelis are born in crisis, they are not afraid of repeated failures and trials.

➜ **In contrast, most Hong Kong people are in a comfort zone, and are less ambitious.**

3. Result oriented



- The Israeli traditional Chutzpah means to dare to challenge the conventional thinking. They are non-hierarchical and not afraid to question their superior and teachers which is essential to innovation.
- They focus on what really matters and seldom engage in superfluous work.

In addition, the Israeli government has been working hard in education and innovation policy for more than 20 years, laying a solid foundation for the opportunities brought by the technology wave later. Hong Kong should catch up now, so that some years later, we can bring today's effort to fruition as Israel has today.

2.9

Hong Kong: Stanford + Silicon Valley model?

Xu Li, CEO of SenseTime, a local unicorn (a startup with a valuation of USD1 billion) from the mainland, who studied a doctoral degree at the Chinese University of Hong Kong, shared his insight recently on how Hong Kong can become an innovation and technology (I&T) hub. He believes that Hong Kong has a solid scientific research foundation which China cannot compete with. The problem is that, its ecosystem for the industry is weak.

I cannot agree more with him. Hong Kong indeed has a number of advantages which have the potential to transform it into an I&T hub, if the policy is right.

First of all, we are well-known in scientific research such as artificial intelligence (AI). In terms of citation and influence (H-index), Hong Kong's AI theses ranks 10th in the world.

At the conference of the world recognised Association for the Advancement of Artificial intelligence (AAAI) held in early 2019, the acceptance rate of theses from Hong Kong was over 20%, among the top five in the world.

GBA's most international city

Being international is also our advantage. In the *Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area*, the word "international" appears 123 times. In the third chapter describing Hong Kong in 140 words, "international" has been mentioned more than five times. Hong Kong is the most international place in the Greater Bay Area (GBA).

Hong Kong is strong in attracting capital from across the globe. Last year, 207 companies were newly listed on the Hong Kong Stock Exchange, raising funds of HK$288 billion, the highest among all stock exchanges. Companies that raise capital in Hong Kong include mainland companies such as China Tower, Xiaomi and Meituan-Dianping.

Apart from capital and networks, more importantly, Hong Kong attracts more overseas talent due to its open culture. According to a survey conducted by Invest Hong Kong at the end of 2018, 35% of entrepreneurs in Hong Kong came from overseas, among them over 40% from the United States, the United Kingdom and Australia. At the same time, INSEAD, a European business school published the *Global Talent Competitiveness Index 2019* where Hong Kong ranks 27th out of 114 cities in the world, its talent competitiveness is significantly ahead of mainland cities (Beijing: 58th, Guangzhou: 87th, Shenzhen: 94th). Hong Kong's simple and low tax rate, combined with a sound legal system, free flow of information and the protection of intellectual property are factors of attraction.

Fierce talent competition

However, since China's State Administration of Foreign Experts Affairs launched the *Thousand Talents Plan* in 2008 by which selected foreign talents can receive a research grant of up to RMB 5 million, lots of talents have left for China. Two local university professors have

had personal experience of losing their postdoctoral researchers to mainland institutes. One of them was offered an extra sponsorship of RMB 0.5 million a year after being recruited by a Shenzhen (SZ) government listed biotech company.

Apart from I&T, the finance sector is another focus for the mainland. Guangzhou (GZ), another major city in GBA, launched a new policy in October 2018 with a subsidy of RMB 500,000 for each senior manager with outstanding performance in the finance industry. For talents newly relocated to GZ, RMB 1 million each will be offered as a settling fee. Additionally, SZ introduced a series of measures in January 2019. For example, RMB 1 million each will be awarded to financial organisations and tertiary institutes which offer first-rate training programmes.

What is more, although the Hong Kong government has already committed over $100 billion in I&T so far and aims at 1.5% of GDP in research and development (R&D) spending from 0.73%, this is still far below SZ's achievement of 4% annually. Yet GZ recorded only 2.4% of

GDP in R&D spending in 2017, they are aiming for 3% in the near future.

Under strong competition from neighbouring cities, it is difficult for Hong Kong to effectively attract and retain talent. The relatively uncompetitive compensation and benefits, small and expensive housing, and poor air quality have all made it difficult for overseas talent to live and work in a comfortable way here. This has also caused Hong Kong's ranking as a top destination to drop from 11th in 2013 to 41st in 2019 in a global expatriate survey.

Hong Kong + Shenzhen?

Although Financial Secretary Paul Chan continues to invest over HK$45 billion to drive the development of I&T infrastructure and talent retention in Hong Kong through the *Budget* released in early 2019, to retain and attract more talent to Hong Kong, the government still has to do more. We need policies and the right environment to encourage researchers and students to commercialise their ideas which can really help jumpstart the development of I&T in Hong Kong.

In fact, SZ, China's Silicon Valley, has a large pool of I&T talent. Can Hong Kong assume the role of primary research and development, while cooperating with the production establishments in GBA cities such as SZ, so that commercialisation can be realised? In other words, we leverage the technology development and industrial capabilities of GBA cities while Hong Kong remains as the driver, just like the inter-dependency between Stanford University and Silicon Valley in the U.S.

Stanford University + Silicon Valley

In the past, Stanford University was a second-rate engineering school but nowadays, it has become the No. 1 choice for most students, over Harvard and Princeton. While the goal of most of academia is to advance knowledge for the sake of knowledge, not to commercialise technology, Stanford's engineering school has shown a strong entrepreneurial spirit in building the tech boom; resulting in some of the most celebrated innovations in Silicon Valley. Stanford's research park houses not only cutting-edge companies like Tesla and

Skype, but also world-renowned tech law firms and research and development labs. What is more, the first 100 staff of Google, the tech giant in the Silicon Valley, hailed from Stanford. Even today, 1 in 20 Google staff are also former Stanford students.

If Hong Kong can encourage an entrepreneurial spirit among local academia and work with Shenzhen using this model to boost the ecosystem, the GBA can one day become a talent magnet like Stanford University and Silicon Valley.

Therefore, whether or not Hong Kong can transform into a talent hub very much depends on the successful development of an ecosystem in the GBA.

Summary

- The Fourth Industrial Revolution driven by artificial intelligence, big data, etc., will turn the world upside down, the key to success is flexibility and planning ahead, the primary task of every country is to be “future ready”.

- The common spatial data infrastructure (CSDI) gathers all data related to people’s livelihoods on a single platform and promotes innovation; the government can also set up an information system on the platform for coordinating resources to address emergencies.

Chapter Three Right Place

What is the economical contribution of spatial data and positioning technology? The answer is thousands of billions of dollars and it is growing. The government should open up more data to society, build a multi-level information sharing platform, and set up appropriate regulations to develop innovative technology such as autonomous driving and AI big data to enhance social efficiency.

3.1

Spatial thinking facilitates development

It is estimated that as much as 60% of the human brain is involved in processing what we see. The eye and brain coordination forms our spatial cognition.

To know where we are and the relative location within the outside world (e.g. buildings, cars or other landmarks) is a very important ability. Our ancestors could not find food or procreate without spatial cognition.

Studies by Nobel Prize winning scientists found that human's brains, like that of migrating birds, have a very sophisticated tracking system, it is like a built-in global positioning system (GPS) which can help us travel around earth. This instinct, which has allowed human beings to survive for millions of years, is very crucial. Today, the importance of spatial cognition continues unabated.

Highly connected internet of things

The geographic information system (GIS), also known as an electronic map, combines, organises, and analyses diversified data based on spatial locations, transforming the data into valuable information to facilitate decision making. Today, many people talk about a smart city where the flexible use of GIS forms a critical foundation for building the smart city.

On many occasions, I have talked about Smart City 3.0 of which the essence is collaboration among the public, the government, business organisations and academia. A common spatial data infrastructure (CSDI) is formed using information provided by the public, social media and sensor networks in public places and solves the problems of every metropolis, such as traffic congestion, elderly care and the heat island effect.

A gigantic network of IoT

If the sensor network serves as human eyes, the internet of things (IoT) is like a brain wave transmission system. Today's IoT is large in scale, the objects connecting to the

network are getting to be more numerous than the number of human beings on earth. It is estimated that by 2020, up to 50 billion pieces of objects will be connected, including smart phones, connected cars, roads and bridges, underground pipes, as well as vehicle and pedestrian traffic detectors, air quality sensors, in-field monitors of atmospheric changes and the movement of tectonic plates. At the same time, they are also connected with shopping malls, schools, and office buildings, as well as all kinds of smart home appliances.

Together, these fragmented and real-time data sources form a CSDI, while GIS software is used to analyse the data to discover the rules and patterns of things, turning it into useful information and insights. This not only promotes efficiency and facilitates the monitoring of governments, but it also enables a smarter modern life.

Hong Kong's way forward

The *Smart City Blueprint for Hong Kong* released by the Government in 2017 announced its intention to open data

from the public and private sectors to promote scientific research and innovations. This is a positive proposal. It also mentioned "Hong Kong is all geared up for the commercial launch of 5G services and applications in 2020" - 5G is a ultra-high speed and high-capacity data service that provides reliable and low-latency communication between the IoT. If 5G can be launched as quickly as possible, the above mentioned solutions to smart city problems will be available sooner.

In the past, our ancestors used the innate abilities of spatial thinking to hunt or procreate offspring. I expect that science and technology will further develop this instinct to a more profound level and lead us and our coming generations to a better life.

3.2

Data platforms enhance governance and promote innovation

When we review Hong Kong's history in the future, 2018/19 should mark a year where the promotion of governance transparency, innovation and development were advanced by leaps and bounds.

Firstly, the Lands Department launched a new website Hong Kong Map Service 2.0 (HKMS 2.0) and an updated version of GeoInfo Map in August and December 2018 respectively, providing a variety of real-time information such as weather, air quality and traffic conditions. Public endorsement could be seen from the average hit rate of five million per week.

In January 2019, the Office of the Government Chief Information Officer (OGCIO) announced the first annual open data plan for over 80 government bureaux and departments.

It also announced that more than 650 datasets will be opened free of charge for the public to browse and use on the website (data.gov.hk) in the same year. Such a move fulfils the promise of the Chief Executive to open data which was given in the policy address of 2018.

In fact, the Government has a huge amount of information. The priority of opening data depends on their use for solving current problems. Therefore, I think the government should set up three different tiers of data sharing platforms to fulfil various needs:

1. Common spatial data infrastructure (CSDI) – to promote innovations
   - An open and easy-to-use data sharing platform
   - Data in a machine readable format or application programming interface (API) for application developers and startups to develop mobile applications
   - The Singapore government plans to make at least 90% of government data available in API by 2023

2. Common Operational Picture (COP) – to address large-scale events or disaster relief
    - A central information platform can immediately become a command and coordination centre in case of emergency, allowing officers in charge to instantly master the overall situation to allocate resources and issue commands
    - The Chicago Marathon in the United States is an example
    - If a COP was available during Typhoon Mangkhut in 2018, the COP could integrate various pieces of data in real time, and link the information on buses and the MTR for full analytical potential on a map. The nightmare of "resuming work" could then be avoided
    - The Geotechnical Engineering Office in the Civil Engineering and Development Department has established a COP with information from various work departments, including the latest data from 90 rain gauges, and emergency information such as landslide reports. Information is uploaded to the cloud server for integration, and the distribution of emergency events is displayed on a large screen to determine the response action

3. City Dashboard – to increase government transparency

- The Hong Kong government will introduce a City Dashboard by the end 2019
- The Mayor's Dashboard in Los Angeles, U.S. updates information of public interest, including on housing, transportation, the economy and public security, etc., and compares the expected standards with the most up-to-date situation, enabling the public to monitor the government's performance at a glance
- A City Dashboard was demonstrated in the 2019 ICT Expo in Hong Kong. Using open data from different government departments to present issues of public interest, eg. the real-time average traffic speed of several major districts and the three cross harbour tunnels, as well as parking availability and the temperature and rainfall of various districts in Hong Kong. It uses maps, icons, charts, and real-time images for easy understanding. The content will later be enriched with the arrival information of public bus companies.

This third-tier platform translates the data analysis into wisdom for better urban management and mobility planning, enhancing the city's governance.

In today's fast-changing world, the use of data not only stimulates urban innovation and leads to rational discussion, it also transforms the discussions into a smart compass to promote better governance. Therefore, the Government should establish the infrastructure of the above three-tier data platforms as soon as possible and transform Hong Kong into a future-ready smart city.

3.3

The cost and benefits of geospatial information

In both the *Budget* released in early 2019 and the central government's *Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area* ("GBA Plan") issued in February 2019, a geospatial data platform was mentioned.

HK$300 million has been earmarked for setting up a one-stop data supermarket or the common spatial data infrastructure (CSDI) according to the *2019 Budget*; while a "spatial service information platform" for the development of a smart city has been detailed in chapter 5 of the *GBA Plan*.

Both platforms are actually the same with all data centring on geographic or locational information.

Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area

The document mentions two information platforms:

1. A "spatial information service platform" for developing smart cities - "exploring the establishment of common standards, opening up data ports, developing interconnected public application platforms and information infrastructure facilities" so that we can "develop smart transport, smart energy, smart municipal management and smart communities." (Chapter 5: Expediting Infrastructural Connectivity)
2. A coordination platform - to "improve the mechanism for contingency management" in the face of accidents, disasters, and public health crisis. (Chapter 8: Developing a Quality Living Circle for Living, Working and Travelling)

Why centre on geographic information

It is estimated that 80% of data is related to geographic location, so it is logical for data to be referenced with respect to their location, and depicted on a map, which makes it easier for people to understand.

At the beginning of January 2019, the open data plan unveiled by the Hong Kong government formed an

important part of the CSDI. What we need to do right now is to speed up the formation of a successful spatial information platform by encouraging greater usage from startups, private organisations and even government departments.

Linking location information with datasets can make better sense of the data, it has been proven to be beneficial to businesses and the society at large as well.

Best practice

The British government is one of the most advanced in the world in terms of open data. The Business, Innovation and Skills Department published a report *Market Assessment of Public Sector Information* in 2013, reviewing the effectiveness of open data, it is worthy of our reference.

The more than 200 pages of report mentioned that geo-spatial data is the most popular and potentially the most valuable, as well as the most sought after data. It is estimated to generate more than £323 million (over HK$3

billion) worth of the U.K.'s GDP. The report also quoted examples from other countries: such as the Australian government's opening of spatial data for free since 2001, with an estimated benefit of USD70 million (nearly HK$550 million). The cost was only eight percent of the revenue. This reinforces the view that making data available generates benefits in excess of the cost involved.

The Lands Department should take the lead

With the above in mind, when opening up the data the Hong Kong government departments should take account of public needs and also attach geographic information to the data required. This seems easy, but industry insiders commented that it is quite cumbersome to unify the address and location information from different sources and non-unified formats. Therefore, the Lands Department, with its rich experience, should take the lead to collaborate with the Office of the Government Chief Information Officer responsible for co-ordination. Jointly they should help other departments to promote the opening of data.

With the continuous increase of the data quantity and quality, together with our more than 20 years experience in utilising an advanced geographic information system for analysis, we can certainly lead our counterparts in the Greater Bay Area to develop a "spatial information service platform" and its application, ie. "emergency response platform" stipulated in the *GBA Plan*. As such, Hong Kong could strengthen its leadership position in the region.

3.4 Dedicated department needed for geospatial policy

From searching for the shortest route to destinations, helping co-ordinate search and rescue operations, locating a lost child or the elderly, to tracking the real-time location of buses and facilitating future autonomous vehicles, geospatial data or location-based services have played an essential role in our daily lives, businesses and society as a whole.

But what economic value does this kind of data bring? The Australian government estimated how geospatial data can generate up to Aus$73 billion (approx. HK$430 billion) benefit to the country by 2030. Improvements in precision navigation (down to 2–5 cm accuracy) can enable innovation and efficiency across a range of activities, including agriculture, transport, emergency management, mining, engineering, and logistics.

Value of Geospatial Data

Australian government	estimate of up to Aus$73 billion (approx.HK$430 billion) brought to the country by 2030
British consulting firm Oxera	up to USD270 billion (about HK$2,119 billion) added to global revenue each year. Growing by 30% annually
Australian firm AlphaBeta	USD400 billion (about HK3,139 billion) of commercial value

A British consulting firm, Oxera, tried to quantify the industry's impact on consumer welfare and the worldwide economy in 2013. Ranging from the lifesaving effects of faster emergency responses, to the billions of dollars and hours saved on travel, as well as the far-reaching impact on jobs and business efficiencies, including digital maps and satellite imagery per year, the agency estimated that geospatial data generated up to USD270 billion (about HK$2,119 billion) in global revenue each year. The figure was expected to grow by 30 percent annually.

The latest estimates went up to USD400 billion (about

HK3,139 billion), according to research conducted by an Australian firm AlphaBeta in 2017. The study was based on consumer surveys from across 22 countries in six regions and employed a big data analysis of online job postings and other analytics. The report also mentioned that the total economic contribution of geospatial data should be several times higher, "as geospatial services have a myriad of other positive effects for society and the environment."

Estimating global value by combining data from multiple sources is certainly not a precise science. However, the above figures clearly show that geospatial data is expected to greatly enable the advancement of the economy and improve our living standards.

Other countries optimise the value of geospatial data

In fact, many countries like the United States, Japan, Australia, India and Canada all appreciate the strategic value of geospatial data, and have well-developed policies, laws, standards, and dedicated departments to manage

this invisible asset, from collecting and disseminating to sharing with the public. They make the best use of the potential and the value of this resource.

U.S.

The Federal Geographic Data Committee in the U.S. has provided executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the Federal government since the 1990s.

Australia

Geoscience Australia, a government organisation founded in 2001, is responsible for coordinating various departments, which in turn are responsible for the location information in all cities and to ensure that the information is properly collected and used.

Japan

Japan's Geospatial Information Authority passed the *Basic Act on the Advancement of Utilizing Geospatial Information* in 2007, ensuring that the state and all local governments follow the same set of standards, it also allows citizens to enjoy the information for free.

Canada

In Canada, a national geospatial policy was introduced in 2009, including a broad range of practical instruments such as guidelines, best practices, procedures and manuals, covering the whole cycle of data collection, management, release, and usage. In 2013, the government of Canada launched an open data portal (data.gc.ca) which houses over 200,000 datasets and of which 97% are geospatial datasets. The aim is to ensure easy and consistent access to government data and information which can accelerate innovation for prosperity.

India

India's national geospatial information agency was set up to promote the *National Geospatial Policy* which unifies and manages data from over a dozen departments.

What about Hong Kong?

Hong Kong has a lot of renowned infrastructure developed and managed by advanced technology entities and dedicated government departments. For example, the Observatory collects weather data, the Environmental Protection Department carries out air pollution analysis, the Electrical and Mechanical Services Department is responsible for electrical installation and the Highways Department maintains the road. If there was a dedicated department for the territory's geospatial data and positioning information, who would be responsible for formulating policies and regulations for the implementation of relevant bureaux and departments, as well as sharing relevant data with the public, it would enhance the efficient application of spatial technology in Hong Kong, and also

create opportunities for innovation in various industries.

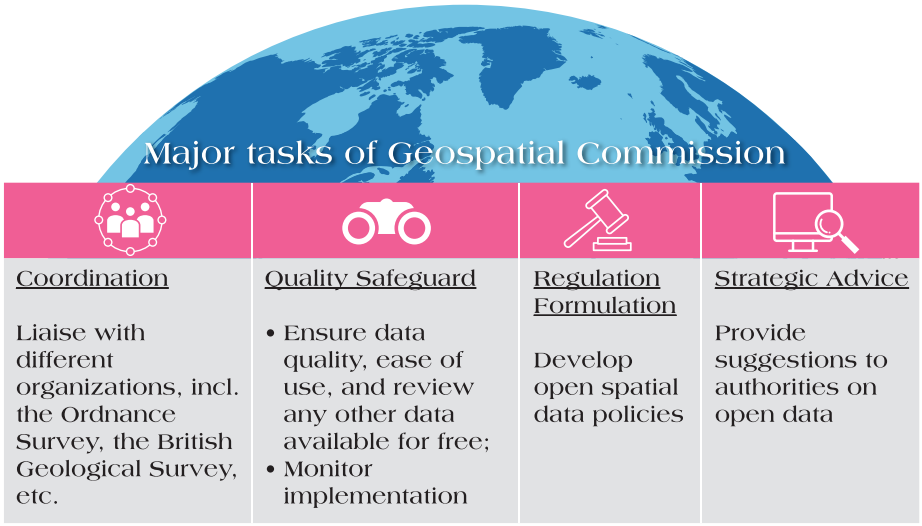
We must seize the opportunity to materialise this concept. Before a dedicated government department is formed which can take some time, we should start by including a transceiver function for accurate positioning information in the smart lamppost project, which is a major smart city pilot programme. With this, a strong foundation will be laid for future use.

3.5

Opening geographic data fosters the new economy

In the *2019 Budget*, Financial Secretary Paul Chan earmarked $300 million for setting up the one-stop data supermarket or a common spatial data infrastructure (CSDI). This is really encouraging.

Over the past decade, the importance of location data for businesses and governments around the globe has grown significantly, with the latest estimates putting the global market for geographical information in excess of USD13 billion (HK$101 billion) by 2025. Many countries around the world value geospatial information. The United Kingdom proclaims to be the global leader in this area. I think the claim is valid with its recent establishment of a new department.



The U.K. has had a number of government agencies that collect and study geographic data, e.g. the more-than-200-year old Ordnance Survey, and the British Geological Survey, which will celebrate its 185th anniversary next year.

At the end of 2017, the U.K. government announced establishing a new Geospatial Commission. The new set-up is under the Cabinet Office with a goal to boost the productivity of public and private organisations and has an annual budget of £40 million (HK$400 million).

The work of the new Geospatial Commission mainly includes:

1. Coordinate different geographic information organisations, such as the Ordnance Survey, the British Geological Survey, the HM Land Registry, and the Valuation Office Agency, etc., to ensure linkage of data, data quality and ease of use
2. Look into making more geospatial data available for free and without restriction
3. Formulate regulation and policies related to spatial data made available to the public sector
4. Monitor the effectiveness of different departments in implementing geospatial strategies; provide strategic advice to government decision-making authorities and relevant organisations.

Its primary task was opening up the data of the Ordnance Survey from 2018, which, in turn, will benefit all sectors, especially SMEs. To ensure accurate data, the Ordnance Survey updates its national MasterMap seven times per minute, equalling more than 10,000 updates each day of the year. In the past, most of these data were not open

to the public, people had to pay to obtain the data, which accumulated to £150 million (HK$1.5 billion) in the previous year.

Spatial data helps spur an £11 billion new economy

However, the British government has long recognised that the potential of geographic information for economic development is far more than the fee collected. The Chairman of Ordnance Survey expected that these spatial data will generate up to £6 billion (HK$ 60 billion) in the next 10 years. The new policy will bring an annual benefit of £130 million (HK$1.3 billion) to the U.K. economy. SMEs and startups can directly use these data, as well as combine them with other public data to generate new information and thus promote innovation. With this chain reaction, it is believed that the overall digital economy of the U.K. will be raised to £11 billion (HK$110 billion) per year.

In addition, the Geospatial Commission promotes the development of spatial information for use by the public,

such as a jointly organised competition with another department, Innovate UK, to encourage crowdsourcing spatial data with a generous bonus of £1.5 million (approximately HK$15 million); thereby improving public services.

If Hong Kong aims at innovation, it is time to set up a designated department to formulate laws and regulations to be implemented by relevant bureaux and departments, and also open the data to the public. By doing so, we could improve the quality of spatial information and create business opportunities made available by innovations and technology!

3.6

Hong Kong can build a cutting edge via open data

According to the navigation company TomTom, traffic congestion has cost each passenger in Hong Kong more than half an hour a day, totalling 145 hours a year on average. No wonder the first issue the *Hong Kong Smart City Blueprint*, released in 2017, addressed was Smart Mobility. Though the government has initiated a number of methods, from in-vehicle units to traffic detectors, to collect real-time traffic data, it is certain that aggregate location information from mobile networks can provide comprehensive insights into commuters' travel patterns - few organisations possess more data than the mobile networks as the number of mobile phone subscriptions in Hong Kong has long outnumbered the size of our total population by over two to one, based on the latest official statistics.

The phrase “aggregate information”, means “collective data that relates to a group or category of services or customers, from which individual customer identities and characteristics have been removed”, according to a definition from the United States legislation.

Utilising these data can promote efficiency and create opportunities for the community at large. It can inspire people to find innovative solutions not limited to traffic issues but also ways to improve our quality of life and boost the economy. According to IDC, a research agency, the big data and business analytics market will grow

globally from USD150 billion in 2017 to over USD210 billion by 2020. The prerequisite of this requires the opening and sharing of public information like New York City where open data is enforced using a law that mandates “all public data be made available on a single web portal”.

Hong Kong's outdated data policy

In Hong Kong, we have yet to legislate open data. Though the Chief Executive has committed to make more data available to the public, the licence conditions of mobile operators, for example, prohibit the operators disclosing the customer information other than as necessary for providing the telecom service, even if the data is aggregate and anonymous. This outdated policy negates the treasure trove of data that mobile operators sit on.

Outside Hong Kong, a lot of places have allowed the use and sharing of these aggregate data, the U.S. is one and Japan another.

In order to “facilitate and legitimise business analytics

and the positive use of big data", Japan has renewed its privacy law, with effect from mid 2017, to introduce a concept of "anonymously processed information". The new change in privacy law allows organisations to process or transfer customer information after data has been "anonymised, pseudonymised". In other words, if a customer's identity, including name, biometric information, and government issued numbers, etc, are all removed, then no consent is required whether the data is aggregated or not. Smart Dubai in the United Arab Emirates has also collected anonymous cellular data from commuters to help transportation officials analyse the traffic flow during peak hours and, in turn, to formulate measures which can reduce traffic congestion.

Singapore: Data is a valuable resource

Singapore has tried to make the best use of anonymous customer data. Its three mobile operators – Singtel, Starhub and M1 – provide data analytics to businesses as well as government agencies. One of these analyses relate to commuting patterns. This data enables selecting new

locations for retail outlets, and differentiating the rental rates and the tenant mix for mall operators, all based on anonymously mapping crowd movements in shopping malls; identifying the peak and off-peak period of the day and which entrances or exits visitors mainly use. Healthcare service providers are using millions of medical transactions at public hospitals to flag any concentration of cases relating to a particular chronic condition such as diabetes, in terms of geographical areas; at the same time, the public housing agency has improved its service after analysing over 90,000 emails and discovering customer concerns on certain issues.

Protection of personal privacy a must

While allowing and encouraging innovation, it is equally important to strike a proper balance between the development of big data applications and the right of individuals to privacy. This is the reason why many governments have tightened people's privacy protection.

The British authority, for example, revised the *Data*

Protection Bill in September 2017, it included tougher rules on consent, the right of access, move and delete data; in May 2018, "the most important change in data privacy regulation in 20 years" regarding the European Union *General Data Protection Regulation* started to take effect. Both of these updates include the "right to be forgotten", that means "individuals will be able to ask for their personal data to be erased" from an organisation's records including on social media. This offers peace of mind for citizens.

As pointed out by Chan Chun Sing, a member of Singapore's Committee on the Future Economy, big data is a valuable economic resource that allows the country to "overcome its intrinsic limitations in land, human capital and natural resources". In the era of smart city 3.0, which is to embrace citizens collaboratively building our future smart city, I truly hope that the Government will hasten the implementation of opening and sharing data to build Hong Kong into a world class smart city.

3.7 Data transparency promotes mutual trust

The smart lamppost project, an important pilot programme of the smart city development in Hong Kong, will collect a lot of city data, for example on air pollution and traffic. However, public concern on their privacy being intruded has been heightened by Facebook's leakage of customer data. How can the government gain the trust of its people? I think enhancing the transparency and opening the data related to people's everyday activities will certainly help. The proven local and overseas experiences tell us it can not only reduce bias, but also help facilitate rational public discussion.

Chicago's example: Array of Things

Increasing data transparency will increase people's confidence in the government. Chicago, one of the largest city in the United States, installed 500 real-time

environmental data collection boxes with sensors and cameras in lampposts by the end of 2018. The project "Array of Things" collects data on air quality, weather conditions, magnetic fields, noise, and traffic.

Though initiated by the University of Chicago, every party of the society, including the public, researchers, private companies, and the government, can submit a proposal. Once approved, the data will be collected for free and made available to the public. It is expected to promote innovative applications, alongside serving as a research instrument.

As it will collect public data and images, privacy concerns have been aroused. For example, one of the applications is to understand the interaction of cars, bicycles and pedestrians at road intersections so as to resolve the conflicts among the three parties. People worried that the video camera erected on the roadside would also record their images.

Public concern on data privacy

Instead of capturing video, the cameras only recorded one or two still images per second. At the same time, the microcomputer in the lamppost box would only extract data according to the researcher's pre-defined requirements, for example, the number of cars, heavy trucks or pedestrians passing through the intersection. After extracting the data, the computer would automatically delete the images within minutes. Moreover, the cameras are limited in the level of detail they can capture, ensuring that researchers cannot obtain information such as licence plates or detailed images of human faces, protecting the privacy of the public.

Increasing transparency can also help to reduce discrimination and bias, as pointed out by two Oxford University scholars. In their article exploring the potential impact of the European Union's new *General Data Protection Regulation* (GDPR). They pointed out that many machine learning algorithms in artificial intelligence are a black-box operation; the impact can be large, such as

cases involving personal credit, criminal tendency, or can be small as in a survey on interest in new products. GDPR, came into force from 25th May 2018 and requires all EU countries to authorise users to obtain their own personal data already collected for free, and to request the removal or transfer of their data to other organisations. Users may also request organisations to provide an explanation of the assumptions made by algorithms if they suspect they have been treated in an unfair manner.

HK Observatory's example: Open data reinforces authority

Government and public organisations may worry that opening data to the public would damage their authority. The 20 years of experience of opening data from the Hong Kong Observatory (HKO) shows that high data transparency helps to reduce public suspicion, and thus enhances the trust with an organisation.

As retold by Lam Chiu Ying, the former Director of the HKO, with the intensive flow of global information in the

1990s, people in Hong Kong established an underground observatory on rich information that attracted many fans. As a result, the HKO decided to set up its own website in 1996, which has been a great success with continuously enriched content since then.

By 2016, the total traffic of the HKO website reached 100 billion pages, equivalent to 40 inquiries per day by each person in Hong Kong. The website is cost effective in that each inquiry only costs the organisation 0.3 cents.

Open data can promote trust

With all data open to the public, "The citizens would not criticise the HKO for hiding facts. This greatly decreased the public's dissatisfaction and mistrust, resulting in rational interaction between the HKO and the public," Lam concluded.

Trust is a lubricant for reducing friction between the government and its people. This will help to drive our city forward. As such, I do hope that the government and the public sector can increase data transparency to facilitate mutual trust and social innovation.

3.8

Is the autonomous vehicle remote to Hong Kong?

Uber's fatal crash has drawn worldwide attention to the safety issues with autonomous vehicles (AVs). The accident reminds us that self-driving technology is still in the experimental stage.

Robin Li, founder of China's most popular search engine Baidu, however expected AVs from his company would be running on public roads, just as all other vehicles, in three to five years' time.

Benefit #1: Cost saving

One of the major benefits from the new mode of mobility is an anticipated significant cost reduction. UBS, an investment bank, estimated that factors such as automation, competition, sharing modes of operation plus

a switch to electric cars will lead to a substantial drop in the cost of robotaxis by 80% to less than US50 cents (HK$4) per mile, half the cost of a private car. Currently, ride-hailing services cost about USD2.5 per mile (HK$19.5, equivalent to the taxi fare for the first two kilometers in Hong Kong). It is much more expensive than a private car operating on US80-90 cents per mile (about HK$7), revealed the Chief Executive of Uber. Meanwhile, each private owned car spends on average 96% of its usable time parking, when the cost of maintenance, depreciation, insurance and other running costs are added together, cars are the most underused asset consumers own, as pointed out by Fitch International, a credit rating agency.

Benefit #2: Air pollution improvement

An autonomous ride-hailing service requires no parking space for car users, and poses no worry that drivers will fall asleep while driving. At the same time, air pollution will also be greatly improved since electric vehicles will mainly be used. Therefore, the robotaxi is expected to intrude on the private car market shortly in the future.

To enable this to happen, however the instantaneous availability of accurate data and its precise interpretation are crucial.

According to Stanford University professor Sebastian Thrun, who founded the self-driving car team for Google, though AV technology is progressing rapidly, a fully driverless car still faces two major difficulties: the perception of surroundings and the prediction of upcoming incidents.

A plastic bag or a flying baby?

AVs need to consolidate the information collected from the surroundings to identify pedestrians, vehicles, road signs and what is happening, which is challenging for a computer. Thrun cited one example that in the early days, it was hard for Google's driverless car to differentiate a plastic bag from a flying child. Over years, the computer learnt lessons by combining data from multiple sensors and the fleet where cars compared sensor readings with other cars' data gathered on the same road. The

accumulated experience helps hasten the maturity of self-driving technology. Therefore, a number of consultancy firms estimated that by 2030, robotaxis will become gradually popular.

This epoch-making trend, which is comparable to that of replacing the horse and carriage with the modern car more than 100 years ago, will not only change the daily lives of humankind, but it will also lead to massive unemployment, changes in urban planning and land use, and legislative amendments.

Hong Kong: Location-based data essential

The emergence of AVs poses both a challenge and an opportunity for Hong Kong. With its unique road conditions, we have confusing road signs, narrow roads crowded with road users, in addition to typhoons. Currently, no AV has been allowed to be tested on public roads. We are lagging behind.

Fortunately, the *2018-19 Budget* pointed out that it is

necessary to invest heavily in innovation and technology. The Science and Technology Park also expressed that it will develop a smart region for research on the latest technologies with AV being one of them.

Apart from the efforts in the academic and research fields, the government should also keep autonomous driving in focus. For example, the smart lampposts mentioned by the Chief Executive in the *Policy Address*, should be considered a key device to release and receive spatial data, and play an important part in the common spatial data infrastructure (CSDI). Due to the high density of buildings in Hong Kong, the locating system may experience significant errors and inaccuracies, smart lampposts can give accurate location-based data, together with the wider application of the IoT and 5G in the future; these are all fundamental for the feasibility of operating AVs.

Furthermore, the location-based data received can be further aggregated with data from smartphone users and shared on the CSDI for easy access from the public and

private sectors. It will benefit Hong Kong's development of new technologies and stimulate the public's creativity.

Smartphones have brought along a massive change in the lives of people. What about AVs? It is also quite possible that after a decade or so when the baby boomers are in their seventies, with the service of AVs, they can remain socially active. This is exactly how a smart city can improve people's lives with science and technology!

3.9

Opening data facilitates rational discussion

The three-day Fourth China Smart City International Expo 2018 was held in Shenzhen in August 2018. As the Smart City Consortium (SCC) is one of the supporting organisers, I represented the SCC and joined the event while at the same time I was able to update my understanding of smart city development in China.

This is a large scale smart city event in the Mainland. I found the *China Urban Governance Smart Level Assessment Report* (the "Report") released at the Expo most informative.

The *Report* is a national assessment covering 294 cities across the country (excluding Hong Kong and Macau). This year sees the second release. It took five months to consolidate the different information, such as a literature

review, telephone interviews and collected public data in the following five criteria for evaluation:

Smart Sensor: Sensing devices installed throughout the city to obtain comprehensive and real-time information on the city

Smart Management: Coordinate city management through open resources, a social credit system and a big data management decision-making system, while improving transparency and precision

Shared Services: Build a public service platform through the internet+ model, so that data can be integrated and shared

Network Collaboration: Improve public management services and the online service process, so that the real world can be synchronised with virtual space

Multiple Participation: The Government, enterprises and citizens work together to actively participate in city management.

Shenzhen only ranked 5th in the previous year's evaluation, in 2018, the city has now jumped to No.1; on the contrary, last year's champion Qingdao, has fallen to 8th place, signifying fierce competition. Out of the nine cities in the Greater Bay Area, four were ranked among the top 20 this year. Apart from Shenzhen, there are Guangzhou (3rd), Foshan (10th) and Zhuhai (12th). This is really impressive.

In addition to the evaluation, the *Report* also analysed the obstacles and made several recommendations.

Major challenge: Collaboration

Collaborative information sharing across government departments is one of the major challenges mentioned in the *Report*.

To present a variety of information, whether it is real-time traffic conditions, air quality monitoring, the age of buildings, etc., in a one stop, "data supermarket" or common spatial data infrastructure (CSDI) is very important for this reason.

To secure collaboration among various government departments is always a challenge in every city.

Hong Kong: Collaboration among government departments

How about Hong Kong? Fortunately, we are progressing in this area. The new website *Hong Kong Map Service 2.0* launched by the Lands Department in August 2018 is a fitting example. It provides map products to the public in one place.

Furthermore, it also integrates information from other government departments, such as the Environment Bureau, the Agriculture, Fisheries and Conservation Department and the Civil Engineering and Development

Department, etc.

It can be treated as a 0.5 version of CSDI. I hope that the authorities will continue to enrich it to enable full information sharing soon.

The *Report* from China also recommends increasing the participation of citizens and private organisations in city management and promoting innovation.

Visualising data encourages public participation

We often mention data driven decisions, but complex data is difficult for the layman to understand. It would be much easier if it was presented in image form for us to grasp the big picture. Apart from the example from the Lands Department in Hong Kong, there are also good practices from overseas using this means of communication.

The *Elevator Report* produced by the New York City Department of Buildings (DOB) is a good example. The

department manages over 84,000 elevator devices, including lifts, escalators and amusement rides in the city, with a total daily usage of 35 million trips. The city has the world's oldest elevators, and more elevator devices than any other city in the U.S.

The 2017 report listed the history, the performance and inspection results, testing data, plan reviews and the compliance filings of these facilities. It also consolidated data from other departments such as the Department of Finance and the NYC Department of City Planning, and presented the data on an interactive map.

Therefore, it is easy to tell which area was not performing and which had a lot of complaints or which had excellent service. It forms a solid foundation for public participation in sharing comments. It also makes the discussion more rational and promotes a common consensus from the public.

This is exactly what drives the development of a smart city.

3.10

Hong Kong students are creative at problem solving

It is a global trend for a smart city to cater to its ageing population and improve people's living through information technology; creativity and analytical skills are equally important to this. But how can young people improve on these capabilities?

The Smart City Project Programme 2017/18 award ceremony was held in June 2018. This project-based study programme, organised by the Education Bureau, included a series of activities for teachers and students, such as special exhibitions, study tours, a STEM education day camp and summer camp, as well as seminars, workshops and visits. In particular, a special exhibition on the smart city was added to showcase the students' comprehensive learning and innovative implementation of the smart city concept at home, on campus, in the community and in the urban environment.

Good understanding of end users

The work from the primary school team who won the Outstanding Smart City Project Award was practical, creative, and shows their understanding of the target group. As a judge, I was impressed by their presentation.

The Smart Home for Seniors and the Smart Electronic Handbook are the best examples of work practicalities with a solid understanding of their target group.

The Smart Home for Seniors designed by The Endeavourers Leung Lee Sau Yu Memorial Primary School provides smart lighting, a rainfall warning, weather condition monitoring and a fire alarm to enhance the quality of living for the elderly. The students of Chan Sui Ki (La Salle) Primary School helped the junior grade students to pack their schoolbags, and shorten the time required to write up their student handbooks. They used the QR code on each textbook to record the packed textbooks, and combined this with the data storage and transmission function of the relevant application to remind students of missing items. It also informs parents on the status of homework completion.

Advanced technologies used: Sensors, IoT, etc.

Some creative and versatile works include a Smart Playground, a Smart Homework Collection Machine and a Smart Rubbish Bin. Po Leung Kuk Luk Hing Too Primary School made full use of sensors and the internet of things (IoT) technology to track and collect the data generated by students moving around the playground, then they analysed spatial data and the number of students in movement to enable the automatic control of fans, air-conditioners and lighting to minimise energy consumption. Lok Sin Tong Leung Kau Kui Primary School (Branch) developed a smart homework collection machine, collecting data on homework with a colour sensor, automatically classifying homework by subjects and dispatching them to different collection boxes, facilitating teachers and students while saving classroom time. The Smart Rubbish Bin from Fung Kai No. 1 Primary School uses an ultrasonic sensor to measure the change in the remaining capacity of the rubbish bin via the displacement method learnt from mathematics. The rubbish bin

automatically prompts a worker to empty the bin, avoiding the overflow of rubbish from the bin which would create a hygiene problem.

As for the secondary school teams, I was encouraged by the winning work from various girl teams. The Christian and Missionary Alliance Sun Kei Secondary School used a medical service application to provide patients with information on public hospitals and medical clinics in Hong Kong, so that they could seek medical treatment nearby according to their medical conditions. This helps to distribute the demand on public hospital services more rationally. The application is also equipped with thoughtful features, like automatic information sorting, a reminder for taking medication and follow-up consultations, as well as reading e-health records to relieve the burden of an ageing population.

Esri Young Scholar Award 2018

Regarding the tertiary education sector, the Esri Young Scholars Award encourages university students from all

countries to solve problems using geographic information system (GIS) software. This year saw the seventh competition. Champions from different places were invited to attend a week-long Esri user conference in the United States in July, where they could exchange ideas with more than 18,000 GIS professionals from all over the world.

Hong Kong's champion in 2018 was Choy Tsz Hin, Frankie from the University of Hong Kong. He researched the local bus service. According to Frankie, the bus service accounted for 33% of the total local trips in Hong Kong, while the MTR represented 37%, the bus is an important transportation mode in Hong Kong. However, in recent years, the government has been determined to develop the railway system, and has treated the bus service as secondary.

In his project titled *A Glimpse of Bus Services in Hong Kong: The Territorial Bus Service Study – Finding Where the Problems are*, Frankie compiled a set of data, including age, income, and population density for each district, as well as the distance to the central business district,

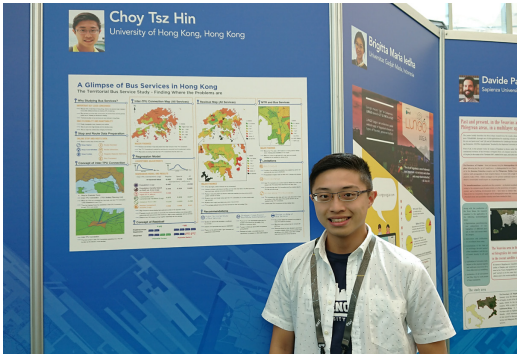
and the inter-district bus routes. He found that there are less choices for inter-district routes connecting to the industrial and commercial areas from the new towns when compared with that from Kowloon and Northern Hong Kong Island. The problem is especially serious in the western New Territories, namely Tuen Mun and Yuen Long. He believes that there should be a holistic review of the bus routes, together with a platform for the public to express their views. Furthermore, many bus routes overlap with the railway resulting in resources not being evenly distributed within the area. He suggested that bus companies could increase the express service to avoid direct competition with the MTR.

I believe through education everyone can learn data analysis to promote their problem-solving ability, together with young people's compassion for society, we can build the smart city from bottom to top, engaging all sectors to develop a better future.

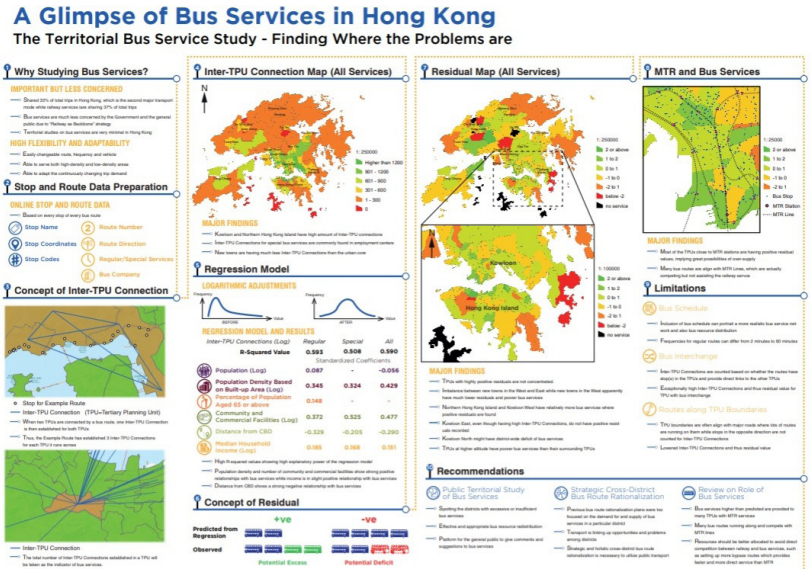
Students from the Christian and Missionary Alliance Sun Kei Secondary School demonstrated the application developed by them to Dr Choi Yuk-lin, Under Secretary for Education (third from left) and Dr Winnie Tang, the writer of this book, and Founder and Honorary President of Smart City Consortium (second from left). It is a one-stop application for the public to obtain real-time information on public medical services, thus, alleviating problems faced by an ageing population.

St. Anthony's School won the Commendable Smart City Project Award - Primary. The students designed a smart home solution that uses the internet of things, a mobile application and cloud data collection to support remote care for new born babies to ensure their safety.

Po Leung Kuk Luk Hing Too Primary School sent two teams to participate in the project, winning Outstanding Smart City Project Award and Commendable Smart City Project Award respectively. The students passionately explained the operation of their award-winning work Sunflower Shade to Dr Winnie Tang (middle). They showed how to make full use of coding and IoT technology in research and development.



The 2018 Esri Young Scholars Award Hong Kong Champion Choy Tsz Hin, Frankie attended the Esri User Conference in the United States by invitation. He exchanged ideas with 18,000 GIS professionals around the world on data analysis.



The research theme for the champion of 2018 Esri Young Scholars Award in Hong Kong is the local bus service, as the bus service accounted for 33% of Hong Kong's total travel, it is very important in people's lives. The picture shows the winning work of Frankie.

Summary

- The essence of Smart City 3.0 is multi-faceted collaboration to create an internet of things across the city through the public and the government's sharing of social media data and sensors installed in public places.

- According to a consulting company, geospatial data has a global value of USD270 billion (HK$2,119 billion) and it is growing at a rate of 30% per year.

Chapter Four Right People

The development of innovation and technology relies on 4Ps: Partnership among the Public (government), Private organisations (enterprises), and People (society). Government investment, corporate collaboration, and general public support can build an active ecosystem, promote STEM education, foster youth to join the innovation and technology industry, and encourage women to unleash their potential, turning their thoughts and beliefs into results.

4.1

How can Hong Kong transform into an innotech hub?

President Xi Jinping directed the state agencies to help make Hong Kong a global innovation hub in mid 2018. Then, a three-year *Technology Talent Admission Scheme* was announced by the Hong Kong Immigration Department. The new Scheme simplified the application procedure and reduces the processing time with approval being granted from four weeks to two weeks. A company can be granted a maximum quota of 100 each year for talent coming from the world's most popular fields: biotechnology, artificial intelligence, cybersecurity, robotics, big data, financial technology, and materials science.

Many countries are competing for scientific and technological talents which has proved to be a shortcut to boost a country's economic development. According to a study from the World Intellectual Property Organization,

from 1995 to 2005, one in four technology startups in the United States were established by foreign-born entrepreneurs, immigrant inventors owned patents twice as much as that of the local born Americans.

Australia & Canada fight for talent

The world is competing for talent. Australia's new pilot scheme launched in 2018 intended to attract highly skilled talent globally. Canada also updated its *Global Skills Strategy* in 2017.

Australia's *Global Talent Scheme* allows two types of companies to recruit foreign talents: (1) technology-based or STEM (science, technology, engineering, and mathematics) related startups which must be recognised by the government; (2) Enterprises with an annual turnover of Aus$4 million (about HK$24 million) may also sponsor overseas experienced professionals (annual income of Aus$180,000 or approximately HK$1.07 million at least). These visas last for four years, and the recipient can apply for permanent residency in the third year. A one-year trial will be conducted from mid 2018.

As for Canada's Strategy, it only takes two weeks for the approval of innotech talent visas and the attached family members. Researchers who participate in research projects for a short period of time do not need a working visa.

However, these measures are relatively mild compared to mainland China's bold strategy. In the past, many highly-educated talents from the mainland went to work in Europe, the U.S., Japan, and South Korea. Out of every 10 migrants in the OECD countries, over 10% came from the mainland, the figure surged from 460,000 in 2009 to 530,000 in 2011.

China's Thousand Talents Plan

The brain drain problem was gradually relieved after China's State Administration of Foreign Experts Affairs launched the *Thousand Talents Plan* 10 years ago. The official name of the programme is *High-Level Overseas Talents Introduction Programme*, it was launched in 2008 with a 5-10 year plan to attract overseas talent to the country's key innovation projects, key laboratories, financial institutions, and hi-tech industries.

Once an applicant meets the required qualifications, the remuneration is very attractive: the selected experts can receive research grants from RMB 3 million to 5 million (about HK$3.69 million to HK$6.15 million). They can enjoy preferential treatment for living, such as household registration, medical care, housing, children's schooling, taxation, etc. In 2017, 900,000 foreigners from 73 countries worked in the Mainland, compared with less than 10,000 in the 1980s, a big jump of 90 times within 30 years. According to the *2018 Global Talent Mobility and Wealth Management Report* released by Forbes, China will become a major "exchange hub" of global talent by 2022 – the country will not be just "the largest export country of students studying abroad, but also a major destination for global talent". This shows the effectiveness of its talent plan even from its early years.

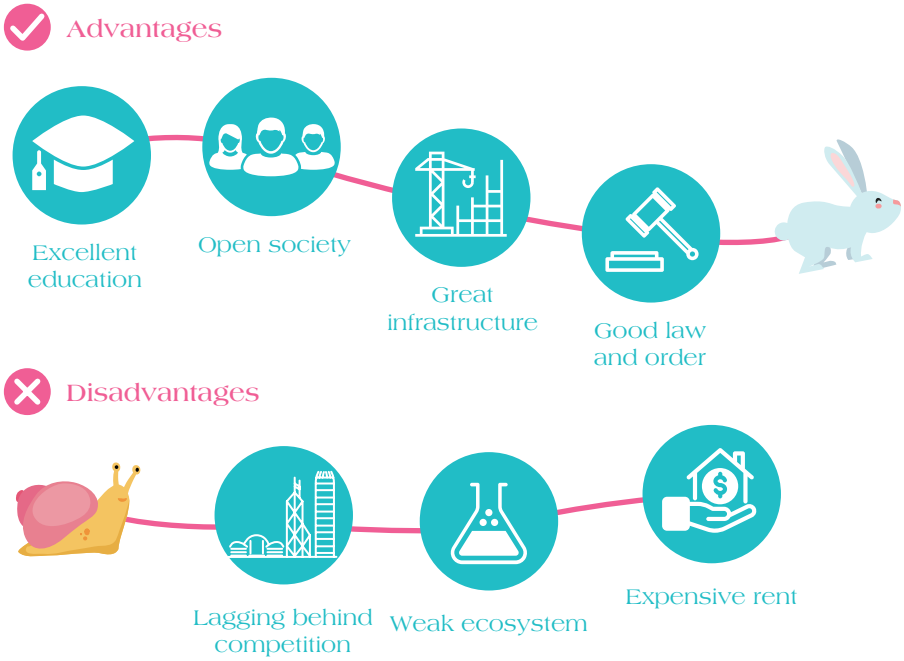
Shenzhen attracted over 100K talents

At the same time, various talent recruitment programmes have been introduced by different regions in China. Shenzhen's achievement is the most obvious. Its *Peacock*

Plan launched in 2010 has attracted talent by granting substantial investment funds. It has attracted 100,000 talented individuals so far. As a result, in the *2017 China's Urban Science and Technology Innovation and Development Report*, Shenzhen ranked second in the Technology Innovation and Development Index of China, next to Beijing; in 2017, its gross domestic product (GDP) also surpassed Hong Kong for the first time, reaching RMB 2.24 trillion (about HK$2.76 trillion).

What is Hong Kong's advantage in attracting talent? At the end of 2017, the *World Talent Ranking* of the International Institute for Management Development in Lausanne, Switzerland ranked Hong Kong as Asia's best for our overall performance in education, on-the-job training, quality of living, salary, and tax rate. Because of Hong Kong's exposure and reputation, we have been positioned by the central government as an "international innotech hub". We are very strong in nurturing talent, we have an open society, comprehensive infrastructure, an effective legal system and the enactment of law.

Hong Kong's Advantages & Disadvantages



However, Hong Kong still has many difficulties in attracting and retaining talent to enhance the development of science and technology. For example, the housing problem has deterred many foreign employees - Hong Kong has been the most expensive city in Asia regarding high-end residential rental for two consecutive years, making it difficult for overseas talent to live and work with peace of mind.

Commercialisation of research results

Hong Kong lacks the desirable ecosystem of government, industry, academia and research institutions. Seldom can we see successful cases of commercialising scientific research and launching the product in the market, not to mention researchers harvesting financial rewards for their efforts. The government, as a major user, can take the lead to assist commercialisation. However, the implementation of the new measures takes a long time. For example, it has taken the pilot programme, Smart Lamppost, three years from proposal to project completion. The first 50 lampposts were only installed by mid 2019. To be honest, the completion of a pilot project by the government in two to three years' time is not too slow. With the rapid development of technology, however, the trial technology may be outdated in a few years.

Another key project for a smart city - the establishment of common spatial data infrastructure (CSDI), will not be ready until 2023. It is only by then that people will be able to enjoy the government's one-stop open information and

data service. These information sharing platforms have already been well established in Europe, the U.S., and Singapore. They are not new, but we have to wait for several years to get them ready, weakening the potential of Hong Kong in the development of innovative technology. I feel extremely helpless.

Carrie Lam, Hong Kong's Chief Executive, stressed that Hong Kong could no longer "rely on its accumulated wealth and wait for luck", she also said that Hong Kong must speed up its innovation and technology development. I hope that the government can examine all aspects of its policy, so as to promote the development of science and technology at full speed.

4.2

Why Hong Kong lacks AI manpower?

Artificial intelligence (AI) is regarded as a key to drive the world's future development. Although Europe and the United States are dominated by private enterprises, while Mainland China is led by national entities, the core of AI formation, in fact, is rested on the availability of top-notch talent. The *2017 Global AI Talent White Paper* released by the Tencent Research Institute stated that there are approximately 300,000 AI researchers and practitioners in the world, while the market demand for AI talent is in the millions. The report suggests that the bottleneck is education - though there are 20,000 graduates from related disciplines each year, the number is far from adequate to meet demand.

University is a battlefield for acquiring talent. For example, Mark Zuckerberg, CEO of Facebook, personally recruited

Yann LeCun, a French professor from New York University. LeCun studied computer deep learning starting in the 1980s. Google recruited Li Feifei, a Chinese-born expert of computer vision at the Stanford University in 2016; Yoshua Bengio, an expert in artificial neural networks in Canada, promised to assist Microsoft. Enterprises have also set up laboratories around the world to attract talent. For example, Tencent has set up an AI lab in Seattle, U.S. and Baidu has a lab in Silicon Valley as well.

Surprisingly high pay for AI talent

A mountain of demand has caused the salaries and bonuses of AI experts to rise. DeepMind, a software development company that beat the world GO champion, has an average annual salary of USD340,000 (approx. HK$2.67 million) each for its 400 employees. Baidu's *Young Leader Programme* screens young people below the age of 30. The outstanding scientists even in training are offered an annual salary of at least RMB 1 million (approx. HK$ 1.22 million). For inexperienced AI-related positions in the market, the average monthly salary in the

Mainland has reached RMB 25,800 (approximately HK$ 31,700) in the past three years, which is much higher than general technical positions and that does not include stock options and other benefits.

AI jobs are well-paid and have a promising future. Does Hong Kong also have a position in the race?

Hong Kong's high quality education

In fact, the education provided by local universities is excellent. Graduates have long been the target of recruitment. For example, Tencent established an AI joint lab with the Hong Kong University of Science and Technology (HKUST) in 2015, it was led by Professor Yang Qiang, an internationally renowned AI expert; Baidu successively recruited interns from the Chinese University of Hong Kong (CUHK), the University of Hong Kong (HKU) and HKUST at the beginning of 2018; HKU and Alibaba jointly established a research institute to develop AI in Hangzhou five years ago.

However, how much AI talent is there in Hong Kong? It is roughly estimated that there are less than 1,000 in the local tertiary institutions - according to Professor Francis Lau, Deputy Dean of the School of Engineering at HKU, there are only 100 AI specialists in the whole of the university. Although CUHK already had applied deep learning studies as early as 2001, it only opened Hong Kong's first deep learning elective course and a bachelor's degree in finance and technology in the past two years. No wonder the financial institutions such as JP Morgan Chase and HSBC have complained about the shortage of technology talent in Hong Kong. HKUST's Professor Yang once told the media that he failed to recruit 50 AI staff for Huawei!

The myth behind Hong Kong's lack of AI talents

HKU, HKUST, and CUHK are among the world's top 50 in several international university rankings. But why is there so little AI talent and such a weak innotech atmosphere? I believe the source of the problem is a lack of a strong ecosystem of government, business, academia and

research; this is exacerbated by a lack of open data and market size.

An ecosystem of government, business, academia and research enables the commercialisation of scientific research and technology, as well as the improvement and marketing of the product.

In addition, the recent German venture capital fund Asgard proposed European policy makers promote AI, saying that Europe must be united to build a market comparable to that of China and the U.S. The proposal is similar to Hong Kong's strategy to integrate with the Greater Bay Area, which is yet to be accepted by the Hong Kong people.

Apart from the rule of law, Hong Kong's long-standing leading edges, as mentioned by Alibaba's Jack Ma at HKU recently, are: accommodating culture, innovation and its young people. Therefore, I sincerely hope that all parties can embrace innovative thinking and provide more opportunities for our young people. Hong Kong can then develop into a leading international innotech hub.

4.3 Social diversity enhances innovative capability

Acquiring innovation and technology talents from overseas has proved to be a shortcut to boost the economic development of a city and even a country. According to a study from the World Intellectual Property Organization (WIPO), immigrant inventors owned twice as many patents as that of the local born Americans in the United States, from 1990 to 2010. Studies by Richard Wong, Chair of Economics and Philip Wong Kennedy Wong Professor in Political Economics at the University of Hong Kong, also echoed the same point.

In his recent article, Prof. Wong pointed out that the labour force participation rate in 1996 among immigrants who arrived in Hong Kong between 1976 and 1996 was 56.9%, higher than the rest of the population's 49.3%. A similar pattern is found for recent immigrants that arrived between

1996 and 2016. As such, he concluded that "recent immigrants were economically more active than the rest of the population for both men and women".

So it is no surprise that the Hong Kong government announced rolling out a fast track immigration scheme to attract more technology professionals in 2018.

Social diversification conducive to development

However, the same WIPO study brought out an interesting point, that social diversification is conducive to social and economic development.

This is because the key to innovation and technology is a novel idea. The top U.S. universities which are famous for science and technology, such as the Massachusetts Institute of Technology and Stanford University, have recently encouraged students to pursue a joint major in computer science and other disciplines, such as language, music, or economics. Their coursework also aims at

integrating both disciplines, hoping to create a spark of creativity with the interaction.

Social diversity is also a common characteristic of the highly competitive and innovative countries. If you map the top 10 countries from the *Global Innovation Index 2017 Report* ("Report") with the talent profile of LinkedIn, the professional social networking website, you can see the close relationship.

LinkedIn categorised the distribution of its numerous members by geography in nine fields of study which include:

(1) Arts and humanities,
(2) Business administration and law,
(3) Education,
(4) Engineering, manufacturing and construction,
(5) Health and welfare,
(6) Information and communication technologies,
(7) Natural science, mathematics and statistics,
(8) Services, and
(9) Social sciences, journalism and information.

According to the *Report*, the top 10 countries including Switzerland, Sweden, the Netherlands, and the U.S., etc., have relatively equal numbers of talent in each of the above nine categories. In short, these countries are diversified in terms of talent variety.

The more diversified, the more innovative

For example, Switzerland, which ranked first in innovativeness, has the largest number of talent in three categories, namely (2) business administration and law, (6) information technology and (9) social sciences. Having said that, each of them only has less than one fifth of the whole talent population. Among the nine professional fields, five of them each only constitute 10% to 20% of the total number of talent in the country. The same is seen in the Netherlands.

Moreover, these countries have no shortage of uncommon talents, such as artists. In the U.S., art practitioners constitute 9% of the overall talent pool. On the contrary, in some countries, a certain category of professional is

particularly plentiful. For example, Uruguay has nearly 40% of adults specialising in information technology, being the highest among all countries, but its global innovation ranking is not quite outstanding.

That is also the reason why I have advocated STEAM education, that is, in addition to training in STEM (science, technology, engineering, and mathematics), we add in art that promotes humanistic qualities, so as to cultivate students' diversified intelligence, promote imagination, and inspire them to think outside of the box.

In addition to the rule of law and the legal system, Hong Kong has the strengths to accommodate different cultures with an open mind. Education is the best way to reinforce these strengths. Therefore, I hope that the government will not forget to nurture our new generation while introducing scientific and technological professionals. This is the way to succeed in the long run.

4.4

A public-private partnership heats up the innotech startup atmosphere

Hong Kong can successfully attract entrepreneurs from overseas, and have excellent contact with countries worldwide, according to the *Global Startup Ecosystem Report 2018* ("Startup Report") released in July 2018 by Startup Gernome, a consulting company.

Hong Kong scored well in "global connection", "market reach of foreign customers" and "immigrant founders" in the *Startup Report*. In fact, the number of startups in Hong Kong in 2018 has doubled that in 2014 to more than 2,600, with venture capital investment surging from HK$600 million in 2012 to over HK$15 billion in 2018.

This is a result of the effort from the government together with public and private organisations like the Hong Kong

Rapid Growth of Hong Kong Startups

No. of companies

↑ 150%
(2014-2018)

2018

>2,600

(source: StartmeupHK)

Venture capital investment

↑ 1,000%
(2012-2018)

2018

>HK$15 billion

(source: Innovation and Technology Bureau, Whub)

Science and Technology Park, Cyberport and tertiary institutions. They not only provide funding and support to the establishment of innovative technology companies, but also identify and nurture potential startups through competitions and accelerator programmes.

Furthermore, the advantages of having world-class infrastructure, high digital competitiveness (ranked second in Asia), an excellent data centre risk index (Asia's third), and a fast internet connection (world's third) all contribute to the more productive competition of the startup atmosphere here. As evaluated by a San Francisco based research firm Compass, Hong Kong has become one of the five fastest growing entrepreneurial ecosystems in the world.

Ecosystem value is yet to improve

The *Startup Report* also came up with a global median for each of the 13 Success Factors after assessing the innovative technology performance of 43 cities in 23 countries from North America, Europe, the Middle East and the Asia Pacific region.

Apparently, Hong Kong is weak in "ecosystem value"; the score is much poorer than the global median. We also have room for improvement in areas such as the availability of "experienced software engineers".

However, we are progressing to improve our ecosystem value.

E&M becomes a match maker

Apart from public and private organisations, individual government departments are also contributing in this aspect. For example, the E&M InnoPortal, a collaboration platform was launched by the Electrical and Mechanical Services Department (EMSD) in June 2018, coinciding with its 70th anniversary. To promote the realisation of R&D results, EMSD matches the needs of other departments in applying new technologies with startup projects.

The portal serves as a business matching platform which lists the needs of technology development in various

government departments, public organisations and the electromechanical industry. It also welcomes universities and startups to provide electromechanical-related innovations on the platform. In addition, the department will also certify the effectiveness and performance of the products and services submitted. The evaluation report is publicly available on the platform, thus, jointly promoting the development and application of innovative technology in the field.

At the time I am writing this article, there are more than 50 projects on the platform's technology development wish list. They include:

- station kiosk queue management (Smart Living)
- solar energy harvesting window panels (Smart Environment)
- energy saving in data centres, intelligent search for potential foreign investors (Smart Economy)
- a universal vehicle running data plug, a smart train door and a platform screen door closing system (Smart Mobility)
- mobile apps for geographic information system (GIS),

elevator fault diagnostic and analysis, a bladeless fan for ventilation and air conditioning systems in markets, a smart reservation system for co-working spaces and car parks (Smart Government), etc.

A survey by Tech Nation, a British government organisation, found that the average annual salary for a digital technology job is £42,578 (about HK$426,000), which is significantly higher than other jobs (£32,477, about HK$325,000). With the joint effort of the government, private and public organisations, together with the completion of the Hong Kong/Shenzhen Innovation and Technology Park in Lok Ma Chau Loop in the next few years, I hope our young people can have more and more quality opportunities for career development.

Let us work hard together.

4.5

A people-private-public partnership can solve social problems

Many predict that advanced technologies, such as artificial intelligence (AI) and automation, will lead to massive unemployment among the working and professional classes; increasing the wealth gap.

For example, Google just shared how it has successfully used AI to sort through the vast amounts of data in electronic medical records and can outperform traditional, clinically-used predictive models. In short, AI can better predict health outcomes, like re-admission within 30 days, and in-hospital mortality, etc.

At the same time, the World Economic Forum report showed that women will face bigger economic disadvantages caused by automation as duties like secretarial and administrative tasks, now largely filled by women, will soon be automated.

Creatvitiy + tech for unfulfilled needs

We are facing lots of pressing issues, such as an ageing 'tsunami', global warming and income inequality. As I have always said, the smart city is not about doing innovation for innovation's sake, technology is only an enabler. What we need to do is to identify the key issues in the city that must be improved. Creative solutions and advanced technology may be needed to facilitate the process. We need our people to attend to unfulfilled needs. That is the reason why I feel encouraged when I have recently seen lots of local initiatives.

Eaxmple #1: Grassroots women to increase income

A social worker lines up women from the grassroots with commercial restaurants so that the housewives can utilise the equipment of the restaurants, during non-business hours, to produce food to earn a living. At the same time, the restaurants can also increase their revenue. I like the idea of making use of idle resources to address the needs of our society.

Example #2: Healthcare service for elderly

Another example is that of a medical doctor, after seeing the difficulties the elderly encountered in seeking healthcare during his service at local hospitals, he co-ordinated with medical practitioners to provide on-site consultations or tele-medical services for the elderly and the under-privileged. The team of professionals, mainly using their free time, consists of nutritionists, speech therapists, and medical specialists. Currently their major clients are elderly homes. Their next target will be the elderly confined to their homes, so that people can spend their last days of life more comfortably.

Example #3: Farming in the city

Global warming seems distant and too massive for us to tackle, however a few young people have thought of transforming under-utilised spaces into urban farm land, so that more people can grow their own vegetables. They work with commercial organisations, eg. financial

institutions, airlines, food and beverage companies, and schools. So far, the total size of the farm land they have taken care of is over 40,000 square feet.

The above are just a few initiatives of how our younger generation can mobilise different sectors of society, including private and public sectors, to make our city a much better place to live. This is in fact an essential ingredient in the development of a smart city: to foster "4P", Partnership among People (citizens), Private organisations and the Public sector including the government, to help pull together human resources, investment and knowledge to make the smart city a success.

Government to work with private sector and citizens

On one hand, the government has to set the directive and regulations, provide funding support, and ensure the smart city infrastructure adheres to the principle of universal availability. This can encourage innovations. In this regard, to establish a common platform for sharing data related to people's everyday activities with the public

is a natural step, as data is a major aspect of the smart city infrastructure.

On the other hand, 4P allows the government to share the burden of building a smart city with the private sector and the people, who not only contribute domain expertise, but also put in the resources and investment needed for the required technology platform.

Therefore, if the government can take the lead in promoting cohesive collaboration with various players in the city, we can address the demands brought by various modern challenges, while at the same time our city can also enhance its efficiency and stay competitive in the years to come.

The initiatives of everyone from individuals to corporations remains the foundation for the success of 4P. Together we shall turn the smart city vision into a reality, step by step.

4.6

How young girls create their smart future

Together with KPMG, CLP, JOS and Siemens, the Smart City Consortium released a survey report on the development of the smart city in Hong Kong in 2018. More than 500 business executives and 1,000 citizens were interviewed; both groups of interviewees expressed their view that education was one of the top three elements for Hong Kong's continued prosperity.

They also expressed their belief that engineering and applied science were crucial to Hong Kong's development in the coming ten years. Today, as we are overwhelmed by information technology, such expectation is very reasonable. However, do our children have the same aspiration?

Education and Employers, a U.K. charity, together with the Organisation for Economic Co-operation and Development (OECD) conducted the biggest survey of its kind, its results were released in early 2018. The project invited children aged 7 to 11 to draw a picture of the job they want when they grow up. Over 20,000 entries were received from all over the world, including China, Indonesia, Pakistan, Britain, Switzerland, Australia, Russia and Uganda. Although there are culture differences, we can see surprising similarities.

First of all, there is a significant mismatch between the career aspiration of primary school students and the anticipated global labour market demands. Meanwhile, the

children's favourite jobs are often those they know and see in daily life, such as the occupation of their parents, their parent's friends, or those roles which appear in the media. However, less than 1% of the children can access their role models at school. As the OECD's Director for Education and Skills said, "The lack of access to role models and awareness of the different jobs is a particular concern for children from disadvantaged backgrounds."

Secondly, the study also found that gender stereotyping starts at a young age and is evident in every country. Girls are always related to secretarial and administrative assistant roles. However, according to the U.S. Bureau of Labor Statistics, these kinds of jobs may be in short supply; 57% of these 1.4 million jobs are projected to fade out by 2026.

Education can inspire girls' imagination

How to inspire our next generation, especially the girls, to broaden their imagination and connect with the real world, and to plan how to establish themselves in future society?

Education and analytical skills are particularly important.

However, another kind of knowledge of equal importance that deserves our attention is spatial thinking, which helps to visualise macro problems such as climate change, an ageing population, transport planning, and disparity between the rich and the poor. Combining data with geospatial information can form a clear view of the situation, allowing decision-making to be more broad based and comprehensive. Over the past two decades, the geographic information system (GIS), an analytic software consolidating geospatial data, has become an indispensable tool for governments and business organisations around the world.

Connects young people with the real world

Esri China (Hong Kong), of which I am the Chairman, launched Asia's first free e-learning project Map in Learning (MiL) programme a few years ago. This project allows primary and secondary students in Hong Kong to use ArcGIS Online, a professional GIS software used

by the government and various enterprises. Through this e-learning software, young people can enhance their problem solving ability, helping them to develop a diversified potential. Close to 200 schools have participated in the programme with over 1,000 teachers and students having attended the training. Although this project is not tailor-made for female students, their enthusiasm shown in the projects and brilliant performance in the competitions has convinced me that this software can really arouse their interest in learning.

As the MiL programme continues to expand, I deeply hope to inspire children and girls from all walks of life to think about our future world. I am confident that we, together, can build a brighter future for our smart city.

4.7

Women's creativity is yet to be released

Local governments and organisations are often concerned with a shortage of talent, but a study suggests that many countries do not make full use of their human capital.

According to the *Global Human Capital Report 2017* from the World Economic Forum, only 25 of the 130 countries assessed have made full use of their talent (i.e. a human resource utilisation rate of 70% or higher); while most countries are at 50-70%, 14 countries are lower than 50%. According to the report, many countries actually have talent, but they lack training to update workers' skills, or their resource allocation is not ideal, so the people are not given enough opportunities to fully apply their strengths.

For example, many women failed to receive equal pay for equal work, which weakened their enthusiasm for work.

Although young people have better formal education, they lack development opportunities in their career. The reason for this is that many employers are old-fashioned and cannot readily accommodate young people's aspirations, expectations or even global views which are rather different from their predecessors.

In fact, young people in the new generations, especially women, should be able to play a more important role in our development as a technology hub.

South Korea: More female participation = more innovation

According to the World Intellectual Property Organization (WIPO), women applying for international patents increased from 12% of the total in the 1990s to 31% in 2017. In South Korea, a male-dominated country, within half of the patent application teams, there is at least one female inventor. This ratio is the highest among the 152 member countries. This is in line with South Korea's rising reputation in the field of innovation in recent years. The country is among

the top performers in a variety of international rankings. For example, South Korea remained as the global-innovation gold medalist in Bloomberg's *Innovation Ranking 2018* for five consecutive years.

China is also performing outstandingly, with 48% of patents including the participation of female inventors, followed by Belgium (36%), Spain (35%) and the United States (33%).

These female inventors mainly contributed in biotechnology (accounting for 58% of all WIPO's international patent applications in 2017), pharmaceuticals (56%), organic fine chemistry (55%) and food chemistry (51%).

There are female inventors in well over 60% of the patent producing companies in South Korea, Switzerland, France, the U.S., and Germany. Their participation in academic institutions is even more prominent: more than 80% of patent applications from the Electronics and Telecommunications Research Institute of Korea have female members; while four institutions in mainland China including the Shenzhen Institute of Advanced Technology

of the Chinese Academy of Sciences, Jiangnan University, Tsinghua University, and Jiangsu University also have female developers in at least 80% of the patent application teams.

However, as the Director General of WIPO pointed out, a pronounced gender gap in the research and development sector still exists. To change the male-dominated culture, education is important.

4.8 The people issue in startup development

In recent years, I have often served as a judge or mentor for innovation technology competitions. One of them is the X-Plan project by the Hong Kong X Foundation. The project selects over 20 startups from the mainland and Hong Kong. Each company only has 15 minutes to present their case, share their challenges and seek advice from the mentors. The companies I interviewed were in different stages of development with various points of focus, some are technology centred, while others are marketing-led.

One of them is a company that combines smart hardware, computer vision, and machine learning to provide a patrol inspection service using unmanned aerial vehicles (UAV). Its capabilities include photo-shooting, problem diagnosis, recircling, and re-charging. The company has been operating for only one and a half years, but has already

cooperated with the largest UAV patrol inspection company in Europe, and also tried cooperation with the second largest wind turbine supplier in China. Another technology startup applies smart visual technology and deep learning to an industrial robot system which aligns with the national direction of “made in China 2025”.

There is also a startup using artificial intelligence, virtual reality, and games to motivate students' interest in learning. After operating for six months, more than 50 schools have expressed their interest in its product. Employment matchmaking is an idea from one of the startups. By using big data, it analyses the abilities of job seekers, then matches them to appropriate jobs. The process also enables employers to find suitable talent. I think this idea has the potential to develop into a cross-region talent matching platform.

"People" is the bottleneck

Although each company faces different challenges, they all agree that a people issue is the major bottleneck of

their development. The people issue refers to the lack of talent for scientific research or sales and marketing, which hinders the development of a business; it also refers to weak networking which is not favourable to financing or business expansion.

As an entrepreneur, I have experienced the same issues.

In my view, these startups are lucky compared to the situation which entrepreneurs of an earlier generation previously found themselves in. At least they have partners or teammates for the division of labour. When I started my business many years ago, I had to fight alone every day on various fronts, from solution development to sales and marketing.

Customer matters most

One thing new startups should bear in mind is when they are thinking about recruiting talent, broadening their networks, or finding quality investors, there is an important "person" they should not forget - the customer.

Products or services may be extraordinarily innovative or technologically advanced, but they could still quickly fade out when moving forward. This has much to do with the degree of acceptance by their customers.

Although I was alone and my network was not very broad at the time when I started my business, I always believed that word of mouth was more valuable than any means of promotion. Therefore, I spent most of my daytime travelling between customers' offices in Central and my tiny office in Sheung Wan, carrying a large and heavy computer every day.

I kept moving around all the time, with a hope that the customers might be willing to try my electronic map software. I entertained customers' various requirements in hardware and software, and often offered services free of charge. Even though I was constantly turned down, I never stopped visiting the prospective customers.

I valued every one of them, regardless of their position in the organisation, whether they were frontline users or high-

level decision-makers. As long as they were willing to give feedback, I would do my best to improve the products and services to ensure the highest possible customer satisfaction. After almost a year, I finally received my first contract. Later, I established a solid customer base through word of mouth.

Loyal customer's value

A story about Ryuichi Sakamoto, the Japanese music master and a New York restaurant in the *New York Times* has outspread recently. Sakamoto lived in New York where he used to visit a Japanese restaurant very often. He thought that its food was excellent, just like the elegant historical palatial villa, Katsura Rikyu in Kyoto, but the strong music in the restaurant was not compatible with the style of food served. As a customer, he went to the chef and volunteered to design a music playlist for the restaurant.

In an interview, Sakamoto said: “Normally I just leave if I cannot bear it. But this restaurant is really something I like,

and I respect their chef, Odo."

There are so many restaurants in New York. If the chef does not live up to and beyond customers' expectations, how can the establishment earn the customers' respect and loyalty?

Some people say that every businessman has to be deceptive in order to succeed. However, from my 20 years of business experience, I would say that the key to success is establishing long-term mutual trust with customers.

4.9 The elevator pitch is crucial to startups

Steve Case, founder of AOL, the world's largest and most valuable internet company in the 1990s, described in his book the concept of the Third Wave of Internet. It means the internet moving from the virtual to the physical world, and how the rules of the game are likely to be re-defined.

1st wave

Foundation – Internet introduced to households, emails became popular

2nd wave

Daily activity – Internet and smart phones make being online a daily necessity

3rd wave

Interconnection with everything – With smart TVs, refrigerator and driverless cars, the internet penetrates into everyone's daily activities

The first wave: the internet was introduced to households by companies like AOL. At that time, emails started to become popular, it was a time for establishing the foundation of the internet.

The second wave: driven by Google, Amazon, Facebook, etc., which made accessing the internet, smart phones and computers a daily necessity.

The third wave: the internet will penetrate into all levels of people's daily activities with the smart TV, refrigerator, and automobiles, etc. It is expected that everything in the world will be interconnected in the future.

These predictions seem to be far off but actually they are close to us. How do the public understand and perceive their role in the future?

That is why I like to observe and talk to young people as they are always creative. Whether or not their ideas are feasible, there is no doubt that there will always be a pleasant surprise.

Think outside of the box

The entrepreneurial spirit in the United States is strong, companies that manage shared workspaces such as WeWork are popular, even Facebook, Amazon, IBM, etc. rent offices from it. Moreover, a startup even created a new workplace in New York and San Francisco by converting over 20 upscale restaurants to co-working spaces, opening from 8:30 a.m. to 5:00 p.m., Monday to Friday.

To be able to work there, you must first become a member by paying a membership fee of USD99 or HK$777 a month for a year. Looking at the photos in the *New York Times*, the working space is elegant and spacious, though I am not sure if the business model works. One thing I am certain of is that the young founders must be very presentable because by May 2018, the company had already raised USD9 million (HK$70.65 million) in venture capital, which allowed the company to expand its business.

In fact, the eloquence which can touch people's hearts

is very important at any time. In the internet age, our attention span is probably shorter than a goldfish's. That is why attracting prospective customers within a very short duration, the so called “elevator pitch”, is a primary ability.

However, many IT people from the mainland and Hong Kong are not effective when presenting. For example, a team I met recently when I was a mentor to startups, delivered a 15-minute speech which was full of technical jargons and not appealing at all. So I challenged the team: If you can convince me within a minute, I will then recommend you to others.

Story telling is always important

One of the most important skills is being able to tell a compelling story about your vision -- and also being able to back it up with data. Partners, investors, and employees all want to see results and it is up to you to take them on that journey.

We can learn from the marketing skills of companies in the

United States. In the early years when Airbnb was founded, Brian Chesky, one of the founders, launched a promotional programme code-named Snow White. He used the oldest method – storytelling to reveal the "emotional moments" experienced in the end-to-end Airbnb journey. These touching stories involved not just tourists, but also the property owners. According to Chesky, the more details in a story, the more sentimental it could be. For example, you had to consider whether the property owner was a man or a woman, young or old, living in a city or the countryside; why they decided to become a host, did they feel anxious? ...

Young entrepreneurs, I am looking forward to being impressed by you in the same way!

4.10

Turn your belief into reality

With the rise and fall of the industrial sectors in the United States over the past 100 years, we can see a surprising progression from the old economy to the new.

Recently, *Forbes*, the financial magazine, listed the most prosperous industries and significant corporate changes in the U.S. over the past 100 years. A century ago, in 1917, the iron and steel industry was the dominant industrial sector. The market capitalisation of the industry was almost two and a half times of that for the oil industry which ranked No.2, it was more than three times that of the mining industry, which ranked No.3. Carnegie's U.S. Steel had the largest market capitalisation at that time, followed by AT&T in the telecommunications industry, and Standard Oil.

50 years later, in 1967, a big alteration was evident. At that time, the market capitalisation of the second and third largest industrial sectors: science and technology, and telecommunications lagged behind the No.1 oil and energy industry by only 50% to 60%, while the top three companies with the highest market capitalisation were IBM, AT&T and Kodak, none were from the energy sector.

Another 50 years later, in 2017, the situation seems to have transformed once again. Today, the largest industry is the science and technology industry, the second is the financial services industry, and the third is the pharmaceutical industry. The market capitalisation of the no.1 industry is almost three times of that for the second and third largest industries. At the same time, the science and technology giants have monopolised the top five places of the largest enterprises for the first time in 100 years, they are: Apple, Alphabet (Google's parent company), Microsoft, Amazon and Facebook. They account for 65% of the market capitalisation of the top 10 companies. It can be said that the current industrial transformation is more intense than 100 years ago. Some

companies regarded as giants 50 years ago have lost their leading positions today, some have undergone many mergers and acquisitions or even made a 360-degree turn-around, and some have even faded out.

Jack Ma, "We believe, and then we will see (the fruit)."

What will happen in the next 50 years or 100 years? Will today's artificial intelligence, robotics, and autonomous vehicles become an indispensable part of our daily lives as we expect today?

In May 2018, at the University of Hong Kong, Alibaba's Jack Ma talked about the similarities between entrepreneurs and scientists. He said, "For most people, seeing is believing. People like us, we believe, and then we will see (the fruit)."

Very often, I have been deeply moved by the stories of entrepreneurs. Many entrepreneurs have a passion, they are loyal to their belief, they do not hesitate to invest even when success is not promised. Their passion is the driver

to turn impossibility to possibility, turn what they believe into a visible result.

We are not sure if today's startup companies or entrepreneurs will still be known after 50 or 100 years. Since there is no crystal ball to tell the future, as an entrepreneur myself, I will only choose to believe and I believe in the future. Then I tell myself: never give up!

Let us encourage each other in our endeavours.

Summary

- Hong Kong should foster an ecosystem of government, industry, academia and research to commercialise scientific research results through its citizens, and develop them into products for market launch, allowing researchers to share the economic results of their efforts.

- Hong Kong's long-standing strength is the spirit of magnanimity and openness. Therefore, while introducing technology professionals, the government should cultivate a new generation of multi-faceted development. It is the key to long-term success.

Epilogue

Epilogue

In 2016, I published the book *Surfing the IT World*, reviewing 20 years of turbulence in my entrepreneurship and the evolution of technology.

In 2017, the second book *Smart City 3.0* was released to explain global problems and how the smart city helps solving problems.

In 2019, I published this book *Are You Future Ready?* at a time of uncertainty. When artificial intelligence, the internet of things, and big data have become the key to driving the world's development, how can people access quality job opportunities in the new economy? How can we find hope and adapt for the better when human jobs can be replaced by automation? How can Hong Kong enhance its competitiveness through collaboration with the cities of the Greater Bay Area and other neighbouring cities?

For these questions, I would like to share with you some of my thoughts:

1. Geographic Information - In 2018, vast amounts of data was generated globally every minute, including 510,000 new Facebook posts, more than 150 million emails, 13 million SMS messages, 43,000 YouTube video browsing hits, nearly 4 million web searches, and countless data from video cameras and sensors, forming a large pool of big data.

   However, to realise the value of this data, it is important to connect fragmented data by linking it to geographical location, and opening it to the public as raw material for startups to develop applications, and for the government to optimise its governance. Through the geographic information system (GIS), the collection, storage, analysis and display of information has revolutionised traffic management, mobility modes, urban planning, health protection and public facilities management. GIS has not only changed the operation of Hong Kong today, but it also enables

Hong Kong to connect with the world. GIS is the city infrastructure that drives our city to be future ready, and allows us to move towards Smart City 3.0.

2. Putting ideas into practice – entrepreneurship, girls, information technology, and the 1990s, all together form a "risk factor", because there was no government support in the 1990s, it was an era where "hi-tech means no jobs, low-tech means earning a lot", but I am convinced that if we apply scientific knowledge and gain valuable feedback through the interaction with users, we can improve products and services.

Today, the internet enables knowledge to be available at our fingertips. Reading a lot of books is not as effective as using Google and artificial intelligence (AI). Therefore, first-person experience is more important than pure book knowledge, because the experience of ups and downs cannot be replaced by robots or AI. In order to pass on my entrepreneurial experience, I am a startup mentor today. I also set up the Tang Chui Wai Hing Project Prize at my alma mater, the University

of Hong Kong, to encourage young people to try and venture out.

3. National and global collaboration – there is no gap between the virtual and the real world, as with the internet and frequent travelling, innovation and technology have a global impact. Therefore, we need to utilise global thinking today. We can learn from other's success stories and seek collaboration with various organisations and governments.

With the above in mind, I have been working non-stop for the past few years, exchanging experiences on smart city development with experts in Hong Kong and other countries, such as the United States, Russia, the Middle East, Japan, South Korea, Taiwan, and the Greater Bay Area. I also exchanged ideas on the challenges of building a smart city with the consulates of the 10 ASEAN countries and relevant government representatives, commissioners from the chambers of commerce, and corporate and academic elites; I studied urban planning trends with professionals

in architecture, surveying transportation and civil engineering; I worked with local and overseas scholars to find the most creative, efficient and sustainable travel and logistics solutions. Apart from sharing my experience, I also look for opportunities for Hong Kong itself. This book is a summary of my experiences and knowledge in recent years.

People often ask me what will happen in the future. Today, technology is changing every day, it can also change our lives within a short period of time. In my time capsule, I have two predictions for the next 10 years:

1. The City Dashboard will become an important landscape in Hong Kong. The Dashboard will show the city's information which concerns the public, such as on transportation, the economy or housing, using a graphical perspective for better understanding.

2. The Personal Dashboard allows people to have an overview of their health conditions. Imagine your house is connected with sensors, once you wake

up in the morning, your phone will show sleep quality, heartrate, blood pressure, blood sugar level, today's dos and don'ts. For example, "you should eat porridge and avoid oatmeal, you can wear a dark coat because of a ruddy face, do not forget to exercise for 30 minutes, you can eat one quarter of black forest gateau at dinner as a reward," etc.

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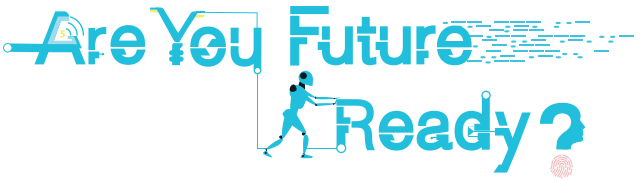
A note to readers

Passing the torch

When I published this book, it happened to be my 20th anniversary since graduating from the Faculty of Science at the University of Hong Kong. It was also the 20th year since my grandmother passed away in 1999. To keep my promise to my grandmother, that is to “contribute to society once I have the capacity”, I started to teach a master's course three years ago, and I established the "Tang Chui Wai Hing Project Prize" in the name of my grandmother. I have also established a scholarship for outstanding undergraduates in the Bachelor of Arts and Sciences in the Applied Artificial Intelligence Programme. I do hope these can encourage more students to embrace technology and work together to build an advanced and livable city for the Hong Kong community.



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Innovation and technology will lead the future. No one objects to the saying today, but are you ready for it?

This book is the third book in Dr Winnie Tang's trilogy on innotech. It discusses the latest trends in the development of science and technology, helping readers master the role of 5G, artificial intelligence and geospatial data in the future era. By putting Hong Kong as the centre point, comparing and referring to the experiences of many overseas countries and neighbouring cities, and commenting on the advantages and opportunities in Hong Kong's development of science and the smart city. The book also raises stimulating suggestions in a variety of areas such as STEM education, industry cooperation, government policies and intercity collaboration.

The development of science and technology is moving very fast. The author hopes this book will inspire and prepare readers for a brighter future.

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